No. 610,017.

Patented Aug. 30, 1898.

C. W. BARNABY.

STEAM ENGINE.

(Application filed Sept. 18, 1897.)

(No Model.)

2 Sheets—Sheet 1.

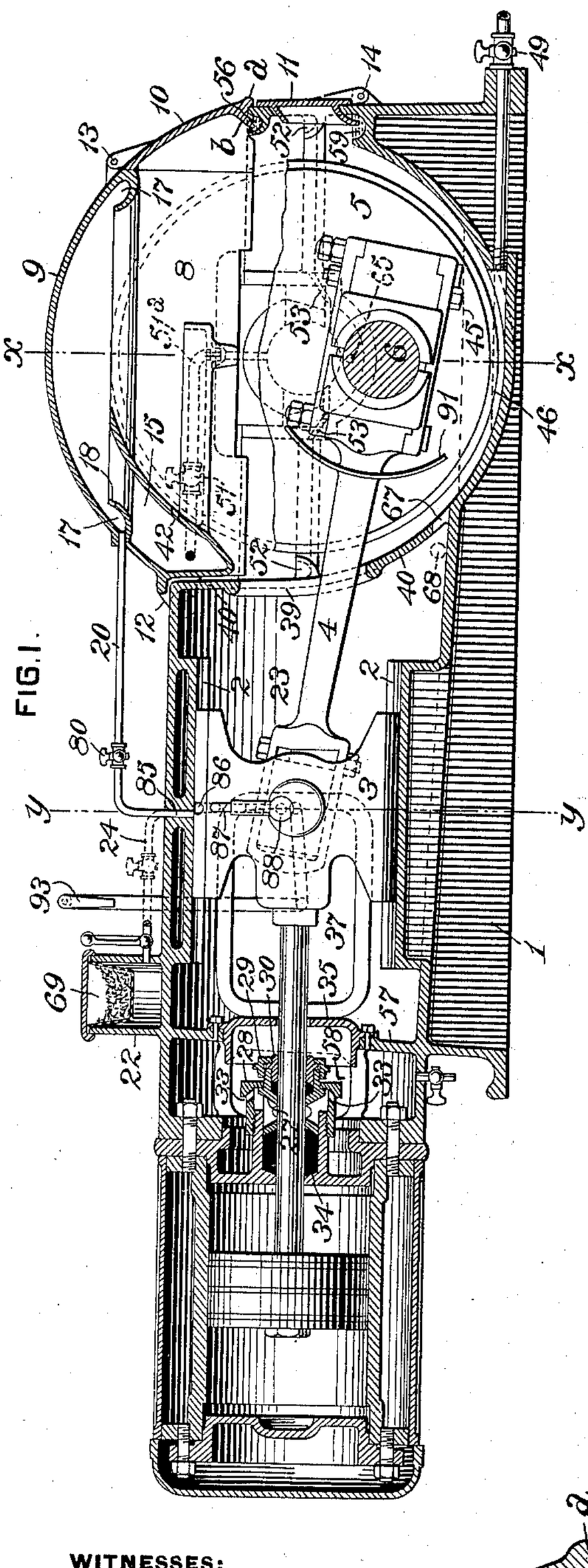

FIG. 1.

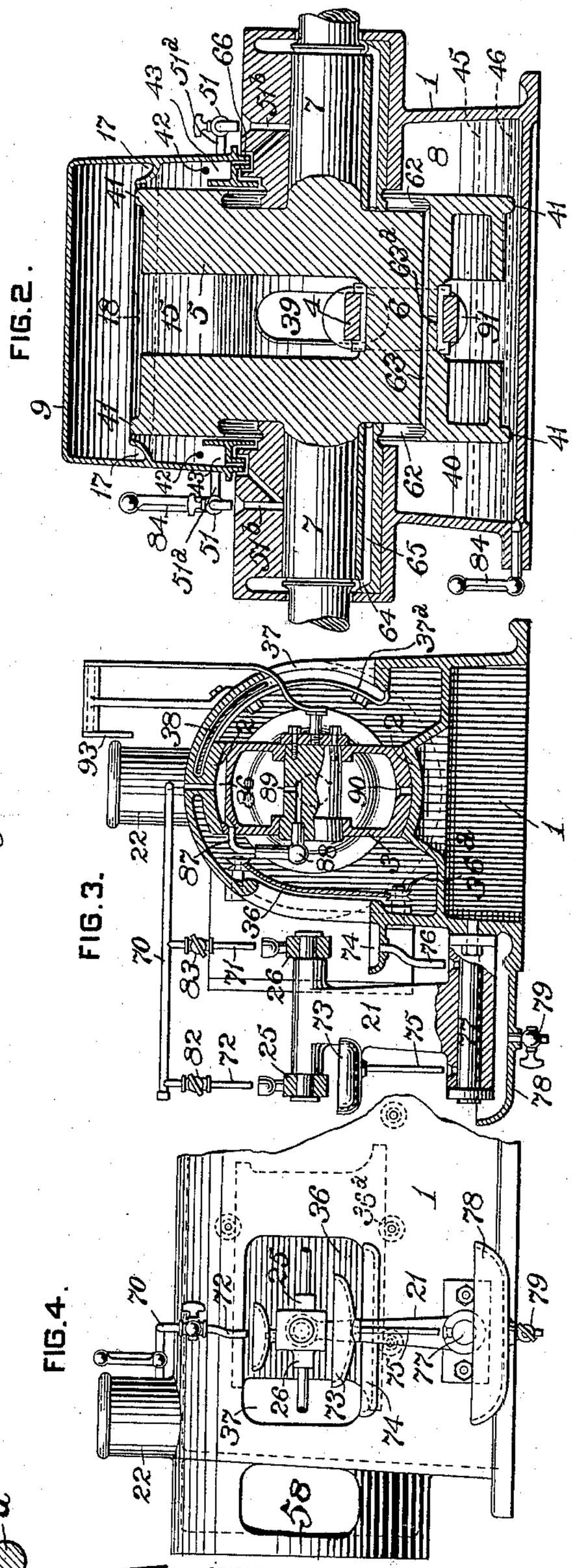

FIG. 2.

