M. L. WILLIAMS & S. E. WITT.

ENGINE.

APPLICATION FILED APR. 3, 1915.

1,298,429. Patented Mar. 25, 1919.

7 SHEETS—SHEET 1.

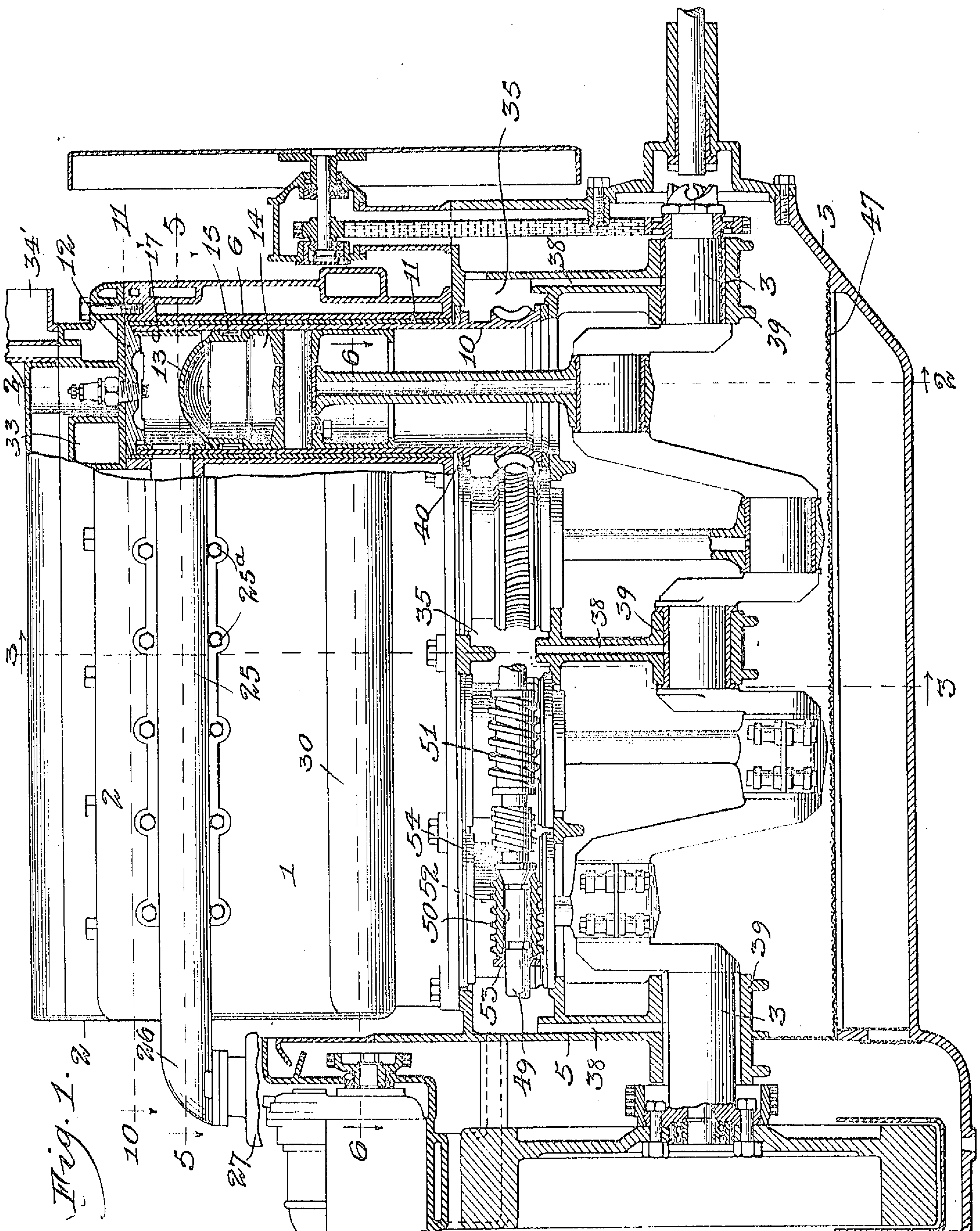

Fig. 1.

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By Frank L. Belknap Atty.

