No. 842,607. PATENTED JAN. 29, 1907.

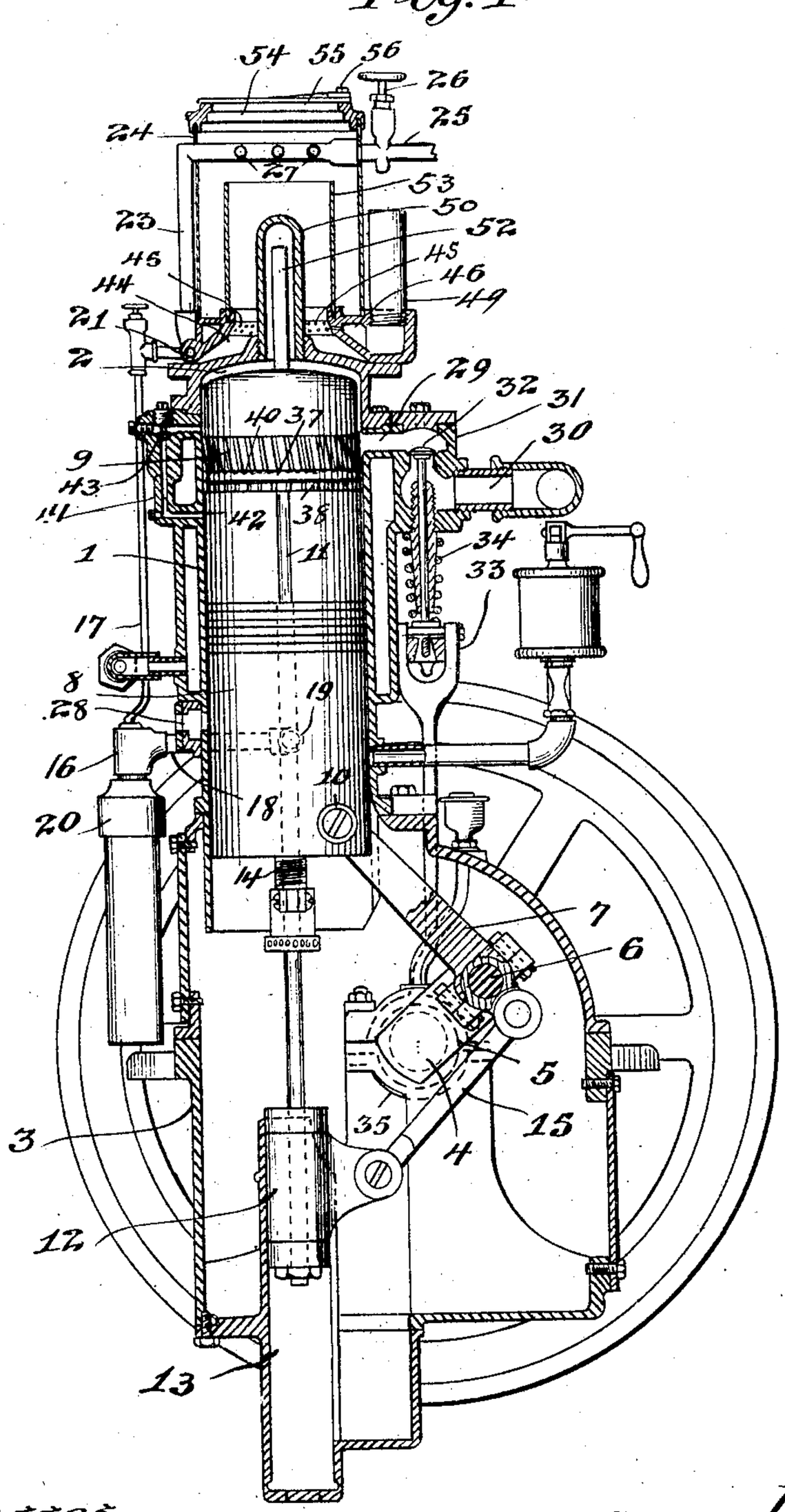
C. A. ANDERSON, E. A. ERICKSON & J. WICKSTROM.

INCANDESCENT IGNITER FOR GAS ENGINES.

