No. 754,486. PATENTED MAR. 15, 1904.

J. F. McCANNA.

APPARATUS FOR FORCE FEED LUBRICATION.

APPLICATION FILED JUNE 8, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

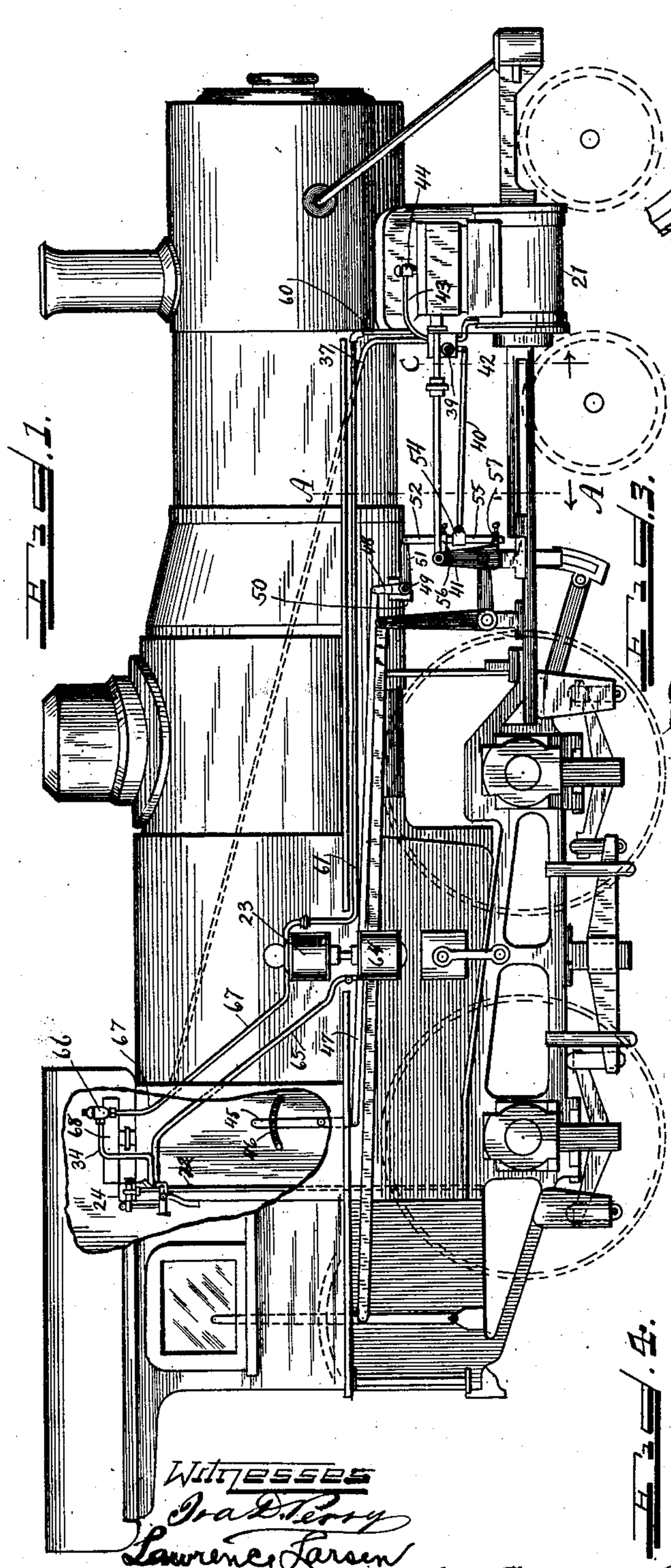

Fig. 1.

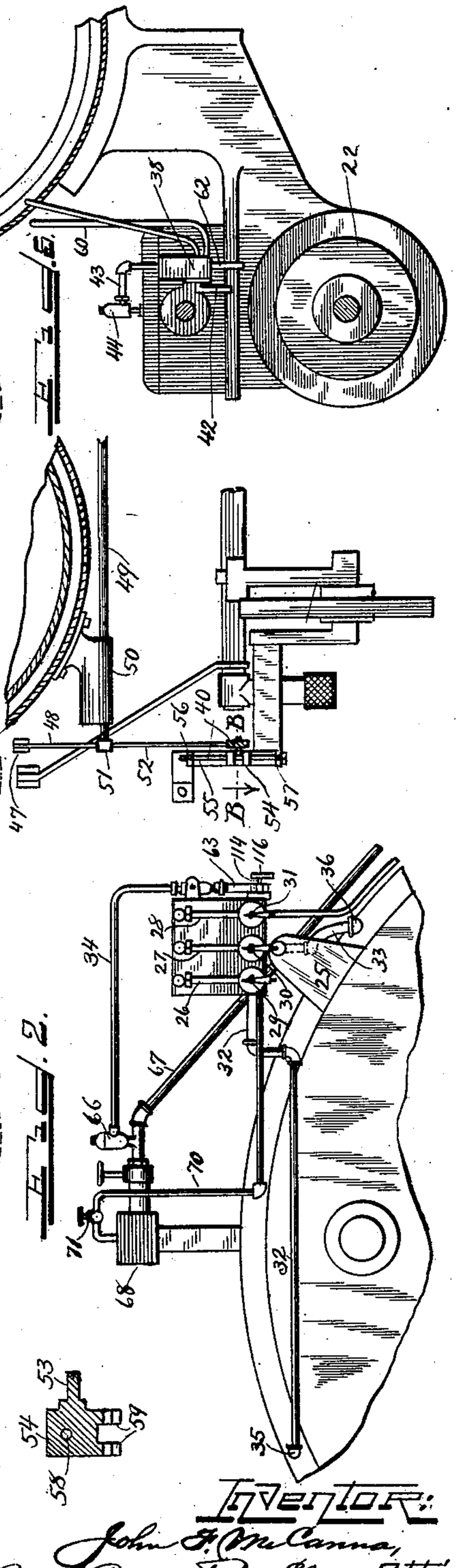

Fig. 3.

Fig. 2.

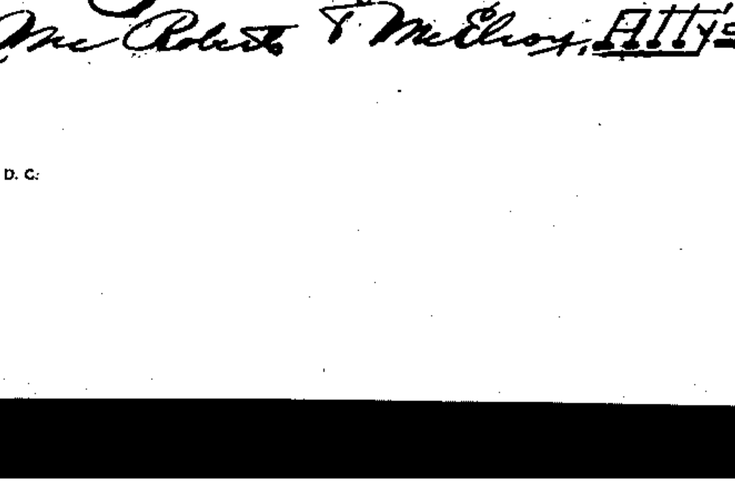

Fig. 4.

Witnesses
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NO MODEL. 3 SHEETS—SHEET 2.

