M. G. KOPF.

PRIMING DEVICE.

APPLICATION FILED SEPT. 8, 1914.

1,148,693.

Patented Aug 3, 1915.

2 SHEETS- SHEET 1.

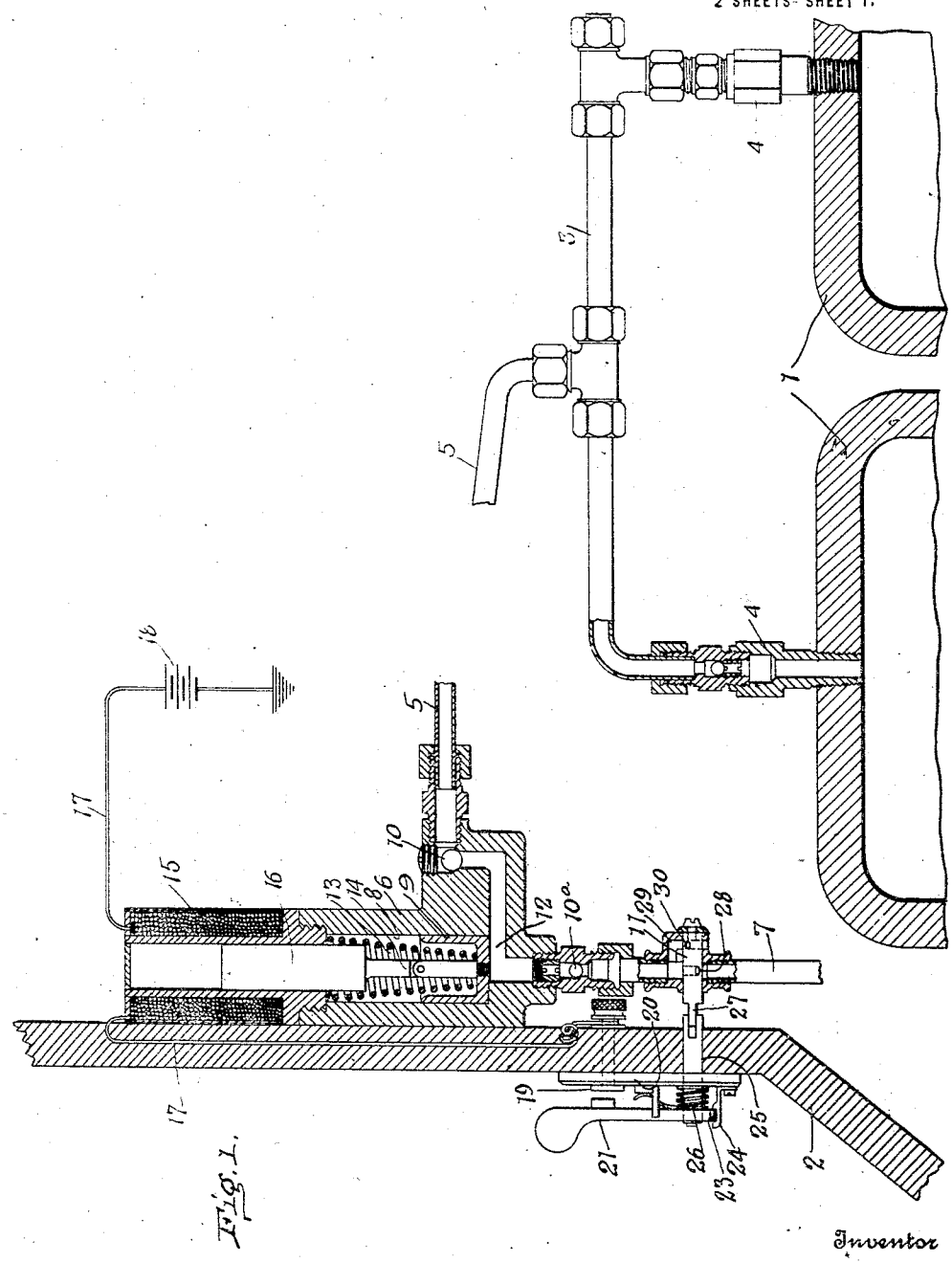


Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

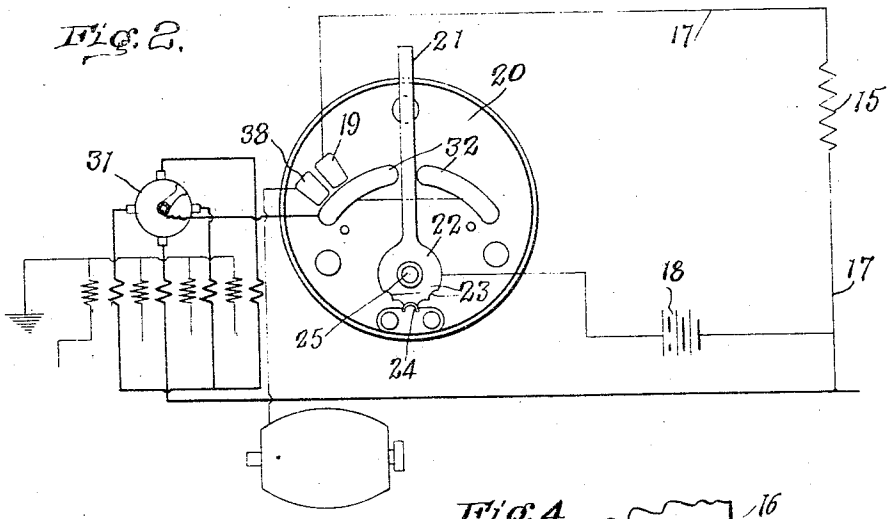


Fig. 3.

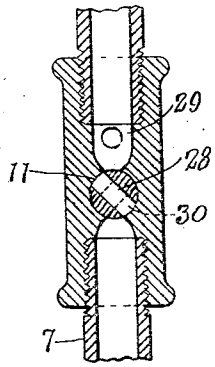
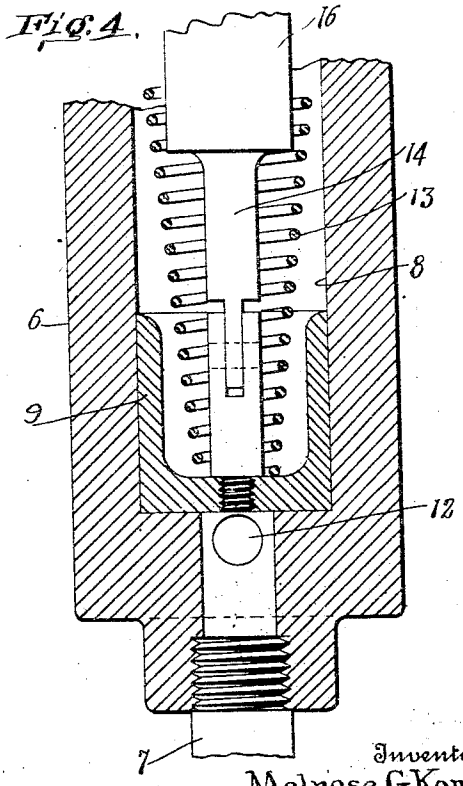


Fig. 4.



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UNITED STATES PATENT OFFICE.

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PRIMING DEVICE.

1,148,693. Specification of Letters Patent. Patented Aug. 3, 1915.

Application filed September 8, 1914. Serial No. 860,545.

To all whom it may concern:

Be it known that I, MELROSE G. KOPF, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Priming Devices, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to priming devices for internal combustion engines and, while the device is applicable to explosive engines of various kinds, it is designed more particularly for use in connection with automobile engines.