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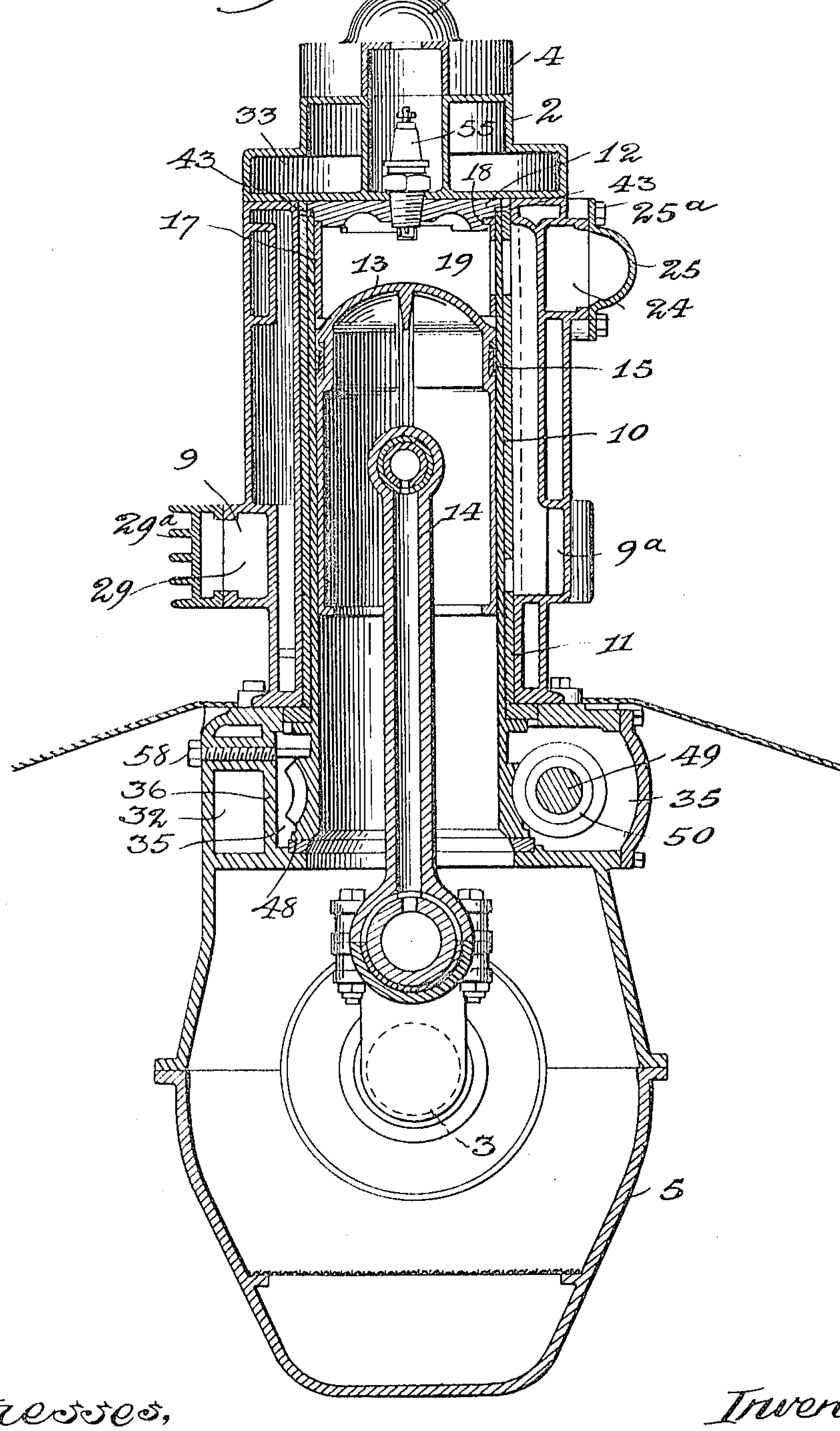
Fig. 2.