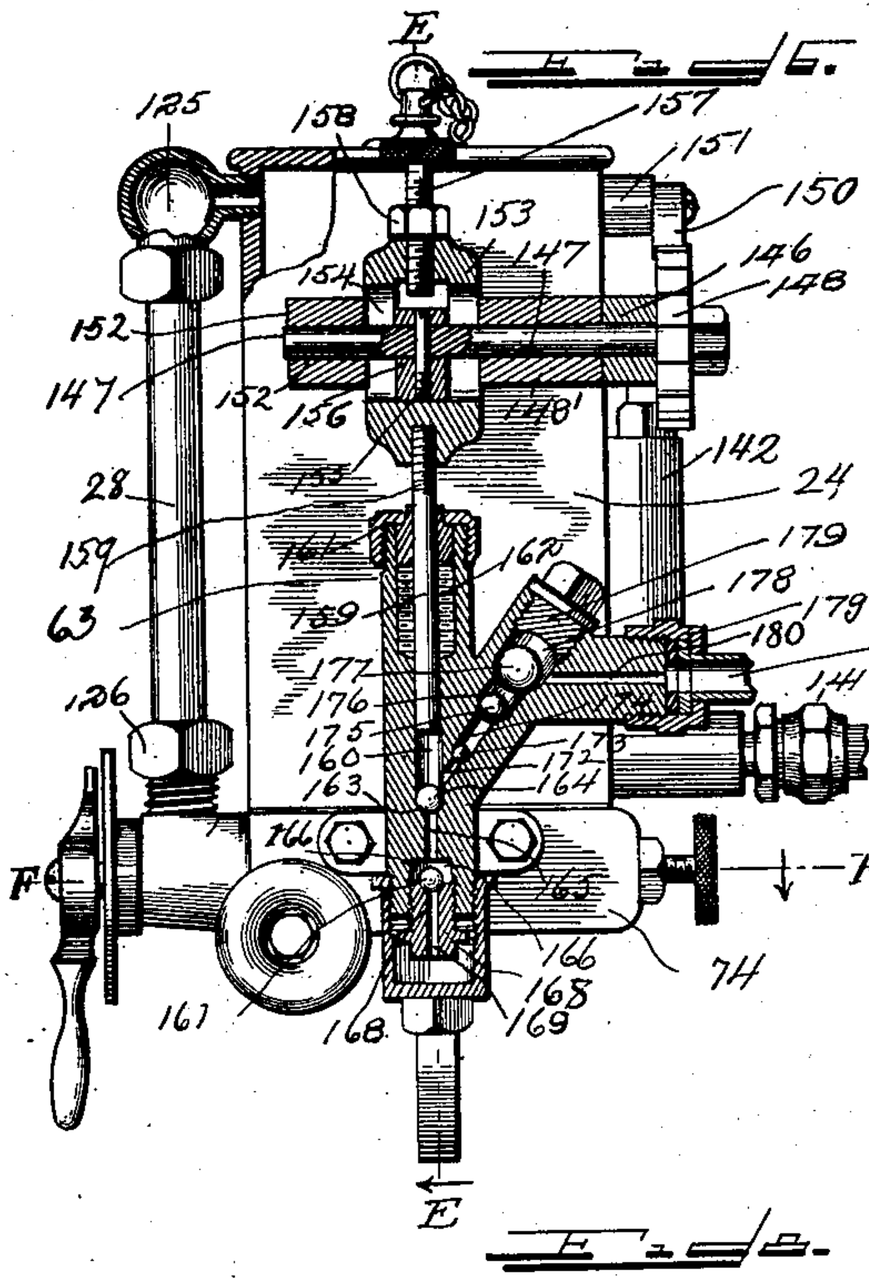

Fig. 6.

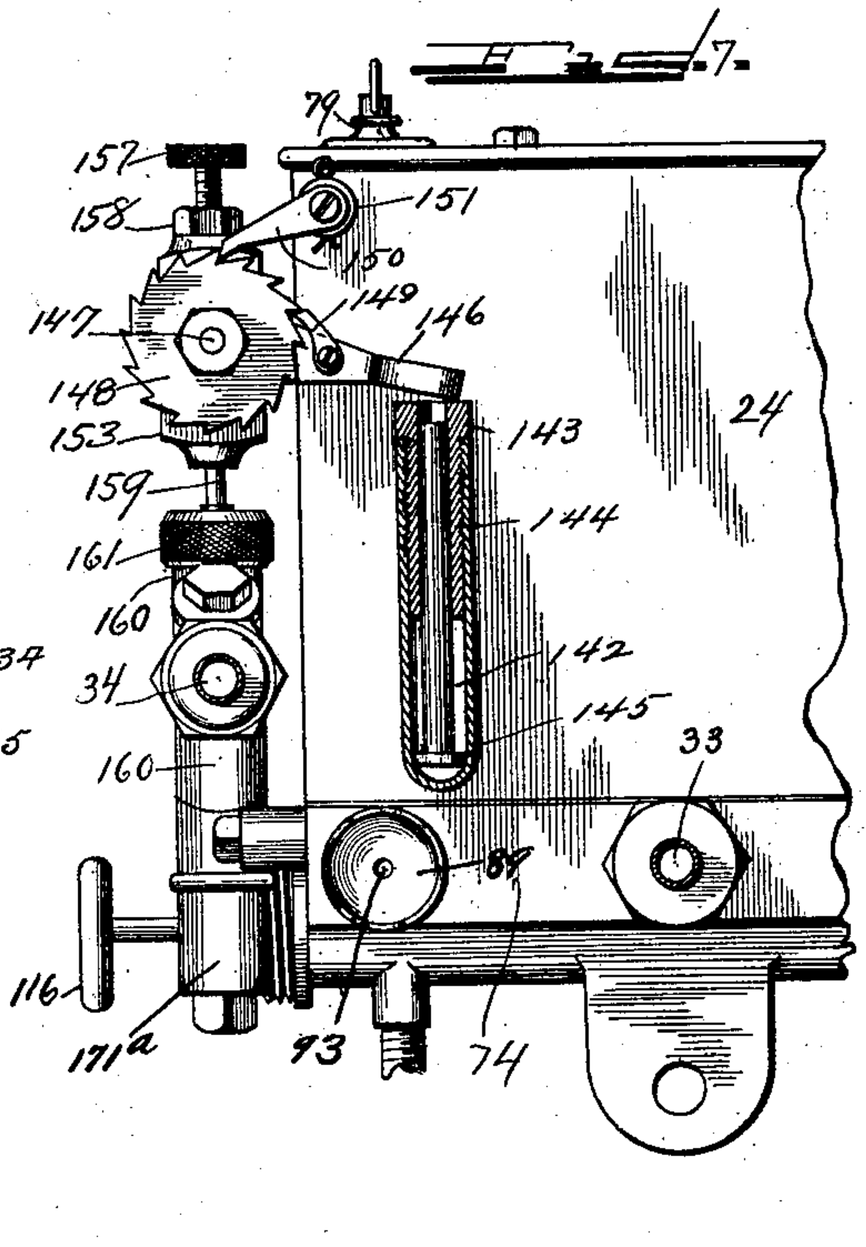

Fig. 7.

