Aug. 2, 1927.

H. FERGUSON

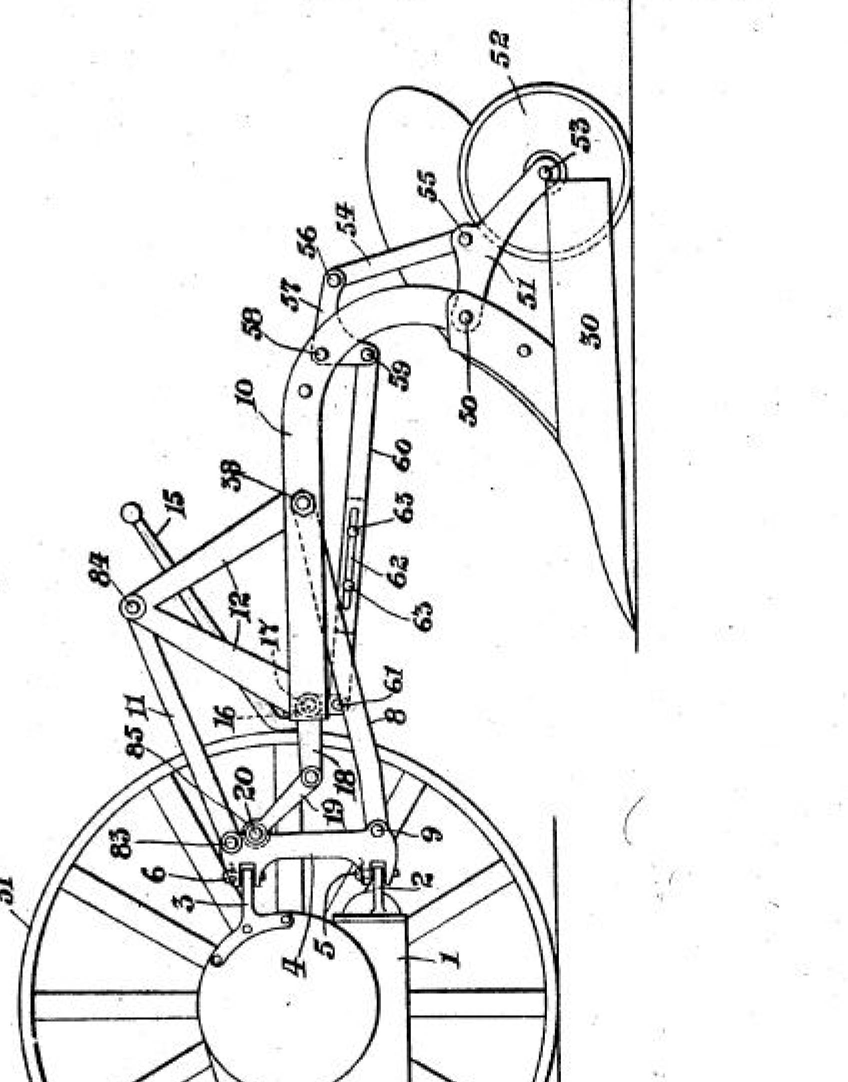
1,637,811

AGRICULTURAL IMPLEMENT

Filed Feb. 21, 1924

2 Sheets-Sheet 1

Fig. 1.



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Aug. 2, 1927.

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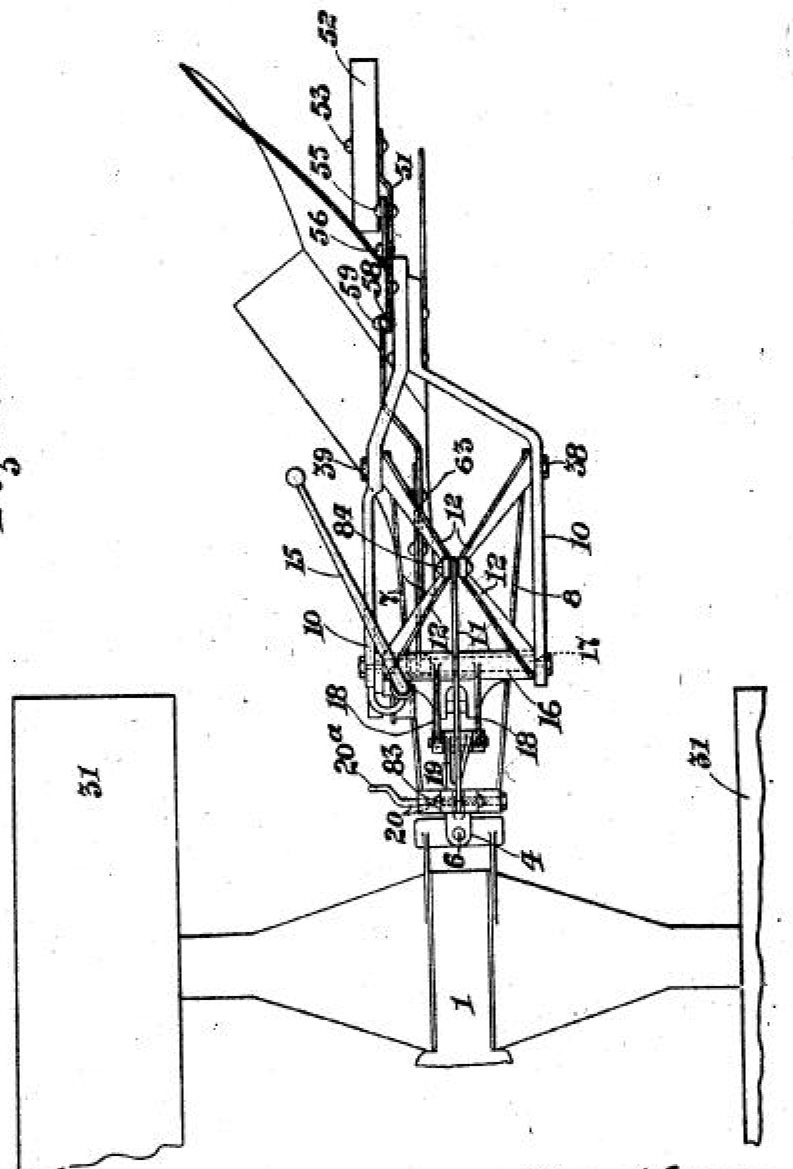
1,637,811

AGRICULTURAL IMPLEMENT

Filed Feb. 21, 1924

2 Sheets-Sheet 2

Fig. 2.



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Patented Aug. 2, 1927. 1,637,811

UNITED STATES PATENT OFFICE.

HARRY FERGUSON, OF BELFAST, IRELAND.

AGRICULTURAL IMPLEMENT.

Application filed February 21, 1924, Serial No. 694,195, and in Great Britain December 11, 1923.

This invention relates to tractor drawn agricultural implements, its object being to provide improvements therein whereby the soil engaging part, or parts, of the implement can be kept at a regular depth of cut in spite of the pitching or tilting movements of the tractor as it travels over undulating ground.

At present, in tractor drawn implements, especially tractor-unit-ploughs the pitching of the tractor affects the implement and varies or alters the ploughing depth. This has been a great source of trouble in the past. The present invention overcomes the difficulty.

According to this invention the implement is provided with a depth regulating member (which may take the form of a wheel or skid, preferably a wheel) which is adapted to contact with and move over or along the ground as the implement is drawn forward by the mechanical tractor or tractor carriage. The depth regulating member and the implement are arranged to be relatively movable and the member is connected by movable members hereinafter, in a general sense, referred to as linkage connections with the implement head in such manner that as the implement is drawn along, the pitching movements of the tractor (communicated to the head) are compensated for and prevented from moving the implement so as to alter or vary its depth of cut from that determined by the depth control lever of the implement, and, consequently, ensure a regular depth of cut.

In the case of a tractor plough the depth regulating member would, preferably, be arranged to run in the furrow.

Hitherto, in order to keep agricultural implements at a regular depth of cut when being drawn by a tractor, they have been, generally speaking, either entirely or partially supported by wheels, or equivalent. Weight carried in this way increases the draft, particularly in soft land where the wheels are inclined to sink. Moreover such arrangements do not obviate the difficulties due to relative movements of tractor and implement. This invention differs from previous practice, where wheels are used, in that only a very slight weight is carried by the depth regulating wheel, the greater part of the weight of the implement being carried on the tractor itself thereby reducing draft, and, therefore, operating costs to the farmer. In some cases, in fact, nearly the whole weight of the implement may be carried by the tractor, the depth regulating wheel simply running on the ground.

In carrying out the invention, say for a tractor plough of the unit type, I provide the implement with a wheel or skid which is movably secured thereto, preferably, by a pivotal arm or the like, which is connected by a link to a pivotal member on the implement frame, the pivotal member, in its turn, being connected by a link to a bell crank or equivalent at the plough head which bell crank is also link connected to the tractor, the whole arrangement being such that, as the tractor moves relatively to the implement, the aforesaid linkage connections between the wheel or skid and the tread are operated. The movable linkage connections are such that as the tractor tilts or pitches longitudinally, as it travels over undulating ground, the movements of the tractor act on the linkage connections whilst the wheel, as it travels over the ground, reacts on the said connections with the result that the implement is automatically maintained at its proper working depth and is not affected by the pitching of the tractor. The working depth can be altered from time to time by a suitable form of depth control gear which forms or may form part of the aforesaid linkage connections.

The arrangement is specially suitable for use in combination with a draft connection such as described in my prior U. S. patent specification No. 1,464,130 issued August 7, 1923, comprising a head for attachment to a tractor and with upper and lower link members pivotally connected to the implement and to the head, the lower link member, or members, being so arranged as to exert a downward force on the implement under the draft of the tractor, and the upper link member, or members, being arranged to prevent the implement turning angularly out of the ground. The depth regulating member may then be connected through the medium of links and levers with depth control means comprising a crosshead pivoted on the implement, a double link connection between said crosshead and the implement head, and a lever for turning said crosshead for the purpose of raising and lowering the implement.

In order that the invention may be more clearly understood I have appended explanatory drawings, whereon Figure 1 is an elevation and Figure 2 a plan of a plough coupled to a tractor, partly shown in outline, by a hitch connection as aforesaid and embodying the improved depth control means.

The tractor 1 (which in the drawings is a four-wheeled "Fordson") has a draw bar 2 and a corresponding abutment 3. The plough head 4 is pivotally connected to the draw bar 2 and the abutment 3, by means of drop pins 5 and 6, its jaw engaging the abutment and the draw bar through which the drop pins pass so that, as will be readily understood, the plough head can freely swing or move from side to side upon the abutment and the draw bar.

The plough frame 10 is connected to the head 4 by means of a pair of lower links 7 and 8 (see particularly Figure 2) which are movably jointed, on the one hand, to the pivot pin 9 of the member 4 and, on the other hand, by bolts 38 and 39 to the frame. The frame is also connected to the head 4 by means of a single upper link 11 and struts 12, 12, on the plough frame, the parts being pivotally connected together by pivot pins 83 and 84. The whole link connection can move bodily upwards and downwards as the implement and tractor change their relative positions owing to the contour of the ground over which the implement is drawn.

The plough is operated manually by means of the control lever 15 secured rigidly at its lower end to a hollow crosshead 16 which is arranged between the parallel sides 10, 10 of the plough frame. The crosshead 16 has two forwardly projecting arms 18 between which a pivotal link 19 is arranged. At its forward end the link is made one with a sleeve 85 mounted on a screwed shaft 20 provided with a turning handle 20ª (Fig. 2), the shaft being mounted in bosses on the plough head 4. This shaft engages with an internal thread in the aforesaid sleeve so that, by rotating the handle 20ª, the screw can be turned and the sleeve 85 made to move laterally and at the same time move the crosshead 16 and the plough frame and share laterally. A forward pull of the lever 15, owing to the fact that its lower end is made one with the crosshead 16, turns the latter upon its shaft 17 with the result that the plough frame 10, together with the shares, are raised and when the plough is not in operation it remains in this position attached to the rear of the tractor, being retained in place by the action of suitable retaining means. A rearward movement of the lever 15 lowers the share into the ground.

Pivoted to the rear of the plough frame, at 50, is an arm 51 on which a ground engaging wheel 52 is rotatably mounted at 53. One end of a link 54 is pivotally connected, at 55, to the arm 51 and its other end is connected, at 56, to one arm of a bell crank lever 57, pivoted at 58 on the plough frame, its other arm being connected, at 59, to a rod 60 whose other end is pivoted, at 61, to a depending arm of the crosshead 16.

For the purpose of initially adjusting the setting of the wheel 52 relative to the plough share the rod 60 is made in two parts connected together by bolts 63 attached to one of the parts and projecting through an elongated slot 62 in the other of the parts. It is apparent that with this arrangement the effective length of the rod 60 can be varied in order to adjust the position of the wheel.

When the plough share is lowered into the ground by means of the hand lever 15 the penetration of the share, as the tractor 1 moves forward, will force it downward into the ground until the wheel 52 comes in contact with the ground, this giving the normal working position of the implement and the tractor relative to each other when operating over level ground. When the wheel 52 bears on the ground the greater part of the weight of the implement is thrown on to the tractor through the link connections hereinbefore described. The weight thus put on the tractor can be varied by an alteration in the leverage of the connections. Should the rear wheel or wheels 31 of the tractor rise on a height (or the front wheels of the tractor drop into a hollow) then while the wheel 52 continues to run along the ground or the furrow bottom, as the case may be, the head 4 will be moved and the link 19 and arms 18 of the crosshead 16 will straighten out automatically and thereby turn the crosshead 16 in a clockwise direction (Fig. 1) so that the rod 60, bell crank lever 57, link 54 and arm 51 carrying the wheel 52 will be moved immediately about their connections and will compensate for the new positions taken up by the hitch members 11, 7, and 8, thereby maintaining the implement at a regular working depth.

Conversely, when the rear end of the tractor falls into a hollow (or when the front end of the tractor rises), the link 19 and arms 18 of the crosshead 16 will be automatically folded to a greater extent and thereby turn the crosshead in an anti-clockwise direction so that the rod 60, bell crank lever 57, link 54 and arm 51 carrying the wheel 52 will be moved about their connections in order to compensate for the new positions assumed by the hitch members 11, 7, and 8, thereby maintaining the implement at a regular working depth.

It will be obvious that, in this way, the pitching movements of the tractor will be prevented from varying the ploughing depth.

In the foregoing the improved depth regulating means has been described as applied to a single furrow plough but it can obviously be applied to a multi-furrow plough.

When used in combination with a hitch connection between the plough and the tractor comprising upper and lower link members as aforesaid and by which a part of the weight of the plough is carried by the tractor, when the former is in operation, there is the advantage of greatly reduced draft and consequently reduced operating costs to the farmer. However, the depth control means is not necessarily restricted for use with such a connection. It could, for example, be connected to an ordinary plough in which the frame is coupled by a one point connection to the tractor. The essential feature is that the wheel or the like be floatingly mounted on the implement and connected with the tractor or its equivalent in such manner that relative upward and downward movement between the tractor and the implement will produce a compensating action on said connection.

In the case of the invention being applied to an implement such as a two or three wheeled plough of the ordinary tractor type the connection between the wheel or equivalent would be designed to give the same results in substantially the same way as hereinbefore described.

Although the invention is specially applicable to tractor-implements of the unit type it can obviously be applied to implements adapted to be drawn by tractors in the ordinary way or by wheeled carriages or the like, themselves drawn by mechanical means or by horse where there is relative movement between the head of the implement and the implement itself.

In the case of a cultivator or other like implement the member 52 may be so connected as to be movable in all directions, for example, by providing a castor connection, or a universal joint connection, at the pin 50.

Provision may be made whereby the wheel 52, in the case of a plough, may run against the furrow wall and take up the normal landside pressure.

When using the term "tractor" it is to be understood to include a "tractor carriage."

Having now fully described my invention what I claim and desire to secure by Letters Patent is:—

1. In combination, an agricultural implement, a draft connection between the implement and the tractor allowing freedom of relative bodily up and down movement therebetween, ground engaging means on the implement, and means cooperating with said draft connection and said ground engaging means whereby, on the occurrence of pitching movements of the tractor, the said movements are compensated for so as to maintain the implement at a regular working depth in the ground.

2. In combination, an agricultural implement, a tractor, a draft connection between the implement and the tractor allowing freedom of relative bodily up and down movement therebetween, ground engaging means on the implement, and linkage connections which co-operate with said draft connection and said ground engaging means to compensate, on the occurrence of pitching movements of the tractor, for said movements so as to maintain the implement at a regular working depth in the ground.

3. In combination, an agricultural implement, a tractor, an implement head pivotally connected to the tractor about a vertical axis, link connections pivoted about horizontal axes to the head and to the implement, ground engaging means on the implement, and linkage means connecting said ground engaging means to said implement head and which, on the transmission of pitching movements of the tractor to the head, comes into operation and compensates for said movements so as to maintain the implement at a regular working depth in the ground.

4. In combination, an agricultural implement, a tractor, an implement head pivotally connected to the tractor about a vertical axis, upper and lower draft links pivoted about horizontal axes to the head and to the implement, a ground engaging wheel on the implement movable relatively thereto, and a system of linkage connections between the wheel and the implement head, which, on the occurrence of pitching movements of the tractor, coacts with the draft links, to compensate for said movements so as to maintain the implement at a regular working depth in the ground.

5. In combination, an agricultural implement, ground engaging means on the implement, a draft connection for hitching the implement to a tractor, and linkage interposed between said draft connection and said ground engaging means which, when the implement is connected to a tractor and the tractor is subjected to pitching movements, coacts with the draft connection and compensates for said movements so as to maintain the implement at a regular working depth in the ground.

6. The combination with an agricultural implement of ground engaging means pivotally carried on the implement and capable of movement relatively thereto, a pivotal draft connection for hitching said implement to a tractor, the draft connection allowing freedom for relative bodily up and down movement between the implement and tractor, and linkage connections interposed between said ground engaging means and said draft connection and adapted to compensate for pitching movements of the

tractor in order to maintain the implement, when working, at a regular working depth in the ground.

7. The combination with an agricultural implement of ground engaging means pivotally carried on the implement and capable of movement relatively thereto, an implement head adapted to be pivotally connected about a vertical axis to a tractor, draft link connections pivoted about horizontal axes on said implement head and on the implement, and linkage interposed between the ground engaging means and the implement head which, when the implement is connected to a tractor and the tractor is subjected to pitching movements coacts with the draft link connections and compensates for said movements so as to maintain the implement at a regular working depth in the ground.

8. The combination with an agricultural implement, adapted to be drawn by a tractor, of depth regulating means comprising an arm pivoted on the implement, and rotatably supported by said arm and adapted to bear on the ground, a bell-crank lever pivoted on the implement frame, a link connecting said wheel supporting arm and said bell-crank lever, a crosshead pivoted on the implement frame and having forwardly projecting arms and a depending arm, an implement head pivoted to the tractor and movable about a vertical axis, and a link pivotally connected for vertical movement to said implement head and to the forwardly projecting arms of the crosshead.

9. In an agricultural implement adapted to be drawn by a tractor, the combination of a hitch connection, comprising upper and lower link members, for coupling the implement to the tractor, means for raising or lowering the implement about said members, and depth regulating means co-acting with said hitch connection and operable by the pitching and tilting movements of the tractor, said depth regulating means comprising an arm pivoted on the implement, and rotatably supported by said arm and adapted to bear on the ground, a bell-crank lever pivoted on the implement frame, a link connecting said wheel supporting arm and said bell-crank lever, a crosshead pivoted on the implement frame and having forwardly projecting arms and a depending arm, an implement head pivoted to the tractor and movable about a vertical axis, and a link pivotally connected for vertical movement to said implement head and to the forwardly projecting arms of the crosshead.

10. The combination with an agricultural implement, of an implement head adapted to be pivotally connected about a vertical axis to a tractor, link connections pivoted about horizontal axes to the head and to the implement, and depth regulating means comprising an arm pivoted on the implement, and rotatably supported by said arm and adapted to bear on the ground, a bell-crank lever pivoted on the implement frame, a link connecting said wheel supporting arm and said bell-crank lever, a crosshead pivoted on the implement frame and having forwardly projecting arms and a depending arm, and a link pivotally connected for vertical movement to said implement head and to the forwardly projecting arms of the crosshead.

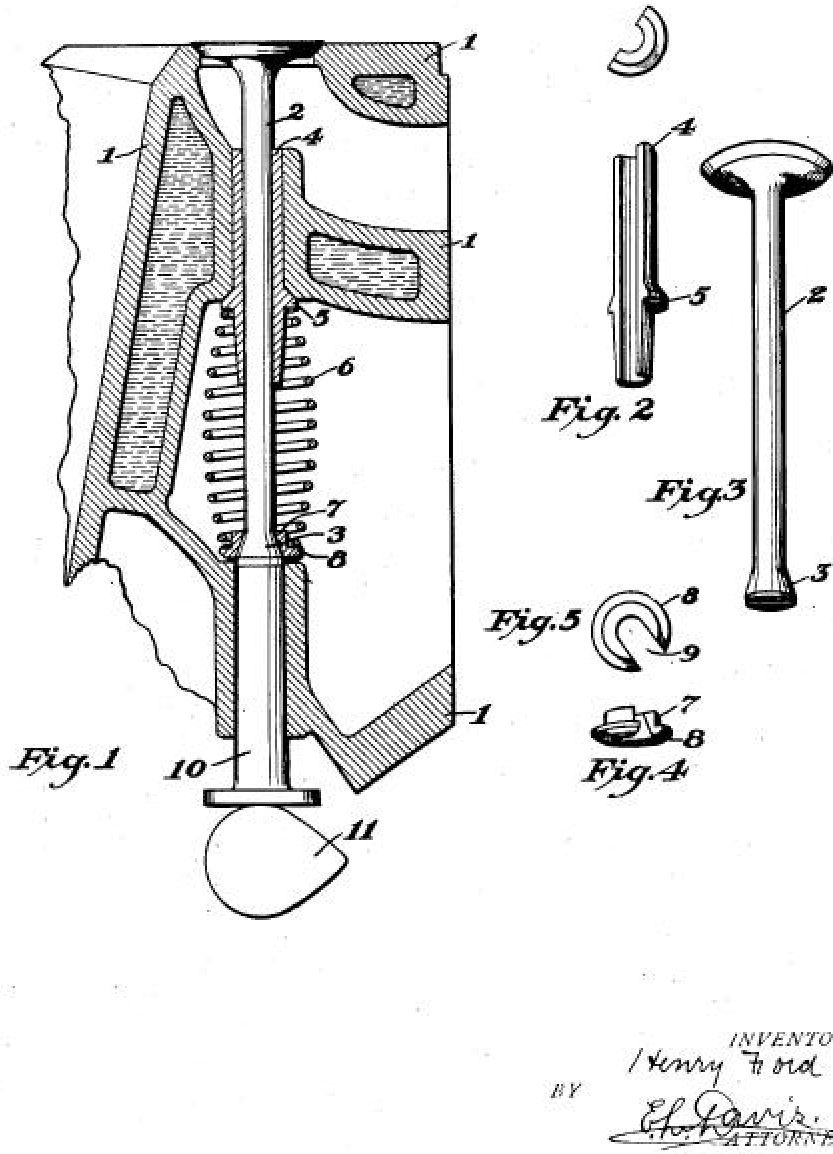
In testimony whereof I affix my signature.

HARRY FERGUSON.

Aug. 23, 1927. **H. FORD** 1,640,118

VALVE MECHANISM FOR INTERNAL COMBUSTION ENGINES

Filed April 22, 1926



INVENTOR
Henry Ford

BY

ATTORNEY

Patented Aug. 23, 1927. 1,640,118

UNITED STATES PATENT OFFICE.

HENRY FORD, OF DEARBORN, MICHIGAN.

VALVE MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

Application filed April 22, 1926. Serial No. 103,956.

My invention relates to valve mechanisms for internal combustion engines, and has for its object to provide more convenient means for assembling and disassembling such mechanisms; to decrease the wear of the valve-stem at the point where it contacts with the push-rod or tappet, and therefore to prolong the life of such stems. My object is further to provide a convenient and inexpensive means for taking up the spring tension after it becomes weakened by use.

My invention is illustrated in the accompanying drawings in which:

Fig. 1, is a section of an internal combustion engine, of a type now in general use, showing in elevation my invention applied thereto.

Fig. 2, is a perspective view of my split bushing or bearing for the upper portion of the valve-stem.

Fig. 3, is a perspective view of my valve-stem.

Fig. 4, is a perspective view of the cap which is adapted to fit the lower end of the valve-stem and form a support for the spring.

Fig. 5, is a plan view of the bottom of Fig. 4.

In the accompanying drawings reference numerals are employed to indicate the several parts. 1 is a section of an engine block of a type now in common use and its construction is well understood. 2 is my valve-stem which is provided with a flare 3 at the bottom and a valve on the opposite end thereof. This stem is secured in the engine block by means of a split bushing 4 which enables me to insert the bushing after the valve-stem is in place. On the lower end of this bushing is a flange 5 which forms an abutment for the upper end of the spring 6. After the valve-stem has been inserted in the aperture in the engine block the parts of the split bushing are forced from the bottom upwardly and are held by frictional engagement with the walls of the upper side of the engine block. A cap 7 is adapted to fit the lower end 3 of the valve-stem 2 and is provided with a flange 8 which forms a support for the lower end of the spring 6. The cap 7 has a cone-shaped bore as shown in Fig. 4, and is adapted to fit the flared end 3 of the stem 2. A segment 9 of the cap 7 is cut out as shown in Fig. 5 to a width slightly greater than the diameter of the stem 2 so that it may be passed over the stem and dropped down until it fits over the flared end of the stem, in which position it may not be removed laterally, hence it forms a secure footing to support the lower end of the spring 6. The cap 7 may be made in different sizes, particularly in respect to the thickness of the flange 8 and by removing this cap one provided with a thicker flange may be inserted which will result in decreasing the distance between the spring supports and increase the normal tension of the spring. It is well known that when such springs become weak it is usually necessary to provide a new spring, whereas with my construction the insertion of a new cap provided with a thicker flange is all that is necessary for a considerable period, and this may be accomplished without the difficulty incident to removing the spring.

A push-rod or tappet 10 is operated by a cam 11, the construction and operation of which is well understood and hence need not be described. In internal combustion engines as heretofore constructed the valve-stem is of less diameter than the head of the tappet and under the severe use to which they are subjected the contacting parts wear away, and sometimes irregularly, but with my construction the lower end of the valve-stem has a diameter equal to that of the upper end of the tappet, hence there will be less wear and besides wear will be substantially equal at all points.

It will be readily understood from the foregoing construction that the valve-stem may be easily removed by first compressing the spring by lifting upwardly thereupon, then removing the cap, then lifting the valve-stem and removing the spring, then driving out the split bushing which incloses the upper portion of the valve-stem.

Having fully described my invention and its mode of operation, what I claim is:

1. In a valve mechanism for internal combustion engines, the combination of an engine block with a valve-stem provided with a valve on one end thereof and having its opposite end flared, a split bushing in which the valve-stem is adapted to be reciprocated, a member adapted to fit the flared end of the valve stem and having a segment slightly wider than the least diameter of the valve-stem cut away, and a resilient member supported by said first named member.

2. A valve mechanism for internal combustion engines as in claim 1 described, wherein the member adapted to fit the flared end of the valve-stem is provided with a flange to support the resilient member.

3. A valve mechanism for internal combustion engines as in claim 1 described, wherein the split bushing is provided with a flange adapted to afford an abutment for one end of the resilient member.

Signed at the city of Detroit, county of Wayne, State of Michigan, this 15 day of April, 1926.

HENRY FORD.

Oct. 16, 1928. 1,687,719

H. FERGUSON

TRACTOR AND TRACTOR IMPLEMENT

Filed Feb. 25, 1925 3 Sheets-Sheet 1

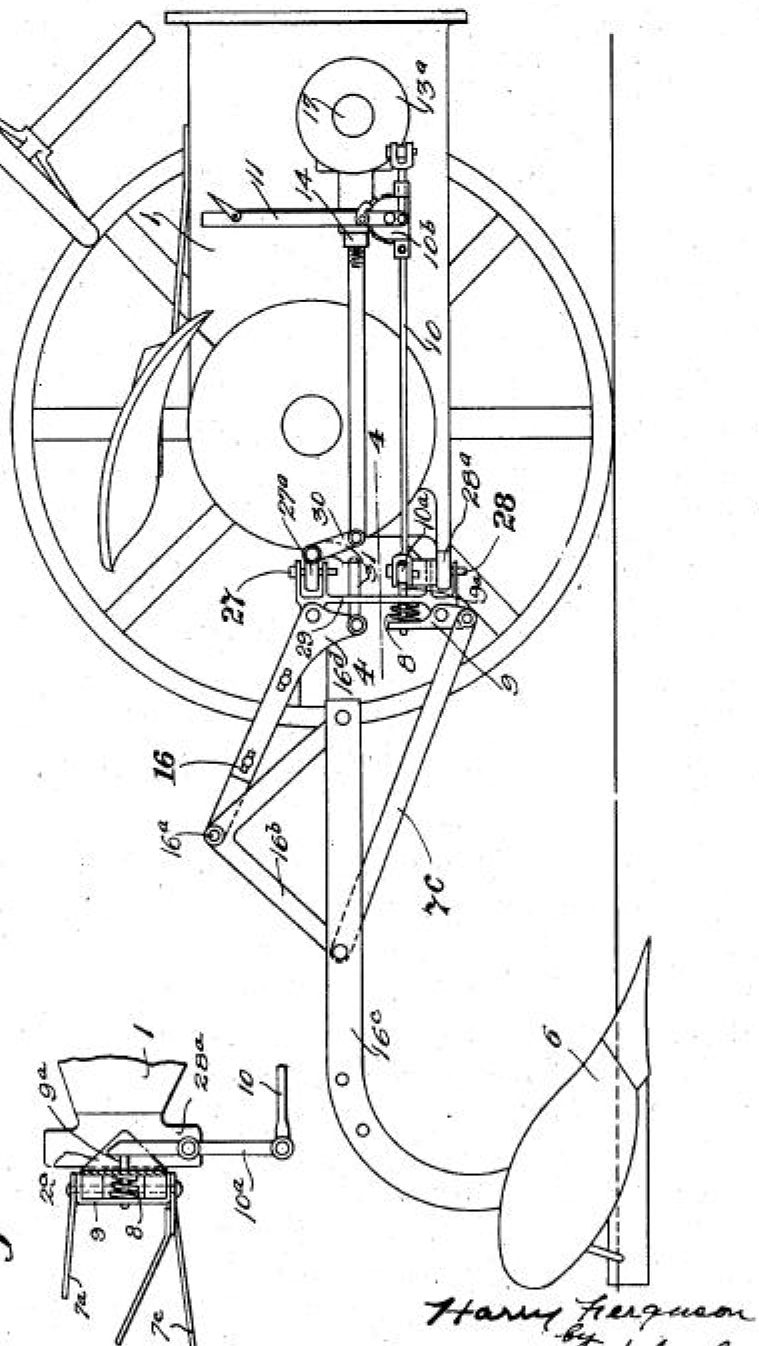


Fig. 1.

Fig. 4.

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TRACTOR AND TRACTOR IMPLEMENT

Filed Feb. 25, 1925

3 Sheets-Sheet 2

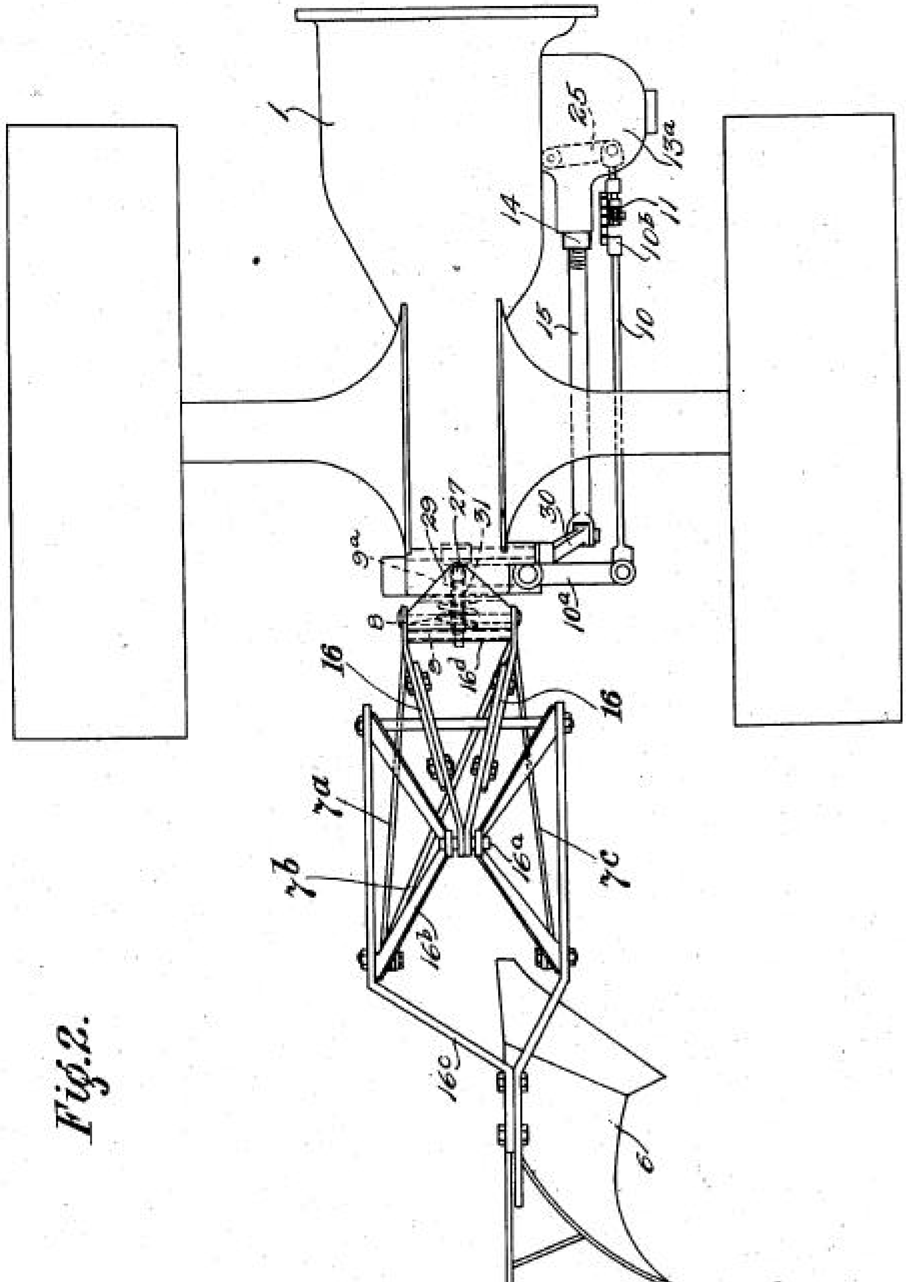

Fig. 2.

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TRACTOR AND TRACTOR IMPLEMENT

Filed Feb. 25, 1925 3 Sheets-Sheet 3

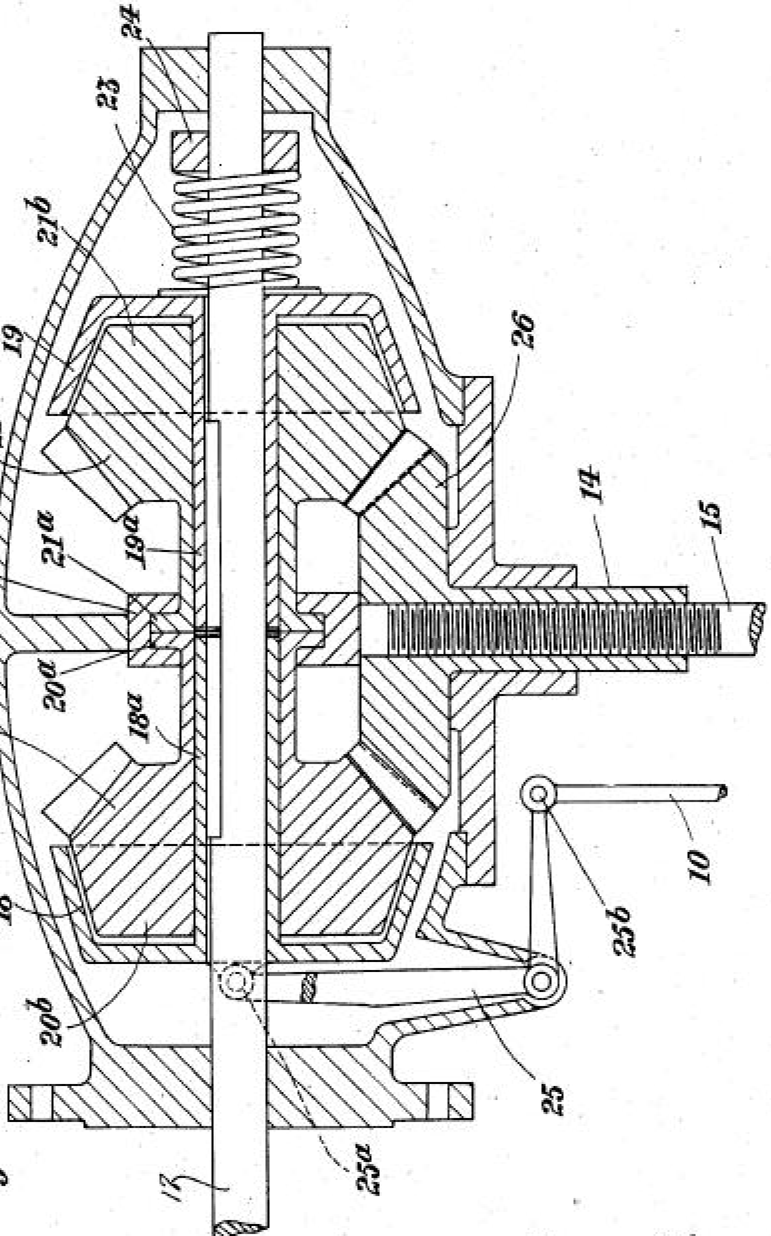

Fig. 3.

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Patented Oct. 16, 1928. 1,687,719

UNITED STATES PATENT OFFICE.

HARRY FERGUSON, OF BELFAST, IRELAND.

TRACTOR AND TRACTOR IMPLEMENT.

Application filed February 25, 1925. Serial No. 11,531.

This invention relates to tractors used for agricultural and general industrial purposes and also to tractors combined, or adapted for use, with agricultural implements.

A tractor for agricultural purposes requires to have considerable weight upon its driving wheels to give it sufficient wheel grip to draw the implement.

An object of this invention is to provide an arrangement of tractor and agricultural implement in which the tractor carries the whole weight of the implement whereby the weight of the implement becomes available for wheel grip so that a light tractor can be used with obvious advantages as regards initial and running costs.

A further object of the invention is to provide a hitch arrangement between the tractor and implement whereby the latter will be automatically kept at a regular working depth.

Other objects of the invention will appear in the following description and from the appended claims.

A convenient embodiment of the invention will now be described by way of example and with reference to the annexed drawings, whereon:—

Fig. 1 is a side elevation of a plow, part of a tractor and coupling means between them,

Fig. 2 is a corresponding plan view.

Fig. 3 shows on an enlarged scale part of the mechanism shown in Figs. 1 and 2 and Fig. 4 is a fragmentary plan view on the line 4—4 of Fig. 1.

Referring to the drawings, the numeral 1 represents the tractor (here shown as an ordinary Fordson), 6 is the plow having a plow beam 16^c. From the plow beam a triangular structure 16^b rigid therewith projects upwardly, this structure terminating in an apex through which a pivot pin 16^a is passed.

The tractor is provided with two rearwardly extending lugs 27^a and 28^a to which an implement head 29 in the form of a plate with forwardly extending lugs is pivoted by two draw pins 27 and 28. The head 29 carries at its upper end the duplex bell crank lever 16 which is connected at one extremity by the pivot pin 16^a to the triangular structure 16^b. The second arm 16^d of the duplex bell crank lever has a push rod 31 pivoted to it. A two armed rocker 30 is pivoted on the lug 27^a, one of the rocker arms being coupled to a rod 15 while its second arm is connected to the push rod 31.

The lower end of the head 29 has a rocking lever 9 of plate form pivoted on it, one end thereof being pivoted to lower or draft duplex links 7^a and 7^c which are also pivotally connected to the plow beam 16^c. The upper end of the rocking lever 9 rests against the short push rod 9^a, which connects with rod 10 by the lever 10^a, pivoted on the rearwardly extending lug 28^a. Between the upper end of the rocking lever 9 and the head 29 a compression spring 8 is fitted. The rod 10 comprises two parts, the rear of which has a block 10^b attached at its end and to this block a hand lever 11 is pivoted. The lever 11 is pivoted at its lower end to a forward part of the rod 10 which part is in turn pivoted to a bell crank lever 25 which controls the operation of a clutch device 13^a which will be described in detail with reference to Fig. 3. Ratchet and detent means are provided on the block and lever respectively.

Referring to Fig. 3, the power for the clutch device 13^a is obtained from a shaft 17 which may be driven from the tractor in any suitable way. It may, for example, be geared to a wheel. The rotating shaft 17 has keyed on it two oppositely disposed cones 18 and 19, which are formed in one with corresponding sleeves 18^a and 19^a slidably keyed on the shaft 17. On the sleeve 18^a and on the sleeve 19^a are two oppositely disposed bevel wheels 20 and 21, the thrust of these wheels being taken by collars 20^a and 21^a supported in a thrust block 22. The bevels 20 and 21 have formed in one with them conic portions 20^b and 21^b which are disposed within corresponding conic portions of the slidable cones 18 and 19. A compression spring 23 is disposed at the outer side of the cone 19 and works between the end of the cone 19 and a collar 24 fixed on the shaft 17. The compression spring 23 serves to keep the cones 19 and 18 in contact with the end 25^a of the bell crank lever 25 whose other end 25^b is connected with the control rod 10. The bevel wheels 20 and 21 mesh with a bevel wheel 26 which is in one with an internally threaded sleeve 14 which engages the externally threaded rod 15 above mentioned.

The action of the mechanism is as follows. The draft of the tractor is transmitted through the links 7 to the plow and tends to turn the lever 9 about its pivot and to compress the spring 8. The spring 8 is arranged to counter-balance the predetermined normal draft, say, for example the draft corresponding to a working depth of 6″ for the plow share. If, for any reason, such as inequalities in the ground, there should be a tendency for the working depth of the implement to decrease, the pull on the links 7 is immediately decreased. This causes the spring to expand and turns the lever 9 in a counter-clockwise direction (Fig. 1). The short push rod 9ª moves backward, and the end of lever 10ª and rod 10 attached to said end, move forward under the action of spring 23 in clutch mechanism (Fig. 3) whereupon the cone 19 of the clutch device is caused to engage the conic surface of 21ᵇ so that the continuously rotating shaft 17 will rotate the bevel wheel 21 and through it the bevel wheel 26 and sleeve 14. Rotation of the sleeve 14 will cause the rod 15 to be drawn forwards so that the rocker 30 will turn counter-clockwise and cause counter-clockwise turning of the bell crank lever 16 which has the effect of lowering the implement bodily until the depth of cut is again normal.

Conversely, when the draft on the plow increases owing to an increase in the working depth, the cone 18 will become engaged with the bevel wheel 20 and the bevel wheel 26 and sleeve 14 will be rotated in the other direction and the bell crank lever 16 will raise the plow in the ground until the depth of cut becomes normal again.

When one of the bevel wheels on the shaft 17 is in action the other will be idling on the shaft. When the implement is at the required depth of cut neither of the cones will be engaged.

In this way the implement is maintained at a constant working depth in the ground automatically and by power means.

It is essential to make provision for wear on the conic faces so that too much end play will not be developed. This may be done by the insertion of shims between the abutting faces of the sleeves 18ª and 19ª.

The implement, it will be noted, is free to turn laterally relative to the tractor.

It will be seen that by lifting the detent and moving the lever 11 in one way or another the effective length of the rod 10 can be altered and this will operate the clutch 13ª in one direction or the other, to lift or lower the plow when it is desired to do so, manually. Means for adjusting the depth at which it is desired to operate the implement is thus provided.

One of the greatest difficulties about carrying an implement entirely on the tractor when in operation is the question of stability under torsional loads. For example, the ordinary type of cultivators are about 5′ in width and these are supported at the extreme ends by wheels so as to keep a wide support for the resistance to torsion. Providing any such wide support on a tractor would mean very heavy and costly construction and increase both purchase and upkeep costs for the farmer.

In order to overcome these torsional stresses I use the light and simple mechanism hereinbefore described. The whole constitutes a triangulated structure so disposed as to offer great resistance to torsional stresses and distortion due to torsional stresses. The upper links 16 are shown in Figs. 1 and 2 provided with adjustment means whereby their length can be altered as required to tilt the implement either laterally or longitudinally or both, relative to the tractor.

It will be obvious that there are many means within the scope of this invention for keeping the implement at a regular depth in the soil.

Any of the means hereinbefore described, or any means employed according to this invention will produce a governing effect on the load or pull on the tractor, thereby avoiding constant manual control, or attention on the part of the operator of the tractor.

Some of the mechanism shown to provide the construction of a light implement and keep it in the ground has already been fully described in my pending U. S. application Serial Nos. 516,403 filed 19th November, 1921, and 281,520 filed 8th March, 1919, and in my U. S. patents already granted under Numbers 1,379,399 granted 24th May, 1921, and 1,501,652 granted 15th July, 1924.

What I claim, and desire to secure by Letters Patent is:—

1. In combination, a tractor, an agricultural implement, a draft connection between said implement and said tractor, a power unit on the tractor adapted to control the working depth of the implement in the ground, and control means for the power unit connected with the implement and sensitive to variations in the draft of the implement from a predetermined normal magnitude and causing the power unit to function on the occurrence of such draft variations to correct same and consequently the variations in the working depth of the implement.

2. In combination, a tractor, an agricultural implement, a draft connection between said implement and said tractor, yielding means acting against the draft and balancing the normal draft, a power unit on the tractor for regulating the working depth of the implement in the ground, and control means for said power unit actuated by relative movement between the tractor and the implement in the fore and aft direction and so causing functioning of the power unit on such variations occurring to correct same and consequently the variations in the working depth of the implement.

3. In combination, a tractor, an agricultural implement, a draft connection between said implement and said tractor and includ-

ing yielding means balancing the normal draft, a power unit on the tractor for regulating the working depth of the implement in the ground, control means for said power unit interconnected with the draft connection by which it is actuated on variation of the draft from a predetermined normal magnitude to cause functioning of the power unit to correct said variations and consequently the variations in the working depth of the implement.

4. In combination, a tractor, an agricultural implement, a draft connection beween the implement and the tractor allowing turning of the implement about a vertical axis relative to the tractor, a power unit on the tractor for regulating the working depth of the implement in the ground, and control means for said power unit connected with the implement and sensitive to variations in the draft of the implement from a predetermined normal magnitude to cause functioning of the power unit and so to correct said variations and consequently the variations in the working depth.

5. In combination, a tractor, an agricultural implement, a draft connection between said implement and said tractor allowing turning of the implement about a vertical axis relative to the tractor and including yielding means balancing the normal draft, a power unit on the tractor for regulating the working depth of the implement in the ground, control means for said power unit interconnected with the draft connection by which it is actuated on variation of the draft from a predetermined normal magnitude to cause functioning of the power unit to correct said variations and consequently the variations in the working depth.

6. In combination, a tractor, an agricultural implement, a draft connection between said implement and said tractor, means on the tractor for lifting and lowering the implement relatively to said tractor, a power unit on the tractor for operating said means, and control means for said power unit connected with the implement and sensitive to variations of the draft from a predetermined normal magnitude to cause functioning of said power unit on such variations occurring and to correct same and consequently the variations in the working depth of the implement.

7. In combination, a tractor, an agricultural implement, a draft connection between said implement and said tractor allowing turning of the implement about a vertical axis relative to the tractor, yielding means embodied in the draft connection and balancing the normal draft, means on the tractor for lifting and lowering the implement relatively to the tractor, a power unit on the tractor for operating said means, and control means for said power unit connected with the implement and sensitive to variations in the draft from a predetermined normal magnitude to cause functioning of said power unit on such variations occurring and to correct same and consequently the variations in the working depth of the implement.

8. In combination, a tractor, an agricultural implement, a bell crank lever pivoted on said tractor, upstanding triangulated members on the implement to which the bell crank lever is pivoted, a power unit on the tractor geared to said bell crank lever, a control device for said power unit, a rocking lever pivotally supported by said tractor, draft links between said rocking lever and the implement, a spring secured to the tractor and to the rocking lever and balancing the normal draft, and a connection between the rocking lever and the control device which latter on movement of the spring is actuated to cause the power unit to operate the bell crank lever and thus maintain the implement at a regular working depth.

9. In combination, a tractor, an agricultural implement, a draft connection between said implement and said tractor, a power unit on the tractor adapted to control the working depth of the implement in the ground, control means for the power unit connected with the implement and sensitive to variations in the draft of the implement from a predetermined normal magnitude and causing the power unit to function on the occurrence of such variations to correct same and consequently the variations in the working depth of the implement, and means for manually controlling the operation of the power unit and determining the normal working depth.