Witnesses,
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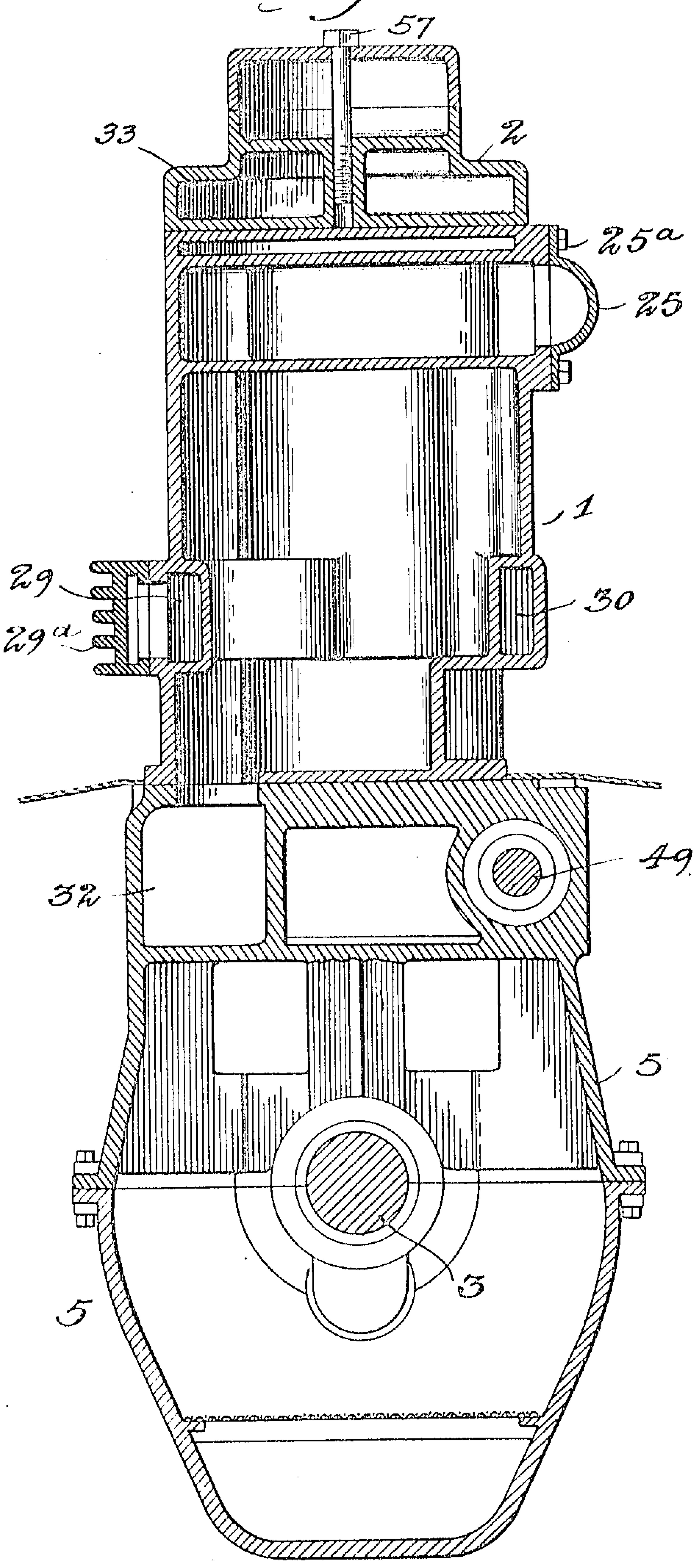
Fig. 3.



