No. 842,507. PATENTED JAN. 29, 1907.

J. N. WEIKLY.

LUBRICATOR.

APPLICATION FILED DEC. 31, 1896.

3 SHEETS—SHEET 1.

FIG. 2.

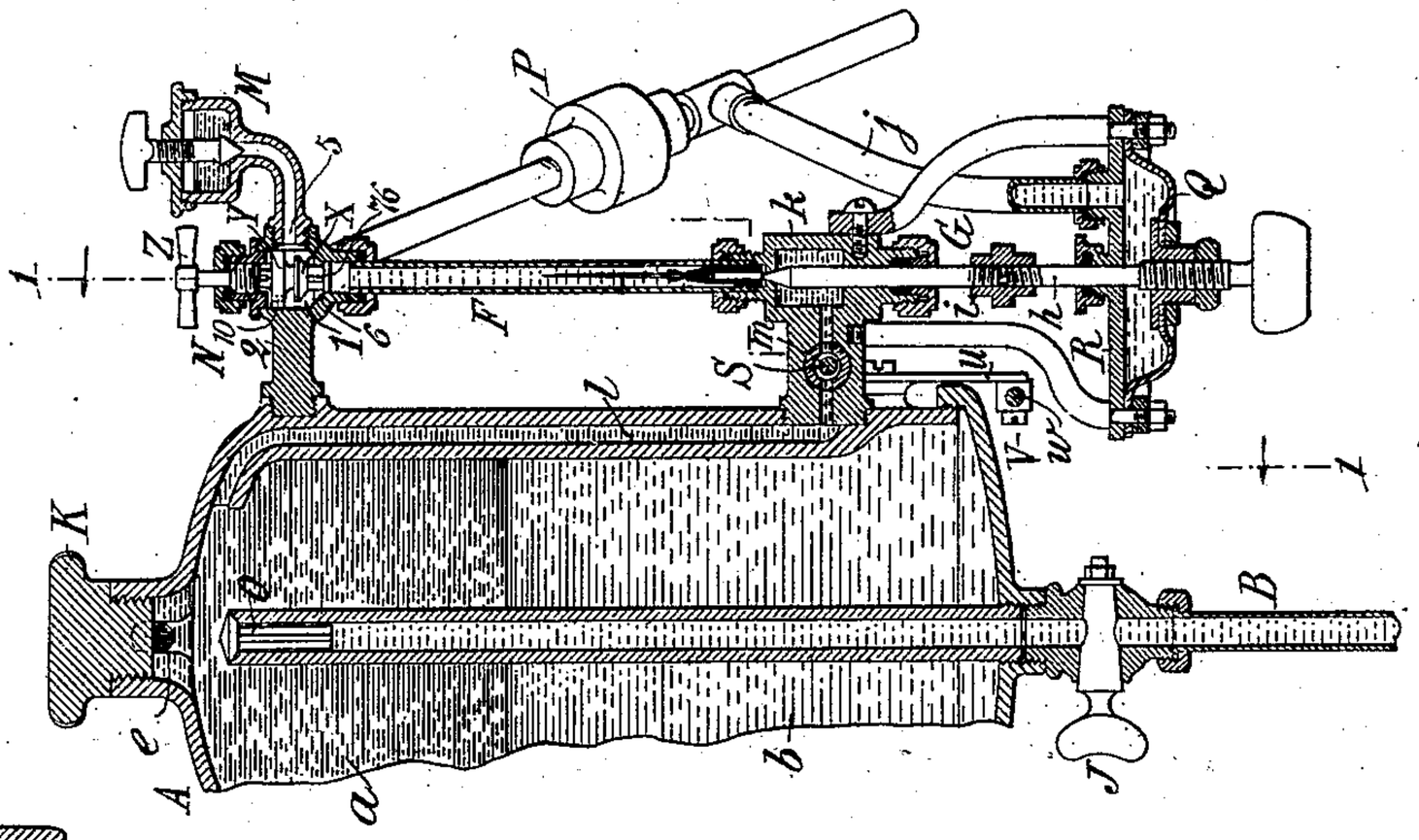

FIG. 6.

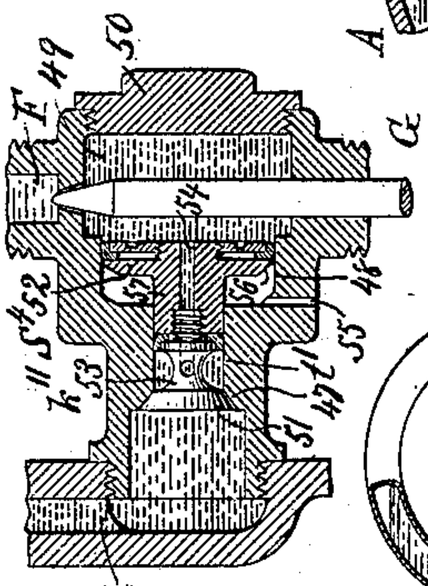

FIG. 1.

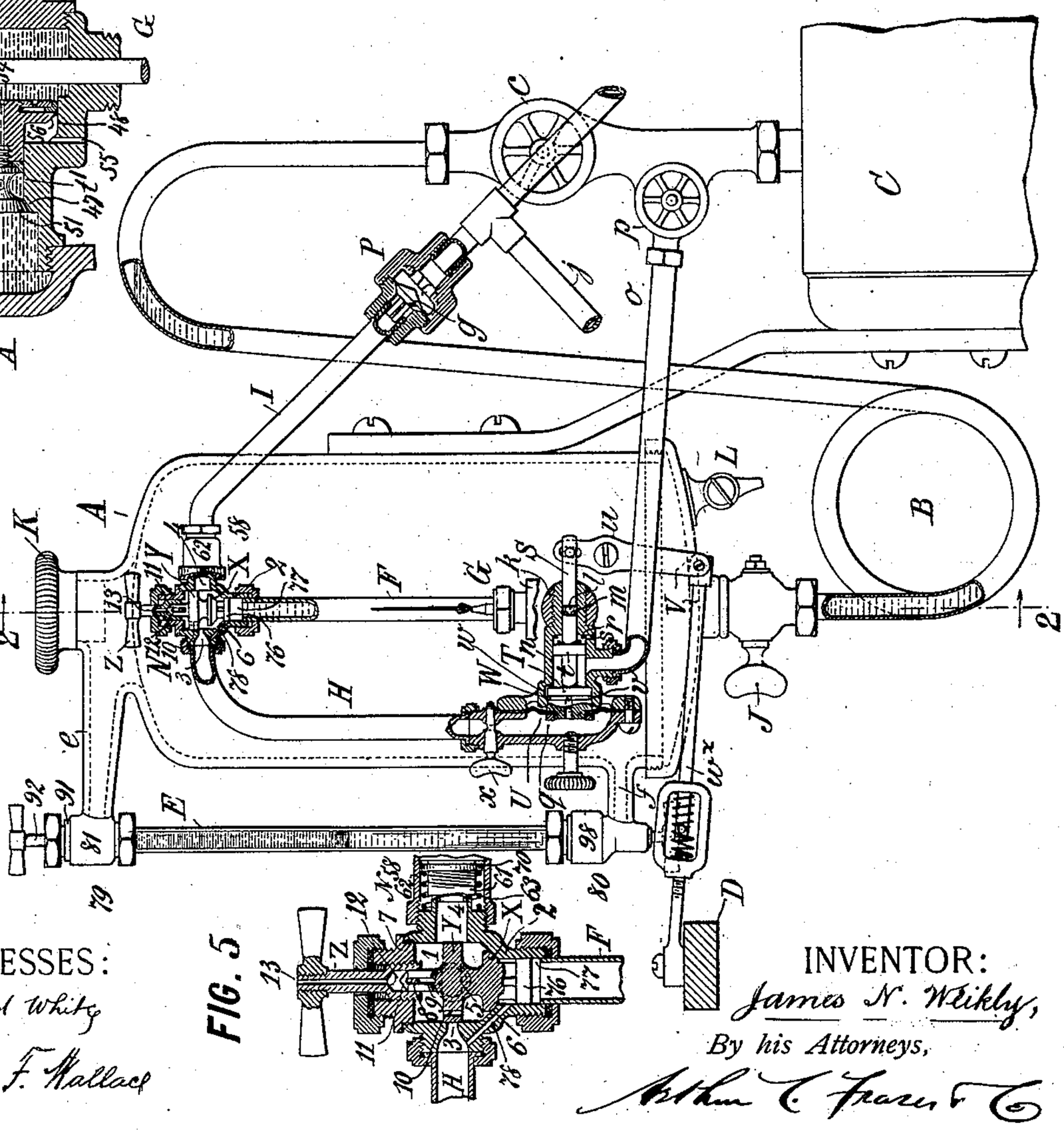

FIG. 5

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3 SHEETS—SHEET 2.

FIG. 4.

