No. 794,167. PATENTED JULY 11, 1905.

# W. B. FEATHERSTONE.

## LUBRICATOR.

APPLICATION FILED OCT. 25, 1902.

2 SHEETS—SHEET 1.

Fig. 2.

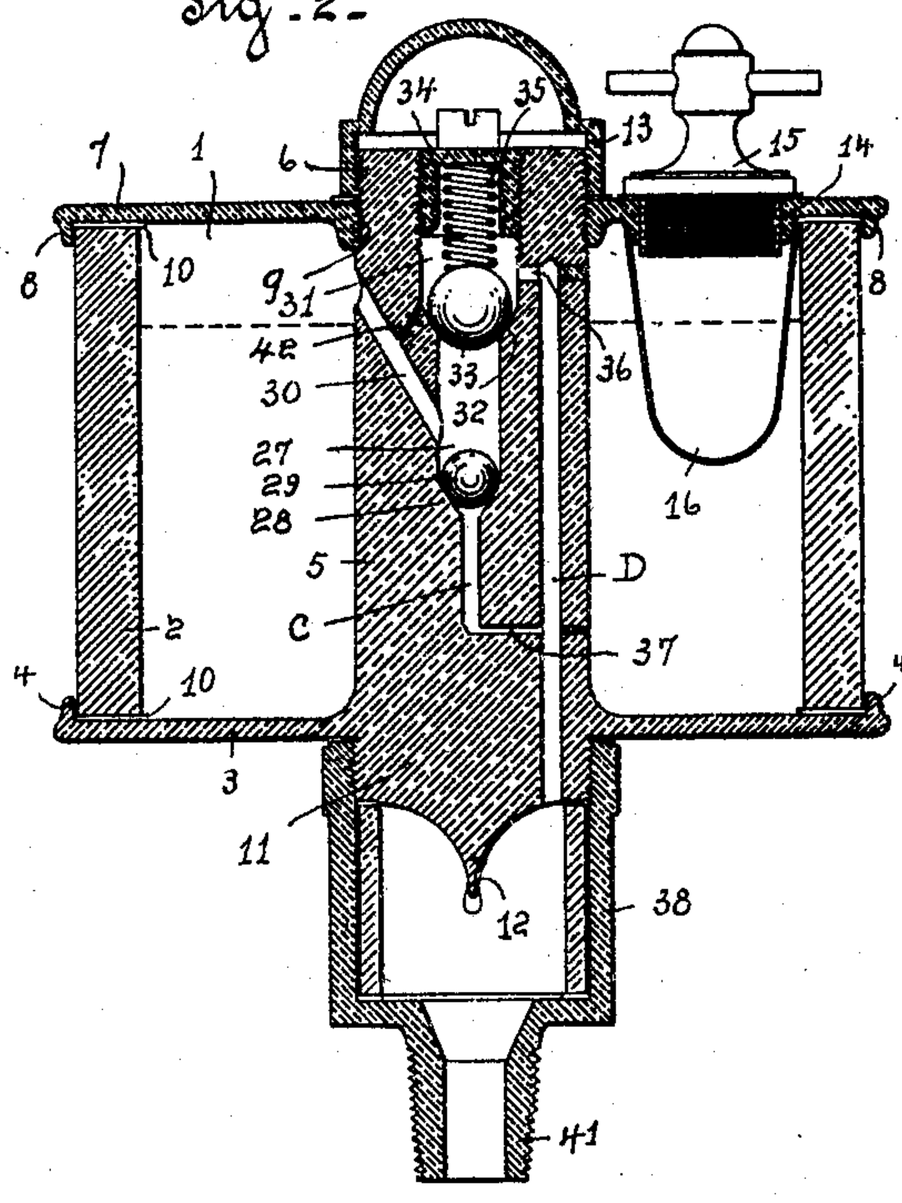



Fig. 3.