FIG. 3.

FIG. 4.

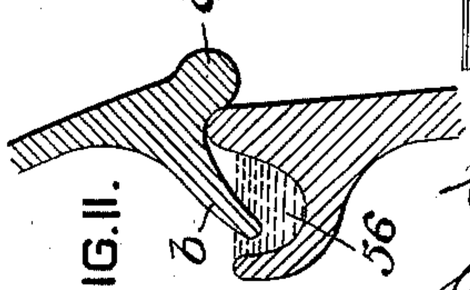

FIG. 11.

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2 Sheets—Sheet 2.

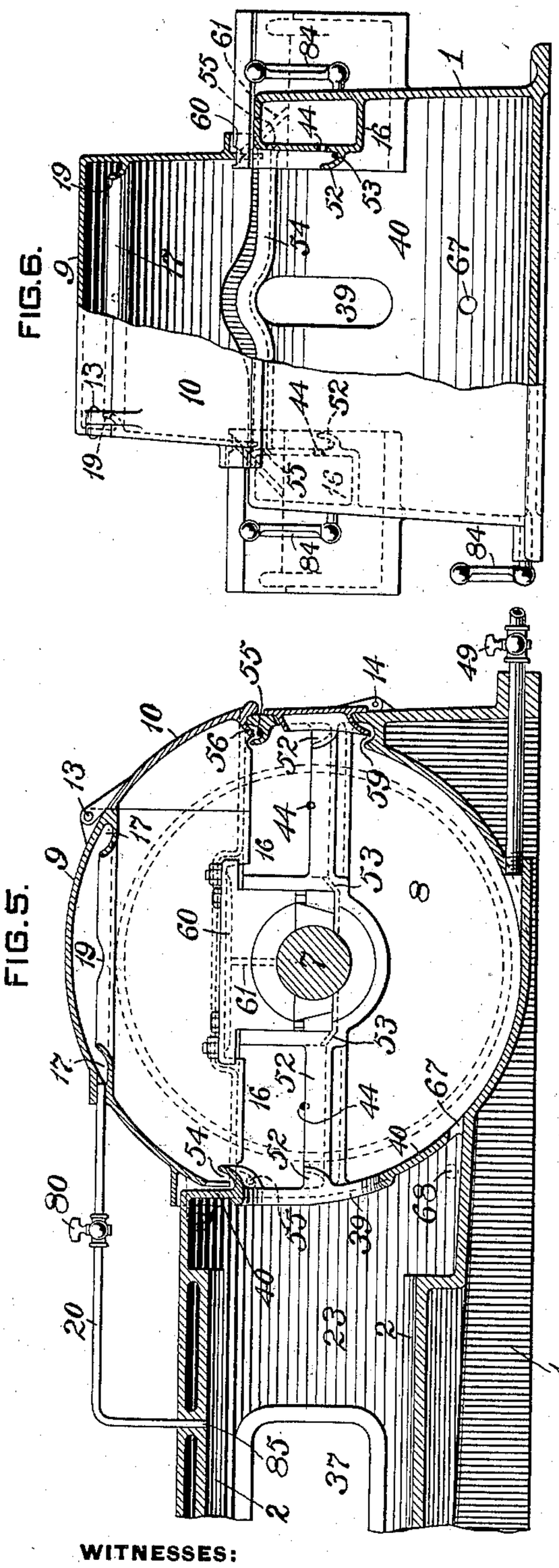

FIG. 6.

FIG. 5.

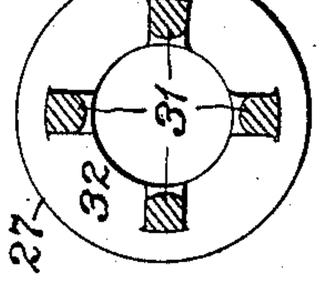

FIG. 9.

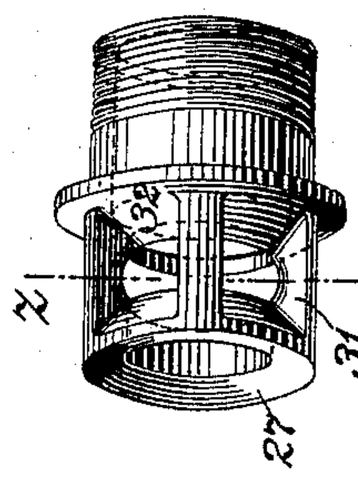

FIG. 8.

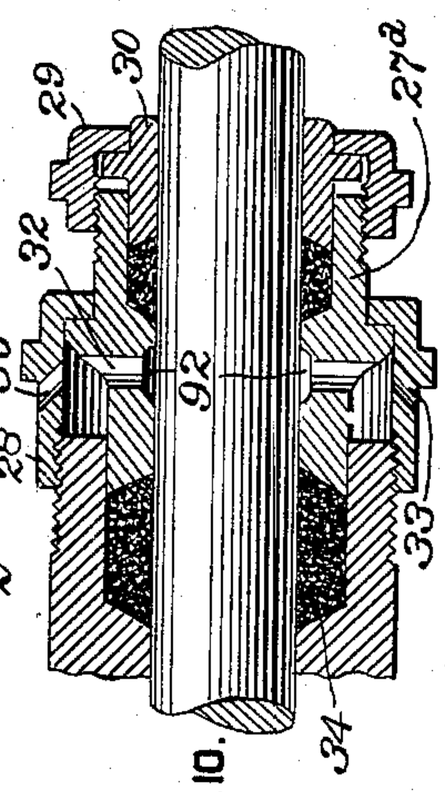

FIG. 10.