APPLICATION FILED JUNE 13, 1904.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

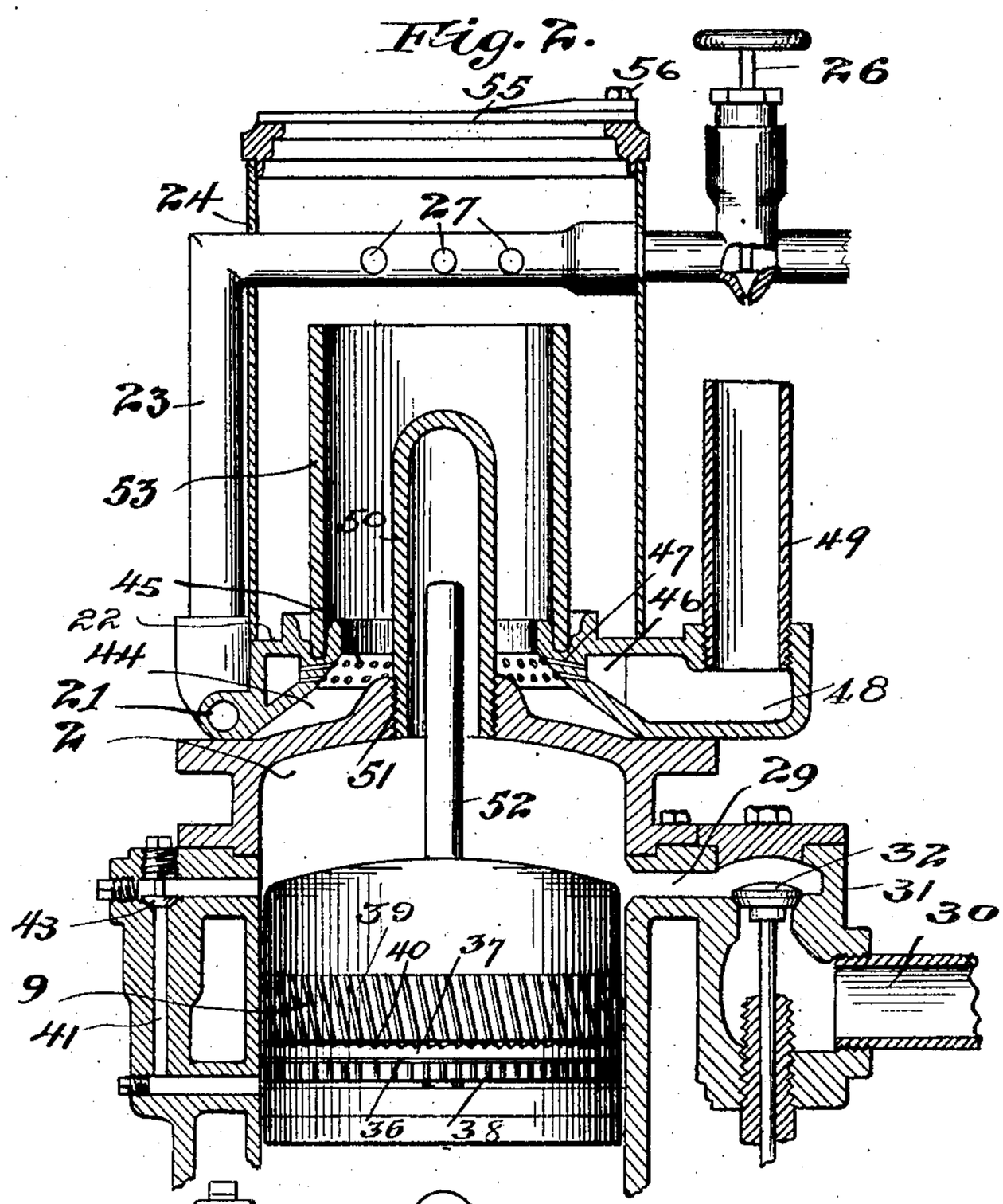
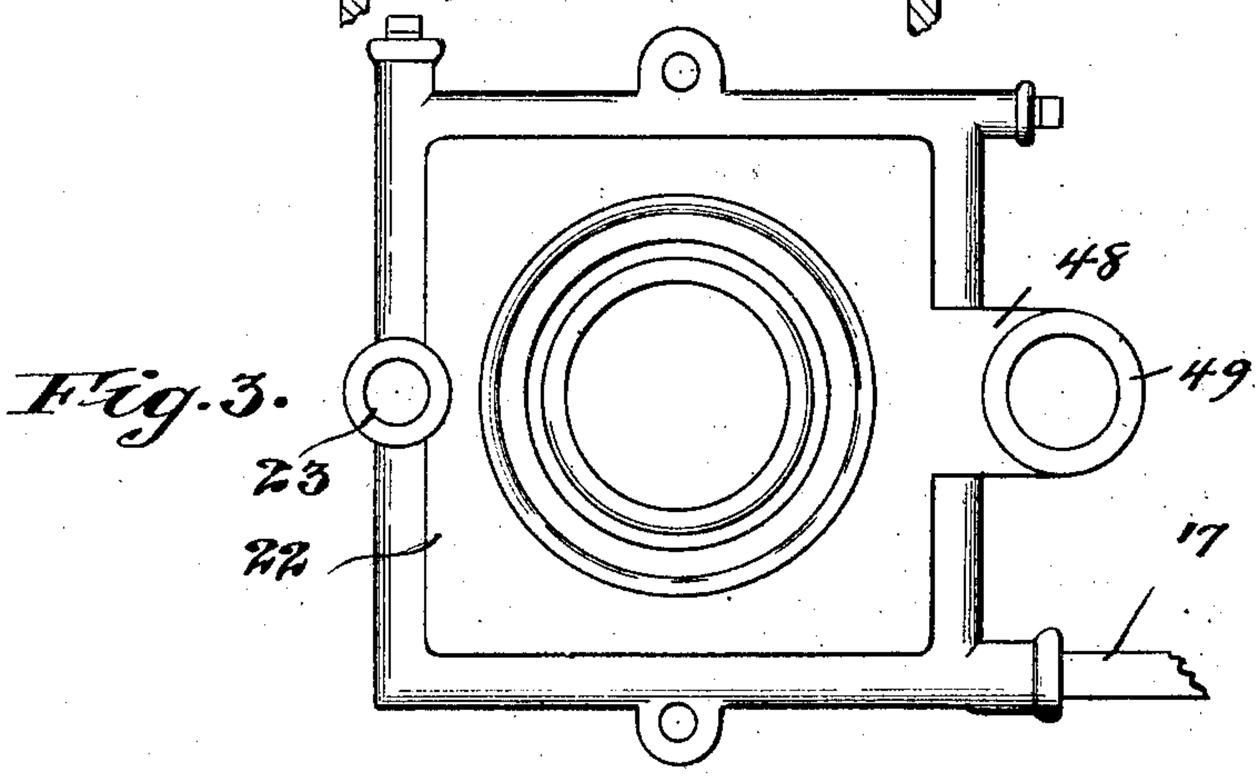