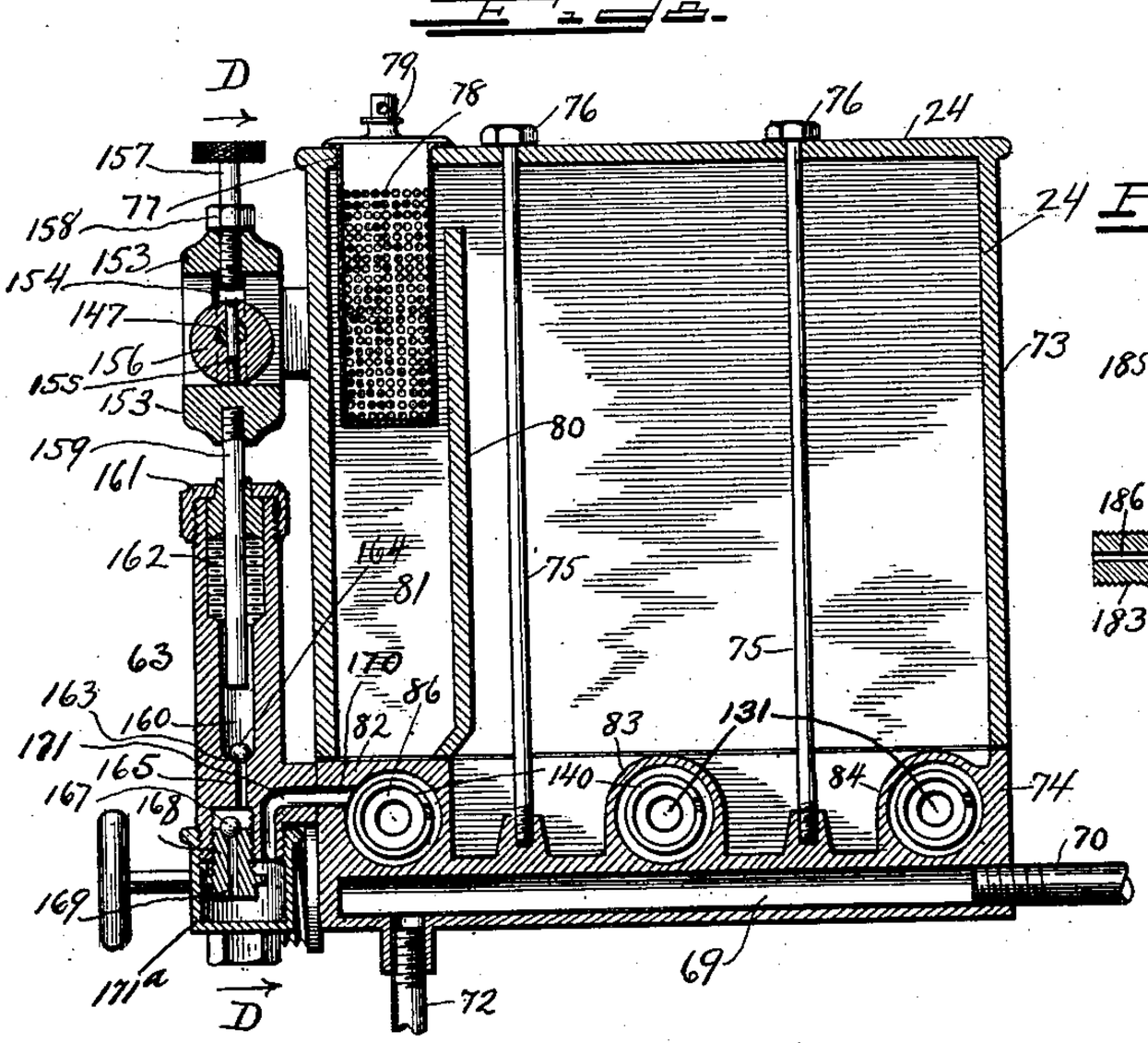

Fig. 18.

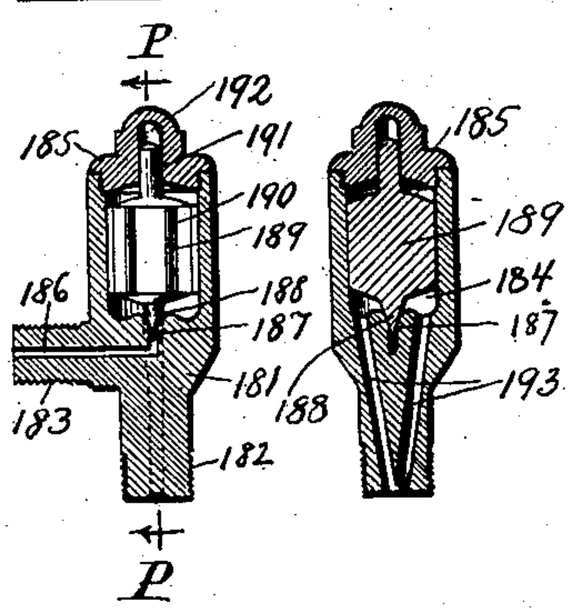

Fig. 19.

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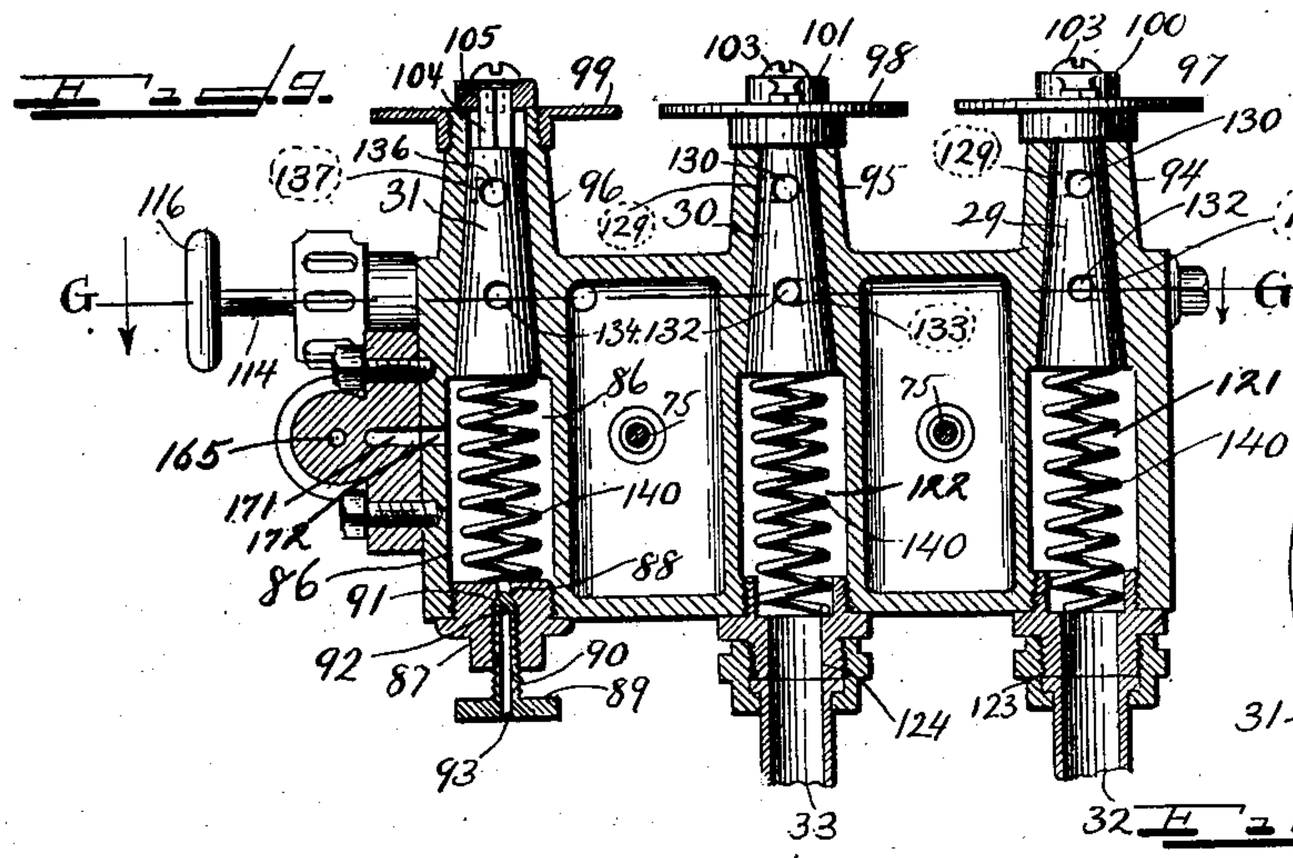
NO MODEL. 3 SHEETS—SHEET 3.



H 2 9.

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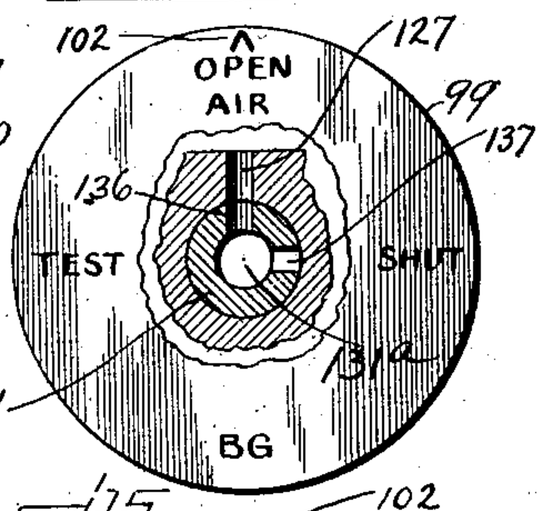

