To all whom it may concern:

Be it known that we, Gottlob Honold, a subject of the German Emperor, residing at and whose post-office address is Stuttgart Miliitstrasse 4, Germany, and Adolf Krauss, a subject of the German Emperor, residing at and whose post-office address is Cannstatt, Bryestrasse 8, Germany, have invented certain new and useful improvements in Priming Systems for Internal-Combustion Engines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

Our invention relates to a pump for introducing air and fuel into the cylinders of internal combustion engines and more especially of such engines as are started by hand or by aid of a starting motor. The object of our invention is to facilitate the starting of such machines. As is well known the usual hand crank does not produce a high velocity of the pistons. Even in case a starting motor is used the starting velocity is comparatively low; for such a motor must be as small as possible in order to keep the weight of the motor and the battery to be carried by the car as well as the cost of such motor as low as possible. Now the low starting velocity has the disadvantage that the carburetor furnishes a mixture of low igniting capacity and the magneto a less energetic igniting spark. As long as the internal combustion motor is warm, it will start easily notwithstanding these circumstances; however, when the motor is cold as will generally be the case during the winter after a longer stoppage, then the mixture produced with a low starting velocity cannot be ignited by the spark or will require a long starting time in order to be ignited.

This disadvantage is minimized in accordance with the present invention by means of a priming system containing a pump connected on one side with the float chamber of the carburetor and on the other side with the fuel inlet of the engine, the piston of the pump preferably containing an air valve, and the conduit connecting the cylinder of the pump with the engine inlet preferably containing a valve which establishes an air vent for the conduit when the pump is not operated, and closes the air vent when the pump is operated, whereby a measured quantity of fuel in the pump is forced into the engine inlet in an atomized condition preliminarily to starting the engine by means of the hand crank or the starting motor.

In the accompanying drawings, Figure 1 represents diagrammatically a priming system according to the invention; and Fig. 2 represents in vertical section a modified form of valve drawn to a larger scale.

Referring to Fig. 1, a is the float-chamber of the carburetor, e is the cylinder of the priming pump and forming a measuring tube, b is a pipe connecting the float chamber with the cylinder, d is the ball of a check valve arranged in the pipe b and adapted to move freely within the valve casing e so that whenever the level of the fuel within the carburetor is higher than in the measuring tube, the ball d is pressed by the liquid passing from chamber e to the tube e to the right into the open position. The piston f of the priming pump is provided with a ball valve g so arranged that when the piston is moved downwardly, the ball closes the inlet opening h, and when the piston is moved upwardly, air enters the cylinder below the piston through the openings j, k and l. From the lower part of cylinder c a pipe leads to the double-faced check valve m provided with a ball x adapted to move between the seats o and p. Seat p is connected with the open air, and seat o with the spray tube q passing through nozzle r and ending in the inlet pipe s of the motor. The float chamber of the carburetor is connected by a separate conduit a' with the inlet pipe s, the slide t' being opened when the pump is operated to prime the engine, and closing the pipe t when the engine is running in normal operation.