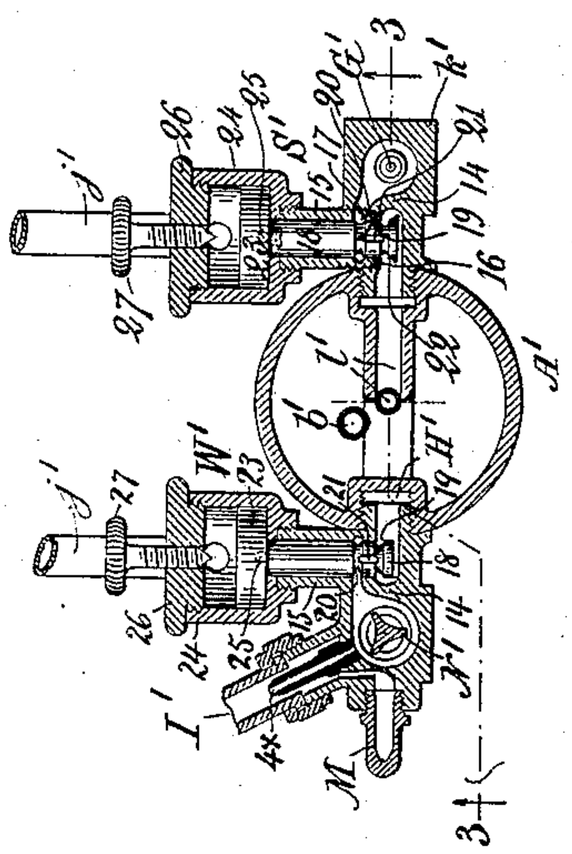
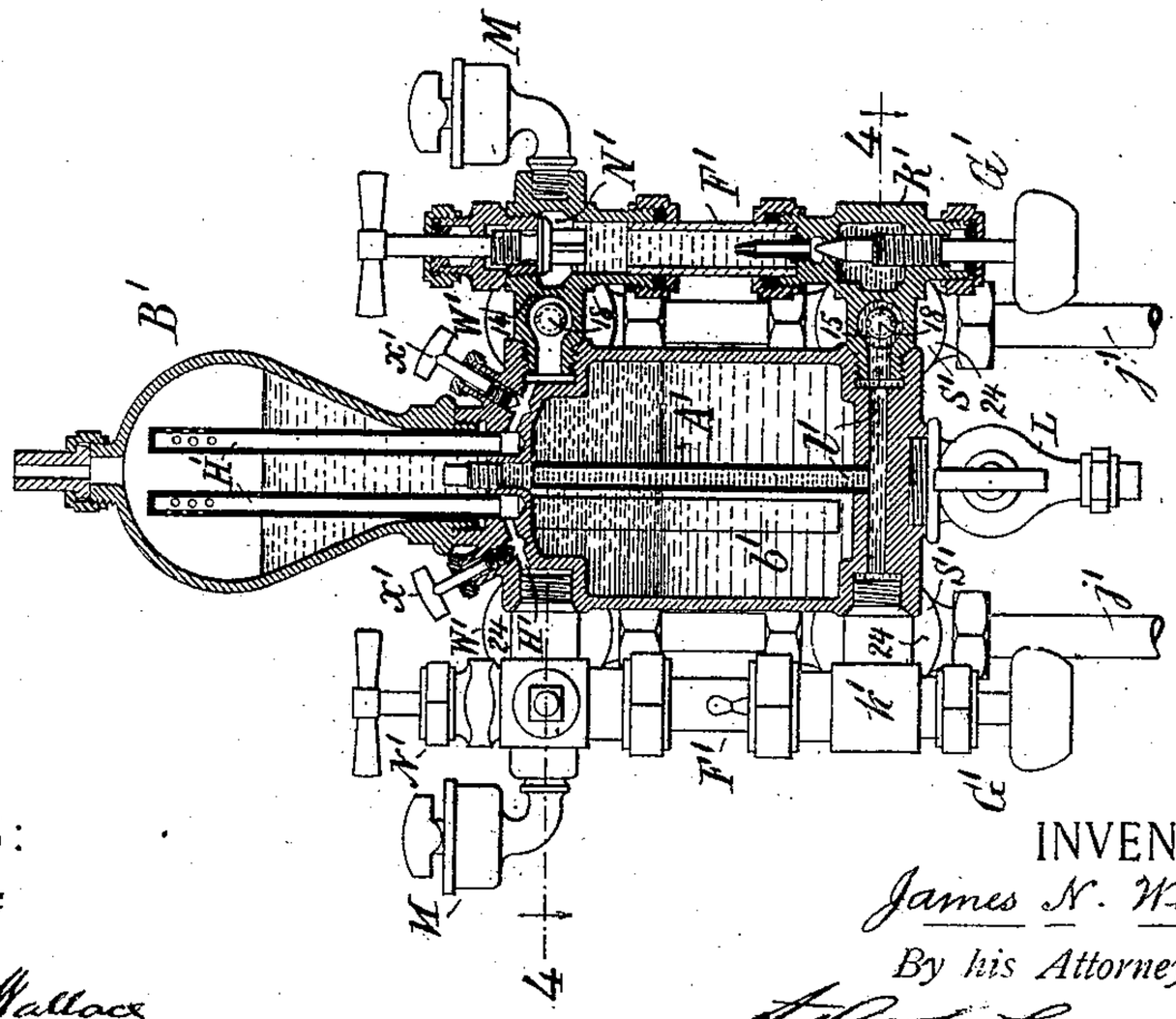


FIG. 3.



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3 SHEETS—SHEET 3.

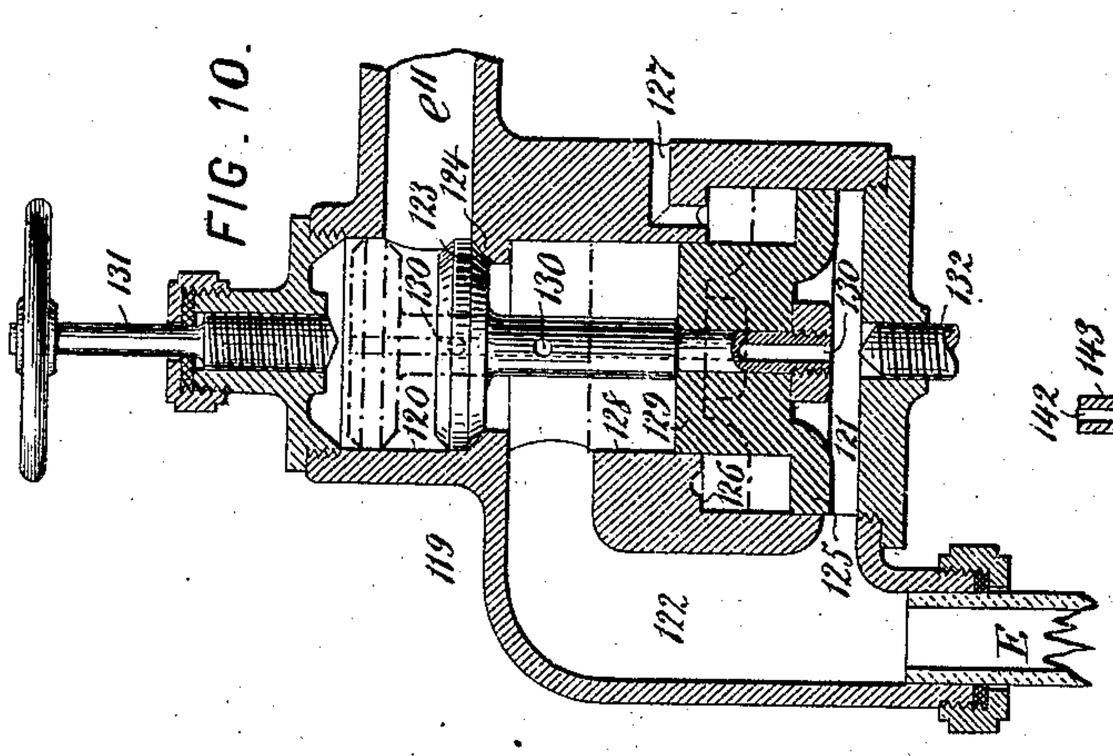

FIG. 10.

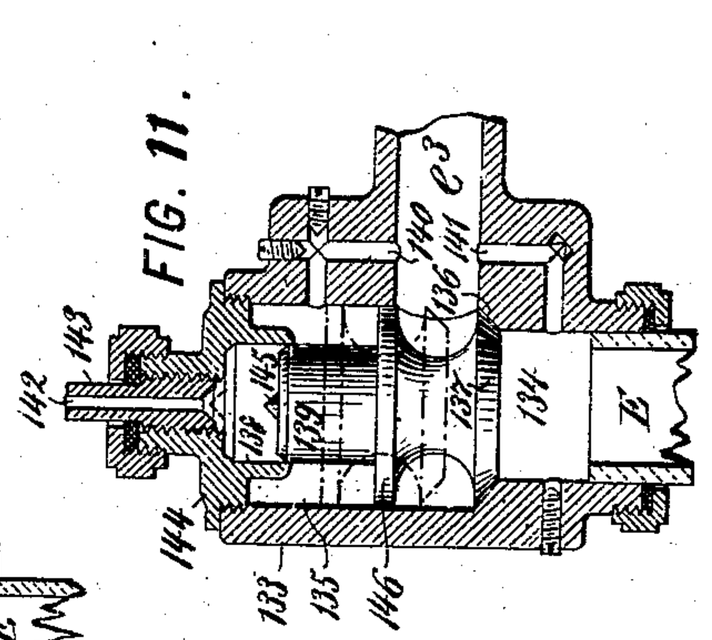

FIG. 11.

