1595342

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Whereas JOHN T. LIGGETT,

of

Des Moines, Iowa,

PRESENTED TO THE **Commissioner of Patents** A PETITION PRAYING FOR THE GRANT OF LETTERS PATENT FOR AN ALLEGED NEW AND USEFUL IMPROVEMENT IN

VALVES FOR INTERNAL-COMBUSTION ENGINES,

A DESCRIPTION OF WHICH INVENTION IS CONTAINED IN THE SPECIFICATION OF WHICH A COPY IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND COMPLIED WITH THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED, AND

Whereas UPON DUE EXAMINATION MADE THE SAID CLAIMANT is ADJUDGED TO BE JUSTLY ENTITLED TO A PATENT UNDER THE LAW.

NOW THEREFORE THESE **Letters Patent** ARE TO GRANT UNTO THE SAID

John T. Liggett, his heirs OR ASSIGNS

FOR THE TERM OF SEVENTEEN YEARS FROM THE DATE OF THIS GRANT

THE EXCLUSIVE RIGHT TO MAKE, USE AND VEND THE SAID INVENTION THROUGHOUT THE UNITED STATES AND THE TERRITORIES THEREOF.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington this tenth day of August, in the year of our Lord one thousand nine hundred and twenty-six, and of the Independence of the United States of America the one hundred and fifty-first.

Attest:

Law Examiner.

Thomas E. Robertson
Commissioner of Patents.

Aug. 10, 1926. 1,595,342

J. T. LIGGETT

VALVE FOR INTERNAL COMBUSTION ENGINES

Filed Dec. 26, 1922 2 Sheets-Sheet 1

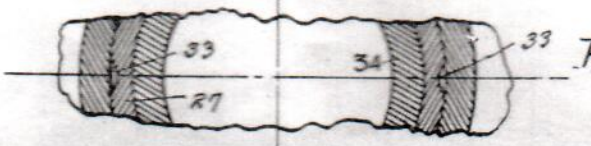


Fig. 4.

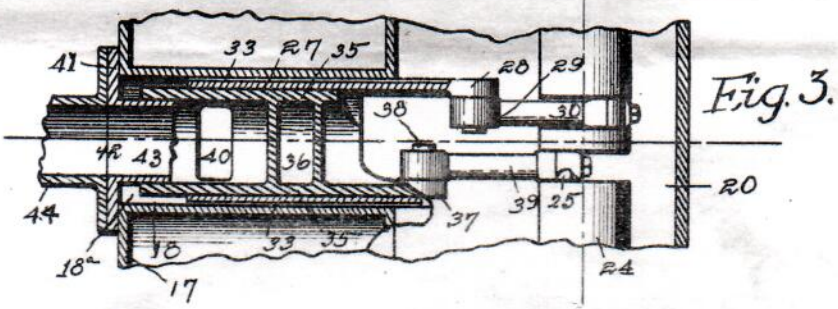


Fig. 3.

Fig. 1.

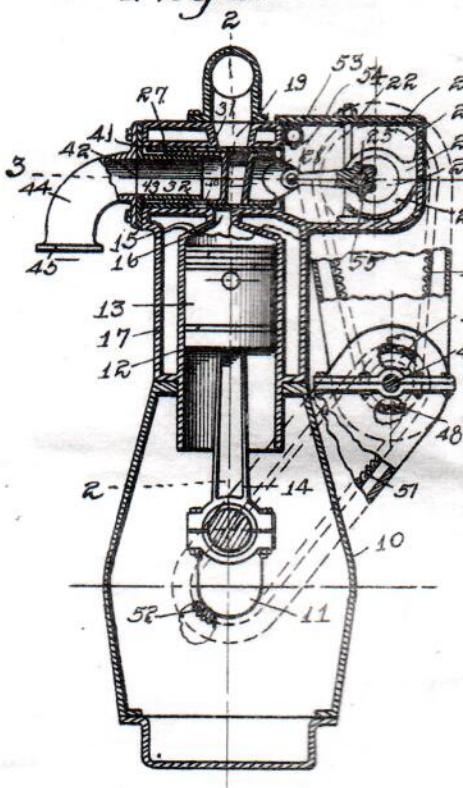
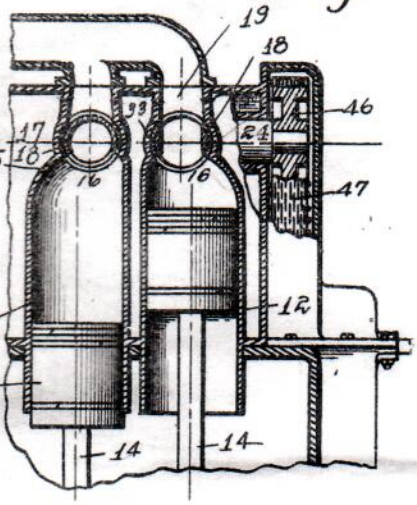