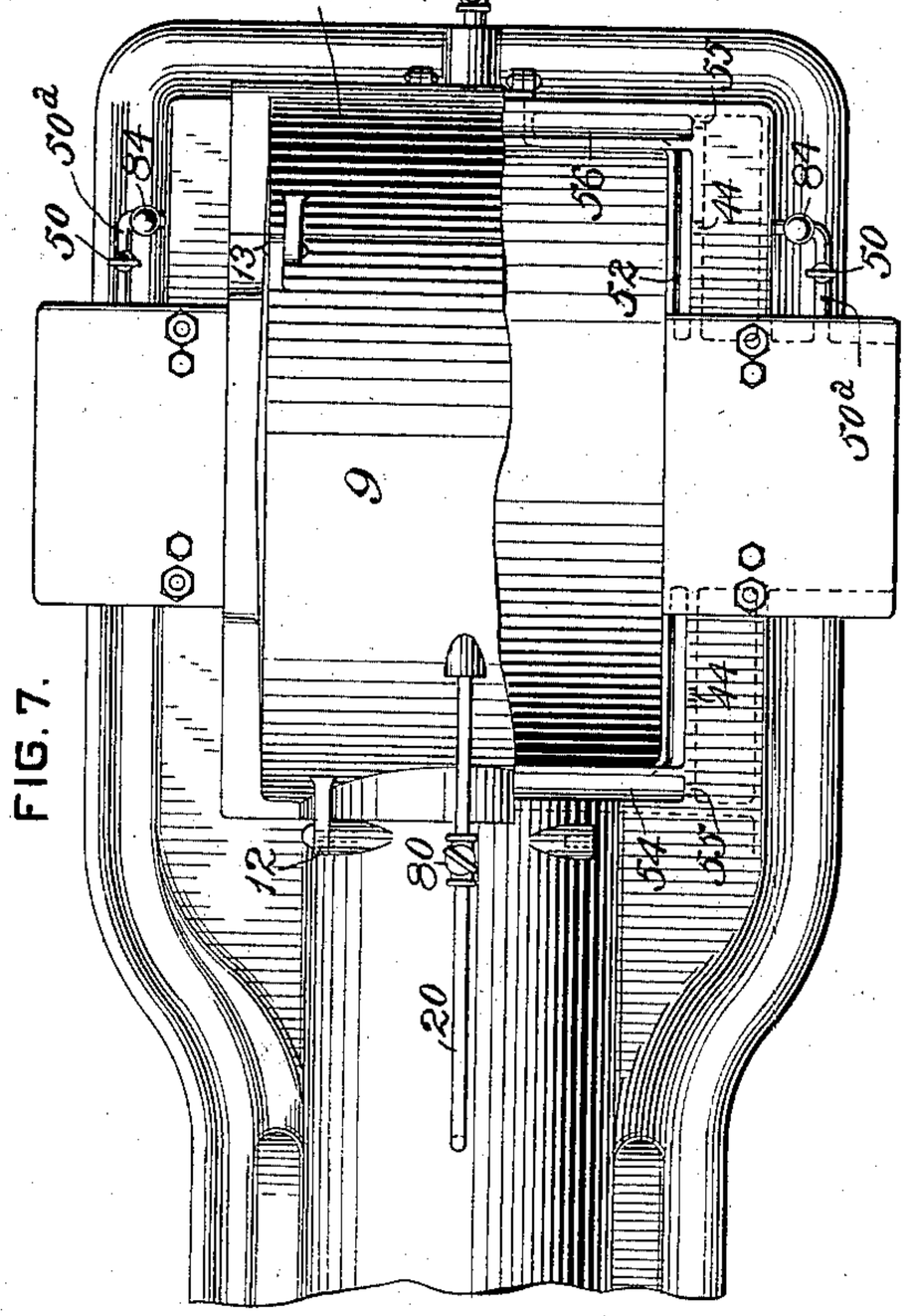

FIG. 7.

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UNITED STATES PATENT OFFICE.

CHARLES W. BARNABY, OF MEADVILLE, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO THE PHŒNIX IRON WORKS COMPANY, OF SAME PLACE.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 610,017, dated August 30, 1898.

Application filed September 18, 1897. Serial No. 652,117. (No model.)

To all whom it may concern:

Be it known that I, CHARLES W. BARNABY, a citizen of the United States, residing at Meadville, in the county of Crawford and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Steam-Engines, of which improvement the following is a specification.

The object of my invention is to provide certain new and useful improvements in steam-engines; and to this end my invention consists in new and improved means for effecting the automatic lubrication of engines and in certain combinations and features of construction, all as hereinafter fully set forth.

In the accompanying drawings, which illustrate my invention, Figure 1 is a central longitudinal section of a horizontal engine constructed in accordance with my invention; Fig. 2, a transverse section on the line *x x* of Fig. 1; Fig. 3, a transverse section on the line *y y* of Fig. 1; Fig. 4, a side elevation of a portion of the engine shown in Fig. 1; Fig. 5, a central longitudinal section through a portion of an engine provided with a modification of my improvement; Fig. 6, a view, partly in elevation and partly in section, at right angles to the view shown in Fig. 5; Fig. 7, a plan view of the portion of an engine shown in Figs. 5 and 6 with part of the crank-cover broken away; Fig. 8, a perspective view of the gland of the main piston-rod stuffing-box shown in Fig. 1; Fig. 9, a transverse section on the line *z z* of Fig. 8; Fig. 10, a central longitudinal section through a modification of the compound stuffing-box for the piston-rod; and Fig. 11, a section, on a larger scale, showing the joint between the engine frame or casing and the cover for the crank-pit.