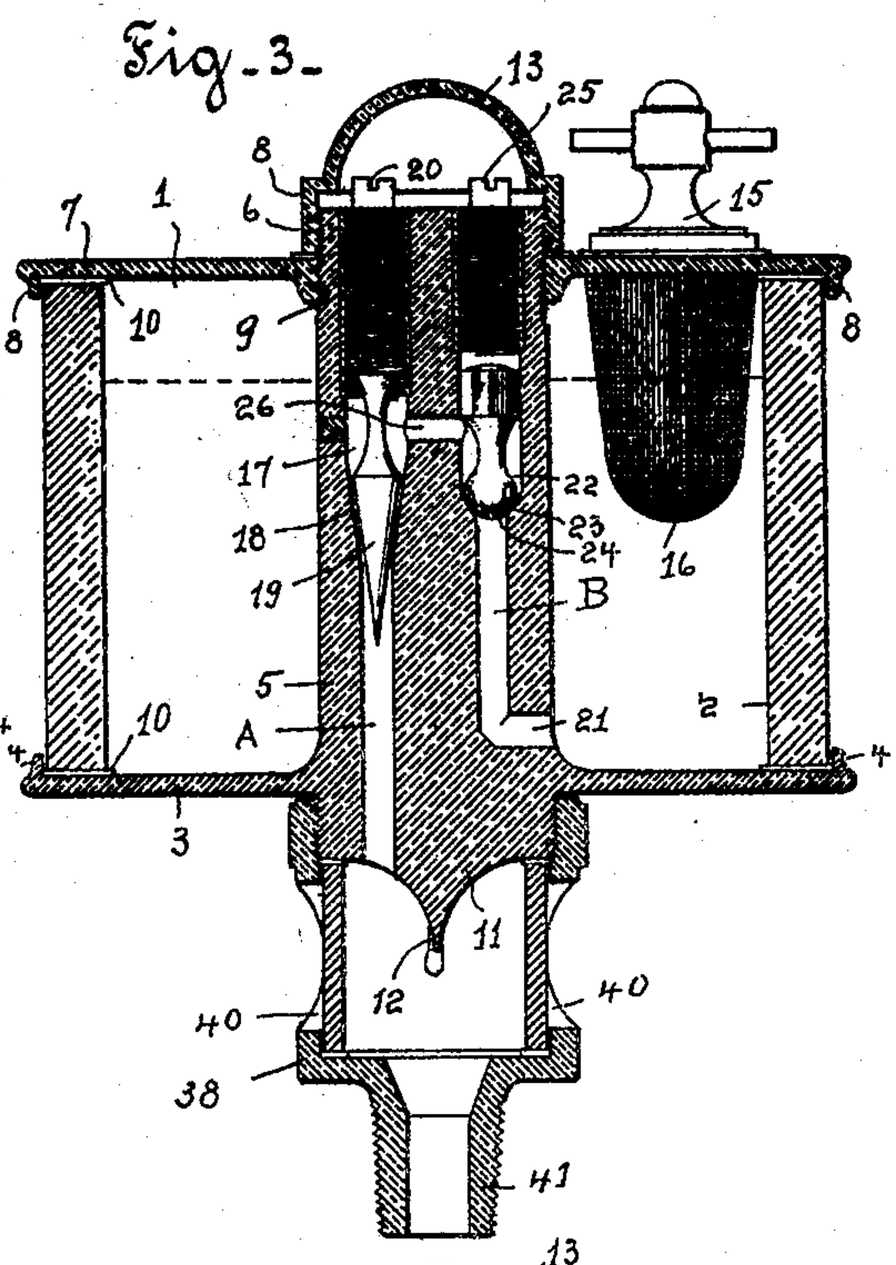



Fig. 1.