H 2 15

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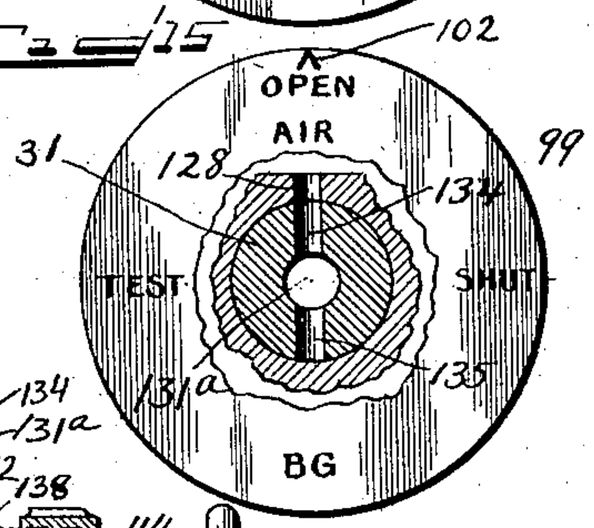
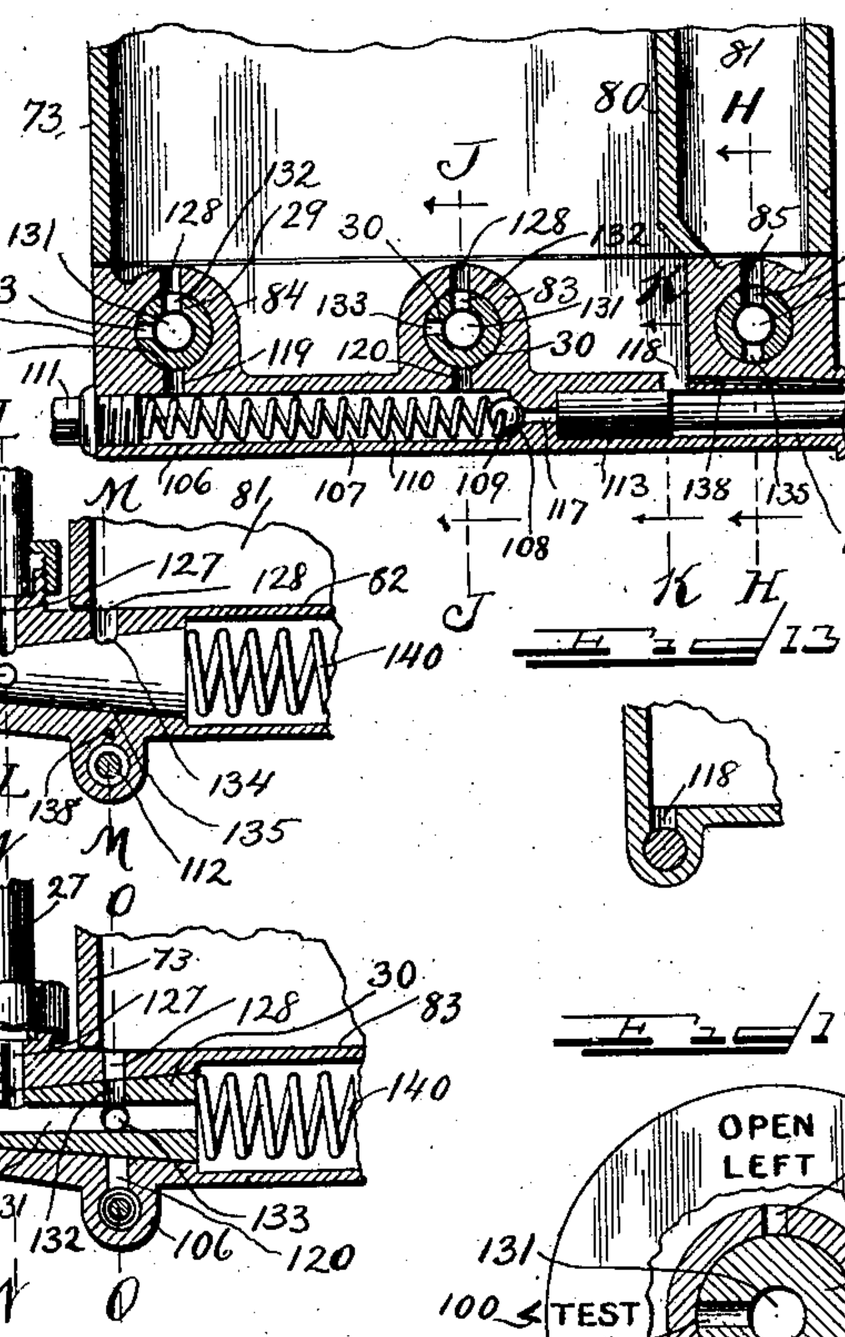
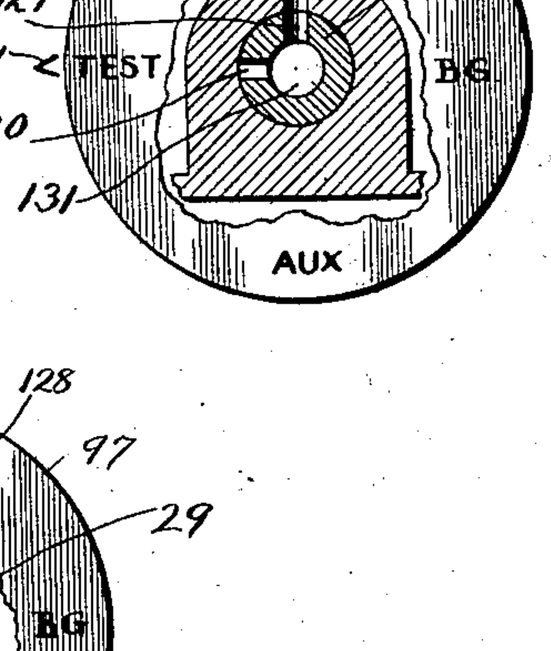




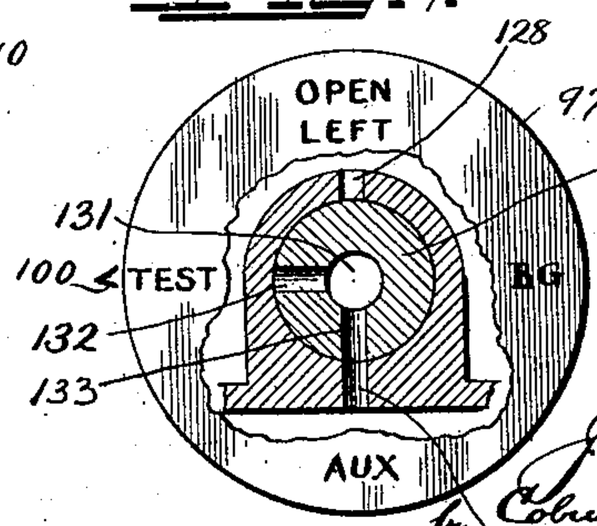
H 2 11.

H 2 13



H 2 12

H 2 17.



Witnesses
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Chas. D. Perry

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No. 754,486. Patented March 15, 1904.

UNITED STATES PATENT OFFICE.

JOHN F. McCANNA, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE JOHN F. McCANNA COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

APPARATUS FOR FORCE-FEED LUBRICATION.

SPECIFICATION forming part of Letters Patent No. 754,486, dated March 15, 1904.

Application filed June 8, 1901. Serial No. 63,680. (No model.)

To all whom it may concern:

Be it known that I, JOHN F. McCANNA, a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Apparatus for Force-Feed Lubrication, of which the following is a specification.

My present invention is concerned, mainly, with certain changes in the structures used in carrying out the system of force-feed lubrication shown in my application, Serial No. 25,107, filed July 28, 1900, for improvements in lubricating-pumps for locomotive-engines, although it will be apparent that some of the apparatus could be used elsewhere in other systems of lubrication.

One feature of my present invention is an auxiliary hand-operated force-feed attachment whereby the engineer can at any time force as much oil as he may desire to the part to be lubricated in addition to that normally supplied automatically by pumping mechanism, so that in case any bearing lubricated thereby should accidentally become too dry the trouble can be remedied instantly and without waiting for the action of the automatic apparatus. In the aforesaid application provision was made for a supplemental gravity-feed for this purpose; but it could only be operated when the automatically-operated pump was thrown out of action and the gravity-feed was insufficiently certain and rapid, so that the present construction was devised to overcome this objection.

Another feature of my invention is concerned with the connections for heating the driving-cylinder pumps. In the old construction steam was led to the pump from the exhaust-port of the driving-cylinder and thence discharged into the smoke-box, while in the new construction the steam is taken from the exhaust-pipe of the air-brake steam-cylinder to the pump and thence discharged into the atmosphere.

Another feature is the employment, in connection with the oil-reservoir, of a steam-chamber and connections whereby the reservoir can be heated with steam as much as may be necessary to keep the oil sufficiently thin, so that it will pump readily in cold weather.

Other features of the invention are the details of construction of the valves and connected parts by which the oil for each pump can be drawn from the reservoir and gage-glass, as in the ordinary operation; from the gage-glass alone, as when it is desired to test the rate of feed; from the reservoir alone, as is necessary in case the gage-glass should become accidentally broken, and by which the oil can be acted upon by the auxiliary pump when desired. In the specific construction shown in the old application the first three adjustments of the valve were possible, but the auxiliary pump not being employed did not require the fourth adjustment.