10. In combination, a tractor, an agricultural implement, a bell crank lever pivoted on said tractor, upstanding triangulated members on the implement to which the bell crank lever is pivoted, a power unit on the tractor geared to said bell crank lever, a control device for said power unit, a rocking lever pivotally supported by said tractor, draft links between said rocking lever and the implement, a spring secured to the tractor and to the rocking lever and balancing the normal draft, a connection between the rocking lever and the control device which latter on movement of the spring is actuated to cause the power unit to operate the bell crank lever and thus maintain the implement at a regular working depth, and means embodied in said connection for altering its effective length and manually controlling the operation of the power unit and the position of the implement.

11. In combination, a tractor, an agricultural implement, a bell crank lever pivotally carried by the tractor, upstanding triangulated members on the implement to which said bell crank lever is connected to carry said implement, a power unit on the tractor, a

control device for said power unit, an internally threaded member rotatable by said power unit, a rod screwed at one end into said internally threaded member and connected at the other end to said bell crank lever to transmit motion of the power unit thereto, a rocking lever pivotally supported by the tractor, draft links between said rocking lever and said implement, a spring on the tractor acting on said rocking lever and balancing the normal draft and a connection between said rocking lever and said control device, and which on variations in the draft, causes the power unit to keep said implement automatically at a regular depth of cut.

12. In combination, a tractor, an agricultural implement, a bell crank lever pivotally carried by the tractor, upstanding triangulated members on the implement to which said bell crank lever is connected to carry said implement, a power unit on the tractor, an internally threaded member rotatable by said power unit, a rod screwed at one end into said internally threaded member and connected at the other end to said bell crank lever to transmit motion of the power unit thereto, a rocking lever pivotally supported by the tractor, draft links between said rocking lever and said implement, a spring on the tractor acting on said rocking lever and balancing the normal draft, a rod connecting said rocking lever to said power unit and which on variations in the draft, brings said power unit into operation, and a hand lever for lengthening or shortening said rod to control said power unit by hand to raise or lower the implement.

13. In combination, a tractor, an agricultural implement coupled thereto, means on said tractor for lifting and lowering said implement relatively to the tractor, a system of friction clutches operatively connected to the tractor propelling means and geared to said implement lifting and lowering means, a draft connection between said implement and said tractor, and a connection between said draft connection and the system of friction clutches to engage one or other of said friction clutches on variations in the draft from a predetermined normal magnitude and move the implement up or down, to keep said implement automatically at a regular depth of cut.

14. In combination, a tractor, an agricultural implement, a bell crank lever pivotally supported by the tractor, upstanding triangulated members on the implement to which said bell crank lever is connected to carry said implement, a system of friction clutches operatively connected to the tractor propelling motor, an internally threaded member rotatable by said power unit, a rod screwed at one end into said internally threaded member and connected at the other end to said bell crank lever to transmit motion of the clutches thereto, a rocking lever pivotally supported by the tractor, draft links between said rocking lever and said implement, a spring on the tractor acting on said rocking lever and balancing the normal draft and a connection between said rocking lever and said clutches to engage one or other of the said friction clutches and thereby to keep said implement automatically at a regular depth of cut.

15 In combination, a tractor, an agricultural implement, a bell crank lever pivotally carried by the tractor, upstanding triangulated members on the implement to which said bell crank lever is connected to carry said implement, a system of friction clutches operatively connected to the tractor propelling motor, an internally threaded member rotatable by said clutches, a rod screwed at one end into said internally threaded member and connected at the other end to said bell crank lever to transmit motion of the clutches thereto, a rocking lever pivotally supported by the tractor, draft links between said rocking lever and said implement, a spring on the tractor acting on said rocking lever and balancing the normal draft, a rod connecting said rocking lever to said system of friction clutches to engage one or other of said friction clutches on variations in the draft, and a hand lever for lengthening or shortening said rod to control said clutches by hand to raise or lower the implement.

16. In combination, a tractor, an agricultural implement, a bell crank lever pivotally carried by the tractor, upstanding triangulated members on the implement to which said bell crank lever is connected to carry said implement, a shaft driven by said tractor, bevel wheels keyed to said shaft, inner clutch members on said bevel wheels, outer clutch members movable axially along said shaft to engage said inner clutch members, an internally threaded member rotatable by said clutches, a rod screwed at one end into said internally screwed member and connected at the other end to said bell crank lever to transmit motion of the clutches thereto, a rocking lever pivotally supported by the tractor, draft links between said rocking lever and said implement, a spring on the tractor acting on said rocking lever and balancing the normal draft and a connection between said rocking lever and said clutches to engage one or other of said friction clutches and thereby to keep said implement automatically at a regular depth of cut.

17. In combination, a tractor, an agricultural implement, a bell crank lever pivotally carried by the tractor, upstanding triangulated members on the implement to which said bell crank lever is connected to carry said implement, a shaft driven by said trac-

tor, bevel wheels keyed to said shaft, inner clutch members on said bevel wheels, outer clutch members movable axially along said shaft to engage said inner clutch members, an internally screwed member rotatable by said clutches, a rod screwed at one end into said internally screwed member and connected at the other end to said bell crank lever to transmit motion of the clutches thereto, a rocking lever pivotally supported by the tractor, draft links between said rocking lever and said implement, a spring on the tractor acting on said rocking lever and balancing the normal draft, a rod connecting said rocking lever to said system of friction clutches to engage one or other of said friction clutches on variations in the draft and a hand lever for lengthening or shortening the said rod to control said clutches by hand to raise or lower the implement.

In testimony whereof I affix my signature.

HARRY FERGUSON.

Patented Mar. 5, 1929. 1,703,920

UNITED STATES PATENT OFFICE.

CHARLES E. BRADLEY, OF MONTCLAIR, NEW JERSEY, AND WILLIS A. GIBBONS, OF NEW YORK, N. Y., ASSIGNORS TO THE NAUGATUCK CHEMICAL COMPANY, A CORPORATION OF CONNECTICUT.

COATING COMPOSITION.

No Drawing. Application filed July 2, 1921. Serial No. 482,175.

This invention relates to coating compositions and is more particularly directed to varnishes, lacquers, and the like comprising derivatives of rubber.

A chloride of crude rubber known as heptachlorcaoutchouc has been described as a suitable material for varnish gum. When compared with an ordinary varnish gum, however, using solutions of equal concentration of the two materials, the solutions of the caoutchouc have been found to be more viscous than those of varnish and to flow less readily when applied. The film of the crude rubber derivative is also cohesive and ordinarily not particularly adherent to the surface to which applied. For example, a solution of rubbed chloride, when poured on glass or similar smooth surface, upon drying may be stripped off as a thin continuous film. The film is fairly flexible. At least it is not to be regarded as brittle in the ordinary sense of the term. It further has only a low lustre or gloss. These properties do not recommend a material for use as a varnish gum, since the latter ordinarily provides solutions of low viscosity which spread well, which adhere to the surface to which applied, and which have a brittleness similar, for example, to shellac as well as a good lustre or gloss.

An object of the present invention accordingly is to provide compositions of rubber derivatives and similar materials which shall provide coatings like those furnished by the better varnish gums. Another object of the invention is to provide a lacquer having in general the desirable properties of lacquers made from nitro-cellulose and similar solutions.

The invention accordingly broadly consists of a coating composition comprising a solution of a halogenated combined rubber in a volatile solvent having a viscosity sufficiently low to permit spreading and providing a relatively brittle coating having a good lustre or gloss.

The expression "combined rubber" herein used is intended to include rubber or similar material vulcanized with sulphur, nitro-compounds or other vulcanizing agents, and rubber resulting from other chemical treatment such as halogenation etc.

It will be understood that by halogenation, it is intended to include other compounds of the halogens having a similar action such as the halogen acids as set forth in our copending application Serial No. 479,100, filed June 20, 1921.

It will also be understood that where the "combined" rubber employed in the process is halogenated rubber, the halogenation of such combined rubber is accomplished by a halogen or halogen acid which differs from that present in the combined rubber.

The preferred coating composition is either a spirit or oil varnish comprising rubber vulcanized with sulphur and chlorinated, for example chlorinated inner tubes. Chlorination is preferably carried out according to the procedure in our co-pending application Serial No. 479,100, filed June 20, 1921, now Patent No. 1,627,725, issued May 10, 1927, and the product is one of those therein set forth.

If a spirit varnish is desired 34 lbs. of chlorinated sulphur-vulcanized rubber, 66 lbs. of benzol and 25 lbs. of solvent naphtha are mixed. Solution takes place almost immediately at ordinary room termperature providing a liquid which flows substantially as freely from the brush as an equivalent solution of shellac. The viscosity is about half that of a corresponding solution of rubber chloride. The film formed from this varnish upon drying is somewhat more resistant to the action of hot water than shellac. It apparently is much less affected by cold water than this material. It resists abrasion better and withstands blows about as well as shellac. It may be dissolved much more readily than shellac. In general it is highly resistant to the action of aqueous chemicals. If the solution mentioned be poured upon a smooth surface such as glass and allowed to dry the film thus formed can ordinarily not be stripped continuously unless it is quite thick and unless the stripping takes place when a small quantity of the solvent is present. The film is in other words more brittle than that of rubber chloride and posseses better adhesion to the glass. By reason of its lower viscosity and greater adhesion it it therefore better adapted as a coating material for wood, metal, and other substances. It will be understood that solvent naphtha or similar material may be omitted from the above formula and that other solvents than benzol may be employed. It will be observed, however, that a high boiling solvent such as naphtha is preferably employed. Such solvent upon drying of the varnish solutions remains until the end of the drying and insures an even lustrous coat.

If an oil varnish is desired, chlorinated vulcanized rubber, boiled linseed oil and solvent naphtha are combined. Dried chlorinated vulcanized rubber is dissolved in solvent naphtha in proportions of 100 grams of the chlorinated product to 140 cc. of solvent naphtha. When solution is complete it is added slowly with constant stirring to 100 cc. of boiled linseed oil. If desired raw linseed oil may be used but in this event approximately 0.5% of drier should be employed to secure a varnish adapted to dry in twenty-four hours. With boiled linseed oil such drying may be accomplished without the use of driers. The oil varnish has a similar desirable low viscosity, is highly resistant to the action of various chemicals, has high resistance to abrasion, and resists cracking under blows of sharp objects. In other respects it generally resembles the film of the spirit varnish.

It will also be understood that the various other combined rubbers set forth in our co-pending application mentioned may also be employed. For example a light-colored lustrous spirit or oil varnish may also be obtained by substituting for chlorinated sulphur-vulcanized rubber, in the above formulas, the sulphur chloride treated crude and combined rubber set forth in the application mentioned.

Dip lacquers may be made by adding to the spirit varnishes various pigments. The following is an example of a white dip lacquer:

		Parts by weight.
Chlorinated vulcanized rubber		100
Sublimed white lead	40%	25- 250
Titanium oxide	60%	
Benzol		375-1750

In general the quantity of benzol employed should be approximately three to five times by weight of the solids employed depending on the contour of the articles dipped. For articles having other than a smooth contour a dilute solution should be employed. For articles having a smooth contour a more concentrated one may be used.

Red and blue dip lacquers may be prepared by substituting for the white pigment mentioned in the above formula 5–50% respectively of toluidine toner or ultramarine based on the weight of the chlorinated rubber employed.

A brush lacquer may be made in accordance with the following formula:

Dried chlorinated vulcanized rubber	100 kg.
Sublimed lead and titanium oxide	100 kg.
Solvent naphtha	200 litres.

Similar additions of pigments to the oil varnishes will produce white and other colored enamels.

As many apparently widely different embodiments of this invention may be made without departing from the spirit thereof, it will be understood that we do not intend to limit ourselves to the specific embodiments herein set forth except as indicated in the appended claims.

Having thus described our invention, what we claim and desire to protect by Letters Patent is:

1. A coating composition comprising a solution of a halogenated combined rubber in two solvents, one of which has a relatively high boiling point.

2. A coating composition comprising a solution of halogenated vulcanized rubber in benzol and solvent naphtha.

3. A coating composition comprising a solution of a chlorinated vulcanized rubber comprising chlorinated vulcanized rubber 27%, benzol 53%, solvent naphtha 20%.

4. A coating composition comprising a chlorinated vulcanized rubber, a pigment, and a solvent.

5. A coating composition comprising chlorinated vulcanized rubber 100 parts, a pigment in the proportion of 5–250 parts and benzol in the proportion of 3 to 5 times the weight of the solids.

6. A coating composition comprising a solution of a sulphur chloride-treated combined rubber in two solvents, one of which has a relatively high boiling point.

7. A coating composition comprising a solution of a halogenated sulphur chloride-treated combined rubber in a volatile solvent comprising solvent naphtha.

8. A varnish comprising a solution of a chlorinated, sulphur-vulcanized rubber in two volatile solvents, one of which has a relatively low boiling point and the other a relatively high boiling point.

9. A varnish comprising chlorinated vulcanized rubber, a drying oil, and a volatile solvent.

10. A varnish comprising chlorinated vulcanized rubber, boiled linseed oil and solvent naphtha.

11. A chlorinated rubber solution containing at least 25% of chlorinated rubber and an unsaturated glyceride.

12. A coating composition comprising a solution of chlorinated rubber in a volatile solvent, and boiled linseed oil.

Signed at New York, New York, this 20th day of June, 1921.

CHARLES E. BRADLEY.

Signed at New York, New York, this 20th day of June, 1921.

WILLIS A. GIBBONS.

March 15, 1932. H. FORD 1,850,006

BRAKE

Filed Oct. 5, 1927 2 Sheets-Sheet 1

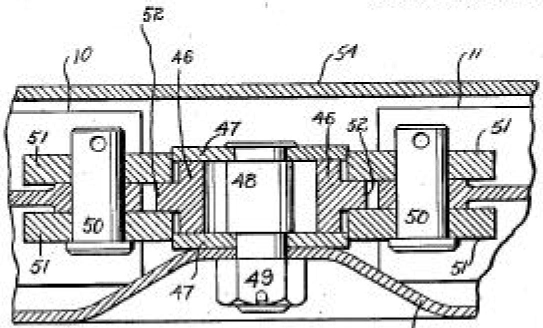

Fig. 6

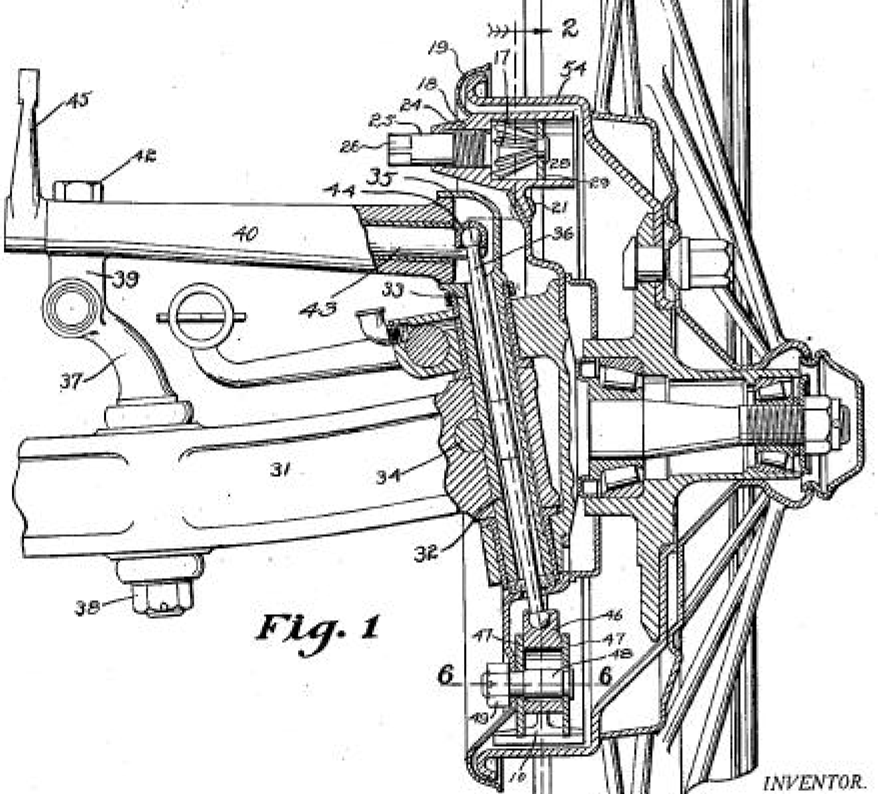

Fig. 1

INVENTOR.

Henry Ford.

BY

C.R. Halbut.

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March 15, 1932. H. FORD 1,850,006

BRAKE

Filed Oct. 5, 1927 2 Sheets-Sheet 2

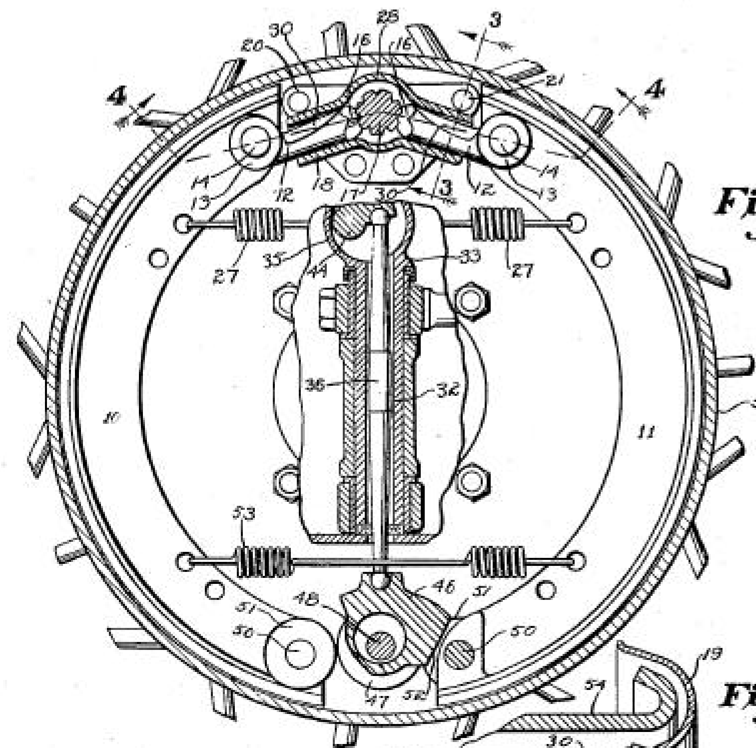


Fig. 2

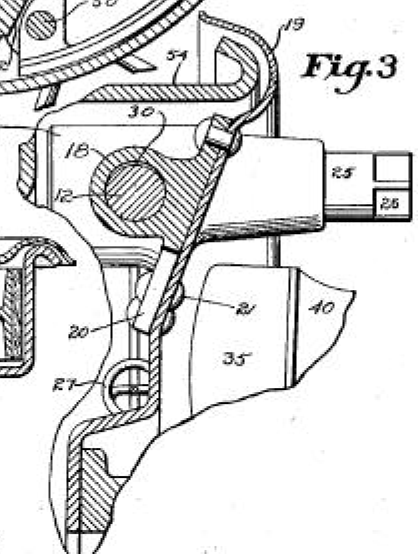


Fig. 3

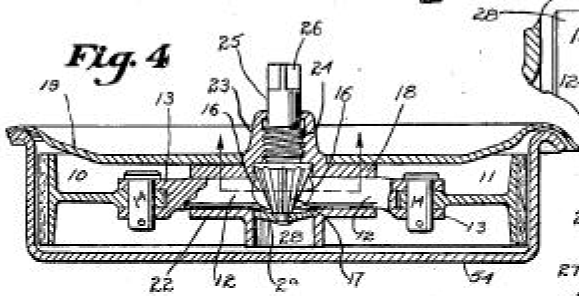


Fig. 4

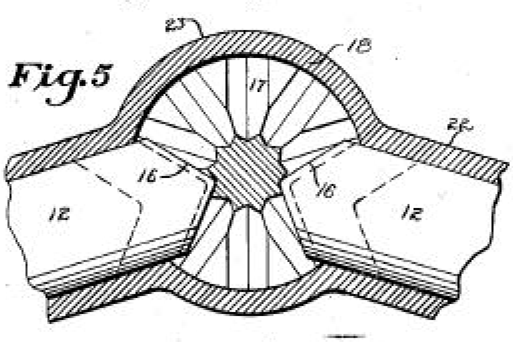


Fig. 5

INVENTOR

Henry Ford.

BY

C. R. Halbert.

ATTORNEYS.

Patented Mar. 15, 1932 1,850,006

UNITED STATES PATENT OFFICE

HENRY FORD, OF DEARBORN, MICHIGAN, ASSIGNOR TO FORD MOTOR COMPANY, OF DEARBORN, MICHIGAN, A CORPORATION OF DELAWARE

BRAKE

Application filed October 5, 1927. Serial No. 224,092.

The object of my invention is to provide a brake of simple, durable, and inexpensive construction.

Still a further object of my invention is to provide a brake which is especially adapted for the front steering wheels of an automotive vehicle.

Still a further object of my invention is to provide such a brake wherein the operating parts are protected from dirt and grease and accidental injury so far as may be possible.

Still a further object of my invention is to provide a novel form of adjusting device for a brake, and to provide in combination with the adjusting device mechanism whereby it is substantially impossible to tighten the brake too much.

Still a further object of my invention is to provide an adjusting device for a brake wherein a cone shaped member may be forced between the ends of the brake to separate the brake ends to thereby adjust the clearance of the brake relative to the brake drum, and to provide in combination with such a cone shaped member, notches whereby the cone may be locked in its adjusted position and whereby it is substantially impossible to adjust the brakes so that they do not have the correct amount of clearance.

Still a further object of my invention is to somewhat loosely mount my improved brake shoe so that engagement of the full length of each brake shoe may be insured whenever the brake is applied even though uneven wear may have occured or the shoes may not have been perfectly made.

Still a further object of my invention is to provide improved means for protecting the adjusting device against dirt, grease, or water so that there is practically no danger that it will ever wear out, or rust, or get out of order.

Still a further object of my invention is to provide an improved method of applying these brakes, comprising a floating wedge which may be pressed between the free ends of the brake shoes whereby equal and full engagement of both brake shoes may be insured whether they were initially accurately constructed or uneven wear has taken place.

Still a further object of my invention is to provide an improved means for mounting a floating wedge for operating the brake shoes.

With these and other objects in view, my invention consists in the arrangement, construction, and combination of the various parts of my improved device, as described in the specification, claimed in the claims, and illustrated in the accompanying drawings, in which:

Figure 1 shows a vertical central sectional transverse view through a front or steering wheel having my improved brake installed thereon.

Figure 2 shows a vertical sectional view taken on the line 2—2 of Figure 1.

Figure 3 shows a detailed sectional view taken on the line 3—3 of Figure 2.

Figure 4 shows a detail sectional view taken on line 4—4 of Figure 2.

Figure 5 shows an enlarged detail sectional view illustrating the construction of the adjusting device, and

Figure 6 shows a horizontal sectional view taken on the line 6—6 of Figure 1.

Referring to the accompanying drawings, I have used the reference numbers 10 and 11 to indicate generally brake shoe members of T cross section. These brake shoe members are similar in all respects and interchangeable, and are provided near each end of each of the vertical webs thereof with openings designed to receive pins for mounting said brakes and operating same. Pairs of openings are provided in this vertical web in position spaced from each of said first openings to receive springs for contracting the brake. Studs 12 are provided at one end with clevices 13, so that a pin 14 may extend through said clevices and the openings at the upper end of the brake shoes 10 and 11 to pivotally connect each of the brake shoes with one of the studs 13. The adjacent ends of the studs 12 are beveled to form a chisel end 16 thereon, which are designed to contact with a conical notched head 17 which forms the adjusting member. A housing 18 is secured to the brake anchor plate 19 by means of laterally extending flanges 20 and rivets 21. The housing has sleeves 22 at either end thereof designed to slidingly receive the studs 12. A third sleeve 23 extends from the housing 18 in substantially the same horizontal plane as the sleeves 22 but with its axis perpendicular thereto. The interior of this sleeve 23 is threaded as at 24 to coact with corresponding threads on the shank 25 of the adjusting member. This shank 25 is preferably formed integrally with the adjusting member 17 and extends through and beyond the brake anchor plate 19 so that the squared end 26 thereof may be rotated by a wrench or other tool to adjust the adjusting member laterally by means of the threads 24.

From the foregoing description it will be seen that the shank 25 of the adjusting member may be rotated to adjust the notched cone 17 axially to thereby spread the studs 12 and consequently the upper ends of the brake shoes 10 and 11 or to permit these studs to approach each other. These studs 12 are normally yieldingly urged into engagement with the cone by the spring 27.

A fourth sleeve 28 extends from the housing 18 at the side thereof opposite the sleeve 23, this sleeve 28 being of greater diameter than the adjusting cone 17 and having its axis coinciding with or registering with the axis of the shank 25 and sleeve 23. A washer 29 is riveted to an extending end of the adjusting cone 17, this washer being of substantially the same diameter as the interior of the sleeve 28. When the adjusting member 17 is in place in the housing 18 it will be seen that the sleeve 28 and washer 29 will form a dust shield at one end of the adjusting cone to thereby protect same from harmful extraneous matter. The outside end of the sleeve 23 is contracted in around the shank 25 to fit closely against same to prevent harmful extraneous matter from entering the adjusting mechanism at the opposite end of the adjusting member. The threads 24 are therefore thoroughly protected against becoming inoperative from causes such as rust, dirt, etc.

The upper sides of the studs 12 within the sleeves 22 are flattened out or relieved as is indicated at 30 in the drawings so that some vertical play of the ends of the brake shoes 10 and 11 is permitted. This is very important feature of the brake as this little vertical movement of the upper ends of the brake when the pressure is applied thereto makes the difference between a nice operating brake and one which does not operate very satisfactorily. The reason for the superior efficiency of this construction is probably that there is a slight wedging action at the end of the brake shoe against the brake drum due to said end swinging on a pivot, the axis of which is the point of contact of the chisel ends 16 of the studs 12 against the adjusting cone 17.

It will be noted that the adjusting cone 17 is provided with a plurality of serations into which the chisel ends 16 of the studs 12 are pressed by the spring 27. This construction has two advantages in that it provides a locking means which prevents the brake adjustment from altering during service and prevents the brake from being adjusted too tightly as the engagement of the brake shoes 10 and 11 with the drum when the studs are passing over the shoulders between the notches in the member 17 will prevent the adjustment from being made too tight. In other words the adjustment is accomplished by screwing the shank 25 until the energy required is considerably greater, due to the engagement of the shoes with the drum when the studs are passing over said shoulders so that the proper adjustment is automatically indicated to the operator. If desired, the notches in the member 17 may be deep enough so that it is impossible to adjust the brakes too tight.

The front axle 31 of the automobile has a hollow sleeve 32 at the end thereof. A hollow king bolt 33 is locked into this sleeve 32 by means of a flat sided pin 34. The upper end of the king bolt 33 is provided with a housing 35 which is open at the inner side thereof. A brake operating rod 36 extends through this hollow king bolt 33 and is provided with a ball at either end thereof. A spring perch 37 extends from the axle 31 is secured thereto by a nut 38. This spring perch 37 has an extension or boss 39 thereon designed to support one end of the sleeve 40. This sleeve 40 has an extension thereon through which a cap screw 42 may pass so that the cap screw 42 may enter the boss 39 and locate and support the inner end of the sleeve 40. The second end of the sleeve 40 enters the open side of the housing 35.

Rotatably mounted in the sleeve is a brake operating shaft 43 which is provided at its outer end with a cam 44 designed to co-act with a brake operating rod 36 to reciprocate same when the brake operating shaft 43 is rotated. The inner end of the brake operating shaft 43 has an arm 45 secured thereto so that the shaft 43 may be rotated by any suitable connections with brake pedals or brake levers mounted on a chassis.

A floating wedge 46 is connected to the ball at the lower end of the brake operating rod 36. This wedge 46 is prevented from lateral movement by the engagement of the ends thereof with spaced parallel retaining plates or washers 47. These plates are mounted on a stud 48 which is secured by a nut 49 to the brake anchor plate 19. The central portion of the stud 48 is enlarged so that the retaining plates 47 may bear against the shoulders at the ends of the enlarged portion and will be held in place thereby.

A pin 50 extends through the openings at bottom of brake shoes in the vertical webs thereof and a pair of rollers 51 are mounted on each pin 50. The wedge 46 is provided with a central rib 52 which extends between the roller 51 of each brake shoe to thereby prevent lateral movement of the brake shoe. The shoulders on each side of this rib 52 form the cam or working faces of the wedge 46 and engage the peripheries of the rollers 51 to spread the brake shoes and thereby actuate the brake mechanism. It will be noted that the rollers 51 are wide enough to engage both the cam surfaces of the wedge 46 and the edges of the washers 47. These washers 47 are fixed in place on the brake anchor plate 19, so that a spring 53 extended between the brake shoes 10 and 11 draws the rollers 51 into contact with the washers 47 when the brake is in retracted position to thereby insure that the brake shoes will always be centralized relative to the brake drum 54 when they are in their retracted position. Whenever the wedge 46 is pushed downwardly to engage the brake, however it floats enough to move toward either of the brake shoes 10 or 11 so that if either of these shoes are not quite accurately made or uneven wear has taken place, then the wedge 46 may float sufficiently to apply an equal pressure to both brake shoes 10 and 11. That is the operating mechanism for the brake is so arranged that it is positively urged into contact with the brake drum, but provision is made to equalize the irregularities of the brake shoes, and at the same time there is a positive stop against which the brake shoes are retracted so that the brake shoes will always be centralized with the drum when they are in their inoperative position.

Among the many advantages that result from the use of my improved brake mechanism, it should be pointed out first that I have constructed a brake such that the full working surfaces of both shoes will be fully and equally pressed into engagement with the drum when the brake is being operated so that I am able to secure the maximum efficiency of the brake shoes used. Another advantage results from the fact that the brake is made so that it is not at all likely to be adjusted so that it is too tight, and it can be made so that it cannot be adjusted so that the brake is too tight. Still a further advantage results from the construction whereby the upper ends of the brake shoes are mounted on a swinging pivot so that they can swing into full engagement with the brake drum whereby the friction on the working surfaces of the brake shoes can be uniform throughout their length. Still a further advantage from the use of the floating wedge for spreading the brake shoes so that the brakes may be evenly applied even though they were not accurately initially formed or have worn unevenly. Still a further advantage results from the use of positive stop for the brake shoes both at the top and bottom thereof in combination with springs designed to yieldingly urge the brake shoes into contact with the stops, whereby the brake shoes are always returned to a central position relative to the drum, and so that the clearances and movements of the various brake operating parts may be small and the brake leverages relatively large whereby an easy operating brake is secured. Still a further advantage results from the use of the tapered wedge which I have provided in that operation of the parts does not tend to vary the adjustment of the brake and provision is made to prevent rust or dirt or the like from preventing operation of the adjustment at any time.

Some changes may be made in the arrangement, construction and combination of the various parts of my improved device without departing from the spirit of my invention, and it is my intention to cover by my claims such changes as may be reasonably included within the scope thereof.

I claim as my invention:

1. In a brake, a brake anchor plate, a rigid brake shoe, a stud, means for operatively connecting one end of said stud to one end of said brake shoe, and the means for adjustably mounting said stud on said brake anchor plate to permit reciprocation and swinging movement of the stud relative to the anchor plate, said means including a tapered stop against which the end of the stud may bear.

2. In a brake, a brake anchor plate, a brake shoe, a stud, means for operatively connecting one end of said stud to one end of said brake shoe, an adjustable cone mounted on said brake anchor plate in position to co-act with said stud, said cone having a plurality of notches therein adapted to be engaged by the end of said stud, and means for yieldingly urging said stud into contact with said cone, whereby the cone may be held in its adjusted position and the maximum adjusted tightness of the brake shoe may be determined by the engagement of the stud with said notches and depth of said notches.

3. In a brake, a brake anchor plate, a pair of studs mounted on said brake anchor plate, an adjustable cone mounted on said brake anchor plate in position to coact with said studs, said cone having a plurality of notches therein adapted to be engaged by the ends of said studs, and means for yieldingly urging said studs into contact with said cone.

4. In a brake, a brake anchor plate, a brake shoe, a pair of studs, means for pivotally connecting one end of each of said studs to one end of one of said brake shoes, an adjustable cone mounted on said brake anchor plate in position to coact with said studs, said cone having a plurality of notches therein adapted to be engaged by the free ends of said studs, and means for yieldingly urging said studs into contact with said cone, whereby

the cone may be held in its adjusted position and the maximum adjusted tightness of the brake shoes may be determined by the engagement of the studs with said notches in the cone and the ends of the brake shoe adjacent to said studs may be permitted to swing substantially radially into contact with a brake drum.

5. In a brake mechanism having a braking member and brake drum, adjusting means compensating for wear of the braking member permitting the portion of the braking member adjacent thereto to move into engagement with the drum in a path other than the path of adjustment, and a stop arranged to limit said engaging movement.

6. In a brake mechanism having a braking member and brake drum, adjusting means compensating for wear of the braking member, means pivotally connecting the braking member with the adjusting means permitting the portion of the braking member adjacent to said pivot to move into engagement with the brake drum in a path other than the path of adjustment, and a stop arranged to limit said movement.

7. In a brake mechanism having a brake shoe and brake drum, adjustable means compensating for wear of the brake shoe, a stud pivotally connecting the brake shoe with the adjusting means permitting the portion of the brake shoe adjacent to the stud to move into engagement with the drum in a path substantially perpendicular to the adjusting movement path and a stop arranged to limit said perpendicular movement.

8. In a brake mechanism having a brake shoe and brake drum and brake anchor plate, adjusting means compensating for wear on the brake shoes, a stud pivotally connected to both brake shoe and adjusting means, and a guide in the brake anchor plate permitting the portion of the brake shoe adjacent to said stud to move into engagement with the drum in a path other than adjusting movement path and limiting said first mentioned movement.

9. A vehicle brake consisting of a braking member and brake drum, adjustable means compensating for wear of the braking member, means pivotally connected both to one end of said braking member and to the adjusting means so as to anchor said end against circumferential movement and permit radial movement of said end into engagement with said drum, and means for applying the other end of said braking member.

10. A vehicle brake consisting of a brake shoe and brake drum, adjustable means compensating for wear of the brake shoe, means pivotally connected both to one end of said brake shoe and to the adjusting means so as to anchor said shoe end against circumferential movement and permit radial movement of said end into engagement with said drum, and means for applying the other end of said shoe.

11. A vehicle brake consisting of a pair of rigid brake shoes disposed within a brake drum, adjustable means compensating for wear of the brake shoes, a pair of studs each pivotally connected both to one end of one shoe and to the adjusting means so as to anchor one pair of adjacent shoe ends against circumferential movement and permit radial movement of said ends into engagement with said drum, and means for spreading the opposite ends of said shoes to apply the brakes.

12. A vehicle brake consisting of a braking member and brake drum, means for anchoring one end of said member so that it may move into engagement with said drum, and means for limiting said engaging movement for the purpose described.

13. A vehicle brake consisting of a brake drum having a rigid brake shoe disposed therein, means for anchoring one end of said shoe so that it may move into engagement with said drum, and means for limiting said engaging movement for the purpose described.

14. A vehicle brake consisting of a brake drum having a rigid brake shoe disposed therein, means for anchoring one end of said shoe so that it may move radially into engagement with said drum, and means for limiting said engaging movement for the purpose described.

15. A vehicle brake consisting of a brake drum having a rigid brake shoe disposed therein, means for adjustably anchoring one end of said shoe against circumferential movement, said means permitting radial movement of said shoe end into engagement with said drum, and a stop limiting said engaging movement for the purpose described.

16. A vehicle brake consisting of a brake drum having a pair of rigid brake shoes disposed therein, an adjusting device for spreading one pair of adjacent shoe ends, a pair of studs connecting said shoe ends with said adjusting device, said studs pivoting around said device thereby permitting said ends to swing radially into engagement with said drum, and means for limiting the engaging movement of said studs for the purpose described.

17. A vehicle brake consisting of a brake drum having a rigid brake shoe disposed therein, a stud pivotally connected to one end of said shoe, and a brake adjusting device having an elongated opening therein through which said stud extends, said opening permitting both longitudinal adjusting movement and radial pivotal movement of said stud and limiting said pivotal movement for the purpose described.

HENRY FORD.

Patented Aug. 16, 1932

1,871,545

UNITED STATES PATENT OFFICE

RUSSELL H. McCARROLL AND GOSTA VENNERHOLM, OF DEARBORN, MICHIGAN, ASSIGNORS TO FORD MOTOR COMPANY, OF DEARBORN, MICHIGAN, A CORPORATION OF DELAWARE

METHOD OF MANUFACTURING CAST IRON, AND CAST IRON ARTICLES

No Drawing. Application filed January 19, 1931. Serial No. 509,879.

This invention relates to the manufacture of cast iron articles and particularly to sand cast iron and has for its principal object to provide a new article of manufacture of cast iron and a new and improved manufacturing method therefor, including the preparation of an iron of a predetermined analysis and a treating of the same to secure a product of unusually high physical properties, heretofore not thought possible in cast iron.

The product heretofore resulting from the casting of iron is gray cast iron, mottled cast iron, and white cast iron, depending upon such factors as the analysis of the iron, the process of melting, and the rate of cooling. The most important of these irons are the gray cast and white cast iron. Gray cast iron is characterized by the presence of carbon interspersed throughout the matrix in the form of graphitic flakes or fissures, while in white cast iron the carbon is in the combined state, that is, in the form of iron carbide and as a solid solution of iron and iron carbide.

White cast iron is extremely hard and very brittle and because of the difficulty of machining it by the ordinary methods its usefulness is very limited. Considerable amounts of white cast iron, however, are employed for the production of malleableized iron, the latter being soft and ductile and of relatively low strength, compared with steel.

It is a matter of common knowledge that gray cast iron, although used extensively in the industries, is of relatively low tensile strength and that it is not possible, although the matrix of gray iron is of essentially the same composition as steel, appreciably to improve the physical properties of gray cast iron by the common and well known hardening and tempering heat treatments that are effectively employed for the treatment of steel. This is mainly due to the presence of the graphitic flakes and fissures which in all cases form planes of weakness. It is, however, possible to improve the physical properties of gray cast iron by special methods of treatment. As far as we are aware the only methods heretofore commercially used, particularly in connection with the production of sand cast iron are what are known as the superheating method and the mold heating method. In the superheating, the molten iron is heated considerably above the temperatures ordinarily employed in the furnace, the object being to increase solubility for carbon and as a result of such increased solubility the final product contains its free carbon in the form of smaller graphitic flakes and fissures than is present in the common gray cast iron. While the superheating method results in securing an improved iron, this method of treatment is subject to the objections that the product still contains graphitic flakes and fissures in an extent sufficient to have a weakening effect, and that the higher temperatures necessary involve greater production costs because of the increased furnace maintenance costs.

The second method, namely, the mold heating method, consists in heating the molds before the molten iron is poured therein and in employing an iron of an analysis that would, if cast into unheated molds, result in the production of white or mottled cast iron. The pre-heating of the molds insures a slow rate of cooling, prevents white cast iron from freezing out, should the analysis be such as would ordinarily form such iron, and results in producing an iron having a pearlitic matrix with free carbon distributed through such matrix as graphitic flakes. This method is subject to the objection noted above with respect to the formation of graphitic flakes and fissures and is also subject to the objection of increased production costs and difficulties in handling the heated molds.

We aim by the present invention to produce as a final product an iron free from graphitic flakes and fissures with the free carbon in the form of temper carbon and with the remainder of the carbon in a state corresponding to that found in the transformations, pearlite, sorbite, troosite or martensite, depending upon the uses for which the product is intended. The present invention may be briefly said to depend upon a predetermined analysis of the iron, the constituents thereof falling within fairly well defined limits, and, in conjunction with such analysis, a heat treatment of the iron after casting so as to control the decomposition of the carbon content. The method hereinafter to be more fully described is particularly applicable to casting in sand molds although the invention is not limited to the use of any particular type of molds.

We have found that an iron, whose constituents fall within the following limits, when subjected to the heat treatment hereinafter to be described, will have the desired high physical properties which it is the object of the present invention to obtain:

Carbon from 1.90 to 2.30%
Manganese from .20 to .65%
Silicon from 1.50 to 2.20%
Phosphorus below .12% and
Sulphur below .12%.

An iron of the following analysis prepared in accordance with the invention has given highly successful commercial results:

Carbon 2.08%
Manganese .21%
Silicon 1.85%
Phosphorus .05% and
Sulphur .06%.

Molten metal of the above described analysis is cast, preferably in sand molds, to secure an article, or articles, of the predetermined desired shape and size. Due to the analysis, the casting produced is mainly white iron. After the casting has cooled it is then reheated to above the critical range, for example, up to approximately 1750° F., followed by various types of cooling treatment depending upon the matrix composition desired as set forth above. The result of this treatment is to give a solid solution, eutectoid or intermediate, matrix with the free carbon in the form of temper carbon. The time of heat treatment will depend upon the cross section of the casting. For castings up to one-half inch cross sectional dimensions, a heat treatment at the maximum temperature of one and a half hours duration has been found to be sufficient.

In some cases the castings are then reheated to a temperature just slightly below the critical range and are allowed to air cool, to insure a matrix which is mainly pearlite (and sorbite) in which is imbedded free particles of temper carbon.

The product resulting from the above described method that is with an iron of approximately 2% carbon, is found to have its carbon content distributed approximately 1% in the form of a combined carbon, that is, iron carbide free in solid solution in the matrix, or eutectoid and approximately 1% in the form of free temper carbon interspersed throughout the matrix. This product has remarkably high physical properties, giving on test a tensile strength of over 90,000 pounds; the hardness of the product is readily controllable as desired.

It will be understood however that the ratios of carbon distribution in the forms of temper carbon and in solution as iron carbide will vary according to the analysis of the batch. It will further be understood that such analysis as well as the heat treatment may be varied from the specific example above described and that such changes, variations and modifications as may be resorted to without departing from the basic underlying principles of the invention are intended to be covered by the claims hereunto appended.

We claim:

1. The method of manufacturing cast iron which consists of preparing a batch of molten metal in which the constituents will be within the following limits:

Carbon from 1.90 to 2.30%
Manganese from .20 to .65%
Silicon from 1.50 to 2.20%
Phosphorus below .12% and
Sulphur below .12%,

casting the molten metal in a mold to secure an article of predetermined configuration, and after the article has cooled reheating to approximately 1750° F. for a predetermined period of time, depending upon cross section and analysis, sufficient to decompose the combined carbon, then lowering the temperature to a point somewhat above the critical range, and preventing further decomposition at such point by a rapid cooling, such as quenching, thereby to obtain a matrix composed of solid solution, and then finally reheating to a point below the critical range, to produce a matrix composed of martensite, troosite, sorbite or pearlite as determined by the reheating temperature.

2. As an article of manufacture, heat treated cast iron having a composition within the following limits:

Carbon from 1.90 to 2.30%
Manganese from .20 to .65%
Silicon from 1.50 to 2.20%
Phosphorus below .12% and
Sulphur below .12%,

free from graphitic flakes and fissures in which the carbon content is substantially equally distributed as solid solution in the matrix and throughout the matrix as temper carbon.

In testimony whereof we affix our signatures hereto.

RUSSELL H. McCARROLL.
GOSTA VENNERHOLM.

Aug. 23, 1932.

H. FORD

1,873,569

ENGINE VALVE

Filed July 10, 1930

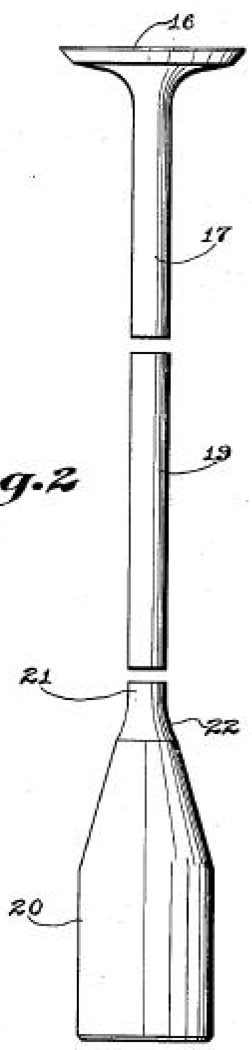


Fig.2

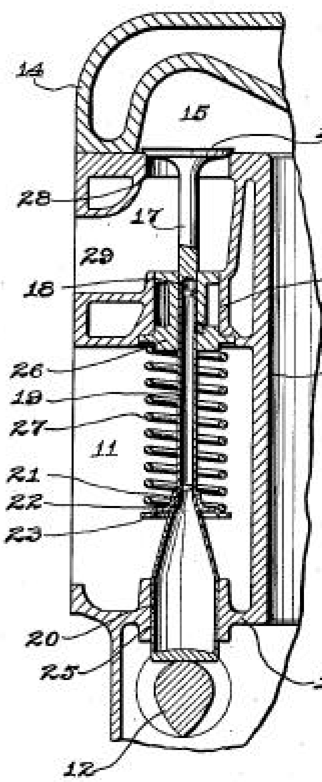


Fig.1

INVENTOR.

Henry Ford

BY

ATTORNEY.

Witness

E. C. McRae.

Patented Aug. 23, 1932

1,873,569

UNITED STATES PATENT OFFICE

HENRY FORD, OF DEARBORN, MICHIGAN, ASSIGNOR TO FORD MOTOR COMPANY, OF DEARBORN, MICHIGAN, A CORPORATION OF DELAWARE

ENGINE VALVE

Application filed July 10, 1930. Serial No. 467,047.

The object of my invention is to provide an engine valve of simple, durable and inexpensive construction, and especially adapted for use in connection with internal combustion engines.

A further object of my invention is to provide an engine valve particularly adapted for high-speed automobile engines which valve will have a longer life and will remain quiet in operation over longer periods than the ordinary valve. My improved valve is designed for L-head engines wherein a horizontal cam shaft is provided which reciprocates all of the valves in the engine, these valves extending from the cam shaft up through the side of the engine to the combustion chambers.

Heretofore in this type of engine, valve tappets have universally been provided for each valve, which tappets were reciprocally mounted in the lower part of the cylinder block in position to act as cam followers for the cams of the cam shaft. Each valve proper extended from the combustion chamber down through one side of the cylinder block to position adjacent to the upper end of its respective valve tappet and a valve spring was arranged to urge the valve down against the valve seat in the combustion chamber and the tappet against the respective cam on the cam shaft.

Still a further object of my invention is to provide a valve for an L-head type engine, the lower end of which valve bears directly on the cam shaft while the upper end is disposed in the combustion chamber. I am thus able to provide a closer commercial tolerance for the clearance between the cam shaft and the valve for the reason that only two finished surfaces, the valve seat and the end of the valve, need be held to accurate spaced dimensions. It will be apparent that it is easier to maintain an accurate overall dimension for the valve and tappet when it is formed in one piece than when it is formed in two separate parts.

With these and other objects in view my invention consists in the arrangement, construction and combination of the various parts of my improved device, as described in the specification, claimed in my claims, and illustrated in the accompanying drawing, in which:

Figure 1 shows a vertical cross-sectional view through an engine having my improved valve incorporated therein, and

Figure 2 shows an elevation of the various parts comprising my improved valve, the parts being shown before they are welded together.

Referring to the accompanying drawing, I have used the reference numeral 10 to indicate generally the cylinder block of an automobile engine having a horizontal valve spring chamber 11 cast along one side thereof. A cam shaft 12 extends horizontally through the lower portion of the block 10 just below the valve spring chamber 11, a wall 13 separating the chamber 11 from the cam shaft chamber. A cylinder head 14 is bolted to the top of the cylinder block 10 so that combustion chambers 15 are formed therebetween in the conventional manner.

In the ordinary structure the weight of the valve and valve tappet was considerable. The valve springs were required to overcome the inertia of both the valve and valve tappet so that stiff springs were necessary to prevent floating of the valves at high engine speeds. It will be apparent that as the speed of the engine increases the size of the valve spring must be increased to more quickly overcome the inertia of the valve and tappet. In my improved valve structure I combine the valve and valve tappet so that my structure weighs only a fraction of the weight of the former separate valve and tappet. A much lighter valve spring may be used with my device and still secure positive operation of the valves at high engine speeds. The use of this lighter valve spring reduces the wear on the cam and adjacent cam follower surfaces so that the valve retains its adjustment over a much longer period of operation.

Still a further object of my invention is to provide a valve which will have a pair of aligned spaced bearing surfaces to thereby secure the valve in correct alignment during the life of the engine. The ordinary valve is provided with a valve bushing which pilots the center portion of the valve stem only. The valve tappet is also piloted in its center portion, but these two members being separate units, one forms no support for the other. During the operation of the engine the valve tappet bearing wears at the lower edge at one side, and the upper edge at the opposite side, due to the torque of the cam shaft, so that the tappet does not remain in a vertical position. The valve stem likewise wears unevenly because the push of the tappet is on one side of the valve stem. The perfect valve seat originally formed on the valve is thus destroyed by the non-alignment of the valve and tappet. In my improved structure, the valve tappet and valve being a unitary structure, the one supports the other so that a pair of spaced and aligned reciprocating bearings are provided to thereby always maintain the valve in an absolutely vertical position so that the valve seat has a much longer life.