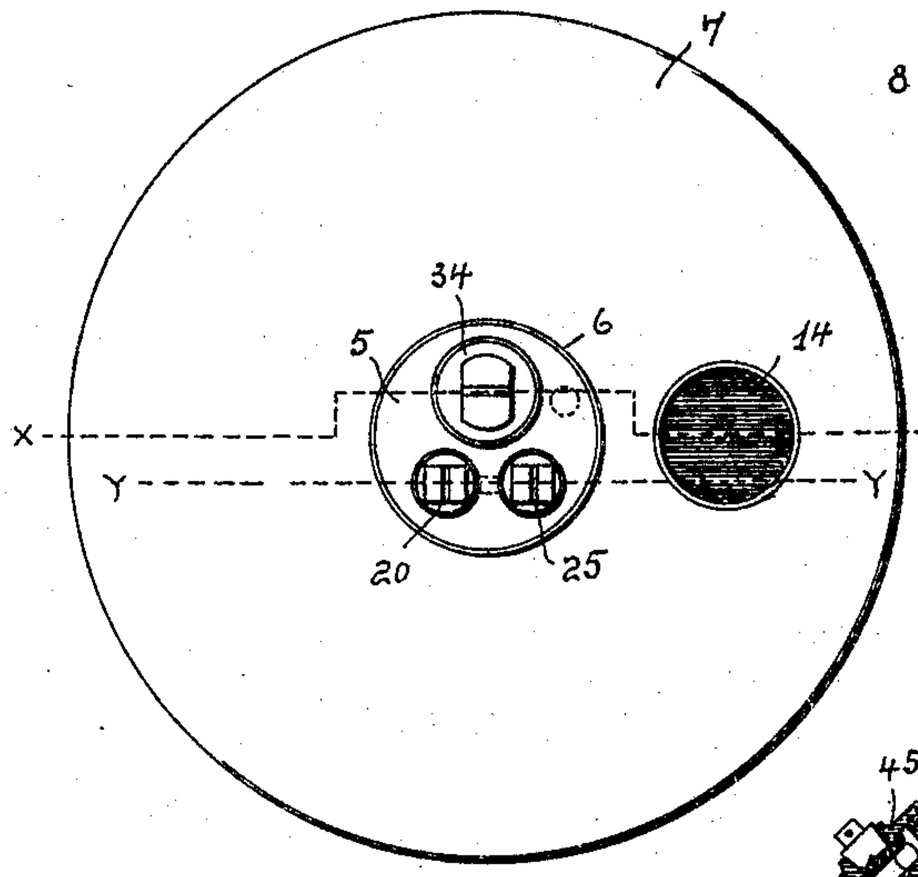
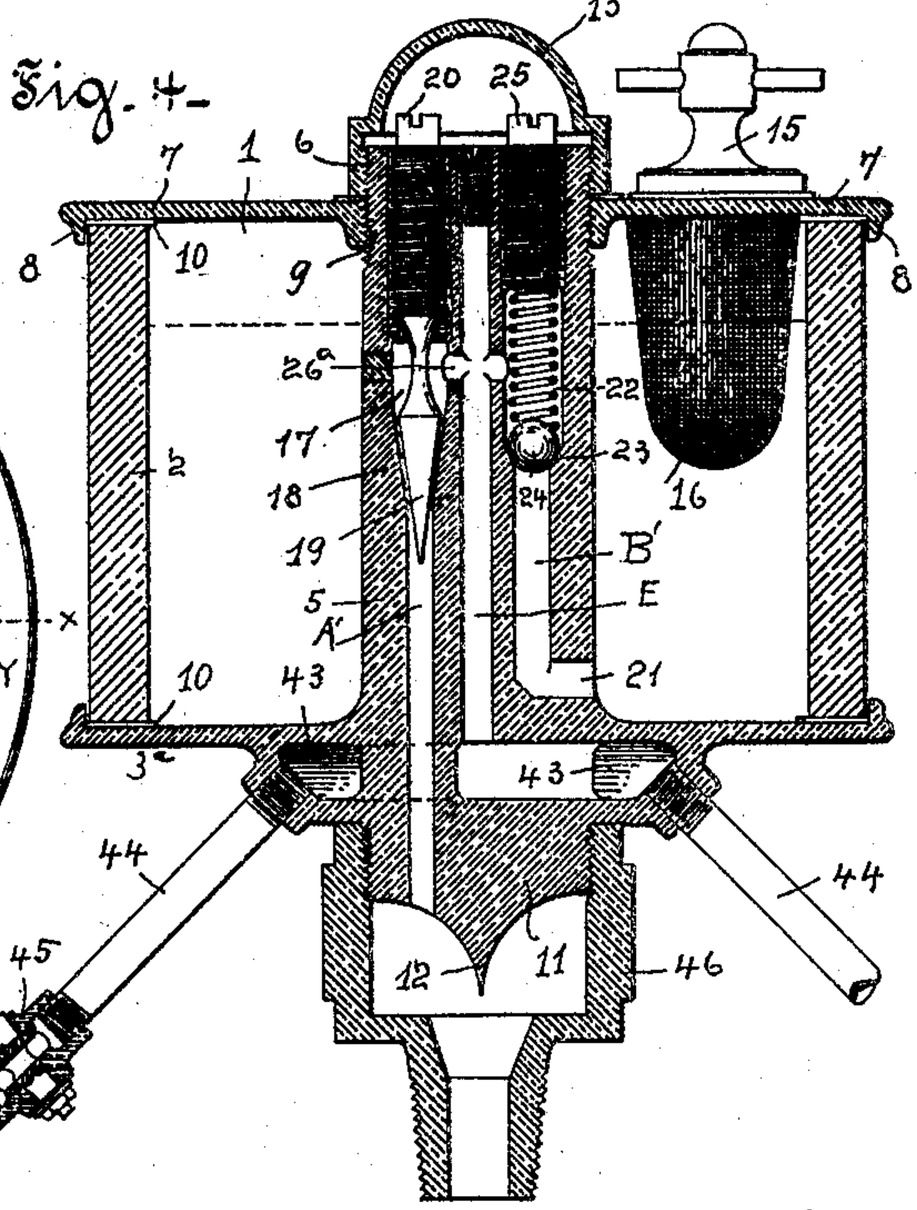



Fig. 4.

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## LUBRICATOR.

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2 SHEETS—SHEET 2.

Fig. 5.