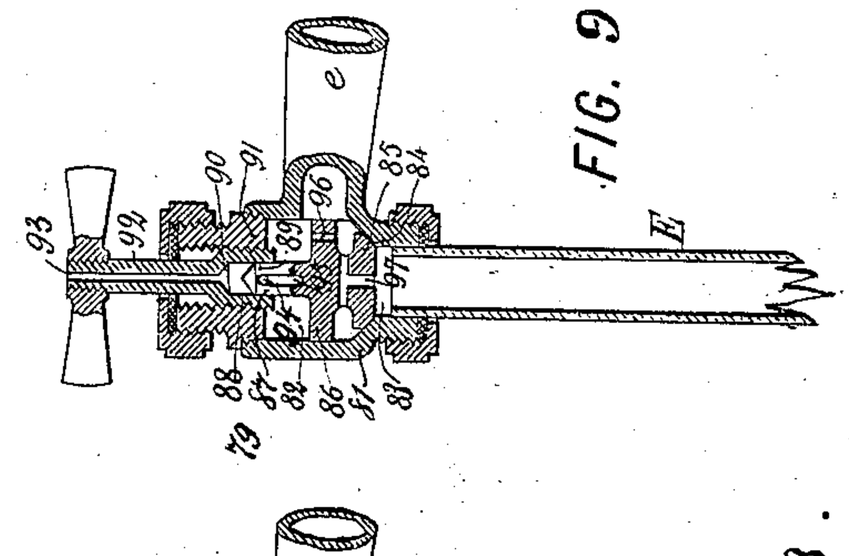

FIG. 9.

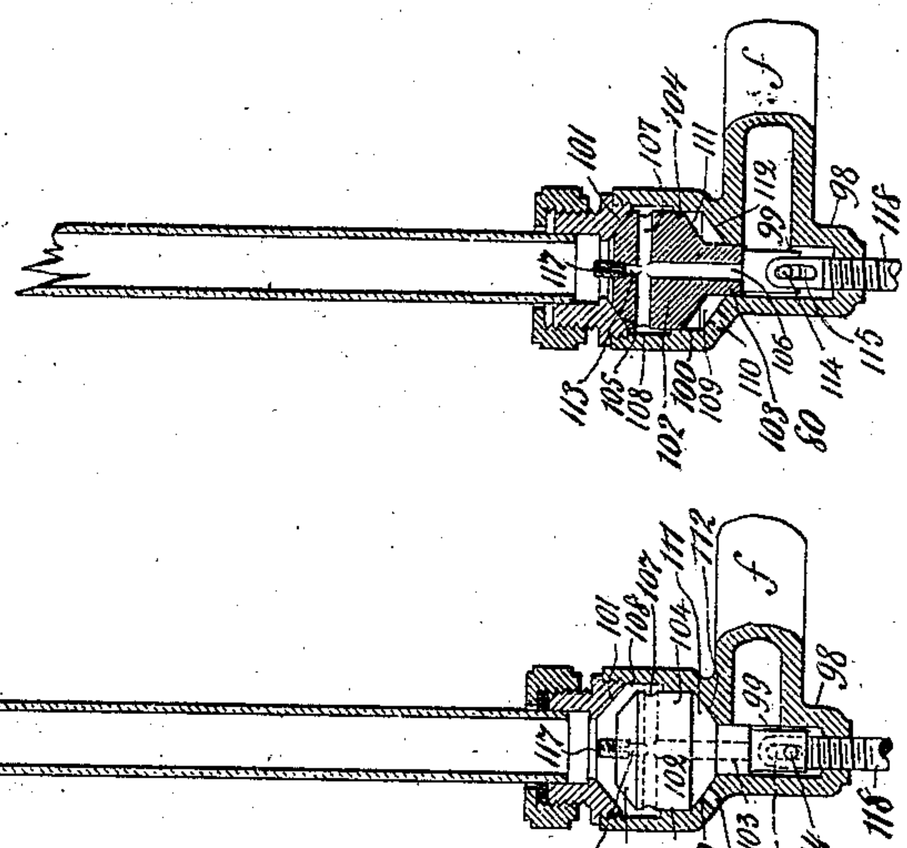

FIG. 8.

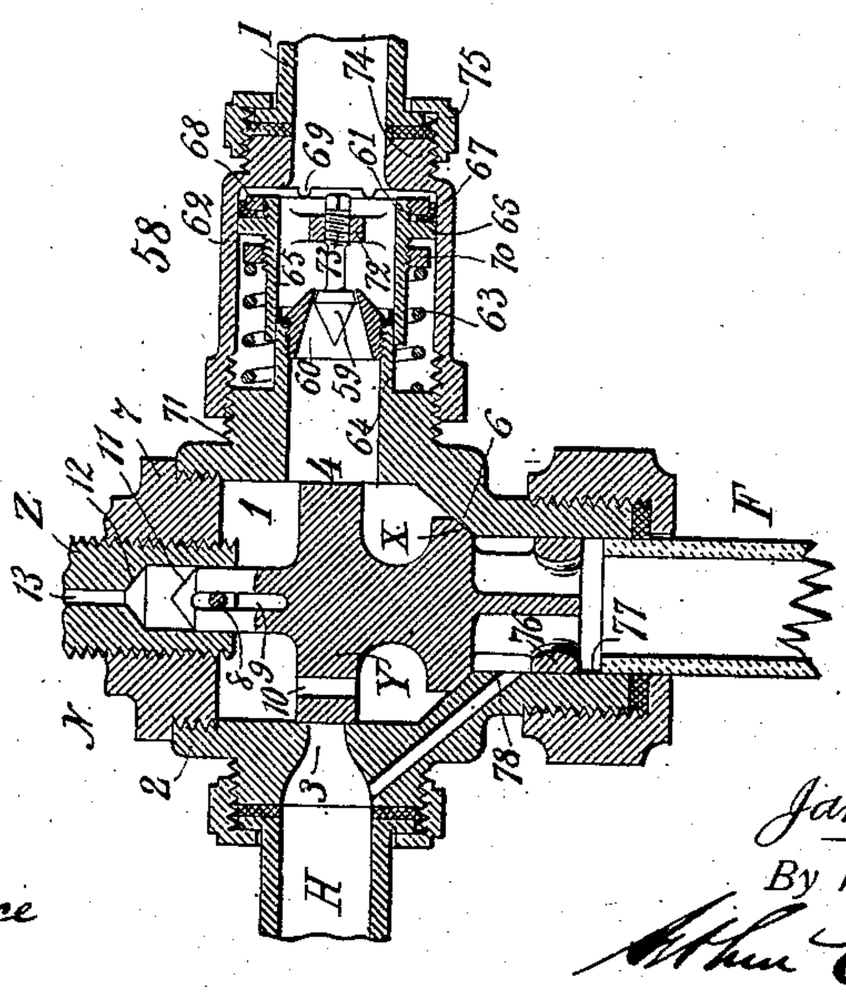

FIG. 7.

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UNITED STATES PATENT OFFICE.

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LUBRICATOR.

No. 842,507. Specification of Letters Patent. Patented Jan. 29, 1907.

Application filed December 31, 1896. Serial No. 617,592.

To all whom it may concern:

Be it known that I, JAMES N. WEIKLY, a citizen of the United States, residing in Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Lubricators, of which the following is a specification.

This invention relates to lubricators, and is especially applicable to automatic feed lubricators operating under pressure, such as the sight-feed lubricators used with steam-engines, and aims to provide certain improvements in such devices useful also with other devices.

It is common in lubricators to carry steam from a boiler to the lubricator, using the water of condensation in the oil-chamber to float the oil to the sight-feed, the feed being controlled by an adjustable cock, and using the live steam as a flow or jet into the tallow-pipe for carrying the oil fed into the latter to a steam-chest or other place of use. Various lubricators having some or all of these characteristics are employed for oiling the valves and cylinders of engines, feeding oil into steam-pipes, and lubricating piston-rods where packed. In using these it is found that great waste of oil occurs during the continued automatic operation of the lubricator while the engine is at rest through the negligence of attendants in failing to shut off the lubricator when a feed is not required and through the fact that after being shut off the lubricator may continue to act until all or part of its contents escapes by reason of the latent heat of the water of condensation vaporizing such water and continuing thereby throughout a considerable time the feeding pressure. It is also found that the great heat to which the oil is subjected impairs its lubricating quality, and that the continuous flow of steam through the lubricator-jet to a steam-chest is at times the cause of accident or inconvenience and always an element of danger when an engine is inactive.