My improved valve extends from the combustion chamber 15 down through the cylinder block 10, valve spring chamber 11 and wall 13, to position where its lower end may ride upon the cam shaft 12. My improved valve is a built up structure consisting of a poppet type valve head 16 having a short stem 17 extending downwardly therefrom. The lower end of the stem 17 is drilled out at 18 so that it may be butt welded to a tubular stem section 19. The drilling at 18 facili-

chambers 15 from gas ports 29 which are cast in the cylinder block. Aligned with these seats 28 suitable bores 24 are provided in the upper wall forming the valve spring chamber 11, these bores being slightly larger than the diameter of the members 20. Integral bearings 25 are provided in the wall 13 aligned with the bores 24 so that the valve may be inserted from the top of the cylinder block down against the cam shaft.

For the reason that the stem 19 is considerably smaller than the bore 24, I have provided vertically split bushings 26 which take up the space between the valve stems and bores. Each of these split bushings consists of two identical halves which are clamped around the stem 19 after the valve is in place and then pushed upwardly from within the chamber 11 into the bore 24. A valve spring 27 is disposed between the lower end of the bushing 26 and the washer 23 so that the valve structure will be urged downwardly at all times against the cam shaft 12 or valve seat 28.

It will be noted, that I preferably formed the member 20 as a drawn steel cup, the base thereof being hardened to co-operate with the cam shaft. It may be desirable to use a cast iron cam shaft 12 so that advantage may be taken of the better coefficient of friction between cast iron and steel.

When the engine is in operation the valve

valve formed thereon on each side of said seat.

2. An engine valve comprising, an integral head and stem and enlarged foot, a spring retaining washer seat formed on said valve at the junction of said stem and foot, and spaced bearing surfaces adapted to guide said valve, one of said surfaces being formed on said stem and the other formed on said foot.

3. In a device of the character described, an engine block, a valve comprising an integral head and stem and foot, and a pair of spaced bearings formed in said block one of which reciprocally receives said stem and the other of which reciprocally receives said foot.

4. In a device of the character described, an engine block, a valve comprising an integral head and stem and enlarged foot, and a pair of spaced bearings formed in said block one of which reciprocally receives said stem and the other of which reciprocally receives said foot.

5. In a device of the character described, an engine block, a valve comprising a head and stem and foot, a valve spring chamber formed in said block, a split bearing secured in the upper wall of said chamber in which said stem is reciprocally mounted, an integral bearing formed in the lower wall of said chamber in which said foot is reciprocally mounted, and a valve spring disposed in said chamber and co-acting with said valve at the junction of said foot and stem.

6. In a device of the character described, an engine block, a valve comprising an integral head and stem and enlarged foot, a valve spring chamber formed in said block, a split bearing secured in the upper wall of said chamber in which said stem is reciprocally mounted, and a valve spring disposed in said chamber around said stem, one end of which co-acts with said valve at the junction of said foot and stem and the other end of which co-acts with said split bearing to resiliently secure it in place.

7. In a device of the character described, an engine block, a valve comprising an integral head and relatively small stem and enlarged foot, a valve spring chamber formed in said block, a split bearing secured in the upper wall of said chamber in which said stem is reciprocally mounted, an integral bearing formed in the lower wall of said chamber in which said foot is reciprocally mounted, and a valve spring disposed in said chamber around said stem, one end of which co-acts with said valve at the junction of said stem and foot and the other end of which co-acts with said split bearing to resiliently secure the bearing in place.

8. An engine valve comprising, a valve stem of relatively small diameter having a valve head integral with one end thereof and an enlarged foot integral with the other end thereof, the adjoining end of said foot being frustrum shaped to form a valve spring retaining washer seat.

9. An engine valve comprising, a valve stem of relatively small diameter having a valve head integral with one end thereof and an enlarged hollow foot portion integral with the other end thereof, the adjoining end of said hollow foot being drawn down to a frustum shape to form a valve spring retaining washer seat.

10. An engine valve comprising, a valve stem of relatively small diameter having a valve head integral with one end thereof and an enlarged cylindrical foot integral with the other end thereof the adjoining end of said cylinder being of conical shape to form a tapered valve spring retaining washer seat.

HENRY FORD.

May 16, 1933. A. TOELLE 1,908,798

IGNITION COIL

Filed May 27, 1932

FIG. 1

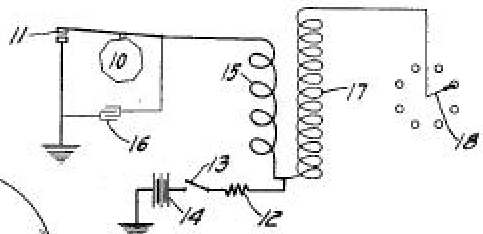


FIG. 2

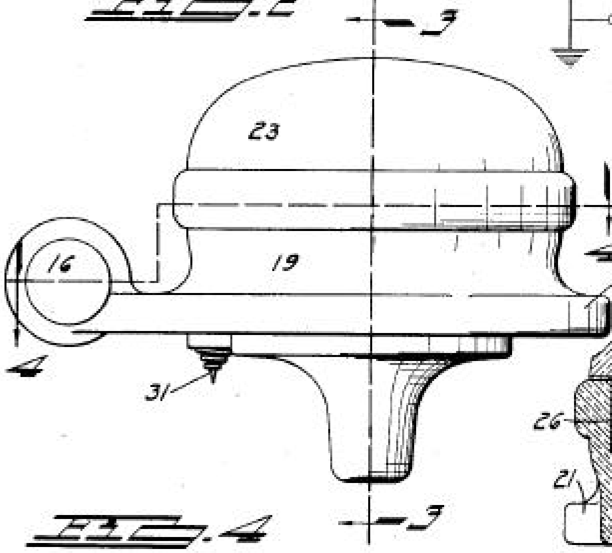


FIG. 3

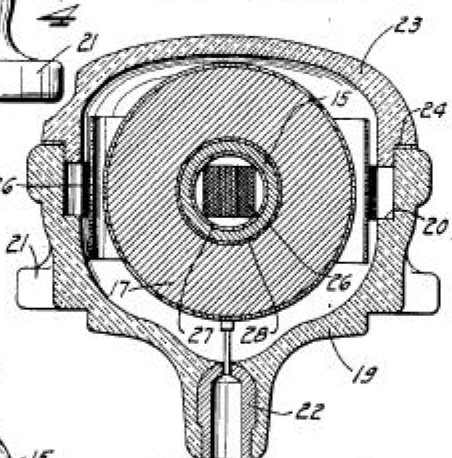


FIG. 4

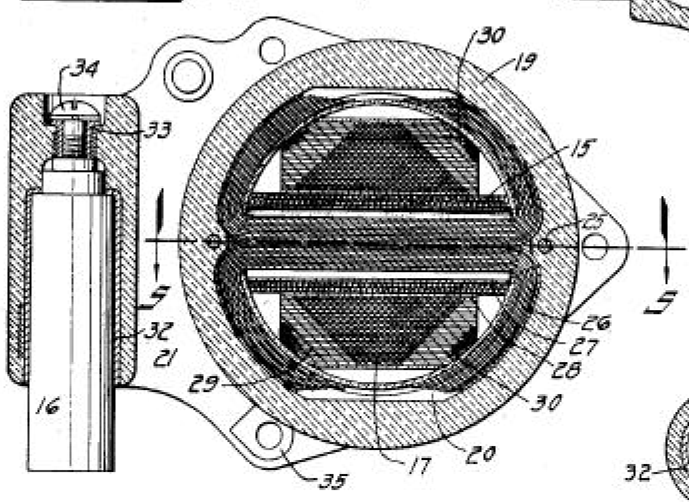


FIG. 5

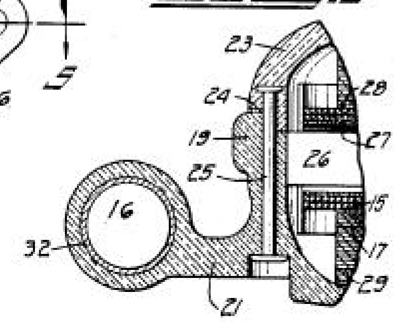
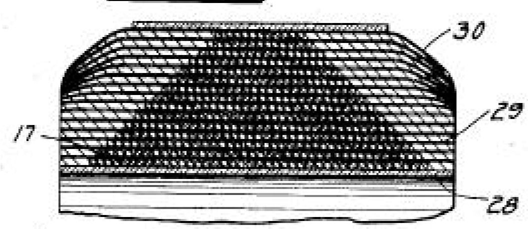


FIG. 6



INVENTOR.
August Toelle
BY
[signature]
ATTORNEY.

UNITED STATES PATENT OFFICE

AUGUST TOELLE, OF DETROIT, MICHIGAN, ASSIGNOR TO FORD MOTOR COMPANY, OF DEARBORN, MICHIGAN, A CORPORATION OF DELAWARE

IGNITION COIL

Application filed May 27, 1932. Serial No. 613,928.

The object of my invention is to provide an induction coil especially suitable for supplying the high-voltage electricity required for ignition in high-speed multicylinder automobile engines. The invention herein resides in the novel arrangement of the various elements comprising the coil, whereby a material increase in manufacturing efficiency and incidentally in electrical efficiency is obtained.

Ordinarily, an increase in the efficiency of a piece of electrical apparatus which requires only the small amount of current required to operate an ignition coil would not be a material factor in the design of an automobile so that in this installation, the reduced current consumption of my coil is not particularly important. The feature of utmost importance which arises from this increased efficiency is that a perfectly satisfactory coil suitable for use on high-speed multicylinder motors can be designed at a substantial saving in cost of production. It is well known that supplying ignition current for medium-speed engines is a comparatively simple problem because the duration of time for building up the magnetic field is sufficiently long to permit the storing up of the required energy in the coil. In high-speed eight to twelve cylinder engines the interval is too brief to permit of storing sufficient energy in the magnetic circuit to cause a spark in the spark plugs. For this reason it has heretofore been the practice with high-speed engines of eight cylinders or more operating at comparatively high compressions to provide two ignition coils, one for each unit of four or more cylinders so that the period available for storing energy in the coil or establishing the magnetic circuit is doubled.

The increased efficiency of my coil directly results in a higher permissible speed of operation so that a single unit of my design may be substituted in place of the two coils heretofore provided for such engines. The primary purpose of producing a coil of higher efficiency is therefore to lessen the cost of the installation and not particularly to reduce the current consumption of the coil. The reasons for this result will be brought out later in the specification, at which time it should be kept in mind that although this unit is considerably smaller than the usual ignition coil, its capacity is equivalent to the ordinary coil and in fact the capacity of all such coils is determined by the electromotive force required to cause a spark at the spark plug points of the engine in the short interval of time available for this purpose, depending upon the speed of the motor.

A further object of my invention is to provide a secondary winding formed by winding a plurality of layers of wire alternated with layers of insulating paper, the paper overlapping the ends of each succeeding layer of wire to an increasing extent, which winding is connected in the circuit so that the potential increases in the succeeding layers, whereby a correspondingly increased insulation is provided between each layer of wire and the core as the potential therein increases.

Other features will appear from the detailed description of this device, among which may be mentioned that this unit is especially simple to construct, is waterproof so that weather will not affect its operation, and is amply proportioned so that even though the primary current is accidentally left on while the engine is not operating, the coil will not be damaged.

With these and other objects in view, my invention consists in the arrangement, construction and combination of the various parts of my improved device, as described in the specification, claimed in my claims and illustrated in the accompanying drawing, in which:

Figure 1 shows a wiring diagram, illustrating the electrical connections required for installing this device on an eight-cylinder motor.

Figure 2 shows a full sized plan view of my improved coil.

Figure 3 shows a sectional view, taken on the line 3—3 of Figure 2.

Figure 4 shows a sectional view, taken on the line 4—4 of Figure 2.

Figure 5 shows a sectional view, taken on the line 5—5 of Figure 4, and

Figure 6 shows an enlarged view, illustrating the manner in which the secondary circuit of the coil is wound.

Before taking up the detailed description of this device, it may be well to mention that this coil is conventional in so far as it consists of an open magnetic circuit in which a primary winding of comparatively few turns together with a secondary winding of many turns is disposed. The primary winding is connected in series with the usual ignition battery and distributor breaker points and a condenser is shunted across the breaker points. The secondary winding is connected to the spark plugs through an ordinary distributor rotor in the usual manner.

The operation of the coil is conventional in that the current from the battery causes the magnetic circuit to be established, the rapid decay of which, in obedience to well known physical laws, as the breaker points open generates E. M. F.'s of great enough difference of potential to cause sparks at the spark plugs, the strength of the magnetic field, hysteresis, and eddy current losses in the core, the disposition of the secondary winding in the field, and the distributed capacity in the secondary winding being factors limiting the total available energy.

The departures from conventional coil construction, whereby an increase in efficiency is obtained, relate to the disposition of the secondary winding in the magnetic circuit, this winding being located in the region of highest flux density. The novel shape of this secondary winding permits the majority of its turns to be located at the point of highest flux density in the magnetic circuit. The direct result of this novel arrangement is that I am able to provide a coil with a secondary winding of extremely low impedance, resulting in an output high enough to give the desired results.

The specific construction employed for accomplishing these results may be better understood by referring to the accompanying drawing in which the reference numeral 10 is used to indicate a distributor rotor which is gear driven by the motor with which my coil is to be used. A pair of breaker contact points 11 are opened and allowed to close upon rotation of the cam 10, these points being included in the primary circuit together with a fixed resistance 12, ignition switch 13, battery 14, and a primary winding 15 in my improved coil. A condenser 16 is shunted across the breaker contact points 11 in the usual manner. One end of a secondary winding 17 in my coil is connected to one end of the primary winding 15, both being grounded through the battery while the other end of the secondary winding extends to a rotor element 18 which is driven in synchronism with the cam 10. The high-tension current generated in the secondary winding is distributed by the rotor 18 to the several spark plugs of the motor in the ordinary manner. My coil proper, however, consists only of the primary and secondary windings together with a laminated core for effecting a magnetic circuit therearound.

Referring now to Figures 2, 3 and 4, it will be seen that I have provided a two-part housing which is molded from a phenolic resin compound, the lower half of the housing being numbered 19 and being of cup-shaped form and having an annular shoulder 20 spaced slightly below the upper edge of its rim. A mounting flange 21 extends from the intermediate portion of this housing, while a high-tension output terminal 22 is molded integrally with the extreme bottom portion thereof. I have also provided a cup-shaped cover 23 which is adapted to be piloted in the rim of the housing 19 and a gasket 24 is disposed between this cover and the housing to form a water and air-tight enclosure in which my coil is disposed. The cover 23 is fixedly secured in place by means of a pair of rivets 25, as shown in Figure 5.

It will be noted from Figure 4 that the iron core of my coil assembly consists of a plurality of flat strip-like laminations 26 which extend diametrically across the annular opening in the housing 19 and which laminations are grouped in two parts with both ends of these groups being bent circumferentially around in opposite directions so as to almost but not quite meet each other. A circumferential magnetic circuit having a pair of diametrically opposed air gaps therein is thus provided, each portion of which is connected by a magnetic core extending diametrically therebetween and perpendicular to a line joining the air gaps. The positioning of air gaps is important in the functioning of the coil, as will later be brought out. It will also be noted that the bent-back portions of these laminations 26, forming an annular ring, fit down into the rim of the housing 19 and bear against the shoulder 20. The cover 23 is clamped directly against the laminations so that they are rigidly held within the enclosure formed by the housing 19 and cover 23.

Around the intermediate portion of the laminations 26 I have provided a dielectric tube 27 upon which tube the primary winding 15 is wound, this winding and tube extending the full diametric length of the core. A second and somewhat shorter dielectric tube 28 is disposed around the periphery of the winding 15 and around this tube the secondary winding 17 of my coil is disposed. It will be noted from Figures 4 and 6 that the inner layers of this winding are about two-thirds the length of the primary winding and that they extend substantially the full length of the tube 28. Each succeeding layer of this secondary winding is of lesser length than the layer beneath so that a radial section through any portion of the coil shows the wire distributed in a flat-topped pyramidal shape. If desired, the wire may be wound in groups of layers of equal length, it only being important that the general shape of the coil be as just described.

It will further be noted that each layer of wire in the secondary winding 17 is alternated with a layer of paper 29 and that all of these paper layers are of the same length. Now, the beginning end of the first layer of the coil is grounded so that the potential of the induced current therein increases with each succeeding layer, but as each succeeding layer is somewhat shorter than the one beneath the paper layers being of uniform length form an insulation of increasing thickness between the high-potential layers of the winding and the bent-back portions of the core laminations. When this coil is assembled in place, the ends of the laminations may be bent back against the corners of the coil and actually flatten this portion, as shown at 30, without reducing the insulation thereof. In this case the spark to ground the coil will ordinarily travel from one end of a particular layer of wire out between the layers of paper to the core laminations, which will be seen to be constant whether or not the corner of the coil is flattened.

From the foregoing, it will be seen that the secondary winding assumes a shape, the purpose of which is to allow the major portion of the coil turns to be located in that region in the magnetic circuit having the greatest flux density. The effective coupling between the windings is thereby increased so that a smaller number of secondary turns for the same voltage output is permissible. This feature of my coil contributes materially to the smaller size of this device.

The method of assembling my coil is almost self-evident and requires very little skill, it being only necessary to wind the two windings and then place one inside of the other and slip the both over the bundle of laminations. The ends of the laminations are then bent back around the coil and the whole inserted into the housing 19. The several winding terminals are connected to suitable terminals molded in the housing, the outer end of the secondary winding being connected to the terminal 22. The inner end of the secondary winding is connected to one end of the primary winding and both are connected by means of encased leads with the battery through the resistance 12 and switch 13. The other end of the primary winding is connected to a coil spring 31 which is molded in the flange 21. The free end of this spring is pointed so as to automatically make contact upon assembling the coil in position on the engine.

In the device shown, the condenser 16 has been installed in a cylindrical pocket formed in the flange 21, this pocket having a metallic sleeve 32 and a metallic grommet 33 molded therein in axial alignment with each other but spaced apart so as to be insulated from each other. The grommet 33 is connected by means of an encased lead with the side of the primary winding which is connected to the breaker arm while the sleeve 32 is connected by an encased lead with a terminal 35 to be thus grounded along with the stationary breaker point of the distributor. Thus, the condenser 16 which is provided with a metallic case will be both held in position and the electrical connections made by simply inserting a single screw 34 in the grommet 33 and threading it into the end of the condenser.

The exact size of the windings, the number of turns and other details will not be given as the construction is subject to many variations and inasmuch as the design of any coil for high-speed ignition must of necessity be a compromise subject to considerable variation. The specific novel features of this coil all coact with each other to produce an improved coil having more desirable characteristics than heretofore obtainable. This result is believed attainable irrespective of the size of the coil constructed.

However, in the design of ignition coils certain requirements must be met. For instance, ignition coils for low-compression slow-speed engines are required to develop an output voltage only sufficient to strike across about $\frac{1}{16}$ of an inch air gap, while ignition coils for high-speed high-compression motors must have an increased voltage, due to the 5 to 6 atmospheres of pressure under which the spark plugs operate. For this reason the voltage of such coils must be increased two to three times the ordinary striking voltage in order to ionize the air across the spark gap in the limited time available. It has been found that an output voltage of between 12000 and 15000 volts is required to insure operation of the coil under all conditions, the time lag due to ionization being particularly noticeable in cold dry weather. The applicant obtains the increased output, not by simply making the coil excessively large but by his novel magnetic core construction and secondary winding. While it is not claimed that this coil is 100 per cent efficient, still it is of considerably higher efficiency than formerly obtainable, which increase results from the predetermined arrangement and proportion of the parts therein.

The ideal induction coil of this type should have a very low inductance because the speed of the coil is controlled by the inductance. A single coil to operate an eight-cylinder engine at 4000 R. P. M. should have an inductance of no more than .006 to .007 henrys.

The coil should also have a low resistance in the primary winding; the current strength at the time the breaker points open should be as high as possible, and the field strength should be a maximum. It is at once apparent that all of these ideal conditions cannot be incorporated into the same device. Nevertheless, due to the specific construction employed a more advantageous combination can be chosen than is possible with any conventional type coil known to the applicant. For instance, the inductance of this coil is reduced to .006 by providing a small number of primary turns having a relatively high-current strength, the inductance equalling the number of primary turns times the flux in lines divided by the current strength in amperes times 10^8. The use of this small number of turns is made possible by the construction of the core and the unique disposition of the secondary winding in the magnetic circuit.

Still further, the current strength in the primary circuit at the moment the contact points open is relatively high. This current depends upon the resistance of the primary winding, the battery voltage and the frequency required and at high frequencies the voltage in the primary winding does not attain the battery voltage, due to the resistance and inductance. The low resistance and inductance of my primary winding causes the current strength to build up at an abnormally fast rate, thereby providing a high-current strength even when the frequency is very great. It is for this reason that I am enabled to use only one coil on eight-cylinder high-speed engines that formerly required two coils, one for each bank of four cylinders.

Just as it is very important to establish the magnetic circuit in the shortest time possible, it is even more important that the collapsing of the circuit be almost instantaneous to thereby increase the E. M. F. in the primary circuit as much as possible and likewise increase the output secondary voltage. A low inductance facilitates the collapsing of this circuit.

However, a low inductance has heretofore been associated only with induction coils having an open magnetic circuit. In such coils the number of primary turns must be increased from five to ten times that required with a closed circuit and this increase in the number of turns directly increases the resistance so that the time element required to build up the primary circuit is thereby materially increased. It is apparent that if a closed magnetic circuit is provided, the high inductance so slows up the establishment and collapsing of the circuit that the coil would be inoperative. Inversely, if an open magnetic circuit is provided, then the inductive effect of the circuit is reduced so that excessively large primary and secondary windings are required. The applicant has provided a magnetic circuit having an air gap considerably larger than the conventional air gap employed and while the field strength is somewhat less than in the conventional coil, this reduced inductive action is offset by his disposition of the major portion of his secondary winding at a point intermediate of the ends of the coil where the flux density is at a maximum to thereby increase the number of effective turns on the secondary winding. The applicant contributes his greater efficiency to the novel design of his laminated core and its relation to the particular shape of secondary winding employed.

In this connection, it may be well to mention that the applicant is aware that numerous transformers have been suggested in which the core is composed of laminations bent back upon themselves, usually having the ends thereof overlapping to form a closed magnetic circuit. However, all of these devices, to the applicant's knowledge, relate solely to transformers and not to induction coils. Although both transformers and induction coils depend upon induction, still the problems connected with each are so different that they are considered as independent devices. A transformer operates only upon alternating current while an induction coil operates only upon direct current. Still further, in all types of transformers the magnetic intensity is controlled by the ampere turns per inch of length and is equal at all points in the circuit. Consequently, induction is not a factor in this device so that the disposition of the secondary winding should theoretically be wound uniformly over the entire magnetic circuit, as in the ordinary torus ring. In an induction coil the intensity of the magnetic circuit is not uniform but reaches a maximum midway between the ends of the primary winding. Thus, while the novel secondary winding provided herein will increase the efficiency of induction coils, still such winding would be detrimental if used in connection with a transformer. These limitations have been mentioned to show that the construction herein is applicable only to induction coils.

Among the many advantages arising from the use of my improved device, it may be well to mention that I have provided an ignition coil a single unit of which is satisfactory for supplying the entire ignition current for operating eight-cylinder motors at speeds upwards of 4000 R. P. M. which requirement was formerly accomplished by the use of two individual spark coils. Still further, the higher efficiency obtained with this device automatically reduces the size thereof for a given output so that a material reduction in cost is obtained thereby. Still further, for the reason that the coil is especially easy to construct and assemble, the manufacturing cost is still further reduced.

Some changes may be made in the arrangement, construction and combination of the various parts of my improved device without departing from the spirit of my invention and it is my intention to cover by my claims such changes as may reasonably be included within the scope thereof.

I claim as my invention:

1. An induction coil for internal-combustion engine ignition system characterized by its low time constant and high efficiency comprising, a cylindrical low tension primary coil winding, a high tension secondary winding wound in layers around said primary coil having each succeeding layer somewhat less in length than the layer beneath to thus form a coil of such shape that a radial section therethrough will show the wire arranged in a pyramidal shape, a ring of insulation disposed between each of said secondary layers, all of said insulating rings having a uniform length whereby the outer edges of said insulating rings will extend beyond each succeeding secondary layer to a greater extent, and a plurality of flat strip core laminations extending through said primary winding, both ends of each lamination being bent back around the secondary winding in a circumferential path having the axes of said windings forming a diameter thereof, and each lamination being of such length that an air gap is provided between its bent-back ends, whereby a progressively thicker section of insulation is provided between the edges of each succeeding secondary coil and said laminations.

2. A device, as claimed in claim 1 wherein a cup-shaped dielectric housing is adapted to receive the arcuate ends of said laminations, and a dielectric cover is arranged to clamp down upon the laminations, to thus both form an enclosure for said windings and retain said bent-back ends in their circumferential shape.

3. An induction coil for internal-combustion engine ignition systems characterized by its low time constant and high efficiency comprising, a cylindrical layer-wound primary coil, a secondary layer-wound coil disposed around said primary coil having a maximum length substantially two-thirds the length of said primary coil, and each succeeding layer of said secondary coil being somewhat less in length than the layer beneath to thus form a coil of such shape that a radial section therethrough will show the wire arranged in a flat-topped pyramidal shape, and a ring of insulation disposed between each of said secondary layers, all of said insulating rings having a uniform length whereby the outer edges of said insulating rings will extend beyond each succeeding secondary layer to a greater extent, and a plurality of flat strip core laminations extending through said primary winding, both ends of each lamination being bent back around the secondary coil, whereby a progressively thicker section of insulation is provided between the edges of each succeeding secondary coil, the layer and bent-back portions of said laminations.

4. A secondary high tension winding especially adapted for use in connection with induction coils having a substantially closed metallic circuit comprising, a multiple layer-wound coil having each succeeding layer somewhat less in length than the layer beneath to thus form a coil of such shape that a radial section therethrough will show the wire arranged in a flat-topped pryramidal shape, and rings of insulation disposed one between each of said layers, all of said insulating rings having a uniform length whereby the outer edges of said rings will extend beyond each succeeding layer to a greater extent, whereby a progressively thicker section of insulation is provided adjacent to the edges of each succeeding layer, for the purpose described.

5. An induction coil for internal-combustion engine ignition systems comprising, a primary coil winding, a secondary coil winding, said primary coil and secondary coil windings having a plurality of core laminations extending therethrough, said laminations being bent back around the coils to form an arcuate ferric path therearound, and a dielectric housing enclosing said coils and laminations having a portion into which said laminations extend to thereby fixedly secure the coils and laminations in position in said housing.

6. A device, as claimed in claim 5, wherein said housing comprises a cup-shaped dielectric member having a recess around its rim which receives said laminations, and a dielectric cover arranged to clamp down over said laminations to thus both form an enclosure for said coils and to retain said laminations and coils within said housing.

7. A device, as claimed in claim 5, wherein both ends of said laminations are bent back around the primary and secondary coils, said ends each coacting with the recess in said housing to fixedly secure the coils in place.

8. A device, as claimed in claim 5, wherein the core laminations are bent back around the primary and secondary coils to form a circular ferric path therearound, which bent back portions are secured in a circular recess in said housing.

9. An induction coil for internal-combustion engine ignition systems, characterized by its small time constant and high efficiency comprising, a cylindrically shaped primary coil winding, a secondary coil winding disposed around said primary coil having each succeeding layer somewhat less in length than

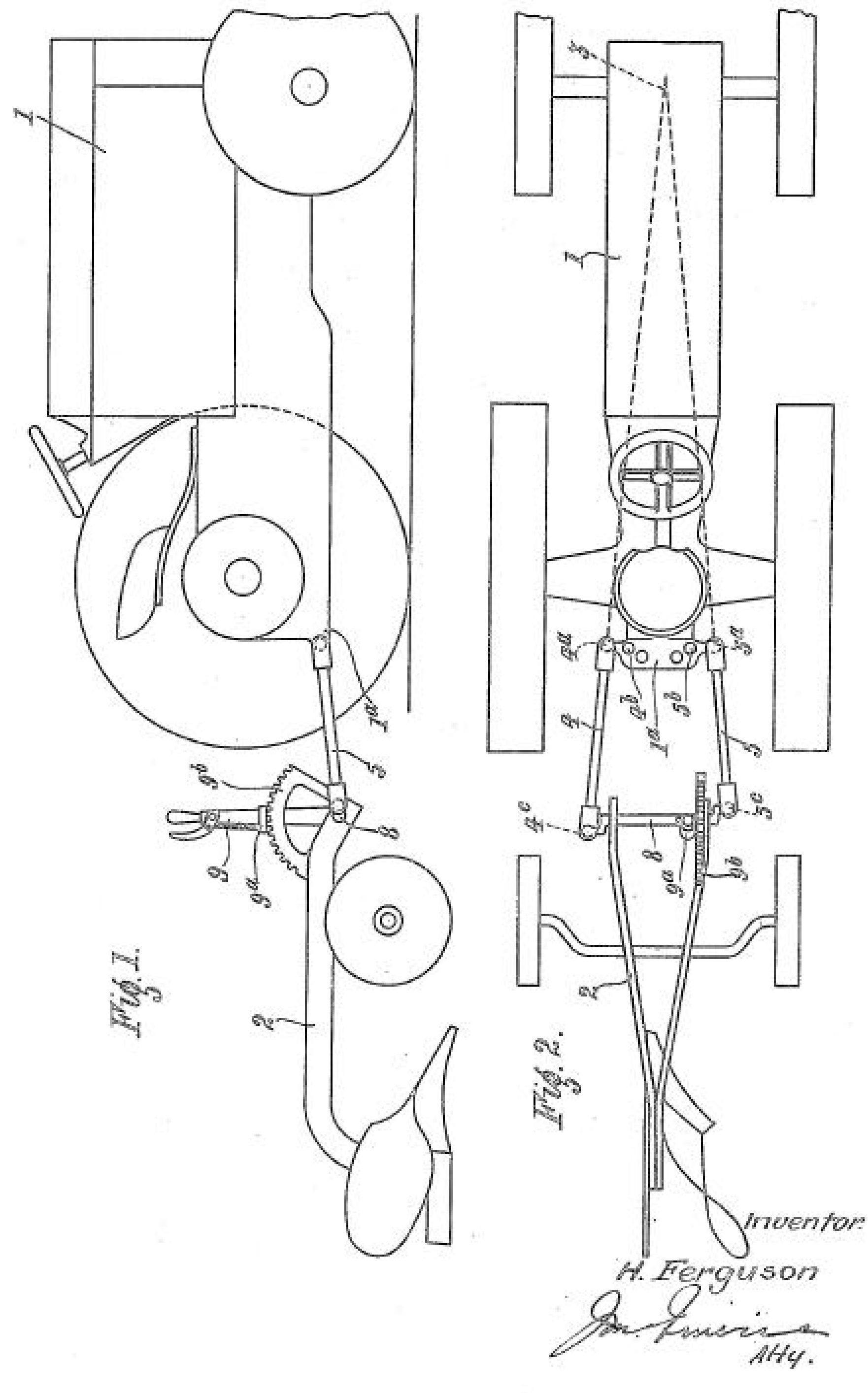
the layer beneath to thus form a coil of such shape that the radial section therethrough will show the wire arranged in a pyramidal shape, a plurality of core laminations extending through said primary coil, both ends of each of said laminations being bent back around the secondary coil to form an arcuate ferric path therearound with the length of each lamination being such that an air gap is provided between its bent back ends in position aligned with the center of said coils, and a dielectric housing having a cylindrical recess therein into which said bent back portions of the laminations are fixedly retained in an arcuate position.

AUGUST TOELLE.

July 4, 1933. H. FERGUSON 1,916,945

TRACTOR DRAWN AGRICULTURAL IMPLEMENT

Filed June 6, 1929 2 Sheets-Sheet 1



July 4, 1933.

H. FERGUSON

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TRACTOR DRAWN AGRICULTURAL IMPLEMENT

Filed June 6, 1929

2 Sheets-Sheet 2

Fig. 3.

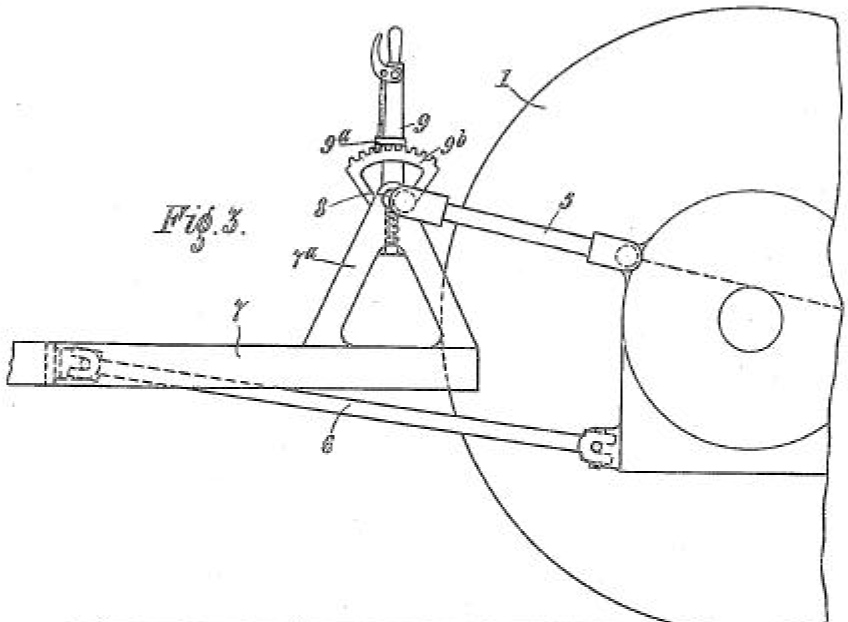
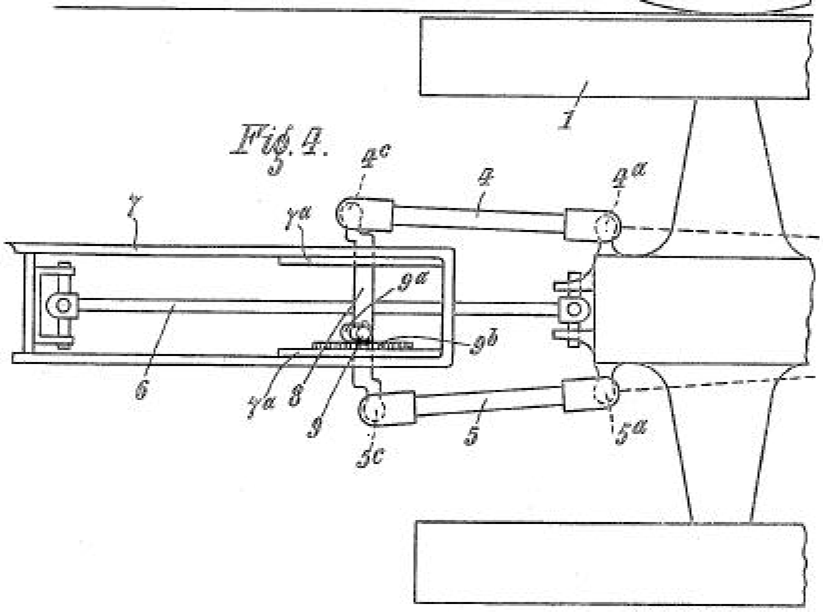


Fig. 4.



INVENTOR
H. FERGUSON

BY [signature] ATTY.

Patented July 4, 1933 **1,916,945**

UNITED STATES PATENT OFFICE

HARRY FERGUSON, OF BELFAST, IRELAND

TRACTOR-DRAWN AGRICULTURAL IMPLEMENT

Application filed June 6, 1929, Serial No. 368,876, and in Great Britain July 3, 1928.

This invention relates to the attachment of agricultural implements to tractors and has for its object means for so hitching an implement to a tractor, that many of the present day difficulties will be overcome. For example, the attachment of an ordinary tractor plough to a tractor is made by a vertical pin behind the rear axle of the tractor, this being necessary in order that the tractor may turn to right and left without allowing the implement to strike the tractor wheels. There are many objections to this form of connection. For example, when ploughing on a hillside the rear end of the tractor slides down the hill, and this carries the implement with it and makes the work very unsatisfactory. Cultivating row crops presents one of the greatest difficulties in using a tractor, because the ordinary single pin connection for an implement means that the implement itself has to be a long way behind the tractor and will wander to either side and destroy the crops. If, when using a tractor, for row crop work the operator, for example, steers to the left, this has the effect of first moving the implement momentarily to the right, owing to the fact that the point of attachment is behind the rear axle. The ideal thing would be to attach the implement close to the front axle and it would then follow the steering, but such attachment would prevent lateral and vertical freedom of movement for the implement.

In my prior Patent No. 1,464,130, August 7, 1923, a link motion hitch is described which causes the effective line of draft to be from a position other than that of the actual connection between the tractor and the implement so that the implement is held down in the ground.

According to the present invention, I provide means constituting a hitch connection for coupling an implement to a tractor comprising links and means for connecting the links to both the tractor and the implement at points spaced apart, the said connecting means and the spacing thereof being such that, in operation, the implement will swing laterally in such manner as to follow the steering of the tractor.

Moreover, I may arrange the said hitch connection so that there is combined with the lateral swinging movement specified, an effective line of draft acting from a position other than that of the said actual connection between the implement and the tractor.

The invention will now be described with reference to the accompanying drawings whereon, by way of example only, I have shown how the invention may be applied to a plough, and also how the invention may be combined with the draft connection described in my prior Patent No. 1,464,130. The invention is illustrated in the accompanying drawings, in which:

Fig. 1 is a side elevation of a tractor and a one furrow plough attached to the tractor in accordance with this invention.

Fig. 2 is a plan view corresponding to Fig. 1.

Fig. 3 is a side elevation of part of a tractor and of part of an implement attached thereto, according to a modified form of the invention.

Fig. 4 is a plan view corresponding to Fig. 3.

Referring to the drawings, the numeral 1 denotes a tractor and 2 a plough. The tractor has a rearward extension 1^a which has two lateral ball projections 4^a, 5^a and a series of upstanding ball projections 4^b, 5^b of which there is an even number.

The plough has a transverse shaft 8 rotatably mounted in it and having cranked ends which are set at different angles to the shaft. The cranks terminate in balls 4^c and 5^c. A hand lever 9 is fixed on the shaft 8, this lever having a detent 9^a engaging with a toothed sector 9^b fixed on the plough.

Two links 4 and 5 having sockets at both ends are fitted over the balls 4^a, 4^c and 5^a, 5^c to couple the plough to the tractor and allow universal freedom of movement between the two. The distance between the rear ends of the links is greater than the distance between their front ends.

When, in ploughing, the tractor is turned to the left or right the plough does not swing laterally about the centre of the rearward extension 1^a of the tractor, but the effect of the quadrilaterally arranged linkage is to cause it to swing as if it were pivoted about a center forward of the actual connection between it and the tractor. If the centre lines of the links are produced until they intersect, the point 3 where they intersect is the virtual centre about which swinging takes place. The plough and tractor function as if the plough were attached at the center 3. As a result, should the tractor be turned to the left or right the plough is immediately turned in the same direction.

By attaching the forward ends of the links to the intermediate balls 4^b, 5^b the virtual centre can be brought nearer the back axle of the tractor but still forward of the actual connection.

If the tractor and plough are being used for ploughing along a hillside, the plough will not "drift" down the hill with the rear end of the tractor, but will follow the virtual swinging centre which is controlled by the steering and thus better results will be obtained. In the case of row crop cultivation where the tractor operator may have allowed the tractor to get too close to one side of the row, he would require to steer away from the row in order to get into the correct position again. If he were using an ordinary wheeled implement hitched with a single pin behind the rear axle, steering away from the row would have the momentary effect of throwing the implement in the wrong direction and into the crop, because its actual connection with the tractor would be behind the rear axle of the tractor. When using the hitch according to this invention, the implement would immediately follow the steering and come away from the crop.

Referring to the modification shown in Figs. 3 and 4, the implement frame 7 is provided with two upstanding triangular frames 7^a, 7^a at whose vertices a cross shaft 8, corresponding to that referred to in Figs. 1 and 2, is journalled, this shaft having cranked ends linked to the rear of the tractor as before and a lever 9 on it.

A lower link 6 is universally jointed to the implement frame 7 and to the rear end of the tractor.

This form of upper and lower linkage permits the implement to have vertical and lateral freedom while giving a virtual swinging centre forward of the actual connection and an effective line of draft from a point other than the said actual connection, the last feature being as in my prior Patent No. 1,464,130.

By turning the cross shaft 8, the angle of the implement relatively to the tractor is altered. In the case of a plough, the adjustment provides for regulating the width of the front furrow in the case of a two-bottom plough, or the width of the furrow in the case of a single-bottom plough. In the case of a row crop cultivator, the same adjustment enables the operator to shift the position of his implement laterally, relative to the tractor, so that it will follow the desired path behind the tractor. Instead of having the crank shaft 8 on the implement, I may have it on the tractor, but preferably I would carry it on the implement.

As an alternative to using a cranked shaft as hereinbefore described, I may make provision for shortening or lengthening either or both of the links 4 and 5, and in this way, change the angularity of the implement relatively to the tractor, for the adjustments mentioned.

Suitable stoppers could be provided to prevent the implement from swinging into the tractor wheels.

I claim:—

1. A hitch connection for coupling an agricultural implement to a tractor comprising two spaced universal mountings on the tractor, two links each secured at one end to one of said mountings, a cross shaft turnably secured to the implement, a crank at each end thereof, the cranks being set at different angles to the shaft and the second ends of the links being universally secured to the cranks, and means for rotating said shaft to vary the relative positions of the links.

2. A hitch connection for coupling an agricultural implement to a tractor comprising quadrilaterally arranged linkage having one side attached to the implement and the opposide side on the tractor having universally jointed vertices, and, in combination therewith, a lower linkage connection.

3. A hitch connection for coupling an agricultural implement to a tractor comprising two spaced universal mountings on the tractor, two links each secured at one end to one of said mountings, two spaced universal mountings supported by the implement and to which the second ends of the links are secured, and a lower linkage connection.

4. A hitch connection for coupling an agricultural implement to a tractor comprising two spaced universal mountings on the tractor, two links each secured at one end to one of said mountings, two spaced universal mountings supported by the implement and to which the second ends of the links are secured, mechanism for adjusting the relationship of links to one another, and a lower linkage connection between the tractor and the implement.

5. Means constituting a hitch connection for coupling an agricultural implement to a tractor comprising two spaced universal mountings on the tractor, two links each secured at one end to one of said mountings, a cross shaft turnably secured to the implement, a crank at each end thereof, the cranks being set at different angles to the shaft and the second ends of the links being universally secured to the cranks, means for rotating said

shaft to vary the relative positions of the links, and a lower linkage connection between the tractor and implement.

6. A hitch connection for coupling an agricultural implement to a tractor comprising a plurality of spaced universal mountings on the tractor, two links whose forward ends can be secured to any two of the said mountings, a cross shaft turnably secured to the implement, a crank at each end thereof, the cranks being set at different angles to the shaft and the second ends of the links being universally secured to the cranks, and means for rotating said shaft to vary the relative positions of the links.

7. A hitch connection for coupling an agricultural implement to a tractor comprising a plurality of spaced universal mountings on the tractor, two links whose forward ends can be secured to any two of said mountings, a cross shaft turnably secured to the implement, a crank at each end thereof, the cranks being set at different angles to the shaft and the second ends of the links being universally secured to the cranks, means for rotating said shaft to vary the relative positions of the links, and a lower linkage connection between the tractor and the implement.

8. Means for constituting a hitch connection for coupling an implement to a tractor comprising elements spaced apart for connecting the implement to the tractor to give free lateral swinging movement of the implement relative to the tractor about centers within a relatively small area located apart from the actual connection between the tractor and the implement.

9. Means for attaching an implement to a tractor comprising spaced connecting members universally attached to the tractor and to the implement, said members permitting free lateral and vertical movement of the implement relative to the tractor when in operation, the members being so spaced that in operation free lateral swinging of the implement is permitted relative to the tractor about centers within a relatively small area located apart from the actual connection between the tractor and implement.

10. Means for attaching an implement to a tractor comprising spaced connecting links and universal means for connecting said links at spaced points on the tractor and on the implement, the links permitting free vertical and lateral movement of the implement relative to said tractor when in operation and the spacing of said links relative to the tractor causing the implement to swing laterally about centers within a relatively small area located apart from the actual connection between the tractor and the implement.

11. Means for connecting an implement to a tractor consisting of spaced connecting members universally attached to the tractor and the implement, said members permitting free lateral and vertical movement of the implement relative to the tractor when in operation, said members being spaced to permit free lateral swinging of the implement relative to the tractor about centers within a relatively small area located apart from the actual connection between the tractor and the implement, in combination with a secondary linkage between the tractor and the implement, said secondary linkage preventing the implement being raised from the ground by rearward pressure on the ground-engaging part of the implement.

12. Means for attaching an implement to a tractor comprising spaced connecting links and universal means for connecting said links at spaced points on the tractor and on the implement to provide for free lateral and vertical movement of the implement relative to the tractor when in operation, the spacing of said links providing for free lateral swinging of the implement relative to the tractor about centers within a relatively small area located apart from the actual connection between the tractor and the implement, and a secondary linkage connection between the implement and the tractor adapted to hold the implement down against rearward pressure on the ground-engaging part of the implement.

13. Means for connecting an implement to a tractor comprising a primary linkage and a secondary linkage in superposed relation, said primary linkage consisting of two spaced connecting elements, and universal means for connecting said elements to the tractor and the implement, and said secondary linkage consisting of connecting means universally attached to the tractor and the implement.

14. Means for connecting an implement to a tractor comprising a primary linkage and a secondary linkage in superposed relation, said primary linkage consisting of two spaced connecting elements, and universal means for connecting said elements to the tractor and the implement, and said secondary linkage consisting of a connecting link, and universal means connecting said link to the tractor and the implement.

15. Means for connecting an implement to a tractor comprising a primary linkage and a secondary linkage in superposed relation, said primary linkage consisting of two spaced, forwardly convergent links, and universal means for connecting said links to the tractor and the implement, and said secondary linkage consisting of connecting means universally attached to the tractor and the implement.

16. Means for connecting an implement to a tractor comprising a primary linkage and a secondary linkage in superposed relation, said primary linkage consisting of two spaced, forwardly convergent links, and universal means for connecting said links to the

tractor and the implement, and said secondary linkage consisting of a connecting link, and universal means connecting said link to the tractor and the implement.

17. A hitch connection for coupling an implement to a tractor, comprising elements spaced apart and connecting the implement and tractor, the movement of the implement relative to the tractor being a swinging movement through said spaced-apart elements, each increment of the swinging movement of the implement being about a center located apart from the actual connection between the tractor and the implement including said elements.

In testimony whereof I affix my signature.

HARRY FERGUSON.

June 19, 1934. H. FORD 1,963,657

IGNITION DISTRIBUTOR AND METHOD OF TIMING SAME

Filed April 1, 1933 2 Sheets-Sheet 1

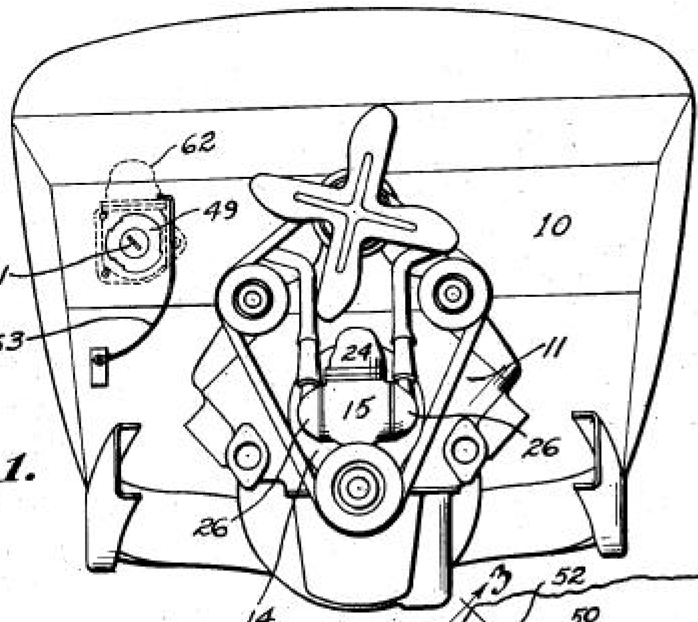


Fig. 1.