My invention relates to improvements in self-oiling engines, and more particularly to engines of the class in which the piston of the engine is connected with the crank-shaft by means of a piston-rod, cross-head, and connecting-rod.

In accordance with my invention separate chambers are provided for the cross-head and for the crank or cranks and an automatic lubricating system is provided for the bearings and surfaces needing lubrication, in which a quantity of oil sufficient for lubricating the parts is kept in continuous circulation so long as the engine is in motion and any excess of oil is stored in reservoirs or receptacles which are in communication with or form part of the system of oil circulation.

By means of my improvement the supply of oil from the reservoirs or receptacles to the bearings to be lubricated is effected by the action of gravity, and after passing through the bearings the oil is automatically returned to the reservoirs or receptacles by the rotation of the crank-disks or other rotating parts, and this operation is effected in such a manner and by such means that only a small quantity of oil is permitted to collect in the bottom of the crank-chamber, and therefore but a very small portion of the oil is subjected to the churning action which usually takes place in engines in which any considerable quantity of oil or of oil and water is contained in the crank-chamber. This churning action is very objectionable, as it seriously affects the efficiency of the lubricant by creating a frothy condition, which prevents it from flowing freely and which interferes with the absorption of heat from the bearings.

By the separation of the crank-chamber from the cross-head chamber and the existence of but a small quantity of oil in the bottom of the crank-chamber the greater portion of the oil is confined to the crank-chamber and to the reservoirs or receptacles therein, and independent means are provided for drawing off from the reservoirs whatever may be desired for lubricating the exposed bearings in the cross-head chamber or for flooding the main bearings in starting the engine; but it is not essential that the oil for the exposed bearings, such as the bearings of the valve-gear or cross-head, should be drawn from the supply in the reservoirs of the crank-chamber, as it is a feature of my improvement that the oiling system for the exposed bearings is independent of the system employed for the main bearings, and the supply for the exposed bearings may be entirely independent of and disconnected from the supply for the main bearings.

In self-oiling engines as heretofore constructed the means of effecting lubrications of the parts has been such that it was essen-

tial to the proper operation of the lubricating devices that the engine should always run in one direction—that is, that the shaft should always rotate in the same direction. Usually the direction of rotation of the shaft has been such that in a horizontal engine the top of the crank-disk moved away from the engine-cylinder. It is an important feature of my invention that an engine provided with my improvement may be reversible and may be run in either direction without affecting or interfering with the efficiency of the lubrication.

In accordance with my invention I provide means whereby the guides and cross-head of the engine are readily accessible while the engine is in operation for inspection or for the purpose of connecting indicator-reducing motion and for inspection and adjustment while the engine is not in motion.

My invention further provides means for preventing access of steam and water of condensation from the piston-rod stuffing-box to the cross-head chamber or crank-chamber of the engine.

My invention is shown in the drawings as applied to a form of engine known to the trade as a "horizontal center-crank" engine; but it is not limited in its application to the particular form of engine shown, as it is equally applicable to side-crank or vertical engines.

As shown in Fig. 1 of the drawings, the engine-cylinder is secured to one end of the base or frame 1 of the engine, and the main frame, shell, or casing of the engine is divided into three compartments or chambers. The crank-chamber 8 is separated from the cross-head chamber 23 by means of a partition 40, in which an opening 39 is formed to permit the necessary movement of the connecting-rod. The purpose of the partition 40 is to cut off communication between the chambers 8 and 23 so far as possible, and particularly to prevent any splashing of oil from the crank-chamber to the cross-head chamber, and the opening 39 in the partition 40 is not intended for the purpose of opening even a limited communication between those chambers, but is merely to permit the movement of the connecting-rod, and is therefore preferably limited to the form and dimensions necessary to permit such movement.

In order to prevent as far as possible the splashing of oil through the opening 39 or its discharge therethrough by centrifugal action, and also to prevent a flow of oil along the connecting-rod 4, I have provided a plate or shield 91, which may be secured to or formed integral with the rod in such position as to hinder or prevent oil from being thrown through the passage 39 into the cross-head chamber. The result of the construction described is that the crank-chamber is practically closed to or cut off from the cross-head chamber so far as any discharge of oil from the crank-chamber by the rotating or moving parts is concerned, and I am therefore enabled to provide within the crank-chamber a continuous system of oil circulation which is independent of the opened or closed condition of the cross-head chamber and which is not interfered with or affected by opening the cross-head chamber, and I provide means whereby the bearings and working surfaces in the cross-head chamber may be lubricated either wholly independently of the system of lubrication in the crank-chamber or by a supply of oil obtained from the main body of the oil contained in the reservoirs or receptacles within the crank-chamber.

In accordance with my invention I provide within the crank-chamber pockets or receptacles for catching the oil thrown up by the action of the moving parts in whichever direction the engine-shaft may be rotated and provide means whereby the oil so caught is delivered by the action of gravity either directly to the bearings or to a reservoir which is so located that the oil may pass under the action of gravity from the reservoir to the bearings, the reservoir being adapted to contain any excess of oil above the quantity in active circulation at any moment for oiling the bearings.

As shown in the drawings, the crank-chamber 8 is provided with a cover 9, which is adapted to be swung on the hinges 12, so as to permit access to the crank-chamber and to permit the removal of the crank-shaft and connecting-rod. A smaller cover or door 10 is hinged at 13 to the cover 9, and below the door or cover 10 is provided a door 11, which covers an opening in the frame or casing of the engine and is provided with hinges 14. The doors 10 and 11 are intended to give access to the chamber for the purpose of adjusting the connections or for ascertaining the temperature.