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 4.

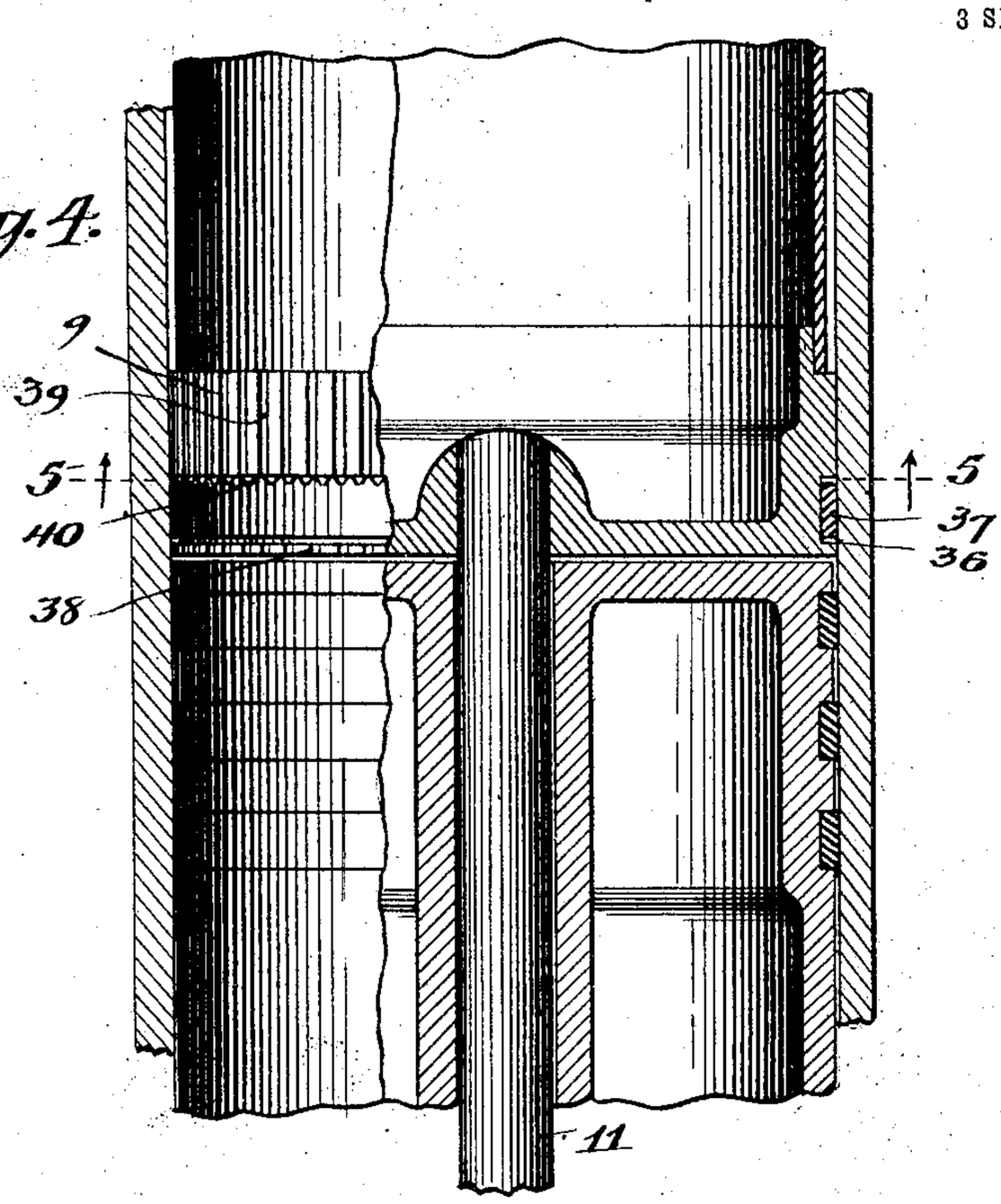
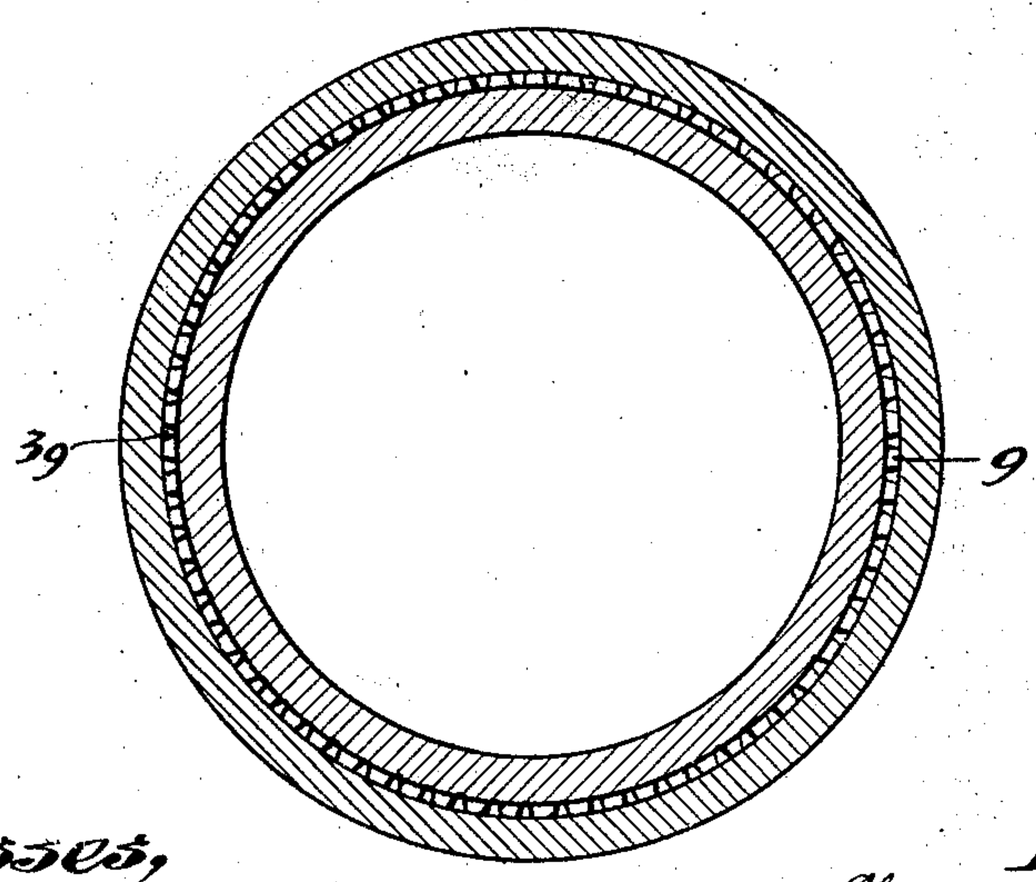