Another feature is a novel construction of the reservoir by which I am able to pour oil into it in which there may be some water and then draw off the water, leaving the oil for lubricating purposes free from it.

Other features of my invention are found in the details of construction of the various parts, all as will be fully set out in the specifications and pointed out in the claims.

Referring now to the accompanying sheets of drawings, in which the same reference characters designate identical parts in all the figures, Figure 1 is a side elevation of an engine equipped with my present lubricating system, a portion of the cab being broken away to disclose the arrangement of the parts. Fig. 2 is a rear elevation of a portion of the top of the boiler, showing the location of the reservoir and the arrangement of the pipe connections. Fig. 3 is a detail in section on the line A A of Fig. 1, but on a larger scale. Fig. 4 is a detail in section on the line B B of Fig. 3 on a still larger scale. Fig. 5 is a detail in section on the line C C of Fig. 1, but showing the other side of the engine. Fig. 6 is a side elevation of the reservoir, on a larger scale, with the air-pump steam-cylinder pump in section on the line D D of Fig. 8. Fig. 7 is a rear elevation of a portion of the reservoir with the pump-operating air-cylinder thereon shown in central section. Fig. 8 is a

longitudinal section through the reservoir on the line E E of Fig. 6. Fig. 9 is a plan view in section on the line F F of Fig. 6. Fig. 10 is a vertical section through the lower part of the reservoir on the line G G of Fig. 9. Fig. 11 is a detail in section on the line H H of Fig. 10. Fig. 12 is a similar view in section on the line J J of Fig. 10. Fig. 13 is a detail in section on the line K K of Fig. 10. Fig. 14 is a front elevation of the dial-plate for the valve controlling the supply for the air-pump steam-cylinder pump and with the central part broken away to show the valve in section on the line L L of Fig. 11. Fig. 15 is a similar view, but with parts broken away to show the valve in section on the line M M of Fig. 11. Fig. 16 is a front elevation of the dial-plate for the valve controlling the supply of oil for the right-hand driving-cylinder with its central part broken away to show the valve in section on the line N N of Fig. 12. Fig. 17 is a similar view of the dial-plate for the left-hand cylinder, but with the valve shown in section on a line corresponding to the line O O of Fig. 12. Fig. 18 is a vertical section through the gravity vacuum-valve, and Fig. 19 is a section on the line P P of Fig. 18.

In illustrating my invention I have shown my system as applied to the lubrication of the right-hand driving-cylinder 21, the left-hand driving-cylinder 22, and the air-pump steam-cylinder 23. As a single kind of oil is used for lubricating all three of these steam-cylinders, I preferably employ a reservoir 24, common to all of them, which is conveniently supported in the position shown in Figs. 1 and 2 by the bracket 25, projecting upward from the rear end of the boiler. Three gage-glasses 26, 27, and 28 are connected to the reservoir through the medium of the valves 29, 30, and 31, which control the entrance of the oil to the supply-pipes 32, 33, and 34, which lead to the left-hand driving-cylinder 22, the right-hand driving-cylinder 21, and the air-pump steam-cylinder 23, respectively. The pipes 32 and 33 or continuations thereof enter the jacket of the engine next to the boiler, as seen at 35 and 36, and thence pass forward and downward to the point 37, where they emerge from the jacket and pass as directly as may be to the pumps 38 and 39, respectively, which are secured against the rear ends of the steam-chests of their respective cylinders 22 and 21. Each of these pumps is given an impulse at each reciprocation of the slide-valve by means of a rod 40, which is connected at one end to the slide-valve rocker-arm 41 and at the other end to the actuating-arm 42 of the pump, which arm is thus reciprocated at each stroke of the driving-pistons, and by the pumping mechanism described in the aforesaid application, Serial No. 25,107, slowly and regularly operates the pump to draw oil from the supply-pipe and force it through the discharge-pipes 43 and past the vacuum-valve 44 into the steam-chest of its cylinder. This vacuum-valve, which will be more fully described hereinafter, consists of a valve controlled, preferably, by a weight so adjusted as to permit the passage of the oil only toward the cylinder and that only under a heavy pressure, the object of its employment being to prevent the oil from the reservoir, which being located in the cab is so much higher than the point of delivery, from flowing down by hydrostatic pressure and wasting the oil when the engine is at rest, as actually occurs with the gravity-feed system heretofore used unless the supply of oil is shut off when the engine is stopped. This valve also prevents the sucking of the lubricating-oil into the cylinder that takes place when the steam is shut off, as this suction is not strong enough to overcome the pressure of the valve, and by the employment of the force-feed pump I can overcome any resistence that may be found necessary in the vacuum-valve.

As is fully described in the aforesaid application, the pumps 38 and 39 are provided with pistons which are reciprocated at a rate of speed varying directly with the speed of the engine, but the connections for which are adjustable, so that the length of the stroke of the piston can be varied at will to pump greater or lesser amounts of oil at a certain rate of speed at the engine. By adjusting the valves 29, 30, and 31 the oil supplied to each of the pumps can be drawn from the sight-feed mechanisms 26, 27, and 28, so that the engineer can at any time observe the rate of feed of the pump without leaving the cab. The rate of feed of the pumps as controlled by the length of the stroke of the piston can of course be changed to suit the ideas of different engineers as to the amount of lubrication required while running under ordinary circumstances; but after it is once set the amount of lubrication relative to the speed of the engine irrespective of the load should not be changed. However, it is desirable that the engineer may be able to materially increase at will the amount of lubrication with an increase of load, as a heavier grade is encountered, or to diminish the amount correspondingly when a downgrade is struck and the work in the engine is reduced. To effect this change from the cab while the engine is running, I pivot in one side of the cab, preferably to the side of the boiler, the hand-lever 45, which may coöperate with the graduated segment 46 in the customary manner to indicate the different rates of feed depending upon the position of the lever. The lower end of this lever 45 is connected by a rod 47 with the arm 48, which is secured to a rock-shaft 49, mounted in bearings 50 and extending beneath the engine and having the horizontal arms 51 secured at either end thereof, which arms have pivoted to their outer ends the connecting-rods 52, the lower ends of which are pivotally secured upon the wrist-

pins 53, Fig. 4, projecting inwardly from the blocks 54, which are mounted to slide freely upon the substantially vertical links 55, which are secured substantially parallel to the rocker-arms 41 by means of the lugs 56 and 57, projecting forwardly therefrom. The lugs 56 and 57 are provided with suitable apertures, (not shown,) through which the links 55 pass and which are rigidly secured therein by means of set-screws or in any other desired way. Each block 54 has the aperture 58 therein, through which its link 55 passes, and it is also provided with the apertured ears 59, in which the end of the rod 40 is pivoted. By the construction herein described it will be seen that as the lever 45 is swung in either direction the shaft 49 will be rocked, and its arms 51 will thereby raise or lower the rods 58, which in turn will raise or lower the sliding blocks 54 upon the links 55, thus bringing these blocks and the pivotal point of the rod 40 farther from or nearer to the axis of the rocker-arm 41, thus increasing or diminishing the length of throw given to the rod 40 and the consequent movement of the actuating-arm 42 for the pumps 38 and 39. If the blocks 54 are dropped down to their lowermost position in line with the axis of the rocker-arm 41, it will be apparent that the lubrication will cease entirely. As will be hereinafter explained, the amount of actuation given to the pumps at each movement of the rocker-arm 41 will vary proportionately, and by means of the mechanism just described the engineer has at his hand means for instantly and simultaneously either shutting off, diminishing, or increasing very materially the amount of lubrication applied to the driving-cylinders 21 and 22, as may be necessitated by the different changes in the work required from the engine.

With the construction and mechanism herein shown I have also provided means for automatically increasing or diminisning the amount of lubrication to correspond with the amount of work to be done as the engineer adjusts the reversing-lever for greater or lesser quantities of steam to be admitted to the driving-cylinders. The method of controlling the amount of steam thus admitted by the link-motion valve mechanism is well known and need not be here explained further than to say that when the load is light the slide-valve is arranged so as to have but a slight reciprocation, shutting off the steam shortly after it starts the piston in either direction, whereas when the load is heavy the valve has a longer reciprocation, not cutting off the steam until the piston is substantially at the end of its throw. As the length of the reciprocation of the slide-valve is controlled by the amount of movement given to the rocker-arm 41, it will be apparent that when the load is light and the rocker-arm is moving through a very small angle the rod 40 will be given but a slight movement, and consequently the pumps 38 and 39 will be operated more slowly than if the load is heavy and the rocker-arm is moving through a larger angle and the rod 40 is given a longer reciprocation.