As shown in the drawings, a pocket or receptacle 17 is provided in the upper part of the crank-chamber, and in the construction shown in Figs. 1 and 2 a reservoir 15 is also located in the upper part of the crank-chamber in such position as to receive the overflow or discharge of oil from the trough or pocket 17. Before starting the engine the reservoir 15 is charged with oil to the height of the flow-hole 42 in the reservoir 15 and the bottom of the crank-chamber is filled with oil to the height indicated by the dotted line 45 in Fig. 2, the drain-valve 49 first being closed.

Before starting the engine the valves 51 may be opened to permit oil to flow from the reservoir 15, through the pipes 51^a, into the main bearings through the passage 51^b, and when the engine is started the oil in the bottom of the crank-chamber will be splashed up by the moving parts or thrown by centrifugal action against the walls and cover of the crank-chamber. That portion of the oil which is thrown to the upper part of the chamber or against the upper part of the cover 9 will be caught in the troughs or pockets 17, and

when the level of the oil in the receptacle 17 is near the top the oil will overflow through the opening or notch 18 and pass by the action of gravity into the reservoir 15. When the oil in the reservoir 15 rises above the level of the opening or flow-hole 42 it will flow through the opening 42 into the troughs or pockets 43, from which it passes through openings 66 to oil-holes in the top of the main bearings.

At the lower edge of the cover 9 is provided a receptacle or trough 56, which is formed on or secured to the upper edge of the engine frame or casing, against which the cover 9 closes. A transverse section through this trough or receptacle is shown in Fig. 11 on an enlarged scale. The lower edge of the cover is provided with a bead *a* on the outside and with a rib or flange *b* on the inside, which when the cover is closed projects into the trough or receptacle 56 and extends below the level of the oil in the receptacle 56. The object of this construction is to prevent the splashing of oil into the joint between the lower edge of the cover and the top of the engine-casing, from which it might flow down on the outside of the casing—that is, the receptacle or pocket 56, with the oil therein, and the flange or ribs *b* form a seal to prevent the passage of oil through the joint. The outer beaded edge of the cover overlaps the top edge of the engine-casing, so as to form a dust-shield to prevent the entrance of dust into the crank-chamber, and serves to cover up an unsightly joint and thereby to improve the appearance of the engine. The rib or flange *b* is so formed on the cover as to permit the cover to be moved in opening and closing without contact or interference of the flange *b* with the edge of the casing. Near the lower edge of the door 11 a similar seal is provided by the pocket or receptacle 59 and the flange or rib *c* on the door 11.

Nearly on a level with the axis of the main bearings, but preferably a little below that level, I provide receptacles or troughs 52, which are adapted to catch oil falling or running down from the upper half of the chamber, and I also provide passages 53, through which the oil is fed by gravity from the pockets or receptacles 52 to the main bearings. These receptacles 52 extend along the side walls of the crank-chamber and around on the front and rear walls of the chamber, so as to be in the path of the oil which is thrown off by the crank-disks, and they are located so low down in the chamber that practically all of the oil that is thrown or splashed up into the chamber above the lower portion of the main bearings is collected by the receptacles 17 and the reservoir 15 or by the receptacles 52, and all of the oil so collected is fed by gravity to the bearings.

A portion of the oil which is fed to the main bearings may pass out on the side of the bearing next to the crank-disk and into the grooves 62 in the crank-disk, and a portion may pass out through the outer end of the bearing into a groove 64, whence it may flow through the passage 65 into a groove 62 in the disk. The oil passing into the groove 62 will flow into the passage 63 and through the hole 63^a to lubricate the crank-pin and then be thrown off by centrifugal action against the walls of the crank-chamber. That portion of the oil which is thrown off in the upper half of the chamber is caught in the pockets or receptacles and returned to the bearings or to the reservoir, and the portion which is thrown off in the lower portion of the chamber finds its way to the bottom and is again taken up and thrown off by the crank-disks.

When the engine is running, but a small portion of the oil is permitted to collect in the bottom of the crank-chamber, and the depth should be so slight that the main cylindrical surfaces of the disks will turn clear of the upper surface of the oil, which should not rise above the level indicated by the dotted line 46 in Fig. 2. Ribs 41, formed on the crank-disks, extend close enough to the bottom of the casing to move in the oil collected therein even when the depth is slight, and these ribs carry the oil upward and throw it outward into the receptacles or pockets.

It will be seen that by means of my improvement the oil which is fed by gravity from the receptacles and from the reservoir to the bearings is being returned continually by the action of the rotating parts, which prevents any considerable quantity from collecting in the crank-chamber, and therefore prevents any churning action on the oil. The passage of the ribs 41 through the oil is effected without any appreciable disturbance of the small body of oil contained in the bottom of the chamber, and the connecting-rod and crank-pin and the main body of the disk do not touch that body of oil.

The quantity of oil which is in active circulation at any moment is just that portion which is being fed by gravity to the bearings and which is being returned to the receptacles or to the reservoir. The excess of oil above that actively-circulating quantity is contained in the pockets or reservoir or in the bottom of the crank-chamber, and the movement of this excess quantity is comparatively so sluggish that there is an opportunity for any solid matter in the oil to be deposited in the reservoir or receptacles or in the bottom of the crank-chamber.

It will be seen that by means of my improvement the churning and splashing of the oil are prevented and that although an opening is provided for the connecting-rod to move in yet the oil is all confined to the crank-chamber.