Fig. 5.



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UNITED STATES PATENT OFFICE.

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INCANDESCENT IGNITER FOR GAS-ENGINES.

No. 842,607. Specification of Letters Patent. Patented Jan. 29, 1907.

Application filed June 13, 1904. Serial No. 212,377.

To all whom it may concern:

Be it known that we, CHARLES A. ANDERSON, ERICK A. ERICKSON, and JOHN WICKSTROM, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Incandescent Igniters for Gas-Engines, of which the following is a specification.

This invention relates to improvements in gas-engines, and relates more particularly to improvements upon that type of engine shown in United States Letters Patent No. 714,352, granted to us November 25, 1902.

Among the salient objects of the present invention are to provide an improved construction and arrangement of the ignition devices whereby the explosive charges are fired, to provide an ignition-tube so constructed and arranged that it is maintained at the required temperature by heat derived from the explosive charges after it has been initially heated, to provide in conjunction with an ignition-tube means for displacing the contents of the tube so as to insure a more certain firing of the main charge and at the same time to effect such a displacement by means of a heated plunger which operates to effect the ignition of the charge with greater certainty and uniformity, to provide improved details of construction and arrangement whereby the ignition-tube is initially heated, to provide an improved construction for effecting the transfer of the compressed charge from between the pair of coöperating pistons to the explosion-chamber without passing the gas over the surface of either piston, thereby avoiding the deposit of carbon upon the cylinder and maintaining the cleanliness of the latter, and in general to provide improvements in the details of construction and arrangement in an engine of the character referred to.

The invention consists in the matters hereinafter described, and more particularly pointed out in the appended claims, and will be readily understood from the following description, reference being had to the accompanying drawings, in which—

Figure 1 is a view showing the principal parts of an engine embodying our invention in vertical axial section. Fig. 2 is an enlarged detail of the upper end portion of the cylinder and connected parts, likewise shown in axial section. Fig. 3 is a top plan view of the initial heater or burner by means of which the ignition-tube is initially heated. Fig. 4 is a fragmentary sectional detail of an intermediate portion of the cylinder and pistons therein, showing particularly the arrangement of the check-valve-ring mechanism and communicating ports. Fig. 5 is a transverse sectional view taken on line 5 5 of Fig. 4 and looking in the direction of the arrows.

Referring to the drawings, 1 designates as a whole the cylinder of the engine, arranged in the present instance vertically, the upper end of said cylinder being closed and constituting the combustion or expansion chamber 2.

3 designates as a whole a frame-casing which constitutes the main frame of the engine and incloses the principal operative parts of the engine, the lower end of the cylinder being arranged to open into said casing.

4 designates as a whole the main shaft of the engine, which extends through the casing 3 and is provided within the latter with a crank 5, having a wrist 6, upon which is mounted a pitman-link 7.