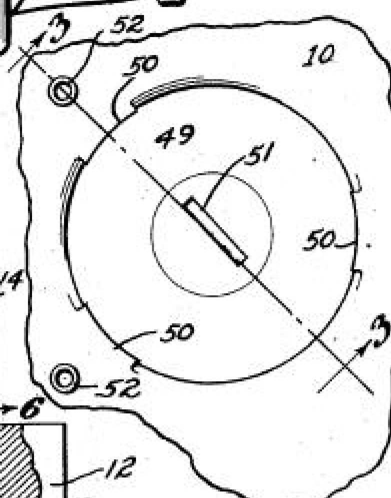


Fig. 2.

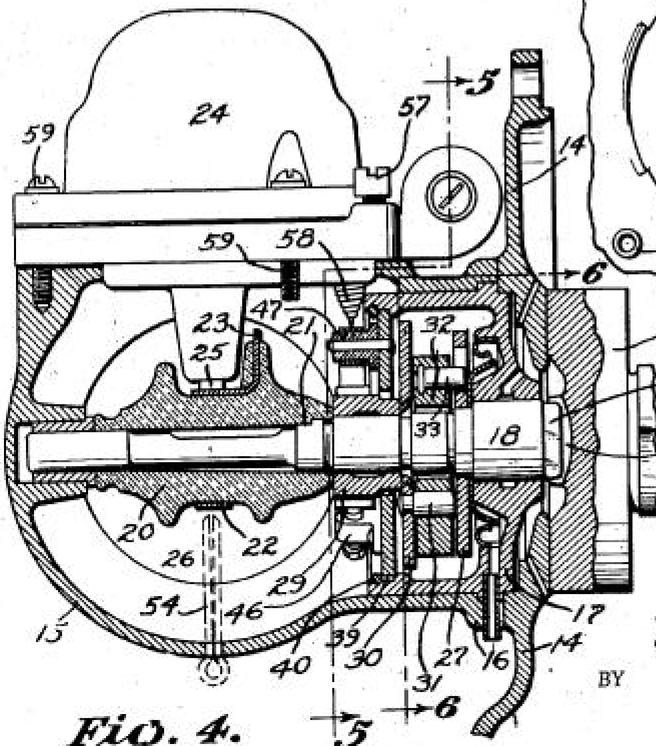


Fig. 4.

INVENTOR.

Henry Ford

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IGNITION DISTRIBUTOR AND METHOD OF TIMING SAME

Filed April 1, 1933 2 Sheets-Sheet 2

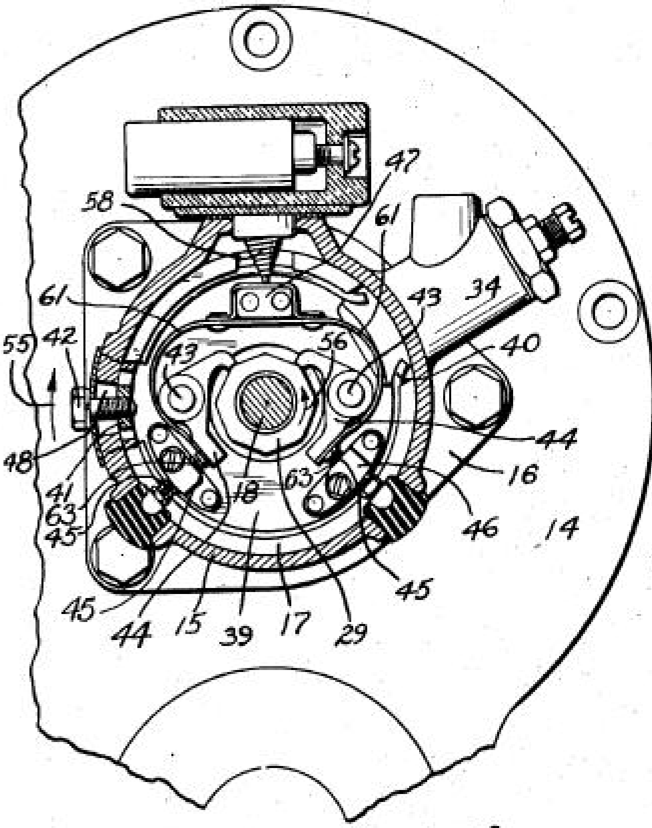

Fig. 5.

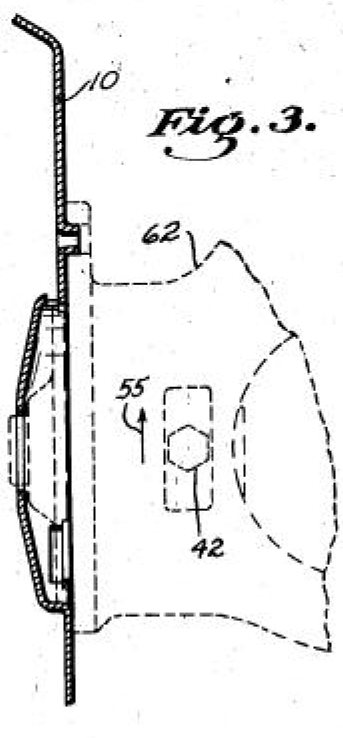

Fig. 3.

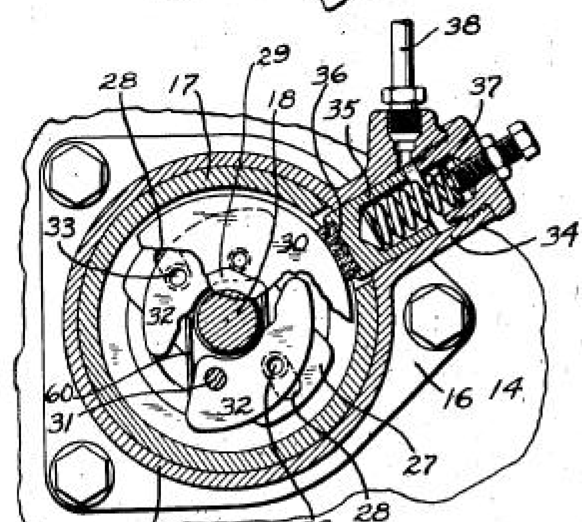

Fig. 6.

INVENTOR.

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UNITED STATES PATENT OFFICE

1,963,657

IGNITION DISTRIBUTOR AND METHOD OF TIMING SAME

Henry Ford, Dearborn, Mich., assignor to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

Application April 1, 1933, Serial No. 663,908

14 Claims. (Cl. 123—148)

The object of my invention is to provide an ignition distributor especially adapted for use in connection with internal combustion engines, which distributor will be of simple, durable and inexpensive construction.

More specifically, my invention comprises a novel distributor which is adapted to be conveniently correctly timed, that is, adjusted to fire each successive spark plug at its correct instant. My method and means for timing the distributor forms a very important part of this invention.

A further object of my invention is to provide a distributor for internal combustion engines which is capable of being installed on the engine in only one predetermined relation to the rotating parts of the engine. To obtain the full utility of this distributor it is required that a distributor driving connection be machined on the engine cam shaft in an exact predetermined relationship to the several cams thereon so that whenever the distributor is secured to the engine the distributor shaft will be angularly fixed in relation to the cam shaft. Inasmuch as my distributor is provided with an automatic spark advancing mechanism in combination with a vacuum operated braking device, it will readily be seen that commercial inaccuracies in the manufacture of these several parts may alter the desired predetermined fixed relationship of the distributor to a considerable extent.

It should be kept in mind that the most desirable condition is to provide a non-adjustable distributor, each part of which is machined to exact dimensions so that such distributor need not be adjusted but need only be assembled on the associated engine. Such a distributor is very expensive to manufacture as the commercial manufacturing limits or permissible manufacturing variations would invariably result in the production of distributors varying by as much as four or five degrees in the timing.

The relatively large variation of such distributors is due to the fact that each of the many parts comprising the centrifugal advance mechanism and distributor parts, although machined to quite close limits, may be assembled in certain combinations to produce distributors wherein the timing will be one or two degrees either ahead of or behind the theoretical position. For example, if a group of parts, the dimensions of each of which are close to one side of the manufacturing limits, are assembled into a unit the timing of the unit will be several degrees different than a distributor formed from parts each of which are close to the other side of the manufacturing limits. As distributors must be commercially assembled from a group of parts chosen at random, the individual part accuracy necessary to form every combination into a unit within the desirable accuracy would be prohibitive from a manufacturing standpoint. For this reason an adjustment capable of covering a range of from five to ten degrees is desirable. However, the adjustment provided for my distributor should not be confused with the ordinary adjustment provided on former distributors inasmuch as all distributors heretofore known to the applicant required a high degree of skill and elaborate mechanism to accurately adjust, while the applicant's distributor may be adjusted in perfect timed relation with the engine by even the most inexperienced mechanic without any knowledge whatsoever of the operation of the distributor itself.

Heretofore, the distributors on all engines known to the applicant were timed by either guess work or the cut-and-try method or by the use of comparatively complicated apparatus which required a high degree of skill to operate. Even with the aid of such apparatus certain inaccuracies could not be compensated for so that the timing of all distributors was very uncertain at the best. The difficulties of correctly timing a distributor of the conventional type may be better understood when it is recalled that to correctly time a distributor the contact point operating cam must open the points at the exact instant a piston reaches a predetermined position in the engine. While the predetermined position of the piston in the engine may be accurately learned, by markings on the engine flywheel, still the exact point at which the cam opens the breaker point is extremely hard to ascertain, inasmuch as the distributor cam is comparatively small in size the effect of a movement of a few degrees around its own axis can not readily be detected.

Further, in all internal combustion engines known to the applicant, the distributor is driven through gear trains and other driving connections, each of which drives are subject to considerable rotary play or what is better known as back-lash. For example, most distributors are driven by means of a spiral gear machined in the engine cam shaft, which gear drives a second spiral gear at right angles thereto, this second gear having a tongue connection to drive an auxiliary shaft and which auxiliary shaft drives the distributor through still another tongue and slot connection. The engine cam shaft is subject to a definite amount of end play as is the auxiliary shaft, the result being back-lash identical to the back-lash resulting from the tongue and groove driving connections. In most distributors this back-lash will amount to between five and ten degrees of movement even when the engine is new and, of course, after the engine has run a considerable period the driving connections wear and increase the total amount of back-lash. This feature has been mentioned because the conventional distributor is adjusted by rotating the distributor cam upon its driving shaft and locking same in its adjusted position. The usual procedure is to rotate the engine flywheel to a position corresponding to the firing position of one of the cylinders and then rotate the distributor cam until the contact points just start to open. Due to the presence of back-lash, it is impossible to rotate the cam in its normal direction and still take up the back-lash in the drive. Consequently, to insure that the back-lash is eliminated the cam must be rotated oppositely to its normal direction and the point at which the contacts close taken to be the correct point for locking the cam on the distributor shaft. This assumption is seldom correct.

The foregoing has been mentioned to illustrate the purpose of this invention and to show the utility in providing an accurate timing means which is within reach of every car owner and which may be included with every automobile at a negligible extra cost, by which the driver of the vehicle or inexperienced mechanic may with a few simple instructions accurately adjust the vehicle's distributor. The utility of this device is especially important in connection with the present type of automobile now manufactured, as such cars are not usually provided with a manual spark advance of any description. With the old-style distributor a manual spark advance lever was usually provided so that a mechanic could ascertain if his distributor was timed within a few degrees of accuracy. For example, if upon adjusting the distributor the spark was too far advanced the engine would knock when the spark lever was fully advanced, while if the spark was too far retarded the engine would slow down and stop upon fully retarding the spark lever. However, with the elimination of the manual spark adjustment the driver now has no such simple means of ascertaining whether or not the distributor is timed correctly. Consequently, the loss of power and prematurely burned-out valves resulting from an ignition which is too slow and the excessive loads resulting from ignition too far advanced are defects which it is believed my improved distributor will eliminate.

While the means shown for timing my improved distributor is especially adapted for use with the distributor described, it should be kept in mind that it may be advantageously used with other distributors for producing a perfectly timed engine, after such other distributors have been roughly timed by the conventionel method. However, even with the conventional distributor it is necessary that the driving connection for the distributor be located in an exact predetermined angular relationship with the engine cam shaft, inasmuch as my method of timing depends upon a predetermined relationship being established between the cams on the cam shaft and the distributor driving connection.

With these and other objects in view, my invention consists in the arrangement, construction and combination of the various parts of my improved device, as described in the specification, claimed in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 shows a plan view of the front end of an automobile chassis, the vehicle dash having a timing plate formed integrally therewith, whereby my distributor may be accurately timed.

Figure 2 shows a larger view of the timing plate, shown in Figure 1.

Figure 3 shows a sectional view, taken on the line 3—3 of Figure 2.

Figure 4 shows a vertical, central, sectional view through my improved distributor when mounted in its position on the vehicle engine.

Figure 5 shows a sectional view, taken on the line 5—5 of Figure 4, and

Figure 6 shows a sectional view taken on the line 6—6 of Figure 4.

Referring to the accompanying drawings, I have used the reference numeral 10 to indicate generally a vehicle dash which is preferably stamped from sheet metal and which extends in a substantial vertical direction directly in the rear of the vehicle engine. A vehicle engine is shown at 11, this engine being of the 8 cylinder V-type in which a cam shaft 12 is rotatably mounted between the two rows of engine cylinders. The forward end of the cam shaft is provided with a driving slot 13 which is considerably offset from the diametrical position and which slot is machined in a predetermined relationship to the several cams of the cam shaft. It is very essential with this device that the angular position of the slot 13 be maintained in a predetermined relationship with the cams on the cam shaft. A cover plate 14 is secured over the forward end of the cam shaft, this cover plate having an opening therein aligned with the forward end of the cam shaft whereby a distributor shaft may extend therethrough and be driven directly by the slot 13 in the cam shaft.

My improved distributor comprises a metallic housing 15 having a flange 16 formed on one end thereof, which flange is adapted to be secured to the cover plate 14 by three unequally spaced cap screws in position directly over the front end of the engine cam shaft. This housing 15 is provided with a cylindrical shaped opening in its flanged side in which opening a cylindrical cup member 17 is fixed. A distributor rotor shaft 18 is rotatably mounted in a pair of spaced bearings, one of these bearings being formed in the housing 15 and the other bearing being formed by the center portion of the cup member 17. The shaft 18 is provided with a tongue 19 machined thereon, this tongue being diametrically offset an amount corresponding to the amount which the slot 13 is diametrically offset from the cam shaft. Thus, the shaft 18 may be assembled to the cam shaft in only one angular position.

I have provided a distributor rotor 20 which is fitted upon the shaft 18 adjacent to its forward bearing, which rotor is molded from a dielectric material and which is adapted to be installed upon the shaft in only one angular position relative thereto, due to a flat 21 being machined upon the shaft which flat coacts with a correspondingly shaped bore in the rotor to thereby form a drive for the rotor and locate it upon the shaft. This rotor is provided with a conductor ring 22 from which a pair of arms 23 extend radially, only one of which is shown, and which arms are molded integrally with the rotor 20. This ring and the arms conduct the high voltage current from a spark coil, about to be described, to the several terminals in the distributor whereby the high voltage current is conducted to the several spark plugs of the engine.

The spark coil associated with this device is given the reference numeral 24 and is secured over an opening which is formed in the upper portion of the housing 15. This coil is provided with a high tension terminal 25 thereon which extends down into the housing 15 and resiliently bears against the ring 22. The spark coil 24 is provided with a low tension terminal 57 whereby low voltage current may be conducted to the coil. The terminal 57 is connected to one end of the primary winding of the coil while the other end of this winding is conducted to a spring terminal 58 which projects down into the housing 15 from the spark coil, this spring terminal being adapted to thus automatically form a connection with the distributor contact points when the spark coil is assembled in position on the distributor housing. Suitable screws 59 secure the spark coil in place upon the distributor.

A pair of terminal heads 26 are disposed over diametrically opposite openings in the side of the housing 15, which heads secure in place the several terminals associated with the high tension system of the distributor. Inasmuch as the high voltage portion of the distributor forms no part of the invention herein claimed, the exact details or the construction employed will not be further described.

Referring now to the contact point operating mechanism employed, it will be seen that I have provided a rectangular shaped driving plate 27 which is fixedly secured to the shaft 18 just within the cup member 17. This driving plate is provided with a pair of radially extending slots 28 therein, which slots coact with suitable pins, about to be described, to drive a centrifugal advance mechanism. The contact point operating cam used in this distributor has been given the reference numeral 29 and is rotatably mounted on the shaft 18 just rearwardly from the rotor 20. This cam 29 is fixedly secured to a plate 30, from which plate a pair of diametrically opposed pins 31 extend rearwardly. These pins form the respective pivots for a pair of centrifugally operated weights 32, each of these weights having a pin 33 fixedly secured in its free end, which pins 33 extend into the adjacent slots 28 in the driving plate 27. A pair of flat springs 60 are secured to the weights 32, which springs yieldably urge the weights 32 to their innermost positions.

The operation of the centrifugal device is quite conventional in that when the driving plate 27 is rotated by the shaft 18 the weights 32 are driven through the slots 28 and pins 33 and centrifugal force upon the weights tends to pivot them around their respective pivots 31. Inasmuch as the slots 28 extend spirally from the pivot pins 31 the radial movement of the weights 32, due to centrifugal force, causes the plate 30 to rotatively advance relative to the shaft and the driving plate 27. This advance, of course, causes an advancement of the position of the cam 29 relative to the distributor shaft. A total advance of about 10 degrees is provided in this distributor.

It will be seen from Figure 6 that a cylinder 34 is formed integrally with the housing 15 in which cylinder a plunger 35 is reciprocally mounted, this plunger having a friction pad 36 secured thereon which is adapted to coact with the periphery of the plate 30. A spring 37 is adjustably mounted within the cylinder 34 and resiliently urges the friction pad into engagement with the rim of the plate 30 to thereby frictionally retard the rotation of the plate. The resistance offered by the pad 36 requires that a higher speed be maintained by the centrifugal weights to keep the distributor in its advanced position against the friction of this pad.

A tubular vacuum line 38 extends from the intake manifold of the engine and connects with the cylinder 34 just above the plunger 35 so that when the engine is normally operating the vacuum in the intake manifold is sufficient to draw the plunger away from the plate 30 to thereby allow the distributor to advance when its speed is sufficient to move the weights 32 radially against only the action of the springs 60. However, when the engine is being started or when the carburetor throttle is suddenly opened, in either of which cases a lower vacuum in the intake manifold results, the frictional resistance of the pad 36 is applied to thereby maintain the cam in its retarded position until a considerably higher rotating speed is attained.

As has been mentioned, the distributor shown is adapted to operate an 8 cylinder, four cycle engine and consequently the distributor cam 29 is provided with 8 cam lobes thereon, which cam lobes actuate two pairs of contact points, one of the pairs of points being adapted to close the primary circuit of the coil and the other pair to open the circuit to thereby cause a high voltage current to be induced in the secondary winding of the coil upon each reciprocation of said pairs of contact points. The time interval between the opening of the last mentioned pair of points and the closing of the first mentioned pair is very short to thereby allow high speed operation of the coil. These two pairs of contact points are mounted upon a plate 39 which is secured in the cup member 17 by means of a snap ring 40. As will be noted in Figure 5, an ear 41 extends rearwardly from the plate 39, which ear projects into a slot of considerable width in the cup member 17. A screw 42 projects through an elongated slot 48 in the housing 15 and is threaded into the ear 41. Consequently, upon loosening the screw 42 the screw and ear and plate 39 may be rotated the length of the slot 48 and upon tightening the screw at any position along its path the plate 39 will be locked to the housing 15. It is upon the plate 39 that the contact points are mounted so that rotation of this plate around the operating cam will cause an advancement or retardation of the spark timing. The contact point operating means comprise a pair of breaker arms 44 which are rotatably mounted upon a pair of pins 43 which are fixed in and extend forwardly from the plate 39. One end of each breaker arm is adapted to coact with the lobes on the cam 29 while in the other end of each arm one of the two pairs of contact points 45 are mounted. Coacting points 63 are adjustably mounted in a pair of brackets 46. A dielectric block 47 is secured to the plate 39 around which a combined spring and electrical conductor 61 is secured, this conductor electrically connecting the contact points 45 together. The spring terminal 58 from the spark coil is adapted to bear directly against the intermediate portion of the conductor 61 whereby the primary winding of the coil may be grounded through either of the contact points 45 to thereby complete the primary circuit of the spark coil.

From the foregoing, it will be seen that rotation of the cam 29 will cause the contact points 45 to successively open and close thereby successively completing and opening the primary circuit of the spark coil. Further, rotation of the plate 39 around the cam 29 by means of the screw 42 will adjust the timing of the distributor. However, only sufficient rotation of the plate is permitted to adjust the distributor to compensate for manufacturing inaccuracies. These inaccuracies invariably result because it is required that the driving plate 27 be assembled to the shaft 18 with the driving slots 28 located in a predetermined position relative to the tongue 19. Further, the cam 29 must be assembled to the cam plate 30 with the driving pins in a predetermined relation to the cam lobes.

With this distributor it is only necessary that sufficient accuracy be maintained to insure that the cam 29 be assembled within three or four degrees from its theoretically correct position. However, sufficient accuracy must be maintained to insure that the distributor rotor conducts the current to the correct spark plug, as no adjustment is provided for altering the angle of the rotor.

A very important feature of this distributor is that the rotor 20 is fixedly secured to the shaft 18 while the cam 29 is rotatably mounted upon this shaft. Considerable friction develops between the terminal 25 and the rotor which causes a drag upon the shaft 18; however, this shaft is positively driven by the cam shaft so that the drag cannot affect the advance movement of the cam 29. It will be appreciated that a centrifugally operated cam advancing mechanism is necessarily quite a sensitive piece of apparatus, as it must advance at a definite speed of the weights and be retarded a definite amount by the action of the pad 36. If the rotor 20 was required to be driven by the cam 29, as is believed required in all other distributors, then the friction of the terminal would alter the control effected by the centrifugally operated weights and vacuum operated brake. This novel arrangement is therefore believed to comprise a patentable improvement.

It will be noted in Figure 1 that I have shown the distributor in position mounted upon the forward end of the engine and have also shown a distributor, by dotted lines 62, as being mounted upon the dash 10. The position shown by the dotted lines 62 is the position in which the distributor is placed to correctly time same for the engine. The novel feature of this method of timing is that the distributor is timed before it is placed upon the engine and not after it has been secured in place, as is believed universal with other types of distributors. The dash 10 is provided with a depression 49 which may be either drawn directly therein or provided in a plate or bracket which is later fastened to the dash. This depression has three tongues 50 extending therefrom which serve to accurately align or pilot the cup member 17 of the distributor within the depression. A slot 51 is provided in the bottom of the depression 49 and a pair of lugs 52 are stamped outwardly from the metal of the dash, the slot 51 serving to locate the tongue 19 of the distributor shaft while the lugs 52 serve to locate two of the bolt retaining holes on the distributor flange 16. This slot 51 is positioned in exactly the same position relative to the lugs 52 as is assumed by the driving slot 13 in the cam shaft relative to the flange retaining bolts when one of the pistons of the engine is in position to fire with a retarded spark.

To accurately time the device, the distributor and coil are placed over the depression 49 with the distributor flange 16 piloted by the lugs 52 and with the tongue 19 extending into the slot 51. A cotter pin 54 is inserted through an opening in the bottom of the housing 15, this cotter pin extending up to position spaced $\frac{1}{16}$ or $\frac{1}{8}$ of an inch from the ring 22. A flexible conductor 53 is then connected to the terminal 57 whereby current is conducted to the spark coil. The screw 42 is then loosened and moved bodily to its extreme retarded position. Then it is gradually tapped in the opposite direction, or that shown by arrow 55, and at some point along its path of movement a spark will flash across the gap between the end of the cotter pin 54 and the ring 22, which spark will be both visible and audible. When this spark occurs the screw 42 is tightened and the ignition system is then exactly in its correctly timed position. It may be well to mention that the normal rotation of the cam shaft drives the cam 29 in the direction shown by arrow 56 which is counter to the movement of the adjusting screw to adjust the distributor. Thus, the movement of the screw 42 takes up all the play between the various driving members and is exactly similar to an equivalent movement of the cam 29 in the direction of the arrow 56.

After the distributor has been timed it is secured in position on the front end of the engine and the cotter pin 54 removed. The device is now ready for operation.

Should the operator decide to replace or readjust the contact points of the device, he simply removes the distributor from the engine, then repairs or replaces the contact points, then retimes the distributor by means of the timing plate and then secures the distributor in position on the engine, with the complete assurance that it is exactly timed.

It may be desirable to equip cars with a portable timing plate instead of the device shown, which provision is believed to fall within the scope of this invention.

Among the many advantages arising from the use of my improved device, it may be well to repeat that even the most inexperienced mechanic can with only a few simple instructions time this distributor within a degree of accuracy heretofore obtainable by only skilled mechanics and with the use of costly and elaborate testing equipment.

Further, the method disclosed herein may be used to advantage in timing other types of distributors, the only essential requirement being the provision of a driving connection machined in a predetermined angular position.

Further, it may not be deemed absolutely necessary to provide a spark gap in the circuit, as the spark at the contact points or even the opening thereof may be sufficient in some instances to inform the operator that the adjusted point has been reached.

Some changes may be made in the arrangement, construction, and combination of the various parts of my improved device without departing from the spirit of my invention, and it is my intention to cover by my claims, such changes as may be reasonably included within the scope thereof.

I claim as my invention:

1. The method of timing an ignition system which consists of a distributor and an engine having a distributor driving connection thereon angularly disposed in a predetermined position relative to the rotating parts of said engine, said

distributor having adjusting means for operably changing the angular relationship between the distributor shaft and the time of opening of the distributor contact points, comprising, securing the distributor shaft and distributor housing in fixed angular positions identical to the respective positions of said shaft and housing at the instant when one of the engine spark plugs is being fired, and then changing the angular relationship between the distributor contact points and the distributor shaft until the distributor contact points just start to open.

2. The method of timing an ignition system which consists of a distributor and an engine having a distributor driving connection thereon angularly disposed in a predetermined position relative to the rotating parts of the engine, said distributor having adjusting means for operably changing the angular relationship between the distributor shaft and the time of opening of the distributor contact points, comprising, securing the distributor shaft and distributor housing in fixed angular positions identical to the respective positions of said shaft and housing at the instant when one of the engine spark plugs is being fired, then conducting current through said contact points and then changing the angular relationship between the contact points and distributor shaft until a spark is seen between the contact points.

3. The method of timing an ignition system which consists of an ignition coil and distributor and an engine having a distributor driving connection therein angularly disposed in a predetermined position relative to the rotating parts of said engine, said ignition coil having a visual spark gap in its secondary circuit and said distributor having adjusting means for changing the angular relationship between the distributor shaft and the time of opening of the distributor contact points, comprising, first securing the distributor shaft and housing in fixed angular positions identical to the positions of said shaft and housing when one of the engine spark plugs is being fired, then conducting current in series through said coil and through the distributor contact point, and then changing the angular relationship between the distributor contact points and the distributor shaft until a spark jumps across said spark gap.

4. The method of timing an ignition system which consists of an ignition coil and a distributor and an engine having a distributor driving connection therein angularly disposed in a predetermined position relative to the rotating parts of said engine, said ignition coil having a visual spark gap in its secondary circuit and said distributor having adjusting means for swinging its contact points around the distributor cam, comprising, securing the distributor shaft and housing in an auxiliary timing plate in fixed angular positions identical to the positions of said shaft and housing when one of the engine spark plugs is being fired, then conducting current in series through said coil and distributor contact points, and then swinging said contact points around said cam until a spark jumps across said spark gap, and then securing said contact points in their adjusted position in the housing, and then installing said distributor upon said engine so as to be driven by said driving connection.

5. A distributor and means for timing same, which distributor is adapted for use with an internal combustion engine having a distributor driving connection therein which is angularly disposed in a predetermined position relative to the rotating parts of said engine, comprising, a distributor housing, means for securing said housing to the engine in a predetermined position, a distributor cam driven by said driving connection, a pair of contact points operated by said cam, adjusting means for changing the angular relationship between the distributor shaft and the time of opening of the distributor contact points, and means for securing the distributor shaft and housing in fixed angular positions identical to the respective positions of said shaft and housing when one of the engine spark plugs is being fired in order that said adjustment may be operated to position where said contact points just open for the purpose described.

6. A distributor, as claimed in claim 5, wherein an ignition coil is connected in series with said contact points which upon being electrically energized causes a visual spark to be produced at the instant the contact points are opened.

7. A distributor, as claimed in claim 5, wherein an ignition coil is connected in series with said contact points, which coil is provided with a spark gap in its secondary circuit, so that when said coil is electrically energized a spark will jump across said gap at the instant the contact points are opened.

8. A device, as claimed in claim 5, wherein the means for securing the distributor shaft and housing in fixed angular positions comprise a timing plate which has locators thereon which coact with both the distributor body and distributor shaft so as to retain these elements in their predetermined angular positions.

9. A distributor and means for timing same, said distributor being especially adapted for use on an internal combustion engine having a distributor driving connection therein which is angularly disposed in a predetermined position relative to the cam shaft of said engine, comprising, a distributor housing, means for securing said housing to the engine in a predetermined angular position, a distributor shaft rotatably mounted in said housing and driven by said driving connection, a contact point plate rotatably mounted in said distributor housing, a pair of contact points disposed upon said plate and adjustable around said shaft by rotating said plate, a contact point operating cam secured on said shaft, an ignition coil, a spark gap in the secondary circuit of said coil, a timing plate having locators thereon for securing both said distributor shaft and said housing in fixed angular positions identical to the positions of said shaft and housing while at the instant one of the engine spark plugs is being fired, and a conductor for conducting current in series through said ignition coil and contact points, for the purpose described.

10. A device, as claimed in claim 9, wherein said timing plate is formed permanently with the dash of an automotive vehicle in which said engine is associated.

11. A distributor especially adapted to be readily timed comprising, a housing, a high voltage rotor disposed in said housing, means for conducting high voltage current to said rotor, and a metallic member extending from said housing to position spaced a short distance from said rotor to thus form a spark pap between said member and said rotor.

12. A distributor, as claimed in claim 11, wherein said metallic member is detachably secured in said housing.

13. A distributor, as claimed in claim 11, where-

in the distributor housing is provided with an opening in which a cotter pin is detachably received, said cotter pin comprising said metallic member.

14. A distributor and means for timing same especially adapted to be used on an internal combustion engine having a diametrically offset slot machined in one end of the cam shaft of said engine, which slot is angularly disposed in a predetermined position relative to the cams on said cam shaft comprising, a distributor housing adapted to be secured over the slotted end of said cam shaft in a predetermined angular position, a distributor shaft rotatably mounted in said housing having a diametrically offset tongue formed thereon which is driven by the slot in said cam shaft, a distributor cam driven in a substantially predetermined relationship by said distributor shaft, said cam being adapted to actuate contact points in said distributor, means for adjusting the distributor contact points around said cam, means for securing the distributor shaft and housing in fixed angular positions identical to the positions of said shaft and housing when one of the engine spark plugs is being fired, and means for conducting current through said contact points for the purpose described.

HENRY FORD.

Oct. 9, 1934. H. FORD 1,975,837

INTERNAL COMBUSTION ENGINE

Filed Nov. 1, 1932 2 Sheets-Sheet 1

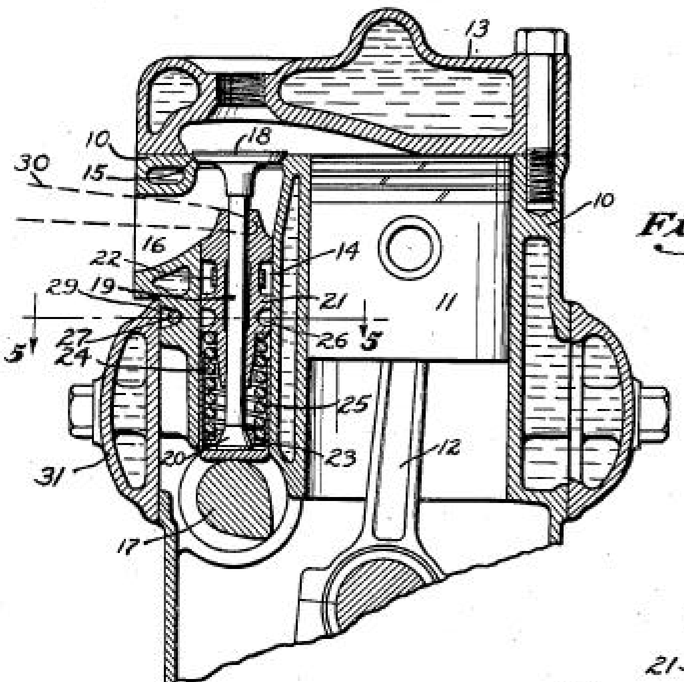

Fig. 1.

Fig. 2.

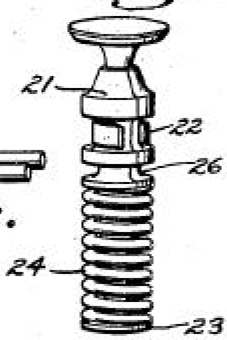

Fig. 3.

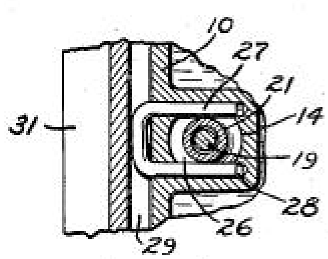

Fig. 4.

Fig. 5.

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INTERNAL COMBUSTION ENGINE

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Fig. 6.

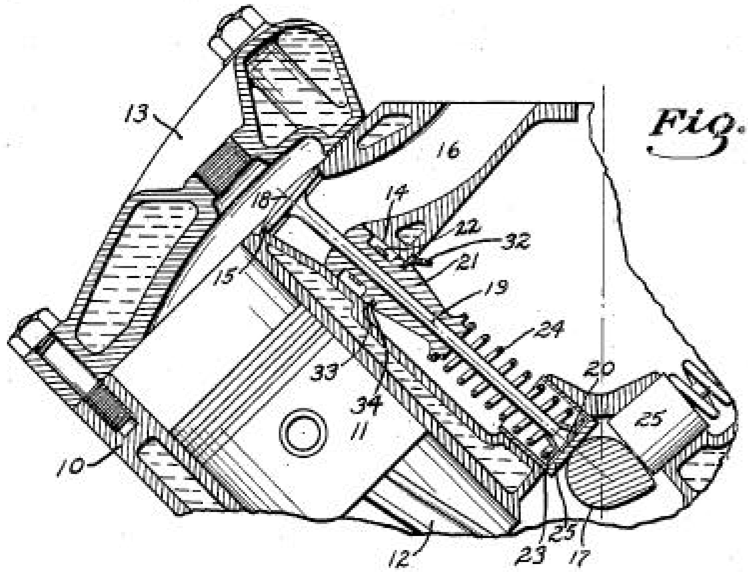


Fig. 7

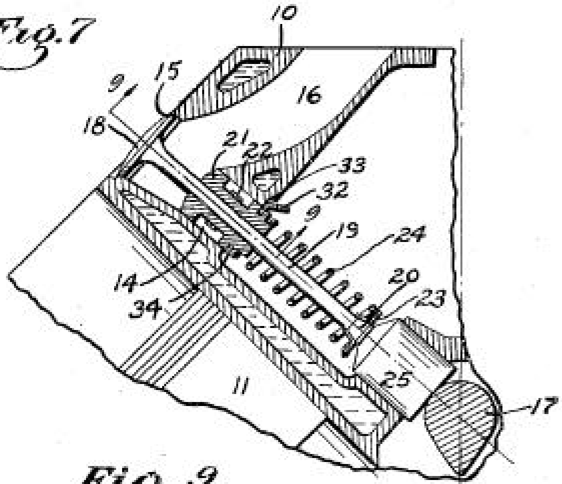
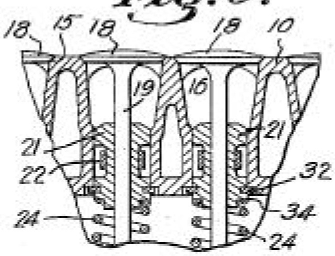


Fig. 8.

Fig. 9.



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Henry Ford

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[signature]

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Patented Oct. 9, 1934 1,975,837

UNITED STATES PATENT OFFICE

1,975,837

INTERNAL-COMBUSTION ENGINE

Henry Ford, Dearborn, Mich., assignor to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

Application November 1, 1932, Serial No. 640,678

9 Claims. (Cl. 123—188)

The object of my invention is to provide an internal-combustion engine having a novel valve arrangement therein, whereby both the initial cost and the cost of servicing the engine is reduced. The valve arrangement used is of the poppet type, the valves operating when installed the same as the conventional poppet valve arrangement. The important improvement of my valve mechanism is in its ease of assembly in the motor.

Heretofore in all engines of the T head type, the assembling of the valves in the engine block has been a rather awkward operation. It was believed always necessary to assemble the valve stem through the cylinder block or valve bushing therein and to then insert the valve spring over the end of the stem and finally after compressing the valve spring insert a spring washer and valve spring retaining member on the stem to retain the valve in position. The compressing of the valve spring and assembling of the washer thereon required the use of a spring compressing tool and at the best was an operation requiring considerable skill. The foregoing difficulty was increased when assembling V type engines wherein the chamber between the two cylinder blocks formed the valve chamber. In such engines the installation of the valves in the limited space available was very difficult, so that the cost of regrinding such valves was excessive.

With my improved device the valve, valve guide bushing, valve spring and spring washer are assembled into a single unit outside of the engine, preferably on a work bench or the like, and then these units are inserted into suitable bores in the cylinder block from the valve seat side thereof. For the reason that the valve spring is compressed and the retaining washer installed on the valve stem before the installation of the unit in the block, the awkward operation of installing such valves is eliminated.

A further object of my invention is to provide an engine having exceptionally short valve stems while still providing valve stem bushings of adequate length to insure accurate alignment of the valves. An important feature resulting from the use of my device is that the tappet used with my valve assembly may be telescoped over the lower end of the valve and valve spring to thereby shorten the distance between the cam shaft and valve head without sacrificing the desirable bearing length on either the tappet or valve stem. Thus, the cylinder blocks may be of less length thereby reducing the weight of the motor. Such an arrangement is not possible in the conventional engine because it would be impossible to assemble the valve spring retaining washer in place with a valve tappet telescoped over the lower end of the valve.

With these and other objects in view, my invention consists in the arrangement, construction and combination of the various parts of my improved device, as described in the specification, claimed in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 shows a vertical transverse sectional view through the upper portion of an automobile engine, having my improved valve mechanism installed therein.

Figure 2 shows a perspective view of my valve, valve bushing, valve spring and spring retaining washer assembly, illustrating the unit which is adapted to be inserted into the cylinder block of an engine.

Figure 3 shows a perspective view of a U shaped clip adapted to lock the assembly shown in Figure 2 in the cylinder block.

Figure 4 shows a perspective view of the valve tappet which is used in the engine shown in Figure 1 and with the unit shown in Figure 2.

Figure 5 shows a sectional view taken on the line 5—5 of Figure 1.

Figure 6 shows a vertical transverse sectional view through a portion of a Ford V-8 engine, illustrating a form of my device for use on such engines.

Figure 7 shows another sectional view of the Ford V-8 engine, illustrating an adaptation of my improved device used for replacement on said engines, and

Figure 8 shows the locking clip used in the devices shown in Figures 6 and 7.

Figure 9 shows a sectional view, taken on the line 9—9 of Figure 8.

Referring to the accompanying drawings, and particularly to Figure 1, I have used the reference numeral 10 to indicate generally a cylinder block of an automobile engine having a conventional piston 11 and connecting rod 12 therein, the piston being reciprocally mounted in a vertical cylinder bore in the block. The block 10 is provided with a pair of vertical valve bores 14 therein spaced along side of each of the cylinder bores. The inner-section of each of the bores 14 with the upper face of the cylinder block is machined to form valve seats 15 of the engine. Valve ports 16 are cored in the block 10 just beneath each of the valve seats 15, whereby intake and exhaust gases may be drawn into or discharged from the engine through the valve seats

15 in the conventional manner. A cylinder head 13 is secured over the valve bores 14 and cylinder bores and a cam shaft 17 is rotatably mounted parallel to the engine crank shaft just beneath the lowermost ends of the bores 14, this cam shaft being driven in the conventional manner through suitable gearing or the like.

My improved valve assembly unit is composed of a valve head 18 adapted to fit the valve seat 15, which head is provided with an integral valve stem 19, the latter having an enlarged conical shaped valve foot 20 formed on its lowermost end. A split bushing 21 is clamped around the valve stem 19 and resiliently retained in position by means of a spring clip 22, the outer diameter of the bushing 21 being adapted to fit one of the vertical bores 14 in the cylinder block. It will be noted that a spring retaining U shaped washer 23 is adapted to fit over the conical foot 20, this washer holding a valve spring 24 in compressed position. The valve spring when assembled in position is compressed between a shoulder on the bushing 21 and the spring washer 23, whereby said valve spring resiliently urges the bushing up against the valve head 18. The construction of the washer 23 and its cooperation with the conical foot 20 is identical to the construction of the washer 8 and foot 9, shown in the United States Patent 1,640,118.

It will readily be seen that the unit, as shown in Figure 2, may be assembled outside of the motor simply by securing the split bushing around the valve stem by means of the spring clip 22, then inserting the stem in the spring 24, and securing the unit together by means of the spring washer 23. There is normally some space between the bushing 21 and the valve head when the unit is assembled in the motor, however, when the unit is outside of the motor the bushing may slide up adjacent to the valve head to thereby lessen the pressure required to compress the valve spring sufficiently to install the washer 23. The bushing, stem and spring may be proportioned so that the valve spring can be compressed sufficiently by the fingers to install the retaining washer. Of course, when the unit is installed in the engine the valve bushing is moved a short distance toward the lower end of the valve stem, thus loading up the valve spring to give the desired valve spring action. These units are adapted to be bodily inserted in the valve bores 14 and are secured therein by means now to be described.

Each of the bushings is provided with an annular groove 26 therein which coacts with a U shaped clip 27, the latter being retained in the cylinder block, or rather inserted through a pair of transverse openings 28 in the block which intersect the opposite sides of each bore 14. The outer ends of each of these openings intersect a longitudinally extending groove 29 cast in the cylinder block. Thus, each clip 27 may be inserted in the pair of openings 28 and if the groove 26 in the valve bushing is aligned with the clip, the bushing will be prevented from axial movement in the bore 14 by said clip.

Before describing the operation of assembling the valve, it may be well to mention that I have provided cup-shaped tappets 25 which are reciprocally mounted in the lower end of the bores 14 and ride on one of the cams of the cam shaft 17 to be thereby reciprocated by the rotation of the cam shaft.

To assemble the valve units in the engine, the valve tappets 25 are first dropped in the vertical bore so as to rest against the cam shaft. Valve assembly units, as shown in Figure 2, are then dropped down on top of the valve tappets. Due to the valve springs 24 forcing the bushings 21 up against the under faces of the valve heads, the grooves 26 in the bushings are located somewhat above the openings 28 in the cylinder block. However, a screw driver or other tool, as shown by dotted lines 30 in Figure 1, is inserted into the ports 16 and the upper end of the valve bushings pried downwardly until the grooves 26 become aligned with the adjacent openings 28. At this time, the U shaped clips 27 may be inserted into the openings 28 so as to project through the adjacent grooves 26, thereby positively preventing the valve springs from moving the valve bushings upwardly after the release of the tool. When the clips 27 are in position, the portion connecting the two parallel arms thereof lies wholly within the groove 29 so that a cover plate 31 may be secured over the side of the motor to prevent the accidental withdrawal of the clips 27 and also to prevent oil leaking from the motor at this point.

When it is desired to remove the valves from the engine, it is only necessary to pry the bushings 21 downwardly a few thousandths of an inch, pull out the clips 27 and then withdraw the valve unit. The important feature is that at no time is it necessary to remove the valve spring retaining washer from the valve stem while the unit is in the motor block.

It will be noted that the cylinder block 10 is provided with a horizontal opening adjacent to the cam shaft 17 which opening is adapted to be closed by the cover plate 31. The purpose of providing such an opening is so that when the valves are being fitted each unit may be dropped in its bore and a feeler gauge, that is a strip of metal the thickness of desired valve clearance, may be inserted between the cam shaft and the valve tappet to accurately ascertain the valve clearance of any particular unit. Further, it will be noted that when regrinding the valves it is not necessary to remove the guide bushings or springs from the units as removing of the clips 27 is sufficient to relieve the tension from the valves so that they may be accurately ground in place.

From the foregoing it will be seen that the tappets 25 extend up over the lower end of the valve stem and valve springs so that the distance between the cam shaft and valve head is materially reduced. This arrangement is made possible because my valve unit may be assembled and then inserted into the tappet whereas if the retaining washer were required to be assembled in place in the motor the conventional type of valve tappets would need to be used.

Referring to Figure 6, it will be seen that I have provided an alternate form of this device for use with V type engines. The parts in this installation which are similar to the parts shown in Figure 1 are given like numerals, in fact, the only essential difference between this device and the one previously illustrated is that instead of inserting the U shaped clips 27 through openings in the side of the cylinder block, a flat washer-type clip 32, illustrated in Figure 8, is provided. The underside of the valve chamber is countersunk at 33 so that when the valve bushing is pressed down slightly from the position shown in Figure 5, the washer 32 may be inserted in a groove 34 formed in the bushing adjacent to the countersunk portion 33. Upon the bushings being resiliently urged by the valve spring upwardly the washer is fixedly secured in position by the countersunk depression thereby retaining the valve bushing in place. In this installation the valve tappet is inserted through the valve chamber opening as is likewise the clip 32; however, the valves, valve bushings, valve springs and spring washers are all assembled outside as units which are inserted through the valve seat openings in the cylinder blocks.

In Figure 7, a replacement unit for the Ford V-8 engine is shown, and it will be seen that to adapt this engine to my improved valve it is only necessary to provide a new valve bushing and retaining clip, the valve, valve spring, spring retaining washer and tappets being the standard Ford parts supplied with such motors.

Among the many advantages arising from the use of my improved device, it may be well to mention that where this device is incorporated into the motor design an exceptionally short valve stem and cylinder block may be used so as to materially lessen the weight of the engine and minimize the warpage on the valve stems. The chief advantage of such structure, however, arises from the ease with which the valves may be assembled or removed from the motor to thus lessen the cost of servicing the engine.

Some changes may be made in the arrangement, construction and combination of the various parts of my improved device without departing from the spirit of my invention and it is my intention to cover by my claims, such changes as may reasonably be included within the scope thereof.

I claim as my invention:

1. A valve unit adapted to be detachably secured in a cylinder block comprising, a valve stem having a valve head on one end thereof and a valve spring retaining member secured to the other end thereof, a valve bushing disposed around said stem, and a valve spring interposed between said retaining member and bushing, said bushing being at least as large in diameter as said spring, whereby said valve stem and spring and bushing and retaining member may be inserted as a unit into a bore in said cylinder block, and means for detachably securing said unit in the cylinder block in such a way that outward axial movement of said unit is prevented after the unit has been so secured.

2. A device, as claimed in claim 1, wherein the valve spring is secured in said unit under compression less than the normal installed compression of said spring.

3. A device as claimed in claim 1, wherein said bushing is provided with an annular groove extending therearound with which a clip is adapted to coact, whereby axial movement of the bushing is prevented.

4. An internal-combustion engine comprising, a cylinder block having a plurality of valve seats formed therein and having cylindrical bores therein each aligned with one of said seats, valve units each comprising a valve and stem and valve bushing and valve spring and valve spring retaining washer adapted to be each inserted as a unit into one of said bores, and means for detachably securing said units into said bores whereby axial movement of said unit may be prevented after said unit is so inserted.

5. A device, as claimed in claim 4, wherein the valve bushing element of each of said units is provided with an annular groove therearound in which a pin inserted transversely through the cylindrical bore coacts to thereby prevent axial movement of said bushing.

6. A device, as claimed in claim 4, wherein said cylinder block is provided with pairs of radially extending openings one on each side of each bore and each opening intersecting the adjacent vertical bore near its periphery, and wherein said block is provided with a longitudinally extending groove intersecting the outer ends of each pair of said openings, whereby a U shaped clip may be used to secure said bushings in place by inserting the arms thereof in said pairs of openings, said clip lying wholly within the lines of said cylinder block.

7. A detachable valve unit comprising, a valve stem having a valve head on one end thereof and a valve spring retaining member secured to the other end thereof, a valve bushing disposed around said stem and a valve spring interposed between said retaining member and bushing, said bushing being at least as large in diameter as said spring and no larger in diameter than said valve head, whereby said valve and bushing and retaining member and spring may be inserted as a unit into a cylindrical bore aligned with a seat for said valve.