It will also be obvious that with my improvement the engine may be run in either direction without interfering with the efficiency of the lubricating system in the crank-chamber, since the circulation and collection of the oil will be the same and will be suffi-

cient for all purposes in whichever direction the crank-disks turn; and a further important feature of my construction is that on account of the independence of the lubricating system for the crank-chamber from that for the cross-head chamber the direction of rotation is not limited. Heretofore in horizontal engines of the class referred to it was essential that the direction of rotation of the shaft should be such that the oil in the crank-case should be thrown backward and upward onto the cross-head bearings by the lower part of the crank-disks and that the cross-head chamber should be kept closed while the engine was running. With my improved construction the engine may be run in either direction and the cross-head chamber may be either open or closed while the engine is in operation, as preferred by the engineer or as may be required for the purpose of inspection, or for connecting indicator-gear, or for other purposes.

In the construction shown in Figs. 5, 6, and 7 of the drawings the main reservoir or receptacle 16 for containing the excess of oil is located on the sides of the crank-chamber below the cover 9. The oil caught in the pocket 17, if not drawn off through the pipe 30, may overflow through the openings or notches 19 and flow down into the pockets 60, from which it may pass through the passages 61 to the reservoirs 16, and oil caught in the pockets 54 and 56 may flow through the openings 55 into the reservoirs 16. The receptacles or pockets 52 are adapted to catch oil coming down from the upper half of the chamber, as in the construction shown in Figs. 1 and 2, and oil from the reservoirs 16 is fed through the openings or flow-holes 44 into the pockets 52, from which it flows through the openings 53 to the main bearings. Before starting the engine and in cases of emergency oil may be supplied directly and in considerable quantity from the reservoir 16 to the main bearings through the valve 50 and pipes 50^a. (Shown in Fig. 7.)

It will be seen that in the construction shown in Figs. 5, 6, and 7, as in the constructions shown in Figs. 1 and 2, the oil is fed from the pockets in which it is caught by the action of gravity either to the main bearings directly or to the reservoirs and thence by the action of gravity to the bearings.

By employing the partition 40 and having a substantially similar arrangement of oil-pockets at the front and back of the crank-chamber it is immaterial in which direction the engine-shaft may be rotated, as the efficiency of the lubricating system will be the same in either case.

It will be seen that with my improved construction a large body of oil may be employed in the crank-chamber and in the reservoirs and receptacles therein for the absorption and dissipation of heat from the bearings, to which the oil is being continually supplied by a comparatively rapid flow of the oil under the action of gravity, and that notwithstanding the large quantity of oil employed the churning action that the oil is subjected to in other constructions is almost wholly prevented by my improvement. The construction and arrangement of the reservoirs and oil-passages by which I am at all times enabled, whether the engine is stopped or in motion, to freely flood the bearings is also an important feature of my invention.

The cross-head and guides may be automatically lubricated by oil supplied through the pipe 20, leading from the pocket 17, or by oil supplied from the independent reservoir 22 through the pipe 24. The pipe 20 is provided with a controlling-valve 80, and the oil flows through passage 85 into the groove 86, and by means of the pipes and fittings 87 and 88 and suitable passages is delivered through opening or passage 89 to the cross-head pin and boxes. The greater portion of the oil falls from the cross-head pin to the bottom of the cross-head and passes through the passage 90 and oils the lower guide.

When the engine is to have the guides and cross-head automatically oiled from the crank-chamber 8 through a pipe 20, an opening 67 between the cross-head chamber 23 and the crank-chamber 8 is provided to permit the oil to return to the bottom of the crank-chamber to be automatically returned to the pocket 17, and when these parts are to be oiled from the independent reservoir 22 through a pipe 24 the opening 67 may be omitted and an opening 68 provided, through which the oil may be removed from the bottom of the cross-head chamber and returned to the reservoir 22.

The reservoir 22 is provided with a filtering-receptacle 69, into which the oil is poured and through which it must pass before entering that part of the reservoir from which the oil is delivered to the bearings.

In Figs. 3 and 4 of the drawings I have shown a rocker-arm 21 and bearings which are adapted to be lubricated by oil supplied from the reservoir 22 through a pipe 70 and branches 71 and 72, which are controlled by valves 82 and 83. The bearing-box 25 forms the connection between the eccentric (not shown) and the rocker-arm, and the bearing-box 26 forms the connection of the rocker-arm with the valve. Oil delivered to these boxes after doing service therein falls into the pans 73 and 74 and flows through the pipes 75 and 76 to the rocker-shaft 77, and after lubricating that bearing it passes to the receptacle 78, from which it may be drawn through the valve 79.

The reservoir 22 may form an integral part of the engine frame or bed, or it may be a separate part attached to the bed or other part of the engine or to the steam-pipe near the throttle-valve.

The level of the oil in the reservoirs 15 and 16 is indicated by the gages or indicators 84. (Shown in Figs. 2, 6, and 7.)

A partition 57 within the engine-frame divides the cross-head chamber 23 from the chamber or space containing the piston-rod stuffing-box, and the passage or opening through the partition 57 is normally closed by the plate or cover 35, which may be removed from the opening to give access to the stuffing-box from the front. The plate or cover 35 has an opening in it through which the piston-rod passes; but the plate should not fit so closely that the rod will rub against the edges of the opening.

Openings 37 are formed in the engine frame or casing to permit access to the cross-head chamber 23, and for the purpose of closing these openings I provide on the inside of the casing sliding doors 36 and 38, which are adapted to slide back and forth within the casing to uncover or to close the openings 37. The door 36 is adapted to slide horizontally on rollers 36^a, and the door 38 is adapted to slide up and down in the guides 37^a. The construction of the frame, the form of the doors, and the position and form of the openings 37 are such that the doors may slide back far enough to uncover the whole or a sufficiently large part of the openings 37, and the chamber 23 may be easily and quickly opened without the trouble of unbolting and removing from the outside an unwieldy bonnet or cover such as is usually employed. With my construction the sliding back of the door to uncover the opening puts the door out of the way inside of the casing, so that it cannot interfere with anything inside or outside or with anything which is passed through the opening, and the interior of the engine-frame is thereby readily and easily accessible and easily and quickly closed when desired. This accessibility is desirable for the purposes of inspection or cleaning or for other purposes and permits the connection of an indicator-reducing mechanism 93 to the cross-head.