8 and 9, respectively, designate two trunk-pistons, the lower one of which will be hereinafter referred to as the "power-piston," while the other will be designated the "transfer-piston." The pitman-link 7 is directly connected with the power-piston by means of a suitable wrist or bearing 10. The transfer-piston is provided with a stem 11, which extends axially out through the power-piston and carries at its lower extremity a slide-shoe 12, working in a suitable guideway 13, formed in the lower part of the frame-casing, a packing-gland 14 being provided at the point where the piston-rod 11 enters the power-piston 8. The transfer-piston is connected with the crank of the main shaft indirectly by means of a link 15, connected at one end with the slide-shoe 12 and at its opposite end with the shorter end of the pitman-link 7. In this engine, as in the engine described in our previous patent referred to, the axis of the main shaft is located laterally remote from the axis of the cylinder, and the connections of the two pistons with the crank of the main shaft are such as to produce a differential movement of the pistons relatively to each other.

The engine illustrated in the present instance is equipped with vaporizing mechan-

ism for converting liquid into gas and is provided with inlets for both carbureted vapor and for air, which is admixed with vapor after entering the cylinder. To this end a mixing-head 16 is supported adjacent to one side of the lower portion of the cylinder and provided at its upper side with an inlet-pipe 17, through which the vaporized fuel is drawn, a suction-pipe 18, leading from the side of the head, communicating with the interior of the cylinder, as indicated in dotted lines at 19, and with an entraining-hood 20, which communicates with the lower side of the head and is of tubular form and open at its lower end. The vapor-pipe 17 leads upwardly and communicates with vaporizing-channels 21, formed to extend circumferentially around the periphery of the rectangular base-casting 22, (shown in detail in Fig. 3,) and constituting the base of the burner by means of which the ignition-tube is initially heated.

23 designates an oil-supply pipe which communicates with the passages 21 of the casting 22 said pipe rising vertically to a point near the upper end of the casing 24, which is mounted upon said base-casting, is thence deflected horizontally through the upper part of said casing, and communicates at the opposite end of the latter with a supply-pipe 25, connected with any suitable source of supply. A needle-valve 26 intersects the supply-pipe 25. At a point within the casing 24 the pipe 23 is desirably provided with a plurality of integral fingers or extensions 27, which serve to conduct the heat more effectively to the pipe 23, and thus to insure a thorough vaporization of the fuel. 28 designates an air-inlet port which communicates with the interior of the cylinder at a point approximately coincident longitudinally with the gas-inlet 19, but disposed angularly with reference to the latter, so as to effect a more thorough mixing of the air and gas.

29 designates an exhaust-passage communicating with the expansion-chamber portion of the cylinder and leading to an exhaust-pipe 30, a valve-casing 31 being interposed between the cylinder exhaust-outlet and the exhaust-pipe 30, within which is arranged an exhaust-valve 32, controlled by an eccentric-lever 33 and spring 34 in a well-understood manner. The eccentric-lever 33 is actuated by an eccentric on the main shaft, as indicated in dotted lines at 35.

In one part of the cycle the upper end of the power-piston descends below the inlets 19 and 28, and while in this position the transfer-piston recedes from the power-piston or moves upwardly, thus drawing in a charge of gas and air. Thereafter the power-piston follows up the transfer-piston, transferring the charge past the transfer-piston to the expansion end of the cylinder.

In the construction of our former patent all of the combustible gases were transferred past the sides of the transfer-piston; but in the present engine most of the charge is transferred through a by-pass, although provision is also made for the transfer of some of the gas between the sides of the transfer-piston and the interior of the cylinder. To this end the transfer-piston is provided, as in the former construction, with an annular groove 36, (see detail Fig. 4,) within which is arranged a check-valve ring 37, inlet-grooves 38, leading from the proximate end of the piston longitudinally into the circumferential groove 36, and outlet-grooves 39, leading from the main groove 36 to the inner end of the transfer-piston. The uppermost edge of the check-valve ring 37 is radially grooved, as indicated at 40, so that it can never close the grooves 39, while the opposite or lower edge of the check-valve ring is constructed to close the inlet-passages 38 under the expansive action of the charge when fired.