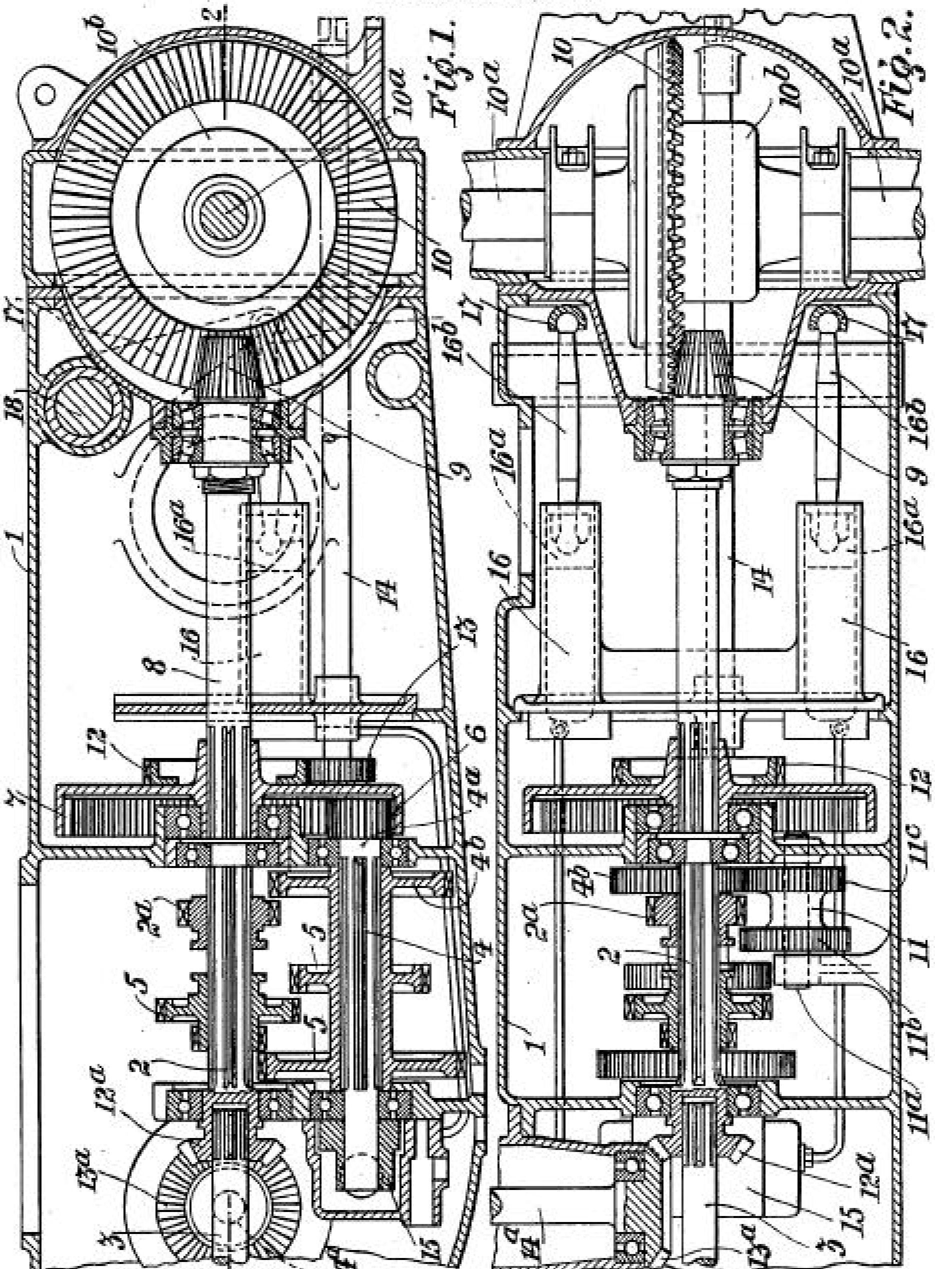
8. A unit, as claimed in claim 7, wherein the diameter of said bushing is appreciably larger than said spring and appreciably smaller than said valve head.

9. An internal combustion engine comprising, a cylinder block having a valve seat formed therein and having a cylindrical bore therein aligned with said valve seat, a valve unit comprising a valve and valve bushing and valve spring and valve spring retaining member adapted to be inserted as a unit into said bore, and means for detachably securing the valve bushing portion of said unit in said bore for the purpose described.

HENRY FORD.

POWER TRANSMISSION ASSEMBLY FOR MOTOR DRIVEN VEHICLES

Filed June 21, 1934



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by [signature] Atty.

Patented Dec. 3, 1935

2,022,762

UNITED STATES PATENT OFFICE

2,022,762

POWER TRANSMISSION ASSEMBLY FOR MOTOR-DRIVEN VEHICLES

Harry Ferguson, Belfast, Ireland

Application June 21, 1934, Serial No. 731,743
In Great Britain July 3, 1933

1 Claim. (Cl. 74—326)

This invention relates to power transmission assemblies for motor-driven vehicles where a big speed-reduction ratio is required in a small space and more particularly to the type of power transmission assemblies for agricultural and road tractors.

An object of the invention is to provide a tractor transmission assembly which, while being light as a whole and therefore not liable to pack the soil, will also be capable of easy manoeuvring and consequently of efficient use under the various conditions met with in practice, including operating on small fields and negotiating awkward corners.

Another object is to provide a compact assembly of gears capable of transmitting power at a high ratio of speed-reduction and preferably arranged adjacent the rear axle of the vehicle in a housing constituting a unitary structure.

Another object is to provide a three-stage speed-reduction power-transmission assembly, one of the speed-reduction stages including variable ratio ahead and reverse gearing.

Another object is to provide an assembly comprising three shafts, namely a motor-driven primary shaft, a secondary shaft extending alongside said primary shaft and connected thereto through variable ratio gears, and a third or vehicle-propelling shaft in continuous connection with the secondary shaft through fixed-ratio gears, one of which is internally toothed and mounted on the third shaft.

Another object is to make provision for suitable power take-offs for external power application.

Another object is to provide a transmission assembly suitable for application to an agricultural tractor where associated implements are operated, and/or controlled, by fluid pressure or other power means.

The transmission is so simple and takes up such limited space that ample room is provided even in a small, light, tractor for power mechanism for controlling or operating the implements, such power mechanism, being, for example, such as is described in my United States patent specification No. 1,687,719. In the case of hydraulic or fluid pressure mechanism for operating or controlling agricultural implements, the drive to the hydraulic or fluid pressure pump may be obtained from the before mentioned secondary shaft. The fluid would be pumped from there to a suitable cylinder or cylinders inside the transmission housing so that the whole transmission gear and power control can be very neatly and compactly housed together in a very light efficient structure.

The invention will now be described, by way of example, with reference to the accompanying drawing,

Fig. 1 is a sectional elevation of a transmission housing containing a power transmission assembly in accordance with the invention.

Fig. 2 is a plan view corresponding to Fig. 1, partly in section on the line 2—2 Fig. 1.

Referring to the drawing:—

The example shown is a power transmission assembly and housing therefor, adapted particularly for an agricultural or road tractor and comprising an outer casing or housing **1**, within which is arranged the entire assembly, including a primary shaft **2**. The primary shaft **2** is driven by an internal combustion engine (not shown) or other prime mover through the medium of the clutch shaft **3**. In the example shown the primary shaft **2** is coupled to a secondary shaft **4** through the medium of variable gearing **5** whereby various gear ratios are obtainable between the speed of the shaft **2** and the speed of the shaft **4**. If desired, the variable gear may be replaced by a direct unalterable drive between the primary shaft **2** and the secondary shaft **4**.

The secondary shaft **4** has at its rearward end **4a** a spur wheel **6** of suitable size. This spur wheel **6** is in constant mesh with an internally toothed spur wheel **7**, of suitable size to give the desired gear ratio. The spur wheel **7** is mounted on the end of a shaft **8** which, in the example shown, is in alignment with the shaft **2**, but need not necessarily be so arranged. Placing the shaft **8** in alignment with the shaft **2** as shown, makes for simplicity in manufacture and also gives compactness to the gear; and it also makes it possible to provide conveniently a clutch (not shown) between the shafts **2** and **8**, so that the shafts can be locked together at will to give a direct drive. At the other end of the shaft **8** there is mounted a bevel pinion **9**, (preferably a spiral-toothed bevel wheel is used) from which the drive to the load-shaft—that is, the back-axles **10a** of the usual ground wheels—is obtained through a large crown wheel **10**. Preferably, as is common practice, the drive from the crown wheel **10** to the back-axles is through differential gearing, the casing of which is denoted by **10b**.

In the example shown in the drawing, provision is made for reversal of the gear when required by providing a reversing idler **11** mounted on a shaft **11a**. To reverse the drive, a gear wheel

2a on the primary shaft 2 is brought into engagement with the wheel 11b of the idler 11 and the drive is then transmitted through the wheel 11c of the idler to a gear wheel 4b on the secondary shaft 4.

Provision is made in the example shown for taking off power for purposes other than propulsion of the vehicle. This may be done by providing an additional spur wheel 12 mounted on the before-mentioned internally toothed wheel 7 and from which spur wheel 12 a variable ratio forward or reverse drive may be taken as required through the spur wheel 13, on the end of the shaft 14 which, in the example shown, is carried to the rear of the tractor. A high-speed fixed ratio power take-off is also provided in the form of a bevel wheel 12a engaging with a bevel wheel 13a on a transverse shaft 14a, from which any desired drive may likewise be taken.

The power transmission assembly hereinbefore described is particularly suitable for application to an agricultural tractor in which the implements are operated and/or controlled by fluid pressure or other power means. In the example shown, control of the implement, or implements, is arranged for hydraulic or fluid pressure operation, and for this purpose provision is made in the housing for an hydraulic or fluid pressure pump 15, mounted on the forward end of the secondary shaft 4 and driven thereby. Oil from the pump 15 is delivered to cylinders 16 for operation of rams 16a therein. The rams 16a are, by the rods 16b connected by levers 17 to the shaft 18 whereby the desired control mechanism to the implement or implements can be operated.

It will be seen that the whole transmission gearing and power control for an implement or implements can be very neatly and compactly housed and protected by providing the power transmission assembly as hereinbefore described. Power control mechanism for implements such as may be operated in conjunction with the power transmission assembly hereinbefore described has, for example, been shown and described in my United States patent specification No. 1,687,719.

I claim:—

A power transmission assembly for vehicles comprising a housing structure, a motor-driven primary shaft, a secondary shaft extending alongside said primary shaft, a pinion shaft coaxial with and rearwards of said primary shaft, all said shafts being journalled in said structure, variable ratio ahead and reverse speed-reduction gearing interconnecting said primary and secondary shafts and adapted to transmit power from the primary to the secondary shaft, a spur wheel fast on the rear of said secondary shaft, an internally toothed spur wheel fast on the front of said pinion shaft and arranged in continuous mesh with said first-mentioned spur wheel, said inter-meshing spur wheels constituting a fixed ratio speed-reduction driving connection to transmit power from said secondary shaft to said pinion shaft, transverse axles at the rear of the assembly, bevel gearing interconnecting said pinion shaft and said axles through the intermediary of a differential gear, said speed-reduction gearing, spur wheels and bevel gearing being all housed in said structure so that the transmission assembly constitutes a complete unit.

HARRY FERGUSON.

Patented Mar. 24, 1936

2,035,392

UNITED STATES PATENT OFFICE

2,035,392

COPPER STEEL ALLOYS

Russell H. McCarroll and Gosta Vennerholm, Dearborn, Mich., assignors to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

No Drawing. Application April 13, 1933, Serial No. 665,954

5 Claims. (Cl. 75—125)

This invention relates to the production of copper-alloys of steel and articles thereof.

Although copper is widely used in industry alloyed with tin and zinc for the production of brass, bronze and the like, it has not heretofore been considered practical to attempt to alloy it with iron or steel except in very small proportions, not in excess of 1%, because of the limited solubility of copper with iron. In fact, the prior teaching in the metallurgical art was strongly to the effect that a satisfactory high copper-iron alloy could not be produced because precipitation of the copper could not be prevented. While it may be true that it has been proposed to add copper in amounts greater than 1% to alloy steels of the so-called stainless or heat resisting types, the use of copper in such steels is for an altogether different purpose than the use contemplated by the present invention in which the object is to produce a steel of high physical properties to enable the steel to be used with highly satisfactory results for the manufacture of machine, engine or automotive parts where great strength, wear and fatigue resistance and good bearing properties are desired.

The principal object of the present invention is to produce a new and improved steel containing a copper content in an amount sufficient to produce supersaturation thereof, or, in other words, so that the internal pressure is equalized just before the point is reached where precipitation would occur. The equalization of the internal pressure just before the precipitation point is reached can only be secured by the maintenance of a proper balancing within comparatively narrow limits of the carbon, silicon and copper contents, as hereinafter more fully set forth. The invention relates primarily, as above pointed out, to the production of alloy steels of high physical properties, and in order to obtain such properties, it is necessary that the balancing referred to, of the respective proportions of the three elements, carbon, silicon and copper, be maintained or the desired results would not be secured. In addition to the proper balancing of carbon, silicon and copper, it is highly desirable to employ a carbide forming element, the proportion of which must also be nicely balanced to that of the other elements. Although the use of chromium is preferred as the carbide forming element, it will be understood that the invention is not limited to the use of this particular element but that other elements having known similar physical and metallurgical properties may be employed.

Considered from another standpoint one of the principal objects of the invention may be said to be the production of a copper-alloy steel in which a high silicon content is employed to insure complete solubility of the copper.

The invention briefly consists in the production of a copper-alloy steel in which a high copper, high silicon analysis is used, the analysis also including a high carbon content together with smaller proportions of other metals such as chromium and manganese, and in which the entire copper content goes into solution while such of the carbon as is not in solution, is in the form of small particles of iron-chrome carbides and iron carbides uniformly distributed throughout the matrix thereby to produce articles having high physical properties, excellent foundry properties, and possessing marked advantages from the standpoint of machinability as well as furnishing an exceptionally good material for bearing surfaces with a low coefficient of friction and relatively high Brinell hardness.

In accordance with the present invention, highly satisfactory results have been obtained by using a material of which the analysis preferably falls within the following limits:

	Percent
Carbon	1.10 to 1.30
Manganese	0.50 to 0.75
Silicon	1.60 to 2.10
Chromium	0.75 to 1.00
Copper	2.00 to 3.00
Iron	Balance

The invention may, however, be practiced with analyses within the wider limits as below:

	Percent
Carbon	.75 to 1.70
Manganese	0.40 to 2.00
Silicon	1.00 to 2.50
Chromium	0.30 to 2.00
Copper	1.00 to 4.00
Iron	Balance

The carbon content should not be above the upper limit of 1.7% which marks the point or line of separation or distinction between steel and cast iron, but should be slightly in excess of the carbon content required for forming solid solutions with the iron in the matrix. Chromium is employed to control the hardness of the product and to form, with a part of the excess carbon, iron-chrome carbides; a portion of the chromium, however, going into solution. Other carbide forming metals, such as molybdenum may be used either in combination with chromium, or separately in substitution for chromium. When molybdenum is used in combination with chromium the amount thereof employed would preferably be less than chromium but the total content of molybdenum and chromium would be within approximately the same limits as in the analyses heretofore given, and when molybdenum is employed separately in substitution for chromium the same limits also apply.

As the result of extensive laboratory and practical tests we have found that precipitation of copper can be entirely prevented by the use of a high silicon content, the silicon increasing the solubility of copper and preventing precipitation up to 4% copper.

As the use of copper decreases shrinkage, increases fluidity and lowers the melting point the metal has excellent foundry properties. The high carbon and silicon contents also contribute to improve the foundry properties.

In addition the copper produces an age hardening effect, insures remarkably easy machinability of articles of relatively high Brinnell hardness and permits the production of a metal having high physical properties without the necessity of resorting to complex heat treatments. A typical analysis, from the use of which a highly satisfactory product has been obtained, is as follows:

	Percent
Carbon	1.17
Manganese	0.69
Silicon	1.95
Chromium	0.96
Copper	2.55
Phosphorus	0.04
Sulphur	0.04

It will be understood that the inclusion of phosphorus and sulphur forms no part of the present invention but that they are present merely as impurities. For certain uses it may be found desirable to normalize the product obtained from the above analysis at a sufficiently high temperature at about 1425° F.–1650° F. depending on properties desired, for a cycle of one and one-half hours for castings having a cross-sectional area of approximately one and one-half square inches; the heat cycle consisting merely of bringing up to the normalizing temperature and cooling, but such normalizing or other heat treatment is not essential and may be dispensed with.

In the cast state the metal has a Brinell hardness of from 364 to 418 which is brought down by normalizing to an average of about 340, at which hardness the product can readily be machined and has excellent physical properties. It will, however, be understood that the metal is machinable in the cast state at a Brinell of approximately 400.

All of the copper enters into solid solution with the iron. The matrix is sorbitic, partly pearlitic, with excess carbon in the form of small particles of iron-chrome carbides and iron carbides uniformly distributed throughout the matrix, so that the final product is completely homogeneous with a fine close grained structure. As hereinbefore pointed out, it is essential that a proper balancing of the carbon, silicon, copper and chromium contents beyond relatively narrow limits be maintained. The amount of the carbon content, as pointed out, should be slightly in excess of the carbon content required for forming solid solutions with iron in the matrix, and when such a carbon content is employed, together with the copper, the effect is for the copper to restrict materially the size of the grain formations. The grain refining properties of the copper tend materially to restrict the size of the carbon particles which are formed as very fine particles of temper carbon uniformly distributed throughout the entire matrix. By using the proper proportion of silicon to carbon substantially complete solubility of the copper is secured and the precipitation is prevented of particles of free carbon, the formation of which along the grain boundaries would tend to produce lines of cleavage that would materially detract from the desired physical properties.

The use of chromium or other iron carbide forming elements results in there being interspersed throughout the matrix fine particles of such carbides embedded in the very tough matrix and aids materially in increasing the wear resisting properties.

It will be understood that as changes, modifications and variations of the invention as hereinbefore described will readily suggest themselves to the skilled metallurgist, such changes are included within the scope of the claims hereunto appended.

We claim:

1. An article of manufacture comprising a readily machinable copper-alloy steel having an analysis within the following limits:

	Percent
Carbon	1.10 to 1.30
Manganese	0.50 to 0.75
Silicon	1.60 to 2.10
Chromium	0.75 to 1.00
Copper	2.00 to 3.00
Iron	Balance

and having a tough matrix in which the entire copper content is in solution, and said matrix having imbedded in it extremely hard particles of iron chromium carbides and free carbon uniformly distributed throughout said matrix.

2. An article of manufacture comprising a readily machineable copper-alloy steel having an analysis substantially within the following limits:

	Percent
Carbon	0.75 to 1.70
Manganese	0.40 to 2.00
Silicon	1.00 to 2.50
Chromium	0.30 to 2.00
Copper	1.00 to 4.00
Iron	Balance

and having a tough matrix in which the entire copper content is in solution, and said matrix having imbedded in it extremely hard particles of iron chromium carbides and free carbon uniformly distributed throughout said matrix.

3. An article of manufacture comprising a readily machinable copper-alloy steel having an analysis lying within the following limits:

	Percent
Carbon	0.75 to 1.70
Manganese	0.40 to 2.00
Silicon	1.00 to 2.50
Chromium	0.30 to 2.00
Copper	1.00 to 4.00
Iron	Balance

the silicon and copper being in balanced proportions with sufficient silicon relatively to the amount of copper employed to insure solubility of the copper content and the amount of copper content being sufficient normally to produce super-saturation were it not for the modification thereof effected by the silicon and the amount of carbon being sufficiently in excess over the amount needed for solid solution to form small particles of carbides and temper carbon uniformly distributed throughout the matrix.

4. An article of manufacture comprising copper-alloy steel containing silicon, chromium and copper and having an analysis substantially within the following limits:

	Percent
Carbon	0.75 to 1.70
Manganese	0.40 to 2.00
Silicon	1.00 to 2.50
Chromium	0.30 to 2.00
Copper	1.00 to 4.00
Iron	Balance

the ratio of the carbon, silicon, chromium and copper contents being substantially in the proportions, carbon 1, silicon 1½, chromium ½ and copper 2, with the balance substantially iron.

5. An article of manufacture comprising high carbon alloy steel having an analysis substantially within the following limits:

	Percent
Carbon	1.10 to 1.30
Manganese	0.50 to 0.75
Silicon	1.60 to 2.10
Chromium	0.75 to 1.00
Copper	2.00 to 3.00
Iron	Balance

and in which the ratio of carbon, silicon, chromium and copper is substantially as 1 to 1½ to ½ to 2 respectively.

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GOSTA VENNERHOLM.

Patented Mar. 24, 1936 2,035,393

UNITED STATES PATENT OFFICE

2,035,393

WEAR RESISTANT CAST IRON

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No Drawing. Application February 9, 1934, Serial No. 710,523

2 Claims. (Cl. 75—125)

This invention relates to a new and improved cast iron particularly adapted for the manufacture of small articles, such for example as the valve push rods of automobile engines, intended for usage where hard wear resistant surfaces are desired.

It has long been a problem in the automotive industry to secure a satisfactory wear resistant material for the valve push rods and many different proposals have been made in an effort to solve such problem, such for example as using two different metals, one for the flat wearing face of the rod and a softer, more readily machineable metal for the bearing portion of the rod. Another method has been to make the rod of an integral casting, the wearing face being cast against a chill and the remainder in sand. The marked trend in the industry towards the use of higher and higher speed engines has served to accentuate the problem which is rendered more acute by the necessity for extreme accuracy in machining the push rods and great precision in their operation if the desired operating efficiency of the engine is to be secured and maintained. The problem is not restricted to push rods but is also encountered in connection with the manufacture of many different articles.

As die casting methods can be employed to produce small metal parts in quantity to precise measurements, the use of a metal having the desired wear resisting qualities would be highly desirable for the manufacture of parts of the type referred to because the parts could then be produced as castings with but a few thousands of an inch of stock provided over the required finished dimensions and this slight amount of material removed by a grinding operation without the necessity of resorting to the use of any metal cutting machining operations; it being well known that hard or tough metal which will resist the operation of cutting tools will yield to grinding.

The use of ordinary white cast iron, of the type commonly used for the manufacture of malleable iron, for valve push rods, has heretofore been suggested, but white cast iron of standard analysis has been found not to be satisfactory because of its great frangibility and consequent high scrap losses due to breakage in handling and machining and due to the fact that such iron does not have the required physical properties to resist frequent impact in operation. It is also unsuitable for die casting and, moreover, due to its extreme hardness is unsuitable for use with co-operating parts rotating in contact therewith at high speeds. In order to offset these disadvantages it has been proposed to use the white cast iron for the flat wearing portion of the push rod and to construct the rod or bearing portion of softer material, but such proposal was unfeasible because it was not possible to unite the two metals satisfactorily because of the difficulty of machining the white iron to effect a mechanical or construction joint and welding or brazing methods cannot be employed with ordinary white cast iron because such iron is very unstable and begins to break down rapidly at the high temperatures required for the welding or brazing operations, thereby resulting in an iron having a large proportion in the graphitic instead of the combined form (Fe3C) which latter is necessary to obtain the desired wearing qualities.

After a considerable period of experimentation we have succeeded in inventing and perfecting an improved metal comprising a high carbon, low silicon cast iron that meets the desired requirements. In accordance with the present invention we use a metal having an analysis falling within the following limits:

C	3.25 to 3.75%
Mn	0.15 to 0.35%
Si	0.75% (maximum)
Cu	0.75 to 1.00%
P	0.05%
Fe	balance

This metal has a relatively low shrinkage due to the high carbon content, and therefore may be used most effectively for die casting in production of parts the measurements of which must be kept within precise limits.

As a result of the high carbon content which forms a solid solution with the iron and the low silicon content which increases the stability of the iron carbides, the metal has great stability under the application of heat. As a result, it is possible to use the metal to construct the flat wear resisting face portion of a push rod or other part and to unite such portion to the bearing portion of the rod by a brazing operation, the metal showing no tendency to break down at brazing temperatures as high as 2100° F.

Due to the graphitizing effect of the copper, and the effect of the copper generally on the solution, the matrix is a very fine close grained structure in which very small particles of graphite are imbedded. This imbedded graphite has marked lubricating properties.

The lower silicon content also results in securing a metal of better physical properties particularly from the standpoint of reducing the frangibility.

After the metal has been die cast in metal molds into the articles of the desired shape, the articles are preferably subjected to a strain drawing heat treatment which consists in bringing the articles up to heat at 1650° F. and permitting them to air cool to room temperature. The metal also lends itself excellently for die casting thin wall hollow castings by using a core to form the central cavity of the casting. The copper content referred to above may be omitted, but its use is preferable to secure better physical properties and to aid in facilitating the production of sound thin wall castings.

While for the purpose of clarity of disclosure we have described our invention from the standpoint of its use in connection with the manufacture of automobile valve push rods, it will be understood that the invention is not to be considered as limited to this one specific use but that, as many other uses will become readily apparent to the skilled metallurgist and those in the art to which the invention appertains, it is the purpose to include herein such other uses. It will also be understood that additions of small amounts of carbide forming elements such as chromium and molybdenum may be made in amounts of from 0.10 to 0.75% where greater wear resistant properties are desired.

We claim:

1. An article of manufacture comprising die cast cast iron having high wear resisting properties and excellent stability at elevated temperatures and of an analysis falling within the following limits:

C	3.25 to 3.75%
Mn	0.15 to 0.35%
Si	0.75% (maximum)
Cu	0.75 to 1.00%
P	0.05%
Fe	balance.

2. An article of manufacture comprising die cast cast iron having high wear resisting properties and of an analysis falling within the following limits:

C	3.25 to 3.75%
Mn	0.15 to 0.35%
Si	0.75% (maximum)
Cu	0.75 to 1.00%
P	0.05%
Fe	balance,

the silicon, copper and carbon contents being maintained approximately in the relative proportions of 1 to 1 to 5 respectively whereby the silicon will impart stability to the iron to prevent decomposition at temperatures above the normal critical range, the carbon will secure a metal of relatively low shrinkage and the copper will increase fluidity for improved casting properties and obtain desired grain refinement.

RUSSELL H. McCARROLL.
GOSTA VENNERHOLM.

Patented Mar. 24, 1936

2,035,394

UNITED STATES PATENT OFFICE

2,035,394

CAST STEEL

Russell H. McCarroll and Gosta Vennerholm, Dearborn, Mich., assignors to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

No Drawing. Application February 9, 1934, Serial No. 710,524

2 Claims. (Cl. 75—125)

This invention relates to a new and improved steel alloy having new and exceptional properties and capable of being employed for the casting of many articles of manufacture for which no known alloys or metals could be satisfactorily employed.

In the fabrication of certain automobile parts it was found desirable to use a casting with relatively thin walls to which was to be integrally united metal tubing. The growth and improvement of welding practice has made the use of welded joints more common because of facility for production methods. While ordinary cast steel lends itself to welding, it cannot be satisfactorily successfully used for very thin wall or intricate castings due to lack of sufficient fluidity. Also because of the greater cost of making an ordinary steel casting of such a design it would be prohibitive, if in fact it were possible to secure sound castings in ordinary steel of such a design. Malleable iron is especially well adapted for thin castings but cannot be welded satisfactorily because of its tendency to harden and become brittle under the high heats of the welding operation which are above the critical temperature and because of the tendency of the free temper carbon content to oxidize and form gases which produce blow holes and thereby weaken the weld. Ordinary grey cast iron could not be successfully employed for articles of the type under consideration because of its relatively low physical properties and because high carbon content thereof results in marked hardening and embrittlement of the metal in the region of the weld after welding.

The present invention has for its principal object to provide a new and improved steel alloy capable of being successfully cast to form thin walled castings and withstanding the high temperatures of welding operations without hardening effect or embrittlement and which, moreover, can be manufactured and fabricated at a relatively low cost.

We have found after considerable experimentation that a steel having an analysis falling within the following limits, will have all of the desired properties and none of the objectionable features as above set forth, of the more commonly used materials:

C	0.25% (maximum)
Mn	0.15 to 0.65%
Si	0.75% to 1.25%
Cu	0.90 to 1.75%
Fe	balance

If desired sulphur up to 0.15 may be added for increasing ease of machineability.

It has been found that the presence of more than 0.25 C. results in a hardening and embrittlement of the metal in the region of the weld after the metal is subjected to the high welding temperatures.

The relatively high silicon content together with the copper results in increased fluidity which enables very thin wall castings to be satisfactorily produced. The silicon or copper contents in properly combined proportions give a lower melting point which tends to improve the welding properties of the metal. It is found that the silicon and copper go into solid solution with the iron to produce an alloy having excellent high physical properties; the high silicon content being important in this respect as it tends to increase the solubility of the copper, the metal having a tensile strength of from 85 to 90 thousand pounds per square inch and a Brinnell hardness of about 150.

While the silicon content should be kept high enough to secure the desired fluidity, it has been found to be best not to have an amount in excess of 1.25%, because of its effect on machineability especially in combination with a relatively high copper content.

It has also been found advisable not to have the copper content greater than 1.75%, thereby to avoid the tendency towards excessive air hardening.

The metal may be cast in green sand molds thus enabling savings to be effected in production costs. After casting an ordinary normalizing treatment is desirable, such normalizing resulting in a decided improvement in the physical properties by producing a marked grain refinement of the metal.

Although copper is employed, the copper content is relatively small, and the production cost of the metal is appreciably lower than that of either cast steel or ordinary malleable iron and possesses marked advantages over either in that it may be used for producing excellent thin wall castings, to which other parts may be integrally secured by welding; a strong welded joint being secured without producing any deterioration of the physical properties of the metal.

Although the invention has been described from the standpoint of its advantages when used for the manufacture of thin wall castings, to which it is desired to weld other parts, it will be understood that the invention is not to be considered as limited to this one specific use, but that as other uses will be readily apparent to the skilled metallurgist and those in the art to which the invention appertains, it is the purpose to include herein such other uses.

We claim:

1. An article of manufacture a sound thin wall casting of low carbon, high silicon steel and having an analysis lying within the following limits:

C	0.25% (maximum)
Mn	0.15 to 0.65%
Si	0.75 to 1.25%
Cu	0.90 to 1.75%

Balance substantially all iron.

2. An article of manufacture comprising a sound thin wall casting of low carbon, high silicon steel capable of withstanding welding temperatures without deterioration or air hardening effects, said steel having an analysis lying between the following limits:

C	0.25% (maximum)
Mn	0.15 to 0.65%
Si	0.75 to 1.25%
Cu	0.90 to 1.75%
Fe	balance

and in which the silicon and copper contents are combined in approximate'y the proportions of 4 to 5 respectively.

RUSSELL H. McCARROLL.
GOSTA VENNERHOLM.

Patented Sept. 7, 1937 2,092,283

UNITED STATES PATENT OFFICE

2,092,283

PISTON ALLOY

Russell H. McCarroll, Dearborn, Mich., assignor to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

No Drawing. Application January 30, 1935, Serial No. 4,126

1 Claim. (Cl. 75—125)

The object of my invention is to provide a steel alloy especially adapted for constructing internal-combustion engine pistons, which pistons will have most of the advantages of aluminum pistons without several of the disadvantages inherent in such aluminum pistons. Aluminum pistons are advantageous in that the metal aluminum is an exceptionally good heat conductor so that the transfer of heat from one part of the piston to another part is rapid enough to allow the piston to remain cool even though comparatively high compression pressures are used. Furthermore, aluminum being very light in weight minimizes the reciprocating strains on the wrist pin and connecting rod bearings, and also requires a minimum of counter-weighting in the crank-shaft to produce a running balance. These advantages are sufficiently important to make an aluminum piston preferable to the ordinary cast iron piston for high speed engine use. However, they are obtained only with certain inherent disadvantages. These disadvantages are that aluminum has a high co-efficient of expansion so that compensating slots, invar struts, or some other means must be provided to prevent piston slap during the warming up period of the motor. Furthermore, aluminum has a comparatively high co-efficient of friction with cast iron so that excessive piston wear results, and further the cylinder surface attains a somewhat hotter temperature than when cast iron pistons are used, due to the increased friction.

Perhaps the greatest disadvantage inherent in aluminum pistons is that the metal is comparatively soft so that the piston ring grooves "pound out" or increase in width appreciably after only a few hundred hours of use. Furthermore, wear on the piston skirt causes the piston to "wobble" as it reciprocates, which motion wears off the sharp edges of the ring grooves. These two conditions cause the engine to pump considerable oil. One of the reasons for oil passing by the pistons in internal-combustion engines is that excessive clearance between the ring grooves and the rings, allows the oil upon the down stroke of the piston to be forced into the space in back of the piston rings so that upon the succeeding down stroke of the piston this oil is deposited on the cylinder walls above the ring. To prevent oil pumping, it is essential that there be a minimum clearance between the ring grooves and the piston rings. The applicant's piston alloy has substantially the same co-efficient of expansion as have cast iron piston rings and it is sufficiently hard and wear resistant that the ring grooves are prevented from appreciably increasing in width. For this reason the rings, even after hundreds of hours of use, fit very closely in the ring grooves.

The applicant's metal is believed unique among steel alloys in that it is an exceptionally good heat conductor to thereby allow a minimum thickness of the piston head. The improved heat conductivity is obtained from a copper matrix which is provided in the alloy.

Still further, the applicant's alloy is an exceptionally free flowing metal to thereby permit the commercial casting of relatively thin ribs and piston walls.

Still further, the sulphur content is particularly high in the applicant's alloy, it being three to four times as high as the maximum usually permissible in cast iron. Experience has shown with this combination of elements a high sulphur content provides for freer machining which is essential when thin wall castings are to be machined.

It is believed that all of these characteristics are essential inasmuch as without an increased heat conductivity, a piston having a light weight piston head, ribs and skirt, could not be used in high compression motors, and without free flowing of the metal, such light weight construction could not be cast, and without freer machining characteristics, such thin walled pistons could not be commercially machined.

With these and other objects in view, my invention consists in the composition and combination of elements in my improved alloy, as described in the specification and claimed in my claim.

My improved alloy consists of the following:

Carbon	1.40–1.70 per cent
Manganese	.90–1.10 per cent
Sulphur	.12– .16 per cent
Silicon	.90–1.10 per cent
Copper	1.50–2.00 per cent
Phosphorus	.12 (max.)
Iron	balance

The above alloy is cast by the conventional sand cast method, however, I prefer to provide a double anneal for the castings so formed. The castings are first heated to 1650 degrees Fahrenheit and then air cooled. They are then brought up to 1400 degrees Fahrenheit, and then slowly cooled to 1000 degrees Fahrenheit. The pistons are then allowed to cool in air to room temperature. With this alloy and this heat treatment, a Brinell of ..07–286 is readily attained, the material having a tensile strength of about 100,000 pounds per square inch.

With the above mentioned heat treatment, the carbon is in the form of temper carbon and not as graphite flakes. The above mentioned heat treatment differs from the conventional normalizing treatment in that heating the castings to 1650° F. breaks up the grains and starts secondary graphitization, while the 1400° draw completes this graphitization while at the same time spheroidizing the pearlite. In this way secondary graphite is formed which result is not obtained by normalizing. This accounts, to a great extent, for the increased strength of the alloy and the increased wear resistance of the metal. Furthermore, a characteristic of my improved alloy is that the copper is held in solution by the silicon.

An important advantage obtained with my improved piston alloy is that the copper content forms a matrix or network throughout the casting which improves the heat conductivity to such extent that the cross-sectional area or thickness of the piston head may be reduced to substantially that required to carry the structural load upon the head. Inasmuch as this material has a tensile strength of approximately 100,000 pounds per square inch a comparatively thin piston head, much thinner than required with cast iron pistons, is sufficient to carry the stresses imposed on same, and due to the improved heat conductivity, pre-ignition does not occur. Excellent results with no pre-ignition have been obtained using a three inch diameter piston having a head thickness of only .090'' and operating at 6.5 atmospheres of compression; whereas, when an ordinary cast iron piston is used, the piston head must be several times this thickness to give the necessary structural strength. If an ordinary steel piston is used, over 50% increase in head thickness must be provided to prevent pre-ignition, due to the lower heat conductivity of steel.

A further advantage obtained with my improved alloy is that the coefficient of friction with a cast iron cylinder is considerably less than the co-efficient of friction between cast iron and cast iron and considerably less than the co-efficient of aluminum on cast iron. Consequently, less wear results on the piston walls and less heat is developed to cause the destruction of the oil film between the piston and the cylinder.

Some changes may be made in the composition and heat treatment of my improved alloy without departing from the spirit of my invention, and it is my intention to cover by my claim, such changes as may reasonably be included within the scope thereof.

I claim as my invention:

A composition especially adapted to constructing internal-combustion engine pistons, comprising.

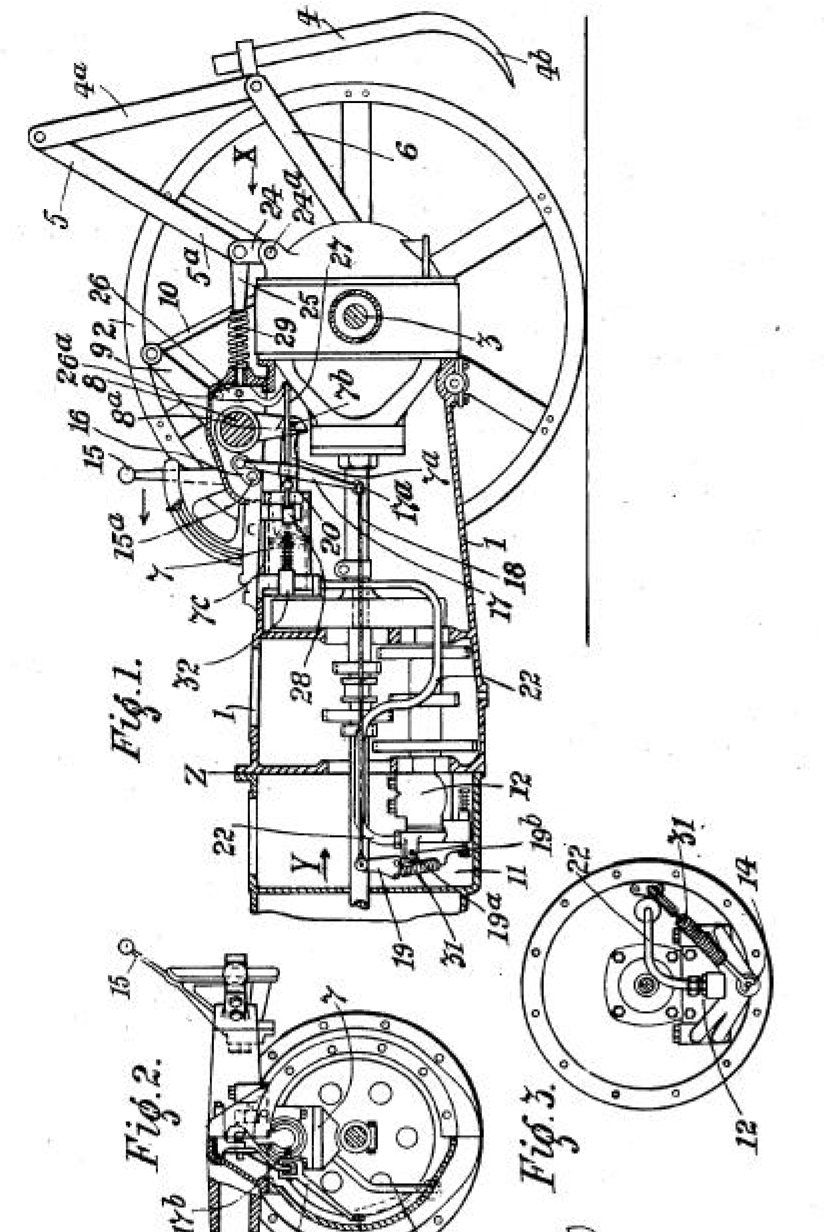
Carbon	1.40–1.70 per cent
Manganese	.90–1.10 per cent
Sulphur	.12– .16 per cent
Silicon	.90–1.10 per cent
Copper	1.50–2.00 per cent
Phosphorus	.12 (max.)
Iron	balance

RUSSELL H. McCARROLL.

May 24, 1938. H. G. FERGUSON 2,118,180

TRACTOR FOR AGRICULTURAL IMPLEMENTS

Filed Jan. 27, 1937 2 Sheets-Sheet 1



Inventor:
Henry George Ferguson,
By, [illegible]
Attorney

May 24, 1938. H. G. FERGUSON 2,118,180

TRACTOR FOR AGRICULTURAL IMPLEMENTS

Filed Jan. 27, 1937 2 Sheets-Sheet 2

Fig. 5.

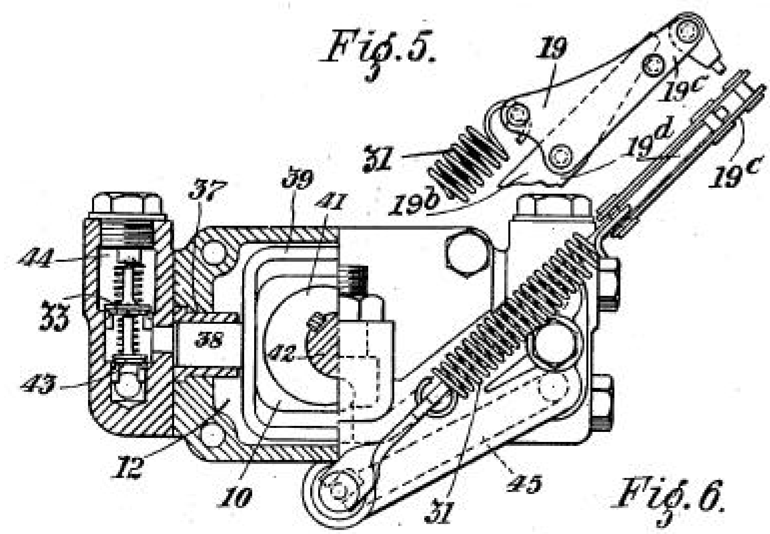


Fig. 6.

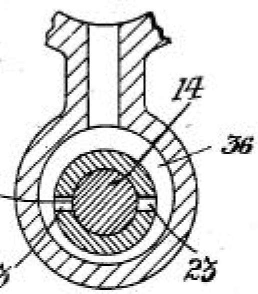


Fig. 4.

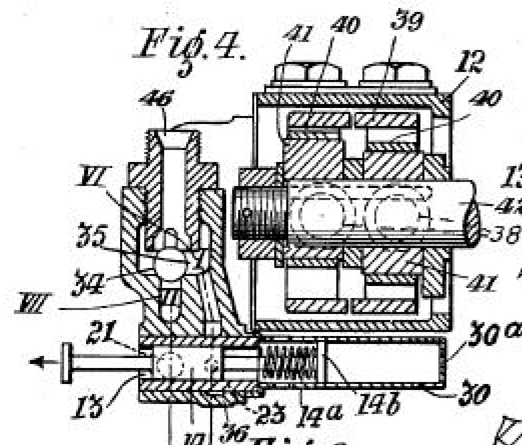


Fig. 7.

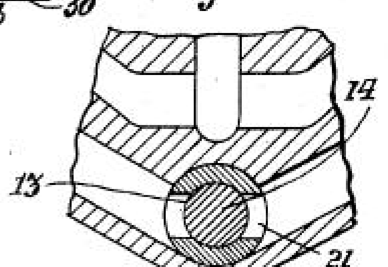
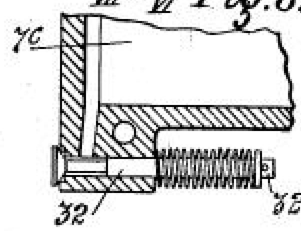


Fig. 8.



Inventor:
Henry George Ferguson,
By [signature]
Attorney.

Patented May 24, 1938 **2,118,180**

UNITED STATES PATENT OFFICE

2,118,180

TRACTOR FOR AGRICULTURAL IMPLEMENTS

Henry George Ferguson, Belfast, Northern Ireland

Application January 27, 1937, Serial No. 122,609
In Great Britain February 5, 1936

20 Claims. (Cl. 97—50)

This invention relates to improvements in control of tractor-drawn agricultural implements, and more especially to tractors having a pressure fluid power-operated control unit for automatically controlling the depth of the implement and/or for raising and lowering of the implement in a manner similar to the power unit described in my prior patent specification No. 1,687,719.

It has been found that when an implement is attached to a tractor as a unit and controlled for depth regulation by fluid pressure means, the operating fluid tends to become overheated and aerated if it has to be pumped continuously and controlled under pressure.

To overcome this difficulty an object of the invention is to provide that the fluid is controlled on the suction side of the pump and so that the supply can be varied, cut off or discharged in accordance with requirements for automatically keeping the implement at a regular depth and/or also for raising and lowering the implement.

A further object is to effect the control by a valve the length of which, and the distance between the suction port or ports and the release port or ports, are so arranged as to provide that both suction and release ports may be covered at the same time, whereby movement of the fluid can be prevented in either direction. The period when the valve covers both ports is what I term the "dead point" or mid-position.

When the implement is operated in the ground at a predetermined depth which has been fixed by manual control means, the valve remains on the "dead point" until changed from it by a variation in the draft. For example, if the implement were to go deeper the draft would be increased. This would open the suction ports and allow fluid into the pump. The implement would then be automatically raised to the predetermined depth and the valve would then automatically return to the "dead point". Similarly, if the draft on the implement were reduced due to its becoming shallower in the ground, the mechanism would work in the opposite way by the uncovering of the release ports and allowing the implement to return to the predetermined depth, the valve again being automatically moved to the dead point. Thus automatic control is effected without continuously pumping fluid under pressure, so that overheating and aerating are avoided.

It has been found that in operation some implements are inclined to move the fluid control valve more than necessary. A further object is to provide damping means on the valve so as to slow or reduce these movements, and so save excessive wear on the valve and its controlling mechanism and on the pump.

To prevent damage to the mechanism for operating the control valve, a further object is to provide safety means between the valve and the control lever worked by the operator. If the operator unduly forces the control lever the safety means, for example, a shock-absorbing spring will prevent any excessive load being imposed upon the mechanism or the valve.

An implement such as hereinbefore referred to is usually transported on the tractor by raising it to a predetermined height above the ground. A further object is to provide automatic means connected with the mechanism for cutting off the fluid supply to the pump, so that when the implement reaches the predetermined height it will automatically stop ascending. This may be done, for example, by arranging that when a ram piston, which operates the raising mechanism, reaches a predetermined position it will come into engagement with control mechanism for the fluid valve and the valve will be moved to the "dead point" where the fluid supply is cut off.

In a preferred arrangement oil is drawn from a tank or sump by a suitable form of pump and in the pipe line leading to the suction side of the pump, I provide a piston valve, in a suitable valve chamber, for controlling the oil, the movements of the said piston valve being controlled by a hand lever convenient to the operator on the tractor, and also automatically controlled by variations of draft on the implement, the hand lever, when required, working independently of the automatic control and also, when required, serving to regulate the automatic control of the implement. On the pressure or ram side of the pump I provide a port or passage connecting with the aforesaid valve chamber so that when the valve is moved, either by hand or automatically, to a predetermined position, this port will be uncovered and allow the fluid to flow back again to the sump or tank. When the pump is in operation and the fluid has passed the pump, it is led to a ram chamber to operate the ram by means of which the implement is operated, or controlled. Thus continual pumping and consequent overheating and aeration of the oil is avoided owing to the control being on the suction side of the pump.

The invention will now be described by way of example only with reference to a specific embodiment thereof as shown on the accompanying drawings wherein:—

Fig. 1 is a part longitudinal sectional elevation of the rear portion of a tractor having means provided for hydraulic control of an implement attached to the tractor, the implement being shown in the raised position.

Fig. 2 is a view partly in section looking in the direction of the arrow X, Fig. 1 with the rear axle and crown gear housing removed.

Fig. 3 is a view looking in the direction of the arrow Y, Fig. 1 with the tractor casing removed at the joint Z.

Fig. 4 is a sectional detail elevation of the hydraulic pump and control valve.

Fig. 5 is a front elevation, one half in section, of the hydraulic pump and showing the control valve and connection thereto.

Fig. 6 is a sectional view to a larger scale, on the line VI—VI, Fig. 4.

Fig. 7 is a sectional view, to a larger scale, on the line VII—VII, Fig. 4.

Fig. 8 is part sectional plan of the ram cylinder showing the arrangement of the safety valve.

Referring to the drawings:—

In the example shown in the drawings, 1 denotes the rear portion of the tractor casing, 2 the rear wheels of the tractor, 3 the rear axle of the tractor, 4 denotes the implement and 5 and 6 respectively denote the upper and lower link connection between the tractor and the implement, which, in this particular example, is a cultivator. Obviously this may be replaced by any other implement as the occasion demands.