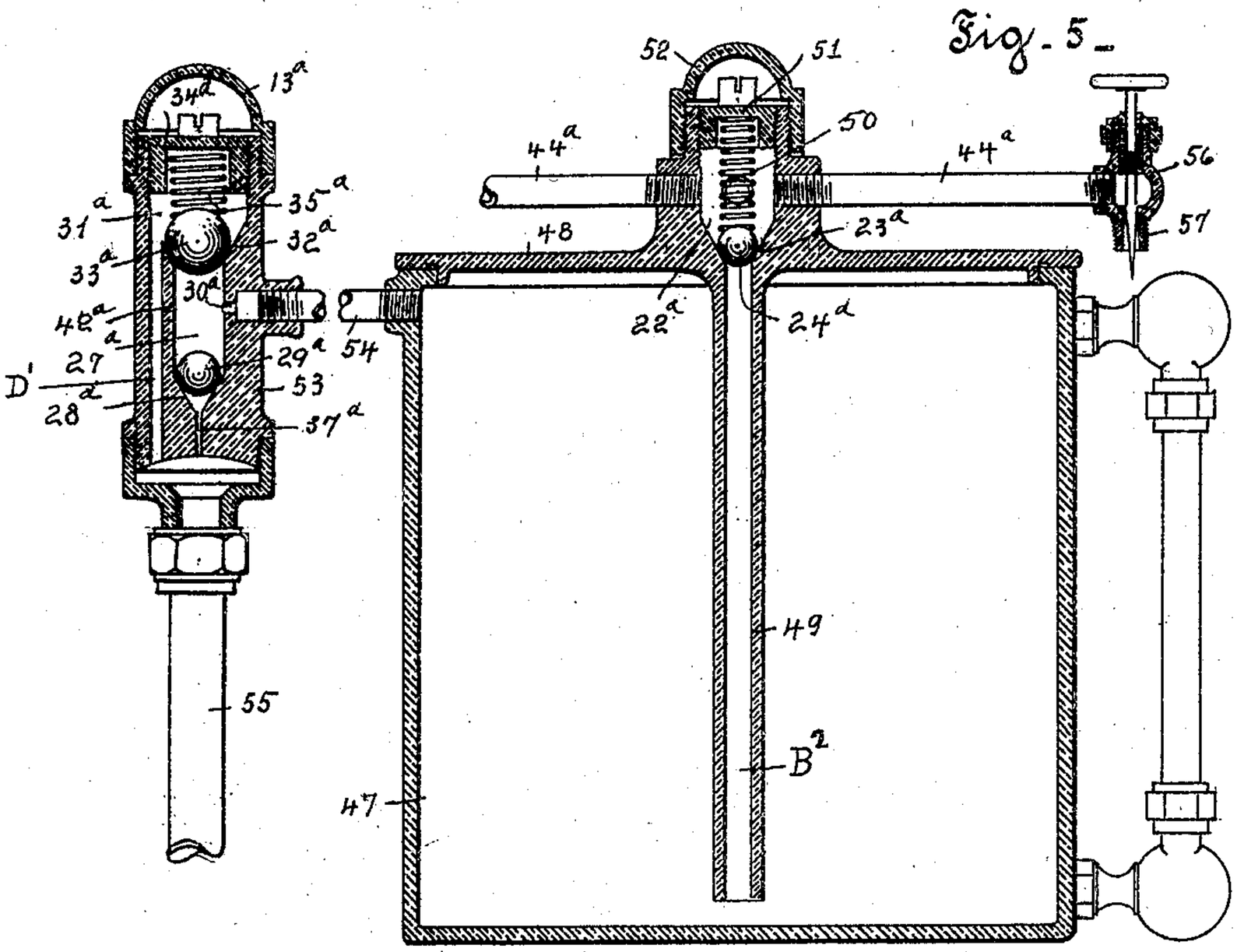
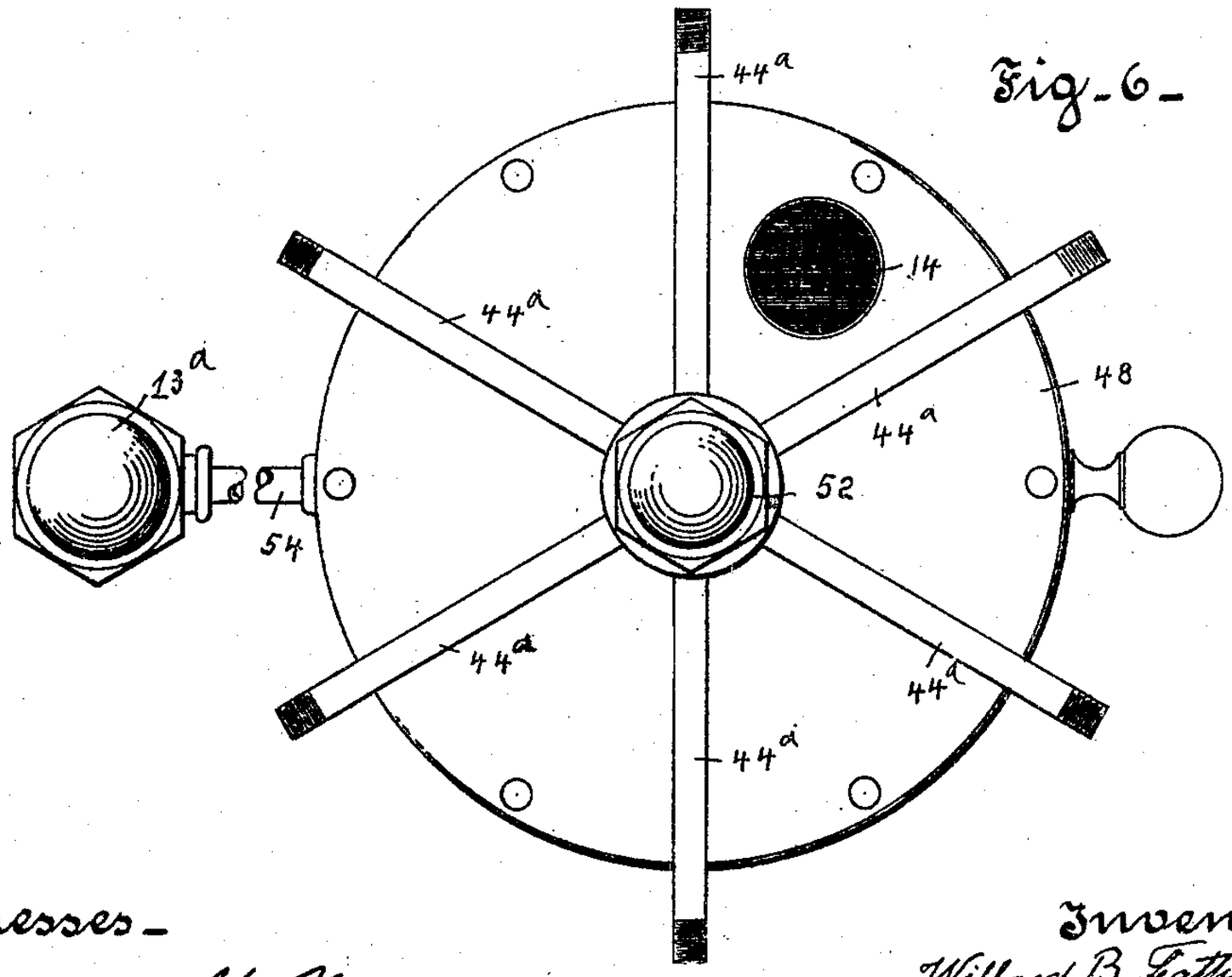