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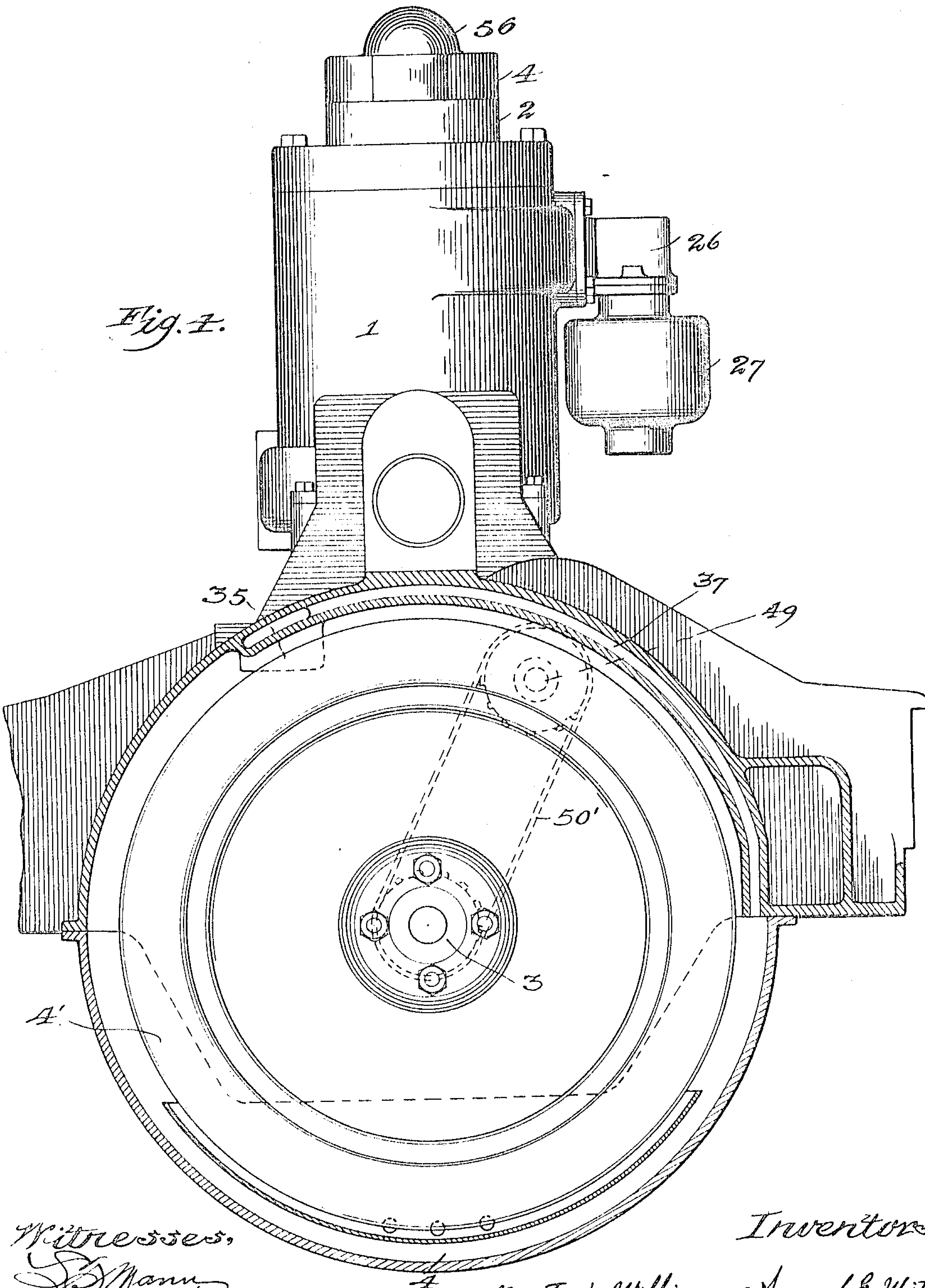

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Fig. 5.