On the tractor and located in front of the rear axle as shown in Fig. 1, is a hydraulic ram 7, which includes the cylinder 7c and the piston of which is pivotally connected to the connecting rod 7a which, in turn, is pivotally connected at 7b to the arm 8a mounted on the ram shaft 8. Connected to the shaft 8 are two lift arms 9 which, in turn, are connected by two lift rods 10 to the lower links 6 connecting the frame 4a of the implement 4 with the tractor, the implement 4 being shown in the raised position. Oil is drawn from a tank or sump 11 by a pump 12 which, together with the ram connected to it by the pipe 22, constitutes a pressure-fluid control unit or assembly referred to in the claims as a "unit" for convenience, the pump being continuously driven by the tractor engine while the engine is running. Details of this pump are shown at Figs. 4 and 5. It is a four-cylinder unit with two pairs of horizontally-opposed cylinders 37. Each pair of pistons 38 projects from the two ends of a square frame 39 embracing a sliding block 40, the reciprocating motion for the blocks 40 being obtained from eccentrics 41 mounted on the driving shaft 42. The two eccentrics 41 are set at right angles as can be seen from Fig. 4, so that the four pistons 38 operate successively giving a sufficiently regular flow to the oil to prevent any perceptible irregularity in the lift of the tool frame. The delivery valves 33 are mounted vertically above the suction valves 43, as shown to the left in Fig. 5. From the chambers 44 above the delivery valves 33, the oil is taken through sloping branch passages 45 to the underside of the ball valve 34, shown below the delivery outlet 46 in Fig. 4, to which outlet the pipe 22 is connected. When the pump is in operation, the ball valve is lifted, and the oil has two possible paths, one being through the delivery outlet 46 to the pipe 22 and the ram cylinder 7c, and the other through the by-pass passage 35 to a circular space 36 embracing the sleeve of the piston control valve 14. This sleeve is drilled as at 23 to give a restricted release port opening into the sleeve centre space, the restriction limiting the speed of lowering the implement as later described. The piston valve 14 is provided in the passage 13 which leads to the suction side of the pump. This valve 14 is for controlling the admission of oil, its movements being controlled by a hand lever 15, (Fig. 1), convenient to the operator, on the tractor. The hand lever 15 is connected with the piston valve 14 as follows:—

Its lower end 15a is mounted on a shaft carrying a crank 16, the other end of which is pivotally connected to the top end of a lever 17. The lower end 17a of the lever 17 is connected with a rod or wire 18 which, in turn, is connected at its opposite end to a spring loaded lever 19, pivoted at 19a, and forked at its end 19b to engage the head of the valve 14. Movement of the hand lever 15 in the direction of the arrow shown in Fig. 1 will move the end 17a of the lever 17 around a fulcrum 20, the lever being kept in contact with the fulcrum 20 by the spring 14a (Fig. 4) which is provided on one end of the valve 14; such movement of the hand lever causing the valve 14 to move in the direction of the arrow in Fig. 4. The spring 14a also serves to keep looseness out of the mechanism and serves to take up any wear that may arise. Movement of the hand lever 15 in the opposite direction will reverse the movement of the valve.

The implement 4, as previously stated, is pivotally connected to the upper and lower links 5 and 6 by means of its frame 4a. The upper link 5 is connected at its end 5a with a rocker 24 pivoted at 24a to the back of the tractor. The rocker 24 is pivotally connected to a rod 25 on which is mounted a heavy compression spring 29. The rod 25 is pivotally connected at its opposite end to a lever 26 which is pivoted at its upper end 26a to the tractor casing and at its lower end to a rod 27 on which is fastened the fulcrum 20, previously referred to. Beyond the fulcrum 20 the front end of the said rod is slidably supported in a bearing 28. The rod 27 passes through a slot in the lever 17.

As regards the manual control of the implement the arrangement is as follows:—

When the hand lever 15 is moved from the vertical position in the direction of the arrow in Fig. 1 the lever 17 is moved anti-clockwise about the fulcrum 20, moving the rod or wire 18 to the right, which in turn operates the articulated lever 19 thereby moving the valve 14 to the left (Fig. 4) and uncovering the release ports 23 and allowing the oil to escape from the ram cylinder 7c at a slow rate. The piston thus moves slowly into the cylinder 7c under the weight of the implement, which drops gently to the ground and, as a result of the draft which is then imposed on the implement, it tends to turn in an anti-clockwise direction about the pivotal connection of the frame 4a. This tendency is resisted by the spring 29 which is compressed by the rod 25 moving to the left, swinging the lever 26 and causing the rod 27 with the fulcrum 20 thereon to swing to the left by its connection to the link 16. This return movement of the lever 17 allows the valve 14 to move to the right and to cover the release ports 23 without moving the hand lever 15 from the position to which it was moved by hand. When the implement reaches the desired depth the valve 14 covers the ports 21 and 23, and it will be seen that the depth is regulated by the position of the lever 15.

Adjustment of the hand lever 15 from the position shown in Fig. 1 (the raised position) moves the top of lever 17 to the left and the implement is lowered as above described. This lowering movement continues until the fulcrum 20 has been moved sufficiently far to the left to allow the valve 14 to close the ports 23 and arrest the lowering movement of the implement. Thus the further the lever 17 is moved to the left by the hand lever 15, the further will the implement be lowered before there has been sufficient movement of the fulcrum to arrest the lowering movement.

To raise the implement, the hand lever 15 is moved back to the vertical position, the bottom end of the lever 17 being moved to the left, thereby moving the rod or wire 18 and lever 19 so that the valve 14 is moved to the right and uncovers the ports 21, which are the inlet ports of the pump, allowing oil to flow to the pump which, operating through the ram and linkage 8a, 8, 9, 10 and 6, raises the implement. As the implement rises, the rod 25 (due to the removal of the draft on the implement) is moved by the spring 29 to the right, thereby swinging the lower end of the lever 26 to the right which in turn moves the rod 27 and fulcrum 20 thereon, to the right, bringing the lever 17 to the right therewith, which, operating through the rod or wire 18 and lever 19 moves the valve to the left, so that, when the implement is fully raised, the valve 14 covers the ports 21 and 23, cutting off the supply of oil to the pump and cutting off the escape of oil from the pump and keeping the implement in the raised position.

I will now describe the action of the automatic control:—Firstly, the control lever 15 is set to give the desired predetermined depth of cut in the ground. As long as the implement is working, and the draft on the implement remains the same, the compression load on the spring 29 will be constant, it being understood that, in operation, the links 5 and 6 are respectively in compression and tension. Under these conditions the valve 14 will remain on the "dead point", that is, with the ports 21 and 23 closed. This position of the valve 14 is shown at Fig. 4, no movement of the oil taking place in either direction and consequently no movement of the ram taking place in either direction.

If, however, the implement 4 is subjected to an increase in draft due, for example, to the front wheels of the tractor rising on a height and pitching the implement more deeply into the ground, such increase will instantaneously be transmitted to the rod 25 causing an increase in the compression thereon, which in turn, will cause the rod to compress the spring 29 further. At the same time the lever 26 will be moved about its pivot 26a with a resultant movement of the rod 27 and the fulcrum 20 thereby permitting the lever 17 to move to the left in Fig. 1, that is, forwardly under the action of the spring 14a on the valve 14. This forward movement of the lever 17, through the rod 18 will cause a corresponding movement of the spring loaded lever 19 which will allow the spring 14a to move the valve 14 rearwardly thus uncovering the suction ports 21 so that oil will be admitted to the pump 12 which then pumps the oil to the ram cylinder 7c which will be moved outwardly and will raise the implement in the manner already described. When the implement has been raised to a point where the draft thereon again reaches the predetermined amount, to give the necessary depth of cut, the spring 29 reacts and brings the valve 14 back again to the dead point with both the ports 21 and 23 closed.

If the implement be subjected to a reduction in draft, due for example, to the front wheels of the traction dropping into a hollow and so raising the implement relatively to the ground and thus making it cut too shallow, the action upon the spring 29 will be reversed and the valve 14 will be moved in a forward direction. This will open the restricted release ports 23, will allow oil to flow back from the ram cylinder 7c and will allow the implement to fall back to the predetermined depth of cut. When the predetermined depth has been reached the control valve 14 will again come back to the dead point under the action of the increased draft as previously described.

It will be noted that control of the oil to the pump 12, which supplies the oil under pressure to the ram cylinder, is arranged on the suction side of the pump. The pump is operating continuously while the tractor is in motion but fluid is only admitted to the suction side of the pump when conditions require that the implement is to be raised on the tractor. It will thus be seen that the pump is only in effective operation when oil is actually required to be pumped to the ram cylinder and thus continuous pumping of the oil is avoided, and also any excessive heating and aeration of the oil. When the implement is operated in the ground at a predetermined depth, which has been fixed by the control lever, the valve remains on the dead point until changed from it by variation in the draft or by the operator when he wishes to raise the implement on the tractor.

Under some conditions of operation and in operating some implements there may be an inclination to move the oil control valve more than necessary and thus cause unnecessary pumping of the oil. To avoid this, I provide damping means in connection with the control valve. For example, I provide, as shown at Fig. 4 a cylinder or dash-pot in which the end 14b of the valve 14 acts as a piston, and by providing a very small aperture 30a at the end of the cylinder 30 and trapping oil in the cylinder 30, the piston end 14b will by its movement, either draw oil into, or force oil out of, the cylinder 30 through the small hole 30a with the result that a damping action is given to the valve.

To prevent damage to the mechanism for operating the control valve I may make the lever 19 in two portions 19c, 19d, hinged together as shown in the detail at Figs. 5 and 5a. This lever is of course situated between the valve 14 and the control rod 17, a spring 31 serving normally to hold together the two portions of the lever 19 as shown in Fig. 5a. The arrangement is such that if the operator unduly forces the control, the jointed lever 19, which can only transmit a certain load (depending on the strength of the spring 31,) will, when its load is exceeded, permit of the control lever 15 being moved to the full extent of its travel without damaging the control valve or its mechanism, the excess movement or force applied simply causing the portion 19a to pivot and stretch the spring 31.

An implement such as hereinbefore described is usually transported on a tractor by raising it to a predetermined height above the ground. I provide automatic means connected with the mechanism hereinbefore described for cutting off the supply of fluid to the pump 12 so that when the implement has been raised to a predetermined height it will automatically stop ascending. In the example shown this is accomplished in the following manner:—

When the implement 4 is raised by the mechanism hereinbefore described and shown in the drawings, the ram piston, in moving rearwardly, that is, outwardly, contacts with a projection 17b on the lever 17 (Fig. 2) and in continuing its movement it moves the lever 17 rearwardly, giving a corresponding movement to the valve control rod 18 and lever 19 and so moving the valve 14 to cause it to come to the dead point and close off the supply of oil to the pump. Thus when the implement is being transported no fluid is being pumped, which again provides the desired result that the oil is not being continuously moved by the pump and thereby avoiding heating and aerating as previously mentioned.

A safety valve may if desired be provided somewhere on the pipe line 22 between the pump and the ram cylinder 7^c or on the ram cylinder itself, the spring loaded valve 32 shown in Figs. 1 and 8 on the ram cylinder 7^c serves to protect the system from excessive pressures, the valve being opened by the end of the rod 27 abutting against it, as for example, when the implement strikes an obstruction.

I claim:—

1. A tractor having means for the attachment of an agricultural implement and a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor and valve means on the suction side of said pump whereby the operation of the unit is effected by controlling the admission of operating fluid to the pump.

2. A tractor having means for the attachment of an agricultural implement and having a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor, valve means on the suction side of said pump whereby operation of the unit is effected by controlling the admission of operating fluid to the pump and manual control means for said valve means.

3. A tractor having means for the attachment of an agricultural implement and having a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor, valve means on the suction side of said pump whereby operation of the unit is effected by controlling the admission of operating fluid to the pump, manual control means for said valve means, and means for automatically controlling said valve means in accordance with the draft on the implement.

4. A tractor having means for the attachment of an agricultural implement and having a pressure-fluid control unit, including a pump for raising and lowering the implement with reference to the tractor, valve means on the suction side of said pump whereby operation of the unit is effected by controlling the admission of operating fluid to the pump and means for automatically controlling said valve means in accordance with the draft on the implement.

5. A tractor comprising means for the attachment of an agricultural implement and a pressure-fluid control unit for raising and lowering the implement with reference to the tractor, said unit comprising a fluid pump, a pressure-fluid operable device connected to the pump, means for driving the pump from the tractor-propelling means, valve means on the suction side of the pump for controlling the admission of fluid to the pump, manual control means for the valve means and means for automatically controlling said valve means in accordance with the draft on the implement.

6. In a pressure-fluid control unit for raising and lowering an agricultural implement with reference to a tractor and which includes a pump; valve means for the pump comprising a piston valve, an inlet or suction port and an outlet port spaced therefrom, the valve being of such length that when it is in its mid-position or "dead point" it covers both said ports; and control means for moving said valve to one or other side to raise or lower the implement.

7. For a tractor for agricultural implements, a pump for supplying a pressure fluid for controlling the height of the implement with reference to the tractor, comprising means for driving the pump from the tractor-propelling means and valve means on the inlet side of the pump for controlling the admission of fluid to the pump and thus the operative effect of the pump on the implement.

8. In a tractor having means for the attachment of an agricultural implement and having a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor; valve means on the suction side of said pump whereby operation of the unit is controlled by controlling the admission of operating fluid to the pump, manual control means for said valve means, and means for damping the movement of said valve means.

9. In a pressure-fluid control unit for raising and lowering an agricultural implement with reference to a tractor and which includes a pump; valve means for the pump comprising a piston valve, an inlet or suction port and an outlet port spaced from the inlet port, the valve being of such length that when it is in its mid-position or "dead point" it covers both said ports, and a dash pot for damping the movement of the piston valve.

10. In a tractor having means for the attachment of an agricultural implement and a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor; valve means on the suction side of said pump whereby the position of the implement is controlled by controlling the admission of operating fluid to the pump and pressure-operable safety valve means on the delivery side of said pump.

11. A tractor adapted for the attachment of an agricultural implement and having a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor, valve means on the suction side of said pump whereby operation of the unit is effected by controlling the admission of operating fluid to the pump, manual control means for said valve means, and a lost motion, safety means in said manual control means.

12. In a tractor having means for the attachment of an agricultural implement and a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor; valve means on the suction side of said pump whereby the implement-controlling effect of the unit is controlled by controlling the admission of operating fluid to the pump, and means for cutting off the supply of fluid to the pump when the implement has been raised to a predetermined height.

13. In a tractor having means for the attachment of an agricultural implement and having a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor; valve means at the suction side of said pump whereby operation of the unit is effected by controlling the admission of operating fluid to the pump, manual control means for said valve means, means for damping the movement of said valve means and a pres-

sure-operable safety valve on the delivery side of said pump.

14. A tractor adapted for the attachment of an agricultural implement and having a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor, valve means on the suction side of said pump whereby the position of the implement is controlled by controlling the admission of operating fluid to the pump, a manual and automatic control for said valve means, a lost motion safety means in said control and a pressure-operable safety valve means on the delivery side of said pump.

15. In a tractor having means for the attachment of an agricultural implement and a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor; valve means at the suction side of said pump whereby the operation of the unit is effected by controlling the admission of operating fluid to the pump, pressure-operable safety valve means on the delivery side of said pump and means for cutting off the supply of fluid to the pump when the implement has been raised to a predetermined height.

16. A tractor having means for the attachment of an agricultural implement and having a pressure-fluid control unit, including a pump, for raising and lowering the implement with reference to the tractor, valve means on the suction side of said pump whereby operation of the unit is effected by controlling the admission of operating fluid to the pump, a manual and automatic control for said valve means, a lost-motion, safety means in said control, pressure-operable safety valve means on the delivery side of said pump and means for cutting off the supply of fluid to the pump when the implement has been raised to a predetermined height.

17. A tractor having means for the attachment of an agricultural implement, a pressure-fluid control unit for raising or lowering the implement with reference to the tractor and comprising a fluid pump, means for driving same from the tractor-propelling means, a pressure-operable device having a fluid connection with the pump and a mechanical connection with the implement, a piston valve co-operating with admission and release ports for the pump and of such length that in its mid-position it covers said ports, a manual control for said valve and an automatic control therefor including a member operated by the draft on the implement acting against resistant means, the valve being returned to its mid-position when said pressure-operable device is set in operation due to displacement of the valve to one or other side of said mid-position.

18. A tractor having means for the attachment of an agricultural implement, a pressure-fluid control unit for raising or lowering the implement with reference to the tractor and comprising an oil pump, means for driving same from the tractor-propelling means, a ram device having a fluid connection with the pump and a mechanical connection with the implement, a piston valve co-operating with admission and release ports for the pump and of such length that in its mid-position it covers said ports, a manual control for said valve and an automatic control therefor operated against the action of resistant means by the draft on the implement, a "floating lever" operatively connected at spaced points to the manual control and to the valve, a fulcrum movable in accordance with the draft on the implement against the action of said resistant means and adapted to co-operate with said lever, the arrangement being that when the point of the lever operatively connected to the valve is moved to shift the valve from its mid-position, the resultant movement of the implement by said device causes a variation in draft which moves the fulcrum in such direction that said point of the lever is returned to the position corresponding to the mid-position of the valve which again closes the admission and release ports.

19. A tractor having means for the attachment of an agricultural implement, a pressure-fluid control unit for raising or lowering the implement with reference to the tractor and comprising an oil pump, means for driving same from the tractor-propelling means, a ram device having a fluid connection with the pump and a mechanical connection with the implement, a piston valve co-operating with admission and release ports for the pump and of such length that in its mid-position it covers said ports, a manual control for said valve including a lever consisting of two pivotally connected parts normally retained in a predetermined angular position by spring means and an automatic control for the valve operated against the action of resistant means by the draft on the implement, a "floating lever" operatively connected at spaced points to the manual control and to the valve, a fulcrum movable in accordance with the draft on the implement against the action of said resistant means and adapted to co-operate with said lever, the arrangement being that when the point of the lever operatively connected to the valve is moved to shift the valve from its mid-position, the resultant movement of the implement by said device causes a variation in draft which moves the fulcrum in such direction that said point of the lever is returned to the position corresponding to the mid-position of the valve which again closes the admission and release ports.

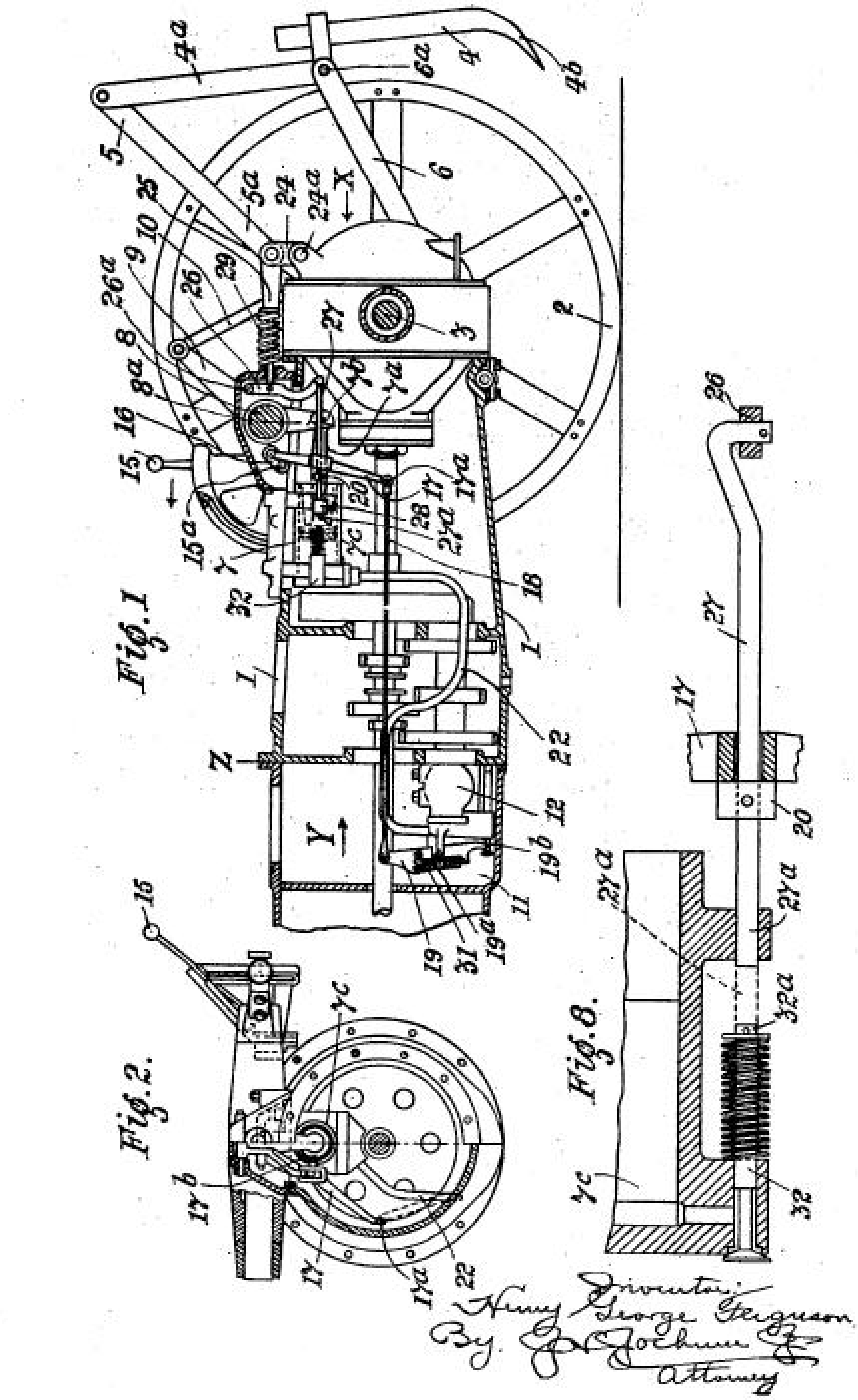
20. A tractor having an agricultural implement pivotally attached by links and comprising spring means for resisting movement of the implement due to the draft thereon and a fulcrum movable in accordance with the displacement of said spring and comprising an oil pressure power unit including a pump driven by the tractor propelling means, a piston and cylinder device hydraulically connected to said pump and mechanically connected to said links, a pressure operable safety valve connected to the discharge side of the pump and a piston valve at the admission side of the pump adapted in its mid-position to cover pump admission and release ports and control means for said valve comprising a manually operable handle connected to one end of a "floating lever" connected at its other end to the piston valve through a lever consisting of two pivotally connected parts retained in a predetermined angular position by spring means, said movable fulcrum being adapted to co-operate with said "floating lever" so that operation of the piston device has for effect to return the piston valve to its mid-position, and said piston having abutment means adapted to return the piston valve to its mid-position when the implement has been raised to a predetermined height on the tractor.

HENRY GEORGE FERGUSON.

May 24, 1938. H. G. FERGUSON **2,118,181**

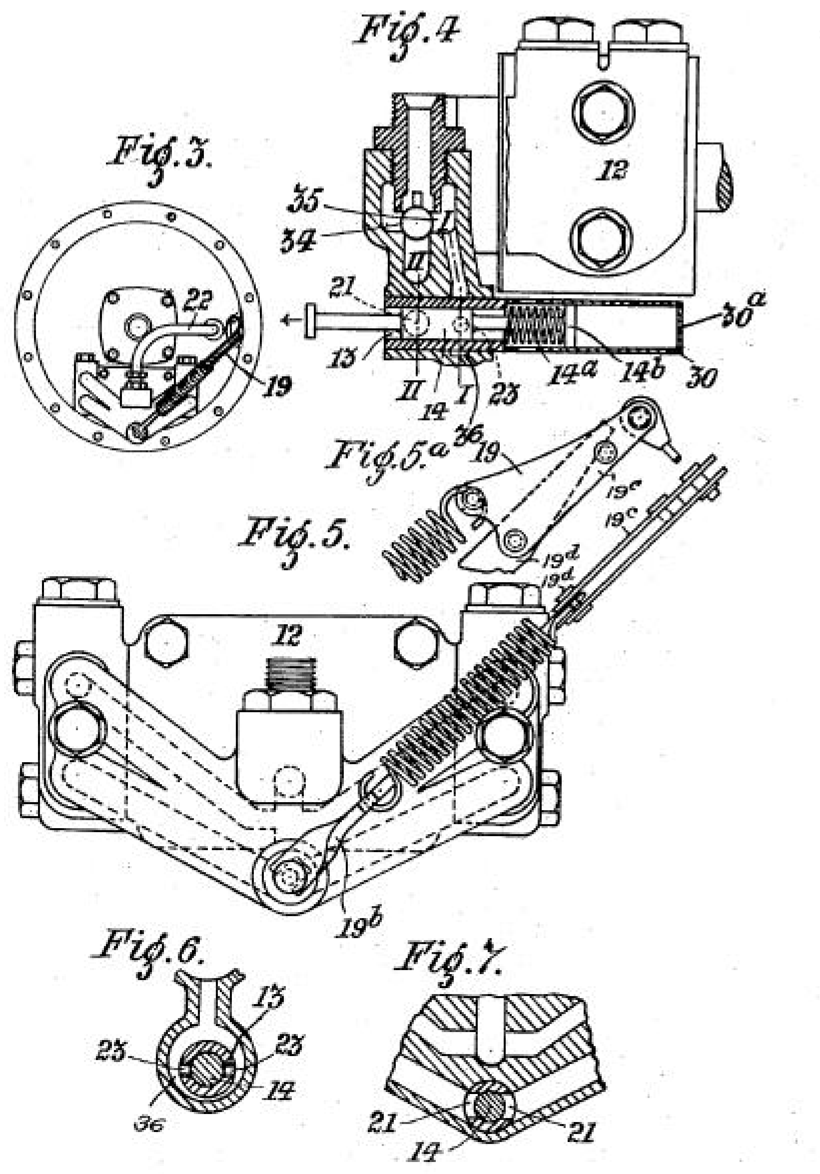
TRACTOR FOR AGRICULTURAL IMPLEMENTS

Filed Jan. 27, 1937 2 Sheets-Sheet 1



TRACTOR FOR AGRICULTURAL IMPLEMENTS

Filed Jan. 27, 1937 2 Sheets-Sheet 2



Inventor:
Henry George Ferguson,
By [signature]
Attorney

Patented May 24, 1938 **2,118,181**

UNITED STATES PATENT OFFICE

2,118,181

TRACTOR FOR AGRICULTURAL IMPLEMENTS

Henry George Ferguson, Belfast, Northern Ireland

Application January 27, 1937, Serial No. 122,610
In Great Britain February 5, 1936

13 Claims. (Cl. 97—50)

This invention relates to improvements in the control of tractor-drawn agricultural implements and more especially to tractors having a power-operated control unit for automatically controlling the depth regulation of the implement as described in my prior patent specification No. 1,687,719.

When an implement is carried as a unit on the tractor as described in my prior patent specification No. 1,687,719, difficulty is encountered due to the fact that when the implement strikes an obstruction such as a root or a rock, the increased draft on the implement puts the power means automatically into operation tending to raise the implement out of the ground. The tendency then is for the implement to be raised out of the ground altogether but it may be so caught underneath a ledge of rock or under a root that it cannot rise. Great downward pressure will therefore be put on the rear wheels of the tractor, which will tend to give them increased traction and lift the front wheels of the tractor off the ground. Thus either the implement or the attachment means may be broken or the front of the tractor may be raised off the ground and turned over backwards, possibly causing a fatal accident.

To overcome these difficulties in accordance with an object of the invention I provide means whereby an excess of draft on the implement due, for example, to striking an obstruction, causes the power unit to be automatically put out of effective operation.

For example, in the case of a fluid pressure control unit for controlling the implement an object of the invention is to provide that an excess of movement in the pump valve, caused by striking the obstruction, will move the valve so far that the release ports will be uncovered and allow the fluid to escape, thus automatically releasing the lifting pressure.

A further object is to provide a pressure-operable safety valve on the delivery side of the pump. This safety valve may serve the two-fold purpose of acting as a safety valve in the ordinary way to prevent excessive pressures and it may also be operable by the implement so that under excessive draft such as is caused when striking an obstruction, the safety valve will be opened and the pressure released as in the case of the above mentioned valve which uncovers the release ports. Thereupon the weight on the rear wheels of the tractor will be automatically reduced, due to the weight of the implement being taken off the tractor and due to the fact that the power-operated control unit is no longer endeavoring to raise the implement. This reduces the tractive effort and the wheels spin or slip on the ground, thus avoiding damage to the implement or connections or danger to the operator through the tractor turning over rearwardly.

The invention will now be described, but by way of example only, with reference to a specific embodiment thereof as shown on the accompanying drawings wherein:—

Fig. 1 is a part longitudinal sectional elevation of the rear portion of a tractor having means provided for hydraulic control of an implement attached to the tractor, the implement being in the raised position.

Fig. 2 is a view partly in section looking in the direction of the arrow X Fig. 1 with the rear axle and crown gear housing removed.

Fig. 3 is a view looking in the direction of the arrow Y, Fig. 1, with the tractor casing removed at the joint Z.

Fig. 4 is a sectional view of the hydraulic control valve and showing its relation to the pump.

Fig. 5 is a front elevation of the hydraulic pump and shows the control valve and connections thereto.

Fig. 5a is a side elevation of a portion of the lever shown in Fig. 5.

Fig. 6 is a sectional view on the line VI—VI, Fig. 4.

Fig. 7 is a sectional view on the line VII—VII, Fig. 4.

Fig. 8 is a part sectional plan view of the ram cylinder showing the arrangement of the safety valve and its operating mechanism.

Referring to the drawings:—

In the example shown in the drawings, 1 denotes the rear portion of the tractor casing, 2 the rear wheels of the tractor, 3 the rear axle of the tractor, 4 denotes the implement and 5 and 6 respectively denote the upper and lower link connections between the tractor and the implement which, in this particular example, is a cultivator. Obviously this may be replaced by any other implement as the occasion demands.

On the tractor and located in front of the rear axle, as shown in Fig. 1, 3 is an hydraulic ram 7, which includes the cylinders 7c and the piston of which is pivotally connected to the connecting rod 7a which, in turn, is pivotally connected at 7b to the arm 8a on the ram shaft 8. Connected to the shaft 8 are two lift arms 9 which, in turn, are connected by two lift rods 10 to the two lower links 6 connecting the frame

4a of the implement 4 with the tractor, the implement 4 being shown in the raised position. Oil is drawn from a tank or sump 11 by a pump 12 which, together with the ram connected to it by the pipe 22, constitutes a power-operated control unit or assembly referred to as a "unit" in the claims for convenience, the pump being continuously driven by the tractor engine while the engine is running. The pump is shown at Figs. 4 and 5 and it is described more specifically in my co-pending application Number 122,609 filed on the 27th of January 1937. In operation the pump delivers oil to the underside of the ball valve 34, shown below the delivery outlet in Fig. 4, to which outlet the pipe 22 is connected. When the pump is in operation, the ball valve is lifted, and the oil has two possible paths, one being through the delivery outlet 46 to the pipe 22 and the ram cylinder 7c, and the other through the by-pass passage 35 to a circular space 36 embracing the sleeve of the piston control valve 14. This sleeve is drilled as at 23 to give a restricted release port opening into the sleeve centre space, the restriction limiting the speed of lowering the implement as later described. The piston valve 14 is provided in the passage 13 which leads to the suction side of the pump. This valve 14 is for controlling the admission of oil, its movements being controlled by a hand lever 15, convenient to the operator, on the tractor. The hand lever 15 is connected with the piston valve 14 as follows:—

Its lower end is mounted on a shaft 15a carrying a crank 16, to the other end of which is pivoted the top end of a lever 17. The lower end 17a of the lever 17 is connected with a rod or wire 18 which, in turn, is connected at its opposite end to a spring loaded lever 19, pivoted at 19a, and forked at its end 19b to engage the head of the valve 14. Movement of the hand lever 15 in the direction of the arrow shown in Fig. 1 will move the end 17a of the lever 17 around a fulcrum 20, the lever being kept in contact with the fulcrum 20 by the spring 14a (Fig. 4) which is provided on one end of the valve 14, such movement of the hand lever causing the valve to move in the direction of the arrow in Fig. 4. The spring 14a also serves to keep looseness out of the mechanism and serves to take up any wear that may arise. Movement of the hand lever 15 in the opposite direction will reverse the movement of the valve.

The implement 4, as previously stated, is pivotally connected to the upper and lower links 5 and 6 by means of its frame 4a. The upper link 5 is connected at its end 5a with a rocker 24 pivoted at 24a to the back of the tractor. The rocker 24 is pivotally connected to a rod 25 on which is mounted a heavy compression spring 29. The rod 25 is pivotally connected at its opposite end to a lever 26 which is pivoted at its upper end 26a to the tractor casing and at its lower end to a rod 27 on which is fastened the fulcrum 20, previously referred to. Beyond the fulcrum 20 the front end of the said rod is slidably supported in a bearing 28. The rod 27 passes through a slot in the lever 17.

As regards the manual control of the implement the arrangement is as follows:—

When the hand lever 15 is moved from the vertical position in the direction of the arrow in Fig. 1, the lever 17 is moved anti-clockwise about the fulcrum 20, moving the rod or wire 18 to the right, which in turn operates the articulated lever 19 thereby moving the valve 14 to the left (Fig. 4) and uncovering the release ports 23 and allowing the oil to escape from the ram cylinder 7c at a slow rate. The piston thus moves slowly into the cylinder 7c under the influence of the weight of the implement which drops gently to the ground, and as a result of the draft which is then imposed on the implement it tends to turn in an anti-clockwise direction about the pivotal connection of the frame 4a. This tendency is resisted by the spring 29 which is compressed by the rod 25 moving to the left, swinging the lever 26 and causing the rod 27 with the fulcrum 20 thereon to swing to the left about its connection to the link 16. This return movement of the lever 17 allows the valve 14 to move to the right and to cover the release ports 23 without moving the hand lever 15 from the position to which it was moved by hand. When the implement reaches the desired depth the valve 14 covers the ports 21 and 23, and it will be seen that the depth is regulated by the position of the lever 15.

Adjustment of the hand lever 15 from the position shown in Fig. 1 (the raised position) moves the top of lever 17 to the left and the implement is lowered as above described. The lowering movement continues until the fulcrum 20 has been moved sufficiently far to the left to allow the valve 14 to close the ports 23 and arrest the lowering movement of the implement. Thus the further the lever 17 is moved to the left by the hand lever 15 the further will the implement be lowered before there has been sufficient movement of the fulcrum to arrest the lowering movement.

To raise the implement, the hand lever 15 is moved back to the vertical position, the bottom end of the lever 17 being moved to the left, thereby moving the rod or wire 18 and lever 19 so that the valve 14 is moved to the right and uncovers the ports 21 which are the inlet ports to the pump, allowing oil to flow to the pump which, operating through the ram and linkage 8a, 8, 9, 10 and 6, raises the implement. As the implement rises, the member 25 (due to the removal of the draft on the implement) is moved by the spring 29 to the right, thereby swinging the lower end of the lever 26 to the right which in turn moves the rod 27 and fulcrum 20 thereon, to the right, bringing the lever 17 to the right therewith, which, operating through the rod or wire 18 and lever 19 moves the valve to the left, so that, when the implement is fully raised, the valve 14 covers the ports 21 and 23, cutting off the supply of oil to the pump and cutting off the escape of oil from the pump, and keeping the implement in the raised position.

I will now describe the action of the automatic control:—Firstly, the control lever 15 is set to give the desired predetermined depth of cut in the ground. As long as the implement is working, and the draft on the implement remains the same, the compression load on the spring 29 will be constant, it being understood that, in operation, the links 5 and 6 are respectively in compression and tension. Under these conditions the valve 14 will remain on the "dead point" or mid-position, that is, with the ports 21 and 23 closed. This position of the valve 14 is shown at Fig. 4, no movement of the oil taking place in either direction and consequently no movement of the ram taking place in either direction.

If, however, the implement 4 is subjected to an increase in draft due, for example, to the front wheels of the tractor rising on a height and pitching the implement more deeply into the ground, such increase will instantaneously be transmitted to the rod 25, causing an increase in the pressure thereon, which, in turn, will cause the rod to compress the spring 29 further. At the same time the lever 26 will be moved about its pivot 26a with a resultant movement of the rod 27 and the fulcrum 20 thereby permitting the lever 17 to move to the left in Fig. 1, that is, forwardly under the action of the spring 14a on the valve 14. This forward movement of the lever 17 through the rod 18 will cause a corresponding movement of the spring loaded lever 19 which will allow the spring 14a to move the valve 14 rearwardly thus uncovering the suction ports 21 so that oil will be admitted to the pump 12, which then will pump the oil to the ram cylinder 7c and the ram piston will be moved outwardly and will raise the implement in the manner already described. When the implement has been raised to a point where the draft thereon again reaches the predetermined amount, to give the necessary depth of cut, the spring 29 reacts and brings the valve 14 back again to the "dead point" with both ports 21 and 23 closed.

If the implement be subjected to a reduction in draft, due, for example, to the front wheels of the tractor dropping into a hollow and so raising the implement relatively to the ground and thus making it cut too shallow, the action upon the spring 29 will be reversed and the valve 14 will be moved in a forward direction. This will open the restricted release ports 23, allow oil to flow back from the ram cylinder and allow the implement to fall back to the predetermined depth of cut. When the predetermined depth has been reached the control valve 14 will come back again to the "dead point" under the action of the increased draft as previously described.

When the ground engaging part 4b of the implement strikes an obstruction such as a root or a rock, the increased draft on the implement will, as previously described, put the hydraulic pump 12 into operation, tending to raise the implement out of the ground. The tendency then is for the implement 4 to be raised out of the ground altogether but it may be so caught underneath a ledge of rock or under a root that it cannot rise. Great pressure will therefore be put upon the rear wheels 2 of the tractor tending to give them increased traction and lift the front wheels of the tractor off the ground with the disadvantages hereinbefore referred to.

These difficulties are overcome when the implement is subjected to an excess of draft, due to such an obstruction, by providing that an excess of movement caused by excessive draft and transmitted from the implement 4 through the link 5 to the rod 25 against the action of the spring 29 will cause corresponding excess of movement of the lever 26, which excess of movement will be communicated to the rod 27 and so to the valve 14 as previously described.

The excess of movement of the valve 14 in a direction opposite to the arrow shown in Fig. 4 will carry the said valve right back until it uncovers the release ports 23, allowing the oil to escape from the ram cylinder thus automatically putting the power device out of effective operation. When the oil pressure has been thus released the weight of the implement is no longer carried on the tractor since it will no longer have the support thereof. This reduction in weight on the tractor wheels reduces the traction on the wheels 2 to the slipping point and the wheels will spin harmlessly.

An alternative or additional means for producing the desired result is shown in Figs. 1 and 8. As before, the excess of draft produces an excess of movement on the lever 26 and a corresponding excess of movement of the rod 27, the end 27a of this rod then comes into contact with the end 32a of the safety valve 32 provided on the ram cylinder 7c. The safety valve is then opened and the oil from the ram cylinder 7c is free to escape into the surrounding casing thus relieving the tractor of the weight of the implement with the results previously described.

Referring again to the example shown in the drawings it may be stated that the safety valve 32 serves a two-fold purpose. It acts, as described to automatically put the power device out of effective operation when the implement encounters an obstruction and it also serves as a safety valve in the ordinary way to prevent excess of pressure in the system.

A damping action on the control valve 14 is effected by a dash pot 30 having a small aperture 30a and which is adapted to receive the piston 14b formed on the valve 14.

To prevent damage to the mechanism for operating the control valve I may make the lever 19 in two sections 19c and 19d hinged together as shown in detail in Figures 5 and 5a. This lever is of course situated between the valve 14 and the control rod 17, a spring 31 serving normally to hold together the two portions of the lever 19 as shown in Fig. 5a. The arrangement is such that if the operator unduly forces the control, the jointed lever 19, which can only transmit a certain load (depending upon the strength of the spring 31) will, when the load is excessive permit of the control lever 15 being moved to the full extent of its travel without damaging the control valve or its mechanism, the excess movement or force applied simply causing the portion 19a to pivot and stretch the spring 31.

An implement such as hereinbefore described is usually transported on a tractor by raising it to a predetermined height above the ground; I provide automatic means connected with the mechanism hereinbefore described for cutting off the supply of fluid to the pump 12 so that when the implement has been raised to a predetermined height it will automatically stop ascending. In the example shown this is accomplished in the following manner:—

When the implement 4 is raised by the mechanism hereinbefore described and shown in the drawings, the ram piston in moving rearwardly, that is outwardly, contacts with a projection 17b on the lever 17 (Fig. 2) and in continuing its movement it moves the lever 17 rearwardly, giving a corresponding movement to the valve control rod 18 and lever 19 and so moving the valve 14 to cause it to come to the "dead point" and close off the supply of oil to the pump. Thus, when the implement is being transported no fluid is being pumped.

I claim:—

1. In a tractor having means for the attachment of an agricultural implement and a power-operated control unit for moving said implement up and down with reference to the tractor; means for manually controlling said unit, and means automatically rendered operable by the implement for putting said unit out of effective op-

eration when there is an excess of draft on the implement.

2. A tractor comprising means for the attachment of an agricultural implement, a unit embodying power means for moving said implement up and down with reference to the tractor and means operable by the implement for putting said power means out of effective relationship with the implement when there is an excess of draft on the latter.

3. For a tractor having means for the attachment of an agricultural implement and power means for moving said implement into and out of active position with relation to the tractor, mechanism for controlling said power means, and a plurality of means for controlling the said mechanism, one of the last said means being itself controlled by the implement when there is an excess of draft on the latter, to render the said power means ineffective with relation to the implement.

4. In a tractor having means for the attachment of an agricultural implement and a power-operated control unit comprising a pump and a device operable by pressure fluid from the pump for moving the implement up and down with reference to the tractor; valve means operable by the implement for relieving the fluid pressure on said device when there is an excess of draft on the implement.

5. In a tractor having means for the attachment of an agricultural implement and a power-operated control unit comprising a pump and a device operable by pressure fluid from the pump for moving the implement up and down with reference to the tractor; valve means on the delivery side of the pump and operable by the implement for relieving the fluid pressure on said device when there is an excess of draft on the implement.

6. In a tractor having means for the attachment of an agricultural implement and a power-operated control unit comprising a pump and a device operable by pressure fluid from the pump for moving the implement up and down with reference to the tractor; a piston valve, admission and outlet ports for the pump so spaced that the piston valve covers said ports when in its mid-position and means operatively connecting the piston valve and the implement so that when the implement is subjected to an excess of draft the piston valve is moved until the end thereof remote from the outlet port has uncovered same.

7. For a tractor for drawing an agricultural implement, a power-operated control unit having means for operating same in accordance with the draft on the implement to maintain the latter at a predetermined depth of cut, said means being adapted to render said unit inoperative when the implement is subjected to an excessive draft.

8. In a tractor having means for the attachment of an agricultural implement and a power-operated control unit comprising a pump and a device operable by pressure fluid from the pump for moving the implement up and down with reference to the tractor; valve means operable by the implement in accordance with the draft thereon for relieving the fluid pressure on said device when the implement is subjected to an excessive draft and a pressure-operable safety valve in the control unit to protect same from excessive pressure.

9. In a tractor having means for the attachment of an agricultural implement and a power-operated control unit comprising a pump and a device operable by pressure fluid from the pump for moving the implement up and down with reference to the tractor; a piston valve, admission and outlet ports for the pump so spaced that the piston valve covers said ports when in its mid-position and means operatively connecting the piston valve and the implement so that when the implement is subjected to an excess of draft the piston valve is moved until the end thereof remote from the outlet port has uncovered same, a pressure-operable safety valve in the control unit to protect same from excessive pressure and means movable by the implement for opening said safety valve when the implement is subjected to an excessive draft.

10. A tractor and an agricultural implement attached thereto, said tractor comprising a member movable against the action of resistant means in accordance with the draft on the implement, a power unit for raising and lowering the implement on the tractor and means for rendering said unit inoperative, said means being controlled by said member so that, when said member is moved excessively due to an excess of draft on the implement, the power unit is rendered inoperative.

11. A tractor and an agricultural implement attached thereto, said tractor comprising a member movable against the action of spring means in accordance with the draft on the implement, a pressure-fluid power unit for raising and lowering the implement on the tractor, and including a pump driven by the tractor-propelling means, a piston valve, admission and outlet valves for the pump so spaced that the piston valve covers said ports when in its mid-position, and operating means for said valve, said means being controlled by said member so that, when said member is excessively moved due to an excess of draft on the implement, the valve is moved until the end remote from the release port uncovers same.

12. A tractor and an agricultural implement attached thereto, said tractor comprising a member movable against the action of spring means by the implement in accordance with the draft thereon, a pressure-fluid power unit for raising and lowering the implement on the tractor including a pump driven by the tractor-propelling means, a piston valve, admission and outlet valves for the pump so spaced that the piston valve covers said ports when in its mid-position, and operating means for said valve, said means being controlled by said member so that, when said member is excessively moved due to an excess of draft on the implement, the valve is moved until the end remote from the release port uncovers same, and comprising a pressure-operable valve on the delivery side of said pump adapted also to be opened by said member when there is an increase of draft on the implement.

13. A tractor and an agricultural implement attached thereto by links, said tractor comprising a rod with a fulcrum thereon movable against the action of spring means by the implement in accordance with the draft thereon, a power unit for raising and lowering the implement on the tractor automatically in accordance with the draft on the implement and including an oil pump and a piston and cylinder device hydraulically connected to the pump and mechanically connected to at least one of said links, a piston valve, admission and release ports for the pump so spaced that the piston valve covers said ports when in its mid-position, operating means for

the valve including spring means urging the valve towards the release port and a "floated lever" connected at one end to the valve and at its other to a manual control and a pressure-operable valve on the cylinder, said floating lever being allowed to move by said fulcrum, when same is excessively moved due to an excessive draft on the implement, so that said spring moves the piston valve until the end remote from the release port uncovers same, said rod also opening the pressure-operable valve when there is said excessive draft on the implement.

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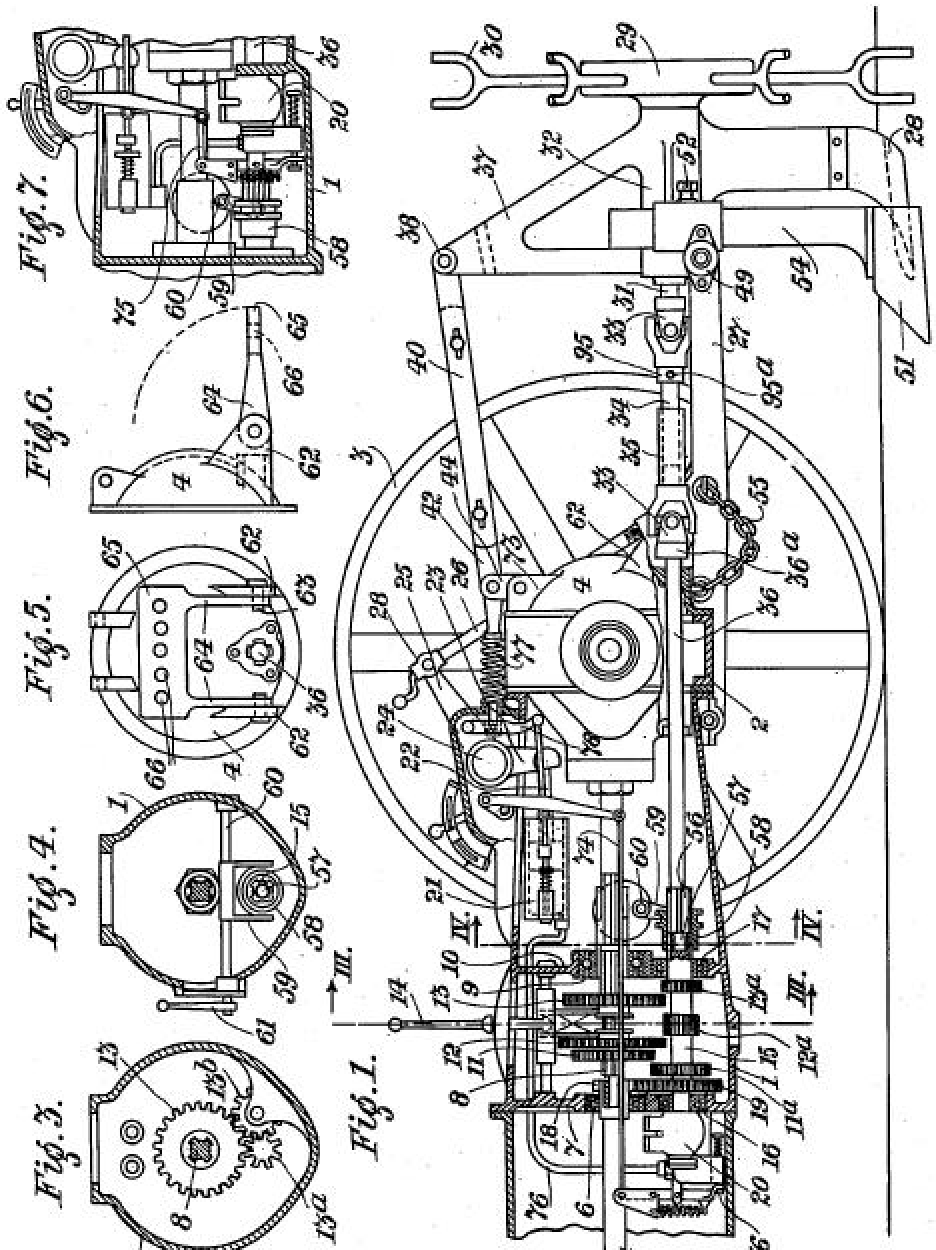
Nov. 26, 1940. H. G. FERGUSON 2,223,002

TRACTOR IMPLEMENT

Filed Nov. 30, 1936 2 Sheets-Sheet 1



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TRACTOR IMPLEMENT

Filed Nov. 30, 1938 2 Sheets-Sheet 2

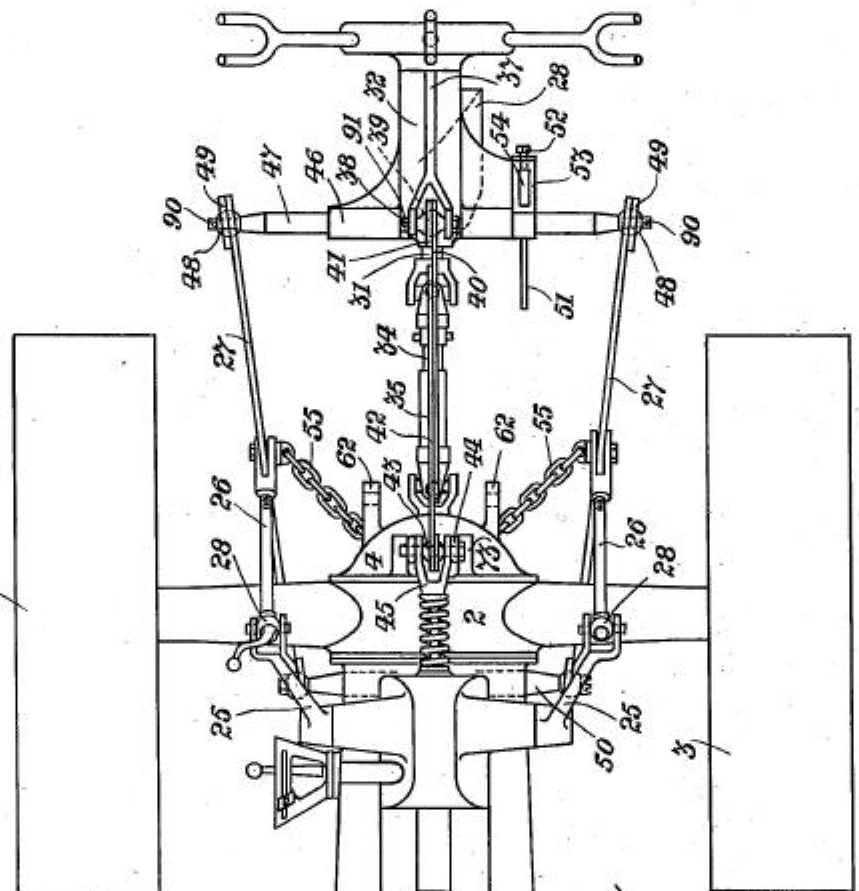

Fig. 2.