Describing in detail the arrangement of the by-pass and referring to Fig. 1, 41 designates a tubular member formed or mounted upon the exterior of the cylinder, one end of said member communicating with the interior of the cylinder at a point approximately coincident with the upper limit of movement of the upper end of the power-piston, as indicated at 42, while its opposite end communicates with the expansion-chamber portion of the cylinder at a point slightly below the upper end of the transfer-piston when the latter is at its uppermost or innermost limit of movement. Within the tubular member 41 is arranged a check-valve 43, which closes by gravity and prevents the backflow of gases during the expansion or combustion of the same.

Describing now in detail the construction and arrangement of the ignition mechanism, the base-casting 22, hereinbefore referred to, is secured directly upon the upper end of the cylinder and is convex at its under side, as indicated in Fig. 1, so as to form an annular space 44 between the casting and the cylinder-head. The casting 22 is provided with a relatively large central opening 45 and is also of hollow or tubular construction, its interior constituting an annular chamber 46, provided with a series of jet-openings 47, which lead radially inwardly and discharge into the central opening of the casting, as indicated clearly in Figs. 1 and 2. The casting 22 is provided with a lateral tubular extension 48, with which is connected an entraining-pipe 49, vertically exposed and in axial alinement with the discharge-opening of the needle-valve 26, hereinbefore referred to.

50 designates an ignition-tube closed at its outer end and threaded at its opposite end into the cylinder-head, as indicated at 51, and 52 designates a displacement-plunger mounted upon the end of the transfer-piston and

operating to enter the ignition-tube and displace the gases contained therein upon each reciprocation of the piston. The diameter of the displacement-plunger is substantially less than the interior of the ignition-tube, so that the gas may readily flow out alongside of the plunger as it expands.

53 designates an inner tubular casing seated upon the base-casting of the burner concentrically with the ignition-tube and open at its upper end. In the top of the casing 24 is formed a draft-opening 54, which is controlled by a valve or slide plate 55, movably secured to the top of the casing, as indicated at 56.

The operation of the engine constructed as described has been substantially indicated in connection with the description of the mechanism, but may be briefly repeated and is as follows: When it is desired to start the engine, the casing within which the needle-valve 26 is seated may be heated temporarily by the application of a torch to a sufficient degree to vaporize the fuel, whereupon the needle is opened and the jet of gas projected into the entraining-tube 49. The entrained air and gas passes through the jet-openings 47, and the burner is ignited by applying a torch to the interior of the casing 53, whereupon the ignition-tube is rapidly heated to incandescence, the products of combustion escaping at this time through the opening 54 in the tube of the casing. The ignition-tube having been sufficiently heated, the engine is started in the usual way by turning its main shaft over once manually, thus drawing in a charge of air and gas between the cylinders, compressing the charge, and transferring it to the expansion-chamber of the cylinder. As the two pistons move inwardly the charge of gas in the expansion end of the cylinder is compressed and the combined action of compression and the heat of the ignition-tube ignites the charge and imparts the outstroke to the pistons. It is to be noted that the instrokes of the transfer-piston occur in advance of the instroke of the power-piston, the exhaust-valve being opened during the inward travel of the transfer-piston, thus permitting the exhaust to take place, while the same instroke of the transfer-piston effects a separation of the pistons, and thus sucks in the fresh charge between the two. The succeeding follow-up movement of the power-piston transfers the charge to the expansion end of the cylinder, as hereinbefore described, the exhaust-valve closing at about the time the power-piston starts to follow up the transfer-piston. After the engine has been running a short time the expansion end thereof becomes heated to such an extent as to maintain the ignition-tube in a state of incandescence, this result being insured by housing in the ignition-tube and head end of the cylinder in the manner described. When this condition is reached, the needle-valve 26 is closed, thus interrupting the action of the burner and the aperture in the upper end of the casing 24 closed.