Fig. 6.

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No. 794,167. Patented July 11, 1905.

# UNITED STATES PATENT OFFICE.

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## LUBRICATOR.

SPECIFICATION forming part of Letters Patent No. 794,167, dated July 11, 1905.

Application filed October 25, 1902. Serial No. 128,734.

*To all whom it may concern:*

Be it known that I, WILLARD B. FEATHERSTONE, a citizen of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented a new and useful Improvement in Lubricators, of which the following is a specification.

My invention relates to that class of lubricators in which the lubricant is delivered under pressure, and has for its object to produce a device of the kind that is adapted to utilize for the purpose varying elastic-fluid pressures. In gas-engines there are two sources of elastic-fluid pressure available for the purpose—viz., the pressures arising from successive explosions of compressed gas and the periodic compression of air in the crank-case by the piston. The pressures arising from the explosion of compressed gas are available either by direct connection with the cylinder or with the exhaust. In each of these three sources there is a periodic variation of pressure from normal atmospheric to a maximum higher pressure and back to normal atmospheric pressure in the nature of a succession of short quick pulsations.

A further object of my invention is to provide means of connecting to either of these sources a lubricant-reservoir having a main feed-outlet for the lubricant adapted to be connected to working parts, whereby while the pressure in the source is increasing compressed elastic fluid therefrom will be admitted to the reservoir and the pressure in the reservoir will be raised to a degree less than the maximum pressure in the source, and while the pressure in the source is diminishing to the normal will permit a limited return of elastic fluid from the reservoir to the source whenever the pressure in the reservoir exceeds a predetermined work-pressure therefor, thereby maintaining a substantially uniform pressure in the reservoir while the engine is in operation, and, furthermore, that is adapted when the engine is at rest to automatically restore an equilibrium at normal atmospheric pressure between the source and the reservoir.

I accomplish these objects by the novel construction and combination of parts hereinafter described, claimed, and illustrated in the drawings, in which—

Figure 1 is a top plan view of a lubricator constructed in accordance with my invention and adapted to the use of oil as a lubricant. Fig. 2 is a vertical section of the same on the line X X of Fig. 1. Fig. 3 is a like view on line Y Y of Fig. 1. Fig. 4 is a like view of a modified form of my lubricator having an integral distributing-chamber provided with multiple outlets. Fig. 5 is a transverse vertical section through a modified form of a lubricator in which the pressure-ducts and pressure reducing and regulating valves are separated from but suitably connected to the lubricant-reservoir. Fig. 6 is a top plan view thereof, showing a plurality of outlets arranged radially around the distributing-chamber, which is located at the top of the reservoir.

Referring to the drawings, 1 is an oil-cup, comprising the glass cylinder 2, the bottom closure 3, provided with an annular flange 4 around its rim to receive the bottom end of the cylinder, and the central column 5, having its top end portion 6 exteriorly threaded, the top closure 7 having an annular flange 8 around its rim adapted to receive the top end of the cylinder and having a central orifice 9, interiorly threaded adapting the top closure to be run down on the threaded end portion of the column 5, and the packing-rings 10, interposed between the ends of the cylinder and the top and bottom closures, respectively.

The column 5 is provided with a lower end extension 11 between the bottom closure and which for a distance is exteriorly threaded and then tapered to a point at the free end to form a drip 12.

The threaded upper end portion 6 of the column 5 extends above the top closure 7 when the latter is closed down upon the top end of the cylinder 2 and is provided with a closed cap 13, which is interiorly threaded and adapted to be run down as a lock-nut for the top closure upon the upper end portion of the

column 5. Closure 7 is also provided with a filling-orifice 14 and closure-plug 15. To the under side of the top closure 7, around the orifice 14, is secured the oil-strainer 16.

In charging the cup with lubricant a suitable air-space is left at the top for the admission of compressed elastic fluid.