As is well known difficulty is often experienced, particularly in cold weather, in securing an initial explosion of such a character that it will start the engine into operation, this being due usually to imperfect carburation. This difficulty is experienced in connection both with engines which are started or "cranked" by hand and those which are started by means of a self-starter, which turns the engine over to cause the initial compression and explosion. When this difficulty is experienced it is customary to inject a quantity of raw gasolene into the several cylinders through special priming cocks. This, however, makes it necessary to raise the hood of the engine and use a special container to inject the gasolene into the cylinders. This is very inconvenient even when the engine is being cranked by hand and is especially so when a self starter is being used, because it makes it necessary for the driver to leave his seat, which would otherwise be unnecessary. Various attempts have been made to provide priming devices. In some instances a by-pass has been provided to carry the gasolene around the carbureter and directly to the engine, the gasolene being drawn through this by-pass by the suction in the cylinders when the engine is turned over. Other devices have been provided in an attempt to enable the driver to control the priming from his seat. None, however, have been satisfactory and the most, if not all of these devices, will cause the carbureter to be flooded because there is no means for determining or regulating the amount of gasolene that is injected into the cylinder. This flooding is particularly serious where the injection is made in the intake manifold as it is usually cold and the fuel injected therein is largely condensed before it reaches the cylinders.

The object of the present invention is to overcome these various difficulties and provide a priming device, the operation of which can be controlled by the driver from his seat to cause measured quantities of fuel to be injected directly into the cylinders.

A further object of the invention is to provide such a device which will be power operated and the operation of which will be controlled by a single controlling device, which will not only cause the operation of the injecting device or pump but will also control the valve which is interposed between the injecting device and the source of fuel supply.

Another object is to provide controlling means which will cause a single operation of the injecting device, which operation can be repeated as often as desired without further manipulation of the valve.

A further object is to provide such a device in which the valve may remain open while the injecting device is idle, thus permitting the fuel to be drawn into the cylinders by the suction of the pistons, and which will permit the regulation of the amount of fuel so drawn into the cylinders.

A further object of the invention is to provide such a device with an air inlet which will be controlled by the valve which controls the fuel supply and which may be adjusted to admit air to the cylinders when it becomes desirable to modify the mixture taken from the carbureter.

It is a further object of the invention to provide an injecting device or pump which will be very simple in its construction, positive in its operation and which, upon each operation thereof, will inject into the cylinders a measured quantity of fuel.

A further object of the invention is to provide a device of this kind in combination with an electric starter and to so arrange the controlling device that it will not only open the valve to cause the operation of the pump, but by a further movement will cause the operation of the self starter to cause the engine to be turned over; and a further object is to connect the ignition system with such controlling device so that when the controlling device is in any position except its neutral position the ignition circuit will be closed, in this manner reducing the number

of parts mounted upon the dash of the machine and rendering the arrangement more compact.

In the accompanying drawings, Figure 1 is a vertical sectional view, partly in elevation, of a mechanism embodying my invention; Fig. 2 is a plan view of the controlling device showing the circuits in diagram; Fig. 3 is a vertical sectional view of the controlling valve; and Fig. 4 is a sectional view of the pump cylinder taken at right angles to the section of Fig. 1.

In these drawings I have illustrated one embodiment of my invention and have shown the same as applied to an automobile engine, two cylinders of which are indicated at 1, and the dash of the machine in which the engine is mounted is shown at 2. It will be understood that the engines may be of any suitable type. In carrying out my invention I provide an injecting device or pump which is power operated and is preferably electrically controlled. This pump communicates with a source of fuel supply which may be either the supply tank for the carbureter or a special container and, where a special container is employed, ether, alcohol or any suitable highly volatile fluid may be used. The injector is connected with each cylinder of the engine whether it has one or six cylinders. The point of connection with the cylinders is optional. It may be either through the intake manifold, through the priming cups or, preferably, through a supplemental manifold connected with the cylinders. In the present instance I have employed a supplemental manifold which is shown at 3, and is connected with the heads of the several cylinders by means of nipples 4 which are inserted in the taps which ordinarily carry the priming cups, these cups having been removed. The manifold 3 is connected by means of a delivery pipe 5 with the injecting device or pump which is shown at 6 and which is connected by means of a pipe 7 with the source of fuel supply, be it either the gasolene tank or a special container.