The operation of this device is as follows: Whenever piston f of the air pump is pressed downwardly, ball g will close opening h and the air within cylinder e is pressed down upon the liquid contained in said cylinder. At the same time the check valve d closes the pipe b leading to the carburetor e. In consequence thereof the petrol is pressed from the pump cylinder or measuring tube into pipe l and exerts a pressure upon the column of air contained within said pipe. Now this current of air and of the petrol fol-
lowing it has a high velocity, and since the pipe $l$ and seat $p$ have a small section, the air and petrol currents will, on account of the arrangement of the ball $n$ in its casing, act against the ball to move it from seat $o$ to seat $p$, so that this valve closes the connection with the free air and opens the spray tube $q$. Now the petrol flows through seat $o$ into the spray tube $q$ and is carried in a strong jet into the engine inlet $s$ where it is mixed with the air sucked in by the motor through the air pipe $t$, the slide $r'$ being open as shown in dotted lines in Fig. 1. When the pipes $l$ and $q$ are only partially filled with liquid, the quantity of air passed over from tube $c$ will flow with energy through the remaining petrol and will carry it into the engine inlet under a vigorous spraying action. As a great excess of air follows, also the particles of petrol adhering to the walls of the pipes are carried along by the air almost completely, thus causing a petrol spray to be produced in the engine inlet. Owing to this energetic spraying of the petrol its mixture with air and the igniting capacity of this mixture is rendered as perfect as possible. After the piston $f$ has reached its lowermost position, it is pulled upwardly, the ball $g$ immediately effecting the connection with the free air so that no vacuum is generated within the measuring tube. At the same time ball $n$ of the double-faced check valve will, owing to the flow in the pipe $l$ being stopped, fall back upon seat $o$ and will thereby place pipe $l$ under atmospheric pressure, so that the level of the liquid in tube $c$ will at once be equal to the level in the carbureter, where the liquid is constantly kept at the same level in a well-known manner. No disturbance of this automatic adjustment from the motor driven with low velocity by the hand crank or the starting motor can arise, as ball $n$ of the check valve closes the spray tube against the vacuum created in the engine inlet $s$. The quantity of air superposed on the quantity of petrol within the measuring tube is predetermined by the length of the path of the piston $f$; it is preferably made two or three times bigger so that for a given level in the carbureter the length of the measuring tube is predetermined. The connection between the pressure valve $m$ and the free air by aid of tube $p$ is provided for the reason that an ordinary spring-actuated pressure valve would impair the efficiency of the whole device for the following reasons:

1. The spring would have to be strong enough to prevent the pressure valve from being opened by the force of the suction created by the motor running at full speed as the motor must be prevented by all means from sucking in uncontrollable quantities of petrol from the float-chamber by going around the carbureter. Therefore such a pressure valve spring should be able to exert a rather strong pressure, but in this case the power to be exerted upon the piston would of necessity be far greater and the tightening of the piston would have to be far stronger thus causing the pump to be far less easily handled.

2. A check valve being placed under the pressure of a strong spring will, during the pressure stroke of the pump, open only a small section and will therefore throttle the supply of the petrol and air mixture. In consequence thereof a diminution of pressure will take place in the valve and this latter will act as a sprayer. This however will destroy the correct spraying effect, as in this case the mixture is sprayed into the tube $q$ instead of being merely sprayed into the mixture tube at the nozzle $r$. Therefore a spring-actuated pressure valve causes the spraying operation to take place at a wrong place, that is to say within the interior of the sprayer tube instead of in the nozzle. 3. If an ordinary pressure valve gets loose the motor will suck in petrol from the float chamber, the ordinary pressure valve having only a backward connection with the pump cylinder (through pipe $l$). Such a sucking in of uncontrollable quantities of petrol cannot be allowed. All these drawbacks are avoided by arranging the pressure valve as described, said valve opening the entire section of the passage to the spray tube with the greatest facility.

As at the beginning of the pressure stroke the current passing into the free air immediately will press the valve down upon its seat and said valve will open the spraying pipe completely, the valve does not oppose any resistance to speak of to the handling of the pump, and in consequence thereof, the piston need be rendered far less tight and can be handled much easier and more comfortably than in the case of a spring-actuated pressure valve.

As the valve will open the full section, the throttling of the mixture and an undesired spraying within the pipe is prevented. The current of petrol and air can pass freely through the spray pipe on to the nozzle and hence only the diminution of pressure takes place which causes the spraying to be effected. Therefore the use of a suitable valve allows of obtaining the right spraying in the mixture tube and owing to this auxiliary atomization the motor will start easily.

As the pressure valve chamber is connected during the normal position of the valve upon the lower seat $o$ through air pipe $p$ with the free air, in case that the valve should get loose, the motor will merely suck in some air from the atmosphere. The harm...
done in this case is far less important than in the case of petrol being sucked in from the float-chamber as is the case with a spring-actuated pressure valve.