Column 5 is provided with oil-conduits A and B and the pressure-conduits C and D, extending longitudinally of the column, conduit A extending entirely and the conduits B, C, and D partially through the column.

Oil-conduit A is provided with an enlargement, forming a valve-chamber 17, which at the lower end is provided with a valve-seat 18 for the needle-valve 19. The upper end 20 of the needle-valve 19 is slotted, as a screw-head, and squared for a wrench to provide means for adjusting the valve.

Oil-conduit B extends from the top of the column 5 nearly to the level of the inner bottom of the cup 1 and is connected by the intersecting conduit 21 with the interior of the cup near the bottom closure 3. The conduit B is also provided with a valve-chamber 22, in the lower end of which is formed a valve-seat 23 for the check-valve 24. The top portion of the valve-chamber 22 is interiorly threaded to receive the threaded closure-plug 25, the top end of which is also slotted and squared for a wrench as a means of screwing the plug into and out of its seat. Valve 24 is preferably of such weight that slightly more than normal atmospheric pressure on the oil in the cup is required to lift the valve from its seat and permit the oil to rise in the conduit B to the level of the oil in the cup.

Valve-chambers 17 and 22 are connected by the cross-conduit 26, and the conduits A and B thus connected constitute a feed-outlet for the lubricant in the reservoir, extending from the intake 21 upward through the conduit B to valve-chamber 22, thence through the cross-conduit 26 to the chamber 17, and thence downward through the conduit A to the drip-point 12.

Pressure-conduit C, which extends in column 5 a suitable distance from the top, is enlarged to form a valve-chamber 27, in the lower end of which is formed a valve-seat 28 for the check-valve 29, and the valve-chamber 27 is connected with the interior of the cup 1 by the pressure-conduit 30 having its opening into the cup near the top closure.

Above valve-chamber 27 conduit C is further enlarged to form valve-chamber 31, having its lower end formed as a seat 32 for the weighted pressure-regulating valve 33, and its upper end portion is interiorly threaded a suitable distance to receive the exteriorly-threaded hollow plug 34, within the bore of which is inserted the helical spring 35, adapted to load the valve 33. The top end of the plug 34 is both squared for a wrench and slotted as a screw, whereby the plug is adapted to adjust the pressure of the spring on the valve.

Adjacent to the pressure-conduit C is the pressure-conduit D, extending into the column 5 from the bottom end to a point near its top, and the top portion of conduit D is connected with the valve-chamber 31 by the cross-conduit 36. The conduit D is also connected with the lower end of the conduit C by the reduced pressure-duct 37. The conduits C and D thus connected by the cross-ducts 36 and 37 form a two-way passage from the lower portion of the conduit D to the conduit 30, with the back check-valve 29 controlling one passage and adapted to open under pressure from conduit D and to be closed by greater pressure in the cup 1, and also with the relief-valve 33 controlling the other passage, said valve being held normally closed by the spring 35, and also adapted to be held closed by pressure in conduit D and to be opened by pressure in the cup 1 when the pressure in the conduit D is less than the pressure in the cup and the pressure in the cup is greater than the resistance of the spring 35.

To the lower extension 11 of the column 5 is attached a sight-feed 38, having glazed openings 40, through which the feed of the lubricant from the drip-point 12 may be readily observed. The lower end of the stem of the sight-feed is provided with a diametrically-reduced portion 41, which is exteriorly threaded for attaching the cup 1 to the cylinder or crank-case of a gas-engine or other source of pulsating or varying pressure.

The cup thus constructed being suitably charged with oil and connected to the closed crank-case of a gas-engine by the portion 41 of the lower extension 11 of the column 5 will operate as follows: At each stroke of the piston the air in the crank-case will be compressed above normal atmospheric pressure and a jet of compressed air will traverse the pressure-conduit D and the cross-duct 36 to the valve-chamber 31 above the weighted valve 33, thereby adding pressure to the weight of the valve and the resistance of the spring 35 to hold the valve in its seat. A smaller jet of less pressure is also admitted through the reduced duct 37 to the conduit C sufficient to lift the valve 29 and cause pressure, reduced below the maximum, to be exerted upon the oil in the cup through the conduit 30. Upon each return stroke of the piston the pressure in conduit D is reduced to the normal and below the pressure in the cup, whereby the valve 29 is seated and prevents the escape of compressed air from the cup through the duct 37. The pressure being also withdrawn from the top of valve 33, if the pressure in the cup has been raised above the weight of that valve, as loaded by the spring 35, it will open and allow air to escape from the cup until the pressure therein does not exceed the weight of the valve plus the re-