In Fig. 1 of the drawings I have shown a compound stuffing-box provided with a main gland 27, held in place by a follower 28, and a smaller gland 30, held in place by a follower 29, which is adjustably secured to the main gland 27. The gland 27 is shown on a somewhat larger scale in Figs. 8 and 9 and comprises two annular portions, which are connected together by webs or ribs 31, between which are openings 32. Backwardly-inclined holes 33 are formed in the follower 28. With this construction any steam or water which may pass through the packing in the main stuffing-chamber 34 will find vent through the openings 32 in the main gland and through the openings 33 in the follower 28 and will be directed backward against the rear wall of the engine-frame and away from the plate 35 or the opening therethrough and away from the piston-rod, so that none of the steam or water will enter the cross-head chamber. The smaller stuffing-box, comprising the gland 30 and follower 29, will prevent any leakage from following the piston-rod into the cross-head chamber.

In Fig. 10 of the drawings I have shown a modification of the compound stuffing-box in which the main gland 27^a is of a somewhat different form. In this construction a groove or chamber 92 is formed on the inside of the gland 27^a, and holes 32, which may be drilled, if preferred, open outward from the groove or chamber 92. The compound stuffing-box shown in Fig. 10 is in all other respects substantially the same as that shown in Fig. 1.

The stuffing-box chamber, which is separated from the cross-head chamber by the partition 57 and plate or cover 35, is preferably open to the atmosphere through the side openings 58, which are preferably left uncovered and permit access to the stuffing-box for inspection or adjustment. Any steam escaping through the stuffing-box into the stuffing-box chamber is prevented from passing into the cross-head chamber by the partition 57 and plate or cover 35, but is free to pass out to the atmosphere through the openings 58.

The division of the engine casing or frame into the three chambers for the stuffing-box, the cross-head, and the crank-disks and rotating parts provides for the exclusion of water and steam from the cross-head chamber which might otherwise enter from the stuffing-box chamber and also provides for the exclusion of oil which might otherwise be thrown in from the crank, and by this arrangement the cross-head is rendered easily accessible, and the chamber may be opened or kept open without interfering in any way with the lubrication within the crank-chamber. The opening in the partition between the crank-chamber and the cross-head chamber is so located that the rotary motion of the crank-disks, by which oil is returned to the pockets and to the reservoir, cannot cause any oil to pass therethrough, as the disks rotate in planes which are to the side of and removed from the opening. The ribs 41 on the crank-disks are on the farther sides of the disks from the opening 39, and as the oil in the bottom of the chamber is only high enough for the ribs to touch or move in without being touched by the main body of the disk about all of the oil that is taken up and returned will be thrown off on each side of the opening 39 from the ribs to the walls and to the receptacles by the action of centrifugal force.

When the lubrication of the cross-head is independent of the supply of oil in the crank-chamber and the oil is supplied to the cross-head and guides from some other source—as, for example, the reservoir 22—it will be desirable to prevent the passage of oil not only from the crank-chamber to the cross-head chamber, but also from the cross-head chamber to the crank-chamber. The oil after being used in the cross-head chamber will not then pass through the opening 67, but will be

drawn off through the opening 68. (Shown in dotted lines in Figs. 1 and 5.)

As already mentioned, the reservoir 15 or 16 is charged to the height of the flow-holes 42 or 44 and the bottom of the crank-chamber is filled with oil to the height indicated by the dotted line 45 before starting the engine, and as there is always a large body of oil in the bottom of the crank-chamber when the engine is standing it follows that when the engine is first started there is a profusion of oil thrown into the oil-pockets and passed through the bearings, thus insuring free lubrication on the start when trouble from heating is most likely to occur, particularly if the bearings have been taken up just before starting. The supply at the start may be still further increased by opening the valves 50 or 51; but as soon as the engine is fairly in motion these valves should be closed. Those valves may be opened at any time during the running of the engine to supply an extra flow of oil in case a bearing should show a tendency to heat up, and, if preferred, they may be so adjusted as to automatically and continuously supply a limited quantity of oil to the bearings.

I claim as my invention and desire to secure by Letters Patent—

1. In a self-oiling engine, a lubricating system, comprising a continuous circuit in which oil is automatically circulated, a reservoir in the circuit adapted to contain a considerable portion of the oil, means whereby oil may be fed from the reservoir to the bearings by the action of gravity, and means for preventing any considerable accumulation of oil in the bottom of the crank-chamber whereby the oil may be automatically returned to the reservoir, and the greater proportion of the oil at all times maintained in a comparatively quiescent state in the reservoir, substantially as forth.

2. In the crank-chamber of a self-oiling engine, a lubricating system comprising a continuous circuit in which oil is automatically circulated, a reservoir in the circuit adapted to contain a considerable portion of the oil, means whereby oil may be fed from the reservoir to the bearings by the action of gravity, and means whereby oil may be supplied to the reservoir by the rotation of the crank-disks, and any considerable accumulation of oil in the bottom of the crank-chamber may be prevented, substantially as set forth.

3. The combination, in the crank-chamber of a self-oiling engine, of a reservoir from which oil is automatically supplied to the bearings by the action of gravity, receptacles for catching oil thrown off by the rotating parts, in whichever direction the engine is rotated, and adapted to feed oil to the reservoir and to the bearings by the action of gravity, substantially as set forth.

4. In an engine, the combination, of a cross-head chamber, a closed crank-chamber, and a partition between the crank-chamber and cross-head chamber, substantially as set forth.