Fig. 2



Inventor.
John T. Liggett
by Owing & Hagan

Patented Aug. 10, 1926. 1,595,342

UNITED STATES PATENT OFFICE.

JOHN T. LIGGETT, OF DES MOINES, IOWA.

VALVE FOR INTERNAL-COMBUSTION ENGINES.

Application filed December 26, 1922. Serial No. 609,040.

This invention relates to an improved valve construction for internal combustion engines, and the object of which is to provide a comparatively simple, durable and inexpensive valve construction, which, when applied to an engine, will operate more efficiently and quieter than the ordinary puppet valve.

A further object is to provide a valve construction for internal combustion engines having intake and exhaust ports which are arranged to be brought into communication with a single port communicating with the combustion chamber of the engine, whereby the intake and exhaust gases will have to enter and be discharged through a single opening so that the intake charge will have a tendency to become heated as they enter the chamber, and further so that the said intake charge will have a tendency to cool certain portions of the valve mechanism.

A further object is to provide in a valve mechanism for internal combustion engines having a movable member capable of being intermittently moved into certain positions for conducting the heated products of combustion from the combustion chamber to the exhaust port, and capable of moving to other positions to close the said exhaust port, improved means for cooling and lubricating the said movable member.

More specifically it is the object of my invention to provide a valve mechanism for internal combustion engines of the reciprocating sleeve and piston type so arranged and constructed that the movable members will remain in contact during their sliding movement to thereby decrease the vibration and noise of the mechanism for operating the valves.

A further object is to provide a valve mechanism of the type above described so arranged and constructed that the parts may be easily and quickly assembled or taken apart for repairs.

These and other objects will be apparent to those skilled in the art.

My invention consists in the construction, arrangement and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 is a vertical, sectional view through an internal combustion engine having my improved valve mechanism applied thereto.

Figure 2 is a detail, sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a detail, sectional view taken on the line 3—3 of Figure 1.

Figure 4 is an enlarged, detail, segmental, sectional view of the valve cylinder and the valve mechanism to show the lubricating grooves or openings.

Figures 5, 6, 7 and 8 are diagrammatic views showing the valve mechanism in various positions of its movement.

The numeral 10 indicates the crank case of an ordinary internal combustion engine having a crank 11 and the usual cylinder 12 in which is slidably mounted the piston 13, said piston being connected to the crank by means of the connecting rod 14. The upper end of the cylinder is provided with a conical shaped head 15, the top of which is provided with an intake and exhaust port 16.

The cylinder 13 is preferably provided with an outer casing 17 to form a water jacket. The upper end of the casing 17 is provided with a series of cylindrical openings 18 which are arranged horizontally and are designed to have their lower sides in communication with the port 16, while their upper side is provided with an exhaust port 19, said exhaust port being located in the opposite side of the cylinder from the port 16, and considerably larger than the said port.