sistance of the spring. The valve 33 will then close, thus retaining a definite pressure in the cup, the amount of which may be regulated by adjusting the pressure of the spring by means of the screw-plug 34. By making the duct 37 of a diameter proportionately less than the diameter of the conduit D the maximum pressure trasmitted by the duct to the cup or reservoir will always be proportionately less than the maximum pressure in the conduit D, and it is manifest that the capacity of duct 37 may be so reduced as that the maximum pressure transmitted by it to the reservoir will approximate the working pressure retained by the valve 33, and that so constructed the pressure in the reservoir will be substantially the same during both periods of compression and expansion in the crank-case. The oil-valve 24 being adjusted to be lifted at a definite lower pressure than is maintained in the cup by the pressure-regulating valve 33 it will be lifted before such pressure is reached, and the oil will be forced through conduit B and the cross-conduit 26 into the valve-chamber 17, and the needle-valve 19 therein being adjusted for the desired rate of feed the lubricant will be forced past it into the lower end of the conduit A, whence following the tapered end of the extension 11 it will drop from the drip-point 12 of the extension through the stem 38 past the sight-opening 39 and into the crank-case, it being obvious that while the pressure in the stem 38 at alternate periods is higher than the pressure in the cup the weighted oil-valve 24 will act as a check-valve to prevent any backward movement of the oil through the conduits A and B during the intervals of higher pressure, and, further, that by reason of the rapid alternations of high and low pressure in the crank-case and of the high pressure being neutralized, as aforesaid, by the check-valve 24, the pressure in the cup being maintained above the mean pressure, there is produced a practically continuous higher pressure in the reservoir than in the crank-case, which produces a steady periodic dropping of the oil from the drip-point 12 while the engine is running.

To automatically and quickly stop the feed when the engine stops, there is provided a minute by-pass 42, preferably connecting the upper part of the cup with the valve-chamber 31. This by-pass, the effect of which is obviously neutralized while the engine is running, operates when the engine stops to restore equilibrium between the cup and the crank-case, and as soon as the pressure in the cup is reduced by it below the resistance of the oil check-valve 24 that valve will close and stop the feed.

In adapting my invention for use on the cylinder of explosive-engines the chamber of the stem 38 is preferably enlarged and the duct 37 reduced in diameter, whereby from the high pressure produced in the cylinder only jets of elastic fluid of greatly-reduced pressure are transmitted to the reservoir, the construction and operation being otherwise as described.

In Fig. 4 is shown a modified form of my invention, in which the bottom closure $3^a$ of the cup is provided with an integral distributing-reservoir 43, having multiple feed-outlets 44 leading to different parts of the mechanism required to be lubricated. In this modified form there is provided between the conduits A′ and B′ the additional oil-conduit E, intersecting the cross-conduit $26^a$ and extending into the reservoir 43. Preferably each one of the outlets 44 is provided with a controlling-valve 45 for regulating the flow. In this form of lubricator for the sight-feed 38 may be substituted a reducer 46 for attaching the cup to the cylinder or crank case of an engine. Reducer 46 may also be used when desired with the form of lubricator shown in Figs. 2 and 3.

Figs. 5 and 6 illustrate another form of my invention, in which the reservoir 47 may be of any suitable construction or form, and the top closure 48 thereof is preferably provided with an integral tubular stem 49, extending from the top closure to near the bottom of the reservoir, and is adapted to form the outlet $B^2$ for the oil, the return-flow of which is prevented by the check-valve $24^a$, located in the valve-chamber $22^a$, which is formed in the top of the closure 48 and is provided with a valve-seat $23^a$. Above the valve-seat $23^a$ the valve-chamber is suitably enlarged to form a distributing-reservoir to supply a plurality of feed-outlets $44^a$, which are arranged radially around the wall of the valve-chamber and suitably secured thereto. The check-valve $24^a$ is loaded by a spring 50, which is interposed between the valve $24^a$ and the regulating-plug 51, run in the top of the valve-chamber, and the top of the valve-chamber $22^a$ is suitably inclosed in a cap 52. In this form of lubricator the duct C is dispensed with, and the duct D′ is formed in a separate casing 53, in which are also located the valve-chambers $27^a$ and $31^a$, with the valves $29^a$ and $33^a$ suitably seated in the respective chambers, and the valve $33^a$ is adjustably loaded by spring $35^a$, the compression of which is adjusted by means of the hollow plug $34^a$, run in the top of the valve-chamber $31^a$. The pressure-duct $37^a$ extends from the valve-chamber $27^a$ to the base of the casing, to the end of which the pressure-supply pipe 55 is suitably coupled. The conduit $30^a$ delivers pressure from the valve-chamber $27^a$ to a suitable conduit 54, which is coupled to reservoir 47 and to the valve-casing. The pressure-relief port $42^a$ is formed in the wall between the valve-chamber $27^a$ and the conduit D′ between the valves $29^a$ and $33^a$, and the top of the valve-chamber $31^a$ is inclosed by the cap $13^a$. Each of the outlets $44^a$ may

be provided with a needle-valve 56, to the outlet-nipple 57 of which the extension of the feed-pipe (not shown) may be coupled.