The injecting device or pump may be of any suitable construction but preferably is of such a character that it may be caused to make a single operation at the will of the driver and that this operation will inject into the cylinders a predetermined quantity of fuel. In the present instance the device comprises a cylinder 8 in which is mounted a piston 9. This cylinder is connected at a point below the lowermost limit of movement of the piston with the supply pipe 7 and also with the delivery pipe 5. Check valves 10 and 10^a are interposed between the cylinder and the delivery pipe and supply pipe, respectively, and a positively actuated valve is provided to control the flow of fluid from the supply pipe 7 to the cylinder. In the present instance this valve is mounted in the supply pipe and is in the nature of a turn plug valve 11. The connections of the pipes 7 and 5 with the cylinder are preferably formed by means of a passageway 12 in the lower part of the cylinder which is of substantially the capacity of the pipes themselves and is entirely below the main portion of the cylinder. Consequently, there is no lost space within the cylinder in which the fluid may collect and further the bottom of the cylinder proper forms a positive limit for the downward movement of the piston.

Any suitable means may be employed for operating, and controlling the operation of, the piston in the cylinder. In the present instance I have employed a spring 13 coiled about a piston rod 14 and confined between the piston and the head of the cylinder, this spring serving to impart downward movement to the piston. Upward movement to the piston is preferably imparted by means of an electro-magnet which is here shown in the form of a solenoid 15 mounted on the upper end of the cylinder 8 and having its core 16 directly connected to, and, as here shown, formed integral with the piston rod 14. The solenoid is connected in a circuit 17 which is connected with a battery 18 and with one of the contact members 19 of a circuit breaker and closer, the other side of the circuit breaker and closer and the battery 18 are grounded in the frame of the machine in the usual manner. By closing the circuit through the solenoid the piston will be drawn upward against the tension of the spring, thus drawing a charge of fuel into the cylinder. When the circuit is broken and the solenoid deënergized the spring will force the piston downward, discharging the fuel through the delivery pipe to the cylinders of the engine. It will be obvious, however, that by providing the piston and solenoid core of sufficient weight gravity may be substituted for and will be the full equivalent of the spring 13. Inasmuch as the piston is moved to the limits of its movement upon each operation thereof it will be apparent that each operation of the pump will inject a measured quantity of fuel into the cylinders.

The circuit breaker and closer may be of any suitable character but is preferably coupled with the valve 11 so that this valve will be opened before the solenoid is energized. As here shown the circuit breaker and closer comprises a base plate 20 on one side of which is mounted the contact member 19 and on which is pivotally mounted a lever 21, and is of the character commonly known as a "kick switch"; these switches being arranged on the dash close to the foot-board where they can be readily engaged by the foot of the driver and operated. The switch