One end of the cylindrical opening 18 is in communication with a substantially rectangular compartment 20 which is cast integral with the casing 17. The compartment 20 is provided with a cover 21 which is secured in position by means of bolts 22, the ends of the compartments 20 are provided with bearings 23 in which is mounted a crank shaft 24, the said crank shaft being provided with twice as many cranks as there are cylinders for the engines. The said cranks are arranged in groups of two and adjacent to each other, and opposite the end of the cylindrical opening 18. The shaft 24 is of a larger diameter than the throw of the cranks, so that the crank or wrist pins 25 of the crank may be turned from the shaft and eccentric therewith, as clearly shown in Figure 1.

The compartment 20 is provided with a trough 26 which is located beneath the shaft

24 and designed to retain the proper amount of lubricant in such a manner that as the cranks are rotated, the connecting rods and valves, hereinafter to be described, will be properly lubricated by the oil from the trough.

The cylindrical opening 18 is provided with a sleeve 27 which forms one of the valves of my improved mechanism. The said sleeve is provided at its inner end and one side with an extension 28 which has an inwardly projecting pin 29, the said pin being designed to receive a connecting rod 30. The sleeve 27 is provided in its upper side with an opening 31 which is substantially midway between its ends. The lower side of the sleeve 27 is provided with a similar opening 32 opposite from the opening 31 and slightly near the outer end of the sleeve. The opening 32 is designed to be moved into and out of communication with the port 16. The sleeve 27 has each of its sides provided with a longitudinal groove 33 which is in communication with the compartment 20 at one end.

Slidably mounted in the sleeve 27 I have provided a piston valve 34 which is substantially a pair of cylindrical sleeves arranged end to end having their adjacent inner ends closed, said ends being spaced apart to form a port 35. The ends of the sleeves are connected together by the members 36, shown in transverse section in Figure 2.

The inner end of the piston valve 34 is provided with an extension 37 at the opposite side from the extension 28 and provided with an inwardly extending pin 38 which is designed to receive a connecting rod 39. The said connecting rod is secured to one of the crank pins 25, as clearly shown in Figure 3.

The bottom side of the outer end of the sleeve portion of the piston 34 is provided with an opening 40, which is designed to communicate with both the openings 32 and 16 when in one position of its movement, as shown in Figure 5.

The outer end of the opening 18 is provided with an end plate 41 secured in position as hereinafter will be described. The said plate 41 is provided with a centrally *located opening 42 which is provided with an inwardly extending sleeve 43, said sleeve* being of such diameter as to slidably enter the inner sleeve portion of the piston valve 34 so that the said piston valve may be slidably mounted between the sleeve 43 and the sleeve 27.

Secured to the outer end of the sleeve 43 I have provided an intake manifold 44, which may be any desired shape. The said intake manifold is provided with a flange 45 to which the carburetor may be secured.

In the specification I have just described one valve and the mechanism for operating the same, but it will readily be seen that the valves may be connected to an engine having a series of cylinders by providing the proper crank shaft for operating the valves and suitable intake and exhaust manifolds.

The crank shaft 24 may be operated by a gear mechanism similar to the one illustrated in Figures 1 and 2 or any other suitable mechanism, which will cause the shaft 24 to operate continuously at half the speed of the crank shaft 11.

The mechanism illustrated in the drawings for operating the said crank shaft consists of a gear 46 mounted on the end of the crank shaft designed to carry a chain 47 which is driven through a sprocket wheel 48 on the counter shaft 49, said counter shaft being driven by a sprocket wheel 50 designed to carry a chain 51 driven from the sprocket 52 of the crank 11.

For lubricating the valve mechanism I have provided a pipe 53 which is arranged horizontally and longitudinally with the crank shaft of the engine at the upper end and near the corner of the compartment 20. The bottom of the pipe 53 is provided with openings 54 which are immediately above each of the sleeves 27 and the piston valves 34 so when they are at their inner limit of movement, oil from the pipe 53 will be dripped on them. This oil will be distributed around the cylindrical facing of said sleeves and valves, and work in between their coacting faces by capillary attraction, as they are reciprocated.