My present invention provides several features of improvement designed to obviate or diminish these disadvantages. To this end in carrying out my invention I provide means automatically closing and opening the oil-feed in accordance with the requirements for such feed; also means automatically arresting the jet or steam flow in accordance with the condition of the engine; also an improved arrangement for supplying steam-pressure and water of condensation to the lubricator and the jet and preventing overheating of the former, and certain other features of improvement, all of which will be hereinafter more fully set forth.

In the accompanying drawings, which show certain adaptations of my present improvements, Figure 1 is a side elevation, partly in vertical section, of a lubricator adapted for use with a locomotive, a fragment of the boiler of the latter being shown in elevation and the throttle-valve lever being shown in cross-section. Fig. 2 is a fragmentary vertical section thereof cut on the line 2 2 in Fig. 1 and looking in the direction of the arrow. Fig. 3 is a fragmentary vertical axial section showing a well-known form of lubricator with certain of my improvements applied thereto, the view being cut on the line 3 3 of Fig. 4 and looking in the direction of the arrow. Fig. 4 is a fragmentary horizontal section thereof cut on the planes of the line 4 4 in Fig. 3. Figs. 5 and 7 are enlarged fragmentary vertical sections of the upper sight-feed arm. Fig. 6 is a like view of a modified construction of the lower arm. Figs. 8 and 9 are like views of the sight-gage arms. Figs. 10 and 11 are like views of modifications of these arms.

Referring first to Figs. 1, 2, and 5, I will describe the certain features of improvement incident to the preferred form of my invention. In these figures, A is the oil-cup or chamber of a lubricator. B is a steam-pipe feeding the latter. C is an engine-boiler. D is a throttle-valve lever of an engine. E is the gage-tube of the lubricator. F is the sight-feed tube thereof. G is the oil-valve controlling feed to the latter. H is the steam-pipe for feeding steam with the oil fed. I is the tallow-pipe or discharge-pipe leading from the lubricator to a steam-chest or other point of delivery for the oil fed. J is the water-feed cock for the cup. K is the filling-plug thereof. L is the emptying-cock therefor. M is the auxiliary cup for hand-feeding, and N is the top valve of the sight-feed. In general operation in pressure-feed lubricators the cup A is filled with oil *a*, which is forced through the oil-feed valve G by feeding water of condensation *b* under steam-pressure beneath the oil, the valve G being adjusted to regulate the maximum flow, and a constant flow

of steam to the outlet-pipe being supplied by the steam-pipe H to preserve a substantial equality of pressure above the sight-feed and to help direct the oil fed into the tallow-tube.

According to one feature of improvement the water of condensation is formed from the steam in a separate compartment, so that the heat of the live steam shall not reach the cup A, this being preferably accomplished by forming the pipe B with suitable length and shape to constitute a condensing-chamber between the boiler and the lubricator. This pipe is shown as bent in gooseneck form with the top bent at least flush with the top of the cup A and the bottom bent in the form of a coil below the latter, from which the pipe rises into the bottom of the cup, the cock J being located between the cup and pipe, so that by turning it communication can be established or terminated between the two. Thus no steam will enter the cup, and the oil will thereby be kept comparatively cool. The cock J will be turned off for refilling the cup, but for ordinary operation of the lubricator feed from the boiler to it will be controlled by the hand-valve *c*. Another feature of improvement consists of means automatically preventing outflow of oil from the cup in case steam-pressure at the feed-pipe is for any reason terminated, which outflow might otherwise be caused if the feed-valves were left open by reason of the pressure generated in the cup by the boiling of the water therein when freed from the pressure under which it was condensed. For this purpose I prefer to use an automatic valve O, which is shown as a check-valve opening with inward flow and closing against outward flow, the steam-pipe being extended to near the top of the cup and formed with a seat at its upper end for this valve. Thus no loss of oil can occur back through the steam-pipe. This valve is shown as prevented from escaping by the length of its stem, which is so long that its top will strike the filling-plug before the stem leaves the pipe. Another feature of improvement relates to the gage-tube E and consists in providing a duct at the top of this tube, which opens from the highest point of the cup A, so that it will take oil from the uppermost part of the cup, thus enabling the user to see the quantity of oil remaining therein until the oil is entirely exhausted. The tubular arm *e* shown for this purpose is preferably formed integrally with the body of the cup and leads from the filling-neck thereof. The lower arm *f* for the gage-tube is preferably likewise formed near the bottom edge of the cup. Another feature of improvement comprises a check-valve P in the tallow-pipe opening with the pressure from the lubricator and closing under reverse pressure to prevent back rushing of pressure from the steam-chest to the lubricator in the case of sudden variations of pressure in the chest. This valve preferably has a small bleed-vent *g*, so that it can permit a gradual backflow of pressure when seated. It thus serves to keep sudden shocks and waves of pressure from reacting against the lubricator or endangering the sight-feed tube. It may be placed at any point beyond this tube and avoids the necessity for using a fixed plate having a contracted orifice where the tube meets the steam-chest, as has heretofore been done in many cases to prevent sudden backward waves of pressure.

The main feature of my invention provides for automatically controlling feed from the lubricator in accordance with the condition of the device to be lubricated. This may be accomplished in various ways, but I prefer to employ the means shown in Figs. 1 and 2 for this purpose, combining several devices for this end, any one of which may ordinarily be sufficient, but which can all be used together, and when so used give greater assurance that in case one is impaired or ineffectual the others will suffice for the control of the feed. Of these devices the valve G constitutes one, and instead of being a mere positively-adjustable passive valve for gaging or shutting off the feed by hand manipulation I make it also an automatically-operating valve, which in addition to its usual functions will automatically close or open with the cessation or renewal of pressure in the tallow-pipe or in the steam-chest or other part to which the oil is to be fed. This may be accomplished in any manner, but I prefer the construction shown for the purpose, wherein the stem *h* of the valve is divided and and its adjacent parts are adjustably connected together by a reverse-threaded sleeve *i*, while its outer part screws into a diaphragm Q, against one side of which pressure from the tallow-pipe or other suitable point is directed by a pipe *j*, the diaphragm being carried by a frame R, which is fixed relatively to the arm *k* of the lubricator and serves as the one wall of a pressure-chamber, of which the diaphragm constitutes the other wall. The diaphragm is sufficiently rigid to normally maintain approximately a predetermined position when there is no pressure in the chamber and sufficiently yielding to spring outwardly from this position when there is pressure therein. The feed-valve G is adjusted in the diaphragm until it will permit the desired extent of feed when the diaphragm is under pressure. In effecting this adjustment the stem may be adjusted through the diaphragm or it may be adjusted by screwing its parts together or apart by means of the sleeve *i*, or both adjustments can be made. In operation the diaphragm holds the feed-valve open for the desired feed so long as there is pressure in the tallow-pipe. As soon as this pressure diminishes sufficiently the elasticity of the diaphragm

moves the valve-stem freely through its stuffing-boxes and presses it against the seat, thus closing off the feed. As soon as pressure returns the pressure will distort the diaphragm and again unseat the feed-valve. Should it be necessary to close the feed-valve while pressure exists the valve will be adjusted by hand until it is seated independently of the condition of or pressure against the diaphragm. The pressure-pipe *j* for the diaphragm leads downwardly thereto, so that the diaphragm-chamber may be retained full of water of condensation. Another feed-controlling valve S is provided in the feed-duct *l*, preferably in advance of the feed-valve G. This valve crosses the duct and has a port *m* permitting free feed when opposite the duct, the valve preventing communication through the latter when its port is out of coincidence therewith. I prefer to operate this valve by live-steam pressure in one direction, and tallow-pipe pressure in the other direction providing for this purpose in this construction a live-steam piston T in a cylinder *n*, receiving live steam from the pipe *o*, controlled by a hand-valve *p*, which piston tends to move the valve to the closed position and providing a diaphragm U connected to this piston, and in a chamber *q* connected by the steam-pipe H with the tallow-pipe I, and thereby receiving steam-chest back pressure, which diaphragm is adjusted in diameter to overcome the piston T at the desired pressure for opening the valve and push the latter to the open position, holding it there so long as this pressure continues or is exceeded. The diaphragm has an elastic tendency to close the valve, which tendency is aided by a spring *r* when desired. When the diaphragm moves the valve to the open position, air may escape from the cylinder *n* through a port *s* at rear of a smaller piston *t*, coupled to the valve, which piston moves with the piston T and prevents leakage back through the cylinder *n*. Thus when steam is turned on the valve S will be opened by the back pressure through the tallow-pipe, and as soon as steam is turned off it will be closed by the live-steam pressure against the piston T. I also prefer to operate this valve by the throttle-lever of the engine, and for this purpose I provide a connection between this lever and the lubricator, closing the feed-valve S when the lever is moved to the fully-closed position, and opening this valve as soon as the lever is moved from the closed position, so that the lubricator feed shall be shut off when the steam at the throttle-valve is shut off. This connection is preferably made directly with the valve S by means of a flexible or yielding connection V, which may be of any suitable character, that shown comprising a lever *u* connected to the valve and an adjustable yoke and spring-link $w^{\times}$ between this lever and the throttle-lever D, a spring being provided to graduate the action of the throttle-lever in opening the valve S and to yield if the valve is set.