For engines which are employed in latitudes where extremely cold weather prevails at any time of the year I preferably employ means for heating the pumps 38 and 39, and this is conveniently accomplished by leading a small steam-pipe 60 from the air-pump steam-cylinder exhaust-pipe 61 to a steam-pocket arranged between the end of the pump and the steam-chest to which it is secured. The details of the construction of this pocket 41 are shown in the detailed description of the pumps 38 and 39 given in the aforesaid application, Serial No. 25,107. A small pipe 62 leads from this pocket to discharge the exhaust-steam therefrom, and it will be readily seen that the exhaust-steam passing through this pocket will keep it thoroughly heated, and its proximity to the pump will prevent the temperature in the pump from falling low enough to cause the oil to be congealed. As previously mentioned, the pipes 32 and 33 in passing from the cab to the pumps are carried, so far as possible, beneath the jacket of the boiler, so as to keep the temperature therein up in spite of cold weather.

As will be seen from Figs. 1 and 5, the portions of the pipes 32 and 33 extending from the jacket to the pumps are immediately adjacent to the pipes 60, so that both of them can be wrapped or incased by the same heat-retaining packing, and the exhaust-steam in the pipe 60 thus serves to keep the oil in the pipes 32 and 33 from becoming congealed while passing from the jacket of the engine to the pumps.

The pipe 34, which furnishes the oil for the air-pump steam-cylinder 23, is connected to the pump 63, which is located on one side of the reservoir, as will be seen and as will be described in detail hereinafter. This pump 63 is operated by air-pressure coming from the pump 64 through the pipe 65 to the actuating mechanism of the pump. The discharge-pipe 34, leading from the pump 63, opens through the medium of a vacuum-valve 66 into the steam-pipe 67, which carries the steam from the fountain-head 68 to the air-pump steam-cylinder 23. As the oil is forced by this pump 63 through the vacuum-valve 66, which is employed for the same purpose as is the vacuum-valve 44 in connection with the driving-cylinder, it enters the tube 67 and is carried down by the steam and enters the cylinder 23 to lubricate it in the customary manner. As the pump 63 is actuated by the air-pump 64, the actuating mechanism of the pump 63 not only serves to pump oil to the cylinder 23 at a rate varying directly with its movement, but it also serves as an indicator in position where the engineer can readily observe it as to whether or not the air-pump is acting.

Inasmuch as I have found that a certain amount of difficulty exists in extremely cold weather in keeping the oil in the reservoir 24 from becoming congealed, I provide with the present construction a steam-chamber 69, (shown in Fig. 8,) extending beneath the bottom of the reservoir and supplied, preferably, with live steam by a pipe 70, leading from the fountain-head 68. A valve or cock 71 is located in this pipe 70, so that during mild weather the steam can be shut off from the pocket. The steam after passing through the pocket enters the pipe 72, opening into the pocket and leading down and discharging at a point beneath the floor of the cab, as indicated in Fig. 1.

From the description of the general construction and operation of the system heretofore given it will be seen that I have provided certain and efficient means for lubricating the various parts of the engine and auxiliaries, all of which are entirely under the control of the engineer at all times and which can be varied within the widest ranges necessary.

The general arrangement of the parts and their connections having been described, I will now describe the details of the reservoir 24 and its associated parts.

As will be best seen from Figs. 6 and 8, the reservoir 24 is of a substantially rectangular shape and consists of the top piece 73 and the bottom or base piece 74, which are secured together by the bolts 75, secured to the bottom piece and passing through the upper surface of the top piece and having the nuts 76 thereon. The aperture 77, through which the oil is inserted, is formed in the top at one end and, preferably, has supported therein the strainer 78 and the cap-piece 79, fitting in the top of the strainer and closing the aperture. A vertical flange 80 extends across the top piece of the reservoir, forming a pocket 81, into which the oil is poured, and if there should be any water mixed with oil the water will, being of greater specific gravity, sink to the bottom, and the oil overflowing the top of the partition 80 will fill the main portion of the reservoir. As will be seen in Figs. 8 to 10, the bottom piece 74 is provided with the three ribs 82, 83, and 84, which are bored out, as will be described, to form the seats for the valves 31, 30, and 29, respectively. The rib 82, which is beneath the chamber 81 and forms the bottom thereof, has the channel 85, leading from the chamber into the interior of the valve 31, the construction of which will be more fully explained hereinafter. The recess 86 in the rib 82 has its rear end closed by the plug 87, which is preferably screwed into it, and it has in connection therewith a port 88, which is normally closed by the hand-valve 89, which consists of the screw 90, shaped so that the conical end 91 thereof can be screwed up against the outer surface of the port 88 to close the same. The inner end of the screw 90 is reduced in size and has the transverse aperture 92 extending through it and the longitudinal channel 93 extending from the aperture 92 to the end of the screw. With this construction it will be apparent in case any water is present in the bottom of the chamber 81 by opening the valve 89 slightly the water can pass through the port 88, thence into the aperture 92, thence out through the channel 93, where it is discharged. When all the water is withdrawn and oil begins to issue from the channel 93, the valve 89 is screwed up tight, and the reservoir contains only oil from which the water has been removed.

The ribs 82, 83, and 84 are extended some distance beyond the front of the reservoir forming the conical valve-seats 94, 95, and 96 for the valves 29, 30, and 31, respectively. Screwed upon the outer ends of these valve-seats 94, 95, and 96 are the dial-plates 97, 98, and 99 for the left-hand driving-cylinder, the right-hand driving-cylinder, and the air-pump steam-cylinder, respectively. The conical valves 29, 30, and 31 have the combined pointers and stems 100, 101, and 102, respectively, secured on the outer ends of the valves by means of the screws 103, the extreme outer ends 104 of the valves being squared to cooperate with the correspondingly-shaped recesses 105, formed in the pointers 100, 101, and 102. The dials 97, 98, and 99 are marked at their tops, "Open left," "Open right," and "Open air," respectively, indicating that when their pointers are opposite these markings the valves are open to both reservoir and their respective gage-glasses 26, 27, and 28, so that oil for the left-hand driving-cylinder, the right-hand driving-cylinder, and the air-pump steam-cylinder, respectively, will be drawn from their respective gage-glasses and from the reservoir. At the left hand of each of the dials is marked "Test," and when the pointers are opposite this mark their respective pumps are connected only with their respective gage-glasses, so that the oil will be drawn from the gage-glasses only, which being of small internal diameter will show how rapidly the oil is being pumped to the respective parts. The right-hand portion of the dials 97 and 98 and the lower portion of the dial 99 is marked "B. G.," being the abbreviation for broken glass, and when their respective pointers are opposite these dials the valves are in such position that the oil will be drawn only from the reservoir 24 and not from their gage-glasses, and it will be understood that there is no occasion to move the pointers to this position unless the gage-glasses should be broken, under which circumstances it is necessary to cut them off from the oil-supply, so that there will be no leakage. At the lower portion of the dials 97 and 98 is marked "Aux," and when either or both of the pointers 100 and 101 are opposite these markings the valves are in such position

that if the auxiliary pumping mechanism, to be more fully described, is operated oil will be forced by it into the one of the driving-cylinders the valve controls. The right-hand side of the dial 99 is marked "Shut," and when the pointer 102 is opposite this indication the valve 31 is in such position that the oil is fully shut off from the air-pump steam-cylinder.