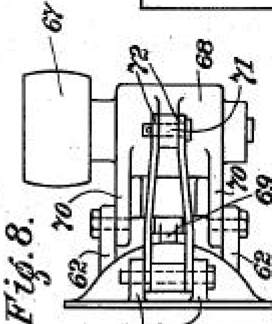

Fig. 8.

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UNITED STATES PATENT OFFICE

2,223,002

TRACTOR IMPLEMENT

Henry George Ferguson, Belfast, Northern Ireland

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In Great Britain November 30, 1937

17 Claims. (Cl. 97—50)

This invention relates to tractors and/or agricultural implements for attachment to tractors and having moving parts requiring a drive such as, for example potato diggers, mowers and the like.

Hitherto such implements as potato diggers, for example, which are adapted to penetrate the soil, were driven through the medium of land wheels or whilst having land wheels may have been driven by a power take-off from the tractor. The wheels were also used for regulating the depth and for transporting the implement. When a power take-off was used from the tractor the land wheels were not used to drive the potato digging machinery, but they were used for depth regulation and transport. With either system such implements as potato diggers were heavy and costly to manufacture, and were not adaptable to small fields because they were made as a separate unit from the tractor and trailed behind it, thus making it impossible to reverse the tractor into small spaces without damage to the implement.

In like manner such implements as mowers, which do not penetrate the soil, were similarly carried on wheels and usually driven therefrom, or in some cases, whilst having land wheels, were driven from the tractor by means of a power take-off. These machines were also heavy and complicated in design and costly to manufacture. Where they were made as a separate unit from the tractor they were not easily adaptable to small fields, and where they were made as a unit with the tractor they could not be quickly attached and detached, and required considerable manual labour to raise and lower them on the tractor.

An object of the invention is to provide a tractor upon which an implement such as a potato digger, mower or other implement having moving parts requiring a drive can be closely supported without the use of land wheels on the implement.

A further object is to provide an arrangement allowing free vertical and/or lateral movement of such implement on the tractor and to provide a power take-off transmission for driving said moving parts without impeding said movement.

A further object is to provide a tractor having a power unit for raising and lowering such implements on the tractor and for automatically controlling the working depth of ground-penetrating implements such as potato diggers in accordance with the draft soil pressure on the implements.

In accordance with a further object, for the quick and easy attachment of the type of implements having a moving part or parts requiring a drive I provide attachment means comprising spaced links and a power transmitting shaft or the like all arranged to allow relative vertical and/or lateral movement and such as will greatly reduce the weight and simplify the construction so that manufacturing and operating costs can be reduced. The implements are made to operate as a unit with the tractor, and are easily operated in very small spaces. Furthermore I provide that the implements can be raised or lowered on the tractor with the greatest ease.

Further objects of the invention will be seen from the following specific description.

The invention will now be described by way of example with reference to the accompanying drawings in which:

Fig. 1 is a part sectional elevation of a tractor with a potato digger attached thereto.

Fig. 2 is a corresponding plan view.

Fig. 3 is a sectional view on the line III—III of Fig. 1.

Fig. 4 is a sectional view on the line IV—IV of Fig. 1.

Fig. 5 is an elevation looking from the rear on the end cap of the tractor casing and showing a hinged draw bar.

Fig. 6 is a corresponding side elevation.

Fig. 7 is a sectional view of a modified pump arrangement.

Fig. 8 is a plan view of the end cap showing a belt pulley attachment.

Referring to the drawings, the numeral 1 represents the rear casing of the tractor to which is attached a housing 2 containing a straight or spiral bevel gear and a differential gear (not shown) for imparting the drive to the traction wheels 3. An end plate or cap 4 is in turn attached to the housing 2.

The casing 1 contains a variable speed gear consisting of an engine-driven primary shaft 5 mounted at its end in a bearing 6 in the partition 7. The shaft 5 is socketed at the end to provide a bearing for an independently rotatable third motion shaft 8 supported intermediate its length on a bearing 9 in the partition 10, said shaft 8 driving the straight or spiral bevel gear and differential gear abovementioned. Spur gear wheels 11, 12 and 13 are slidably mounted on the shaft 8 and adapted to engage in known manner under control of the gear lever 14 with corresponding spur wheels 11a, 12a and 13a on the second motion or lay shaft 15 to give different forward gear ratios and reverse drive. As shown more clearly in Fig. 3 the reverse drive is obtained from the wheel 13ᵃ which engages an idler wheel 13ᵇ which in turn engages the wheel 13.

The second motion or lay shaft 15 is mounted in the bearings 16 and 17 and is constantly driven through a reduction gear consisting of spur wheels 18, 19 from the primary shaft 5.

Mounted on the inner end of the shaft 15 and constantly driven thereby is an oil pump 20 which forms part of an arrangement for hydraulically raising and lowering the implement and also for automatically controlling the depth of cut of the implement in accordance with the draft pressure. The hydraulic control arrangement operates on the general principle set forth in my prior Patent No. 1,687,719 and is constructed and arranged as set forth in my prior Patents Nos. 2,118,180 and 2,118,181. It is therefore not necessary to describe in detail the hydraulic control arrangement and it will be sufficient to note that 21 is an hydraulic ram whose connecting rod 22 is connected to the arm 23 on the shaft 24 which carries two lift arms 25 connected by adjustable rods 26 to links 27, the upper connection of the rods 26 consisting of universal ball joints 28. It will thus be seen that outward movement of the ram piston will raise the links 27 while inward movement will lower same.

The implement shown is a potato digger comprising the usual share 28 for loosening up the potatoes and the usual rotary digger 29 with fork-shaped digging arms 30 for throwing up the potatoes. The digger 30 is mounted on a driving shaft 31 in the frame 32, said shaft being attachable through a Hooke's joint 33 to a shaft 34 having telescopic driving engagement with a hollow shaft 35 connected by a similar Hooke's joint 33 with a power take-off shaft 36 at the rear of the tractor. The ends of the shafts 31 or 36 or the ends of both are splined to give a quickly attachable and detachable connection with a corresponding socket in the joints 33 after the removal of fixing means, for example, cross pins, to prevent disengagement while in use, and there may be reduction gearing between the shaft 31 and the spinner 29. The frame or body 32 has a vertical projection 37 forked at the top to receive the pin bearing 38 for a ball member 39 on which is universally mounted the end of a link 40 and a retaining plate 41. A further link 42 is attached by bolts and slots to link 40 thus forming a composite upper link of adjustable length, the link 42 being similarly attached by the universal joint 43 to the links 44 pivoted on lugs 73 on the end plate 4 and to the draft-sensitive element 45. The frame 32 has also a transverse sleeve 46 adapted to receive a transverse shaft 47, the reduced ends of which are adapted to form bearings for balls 48 on which the ends of the lower laterally spaced links 27 are universally attached by plates 49. In a similar manner the inner ends of the links 27 are universally attached to the ends of lateral projections 50 under the casing 1.

It will thus be seen that the implement is adapted for three point universal connection to the tractor through the upper composite link 40, 42 and the lower laterally spaced links 27. This connection is in accordance with my prior Patent No. 1,464,130 the forward convergence of the link 40, 42 with respect to the lower links 27 creating a line of draft on the implement tending to keep the latter in the ground. The connection is also in accordance with my prior Patent No. 1,916,945, the links 27 being forwardly convergent so that their axes, if produced, would meet at a point at, or about, the front axle of the tractor. As a result of this arrangement of linkage, the implement and tractor function as if the implement were attached at said point, and consequently should the tractor be turned to the left or the right, the implement is immediately turned in the same direction.

Owing to the convergence of the links 27 the implement does not swing with a parallel movement and the outwardly swinging side approaches the tractor relatively more than the other side which recedes relatively from the tractor. In order to minimise the consequent increase or decrease in length of the composite driving shaft 34, 35 the power take-off shaft 36 and the driving shaft are centrally located. This arrangement has the further advantage that the rotatable driving shaft 34, 35 is protected by the links 27 and also by the links 40, 42 from causing damage or being damaged by coming into contact with any object. Further, the links 40, 42 prevent the operator from falling on to the shaft 34, 35 should the seat break, this not being an infrequent occurrence with certain types of seats.

The potato digger is also provided with guiding means to give an automatic self centering effect as set forth in my pending application No. 121,878 of 22nd January, 1937. This means consists of a fin 51 having a vertical, resilient stem 54 near the rear thereof, said stem being secured by a set screw 52 in a slot 53 in the frame 32, this arrangement permitting vertical adjustment of the fin 51. Owing to the resilience and disposition of the stem 54 the fin is capable of deflection about an axis near the rear thereof and so gives the automatic steering or self-centering effect described in the said pending application.

Chains 55 are provided which are connected to the bottom of the end cap 4 and to the links 27 as shown. When the implement is in the working position as shown in Fig. 1, the chains 55 are slack and thus permit a limited amount of lateral swinging movement of the implement. When, however, the implement is raised the chains are straightened out and automatically centre the implement with respect to the tractor and reduce or eliminate lateral swinging movement of the implement and at the same time restrict or eliminate further upward movement of the implement with reference to the tractor.

The power take-off shaft 36 is splined at the inner end 56 and is formed with a reduced part 57 rotatably engaging in the recessed end of the lay shaft 15 which is similarly splined. The said shafts 15 and 36 are engageable and disengageable by means of a sliding splined collar 58 operable in usual manner by a fork 59 mounted on a transverse shaft 60 (Fig. 4) which is operable by a hand lever 61 located at the side of the casing 1. It will be seen that as a result of the shaft 15, being in constant engagement with the engine shaft 5, it is possible to obtain a constant ratio drive for the power take-off shaft 36 as long as the engine is running and irrespective as to whether the tractor is in gear or not. The same applies to the pump 20.

The outer end of the shaft 36 is also splined as above described or similarly adapted to have a driving, slidable connection with the coupling element 36ᵃ of the Hooke's joint. Thus the telescopic shaft 34, 35 can be readily engaged with or disengaged from the shaft 36 when attaching or detaching the implement.

As shown more clearly in Figs. 5 and 6 the end cap 4 has two apertured lugs 62 to which a draw bar device is pivotally attached by pins 63. The device comprises two apertured arms 64 having a transverse interconnecting bar 65 with a series of holes 66 therein for the attachment of a drawbar. When not required this device can be hinged upwardly into the position shown in Fig. 5 and catch or other means for holding it in this position may be provided. The device may be used for hauling carts or implements or the like which have to be kept clear of the tractor wheels 3. It will be seen that the hinge axis of the device is in alignment with the front universal joint 33.

As shown in Fig. 8 the lugs 62 may also be used for the attachment of a device adapted to be operated by the power take-off shaft 36. The device shown in Fig. 8 consists of a belt pulley 67 mounted in a casing 68 containing bevel or worm gearing for driving the pulley from the shaft 69 which is adapted for slidable driving engagement with the splined end of the power take-off shaft 36. The casing 68 has apertured lugs 70 for engagement with the lugs 62 and has a top projection 71 connected by a pin with a double link 72 which is attached by a pin to the spaced apertured lugs 73 on the top of the end cap 4. The pulley 67 can be used for imparting a belt drive to any machine requiring such drive, for example, to a threshing machine. Obviously the pulley could be replaced by another driving element, for example, by a winding drum for haulage, mole draining or analogous purposes.

As shown in Fig. 1 the pump 20 is located at the inner end of the lay shaft 15 but it will be understood that it may be located on any other suitable part of this shaft or on the power take-off shaft 36 which may be regarded simply as an extension of the lay shaft. For example as shown in Fig. 7 the pump 20 is located on the inner end of the power take-off shaft 36, the coupling sleeve 58 in this case being located between the pump 20 and the lay shaft 15 so that the pump is engageable or disengageable with the layshaft. The arrangement of the hydraulic control mechanism is substantially the same except that the cable 74 (Fig. 1) is replaced by a short link 75 (Fig. 7) and the oil conduit 76 between the pump 20 and the ram 21 is shortened.

As previously mentioned the hydraulic mechanism for raising and lowering the implement and for automatically controlling the depth of operation is the same as that disclosed in my prior Patents 2,118,180 and 2,118,181. It thus embodies the valve 76 located on the suction side of the pump for controlling the admission of oil to the pump and adapted to release the oil from the ram 21 when there is an excess of draft on the implement. As explained in said two prior patents the draft pressure on the implement causes a thrust on the upper link 40, 42 which is transmitted against the resistant spring 77 to the lever 78 which, as described, controls the operation of the valve 76 which is also additionally controlled by the hand lever 78.

The example in the drawings shows a potato digger, which being a ground-penetrating implement, is advantageously subjected to the automatic depth control. It will be understood, however, that implements such, for example, as mowers which do not penetrate the ground may also be connected to the tractor in the manner shown. With such implements there is no substantial draft pressure thereon giving a thrust on the link 40, 42 and thus the automatic depth control arrangement is caused to remain dormant by suitable setting of lever 78 but it will be seen that if the implement meets an obstruction a draft pressure may be created which is sufficient to operate the valve 76 and release the oil pressure, in the manner described in said prior Patents 2,118,180 and 2,118,181. The telescopic shaft is located within the triangular disposition of the links.

The arrangement shown provides for rapid attachment and detachment of the implements. For example, to detach the implement shown it is only necessary to remove the split pins 90, 91 (Fig. 2) whereupon the links 27 can be slid off the shaft 47 and the pin 38 can be withdrawn, thus completely detaching the implement.

A safety device is provided in the power take-off to prevent damage, as for example, when the driven element or elements of the implement strikes an obstruction. In the example shown this device takes the form of a shearing pin 95ᵃ between the shaft 34 and the sleeve 95 of the Hooke's joint, but may be a safety clutch or equivalent device.

The invention has been described with reference to a potato digger but it will be understood that any other implement having parts requiring a drive can be used, for example, a mower, there being, if necessary, gearing in the implement to impart the necessary rotary or oscillating movement, which gearing if necessary will include any convenient means for converting rotary motion into reciprocating or oscillating movement.

In the following claims the word "flexible" as applied to the telescopic or equivalent shaft is to be understood as also including a shaft as shown, that is a rigid shaft deriving flexibility from universal joints therein.

What I claim is:

1. In a tractor for agricultural implements including a prime mover, traction wheels, a variable speed gear between said prime mover and traction wheels and having a second motion or layshaft in constant engagement with the prime mover, and a pressure-fluid-operated unit for raising and lowering the implement and having a pump for the fluid; a power take-off driven by said layshaft and a driving connection between said pump and layshaft, the power take-off and pump being driven so long as the prime mover is running and irrespective of whether the tractor is moving.

2. A tractor as claimed in claim 1, in which the pump is mounted on one end of the layshaft and coupling means is provided at the other for connecting the layshaft with a power take-off shaft.

3. In combination a tractor including a prime mover, traction wheels and a variable speed gear between the prime mover and the wheels, an implement including movable members adapted to be driven, and means for attaching the implement to the tractor comprising laterally spaced links, universal means for attaching the links to the implement and tractor so that the links converge forwardly and the implement closely follows the steering of the tractor, a further link vertically spaced from the first links and forwardly convergent thereto to create a line of draft tending to keep the implement in or on

the ground, universal means for connecting said link to the implement and the tractor, the arrangement permitting vertical and lateral movement of the implement with reference to the tractor, a power take-off shaft located within said laterally spaced links, and a flexible telescopic coupling for connecting said shaft and movable member without hindering said vertical and lateral movement of the implement and located within said laterally spaced links to minimise variation in the length of said coupling due to lateral swinging of the implement and to protect the coupling against striking any object.

4. The combination as claimed in claim 3, in which said gear comprises a primary shaft driven by the prime mover, a centrally located layshaft in constant engagement with the primary shaft, and the power take-off shaft and coupling are in alignment with said layshaft so that the coupling is centrally located within the laterally spaced links, and clutch means is provided for detachably connecting the layshaft and power take-off shaft.

5. A tractor having a power take-off shaft, means on said shaft at the rear of the tractor for the attachment of a universally jointed shaft, spaced attachment means at the rear of the tractor, and a drawbar device pivotally connected to said means so as to be capable of vertical movement about a horizontal axis substantially in lateral alignment with a universal joint of said jointed shaft said device having means spaced rearwardly of said axis to provide a laterally pivotal connection for an implement.

6. In combination a tractor, an agricultural implement, and hitch means for detachably connecting the implement to the tractor, the implement comprising movable working members and a drive-obtaining element for driving same and triangularly spaced attachment means; the tractor comprising an engine-driven primary shaft, traction wheels, a variable speed gear between said shaft and wheels, a second motion or layshaft in said gear in constant engagement with said primary shaft, a power take-off shaft in alignment with the layshaft and extending to the rear of the tractor, clutch means for coupling the inner end of the power take-off shaft to the layshaft and a drive-imparting element at the outer end of the power-take-off shaft, an hydraulic power unit for raising and lowering the implement on the tractor including a pump driven by the layshaft and triangularly spaced attachment means at the rear of the tractor, and said hitch conection comprising an upper link and two lower spaced links universally connected by said attachment means to the tractor and implement, which attachment means is so spaced that the links are forwardly convergent and the implement is capable of vertical and/or lateral movement with reference to the tractor and a telescopic transmission shaft connecting the said drive-imparting and drive-obtaining elements and including at least two spaced universal joints thereon to permit of said movement.

7. A combination as claimed in claim 6, in which said transmission shaft comprises a safety element adapted to yield under a predetermined load.

8. The combination as claimed in claim 6, in which stop means is provided between the tractor and the lower links to limit the lateral and vertical movement of the implement and to centre the implement on the tractor when raised to the upper limit.

9. In combination a tractor, an implement such as a potato digger, mower or the like, and a hitch and power drive connection for detachably connecting and entirely supporting the implement on the tractor without the necessity of land wheels on the implement, the tractor comprising an engine-driven primary shaft, a variable speed gear box including a layshaft at the bottom, reduction gearing constantly connecting same with the primary shaft, a third motion shaft in alignment with the primary shaft, slidable variable forward and reverse drive gear wheels between the layshaft and the third motion shaft, traction wheels, bevel and differential gearing between said third motion shaft and the traction wheels, a power take-off shaft in alignment with the layshaft and passing to the rear of the tractor, slidable clutch means between the layshaft and power take-off shaft and a splined rear end on the power take-off shaft, a power unit on the tractor for raising and lowering the implement including a pump, the pump being located on the forward end of the layshaft and an end cap comprising two upper closely spaced apertured lugs an dtwo lower wider spaced apertured lugs; the implement comprising a frame bearing a shaft with a slidable engagement clutch element thereon, a rotary or reciprocating working element connected to said shaft, upper lug means to receive a pin adapted to carry a ball member, a lower cross shaft with reduced ends to slidably receive ball members and a socket to receive the resilient stem of a ground-engaging fin projecting forwardly of the stem; the hitch connection comprising an upper longitudinally adjustable link having ball members at the ends respectively supported on said implement upper lug means and on the closely spaced lugs on said end-cap, two laterally spaced links having ball members at the ends supported on the reduced ends of said cross shaft and on lateral projections on the tractor, a chain connecting each of said last mentioned links with the tractor and a power transmission shaft having end clutch elements slidably engaging the clutch elements on the power take-off shaft and the implement, two universal joints on said transmission shaft, a telescopic part thereon and a shearing pin on said power transmission shaft.

10. A tractor for the attachment of an agricultural implement including movable working elements, comprising in combination at the rear thereof, three substantially triangularly spaced attachment elements for the universal attachment of hitch links, and a power take-off located within said triangularly spaced elements.

11. An agricultural implement for attachment to a tractor which includes a power take-off, said implement comprising three triangularly and laterally and vertically spaced members for the universal attachment of hitch links, movable working means and a drive-obtaining element connected to said means for detachable connection with the power take-off and attachment means for a ground-engaging steering fin.

12. An agricultural implement for attachment to a tractor which includes a centrally or substantially centrally located power take-off, said implement comprising three triangularly and laterally and vertically spaced members for the universal attachment of hitch links, a movable work-

ing member and a drive-obtaining element connected to said member for detachable connection with the power take-off, said element being located centrally or substantially centrally within parallel longitudinal vertical planes containing the laterally spaced members for the attachment of the hitch links.

13. An agricultural implement as claimed in claim 12, in which said drive-obtaining element is located on the central vertical plane within the triangularly spaced members.

14. The combination as claimed in 6, comprising control means for the power unit connected with the implement and sensitive to variations in the draft of the implement from a predetermined normal magnitude and causing the power unit to function on the occurrence of such draft variations to correct same and consequently the variations in the working depth of the implement.

15. In combination an agricultural tractor and an attachment device, said tractor comprising in combination at the rear thereof three substantially triangularly spaced attachment elements for the universal attachment of hitch links and a rearwardly directed power take-off shaft located within said spaced elements and normally adapted for driving implements such as potato diggers having a driven member or members, and attachment means on the rear of the tractor for attachment of the attachment device; said attachment device comprising attachment means for engagement with the attachment means on the tractor whereby the device is wholly supported on the tractor, a driven element such as a pulley rotatable about an axis out of alignment with the power take-off shaft, a rotatable coupling element supported in engagement with the power take-off shaft by said attachment means, and gearing means between said driven element and the rotatable coupling element.

16. A tractor for the attachment of an agricultural implement including movable working elements, comprising in combination at the rear thereof, three substantially triangularly spaced attachment elements for the universal attachment of hitch links, and a power take-off shaft located within the two parallel longitudinal vertical planes containing the two outer attachment elements.

17. A tractor for the attachment of an agricultural implement, comprising an engine-driven primary shaft, traction wheels, a variable speed drive between said shaft and wheels which comprises a second motion or lay shaft below said primary shaft and in constant engagement therewith, a third motion shaft in axial alignment with said primary shaft, a differential gearing between said third motion shaft and traction wheels, casing means enclosing said shafts and differential gearing and extending to the rear of the tractor, a power take-off shaft in axial alignment with said lay shaft and passing within said casing means and below the differential gearing to the rear of the tractor where it projects through the casing means, and a pressure-fluid operated unit for raising, lowering, and supporting the implement and including a pump for the fluid, said pump being arranged in alignment with and driven from the end of the lay shaft remote from the power take-off shaft.

HENRY GEORGE FERGUSON.

May 13, 1941. L. S. SHELDRICK 2,241,677

TRACTOR

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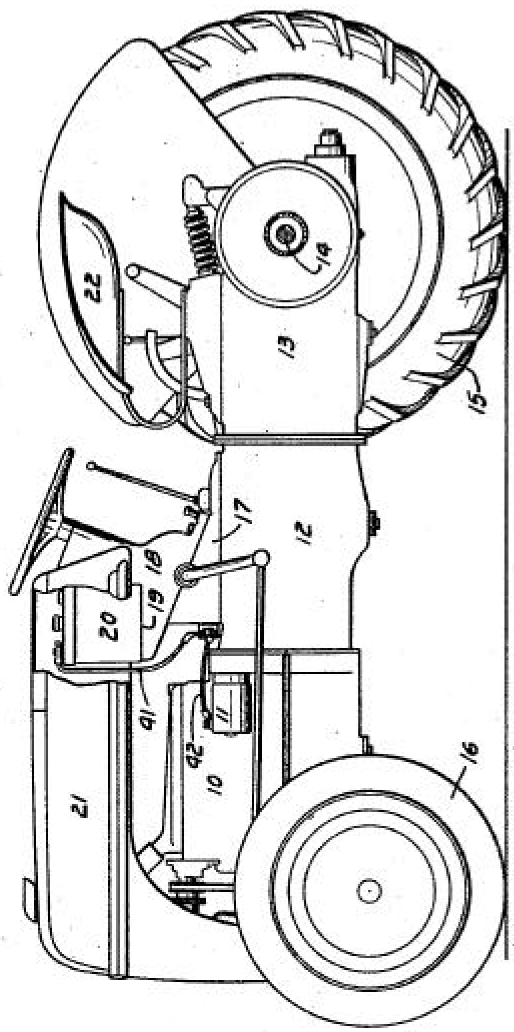

FIG. 1

WITNESS

E. Witzke

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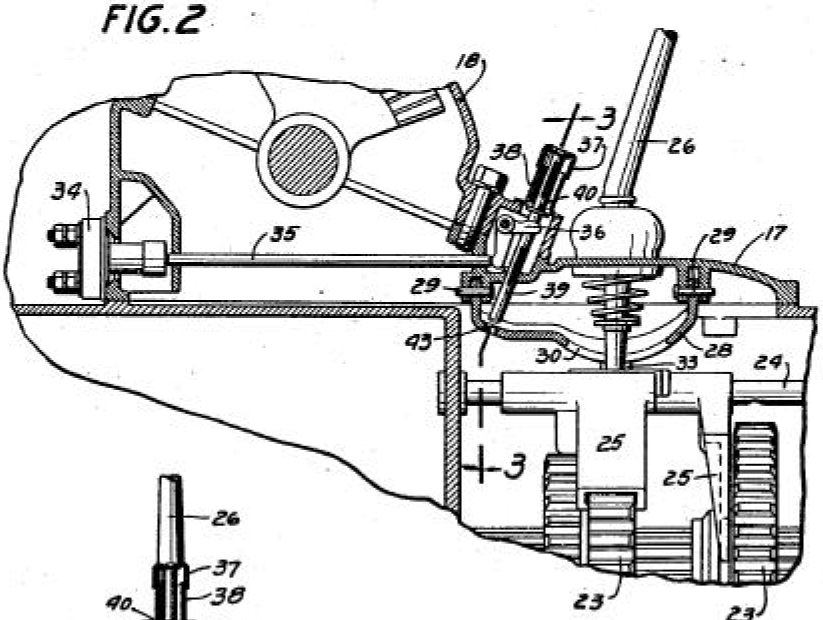
TRACTOR

Filed Dec. 8, 1939 2 Sheets-Sheet 2

FIG. 2



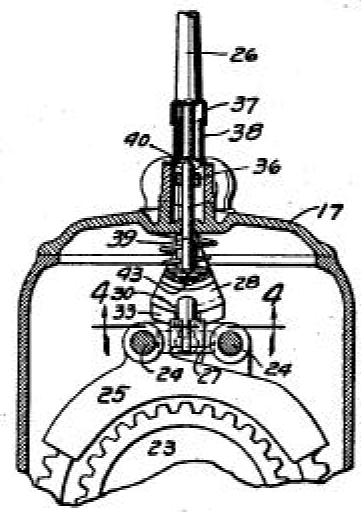


FIG. 3.

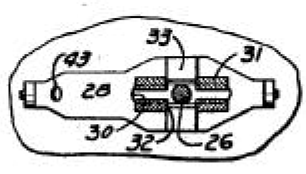


FIG. 4

WITNESS

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Patented May 13, 1941

2,241,677

UNITED STATES PATENT OFFICE

2,241,677

TRACTOR

Laurence S. Sheldrick, Dearborn, Mich., assignor to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

Application December 8, 1939, Serial No. 308,141

1 Claim. (Cl. 123—179)

The object of my invention is to provide a tractor having a starting mechanism thereon, which tractor will eliminate certain hazards heretofore inherent in other starter equipped tractors.

Electric starters were first used on automobiles and then later provided on tractors. In an automobile installation the control button or starter switch was invariably placed in such position that the driver could start the engine only when sitting in the driver's seat. This prevented the accidental starting of the car with no driver.

When electric starters are installed on tractors the starter switch must be placed in a position which is accessible for operation either when sitting on the seat or standing alongside of the tractor, as any position on the tractor which is accessible to the driver when he is sitting in the driver's seat is equally accessible when he is standing along side the tractor. It frequently has happened that persons, while standing alongside a tractor in position between the front rear wheels, have accidentally pushed the starting button. If the tractor is in gear when this occurs the tractor is caused to lurch forwardly and the person directly in the path of the wheels may be seriously injured.

My improved tractor is designed to eliminate this hazard by so interlocking the starting mechanism that it may be actuated to start the engine only when the transmission is in a neutral position. Thus, a person may accidentally lean against the starting switch when the transmission is in gear but the switch will then be able to operate the starting motor. However, should the transmission be in neutral the engine may start but the tractor will not be driven thereby.

Specifically my invention comprises a novel starting switch control button which is adapted to be interlocked with the transmission gear shifter so that the starting switch may be operated only when the transmission is in neutral.

With these and other objects in view, my invention consists in the arrangement, construction and combination of the various parts of my improved device, as described in this specification, claimed in my claim, and illustrated in the accompanying drawings, in which:

Figure 1 is a side elevation of a tractor having my improved starting mechanism installed thereon, one of the rear wheels and a portion of the cowl being broken away to better illustrate the construction.

Figure 2 is a vertical central sectional view through the transmission and starting mechanism, illustrating the mechanical interlocking therebetween.

Figure 3 is a sectional view, taken on the line 3—3 of Fig. 2, and,

Figure 4 is a sectional view, taken on the line 4—4 of Fig. 3.

Referring to the accompanying drawings, I have used the reference numeral 10 to indicate a conventional internal combustion engine which is associated with my improved tractor. An electrically operated starting motor 11 is secured to the engine in the usual manner. A transmission housing 12 is bolted to the flywheel end of the motor 11 and a rear axle housing 13 is attached to the rear end of the transmission housing 12. Axle shafts 14 are rotatably mounted in the housing 13 and a pair of rear wheels 15 are secured to the outer ends of the shafts 14. Front wheels 16 are mounted at the front end of the tractor on the outer ends of an axle, not shown in the drawings.

A transmission cover member 17 is detachably secured over the upper face of the transmission housing 12 and a combined cowl, steering gear housing and battery support 18 is detachably secured over the upper face of the cover 17. It will be noted that a shelf 19 projects forwardly from the housing 18 and a battery 20 is mounted upon this shelf 19. A sheet metal hood 21 extends from the front of the tractor rearwardly to position over the battery 20, the rear end of this hood coacting with the cowl portion 18. A seat 22 is fastened to the top portion of the rear axle housing 13 in position just rearwardly of the transmission housing 12.

The tractor construction just described brings out one tractor to which my invention is applicable, but it should be noted that my invention is adapted to be readily incorporated into other standard tractor constructions.

Referring to Figs. 2 and 3 of the drawings, I have shown a transmission which is provided with a plurality of gears therein, which gears have been given the general reference numeral 23. A pair of parallel shifter shafts 24 are fixedly mounted side by side in the transmission and extend lengthwise of the tractor. A pair of shifter forks 25 are reciprocally mounted on the shafts 24 and coact with the gears 23 so that when these forks are shifted horizontally fore and aft from a neutral position on the shafts the various speed ratios in the transmission will be effected.

A vertical gearshift lever 26 is universally mounted in a suitable bearing in the upper portion of the cover 17 with its lower end extending downwardly to position between the forks 25. Each of these forks are provided with a notch 27 therein into which the lower end of the fork may be moved so that when the lever engages either notch the respective fork may be moved longitudinally by movement of the upper end of the lever. The notches 27 in the two shifter forks 25 are aligned with each other when the forks are in a neutral or intermediate position.

In order that two speeds of the transmission may not be simultaneously engaged, I have provided an interlocking mechanism which consists of a yoke 28 which is pivotally mounted on pins 29 in the cover 17 to rock laterally beneath the cover. This yoke is provided with a longitudinally extending slot 30 therein through which the lower end of the lever 26 extends. The lever may therefore be moved in a fore and aft direction without rocking or otherwise moving the yoke 28 but when the lever is moved laterally, then the yoke 28 is rocked around its pivot pins 29.

Each of the forks 25 is provided with an interlocking boss 31 formed at its upper edge in which a transversely extending interlocking slot 32 is machined. The yoke 28 is also provided with a pair of lugs 33 which project downwardly therefrom and which, when the yoke is in a vertical or neutral position, engage the respective slots 32 in the boss 31. In this neutral position neither of the forks 25 may thus be shifted longitudinally. However, when the lever 26 is moved laterally to engage one of the notches 27, then the yoke 28 is rocked laterally to position where one of the lugs 33 swings clear of the slot 32 in the engaged fork. The other lug 33 still engages the slot 32 in the other shifter fork and thus effectively prevents this last-mentioned shifter fork from movement in either direction from its neutral position.

The foregoing interlocking mechanism forms no part of my invention but is described to show that when the transmission is in any of its engaged positions that the yoke 28 must necessarily be rocked to one side or the other of its intermediate vertical position. This characteristic of the transmission is made use of to interlock the starting motor switch so that it may be operated only when the transmission is in its neutral position.

A conventional starting motor switch 34 is fixed to the forward wall of the cover member 17 in a horizontal position and a push rod 35 is reciprocally mounted in a horizontal plane through the cover member in position to engage the switch. A bell crank lever 36 is pivotally mounted in the housing 18, one arm of which engages the adjacent end of the rod 35 while the other end extends rearwardly where it is engaged by a pin 39 which is fixed to a foot actuated starter button 37. The starter button 37 is reciprocally supported by a sleeve 38 which is fastened on the housing 18 in a vertical position. The pin 39 is secured to the button 37 and extends downwardly through a suitable opening in the transmission cover 17. A shoulder 40 is formed on the intermediate portion of the pin 39 and coacts with the free end of the bell crank lever 36 so that when the starter button 37 is pressed downwardly the bell crank 36 will be oscillated to thereby push the rod 35 forwardly and thus engage the starting motor switch 35.

One terminal of the battery 20 is grounded in the conventional manner while a cable 41 extends from the other terminal to one terminal of the starting motor switch 34. A cable 42 extends from the other terminal of the switch 34 to a terminal on the starting motor 11. Thus, when the button 37 is depressed the switch 34 will be engaged to energize the starting motor 11 from the battery 20.

In order that the operator will be unable to depress the button 37 when the transmission is in an engaged position, I have formed the pin 39 so that in its upper position it extends downwardly to position just above the yoke 30. A suitable opening 43 is provided in the yoke 28 which is in alignment with the pin 39 when the yoke is in an intermediate position. When the yoke is rocked to one side or the other, as is necessary when the transmission is in any one of its engaged positions, the opening 43 becomes out of alignment with the pin 39 so that this pin may not then be moved downwardly. However, when the shift lever 37 is in its neutral position wherein none of the speeds of the transmission is engaged, then the yoke 28 will be in position where the opening 43 is aligned with the pin 39 so that the starting motor switch may be actuated.

Among the many advantages arising from the use of my improved construction, it may be well to mention that the operator or bystander may not either intentionally or accidentally engage the starting switch while the transmission is in gear. Thus, the danger of being run down by the accidental touching of the starting motor button is eliminated.

Some changes may be made in the arrangement, construction and combination of the various parts of my improved device, without departing from the spirit of my invention, and it is my intention to cover by my claim such changes as may reasonably be included within the scope thereof.

I claim as my invention:

A tractor comprising, an engine, an electrical starting circuit for said engine consisting of a starting motor and battery and starting motor switch, driving wheels, a sliding gear transmission associated with said tractor through which the torque of said engine is transmitted to said driving wheels, a pair of shifting forks in said transmission, a shift lever universally mounted upon the upper part of said transmission, said lever being arranged to swing laterally to selectively engage said forks to then be moved longitudinally to shift the gears associated with the selected fork, a yoke pivotally mounted in said transmission through which said shift lever extends, said yoke being rocked laterally by said lateral swinging movement of said shift lever, a starting button mounted upon said tractor which upon being depressed closses said switch, and a pin extending from said button in axial alignment with an opening in said yoke when the yoke is in a neutral position, said yoke when rocked by said shift lever preventing the depression of said pin, for the purpose described.

LAURENCE S. SHELDRICK.

July 1, 1941. H. G. FERGUSON 2,247,725

TRACTOR

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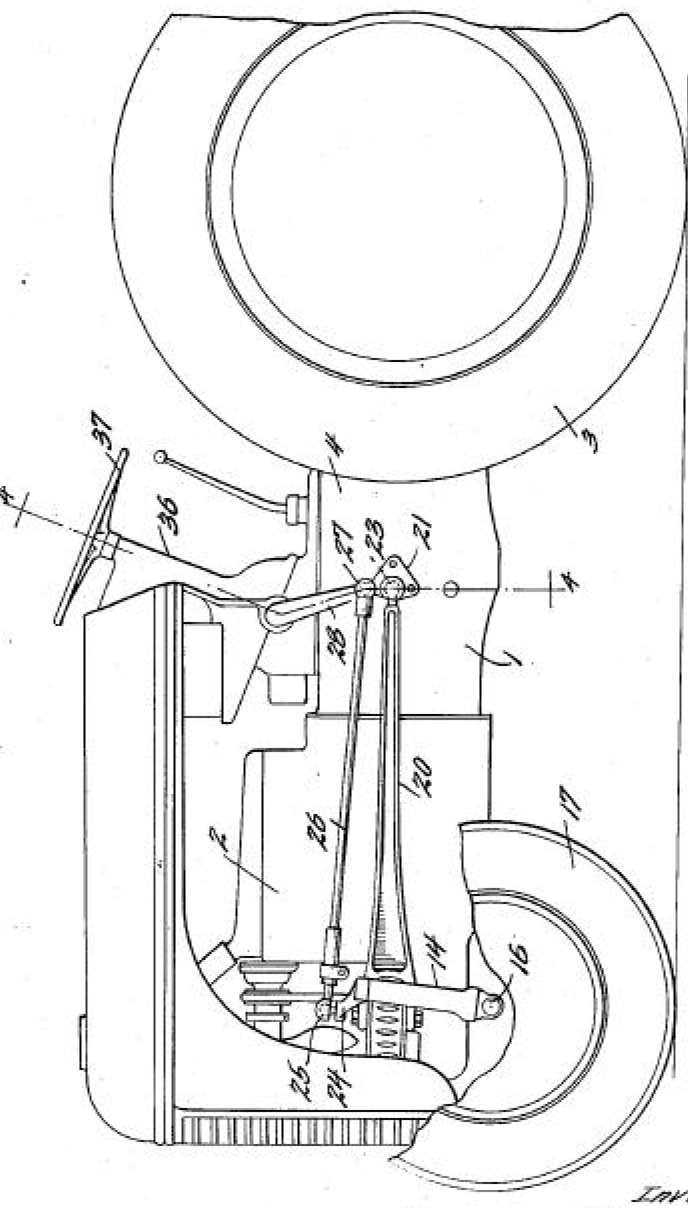
FIG. 1.



Inventor

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TRACTOR

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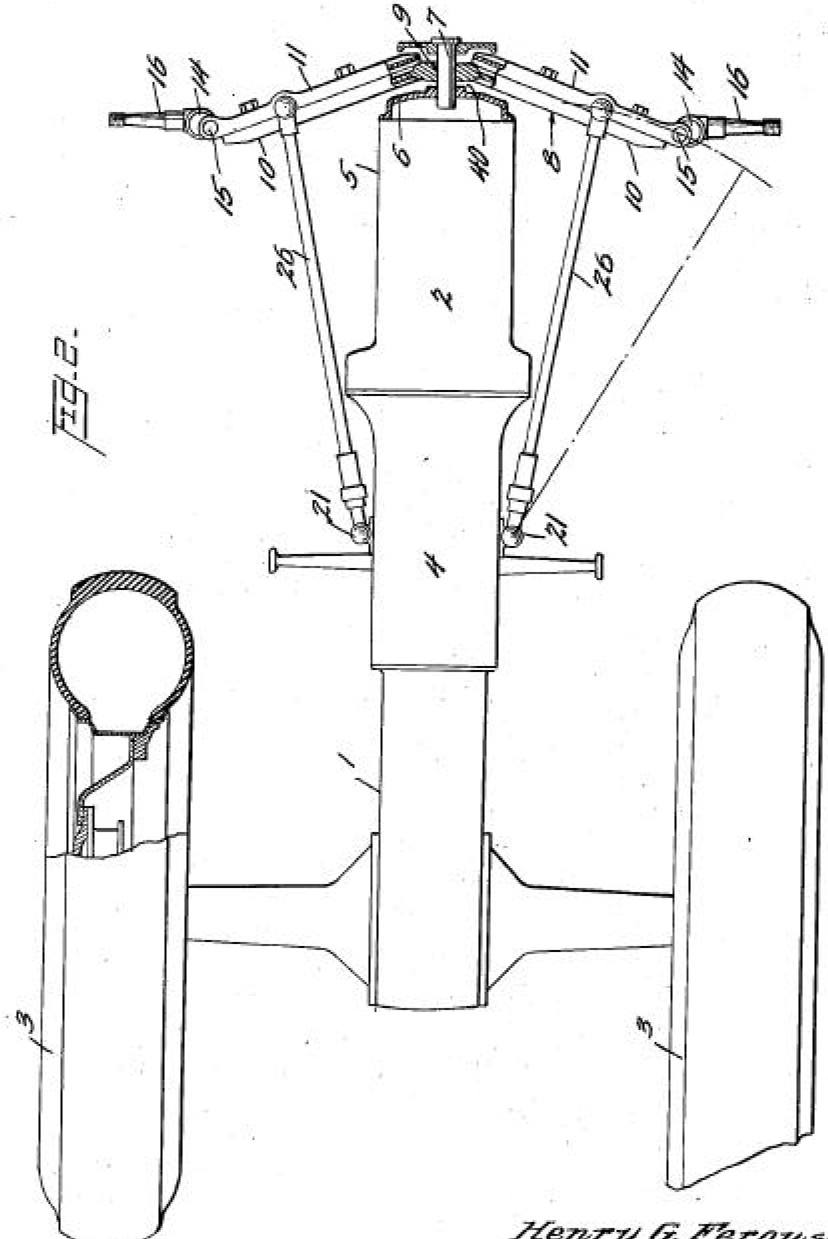

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TRACTOR

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FIG. 3.

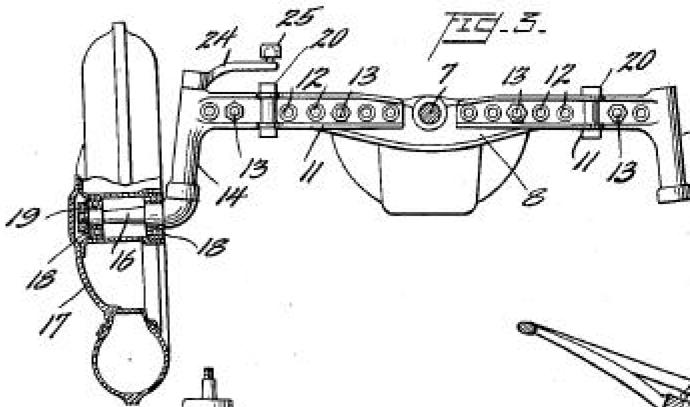


FIG. 4.

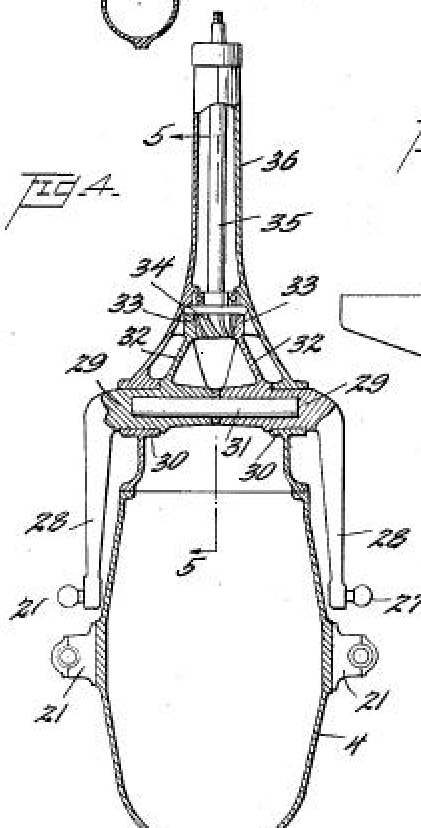
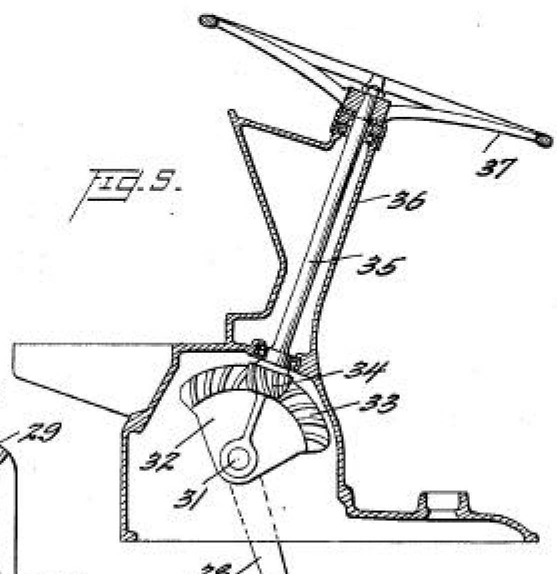


FIG. 5.