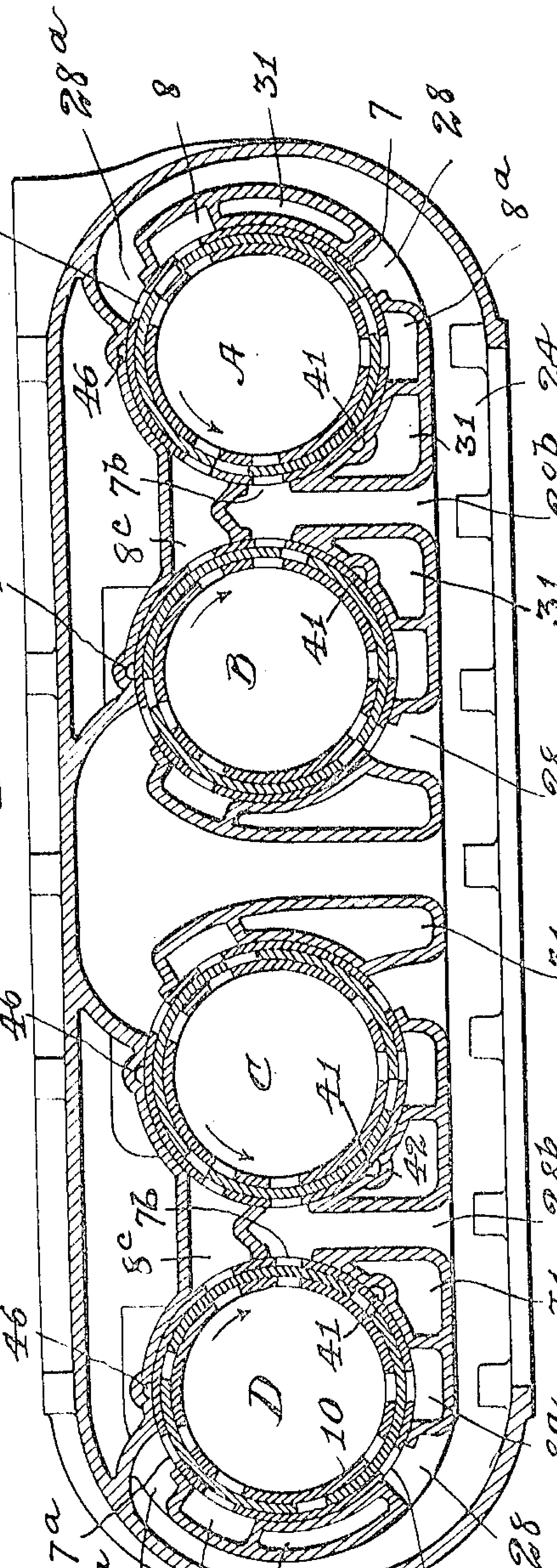
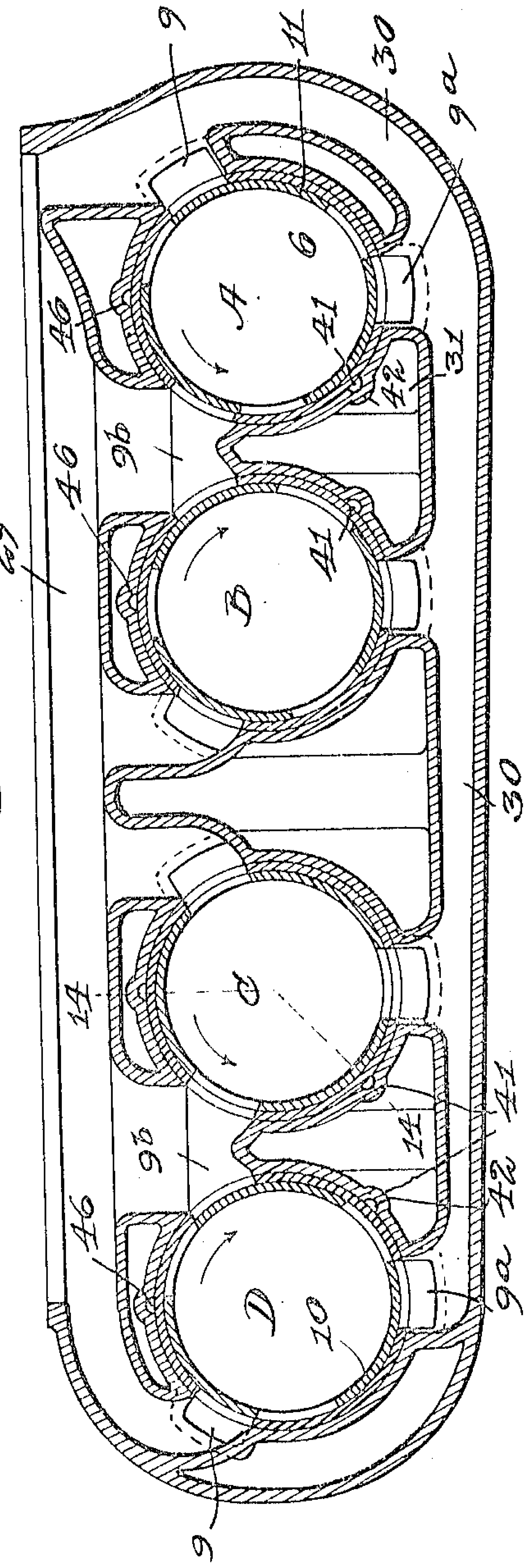


Fig. 6.