According to another feature of improvement I automatically control the steam-jet to the lubricator, so that this jet shall only flow when the lubricator should be in operation. This may be accomplished in any suitable way; but I prefer to control it by the back pressure in the tallow-pipe, so that the steam-jet feed will be closed when this pressure falls below a predetermined limit and be opened when it exceeds such limit, and I also prefer to control it from the throttle-lever, so that it will be turned on with the opening of the throttle-valve and closed with the closing thereof. This is accomplished readily by adding to the valve S a steam-valve W, which is manipulated with this valve S and by the same means, so that the one mechanism serves for the two valves. The valve W in the construction shown comprises a peripheral port *v* on the piston T, which communicates with the chamber *q* by means of a transverse and an axial port in the piston and which when the piston is in the open position also communicates with a port *w*, consisting of a groove in the wall of the cylinder *n*, so that then steam can flow from this cylinder through the ports and into the chamber *q*, from which it can flow through the pipe H across the top of the sight-feed to the tallow-pipe. When the piston T moves outwardly toward the closed position, the port *v* passes beyond the duct *w*, thereupon closing all the steam-feed. A screw or other means for holding the valves S and W in any desired position or limiting their movement may be provided, as shown, so that the valves can be held in the open position constantly when desired, the yielding link $w^{\times}$ then permitting independent movement of the lever D. A steam-cock *x* is provided in the pipe H, so that the feed therefrom can be prevented when desired.

Another feature provides for closing the sight-feed and also the steam-jet feed, so that hand-oiling can be effected. To this end I construct the valve N as a double valve having, in addition to its usual sight-tube seat X a steam-valve Y, which when the valve is adjusted closes the steam-feed as the valve X closes the sight-feed, leaving open the tallow-tube and the tube from the cup M, so that by opening the valve of the latter oil can flow therefrom through the chamber of the valve N and down the tallow-tube. Any suitable valve for making these two closures by the one operation will suffice. I accomplish this in the construction shown by making the chamber 1 in the arm 2 an internally-smooth or cylindrical chamber, into which the port 3 from the steam-pipe H opens in a contracted orifice at the same height as the

port 4 of the tallow-pipe and the port 5 of the oil-cup and constructing the valve Y as a cylinder fitting this chamber and of sufficient height to cover the port 3, while of less height than the ports 4 and 5, when the valve X closes on its seat 6, as shown in Fig. 5. In this way when the handle Z is screwed down to seat the valve X it also seats the valve Y over the port 3, and when it is screwed up it opens both valves, whereupon they stand in the position shown in Fig. 1, in which position there is free communication from the feed-pipe and the steam-pipe to the tallow-pipe, while in the position shown in Fig. 9 both the sight-feed and the steam-pipes are closed, and the chamber of the valve N is open to the tallow-pipe and to the oil-cup both above and below the valve Y. As usual, to facilitate inserting the tube F, the passage through the chamber 1 and seat 6 is large enough for this tube to be passed through from above after the thimble 7 has been unscrewed, and in ordinary use the tail of the valve X is low enough to prevent accidental rising of the tube F so high as to free its lower end.

By another feature of improvement I provide an automatic operating-valve for the valve N, which will instantly close in case of fracture of the tube F and will automatically open and remain open when the lubricator is started and the tube F is normal. This may be accomplished in many ways; but I prefer the construction shown, which is taken as an example for attaining this end, the object being to provide a valve which will in no wise interfere with the gravity-feed of the oil, as is the case with a mere check-valve, which rests its weight on top of the sight-feed, and also to provide means automatically preventing the blowing out of steam in case of fracture, from which great injury might result. In the construction shown the valve Y is movably connected to the stem Z, as by the pin 8 in the stem entering the groove 9 in the valve, so that by extreme manipulation of the stem in either direction the valve can be manually manipulated, but ordinarily it is free to move independently of the stem. A cross-port 10 is provided through the valve Y, which valve acts as a piston in the chamber 1, and another valve 11 is provided which works against a seat 12 on the stem, the stem preferably surrounding the valve, from which seat a port 13 extends through the stem to the outer air. Thus above the valve 11 there is only air-pressure, the same being the case beneath the valve X when the lubricator is out of action. As soon as pressure is turned on to the lubricator it rises through the sight-feed F and lifts the valve X. The tendency of the pressure to escape past the valve 11 seats the latter, so that the pressure within holds the valves X and Y open. The pressure below valve Y rises through the port 10 to the upper side thereof, so that there is an equilibrium of pressure on each side of this piston and there is a free way from the sight-feed and the steam-pipes to the tallow-pipe, as shown in Fig. 1. Should the glass pipe F break, the release of pressure below the piston-valve Y would permit the pressure above it to instantly throw it down, thus seating the valve X and instantly closing the steam-port 3, so that live steam feed to the chamber would be closed. Then the only pressure entering the latter would be back pressure through the tallow-pipe, which would hold the valves in this position because of the greater area of the valve X, then open to the outer air, than the area of the valve 11, also open to the outer air. To provide an indication of such seating of the valve X, I provide for the whistling of the back pressure in a reduced stream in any suitable manner so long as the valve is in this position—as by extending the slot 9 far enough to give access past the valve 11 and seat 12 to the duct 13, from which a stream of pressure will whistle, so that the attention of the attendant will be drawn to the necessity of repairing the sight-feed. Then the attendant can screw down the stem Z until the valve is held seated, turn off the feed-valve G and any or all of the valves J, *c*, *p*, or *x*, whereupon he can remove the thimble 7 with the valve N and stem Z and replace the tube F in the ordinary manner when it is convenient to do so. Until such time, by screwing down the stem until the valve X is held closed, he can whenever the back pressure is off fill the cup M, and thereby apply oil by hand through the tallow-pipe, closing this cup whenever back pressure again occurs. In this way the engine can be oiled by hand whenever it is not running.

While the valve N is used, as shown, for both automatically closing the sight-feed pipe and the steam-feed pipe, it will be seen that it will work as well for performing either of these closures alone, if desired, as would be convenient when the steam-feed pipe is not discharged directly into the chamber at top of the sight-feed. It will also be seen that the principles involved in the valve N are important and far-reaching in their application, and it will be understood that they can be employed for any purpose where automatic opening and closing under predetermined conditions is desirable. By separating the valve X from the valve Y the latter can be used as an automatic steam-check which will open with the inrush of back pressure through the tallow-pipe, but will close with a sudden cessation of such pressure, and when closed will remain closed until such pressure is again renewed, and during such closure will prevent flow of steam from the steam-pipe, or by removing the steam-pipe connection the valve will act merely to control backflow to

the sight-feed in case that is broken, ordinarily being held open by the pressure rising through the sight-feed tube.

In use with the construction thus far described the operation will be understood from what has heretotore been said. After proper adjustment of the various parts of the device the operation thereof will be thoroughly automatic, and the lubricator can be used without danger of waste of oil by reason of neglect of the attendant without danger of a flow of steam through the tallow-pipe into the steam-chest when the engine is inactive and without risking the loss of any oil backward through the main feed-pipe B, as might possibly occur should pressure for any reason be withdrawn from this pipe while the contents of the cup A was above a vaporizing temperature. The various automatic provisions for safety and saving will act in conjunction in a device embodying the combination of these features shown; but should it be deemed sufficient to employ fewer of these features in combination in any device this can be done without departing from the spirit of my invention, any of my improved provisions being capable of use independently of the others, as will be apparent to those skilled in the art, and all being applicable to any desired style of lubricator or other device requiring their peculiar functions other than the particular construction taken as an example.

To blow out the lubricator for cleansing its sight-tube and other parts from gum or discoloration, it is only necessary to close the cock J and open the cock *x* and steam-valves W and Y in the construction shown and the draw-off cock L and steam-valve *p*, whereupon steam will rush through the pipes *o* and H and down through the sight-feed tube, the valve G being set to the open position and the automatic oil-valve S being also open for this purpose, so that steam can flow inward through the sight-feed jet and upward through the duct *l* into the cup A, which it will fill and from which it will escape through the water-cock L, a portion of the steam flowing down through the tube E. This reverse flow of steam will have the same cleansing effect as has a similar common operation known as "blowing out," now resorted to in pressure-lubricators. When thus cleaned, the cock L can be closed and the cup filled with oil through the plug K, the valve G being closed and the steam-valves left open until condensation has filled the sight-tube F. Then the feed-valve G can be adjusted and the valves S, W, X, and Y set for automatic operation, whereupon the lubricator can be used as ordinarily. The oil will not come in direct contact with the steam until it is delivered at the top of the feed-pipe. Hence its temperature will be much lower than that of the live steam and its lubricating qualities will be correspondingly preserved.