lever 21 has a disk 22, surrounding its pivot, which is provided along its lower portion with a series of notches 23 adapted to engage a resilient detent 24 which serves to hold the lever in adjusted positions. The switch lever 21 not only has pivotal movement but is also mounted for movement toward and away from the base plate. To this end it is rigidly secured to a pivot pin 25 which is slidably mounted in the base plate 20 and the dash 2. A spring 26 coiled about the pin 25 between the base plate and the switch lever tends to hold the switch lever outward and when in its outward position the lever is spaced such a distance from the base plate that the pivotal movement of the lever will not cause it to engage the contact member 19. The pivot pin 25 is slidably connected with the stem 27 of the valve 11 and the port 28 in the valve 11 is so arranged that when the lever is in its neutral position which, in the present instance, is its vertical position, the port will be out of alinement with the pipe 7 and the flow of the fluid will be prevented. The sliding connection is such that it will not be broken by the movement of the lever toward or away from the base plate 20, and the resilient detent 24 is elongated in such a manner as to permit this bodily movement without releasing the lever for pivotal movement. It will be apparent, therefore, that with the switch lever 21 in its neutral position, as shown in Fig. 2, the valve will be closed and the circuit through the solenoid will be broken. To insert a charge of fuel in the engine the lever is first moved about its axis toward the contact member 19 and is then moved inward to cause it to engage that member, the first movement opening the valve and the second closing the contact and energizing the magnet, thereby elevating the piston and drawing a charge of fuel into the cylinder. The lever is then released and the spring 26 moves the same outward, breaking the contact, deënergizing the solenoid and permitting the spring 13 to move the piston downward, thereby injecting a charge of fuel into the engine. In the ordinary operation the first two of these movements may be combined in a single movement, that is, as the lever is being thrown over about its axis it will also be pressed inward so that it will engage the contact member as soon as it has been rotated a sufficient distance. After the charge has been injected a spark is produced in the cylinder in any suitable manner, the usual method being to turn the engine over, by the use of the starting mechanism, or otherwise, to produce the spark in the usual manner. In the present instance I have combined the starting switch with the priming switch so that a single switch lever serves for both purposes. As here shown, a second contact 38 is mounted on the base plate 20 just beyond the contact 19. When the switch lever has been moved into engagement with the contact 19 instead of releasing the same it may be moved a notch further and brought into engagement with the contact 38, thus not only deënergizing the solenoid and causing a charge to be injected into the engine, but causing the starting mechanism to operate. If the engine does not start when first turned over a new charge may be injected therein by again moving the switch lever into engagement with the contact 19, this movement being such that it will not affect the position of the valve 11, it being understood that this valve remain open so long as the lever is in engagement with the contact members 19 or 38. Thus, repeated operations of the pump may be had without affecting the valve. Inasmuch as the valve remains open the fuel supply is directly connected with the engine and the action of the pistons in the engine cylinders, whether these be operated by an explosion in the cylinder or by starting mechanism, will serve to draw the fuel through the pipes 7 and 5 to the cylinders. Consequently, a charge of fuel is drawn into the cylinder when the pistons are operated even though the carbureter may not yet be operating properly.

If after the engine is in operation and before the engine and carbureter have warmed up to their normal operating condition, it is found the fuel supply is inadequate, this may be increased by manipulating the valve, independently of the injector to connect the engine with the supply tube 7, thus permitting an additional supply of fuel to be drawn into the cylinders through this pipe. As the engine approaches its normal condition this valve can be gradually closed and this additional supply reduced and finally cut off entirely. Likewise, it will also be apparent that inasmuch as the valve is capable of operation independently of the injector the supply pipe 7 can be connected with the engine at any time this additional supply of fuel is desired.

It sometimes happens when operating at a high speed, or under other conditions, that the air supplied by the carbureter is insufficient to provide a proper mixture and I have, therefore, provided means in connection with the priming mechanism for supplying the additional air to the cylinders and for positively controlling this supply. As here shown the casing of the valve 11 is provided with a by-pass 29 and the turn plug of the valve has a second port 30 arranged at an angle to the port 28 and adapted to be moved into alinement with the by-pass 29 only when the port 28 is in a position to prevent the flow of fuel through the pipe 7. Further, the port 30 is so arranged with reference to the port 28 and the switch

lever that when the lever is in its neutral position both the port 28 and the port 30 will be closed and neither fuel nor air will pass to the cylinder. When an additional quantity of air is desired it is only necessary to move the switch lever to the right, thus opening the by-pass and permitting the operation of the pistons to draw air through the by-pass and delivery pipe 5 into the cylinders. By adjusting the position of the valve the amount of air can be regulated. In this manner the richness of the mixture in the engine can be adjusted to accommodate it to temporary conditions without altering the adjustment of the carbureter.