The connecting rods 30 and 39 are each provided with a downwardly extending portion 55, which is designed to enter the oil within the trough 26. Some of this oil will be thrown into the ends of the pistons and sleeves, which will further assist in the lubrication. *Some of the oil will work into the outer end of the compartment 18ª of the* opening 18 formed between the sleeve 43 and the walls of said opening 18. This oil will assist in lubricating the outer ends of the sleeves 27 and 34.

By forming the grooves 33 in the sleeves 27 I have provided means which will assist in lubricating the outer ends of the sleeves 27 and 34. *It will be seen that as the sleeves are reciprocated between the sleeve 43 and the walls of the openings 18*, pressure or suction will take place in the said compartment 18ª, causing some of the oil from the compartment 20 to be drawn into the compartment 18ª through the grooves 33 as the suction takes place, and the excessive oil to be expelled again through said grooves as compression takes place.

As hereinafter described, it will be seen that when certain positions of the main crank are reached, the two pistons operate in the same direction at which time the suction and compression will take place. In

other positions of the crank, the two pistons will be moving in opposite directions, at which time comparatively no compresion or suction will take place, but the distribution of the lubrication between the valve members themselves will be thoroughly accomplished.

The operation of my improved valve is substantially as follows:

In the diagrammatic views I have used the solid lines to show the connecting rod 30 and its crank pin 30ª, while the dotted lines indicate the connecting rod 39 and its crank pin 39ª. Figure 5 shows the valves in that position in which the intake ports are at a maximum opening and in which the sleeve 27 is moving toward the left or to the outer end of the opening 18, while the piston valve 34 is moving slightly inwardly, the piston of the engine being at this time substantially at half stroke. The pins 30 and 39 are located in the shaft substantially at ninety degrees apart, the said pins having traveled through an angle of substantially ninety degrees in a direction indicated by the arrows.

It will be seen that the pin 39ª has traveled from such a position in which the piston valve 34 has moved from a point of maximum travel to a point of minimum travel, which would cause the products of combustion in the tube 43 to be moved inwardly and the momentum of the same established by the inward movement of said piston 34. When the valves have assumed such position that the intake ports are at their maximum amount of opening, the gases have already been set to an inward motion which is continued by the suction of the piston. This helps to increase the amount of combustible material that may be drawn into the cylinder. The crank 30ª is at this time at its maximum amount of movement outwardly, which will cause the intake to be rapidly closed at the end of the stroke.

In Figure 6 I have shown the valves in their closed position, and at the time when the engine piston is under compression. Figure 7 shows the crank moved through another ninety degrees in which the piston valve 34 is moved to position with the passage 36 in alinement with the passages 16 and 19.

Thus it will be seen that the sleeve 27 is at its active inward point of movement and just ready to open, which is accomplished before the piston has reached its full downward limit of movement on the combustion stroke.

It will be seen that a slight movement of the crank shaft 24 will cause the slots 31 and 32 to be moved into alinement with the passage 36 and the passages 16 and 19, as illustrated in Figure 8, at which time it will be seen that the products of combustion will readily and quickly exhaust from the engine cylinder. The pressure within the cylinder is reduced to a minimum very rapidly, thereby causing the heated gases to be discharged from the cylinder quickly and the heating of the cylinder walls and the pistons greatly reduced, which materially reduces the lubrication difficulties.

It will be seen that as the heated gases are discharged, the end walls of the sleeve portion of the piston valve will become heated. The left hand one of these walls, as illustrated in the drawings, is also the end of the intake sleeve, and is so arranged that the fuel will engage the said wall and cause the same to become cooled. The heating effect of the fuel is also beneficial.

Referring to Figure 5, and when the valves are in the position illustrated therein, and the charge is being drawn into the port 16 from the intake tube 43, it will be seen that the gases move longitudinally through the said tube and are moved downwardly through the ports causing them to move in a circular path and the heavier particles of unvaporized fuels will engage the said end plate, which will cause them to become vaporized, thereby producing a better mixture. The opposite end plate of the inner sleeve is cooled by the oil within the chamber 20 being splashed over its inner face through the splash pin before referred to.