One example of a modification embodying features of my invention is shown in Figs. 3 and 4, in which a well-known form of pressure-lubricator is equipped with certain features of my improvements. In this construction the oil-cup A′ has a steam-dome B′, receiving live steam from the boiler and collecting water of condensation which flows down through a pipe *b′* to the bottom of the cup, where it rises beneath the oil and forces the latter down through the oil-duct *l′* to the sight-feeds, from which it flows to the tallow-pipes I′. Steam-pipes H′ take steam from the top of the dome and discharge it in the tallow-pipes around the port of a nozzle 4×. An ordinary feed-valve G′ graduates the flow of oil to the sight-tubes F′, and an ordinary hand-valve N′ provides for closing manually the tops of these tubes. One feature of improvement applied to this lubricator consists in an automatic oil-valve S′, which is opened by steam-pressure in the tallow-pipe, with which it communicates by a branch pipe *j′* and is closed by the pressure in the oil-cup when tallow-pipe pressure ceases. When opened, it completes communication through the part of the oil-duct *l′* leading to its feed-valve G′ and when closed it cuts off such communication. A simple provision for this valve is that shown, wherein the arm *k′* has a partition 14 in its oil-duct, into which the end of a tubular cylinder 15 screws, which has a seat 16 on its inner end and a port 17 beyond the partition, in which cylinder I place a plunger 18, surrounded by a groove 19 at one side of the partition 14 and another groove 20 at the other side thereof, connected together by a duct 21, the end of the piston having a valve 22, which seats against the end of the tube to close communication through the partition, and moves inwardly of the tube to open such communication, whereupon oil can flow through the groove 19, duct 21, and groove 20 to the port 17, through which it can flow to the valve G′. On the end of the plunger 18 is screwed a large piston 23 in a cylinder 24, into which the pipe *j′* opens at the outer side of the piston and from which an air-port 25 opens at the other side of the piston. The cylinder is closed by a cap 26, in which is an adjustable screw 27, by screwing in which the valve can be forced to and held at the open position.

In operation the pressure in the duct *l′* seats the valve 22 and closes communication through the duct. As soon as back pressure rises through the tallow-pipe it acts against the piston 23 and owing to the relatively great area of the latter instantly throws the valve to the open position. Upon cessation of this back pressure the live-steam pressure instantly closes the valve.

The relative areas of the plunger 18 and piston 23 will be so proportioned as to effect operation of this valve at predetermined limits of pressure. The description of this valve applies to each of the automatic oil-feed valves S′ and also to each of the automatic steam-feed valves W′, all being shown as identical in construction and operation, so that the oil-feed and the steam-feed are both controlled by the back pressure in the tallow-pipe. Additional to this provision for controlling the steam-feed my invention also provides separate hand-valves x' in the steam-pipes H′, so that in case of breakage of the sight-feed the steam-pipe leading over it can be shut off and hand-oiling from the cup M can be accomplished after the valve N′ has been closed. In their structural details, however, the steam-valves W′ are slightly differentiated from the oil-valves S′, so that the arms k' at top consist of an integral casting of which the tube 15 is a part and onto which the cylinder 24 screws, the valve 22 being omitted and a closure being effected by the movement of the plunger 18 sufficiently into the partition 14, which it snugly fits, to prevent access from the duct H′ to the groove 19, this being a simpler construction than that described for the valve S′ and sufficiently effective for some cases.

In lubricators of the character described closing of one of the sight-feeds and its steam-feed—as, for example, by the valves G or G′ and the steam-valves x or x' or W or W′—permits the use of the other sight feed or feeds while the one closed is in disuse or is used for hand-oiling, as explained.

In its preferred form my invention provides means for preserving a substantially uniform flow of pressure across the top of the sight-feed or in connection with this feed to the cylinder or other place where the oil fed is to be conducted, the means preferred for this purpose and shown in Figs. 1, 5, and 7 being adjustable and operating automatically under the back pressure in the tallow-pipe to control the area of the aperture between the steam and tallow pipes, contracting this aperture as the tallow-pipe pressure falls and enlarging it as this pressure rises, so that when there is a great differential between steam-feed and tallow-pipe pressures the contracted orifice will choke back the steam-flow and when there is a small differential between such pressures the orifice will be correspondingly enlarged to facilitate such flow. This can be accomplished in any suitable manner; but I prefer to employ the improved regulator 58 between the arm 2 and the tallow-pipe I, which, as shown, consists of a valve-head 59, movable axially in an internally-tapered nozzle 60, constituting the outer end of the duct 4, leading from the chamber 1, which head is moved by an annular piston or equivalent device 61, moved within an adjustable cylinder 62 by the back pressure in the pipe I against the resistance of a spring 63, so that as the back pressure rises the head will be forced into the nozzle to stand opposite the part thereof of greater diameter, and as the pressure falls the spring will force the piston outwardly, thus moving the head into the portion of the nozzle of smaller diameter and contracting or closing the latter as desired, according to its adjustment. In the construction shown an internally-screw-threaded and externally-cylindrical neck 64 projects from the arm 2, on the end of which neck a cupped packing-ring is clamped by the nozzle 60, and the piston 61 has a tubular cylindrical portion 65 surrounding and fitting the neck 64 with a leak-tight joint, having a flange 66 near its outer end externally screw-threaded at opposite sides of this flange and carrying outwardly thereof a cupped packing 67, held by a nut 68, making a leak-tight joint with the interior of the cylindrical shell 62 and constituting the inner end of the piston, against which the tallow-pipe pressure acts and which is arrested in its maximum outward position, either by the head 59 closing the nozzle 60 or by the piston striking stops 69 in the cylinder 62. At the other side of the flange 66 an adjusting-nut 70 may be screwed on the piston, which may be adjusted toward and from the spring 63 for adjusting the tension of the latter. The spring reacts against the arm 2 and the nut 70 of the piston in this construction. The cylinder 62 has an internal screw-thread engaging the external screw-thread 71 of the arm, so that by screwing the cylinder on or off the arm adjustment can be effected, if desired. Internally the piston has a cross-bar 72, through which is screwed the stem 73 of the head 59 for adjusting the head relatively to the piston. At its outer end the cylinder 62 has a screw-thread 74, engaged by a union 75 for clamping the tallow-pipe to the regulator. With this construction I avoid the necessity for the usual choke-plug which has heretofore been employed to maintain a positive limit for the steam-feed and with the further object of reducing the risk of such feed being sufficient to start an engine, and I maintain the control of the steam-feed according to the conditions surrounding the lubricator or a uniformity of this feed, as may be desired.

Another feature of improvement incident to the preferred form of my invention provides means for automatically closing the oil-feed in case of breakage of the feed-tube, so that there shall be no discharge of oil in such case. One of many suitable ways for accomplishing this is shown in Figs. 1, 5, and 7, in which a safety-valve 76 is employed, which automatically operates to control the oil-feed according to the condition of the lubricator. This valve may be variously con-

structed; but for convenience and simplicity I prefer to make it a part of the valve N by forming it as an externally-cylindrical ring on the tail of this valve, which ring snugly fits in the chamber 77 of the arm 2 and when in one position—that of the normal operation of the lubricator—rests over and closes an escape-port 78, leading from the steam-pipe H, so that then no flow can escape through this port, but which in case of breakage of the tube F at once falls with the valve N and passes below the port 78, thus opening the latter to the outer air, so that all pressure can at once escape from the pipe H, flowing down through the center of the valve 76 and out through the broken tube F. This action has the effect of relieving the diaphragm-valve W from back pressure, so that this valve is immediately able to assume the closed position by the action of the live steam against the large piston T, thereby closing the safety feed-valve S and cutting off all oil-feed. This valve being below the valve X does not in opening permit the steam escaping from H to enter the chamber 1.

Another important feature of improvement incident to the preferred form of my invention comprises means automatically opening and closing pressure-conduits to prevent injury from bursting and still permit a normal flow or current through such conduits, which means are especially applicable to the sight-gage tubes of lubricators and are also applicable to any analogous or known pressure-conductor in which there is either only a temporary flow and then a continual pressure or in which there is a rapid continuous flow of pressure—such, for example, as the live-steam pipes extending between boilers and throttle-valves. My invention provides an improved valve which will automatically open against the current or pressure in such devices and will automatically maintain itself open during normal conditions of pressure and permit, if desired, a uniform flow through the conductor, but which in case of breakage beyond it or in case of an abnormal decrease of back pressure beyond it will at once close to check an abnormal flow or escape of pressure through the conductor. The danger of fracture of gage-tubes renders such a valve especially desirable therefor. Heretofore the desirability for safety from such breakage has led to the use of a gravity-valve for sight-gage tubes in which there was no material current speed, a weighted plug being employed which would remain unseated while no current flowed past it, but in case of breakage of the tube and the consequent sudden escape of current through the tube-carrying arms would be carried by the current against the seat and held there. The tendency of such a valve, which was essentially a gravity check-valve, was to seat under so slight a current as to prevent its use, except where substantially no current and where no sudden pressure existed. My invention in this respect provides a valve which will operate positively and by pressure in both the closing and opening operations without respect to gravity and which can be operated independently of current conditions, so that any flow below that to which the valve is set can be maintained without danger of its interruption by premature operation of the valve, but instantaneous interruption will be assured in case an abnormal reduction of pressure occurs at the egress side of the valve. Many expedients for accomplishing this may be employed, according to the particular requirements of the device to which the valve is applied but for a sight-gage for lubricators I prefer to employ for the oil end the valve 79 and for the water end the valve 80, (shown in elevation in Fig. 1 and in section in the open and closed positions in Figs. 8 and 9, respectively,) using these valves in conjunction, although either may, if desired, be used alone or with a like opposite valve or with any known gravity check-valve.