With the modification described above, if a very slow movement is given to the piston, it may happen that the current of air passing through the air pipe of the pressure valve does not suffice to throw the ball of the valve upon its seat. By slowly pressing the piston farther down the petrol and the air would in this case pass through the pipe into the atmosphere and the motor would not be started. Although one may assume in general that the operator will press the piston down quickly, thus avoiding the danger mentioned, it is preferable to provide for the case of a too slow handling of the pump.

This can be effected by providing the valve body of the pressure valve \( m \) with a piston easily moving within the pipe connecting the valve casing with the outer air and having the shape of a cylinder as shown in Fig. 2. Here \( m' \) is the plug of the pressure valve having the form of a double-cone connected by a rod with a little piston \( u \) movable within a small cylinder \( v \) provided with openings connecting its interior with the free air. The cylinder \( v \) replaces the air passage \( p \) of the modification shown in Fig. 1. The piston \( u \) can move with some play within the cylinder \( v \).

It is easy to see that even at a very low velocity of the piston \( f \) either the escaping air or the petrol following it will cause piston \( u \) to be lifted with certainty, until valve \( m' \) is seated upon its upper seat. As piston \( u \) can move within cylinder \( v \) with some play, the movability of valve \( m' \) is not impaired.

In the embodiments represented in the drawings the spray pipe leading to the engine inlet forms the pressure chamber between the pump and the valve \( n \); it is however feasible to arrange a special pipe leading from the air chamber of the measuring tube or pump to the valve, said pipe effecting a connection in such a way that at the beginning of the spraying movement the valve is caused by the air jet escaping from the air pipe \( p \) to pass from the lower to the upper seat.

We claim:

1. In a priming system for internal combustion engines having a fuel inlet and a carbureter, a fuel pump connected between the engine inlet and the fuel float chamber of the carbureter, and valved connections which, when the pump is not operated, maintain in the pump a measured supply of fuel from the carbureter and air from the atmosphere and which, when the pump is operated, closes off the pump from the carbureter and the atmosphere and opens up the engine inlet to the pump so that the measured quantity of fuel and air passes into the engine inlet in the form of a spray.

2. In a priming system for internal combustion engines having a fuel inlet and a carbureter, a fuel pump connected between the engine inlet and the fuel float chamber of the carbureter, and valved connections which, when the pump is not operated, maintain in the pump a measured supply of fuel from the carbureter and air from the atmosphere and also closes off the engine inlet, and which, when the pump is operated, closes off the pump from the carbureter and the atmosphere and opens up the engine inlet to the pump so that the measured quantity of fuel and air passes into the engine inlet in the form of a spray.

3. In a priming system for internal combustion engines having a fuel inlet and a carbureter, a fuel pump connected between the engine inlet and the fuel float chamber of the carbureter, a valve in the connection between the pump and the fuel float chamber, and a three way valve in the connection between the pump and the engine inlet comprising a piston loosely fitting in a cylinder and carrying a plug which, when the pump is not operated, closes off the engine inlet and vents the pump to the atmosphere, and which, when the pump is operated, closes the vent to the atmosphere and opens the engine inlet to the pump to conduct a measured quantity of fuel and air from the pump into the engine inlet in the form of a spray.

4. In a priming system for internal combustion engines having a fuel inlet and a carbureter, a fuel pump having a cylinder and a piston with an air valve, a conduit connecting the cylinder with the fuel float chamber of the carbureter, a conduit connecting the cylinder with the engine inlet, valves in said conduits which, when the pump is not operated, establish communication between one side of the cylinder and the fuel float chamber and between the other side of the cylinder and the atmosphere to maintain a measured supply of fuel and air in the cylinder, and when the pump is operated, interrupt communication between the cylinder and fuel float chamber and substitute for the communication between the cylinder and the atmosphere a communication between the cylinder and the engine inlet so that the measured quantity of fuel and air passes into the engine inlet in the form of a spray.

In testimony whereof we affix our signatures, in presence of two witnesses.

GOTTLOB HONOLD.
ADOLF KRAUSS.

Witnesses:
P. WOLF, PAST,
ADOLF LEBBERS.