The end plates of the sleeve portions of the piston valves are connected together by the members 35, which are comparatively thin, and which would prevent any material warping or twisting of the two sleeve members relative to each other, inasmuch as a very small amount of material is employed for securing the two sleeves together, and the two members 35 being spaced on opposite sides of the port, will receive substantially the same amount of heat, or in other words, are equally heated so the expansion or contraction will be the same.

I have found considerable advantage in forming the piston valve of two substantially independent sleeve members secured together by narrow or thin connecting members 35, over the ordinary form of a piston valve which is formed of comparatively a large amount of material having comparatively small openings through it, as I find that in piston valves of the solid type a great deal of warping is caused, due to the expansion and contraction of the metal as it is rapidly heated and cooled, which causes the valves to fit tight in the bearings.

When the sleeve 27 is in the position shown in Figures 6 and 7, it will be seen that a portion of its under surface is in actual contact with the heated gases of the combustion chamber, while combustion is being produced. The said heated portion of the sleeve is quickly drawn to the open position shown in Figure 8, in which it is

in direct contact with a water jacketed wall of the opening 18 at the point 56. This portion of the sleeve 27 is moved into substantially the inner end of the lower side of the opening 18, which is adjacent to the oil compartment 20, and the said inner end of the opening 18 being thoroughly lubricated. The said heated portion of the sleeve 27 will also become lubricated.

By this arrangement it will be seen that the sleeve 27 and the piston valve 34 will operate freely adjacent to each other, and their entire surfaces will always be sufficiently lubricated. The piston valve is always mounted inside of the sleeve 27, and never becomes heated, except the end plates forming the passage 36. These end plates are provided with adequate means for cooling.

By this arrangement all of the parts of the valve will be substantially uniformly heated. The higher the speed of the engine is, the more uniformly will the parts be heated, inasmuch as the heating and cooling takes place more rapidly and time is not given for any material change in temperature to take place. For this reason the valve is particularly adapted for high speed work.

By mounting the sleeve 43 slidably within the outer sleeve of the piston valve, it will be seen that I have provided means whereby any condensed liquid fuel will not enter the compartment 18ª or get between the sliding surfaces between the said sleeves or between the sleeves and the walls of the opening 18. This is also of material advantage in any sleeve valve construction, as any such liquid fuel thins the lubricant, and breaks down its lubricating qualities.

By this arrangement it will be seen that I have produced a valve mechanism of comparatively simple, durable and inexpensive construction, and one which may be easily and quickly taken apart for repairs or renewal. The said valve is removed by simply removing the sleeve 43 and the intake manifold connected therewith, and also removing the cover member of the compartment 20, after which the connecting rods may be removed from the crank pins by the usual method, after which the said connecting rods may be slipped from the pins 29 and 38. The sleeves may then be pulled out through the outer end of the opening 18.

It will be seen that the sleeves may be operated either horizontally or vertically without departing from the spirit of my invention.

I claim as my invention:

1. A cylinder head for internal combustion engines provided with a cylindrical valve opening, a compartment adjacent to one end of said opening and in communication therewith, a sleeve valve slidably mounted in said cylindrical opening, said sleeve valve being provided with a longitudinal lubricating groove extending throughout the entire length of its side wall member, a piston valve slidably mounted within said sleeve, means mounted in said compartment for independently operating said sleeve and said piston valves, a detachable plate for covering the exterior end of said cylindrical opening, said plate having a sleeve projecting inwardly and slidably mounted within said piston valve, said sleeve and the said plate being designed to form a compartment for the adjacent ends of said sleeve and piston valves, said lubricating groove being designed to form a passage whereby lubrication may be distributed from the first said compartment to the second said compartment through the suction formed by the action of the valve within the second compartment.