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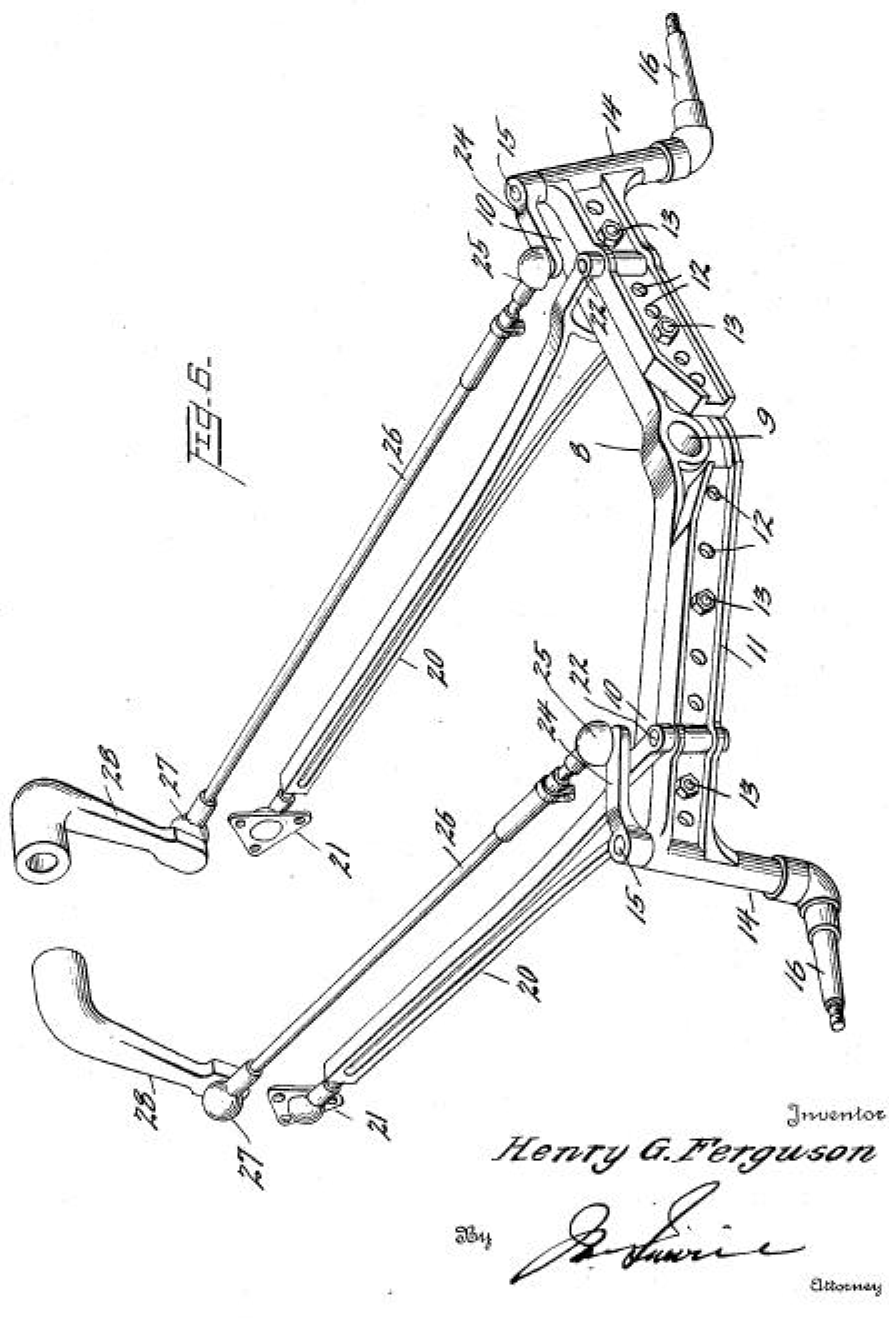

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Henry G. Ferguson

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Attorney

Patented July 1, 1941

2,247,725

UNITED STATES PATENT OFFICE

2,247,725

TRACTOR

Henry George Ferguson, Belfast, Northern Ireland

Application July 8, 1939, Serial No. 283,481

14 Claims. (Cl. 280—93)

This invention is directed to an improvement in tractors wherein more particularly the adjustably controlled spread of the front wheels without the slightest interference with the normal steering control is a characteristic feature.

The large and varied use of tractors, particularly for use in connection with farm implements, has demonstrated the great necessity of providing for variable lateral spread of the front wheel ground contact, to insure stability of the tractor under varying ground conditions or to provide for a particular front wheel spread which will best accommodate the tractor to the particular ground or road conditions where it is being handled. One particular difficulty in connection with adjustable or variable ground spread of the front wheels of a tractor is that of maintaining completely flexible and perfectly controlled steering mechanism for the front wheels under any and all conditions of front wheel spread without the use of complicated mechanism to this end and without the necessity of changing or correcting the steering mechanism connections at any time regardless of the front wheel spread adjustment.

The primary object of the present invention is, therefore, the provision of a tractor in which the front wheels are supported on axle bars mounted for adjustment longitudinally of the axle proper and designed to be rigidly fixed in any position of adjustment longitudinally of such axle proper, whereby the wheels may, within the limits of the adjustment provided, be given a minimum spread in ground contact, a maximum spread or any desired intermediate position without requiring adjustment of the steering mechanism.

A further object of the invention is the provision of means whereby the radius rods connected to the axle proper and the steering rods connected to the wheel shafts of the front wheels are mounted to compel their movement from vertically aligned centers to thereby insure simplicity of steering without liability, incident to change of centers, from buckling or distorting the rods.

A further object of the invention is the arrangement of manually controlled steering mechanism by which the steering rods, through the use of a single steering wheel or manually operable element, are compelled to function in a simple direct manner for steering purposes.

The invention is illustrated in the accompanying drawings, in which:

Figure 1 is a side view of the tractor with a portion of the engine hood removed.

Figure 2 is a plan of the same.

Figure 3 is a view in elevation, partly in section, showing more particularly the construction of the front axle as a whole and the mounting of one of the front wheels.

Figure 4 is a section on line 4—4 of Figure 1.

Figure 5 is a section on line 5—5 of Figure 4.

Figure 6 is a broken perspective view illustrating the mounting of the front axle proper, the wheel carrying bars and the connected parts.

The improved tractor is provided with a frame 1 having a motor 2, rear wheels 3, transmission 4 and other typical parts with which the invention is not particularly concerned and which may be conventional and of any desired character.

The forward end 5 in the form shown constitutes the engine housing and this is provided with an appropriate bracket 6 in which is rigidly mounted a king pin 7 extending outwardly and in the horizontal plane of the frame.

On the king pin is mounted what may be termed the axle proper 8 constituting a bar of appropriate strength centrally formed with an opening 9 which is mounted on the king pin 7 with appreciable freedom of play on said king pin, both angularly and forward and backward. From the king pin opening the axle proper extends in both directions in the form of rearwardly inclined axles 10.

Wheel-carrying bars 11 are arranged to bear against the outer faces of the axle sections 10, both bars 11 and sections 10 being formed with a plurality of openings 12 to receive bolts 13 whereby the wheel-carrying bars 11 are adjustable longitudinally of the axle sections toward and from the king pin and with the use of the bolts, rigidly held in such adjustment. The outer ends of the wheel-carrying bars have depending columns 14 in which are rotatably mounted wheel-carrying shafts 15 having integral wheel spindles 16 at their lower ends. Ground wheels 17 of any preferred or conventional form, being here shown as rubber tired disk-type wheels, are supported on the spindles 16 through appropriate anti-friction bearings 18 and securing means 19.

Radius rods 20 extend from the wheel-carrying bars 11 near their free ends to a mounting 21 on the engine or transmission case, the forward ends of the radius rods being preferably forked and connected by a bolt 22 to an appropriate enlargement on the bars 11 to thus define a pivotal connection at the forward ends of the radius rods.

The rear end of each radius rod has a universal mounting at **23** in the mounting **21**, so that the rods can follow outward and inward adjustment of the bars and also rocking movement of the bars and the axle **8** about the pin **7**. In all positions the rods **20** serve to brace the axle **8** and bars **11** against bending and, owing to the deep forked connection they also brace the axle and bars against torsional deflection. The axle **8** is arranged to be capable of slight torsional deflection to accommodate the slight tendency of the vertical axes of the pivot bolts **22** to go out of vertical alignment when they move up and down round the universal mountings **23** due to rocking movement of the axle.

The upper end of the wheel shaft **15** is provided with a fixed lateral arm **24** to which through the medium of a universal joint connection **25** is secured a steering rod **26**, the rear end of which has a universal joint connection **27** to the steering arm **28**. The radius rods are provided near the free ends of the axle sections **11** and the steering rods **26** are so arranged that when the wheels are straight ahead, the forward connections of the radius rod and steering rod on each side are in vertical alignment. The rear connections of the radius rod and steering rod on each side, that is the universal connections **23** and **27**, are also at this time in vertical alignment.

The control of the steering rods is illustrated more particularly in Figures 4 and 5. The upper ends of the steering arm **28** have inwardly projected bearing sections **29** supported in bearings **30** of the frame of the tractor and connected to maintain alignment by a rod **31** which is rotatably mounted in each extension **29**. Secured on the extensions **29** are webs **32** formed at the upper ends with arcuate toothed sectors **33**. A pinion **34** cooperates with both sectors **33** and is supported on a steering shaft **35** rising through a column **36** of the frame structure and carrying a steering wheel **37** or like manually operable element.

The shaft **35** will, of course, be appropriately mounted in anti-friction bearings.

It will be apparent from the above that the wheel-carrying bars may be adjusted laterally to increase the spread of the wheel ground contact to the maximum permitted by the construction; may be adjusted to their inward limits as in the position illustrated in Figure 2; or to any intermediate position. Thus, within the limits permitted, the wheel spread may be controlled to suit the requirements in the particular ground or road conditions in which the tractor is being used. Naturally a wide spread will materially increase the stability of the tractor as a whole while the narrower spread will provide for less over-all width of the tractor when being transported along the road. The conditions requiring varying spread adjustments are well understood by those experienced in the handling of tractors, particularly on the farm, and there is no necessity for discussing such numerous instances here.

When the wheel-carrying bars are adjusted they move around the mountings **23** as centres. The axle proper has therefore to move forward or backward and this is permitted by arranging for play on the king pin **7** to permit such slight forward or backward movement of the axle, the space being indicated at **40** in Figure 2. Owing to the forward and rear connections of the bracing rods **20** and steering rods **26** being in vertical alignment in the straight ahead position, and owing to the backward and forward movement of the axle, the pivot bolts **22**, during adjustment of the bars **11**, follow the arcuate path of the universal connections **23**. Thus the angular position of the steering arms **24** with reference to the bars **11** is not altered from which it follows that the wheels and wheel-carrying bars execute a parallel movement (the axle parts **10** being straight) and the steering is not affected and no compensating adjustment of the steering mechanism is necessary. Of course, the axle proper, and therefore the wheel bars and wheels, are capable of rocking movement relative to the king bolt to permit irregularities in the vertical movements of the wheels relative to each other as necessary in this type of tractor.

The steering mechanism proper is extremely simple, involving a single pinion for operating simultaneously arcuate sectors and through these sectors the steering rods.

What is claimed to be new is:

1. A tractor including a front axle capable of forward and backward movement, wheel-carrying bars adjustable in both directions longitudinally of the axle, a radius bar connected to each bar and a fixed part of the tractor, wheels carried by the wheel-carrying bars, and a separate steering rod connected to each wheel the radius bars constraining the wheel-carrying bars to move during adjustment through an arcuate movement about the rear ends of the steering rods.

2. A construction as defined in claim 1, wherein the rear ends of the radius bars and steering rods have universal connections in vertical alignment when the wheels are in the straight ahead position and wherein the front axle is capable of rocking movement in a transverse plane.

3. A tractor comprising a body, a king pin projecting forwardly of the body, an axle proper mounted loosely on the pin for angular and backward and forward movement and inclined rearwardly of the tractor body on each side of the king pin, wheel-carrying bars, the bars and axles being formed with openings for registry in adjustment of the bars longitudinally of the axle, and means for fixing the bars and axle through the registered openings.

4. A construction as defined in claim 3, including a radius rod for the wheel-carrying bar on each side of the king pin, and a universal mounting for the rear end of said rod on the tractor body, the radius rod having pivotal connection with the wheel-carrying bar.

5. A tractor comprising a frame, a king pin projecting in advance of the frame, an axle mounted for angular and backward and forward movement on the king pin, wheel-carrying bars carried by the axle on each side of the king pin, means for fixing the bars in adjusted positions on the axle relative to the king pin, wheels carried by the wheel-carrying bars, radius rods connected to the said bars and to the frame, steering mechanism on the vehicle frame, and steering rods intermediate the mechanism and the wheels.

6. A construction as defined in claim 5, wherein the ends of the steering rods connected to the steering mechanism are in vertical alignment with the rear ends of the radius rods

when the wheels are in the straight ahead position, said rear ends being universally attached to the frame.

7. A construction as defined in claim 5, wherein the steering mechanism includes steering arms mounted for swinging movement on the frame and having universal connection with the rear ends of the steering rods, a sector carried by each steering arm, and a manually controlled pinion engaging with the sectors.

8. A tractor including a body, an axle mounted for angular and limited backward and forward movement with respect to the body, wheel-carrying bars mounted for adjustment longitudinally of the axle, wheels carried by the bars, radius rods pivotally connected to the bars and universally connected to the body, and steering rods pivotally connected at the forward ends to the wheels and pivotally connected at the rear to steering mechanism, the radius rods maintaining substantial rigidity of the axle and wheel-carrying bars while constraining the bars, during adjustment, to follow an arcuate movement about the rear ends of the steering rods so that the steering action is undisturbed.

9. A tractor comprising a frame, an axle mounted thereon, steering ground wheels, parts carrying said wheels and adjustably attached to said axle to permit adjustment of the wheel track, a steering mechanism, a separate fore-and-aft steering rod for each wheel, each rod being pivotally connected at the rear end to said mechanism and having a pivotal connection with the corresponding wheel at the front end, and means constraining said wheel-carrying parts to execute, during track adjustment, a parallel arcuate movement corresponding to that of the connections of the steering rods with the wheels so that the latter execute a parallel movement.

10. A tractor comprising a frame, an axle mounted thereon, steering ground wheels, parts carrying said wheels and adjustably attached to said axle to permit adjustment of the wheel track, a steering mechanism, a separate steering rod for each wheel, each rod being pivotally connected at one end to said mechanism and having a pivotal connection with the corresponding wheel at the other end, and means constraining said parts to execute, during track adjustment, a parallel arcuate movement corresponding to that of the connections of the steering rods with the wheels so that the latter execute a parallel movement, said constraining means comprising bracing rods pivotally connected to the frame at the rear ends and each pivotally connected at the forward end to the corresponding wheel-carrying part, the said connections being in vertical alignment with the pivotal connections of the steering rods when the wheels are in the straight ahead position, and the axle having an attachment to the frame allowing forward and backward movement of the axle with reference to the frame.

11. A tractor comprising a frame, an axle mounted thereon, steering ground wheels, parts carrying said wheels and adjustably attached to said axle to permit adjustment of the wheel track, a steering mechanism, a separate steering rod for each wheel, each rod being pivotally connected at one end to said mechanism and having a pivotal connection with the corresponding wheel at the other end, and means constraining said parts to execute, during track adjustment, a parallel arcuate movement corresponding to that of the connections of the steering rods with the wheels so that the latter execute a parallel movement, the axle having straight, rearwardly swept outer end portions along which said wheel-carrying parts are adjustable.

12. A tractor comprising a frame, an axle mounted thereon, steering ground wheels, parts carrying said wheels and adjustably attached to said axle to permit adjustment of the wheel track, a steering mechanism, a separate steering rod for each wheel, each rod being pivotally connected at one end to said mechanism and having a pivotal connection with the corresponding wheel at the other end, and means constraining said parts to execute, during track adjustment, a parallel arcuate movement corresponding to that of the connections of the steering rods with the wheels so that the latter execute a parallel movement, said constraining means comprising bracing rods pivotally connected to the frame at the rear ends and each having a forked pivotal connection at the forward end to the wheel-carrying parts, the said connections being in vertical alignment with the pivotal connections of the steering rods when the wheels are in the straight ahead position, and the axle having an attachment to the frame allowing forward and backward movement of the axle with reference to the frame.

13. A tractor comprising a frame, an axle mounted thereon, steering ground wheels, parts carrying said wheels and having a pivotal connection therewith and adjustably attached to said axle to permit lateral movement thereon to adjust the wheel track, a steering mechanism, a separate steering rod for each wheel, each rod extending fore and aft and being pivotally connected at one end to said mechanism and having a pivotal connection with the corresponding wheel at the other end, and means constraining the pivotal connections of said wheels to execute the same movement as their pivotal connections to said rods as a result of track adjustment.

14. A tractor comprising a frame, an axle mounted thereon, steering ground wheels, parts carrying said wheels and adjustably attached to said axle to permit adjustment of the wheel track, a steering mechanism, a separate steering rod for each wheel, each rod being pivotally connected at one end to said mechanism and having a pivotal connection with the corresponding wheel at the other end, and means constraining said wheels to follow a parallel movement as a result of track adjustment so that their alignment is unaffected by said adjustment, the axle comprising straight outer parts swept rearwardly for receiving the wheel-carrying parts.

HENRY GEORGE FERGUSON.

April 14, 1942.

H. FORD

CYLINDER LINER

Filed March 27, 1939

2,279,671

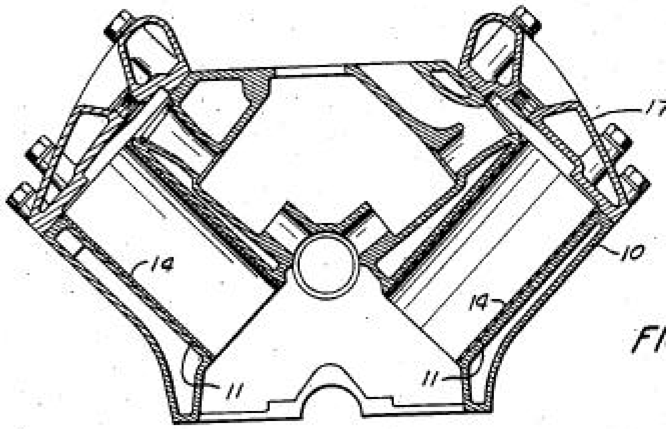

FIG. 1

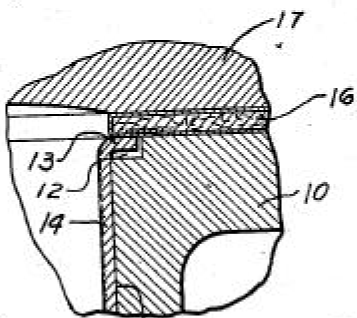

FIG. 2

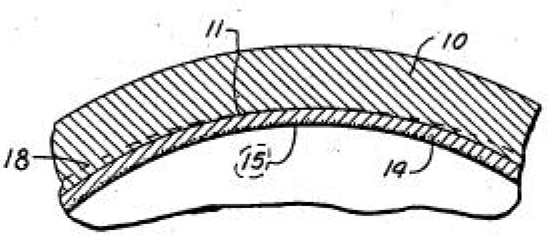

FIG. 3

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2,279,671

UNITED STATES PATENT OFFICE

2,279,671

CYLINDER LINER

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Application March 27, 1939, Serial No. 264,315

4 Claims. (Cl. 309—3)

This invention relates to cylinder liners and has for its object to provide a new and improved construction of a liner or shell particularly adapted for, but not limited to, use in the cylinders of an internal combustion engine.

Many proposals have heretofore been made to provide the cylinders of an internal combustion engine block with liners, or sleeves, of different metals or compositions, that would give better and longer wearing surfaces than the cast iron material usually employed for the fabrication of such cylinder blocks, but to date no form of cylinder liner has gone into extensive commercial use although the advantages of this type of cylinder construction have long been recognized.

The principal reason why the lined cylinder type of construction has not gone into more general use is apparently because heretofore the problem of providing a liner that would function efficiently yet be capable of manufacture at a low production cost, had not been satisfactorily solved. Therefore lined cylinders have been found only in higher priced engines. One of the major difficulties encountered is that of cooling the liner, or insuring uniform heat transfer between the liner and the surrounding cylinder walls. Simply expressed, a solution of this difficulty involves but one condition,—an intimate contact between cylinder wall and liner along the entire area of their mating surfaces. If this contact is not maintained in any localized area, an insulating air space will be formed or exist between the liner and cylinder block; heat transfer will be retarded, and the liner will develop a hot spot at that point which will not only produce very unsatisfactory operating conditions within the cylinder, but which may possibly result in the destruction of the liner. The general types of construction that have been used in the past to obtain the required degree of heat transfer relationship between cylinder wall and liner, are a water jacketed liner or, as it is termed, a "wet sleeve" construction, and a tight press fitted liner. Of these the press fit type is perhaps the simplest and the improved liner of the present invention falls generally within this category.

However, where former press fitted liners have relied solely upon the overlapping in dimensions between the outside diameter of the liner and the diameter of the cylinder to provide a tight press fit and thereby attain the required intimacy of contact, the liner of the present invention depends principally upon the characteristics of the metal of which it is constructed and the heat treatment of this metal before insertion within the cylinder to achieve the desired result. The principal objection to former press fitted liners aside from their high initial cost of production is that they have not been capable of retaining the required snug relationship between the outer surface area of the liner and the cylinder walls over a long period of engine operation, and this is due to the fact that operation of an engine causes appreciable general and localized distortional effects upon its cylinder walls. Bell mouth, or increase in diameter, takes place at the head ends of the cylinders because of the high combustion temperatures and pressures developed in that region, while temperature differentials, unevenly tightened cylinder heads, etc., have other distortional effects and therefore the liner to be effective must either be of sufficient cross sectional wall thickness to resist the localized effects or of such a nature as to be capable of following the changing contours of the cylinder walls. Such pliability to be effective, must be an inherent property of the liner alone so that the liner will not be materially influenced by the manner in which it is fitted within the cylinder. Apparently the necessity for the liner being inherently pliable had not heretofore either been fully appreciated or it had not been thought to be possible of achievement with available methods of heat treatment.

The principal object of the present invention is to provide a new and improved construction of a cylinder liner or shell which will have sufficient flexibility to be capable of automatically adjusting itself, not only to any inequalities due to machining inaccuracies between the cylinder bore and liner as the latter is pressed into the block, but also to any subsequent changes in contour of the cylinder bore during the operation of the engine.

Another object is to construct a cylinder liner or shell of a low carbon steel of high ductility capable of being fabricated from a flat blank of sheet steel by the well known relatively low cost drawing operations into a finished tubular sleeve or liner of the requisite accuracy of finished size without necessitating any of the more costly machining operations.

A further object is to provide a liner or shell construction for cylinders which when inserted into the cylinder block will be securely retained therein against accidental longitudinal movement but which may be readily removed from the block for replacement.

Another object is to provide a cylinder liner or shell in which the inner wearing surface is subjected to a hardening process to secure a hardened corrosion resistant surface or skin, the penetration of which is of a limited extent while the outer peripheral surface and the major part of the cross sectional thickness of the liner wall will remain unhardened.

A further object is to provide the outer peripheral wall thereof with a corrosion resistant coating such as a tin, or chromium plating which in turn has three main purposes; namely to prevent destructive oxidizing effects after the liner has been placed in position and during operation of the engine, to serve to form a protective coating to limit the penetration of the hardening effects to the inner wearing surface of the liner and the cross section of the wall immediately adjacent thereto, and to form a film which will aid in providing and maintaining intimate contact between the surface of the liner and the cylinder wall and thus insure that said surfaces will be kept in the required degree of heat transfer relationship throughout the period of operation of the engine.

A still further object of this invention is to improve upon the construction disclosed in my application, Serial No. 212,724, filed June 9, 1938, of which this application, is, as to certain features, a continuation in part.

The above and other objects of the invention will appear more fully from the following more detailed description and by reference to the accompanying drawing in which

Fig. 1 shows a vertical section through a V-type of motor, showing the improved liner inserted in place within the cylinder block;

Fig. 2 is an enlarged sectional detail showing the interengagement between the cylinder liner and block to prevent longitudinal displacement of the liner, and

Fig. 3 is an enlarged horizontal sectional view through a portion of the liner and cylinder block and showing on an enlarged and somewhat distorted scale the manner in which the flexibility of the liner permits it to conform to any inequalities in the cylinder block.

As shown in the drawing the numeral **10** indicates the cylinder block of a V-type motor provided with cylinder bores **11**, the upper end of each bore being countersunk to provide a recess **12** to accommodate a horizontally outwardly projecting flange **13** of the liner **14**. Although the liner is shown as inserted in the cylinder bores of a V-type combustion engine, it will be understood that the invention is not limited to any particular type of engine, but that it is equally applicable for use in any case where it is desired to line a cylinder with a more wear and corrosive resistant surface than provided by the metal of which the cylinder is constructed.

The liner is preferably constructed as a tubular shell drawn from flat stock of from three and one half to six hundredths of an inch in thickness, preferably of sufficient ductility to be drawn by well known drawing operations into the desired tubular shape and size and of low carbon steel containing, for example, not over 0.10% carbon. Steel of such a low carbon content is ordinarily incapable of being case hardened or nitrided in a short time by the usual methods heretofore employed. It has been found, however, after extensive experiment, that a surface hardening of such steels may be effected to produce an extremely hard corrosion resistant skin which provides a highly efficient wear resistant surface, and also that the penetration of the hardening may be limited to but a few thousandths of an inch, thereby retaining in the remainder of the cross-sectional thickness of the material all of the physical properties of low carbon steels. This hardening process, which forms no part of the present invention but is made the basis of a separate application, is effected by applying a coating of a strong alkali such as sodium carbonate, to first passivate the surface to be hardened and immediately thereafter placing the liner in a furnace where it is subjected to a temperature of 1250° F. to 1400° F. in an atmosphere of ammonia gas and carbon monoxide NH_3 and CO. After the liners are subjected to this heating process they are then air cooled in a reducing atmosphere down to a temperature of about 400° F. Before subjecting the liner to the nitriding treatment however, the outer peripheral surface thereof is given a plating of tin, chromium or other material which is resistant to nitrogen penetration, in order to prevent nitriding thereof and consequent growth.

As a result of the above treatment the liner is provided with a hardened inner skin which is indicated by the reference character **15** in Fig. 3. Since the outer surface is plated with either tin or chromium before the nitriding takes place, the remainder of the cross-sectional thickness of the wall of the liner has the well known soft and ductile properties of low carbon steel. After the liner has been hardened and cooled, as above described, it may then be inserted into the cylinder block. The cylinder bores provided in the cylinder block are approximately one thousandth of an inch smaller in diameter for a bore of $3\frac{1}{8}$ inches than the outer diameter of the liner, and the liner is press fitted into the cylinder bore. Due to the fact that the cross-sectional thickness of the wall of the liner is exceedingly thin and as the soft ductile properties of a low carbon steel is maintained in nearly the entire cross-sectional thickness of the liner wall except for the relatively thin case hardened inner surface which extends only to a depth of approximately six thousandth of an inch, the liner has such flexibility to be automatically self-conforming to any slight inequalities or inaccuracies resulting from the machining or subsequent distortion of the bore of the cylinder. It is desirable to machine the bore with a fairly high grade of accuracy and to maintain dimensions within a tolerance of one thousandth of an inch so that any warping of the liner to adjust itself to inaccuracies will not exceed a maximum of one-half thousandth of an inch. As the liner is but slightly larger in diameter than the bore of the cylinder in which it is to be inserted, no great amount of pressure is required to force it into the cylinder bore to a point where the upper surface of the horizontal flange **13** at the top end of the liner lies in the same plane with the surrounding surface of the cylinder block. After the liner has been inserted into position it is then lapped to the exact finished dimension, leaving a case hardened skin of about two and one-half thousandths of an inch in thickness to provide a wearing surface. Because of the fact that the liner is but a very slight amount over size and is forced into the cylinder bore with but a relatively small amount of pressure, no difficulty is experienced in removing a liner should it become necessary or desirable to do so, and replacing the same with a new liner.

It will be noted by referring to Fig. 2 of the drawing that the cylinder gasket 16 is so proportioned as to extend over and cover most of the horizontal flange 13 of the liner, thereby sealing any possible annular space that may exist between the liner and the cylinder block from the combustion chamber and after the cylinder head 17 is attached to the cylinder block, the liner is firmly held against movement longitudinally of the bore by the inter-locking engagement of the flange 13 between the shoulder 12 and gasket 16.

I have indicated in Fig. 3, by the dotted line showing, the manner in which the flexibility of the liner permits it to adjust itself to any inequalities of the bore, the dotted line 18 being intended to depict, in a greatly exaggerated degree, the normal cylindrical form of the liner and the full line showing being intended to represent a departure from the true cylindrical form that might possibly occur due to inaccuracies in machining operations. It is to be understood, however, that it is necessary to keep the machining of the parts within fairly close limits so that when the liner is lapped, the amount of material removed will not be so great as to go below the case hardened inner skin or surface. Due to the fact that the liners are not heated to a very high temperature to perform the hardening of the inner skin thereof, no measurable or appreciable distortion of the liner results from the hardening process, and as the dimensions of the liner may be held within great accuracy in fabricating the same by a drawing operation, the liner may be produced in large quantities by mass production methods and held within very close tolerance while at the same time the production costs are kept to a minimum.

By the use of the present invention it now becomes possible to provide an internal combustion engine for automobiles or other uses in which all of the surfaces subjected to wear may be readily replaced whenever it becomes necessary so to do and consequently the cylinder block which is one of the most expensive parts of such engines may be used practically indefinitely as all of the other parts of the motor such as valve seats, bearings, pistons, connecting rods, etc., have for some years been made detachable from the block for replacement or servicing.

In addition to providing a cylinder wall surface which is more resistant to the frictional wear produced by movement of the piston, the liner of the present invention also affords marked protection against deterioration caused by corrosion, which frequently is a greater contributing factor in causing cylinder and bore failure than frictional wear thereof. As a nitriding process in addition to producing a more wear resistant surface also produces a surface which has very high corrosion resisting properties, the liner of the present invention has its entire exposed surface made more corrosive resistant by the nitriding of the inner wall and the plating of the outer wall. The use of a cylinder wall surface having the above properties, has another important advantage from the standpoint of engine operation in that it permits greater control over oil consumption, since increased pressure between the piston rings and the cylinder wall surface becomes possible owing to the improved wearing qualities of the latter, and thus the seal between the combustion chamber and the crank case is more positive.

The high inherent flexibility and ductility of the liner of the present invention is also a distinct advance over prior constructions as these properties permit repeated distortions of localized areas of the liner without cracking or failure of the material, which would not be possible with the cast iron liners heretofore used. These localized distortions of the present liner, as for example, in compensating for bell mouth, are to be distinguished from an overall change of shape to compensate for out of roundness. The relatively thick walled cast iron liners of the prior art were capable of such overall distortions to a limited extent but were incapable of any increase of their area to compensate for localized distortions.

Moreover, it has been found that the thin film of plating given to the outer surface of the liner possesses to a certain degree flowing or conforming properties independent of any actual change of contour in the material of the liner itself, and thus this film is capable of eliminating any possible minute spaces between the liner and the cylinder wall due to minor machining imperfections or small distortional effects which would otherwise not be material enough to cause a change in contour of the liner. This property of the outer surface plating when added to the aforesaid properties of the liner proper results in a complete structure having the inherent capacity to cling to the cylinder wall thruout any distortions found in normal engine construction and operation, and as previously stated, this is the principle requirement for satisfactory lined cylinders of any type.

While I have shown and described a construction of a liner which has proved highly satisfactory in actual practice, it will be understood that many variations, changes and modifications may be resorted to without departing from the principle of the invention.

I claim:

1. The combination with a cylinder of a preformed replaceable one-piece cylindrical liner constructed of low carbon steel and having an extremely thin uninterrupted side wall, said liner being pressed into a bore of said cylinder, the inner surface of said liner being nitrided to produce a wear-resistant surface of great hardness, the major portion of the radial thickness of said liner being left unhardened so that said liner retains such flexibility as to be automatically self-conforming to any slight inequalities existing between the outer periphery of said liner and the bore of said cylinder, and a film of metal forming the exterior surface of said liner, said film being of less hardness than said inner surface and being sufficiently soft to establish an intimate contact for heat transfer from the exterior surface of said liner to the adjacent surface of said bore.

2. A liner for use in an internal combustion engine cylinder comprising a one-piece preformed circumferentially continuous cylindrical shell of low carbon sheet steel of extremely thin cross-section, the inner surface of said shell being nitrided to provide a hard wear-surface, the depth of penetration of said nitriding being limited to but a minor portion of the radial thickness of said shell and the remaining portion of said radial thickness having preserved therein the inherent flexing qualities of said low carbon steel so that said shell can readily flex to conform to slight inequalities of a cylinder bore when inserted therein, and a layer of relatively soft metal on the outer peripheral surface of said shell adapted to provide intimate contact of the

shell with the wall of the bore of said cylinder when said shell is pressed into said bore.

3. A liner for use in an internal combustion engine cylinder comprising, a one-piece, preformed circumferentially continuous cylindrical shell of low carbon sheet steel having a radial thickness of approximately three and one-half to six hundredths of an inch, the inner surface of said shell being nitrided to provide a hard wear-surface, the depth of penetration of said nitriding being limited to but a minor portion of the radial thickness of said shell and the remaining portion of said radial thickness having preserved therein the inherent flexing qualities of said low carbon steel so that said shell can readily flex to conform to slight inequalities of a cylinder bore when inserted therein, and a layer of metal on the outer peripheral surface of said shell adapted to provide intimate contact of the shell with the wall of the bore of said cylinder when said shell is pressed into said bore.

4. A liner for use in an internal combustion engine cylinder comprising, a drawn low carbon steel cylindrical shell having an uninterrupted side wall of a radial thickness of approximately three and one-half to six hundredths of an inch, the inner surface of said shell being nitrided to provide a hard wear-surface, the depth of penetration of said nitriding not being in excess of approximately six thousandths of an inch so that said shell can readily flex to conform to slight inequalities of a cylinder bore without cracking when inserted into said bore, and a layer of metal on the outer peripheral surface of said shell adapted to assure intimate contact of the shell with the wall of the bore of said cylinder when said shell is pressed therein.

HENRY FORD.

Aug. 10, 1943. E. ZOERLEIN ET AL 2,326,113

DISTRIBUTOR

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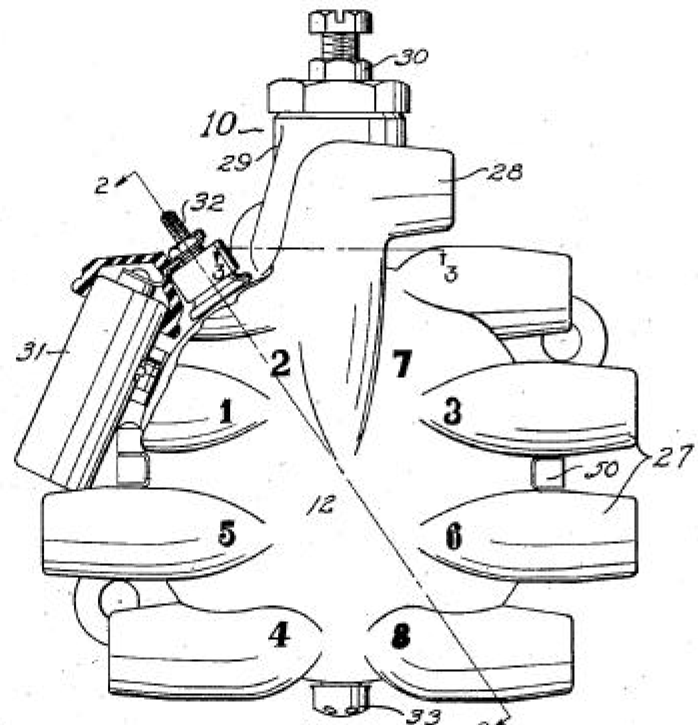

FIG. 1

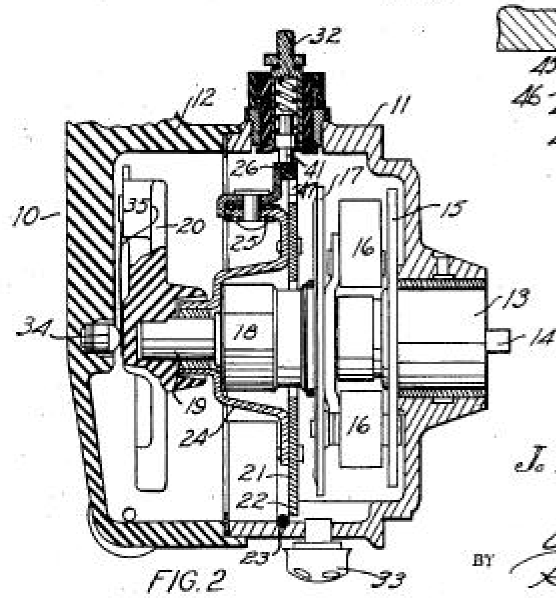

FIG. 2

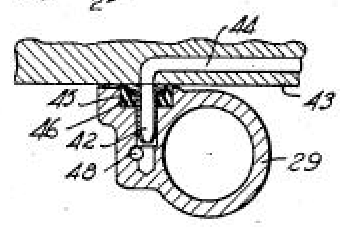

FIG. 3

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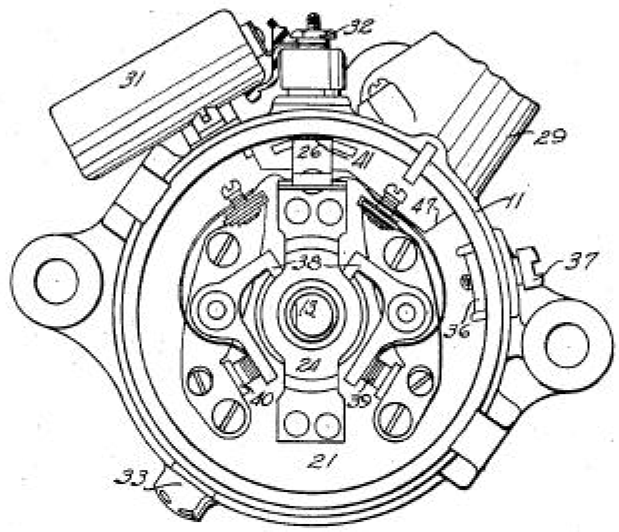

FIG. 4

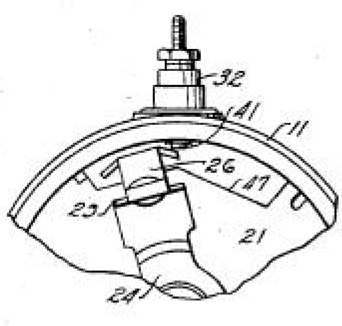

FIG. 5

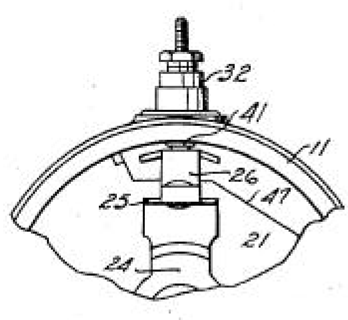

FIG. 6

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Patented Aug. 10, 1943 2,326,113

UNITED STATES PATENT OFFICE

2,326,113

DISTRIBUTOR

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Application September 20, 1941, Serial No. 411,642

6 Claims. (Cl. 200—19)

This invention relates to ignition systems for internal-combustion engines; and, more particularly, to a distributor to be used in connection with such systems.

The distributor constructed according to this invention embodies a novel shaft bearing support and an internal construction that facilitates assembly of the distributor unit. It further embodies an improved primary circuit contact and a new manifold connection by means of which the attachment of the distributor to the engine is simplified.

The conventional internal-combustion ignition system includes a distributor having a plurality of terminals from which insulated wires lead to the spark plugs to give the desired firing order. The preferred drive for the distributor is directly from the engine camshaft. The most convenient mounting in which this drive may be had is at the front end of the engine. This necessarily requires sufficient additional room between the radiator and the engine block to accommodate whatever form of distributor is chosen.

It is therefore an object of this invention to provide a distributor having the smallest practicable longitudinal dimension so that the room required for its mounting between the engine block and the radiator will be kept to a minimum. A further object is to provide an internal support and bearing for the distributor shaft which will perform satisfactorily and yet which may be economically constructed and assembled in the completed distributor without difficulty. Still another object of this invention is to provide an improved primary electrical connection which also facilitates assembly of the device and with which necessary adjustments may be easily and positively made. Another object of this invention is to provide an improved connection for the vacuum brake used in connection with the timing control. Each of these improvements and a specific example of the construction by which they are obtained will now be described in full.

With these and other objects in view, the invention consists in the arrangement, construction and combination of the various parts of the improved device, as described in the specification, claimed in the claims and illustrated in the accompanying drawings, in which:

Figure 1 is a front elevation of the distributor.

Figure 2 is a sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a sectional view taken on the line 3—3 of Figure 1 through the vacuum brake and its connection.

Figure 4 is an elevation of the interior of the distributor, the cover being removed.

Figures 5 and 6 are partial elevations of the interior of the distributor showing the range of timing adjustments possible.

Referring to Figure 1, a front elevation, a distributor designed for an eight-cylinder internal-combustion engine is shown. The distributor 10 is designed to be mounted vertically, in substantially the position shown, in contact with the front of the engine block and aligned with the engine camshaft by which it is driven. As best shown in Figure 2, this comprises the housing 11 and the cover 12 held in place by spring clips 50. The distributor shaft 13 is rotatably mounted in the housing 11 and has an offset key 14 which will engage the engine camshaft in but one position to insure that when the camshaft and distributor shaft are engaged they are at the proper relative angle.

The rear portion of the housing 11 contains the centrifugal control for the breaker point operating cam. This mechanism includes the supporting plate 15, the weights 16 and the friction plate 17. The construction of this control forms no part of this invention and a full description of a type which is suitable for use herein may be found in United States Patent No. 2,092,269.

Continuing outwardly along the distributor shaft 13, the breaker point cam 18, the outer bearing 19 for the distributor shaft and the rotor 20 secured to the shaft are shown. The support plate 21 is mounted for limited rotation within the housing and is held therein against a rabbet 22 by a split spring 23. Secured to the plate 21 is the bearing bracket 24 which has one end bent upwardly to form an ear 25 to which the primary connection shoe 26 is attached.

As best shown in Figure 1, the cover 12 has a plurality of connecting nipples, one for the connection to each cylinder, and the high-tension nipple 28, as is customary; and appropriate indicating numerals are molded on its surface. Mounted on top of the housing and integral therewith is the vacuum-brake cylinder 29 and its tension adjustment 30. Secured to the side of the housing is the condenser 31 which is connected to the binding post 32 of the primary connection. An air filter 33 is provided at the bottom of the housing to permit ventilation of the interior. The high-tension connection is effected through the contact 34 on the cover 12 and the spring 35 carried by the rotor 20.

The arrangement and construction of the support plate 21 is as shown in Figure 4. It will be noted that the plate 21 has a lug 36, which is associated with an adjusting screw 37 by which the angular position of the plate 21 may be adjusted to obtain the desired spark timing characteristic. As described previously, the primary contact shoe 25 is fixed to the bearing bracket and hence rotates with any change in the angular position of the plate 21. Also secured to the support plate 21 are the usual breaker arms 38, contacts 39 and stationary points 40.

The primary connection is effected through the spring plunger 41, best shown in Figure 2, which is insulatingly and slidably supported in the housing 11 and which is in electrical contact with the binding post 32. The lower end of the plunger resiliently engages the shoe 26. A particular advantage of this form of construction is the ease with which the assembly may be carried out. It will be noted that the support plate 21 is cut out in the vicinity of the primary connection as at 47.

Referring now to Figures 5 and 6, the support plate 21 with all of its attached mechanism is placed on the distributor shaft 13 and slid inwardly into the housing in the angular position shown in Figure 5, the cut-away portion 47 clearing the plunger 41. When the plate 21 engages the rabbet 22, the split spring 23 is applied, holding it securely in that position. The angular adjustment of the plate 21 may then be made, during which it assumes the position shown in Figure 6, the plunger 41 sliding over and into contact with the shoe 26. This is a better electrical connection and is much easier to assemble than the pigtail which heretofore has been used. Subsequent timing adjustments by means of the screw 37 do not disturb the contact.

Another novel feature is the manner in which the connection between the vacuum brake and the engine manifold is effected. The operation of this brake is dependent upon the manifold pressure in the engine and it has been the practice to connect a duct from the manifold directly to the brake cylinder. This requires, in the assembly of the engine, that the distributor be attached to the engine block and then the duct, through some suitable union, connected with the cylinder. The work space is very limited and this latter connection is sometimes somewhat difficult to make. To avoid this, a duct connection 44 is provided in the adjacent part of the engine 43. This duct connection is joined by a suitable conduit to the manifold during the assembly of the engine. As shown in Figure 3, the complementary connection 42 is formed in the distributor housing. This is counterbored, as at 45, to receive a gasket 46 and a hole 48 is drilled from the interior of the brake cylinder, intercepting the complementary connection 42. Elements 44 and 42 are so located on the block and distributor housing, respectively, that when the distributor is aligned with the engine camshaft and bolted into place, they are in communication and the gasket 46 makes an airtight joint through which the manifold pressure is communicated to the brake cylinder. In other words, the mere placing of the distributor in its proper position completes the necessary connection.

The provision for ventilation is most important. Ozone in appreciable quantities is formed incident to the arcing of contacts. If this reaches too high a concentration, the atmosphere within the distributor is subject to ionization and electric discharges through it may occur. Placing the ventilator in proximity to the centrifugal control insures a constant circulation of air.

One of the most important constructional features, however, is that involved in the use of the support plate 21, which has attached thereto not only the customary breaker arm assembly and primary contact but a straddle outer bearing 19 for the distributor shaft 13 as well. Heretofore, an outer bearing could be provided only by the use of an additional bearing plate located near the front end of the housing or by a bushing contained in the cover. The first of these expedients is unsatisfactory since the housing must be extended to at least the plane of the bearing, an additional plate must be provided, together with seating and securing means, and the assembly is made more complex while accessibility is decreased. The second has the disadvantages of requiring a stronger cover than would otherwise be necessary, a high degree of accuracy in fitting the cover, and redesigning of the high-tension contact which, in the present form, is more satisfactory.

In this construction, on the other hand, the bearing support is provided well toward the outer end of the distributor shaft where it is required, but no extension of the housing is necessary as the point of support on the housing is well back of the bearing point. The bearing is carried on the regular support plate and assembled with it as a unit. The cover design is not affected and the breaker arms and contacts are immediately accessible when the cover is removed.

Summing up these advantages, a distributor is obtained having a longitudinal dimension considerably less than that of other distributors suitable for the purpose. The construction is so arranged that both the internal assembly of the distributor and its attachment to the motor block are facilitated. Means has been devised to provide an outer bearing for the distributor shaft without the addition of other elements heretofore found necessary. The primary connection which has been devised not only permits the angular adjustment of the supporting plate but also facilitates the assembly of the distributor. Finally, the manifold connection is improved, both from the standpoint of permanence and assembly.

Some changes may be made in the arrangement, construction and combination of the several parts comprising the improved device without departing from the spirit of the invention, and it is the intention to cover by the claims such changes as may reasonably be included within the scope thereof.

We claim as our invention:

1. An internal-combustion engine distributor, comprising, a housing, a cover, a shaft journaled in said housing, support means rotatably mounted within said housing, said means carrying the distributor breaker arm assembly, a bearing bracket secured to said means and extending therefrom toward said cover, said bracket serving as an outer journal for said shaft.

2. An internal-combustion engine distributor, comprising, a housing, a cover, a shaft journaled in said housing and extending toward said cover, means supporting the distributor breaker arm assembly mounted in said housing and having a bearing bracket attached thereto, said bracket extending beyond said housing and serving as an outer journal for said shaft, a contact shoe mounted on said means, a primary contact on

said housing adapted to contact said shoe, said contact including a longitudinally movable member and resilient means normally urging said member into contact with said shoe.

3. An internal-combustion engine distributor, comprising, a housing, a cover therefor, a shaft journaled in said housing and extending into said cover, a support plate rotatably mounted in said housing and constrained against longitudinal movement with respect thereto, a bearing bracket attached to said means, said bearing bracket extending from said means beyond said housing toward said cover and serving as an outer journal for said shaft, primary connection means affixed to said first means and including a shoe having an extended contact surface, a contact in said housing including a longitudinally movable means mounted therein, resilient means normally urging said movable means into contact with said shoe and means by which the angular position of said supporting means with respect to said housing may be adjusted and secured.

4. An internal-combustion engine distributor, comprising, a housing, a cover therefor, a supporting plate rotatably mounted within said housing, means to regulate the angular position of said plate, a straddle bearing affixed to said plate and extending therefrom toward said cover, a shaft having one end journaled in said housing and journaled adjacent its outer end in said straddle bearing, a rotor secured to said shaft adjacent and beyond said straddle bearing, a primary contactor slidably mounted in the wall of said housing and resiliently urged to extend into the cavity formed therein, cut-away portions on said plate whereby said plate may be slid into said cavity past said contactor, a primary connecting shoe attached to said supporting plate, said shoe having a contact surface and extending cam surfaces communicating therewith, whereby, upon rotation of said plate, said cam surfaces will engage said contactor and engage it with the contact surface of said shoe.

5. A distributor, a housing, a cover therefor, a shaft journaled in said housing and extending toward said cover, a supporting plate adapted to be rotatably secured within the cavity of said housing, a straddle bearing affixed to said supporting plate and extending therefrom toward said cover, said bearing serving as an outer journal for said shaft, portions of the periphery of said plate being cut away, a contactor slidably mounted in the wall of said housing and resiliently urged to penetrate within the cavity formed thereby, a primary connecting shoe secured to said supporting plate and extending adjacent to the inner wall of said housing whereby said supporting plate is placed over said shaft and engaged within said cavity, said cut-away portion permitting the passage of said contactor with respect to said plate, and cam means forming a part of said shoe whereby upon angular rotation of said support plate, said contactor will engage said cam surfaces and be forced thereby into contact with said shoe.

6. An internal-combustion engine distributor, comprising, a housing, a cover therefor, a shaft journaled in said housing and extending therefrom toward said cover, a plate secured within said housing intermediate its extent, said plate being mounted for limited rotational movement with respect to said housing, a breaker arm assembly secured to said plate, a straddle bracket secured adjacent its ends to said plate, the midportion of said bracket extending from said plate toward said cover, a bushing in said bracket, said bushing being located beyond said housing and enclosed by said cover, one end of said bracket being formed into an extending ear, a contact shoe secured to said ear, and contact means on said housing resiliently engaging said shoe.

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