To make the various connections indicated by these dials, the valves 29 and 30 are constructed as follows: As seen in Fig. 10, extending longitudinally of the base-piece 74 underneath the front wall of the reservoir, is a rib 106, which has bored into it from the left-hand side the channel 107, which terminates in the conical valve-seat 108, against which is placed the ball-valve 109, which is normally held in place by the helically-coiled expanding spring 110, placed in said channel and held therein by the plug 111, screwed in the outer end thereof. Bored into the rib 106, from the right-hand end thereof, is the channel 112, which has therein the solid piston 113, connected to the piston-rod 114, extending out through the packing-gland 115 terminating the right-hand end of the rib 106 and provided with the handle 116, by which the piston 113 can be reciprocated back and forth in the channel 112. The channels 107 and 112 are connected by the passage 117, which is normally closed by the ball-valve 109. The channel 112 is connected with the main chamber of the reservoir by the aperture 118, and the channel 107 is connected with the valves 29 and 30 by the apertures 119 and 120, respectively, and it will be apparent that when the piston 113 is reciprocated back and forth by the handle 116 if either of the valves 29 or 30 are in the proper position the oil will be pumped from the main chamber of the reservoir into the valve 29 or 30, as the case may be, and thence through their respective channels 121 or 122 in the ribs 84 or 83 into their pipes 32 or 33, which are connected with the channels 121 or 122 by the connections 123 or 124, as the case may be. Projecting outwardly from the top of the reservoir 24 directly above the valve-seats 94, 95, and 96 are the angular hollow connections 125, between which and the seats 126, formed in the upper side of the conical valve-seats 94, 95, and 96, are the gage-glasses 26, 27, and 28, which are secured therein oil-tight in the customary manner. The seats 126 are provided with the ports 127, extending through the upper surface of the valve-seats 94, 95, and 96 and connecting the gage-glasses 26, 27, and 28 with the valves 29, 30, and 31, respectively. Just inside of the front wall of the reservoir are the ports 128, extending through the upper surface of the ribs 82, 83, and 84 and connecting the reservoir with the valves 31, 30, and 29, respectively. Each of the valves 29 and 30 in line with the ports 127 are formed with the ports 129 and 130, which open from the exterior of the valve into the hollow interior channel 131 thereof. The valves 29 and 30 are each provided in line with the ports 128, 119, and 120 with the ports 132 and 133, passing from the exterior of the valve into the interior channel 131.

When the valves 29 and 30 are in the open position, the oil from the reservoir passes through the ports 128 in the ribs 83 and 84 and through the ports 132 in the valve into the interior channel 131, and at the same time the oil passes from the gage-glasses through the ports 127 in the bearing-seats, thence through the ports 130 in the valves into the interior channel 131, so that the oil for the pumps is drawn from both the reservoir and the gage-glasses.

When the pointers are opposite the word "Test," the port 129 is uppermost and opposite the port 127, while both of the ports 132 and 133 are out of alinement with the ports 128, so that the oil for the pumps can be drawn only from the gage-glasses.

When the pointer is opposite "B. G.," the port 133 is opposite the port 128 and the ports 129 and 130 are both out of alinement with the port 127, so that the oil can be drawn from the reservoir only, and if the gage-glass should be broken there can be no leakage of oil from it.

When the pointer is opposite the indication "Aux," the ports 129 and 130 are out of alinement with the port 127 and the ports 132 and 133 are of alinement with the ports 128, so that no oil can pass directly from the reservoir or gage-glass into the channel 131 of the valves or, what is more to the point, any oil that may be forced into these channels 131 cannot pass back into the oil-reservoir or gage-glass if the pressure should be less in that direction. The ports 132 in this position are on the under side and in alinement with the ports 119 and 120, so that as the auxiliary pump is operated the oil can be passed through the port 118 into the piston-chamber 112 and thence be forced by the piston 113 after it is past the port 118 through the channel 117, opening the valve 108 and forcing the oil through the ports 119 or 120, as the case may be, through the ports 132 into the interior channel 131, whence the oil is delivered to the driving cylinder or cylinders, for whose benefit the auxiliary pump is operated.

The valve 31 is provided with the central channel 131[a], and opening into it in the line of the port 128 of its rib 85 are the two oppositely-disposed ports 134 and 135. Opening into said channel, in line with the port 127 in its conical valve-seat, is the port 136, which is immediately adjacent to and in the same angular relation as the port 134, and at an angle of ninety degrees to the port 136 and in the same vertical plane is the port 137 opening in the interior channel 131.

When the pointer 102 is opposite the indication "Open air," the ports 134 and 136 are beneath their respective ports 128 and 127, so that the oil for the air-pump steam-cylinder is drawn from the gage-glass and the reservoir. When the pointer 102 is opposite the indication "Test," the port 137 is beneath the post 127 and the ports 134 and 135 are both out of register with the port 128, so that the oil can be drawn only from the gage-glass 28. When the pointer 102 is opposite the indication "B. G." the port 135 is beneath the port 128 and the ports 136 and 137 are both out of register with the port 127, so that the oil for the pump is drawn only from the reservoir, and if the gage-glass is broken there is no escape of oil from it. When the pointer 102 is opposite the indication "Shut," none of the ports 134, 135, 136, and 137 are opposite their respective ports 128 and 127, so that the oil is completely shut off from the pump.

To permit of the oil which may enter the channel 112 after the piston 113 has passed the port 118 flowing back into the reservoir as the piston is withdrawn, I make a fine channel 138, (see Fig. 10,) extending across the rib 85 beneath the valve-seat and opening into the channel 112 by the small port 139. With this construction it will be apparent that as soon as the outer end of the piston 119 passes the port 118 as it is drawn outward the oil back of the piston 113 will be forced through the port 139 and the channel 138 and into the port 118, whence it can pass into the reservoir or the channel 112 on the other side of the piston 113, depending upon the position of the piston.

To assist in holding the valves 29, 30, and 31 securely in position with their ports in alinement with the ports 127 and 128, I place in the channels 86 the helically-coiled expanding-springs 140, which serve to keep the valves firmly seated in spite of any wear that may have occurred.

Referring now especially to Figs. 6, 7, and 8, the air from the pipe 65 as it is compressed by the action of the air-pump is forced through the connection 141 into the vertical air-cylinder 142, which is secured to and preferably formed integral with the rear of the reservoir. This air-cylinder has screwed into its upper end the bearing-cylinder 143, whose inner bore receives with a substantially air-tight fit the solid piston 144, which extends down nearly to the bottom of the cylinder 142 and is provided at the bottom with a head 145, which prevents the air-pressure from forcing the piston entirely out of the cylinder. As the piston rises it contacts with the outer end of a lever 146, which is pivotally mounted on a shaft 147 between the ratchet-wheel 148, rigidly secured on said shaft, and the bearing 148′ for said shaft, projecting outwardly from the main casing of the reservoir. The lever 146 has pivoted thereon the actuating-dog 149, which engages with the teeth of the ratchet-wheel 148 and serves to advance said ratchet-wheel one tooth at each movement of the piston 144, the backward movement of the ratchet-wheel 148 being prevented by the detent-pawl 150, pivoted on the stud 151, projecting from the rear of the reservoir-casing. Embracing the shaft 147, between the bearing 148′ and a corresponding bearing 152, is the yoke 153, which has the elongated slots 154 in its sides, which permit the yoke to be reciprocated up and down relative to the shaft 147. Mounted on the inside of the yoke 153 and rigidly secured upon the shaft 147, as by the screw 155, passed therethrough, is an eccentric disk 156, which as the shaft 147 rotates coöperates with the bottom of the yoke 153 and with the lower end of the set-screw 157 to determine the amount of vertical movement given to the yoke 153, it being apparent that if the screw 157 is adjusted so that no lost motion occurs between the eccentric and the yoke the throw of the yoke will be the greatest possible, whereas if the screw 157 is adjusted so that practically all the motion of the eccentric 156 is lost the amount of movement given to the yoke 153 will be very slight. When the screw 157 is adjusted in the desired position, the lock-nut 158 is screwed down upon the top of the yoke 153 to hold the set-screw in the desired adjustment. The yoke 153 has rigidly secured in its lower end the plunger or piston 159, which is thereby reciprocated in the barrel 160 of the pump 63, it of course passing through the customary gland 161 and packing 162. At the bottom of the barrel 160 is formed a valve-seat 163, upon which seats the ball-valve 164, which closes the channel 165, leading from the barrel 160 into the recess 166, formed in the bottom of the pump, in which I preferably place another ball-valve, 167, resting upon a valve-seat formed in the top of the screw-threaded plug 168, having the channel 169 therein. The rib 82 has leading from its channel 86 a port 170, which communicates with a right-angled channel 171 in the bottom of the pump 63, opening out, as shown in Fig. 8, into the cap 171ª, screwed upon the bottom of the pump 63.