The valve 79 is shown as constructed of a shell 81, internally cylindrical, and there constituting at its upper end a cylinder 82 and at its lower end a cylinder 83, between which is a seat 84, on which closes a valve proper, 85, connected to a piston or plunger 86, which fits the cylinder 82 and carries a smaller piston 87, which fits a cylinder 88, formed in the lower end of stem 92, hereinafter described, and terminates in a valve proper, 89, closing on a seat 90. The shell 81 is part of the arm *e*, the tubular interior of which opens into the cylinder 82 above the seat 84. The cylinder 83 corresponds with the external diameter of and receives the upper end of the glass gage-tube E. The top of the shell 81 is closed by a thimble 91, through which screws a stem 92, traversed by a duct 93, leading from the cylinder 88 to the air. The stem and valve are coupled together in any suitable manner, as by the pin 94 on the stem entering the slot 95 in the piston 87. A duct 96, shown as extending through the plunger 86, serves to convey pressure across the latter. A duct 97 (shown as extending through the valve 85) serves to convey pressure past the seat 84 when the valve is in the closed position. The ducts 96 and 97 are contracted and gaged according to the particular requirements of use.

In operation the stem when used is only employed to correctly adjust the seat of the air-valve 89 and is left in this position until it becomes necessary either to lock the valve open or closed or to revolve it for insuring free working, which can be done by screwing the stem in and out to open and close the

valve. The valve is free and passive in the construction shown, the connection between the valve and stem permitting sufficient lost motion for the operation of the valve. Should the valve be seated and the pipe E be normal when pressure enters from the tube *e*, it will flow to both sides of the piston 86, either through the duct 96 or by reason of the greater width of the interior of the tube than the thickness of the piston, so that the latter is balanced. The pressure will act against the valve proper, 85, to hold it against its seat 84 and will, to a small extent, escape around the valve 89 and blow out through the duct 93, serving as a whistling indicator of the position of the valve. The difference in diameter between the valves 89 and 85 will cause the latter to overbalance the former and resist its tendency to seat until a sufficient pressure has accumulated beyond the valve 85 to reduce its seating tendency to less than that of the valve 89, whereupon the latter will at once seat, raising the piston 86 in the cylinder 82 and lifting the valve 85 from its seat, as shown in Fig. 12. The pressure for effecting this result can be conveyed to the egress side of valve 85 in any suitable way and by any suitable port or passage-way affording communication between the tube *e* and pipe E, around or past the seat 84. I prefer to use the bleed-duct 97 and to form this in the valve proper itself, making the duct of sufficient capacity to cause a flow across the valve-seat capable of raising the desired pressure at the egress side of the valve within the desired limit of time and still sufficiently contracted to prevent such an outflow of pressure as would be dangerous or undesirable in case of breakage of the tube E or of an abnormal condition therein, such as a free exhaust therefrom. As shown, the duct is designed to soon give the desired back pressure provided there is a confined space beyond the tube, but to avoid giving so much pressure as would unseat the valve 85 if the space beyond it is open to the air. The proportions shown would cause the valve 85 to open when the pressure in the pipe E was substantially one-fourth of that in the tube *e*, the area of the valve 85 being approximately three times that of the valve 89.

While the valve 85 is in the open position the pressure above and below the piston 86 is balanced through the duct 96, which may be any suitable channel for conveying pressure to the side of the piston opposite the valve 85. The piston is then one wall of a confined chamber, of which the cylinder 82 constitutes the other walls. Should pressure below the piston be suddenly reduced to the predetermined extent for which the areas of the valves 85 and 89 are proportioned, the confined pressure in the chamber above the piston would at once throw the latter outwardly until the valve 85 was near or on its seat, whereupon the difference in pressure between that above this valve and that below would hold the valve 85 seated and escape would only exist through the duct 97, while warning of this condition would be given by the whistling of pressure past the air-valve 89. In the construction shown this would only take place in case the glass tube were broken, and normally the valve 85 would be held open by reason of the relatively low or air pressure existing above the valve 89, the area of this valve being adjusted to be sufficient to resist any tendencies of the current flowing through the conductor to seat the valve 85 by blowing it to its seat. While in a sight-gage tube in normal operation this current is generally too small to materially affect the valve, it is in some pressure-tubes to which the valve may be applied—such, for example, as the steam-pipes leading from boilers to throttle-valves for high-speed engines—so swift and strong that careful proportioning and adjustment of the parts will be required to enable the safety-valve to resist the tendency of the flow to close it and still to promptly close in case of such an abnormal flow as would occur upon bursting of the pipe beyond it or racing of the engine, if sufficient adjustment to prevent the latter were desired. In such a case as an abnormal reduction of pressure resulting from racing of an engine beyond the safety-valve the latter would close upon the predetermined reduction of pressure, remain closed until pressure had again accumulated beyond it to the point for opening it, and would then pop open and remain open until conditions again closed it. At the turning on of pressure, should it be lying in the closed position, it would not open until the space beyond it had been filled with the predetermined pressure by the by-pass or duct provided for this purpose.

In such a case as a sight-gage tube, where pressure flows in both directions into the tube, a valve for automatically closing may be employed at each end of the tube, and each may be operated by pressure, while only one by-pass will be required for opening both valves, as it is only necessary to get the pressure at the egress side of the valves, so that they can normally automatically open, while they are still capable of closing automatically in case pressure beyond them is suddenly released. The by-pass in such cases can best be made in the upper or steam valve, so that there will be no escape whatever from the lower or water valve; but I prefer to make the lower valve 80 in the adaptation shown with a by-pass which can be used, if desired. My invention also provides an improved construction of this valve, which in the form shown consists of a shell 98, formed integrally with the tubular arm *f*, having a small inner cylinder 99,

a large upper cylinder 100, and a seat 101, within which shell is a plunger 102, having a small piston 103 fitting and playing in the cylinder 99, a large piston 104 fitting and playing in the cylinder 100, and a valve proper, 105, engaging the seat 101. The passage through the valve consists of a duct 106, leading concentrically of and through the plunger from the inner end of the piston 103 to the piston 104 and opening in side ports 107 at rear of the valve 105 in a chamber 108 beyond the cylinder 100. The flow from the tube *f* passes from the cylinder 99 through this duct to the chamber 108 and, when the valve is open, past it across the seat 101 and into the tube E, as shown in Fig. 12; but when the valve is closed escape of this pressure from the chamber 108 is prevented by the engagement between the valve proper and seat, as shown in Fig. 9. The cylinder 100 has an annular chamber 109 at back of the piston 104, which is a low-pressure chamber, being shown as provided with a duct 110 leading from it to the air. As thus far described the plunger is passive and balanced in all respects except that the pressure from the tube *f* against the piston 103 tends to seat the valve 105 when there is no pressure in the pipe E. When there is pressure in this pipe, it reacts against the outer face of the plunger until the pressure against this face, which is of relatively great area, is sufficient to overcome the pressure against the piston 103, whereupon it unseats the valve proper and exposes the entire end of the latter to the pressure in the pipe E, when the plunger is quickly thrown to the open position by reason of the area of air-pressure in the chamber 109. The pressure against the valve proper throws the plunger to the end of the chamber, whereupon the bottom face or valve proper, 111, of the plunger rests against the rear wall 112 of the cylinder 100, thus closing exit to the air by the duct 110. The valve will stay in the open position until a reduction of pressure in the pipe E, whereupon it will be immediately thrown to the closed position by the greater pressure in the cylinder 99. Should the escape of a small stream through the valve not be objectionable, it may be provided with the by-pass 113, which is shown as a contracted extension of the duct 106, the feed through which will soon be sufficient to open the valve if the tube E is intact. Its area is adjusted by a screw 117.

If hand manipulation is desired, the stem 118 may be screwed into the shell 98 and connected to the end of the valve by a pin 114 on the plunger, traversing a slot 115 in the flattened end of the stem, which end passes between the forks of the end of the plunger in the particular construction shown, enough lost motion being left to permit automatic operation of the valve and the connection still being such that the valve can be manually placed in either position, if necessary.

It will be noted that in the constructions described with reference to the valves 79 and 80 the different portions of the valves and their casings constitute pistons and cylinders or chambers differentiated in size or conditions to attain the results desired by means of pressure conditions, and it will be understood that any known or suitable expedient for accomplishing this result comes within the scope of my invention and is included within the terms used for describing my improvements and that I consider diaphragms and pressure-chambers and other devices equivalents of the pistons and cylinders which I have taken as convenient elements for illustrating my improvements. It will be also understood that all or any part of my improvements can be adapted for use with any devices and that they are described as applied to automatic lubricators for such engines as locomotives simply for convenience of illustration, they being equally applicable to any other kind of engines or devices requiring lubrication and capable of application either to feed directly to cylinders, steam-chests, or steam-pipes from any source of steam or other supply where the supply is drawn from a boiler, cylinder, steam-chest, or steam-pipe.