In the type of lubricators shown in Figs. 2 and 3, designed for attachment to the crank-case or cylinder of an internal-combustion engine, it is manifest that an enlarged duct 37, capable of transmitting jets of compressed gas to the reservoir without diminution of power, may be used without materially affecting the result attained, as, while during the impulses the pressure in the reservoir would be greatly increased, such pressure would be neutralized and slightly overbalanced during such impulses by the same degree of pressure on the oil in the outlet A plus the weight of the valve in the oil-outlet and that during the intervals between the jets the valve 33 will open to release gas from the reservoir until the pressure therein is reduced to the degree that the valve is weighted to retain, the gas so released returning to the source of the jets. The result attained, by reason of the rapid succession of jets, is the practical equivalent of a constant pressure in the reservoir equal to the weight of the valve 33 as loaded by its spring. In the types of lubricators shown in Figs. 4 and 5, however, wherein the high pressures in the reservoir would not be counterbalanced by equal pressure on the oil outlet or outlets, a restricting-inlet 37[a] or its equivalent is preferably used to limit or reduce the pressure of the jets of compressed gas transmitted to the reservoir, and it is manifest that by the use of such restricting-inlet a substantially constant pressure, equal to the resistance of the valve 33[a] as loaded by the spring, may be maintained in the reservoir at all times while the engine is in operation.

It is also manifest that lubricators constructed in accordance with my invention are not dependent in their operation upon any regularity of succession or intensity of the impulses and that they may be successfully employed for lubricating the cylinders of throttling-engines in which the explosions are extremely variable in intensity and in engines of the "hit or miss" type, in which the explosions occur at irregular intervals.

By utilizing the pressure impulses as described and providing an air-tight reservoir for the lubricant the leakage of oil, which occurs when air-vents to the atmosphere are used, is entirely avoided.

What I claim to be new is—

1. In a force-feed lubricator, the combination of a lubricant-reservoir closed to the outer air; a feed-outlet adapted to deliver lubricant from the lower interior portion of the reservoir to parts requiring lubrication; a two-way conduit for elastic fluid adapted to connect the upper interior portion of the reservoir with the interior space of the cylinder, crank-case, or exhaust of a gas-engine; a back check-valve in one branch of the conduit, adapted to close the branch when the pressure in the reservoir is greater than the pressure in the branch; and a weighted relief-valve in the other branch, adapted to normally close said branch, and to be opened by pressure in the reservoir greater than the pressure in the branch plus the resistance of the valve.

2. In a force-feed lubricator, the combination of a lubricant-reservoir closed to the outer air; means to deliver lubricant from the reservoir to parts requiring lubrication, comprising a conduit extending within, and from near the bottom toward the top of the reservoir, and having an intake for lubricant near the bottom of the reservoir, a valve-chamber in the conduit, a weighted valve in the valve-chamber adapted to normally close the conduit against the weight of the oil column in the reservoir, an outlet or outlets from the valve-chamber above the valve, and a regulating-valve for each outlet; a two-way elastic-fluid conduit adapted to connect the upper interior portion of the reservoir with the interior space of the crank-case, cylinder, or exhaust of a gas-engine; a check-valve in one branch of the conduit, and an adjustably-compressed relief-valve in the other branch, operating substantially as set forth.

3. In a force-feed lubricator, the combination of a lubricant-reservoir closed to the outer air; a feed-outlet adapted to deliver lubricant from the lower interior portion of the reservoir to parts requiring lubrication; a two-way conduit for elastic fluid adapted to connect the upper interior portion of the reservoir with the interior space of the cylinder, crank-case, or exhaust of a gas-engine; a back check-valve in one branch of the conduit, adapted to close the branch when the pressure in the reservoir is greater than the pressure in the branch; a weighted relief-valve in the other branch, adapted to normally close said branch and to be opened by pressure in the reservoir greater than the pressure in the branch plus the resistance of the valve, and a vent from the upper interior of the reservoir to one branch, past the valve of the branch, for the escape of elastic fluid.

4. In a force-feed lubricator, the combination of a lubricant-reservoir closed to the outer air; means to deliver lubricant from the reservoir to parts requiring lubrication, comprising a conduit extending within, and from near the bottom toward the top of the reservoir, and having an intake for lubricant near the bottom of the reservoir, a valve-chamber in the conduit, a weighted valve in the valve-chamber adapted to normally close the conduit against the weight of the oil column in the reservoir, an outlet or outlets from the valve-chamber above the valve, and a regulating-valve for each outlet; a two-way elastic-fluid conduit adapted to connect the upper interior portion of the crank-case, cylinder, or

exhaust, of a gas-engine; a check-valve in one branch of the conduit, and an adjustably-compressed relief-valve in the other branch, operating substantially as set forth; and a vent from the upper interior of the reservoir to one branch of the elastic-fluid conduit past the valve of the branch, for the escape of elastic fluid.

5. In a force-feed lubricator, the combination of a lubricant-reservoir closed to the outer air; a feed-outlet adapted to deliver lubricant from the lower interior portion of the reservoir to parts requiring lubrication; a two-way conduit for elastic fluid adapted to connect the upper interior portion of the reservoir with the interior space of the cylinder, crank-case, or exhaust of a gas-engine, said conduit comprising end portions and two branch portions each continuous with the end portions and forming a loop in the line of the conduit, one of said branches for a portion of its length being of reduced diameter; a back check-valve in the reduced branch of the conduit and an adjustably-compressed relief-valve in the other branch operating substantially as set forth.

In witness whereof I have hereunto set my hand this 10th day of October, A. D. 1902.

WILLARD B. FEATHERSTONE.

Witnesses:
ROY R. STUART,
MINNIE L. MILLER.