2. In combination, a cylinder head having a cylindrical opening open at each end with a port for communicating with the combustion chamber of an engine and an exhaust port opposite the first said opening, a compartment in communication with one end of said cylindrical opening, a crank shaft in said compartment provided with a set of wrist pins, a sleeve slidably mounted in said cylindrical opening, said sleeve being provided with oppositely arranged openings designed to communicate with said ports, the inner end of said sleeve having an extension, an inwardly extending pin on said extension, a connecting rod for said pin and one of the wrist pins of said crank, said sleeve being provided with a longitudinal lubricating groove extending through the entire length of its outer side wall members, a piston valve slidably mounted within said sleeve comprising substantially two abutting sleeves, the adjacent ends of said sleeve being provided with a head spaced slightly apart, comparatively thin and narrow walls for connecting the opposite side edges of the end members of said sleeves, the inner one of said sleeve members of said piston valve being provided with an extension, a laterally extending pin for said extension, a connecting rod carried by said pin and the other one of said wrist pins, the opposite sleeve member of said piston valve being provided with an intake opening in one of its side wall members designed to communicate with one of the openings of said sleeve and with the first said port opening of said cylindrical opening and one of the openings of said sleeve when said piston valve is in certain position of its movement, the outer end of said cylindrical opening being closed with a plate having a sleeve extending inwardly and slidable within the inner sleeve member of said piston valve.

3. In combination, a cylinder head having

a cylindrical opening open at each end, a port for communicating with the combustion chamber of an engine and an exhaust port opposite the first said opening, a compartment in communication with one end of said cylindrical opening, a crank shaft in said compartment provided with a set of wrist pins, a sleeve slidably mounted in said cylindrical opening, said sleeve being provided with oppositely arranged openings designed to communicate with said ports, the inner end of said sleeve having an extension, an inwardly extending pin on said extension, a connecting rod for said pin and one of the wrist pins of said crank, said sleeve being provided with a longitudinal lubricating groove extending through the entire length of its outer side wall members, a piston valve slidably mounted within said sleeve comprising substantially two abutting sleeves, the adjacent ends of said sleeve being provided with end members spaced slightly apart, comparatively thin and narrow walls for connecting the opposite side edges of the end members of said sleeves, the inner one of said sleeve members of said piston valve being provided with an extension, a laterally extending pin for said extension, a connecting rod carried by said pin and the other one of said wrist pins, the opposite sleeve member of said piston valve being provided with an intake opening in one of its side wall members designed to communicate with one of the openings of said sleeve and with the first said port opening of said cylindrical opening and one of the openings of said sleeve when said piston valve is in certain position of its movement, the outer end of said cylindrical opening being closed with a plate having a sleeve extending inwardly and slidable within the outer sleeve member of said piston valve, and means within said compartment for lubricating the inner ends of said piston valve and said sleeve when at their inner limit of movement.

4. In combination, a cylinder head having a cylindrical opening open at each end, a port for communication with the combustion chamber of an engine, a compartment in communication with one end of said cylindrical opening, an exhaust port opposite the first said opening, a sleeve valve slidably mounted in said cylindrical opening, said sleeve valve being provided with oppositely arranged openings designed to communicate with said ports, a piston valve slidably mounted within said sleeve comprising substantially two abutting sleeves, the adjacent ends of said sleeves being provided with end members spaced slightly apart, comparatively thin and narrow walls for connecting the opposite side edges of the end members of said sleeves, means for actuating said sleeve and said piston valves, one of the sleeve members of said piston valve being provided with an intake opening and one of its side wall members designed to communicate with one of the openings of said sleeve and with the first said port openings of said cylindrical opening, and one of the openings of said sleeve when said piston valve is in a certain position of its movement, the outer end of said cylindrical opening being closed with a plate having a sleeve extending inwardly and slidably mounted within the inner sleeve member of said piston valve, said sleeve being provided with a longitudinal lubricating groove extending throughout the entire length of its outer side wall members.

Des Moines, Iowa, December 20, 1922.

JOHN T. LIGGETT.