With the construction shown it will be apparent that as the piston 159 is raised the oil from the channel 86 will be drawn through the port 170, the right-angled channel 171, up the channel 169, raising the ball-valve 167, up the channel 165, raising the ball-valve 164, and passing into the barrel 160, where it is held by the valves 164 and 167. As the plunger 159 is depressed the pressure of the oil forces it through the channel 172, raising the ball-valve 173 upon the seat formed by the bottom of the larger channel 174, into which the channel 172 opens, and passing through this channel the oil raises the larger ball-valve 175, resting upon the seat formed by the larger channel 176, into which the channel 174 opens.

The oil passing the ball-valve 175 through the channel 176 raises the still larger ball-valve 177, resting upon the seat formed by the channel 176, opening into the larger pocket 178, which is closed by the screw-threaded plug 179. Opening into the pocket 178 is the channel 179[a], which by means of the connection 180 opens into the pipe 34, by which the oil for the air-pump steam-cylinder passes through the connection previously described to this cylinder.

The details of construction of the preferred form of the vacuum-valves 44 are shown in Figs. 18 and 19, where they will be seen to consist of the body portion 181, having the screw-threaded lower end 182, which is adapted to be screwed into the top of the steam-chest or other part to which the valve is applied. A horizontal branch 183 is provided, which is also screw-threaded, to receive the pipe connections. Formed in the body of the valve is the cylindrical recess 184, the upper end of which is closed by the cap 185, screwed therein. The branch 183 is provided with the channel 186, which leads to the center of the valve and is turned upwardly to form the minute valve-seat 187, upon which rests the conical end 188 of the valve 189, which will be seen to consist of a heavy cylinder provided with the flanges 190, which take against the sides of the recess 184 and prevent any lateral play of the valve in the recess. I preferably provide the upper end of the valve with the stem 191, which projects into the correspondingly-shaped recess 192 in the cap 185, so that when the cap is removed the valve can be readily lifted out by taking hold of the stem 191. One or more channels 193 are provided leading from the recess 184 to the bottom of the valve.

The operation of the device will be readily apparent. The oil is forced through the channel 186, and inasmuch as the size of the valve seat or channel is very small as compared with the size and weight of the valve 189 it requires a considerable pressure on the oil to raise the valve and keep it raised, so that the oil will flow into the recess 184 and thence through the channels 193 to the part to be lubricated. By employing this minute valve-seat with the heavy valve coöperating therewith I am enabled to obtain the desired resistance without the employment of any springs, which are objectionable for the reasons before stated.

While I have herein disclosed the details of my gravity vacuum-valve, I do not herein claim the same, as it is the subject-matter of a divisional application, Serial No. 81,242, filed November 5, 1901.

While I have herein illustrated my various features of improvement as embodied in the form which I at present consider best adapted to carry out their purposes, it will be understood that they are capable of modifications and that I do not desire to be limited in the interpretation of the following claims, except as may be necessitated by the state of the prior art.

I claim—

1. In a device of the class described, the combination with the force-feed pump and means for operating said pump automatically, of the reservoir, connections between said pump and reservoir and said pump and the part to be lubricated, a vacuum-valve in said connections between the pump and the part to be lubricated, and an auxiliary pump adapted to be operated when desired to force an additional quantity of oil from said reservoir past the vacuum-valve to the part to be lubricated.

2. In a device of the class described, the combination with the force-feed pump and means for operating said pump automatically, of the reservoir, connections between said pump and reservoir and said pump and the part to be lubricated, a vacuum-valve in said connections between the pump and the part to be lubricated, and an auxiliary pump adapted to be operated when desired to force an additional quantity of oil from said reservoir through said automatic pump to the part to be lubricated.

3. In a device of the class described, the combination of a plurality of force-feed pumps and means for operating said pumps automatically, of the reservoir common to said pumps, connections between said pumps and reservoir and said pumps and the parts they respectively lubricate, a vacuum-valve between each pump and the part it lubricates, an auxiliary pump adapted to be operated to force an additional quantity of oil from said reservoir through the vacuum-valves to the parts to be lubricated, and valve connections to said auxiliary pump whereby when operated the oil will be forced from said reservoir to any of the parts said automatic pumps are adapted to lubricate.

4. In a device of the class described, the combination of a plurality of force-feed pumps and means for operating said pumps automatically, of the reservoir common to said pumps, connections between said pumps and reservoir and said pumps and the parts they respectively lubricate, a vacuum-valve between each pump and the part it lubricates, an auxiliary pump adapted to be operated to force an additional quantity of oil from said reservoir through said pumps and through the vacuum-valves to the parts to be lubricated, and valve connections to said auxiliary pump whereby when operated the oil will be forced from said reservoir to any or all of the parts said automatic pumps are adapted to lubricate.

5. In a device of the class described, the combination with a reservoir, a force-feed pump in communication therewith, and means for carrying oil from said pump to the parts

to be lubricated, of a feed-test mechanism connected to said reservoir, an auxiliary pump for forcing an extra supply of oil through the force-feed pump to the parts to be lubricated, and valve connections between said reservoir, feed-test mechanism and auxiliary pump, whereby, as desired, oil can be fed to the parts to be lubricated by said force-feed pump directly from the reservoir, or from the feed-test mechanism alone, or by said auxiliary pump from said reservoir.

6. In a device of the class described, the combination with a reservoir, and means for carrying oil therefrom to the parts to be lubricated, of a feed-test mechanism connected to said reservoir, an auxiliary pump for forcing an extra supply of oil to the parts to be lubricated, and valve connections between said reservoir, feed-test mechanism and auxiliary pump, whereby, as desired, oil can be carried to the parts to be lubricated by said means from the reservoir and feed-test mechanism, or from the reservoir alone, or from the feed-test mechanism alone, or by said auxiliary pump from said reservoir.

7. In a device of the class described, the combination with a reservoir, and means for carrying oil therefrom to the parts to be lubricated, of a feed-test mechanism connected to said reservoir, an auxiliary pump for forcing an extra supply of oil to the parts to be lubricated, and a single valve with multiple ports between said reservoir, feed-test mechanism and auxiliary pump, whereby, as desired, oil can be carried to the parts to be lubricated by said means from the reservoir or from the feed-test mechanism, or by said auxiliary pump from said reservoir.

8. In a device of the class described, the combination with a reservoir, and means for carrying oil therefrom to the parts to be lubricated, of a feed-test mechanism connected to said reservoir, an auxiliary pump for forcing an extra supply of oil to the parts to be lubricated, and a single valve with multiple ports between said reservoir, feed-test mechanism and auxiliary pump, whereby, as desired, oil can be carried to the parts to be lubricated by said means from the reservoir and feed-test mechanism, or from the reservoir alone, or from the feed-test mechanism alone, or by said auxiliary-pump from said reservoir.

9. In a device for locomotive lubrication, the combination with the oil-pump for the driving-cylinder, of a steam-chamber located adjacent to said pump, and a pipe leading from the air-pump-cylinder exhaust-pipe to said chamber.

10. In a device of the class described, the combination with the reservoir having the horizontal valve-seat extending through its base, of the gage-glass located in front of said reservoir and having its lower end seated on a portion of the reservoir-base above the seat projecting from the front of the reservoir, the ports connecting the reservoir and gage-glass with the valve-seat, and the valve having the different channels therein, substantially as and for the purpose described.

11. In a device of the class described, the combination with the reservoir having the horizontal valve-seat extending through its base, of the gage-glass located in front of said reservoir and having its lower end seated on a portion of the reservoir-base seat projecting from the front of the reservoir, the ports connecting the reservoir and gage-glass with the valve-seat, the valve having the different channels therein, and a dial-plate secured to the outer end of said valve-seat and the pointer secured on the end of the valve and coöperating with the dial-plate; substantially as described.

12. In a device of the class described, the combination with the reservoir having the valve-seat extending beneath its base and the gage-glass seated above the outer end of the valve-seat, with the passage extending beneath said valve-seat, the channels 127 and 128 connecting the gage-glass and the reservoir with the valve-seat, the channel 120 connecting the valve-seat with the passage, the pump coöperating with said passage, and the valve in said valve-seat having the ports therein adapted to coöperate with the channels 127, 128 and 120 for the purposes described.

13. In a device of the class described, the combination with the reservoir having the valves extending through its base and the auxiliary pump-chamber extending beneath said valves, said valves being adapted to connect with the reservoir or with the pump-chamber depending upon their position; substantially as described.

In witness whereof I have hereunto set my hand this 28th day of March, 1901.

JOHN F. McCANNA.

In presence of—

JOHN H. McELROY,

LAWRENCE LARSEN.