A modification of the sight-gage valve is shown in Fig. 10, in which a shell 119 is shown as formed integral with the tubular arm *e''*, which shell has an egress-pipe 122, communicating with the gage-tube E and is constructed with an ingress-cylinder 120, an egress-cylinder 128, and a piston-cylinder 121, a seat 124 being provided between the ingress and egress cylinders, at which seat the valve 123 closes. This valve is crossed by a duct 130, leading from the cylinder 120 to the cylinders 128 and 121, both of which cylinders are in communication with the pipe 122. A large piston 125 is connected to the valve and fits the cylinder 121, having a small piston 129 fitting the cylinder 128. The piston 125 and its extension 129 isolate the upper part of the cylinder 121 from the lower part thereof and from the pipe 122. The upper part of the cylinder 121 has a face 126, from which a duct 127 leads to the air, which face is engaged by the piston 125 when this piston is in the upward position. The part of the cylinder 121 above the piston 125 constitutes a low-pressure or air chamber, while the part below this piston constitutes an egress-pressure chamber. The valve 123 is free to move to the open or closed position, the parts being proportioned to open the valve when a pressure of, say, one-half that above it has accumulated in the cylinder 121. When opened, the valve will remain open until the egress-pressure falls to such a point

that the confined pressure between the valve and the top of the cylinder 120 is able to throw the valve toward the closed position. This pressure will be assisted by the current reacting against the face of the extension 129 and having started the valve toward the closed position the outflowing current will assist to close it. It will remain closed until the pressure beyond it is raised sufficiently to overcome the closing tendency of the ingress-pressure. Solid screw-stems 131 and 132 above and below the valve can be screwed against it to hold it in either position, the upper stem entering the port 130 when screwed home, and thus closing the cross-bleed when desired.

In the modification shown in Fig. 11 the shell 133 has an ingress-pipe e^3, an egress-pipe 134, an intermediate valve-seat 136, a port 141, leading through the shell across this seat, a valve-cylinder 135, a piston 146, fitting this cylinder, a port 140, leading from the pipe e^3 to the valve-cylinder past this piston, an imperforate valve 137, closing on the seat 136 and carried by the piston 146, an air-cylinder 138, an air-piston 139 in said cylinder and connected to the piston 146, a cap 144, and a valve-stem 143, having an air-duct 142 opposite the air-valve 145. The gage-glass E communicates with the egress-tube 134. The duct 141 supplies pressure under the valve 137 until this pressure exceeds the resistance offered by the ingress-pressure supplied to the cylinder 135 by the duct 140. Then the pressure beneath the valve lifts it, and it is thrown to the maximum outward position, in which the end of its piston 139 makes a leak-tight seat with the end of the cylinder 138. The valve is held in this position until a release or sufficient reduction of the egress-pressure occurs, whereupon the confined pressure in cylinder 135 forces the valve quickly to its seat, where it remains until the excess of egress-pressure is again obtained. The capacity of the cylinder 135 for pressure-storage purposes is increased by cutting out the under face of the cap 144. The capacity of the duct 140 will be adjusted or regulated in any suitable manner to sufficiently check exhaust through it to enable the pressure confined in the cylinder 135 to force down the piston 146 before it can escape backward through the duct 140 and obtain an equilibrium with the increased pressure when the latter is abnormally reduced by breakage or otherwise. Screwing the stem 143 down against the point 145 brings this point into the air-vent 142 and closes the latter.

What I claim is, in lubricators and other devices and for use therewith, the following-defined novel features and combinations, substantially as and for the purposes hereinbefore set forth, namely:

1. The combination with an engine having a throttle-valve handle, of a lubricator having a feed-valve, and means for locking said valve open, a yielding connection between such valve and said handle operating said feed-valve with the operation of the handle, and yielding when said feed-valve is locked.

2. The combination with an engine having a throttle-valve handle, of a lubricator having a steam-valve for supplying an auxiliary jet of steam and an oil-valve for controlling outflow of oil, and a connection between such handle and said valves operating both said valves with the operation of the handle.

3. In combination with a lubricator provided with suitable oil-ducts and steam-ducts arranged to balance the contents of the lubricator between opposing forces, and a discharge-pipe in communication with said ducts, of an automatically-actuated valve operated by the pressure in said pipe to close communication between said discharge-pipe and said ducts.

4. In combination with a lubricator provided with oil-ducts and steam-ducts arranged to balance the contents of the lubricator between opposing forces, and a discharge-pipe in communication with said ducts, of an automatically-operated valve operated by the pressure in said pipe to close said oil-duct.

5. In combination with a lubricator provided with an oil-duct and a steam-duct arranged to balance the contents of the lubricator between opposing forces, and a discharge-pipe in communication with said ducts, of an automatically-actuated valve adapted to close said steam-duct and operated by the pressure in said pipe.

6. In combination with a lubricator provided with an oil-duct and a steam-duct arranged to balance the contents of the lubricator between opposing forces, and a discharge-pipe, of an automatically-actuated valve adapted to close both said ducts and controlled by the pressure in said pipe.

7. In a pressure-lubricator or the like, a reservoir, an oil-feed and an equalizer pipe connected to said reservoir and both discharging into a discharge-pipe, and such pipe in combination with a pressure-operated valve for closing said equalizer-pipe, said valve being opened by the pressure from said discharge-pipe.

8. In a pressure-lubricator, a pressure-reservoir having a discharge-pipe and an oil-feed and equalizer pipe leading to said discharge-pipe, in combination with a valve controlling said equalizer-pipe operated automatically by pressure from said discharge-pipe.

9. In a pressure-lubricator, a reservoir having a discharge-pipe and an oil-feed and equalizer pipe leading to said discharge-pipe in combination with a valve to said equalizer-pipe opened by the pressure at its egress side and closed by live-steam pressure.

10. In a pressure-lubricator, a reservoir, a discharge-pipe, and an oil-feed and equalizer pipe leading to said pipe, in combination with a valve for said equalizer-pipe closed by the steam-pressure at its egress side and opened by pressure from said discharge-pipe.

11. In a pressure-lubricator or the like, the combination with a reservoir having an oil-feed and an equalizer pipe, of one automatically-actuated valve controlling both said oil-feed and equalizer pipe.

12. In a pressure-lubricator, a reservoir and an equalizer-pipe, and a pipe leading therefrom for discharging such equalizer-pipe, in combination with a valve for such equalizer-pipe opened by the back pressure from such discharging-pipe.

13. In a pressure-lubricator, a reservoir and an equalizer-pipe for injecting the oil fed from said reservoir, and a discharge-pipe, in combination with a valve controlling the steam-feed of such equalizer-pipe, and a piston operating said valve and receiving back pressure from said discharge-pipe at one side and steam-feed pressure at its other side.

14. In a pressure-lubricator, a reservoir and an oil-gage valve therefor, in combination with pressure-operated means automatically closing said valve at a predetermined condition therebeyond, and operated by fluid-pressure to both open and close said valve.

15. For a pressure-lubricator or the like, a reservoir, an oil-gage valve and a discharge-pipe, in combination with means automatically opening said valve and operated by the pressure in said discharge-pipe, and operated by fluid-pressure to both open and close said valve.

16. For a lubricator or similar device, a discharge-pipe and a pressure-operated valve controlling the flow therethrough and comprising a valve proper and seat, movable the one relatively to the other, a tubular conduit controlled thereby, a piston operated by pressure and moving the movable member, and a spring resisting such movement.

17. For a lubricator or similar device, a discharge-pipe and the improved regulator 58 controlling the flow therethrough and comprising a valve 59, a seat 60, a cylinder 62, and a piston 61, substantially as and for the purpose set forth.

18. For a lubricator or similar device, an equalizer-pipe, in combination with a pressure-operated valve controlling the feed therethrough, and a second pressure-operated valve controlling the pressure operating said first valve.

19. In a pressure-lubricator or similar device, a casing having a pressure-conduit and a seat, in combination with an automatic valve controlling communication through said conduit and engaging said seat, and a by-pass communicating between the ingress and egress sides of said seat.

20. For a pressure-lubricator or similar device, a casing having a pressure-conduit, a seat, and a low-pressure cylinder, in combination with a valve engaging said seat, and a piston in said cylinder operating said valve and operated by the difference between the pressures in said cylinder and casing.

21. For a pressure-lubricator or similar device, the improved valve 79 comprising a shell having a valve-chamber and seat, in combination with a valve proper in said shell for seating on said seat, and a piston fitting said chamber and connected to said valve proper for operating it, and a by-pass for communicating across said seat when said valve proper is closed.

22. For a pressure-lubricator or similar device, the improved valve 80 comprising a valve-chamber having a seat, a plunger fitting in said casing and engaging said seat, a by-pass affording communication across said seat when said plunger is seated thereon, and a relief-vent for said plunger.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES N. WEIKLY.

Witnesses:

GEORGE H. FRASER,

THOMAS F. WALLACE.