There is necessarily a number of actuating and controlling devices on the dash board of the present day automobile and it is desirable to eliminate as many of these parts as possible and render the constructions as compact as may be. To this end it is also desirable to combine the ignition switch with the priming switch and starting switch, and I have connected the ignition devices, which are shown as a whole at 31, with contact plates 32 mounted on the base 20 and so arranged that when the switch lever is in its neutral position it will not engage either of these plates but as soon as it is moved from its neutral position it will engage one of the plates and close the ignition circuit. If desired, the valve mechanism may be so arranged with relation to the switch lever that one or the other of the ports 28 or 30 will not begin to open until the lever has been moved an appreciable distance, thus allowing the lever to be brought into engagement with one of the contact plates without moving the valve far enough to open either of the ports, thereby providing a secondary neutral position in which the switch lever is neutral as to all parts except the ignition. In addition to regulating the mixture in the cylinders it has been found that the passage of the air through the valves and chambers of the priming mechanism serves to cleanse these parts of oil or other matter which might adhere thereto and cause the parts to become gummy.

The operation of the priming device will be readily understood from the foregoing description of the several parts thereof and it will be apparent that by the manipulation of a single device I connect the injecting device with the source of fuel supply to cause the same to operate to inject a measured charge of this fuel into the cylinders of the engine. It will also be apparent that by the further manipulation of this controlling device or switch lever the starting device, which has been inoperative during the action of the priming device, can be set into motion. Further, by the manipulation of this same controlling device air can be admitted to the cylinders and the quality of the mixture therein regulated. Moreover, it will be apparent that the mechanism is very simple, very compact and is positive in its operation; that it can be mounted on the forward side of the dash-board without occupying the space that is otherwise needed, and the controlling device mounted on the rear side of the dash-board where it will be readily accessible and will not only occupy but little space but will combine in itself the control of a plurality of mechanisms, thereby eliminating from the dash-board separate controlling devices for these mechanisms.

While I have shown and described one embodiment of the invention it will be understood that this has been chosen for the purpose of illustration only and that I do not desire to be limited to the details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, and a valve to control the flow of fuel to said engine, of a single device to cause said valve and said injector to be separately operated, whereby one of said parts may be operated independently of the other.

2. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, and a valve to control the flow of fuel to said engine, of a single device operable to open said valve and to cause repeated operations of said injector while said valve is in its open position.

3. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, and a valve to control the flow of fuel to said engine, of a single device operable to open said valve, cause the operation of said injector and retain said valve in its open position independently of the operation of said injector.

4. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, and a valve to control the flow of fuel to said engine, of a controlling device for said valve and said injector, said controlling device being capable of two movements, one to open the valve and the other to cause the operation of said injector.

5. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, and a valve to control the flow of fuel to said engine, of a controlling device for said valve and said injector, said controlling device being capable of two movements, one to open the valve and the other to cause the operation of said injector, said controlling device being capable of repeated movements to cause the operation of said injector without moving said valve.

6. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply, connected with the cylinder of the engine and having a spring-actuated piston, a power operated device to move said piston against the tension of said spring, and a valve to control the flow of fuel to said engine, means to open said valve, to actuate said power device to move said piston and to release said piston to permit it to be operated by said spring.

7. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply, connected with the cylinder of the engine and having a spring actuated piston, and a valve to control the flow of fuel to said engine, of a controlling device movable into one position to open the valve and to cause said spring to be compressed and movable into another position to release said piston to permit it to be operated by said spring.

8. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply, connected with the cylinder of the engine and having a spring actuated piston, an electrically operated device to compress said spring, and a valve to control the flow of fluid to said engine, of a controlling device having one movement to open said valve, a second movement to close the circuit through said electrically operated device, and a third movement to break said circuit and permit said spring to operate said piston.

9. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine and having a spring actuated piston, an electrically operated device to compress said spring, and a valve to control the flow of fuel to said engine, of a controlling device having one movement to open said valve, a second movement to close the circuit through said electrically operated device and a third movement to break said circuit and permit said spring to operate said piston, and a detent to hold said valve in its open position without interfering with said second and third movements of said controlling device.

10. In a priming device for an internal combustion engine, the combination, with a cylinder communicating with a source of fuel supply and connected with the cylinder of the engine, and a piston mounted in the first-mentioned cylinder, of power-actuated mechanism to actuate said piston, and means under the control of the operator to cause said power-operated mechanism to cause a single movement of said piston in each direction.

11. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, said injector comprising a cylinder, a piston mounted therein, and means including an electro-magnet to cause a single complete movement of said piston in both directions, whereby a charge of fuel is injected into said cylinder.

12. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, said injector comprising a cylinder, a piston mounted in said cylinder, a spring to move said cylinder in one direction, and an electro-magnet to move said piston in the other direction, of a controlling device to cause said magnet to be energized and to release said piston.

13. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, and a valve to control the flow of fuel to said engine, of a controlling device adapted to open said valve and to close the circuit through said electrically operated device.

14. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, and a valve to control the flow of fuel to said engine, of a switch to control the flow of current to said electrically operated device and comprising a movable contact member, and a connection between said movable contact member and said valve.

15. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, and a valve to control the flow of fuel to said engine, of a switch to control the flow of

current to said electrically operated device comprising a part having movement in two directions, said part being connected with said valve, whereby the movement of said part in one direction will open said valve and its movement in the other direction will close the circuit through said electrically operated device.

16. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, and a valve to control the flow of fuel to said engine, of a switch to control the flow of current to said electrically operated device comprising a switch lever mounted for rotary movement about a fixed axis and for movement lengthwise of said axis, and a connection between said switch lever and said valve.

17. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, and a valve to control the flow of fuel to said engine, of a switch to control the flow of current to said electrically operated device comprising a switch lever mounted for rotary movement about a fixed axis and for movement lengthwise of said axis, a connection between said switch lever and said valve, and a spring tending to move said switch lever lengthwise of said axis.

18. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, and a valve to control the flow of fuel to said engine, of a switch to control the flow of current to said electrically operated device comprising a switch lever mounted for rotary movement about a fixed axis and for movement lengthwise of said axis, a connection between said switch lever and said valve, a detent to hold said switch lever against movement about its axis but to permit said movement lengthwise of said axis.

19. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, and a valve to control the flow of fuel to said engine, of a switch comprising a base having a contact member connected in the circuit of said electrically operated device, a switch lever pivotally mounted on said base for movement into and out of engagement with said contact member, said lever also being mounted for movement toward and away from said base and having a sliding connection with said valve, and a spring tending normally to move said lever away from said base.

20. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, power operated mechanism to actuate said injector and a power-operated starter for said engine, of a device to control the operating mechanisms of both said injector and said starter, whereby said device may be manipulated to cause a charge of fuel to be injected into a cylinder of the engine and the starter operated to actuate the piston of the engine.

21. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, and an electrical starter for said engine, of a switch comprising two contact points connected, respectively, with said electrically operated device and said electrically operated starter and also comprising a movable contact member, whereby said injector and said starter may be successively operated by the manipulation of said switch.

22. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, a valve to control the flow of fuel to said engine, and an electrically operated starter for said engine, of a switch comprising two contacts connected, respectively, with said electrically operated device and said electrically operated starter and also comprising a movable contact member, and a connection between said movable contact member and said valve, whereby one movement of said contact member will open said valve, another movement will cause the operation of said electrically operated device and another movement will cause the operation of said starter.

23. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, a valve to control the flow of fuel to said engine, and an electrically operated starter for said engine, of a switch comprising two contacts connected, respectively, with said electrically operated device and said electrically operated starter, and also compris-

ing a movable contact member, and a connection between said movable contact member and said valve, whereby one movement of said contact member will open said valve, another movement will cause the operation of said electrically operated device and another movement will cause the operation of said starter, said movable contact member having movement independently of said valve to cause the same to operatively engage said contact members, whereby said electrical devices may be repeatedly operated while the valve remains open.

24. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, an electrically operated device to control the action of said injector, a valve to control the flow of fuel to said engine, and an electrically operated starter for said engine, of a switch comprising two contacts connected, respectively, with said electrically operated device and said electrically operated starter and also comprising a movable contact member, a connection between said movable contact member and said valve, whereby one movement of said contact member will open said valve, another movement will cause the operation of said electrically operated device and another movement will cause the operation of said starter, said movable contact member having movement independent of said valve to cause the same to operatively engage said contact members, whereby said electrical devices may be repeatedly operated while the valve remains open, and a detent to hold said movable contact member against movement which would close said valve and permit said contact member to move into and out of engagement with the first-mentioned contact members.

25. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, and an air passage also communicating with said injector, of a single controlling device to close said air passage and to interrupt the communication between said injector and said source of fuel supply.

26. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, a valve to control the flow of fuel to said engine, said valve having an air passage, and also having a single member to control said fuel supply and said air passage, of a controlling device to operate said valve.

27. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, a valve to control the flow of fuel to said engine, said valve having an air passage, a single member to control said fuel supply and said air passage, of a controlling member to operate said valve member to open either one of said ports and to cause the operation of said injector.

28. In a priming device for an internal combustion engine, the combination, with an injector comprising a cylinder and a piston therein, a fuel delivery pipe connecting said cylinder with the cylinder of said engine, and a fuel supply pipe communicating with said injector cylinder, of a valve mounted in said fuel supply pipe and comprising a casing having a by-pass communicating with the atmosphere and with said injector cylinder, and a single valve member having ports to register, respectively with said fuel supply pipe and with said by-pass, said ports being so arranged relatively one to another that both ports cannot register with their passages at the same time.

29. In a priming device for an internal combustion engine, the combination, with an injector comprising a cylinder and a piston therein, a fuel delivery pipe connecting said cylinder with the cylinder of said engine, and a fuel supply pipe communicating with said injector cylinder, of a valve mounted in said fuel supply pipe and comprising a casing having a by-pass communicating with the atmosphere and with said injector cylinder, a single valve member having ports to register, respectively, with said fuel supply pipe and with said by-pass, said ports being so arranged relatively one to another that both ports cannot register with their passages at the same time, an operating device for said injector, and a controlling device connected with said operating device and with said valve member.

30. In a priming device for an internal combustion engine, the combination, with an injector communicating with the source of fuel supply and with a cylinder of said engine, and a valve to control the flow of fuel to said injector, of an electrically operated device for actuating said injector, an ignition circuit for said engine, and a controlling device comprising contact members connected with said ignition circuit and said electrical operating device, and a movable contact member adapted to engage either of said first-mentioned contact members and operatively connected with said valve.

31. In a priming device for an internal combustion engine, the combination, with an ignition circuit, an electrical starter, and an electrically operated injector communicating with a cylinder of said engine and with the source of fuel supply, and a valve to control the flow of fuel to said injector, of a controlling device comprising contact members, connected, respectively, with said ignition

circuit, said electrical starter and said electrically operated injector, and a movable contact member having parts adapted to engage said contact members and operatively connected with said valve.

32. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, and a valve to control the flow of fuel to said engine, of a controlling device to cause the operation of said valve and said injector, said controlling device being operable to adjust said valve independently of the operation of said injector.

33. In a priming device for an internal combustion engine, the combination, with an injector communicating with a source of fuel supply and connected with the cylinder of the engine, and a valve to control the flow of fuel to said engine, of means to cause the operation of said injector and to operate said valve independently of said injector.

In testimony whereof, I affix my signature in presence of two witnesses.

MELROSE G. KOPF.

Witnesses:
ROBERT K. LANDIS,
EDWARD N. REED.