5. In an engine, the combination, of a closed crank-chamber, a cross-head outside of the crank-chamber, and an opening in the wall of the crank-chamber through which the connecting-rod may pass, substantially as set forth.

6. In an engine-frame, a closed crank-chamber, a cross-head chamber separated therefrom by a partition, and a stuffing-box chamber separated from the cross-head box-chamber by a partition, substantially as set forth.

7. In an engine provided with a piston-rod, a cross-head, and a connecting-rod, the combination, with a closed crank-chamber, of an automatic lubricating system in the crank-chamber, a cross-head chamber, and a partition, between the crank-chamber and the cross-head chamber, substantially as set forth.

8. In a self-oiling engine, the combination, of a closed crank-chamber, an opening in the wall of the chamber, a crank-disk on one side of the opening, and a rib on the periphery of the disk from which oil may be thrown off to one side of the opening, substantially as set forth.

9. In a self-oiling engine, the combination, of a closed crank-chamber, an opening in the wall of the chamber, crank-disks on opposite sides of the opening, and means whereby oil thrown off from the crank-disks will be deflected away from the opening, substantially as set forth.

10. In a self-oiling engine, the combination, of a closed crank-chamber, a lubricating system therein comprising receptacles for feeding oil to the bearings by the action of gravity and to which oil may be supplied by the rotating parts, a crank-disk, and a rib on the crank-disk adapted to take up oil from the bottom of the crank-chamber and to deliver it to the receptacles, whereby the oil may be carried at such a low level in the bottom of the crank-chamber that the main body of the crank-disk may not dip therein, substantially as set forth.

11. In a self-oiling engine, the combination, in a closed crank-chamber, of a receptacle located in position to receive oil from the upper half of the crank-chamber, and to prevent oil passing to the bottom of the chamber, and means whereby oil may flow from the receptacle to a bearing by the action of gravity, substantially as set forth.

12. The combination, with an engine-bearing, of a groove, or pocket, on the outside of the bearing, adapted to receive oil passing through the bearing, a passage for conducting the oil to the inner end of the bearing, a crank-disk and a groove in the crank-disk near the end of the passage which is adapted to receive oil from the passage, substantially as set forth.

13. In an engine, the combination, with a crank-shaft and crank-disk, of a bearing, a groove in the crank-disk, a groove, or pocket,

on the outer end of the bearing, a free passage from the groove, or pocket, on the bearing, to the inner end of the bearing, by which oil may be led to the groove in the crank-disk, and a passage from the groove in the disk to the crank-pin, through which oil may pass to the crank-pin, substantially as set forth.

14. In a self-oiling engine, the combination, with a closed crank-chamber and an automatic lubricating system therein, of a reservoir adapted to supply oil by the action of gravity to the main bearings within the crank-chamber, and by means of distributing-pipes to the bearings outside of the chamber, substantially as set forth.

15. The combination, in an engine, of a rocker-arm, bearings for the connections from the rocker-arm to an eccentric and to a valve, means for supplying oil by gravity to the bearings, and from the bearings to the rocker-shaft, substantially as set forth.

16. The combination, with an engine frame, or casing, of a sliding door mounted on the inside of the frame, or casing, and so arranged as to permit, when open or closed, drainage into the casing of any oil or other liquid which may be deposited on the door, substantially as set forth.

17. The combination, in an engine frame, or casing, of a cross-head chamber, a partition between the cross-head chamber and the chamber or space in which the piston-rod stuffing-box is located, and a removable cover surrounding the piston-rod, and adapted to be removed to give access to the stuffing-box, substantially as set forth.

18. The combination, in an engine, of a cross-head chamber, a partition between the cross-head chamber and the chamber, or space, in which the piston-rod stuffing-box is located, to prevent the passage of steam or water from the stuffing-box into the cross-head chamber, and a compound piston-rod stuffing-box, comprising a gland and a follower to prevent the passage of water, or moisture, along the piston-rod, into the cross-head chamber, vent-openings in the follower for permitting the escape of water or vapor to the atmosphere, substantially as set forth.

19. The combination, in an engine, of a cross-head chamber, a partition between the cross-head chamber and the chamber or space in which the stuffing-box is located, a compound stuffing-box, comprising a main gland and follower, with an opening, or openings, for the release of steam or water of condensation, and an auxiliary gland and follower, for preventing the passage of moisture along the piston-rod, substantially as set forth.

20. In a self-oiling engine, the combination, with a closed crank-chamber, of an automatic lubricating system therein, a reservoir to which oil is automatically supplied and from which oil is fed by gravity to the bearings, through openings, or flow-holes, above the bottom of the reservoir and means whereby oil may be drawn off from the reservoir from below the flow-holes to oil the bearings, substantially as set forth.

21. In an engine, the combination, with a closed crank-chamber, of an opening in the walls of the chamber, connecting-rod, passing through the opening, and a shield on the connecting-rod, substantially as set forth.

22. In an engine, the combination with a crank-chamber and a cross-head chamber, of a partition between the chambers, an opening in the partition, a connecting-rod passing through the opening and a shield on the connecting-rod, to prevent the passage of oil through the partition, substantially as set forth.

23. The combination, with the crank-chamber of an engine, of a cover for the crank-chamber, and a liquid seal to prevent the splashing of oil through the joint between the engine-casing and the cover, substantially as set forth.

24. The combination, with the crank-chamber of an engine, of a cover for the crank-chamber, which is adapted to rest on the edge of the engine casing, or frame, a receptacle, or trough, on the edge of the casing adapted to contain a liquid, and a rib, or flange, on the cover which is adapted to project into the receptacle, or trough, substantially as set forth.

In testimony whereof I have hereunto set my hand.

CHARLES W. BARNABY.

Witnesses:

JAMES G. FOSTER,

WIN S. ROSE.