It is found in practice that the use of the displacing-plunger 52, which enters the ignition-tube upon each stroke of the transfer-piston, is a decided improvement in securing regularity of firing and uniform and efficient combustion of the charges. This is probably due in part to two causes, namely: The plunger being within the explosion-chamber is itself heated to incandescence, and therefore coöperates with the ignition-tube in rapidly raising a thin film or body of gas to the ignition-point while the plunger is within the tube, and the plunger further operates to disperse the ignition charge, which of course ignites within the tube and burns outwardly into the main chamber of the cylinder. Furthermore, the entrance of the plunger into the ignition-tube acts to positively displace the exhaust-gases therein, and as the plunger starts to withdraw, which occurs prior to the power-piston reaching its inward limit of motion or dead-center point, creates an exhaust action which results in effectively drawing in to the ignition-tube a charge of combustible gas. The displacement of the burning gases and drawing in of the fresh charge obviously greatly enhances the certainty of ignition and also times the ignition very exactly.

The provision of the by-pass for the transfer of the charge from between the pistons to the expansion-chamber is a feature of importance, for the reason that it prevents undue compression of the charge between the pistons, and therefore economizes in power, and it also provides a definite path for the transfer independent of that which leads past the transfer-piston.

Owing to the comparatively small annular space for the passage of the gas past the transfer-piston, it is found in practice that this passage sometimes becomes very considerably obstructed by the carbonizing of oil used as a lubricant for the pistons, and any detrimental effect which such throttling of the passage might produce is obviated by the provision of the by-pass. There are other advantages incident to this feature.

While we have herein shown and described the preferred embodiment of our improvements, yet it is to be understood that the details may be modified without departing from the invention, and accordingly we do not limit ourselves to these details except to the extent that they are made the subject of specific claims.

We claim as our invention—

1. In an explosive-engine, the combination of a cylinder, two coacting reciprocating pistons operating therein, an ignition-tube

communicating with said cylinder, and a displacer-plunger carried by one of said pistons and working in and out of said ignition-tube as said piston reciprocates, substantially as described.

2. In an explosive-engine, the combination of a cylinder, two coacting reciprocating pistons operating therein, an ignition-tube having a closed outer end and communicating at its inner end with said cylinder, a displacer-plunger of substantially smaller cross-section than the interior of said tube carried by one of said pistons and working in and out of said ignition-tube as said piston reciprocates, substantially as described.

3. In an explosive-engine, the combination of a cylinder, a power-piston and a transfer-piston reciprocating therein, an ignition-tube communicating with the interior of said cylinder through one end thereof, a displacer-plunger carried by said transfer-piston and adapted to enter and be withdrawn from said ignition-tube as said transfer-piston reciprocates, and means to move said transfer and power pistons in such a manner that when said power-piston is at its limit of inward movement in said cylinder said transfer-piston has accomplished part of its outward movement, whereby said displacer-plunger has completed part of its outstroke, substantially as described.

4. In an explosive-engine, the combination of a cylinder, a power-piston and a transfer-piston reciprocating therein, an ignition-tube closed at one end and communicating at its other end with the interior of said cylinder through one end thereof, a displacer-plunger of substantially smaller cross-section than the interior of said tube carried by said transfer-piston and adapted to enter and be withdrawn from said ignition-tube as said transfer-piston reciprocates, and means to move said transfer and power pistons in such a manner that when said power-piston is at its limit of inward movement in said cylinder said transfer-piston has accomplished part of its outward movement, whereby said displacer-plunger has completed part of its outstroke, substantially as described.

5. In combination with an explosive-engine, a cylinder closed at one end, and a piston working therein, an ignition-tube mounted upon the closed end of said cylinder and communicating with the interior of the latter, an annular gas-burner mounted upon the end of the cylinder and encircling the ignition-tube, a casing forming in conjunction with the annular burner a complete inclosure for the ignition-tube, a draft-opening in said casing and movable closure therefor, and means for supplying fuel to said burner.

6. In combination with an explosive-engine and an ignition-tube communicating with the cylinder and protruding outside of the latter, an annular hollow burner-casting arranged to encircle said ignition-tube and provided with jet-openings leading from the cavity of the casting inwardly toward the ignition-tube, an outer casing forming in conjunction with said annular casting a complete housing for the burner, a draft-opening in said outer casing and a movable closure therefor, an inner casing mounted upon said burner-casting and interspaced between the ignition-tube and the outer casing, said inner casing being open at its end remote from the burner-casting, an entraining-pipe communicating with the interior of the burner-casting and mechanism for injecting a jet of gaseous fuel into said entraining-pipe.

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