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7 SHEETS—SHEET 6.

Fig. 7.

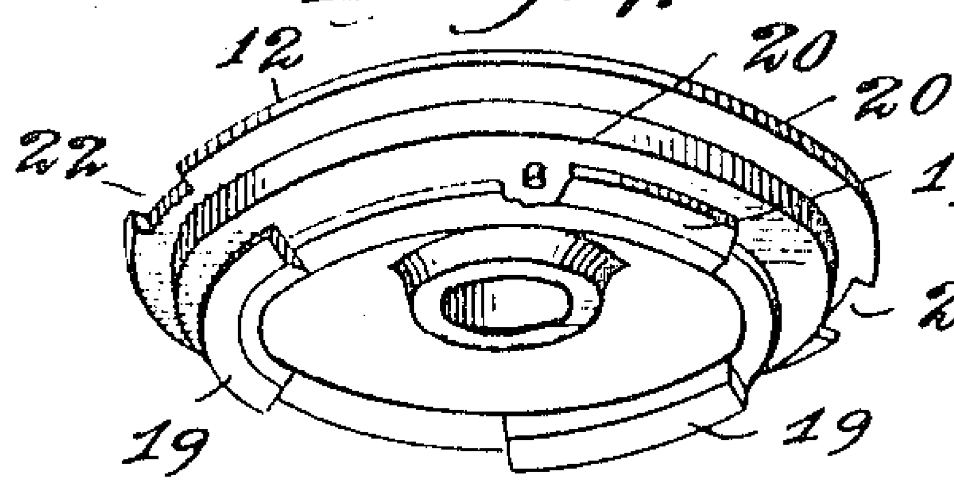


Fig. 8.

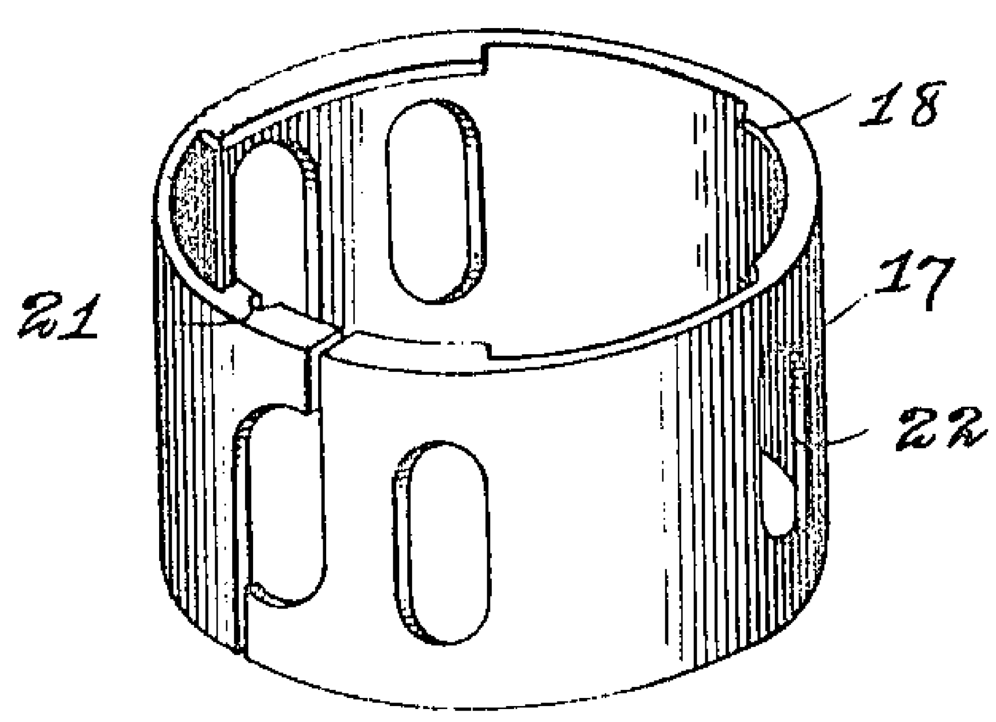


Fig. 9.

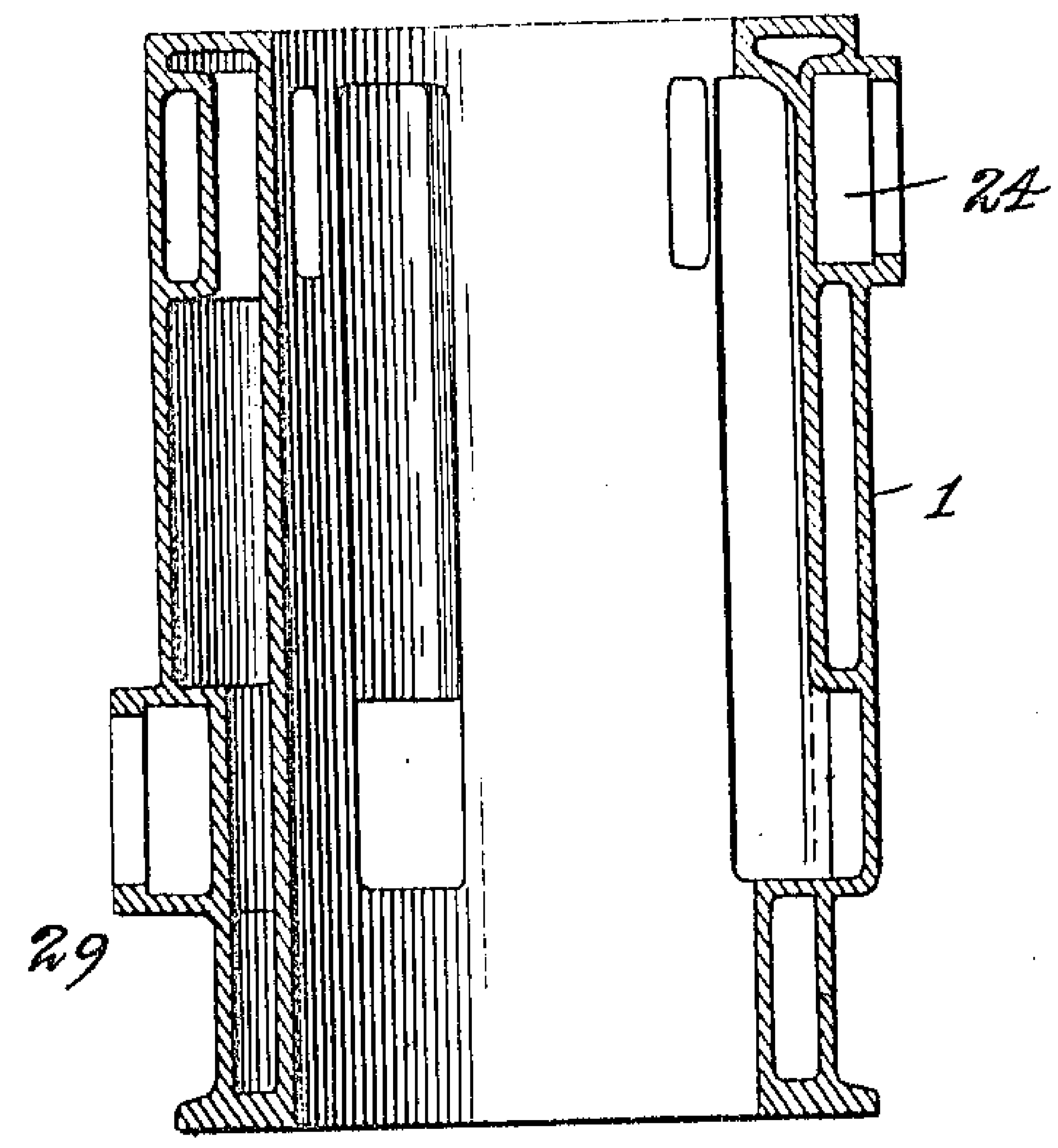


Fig. 10.

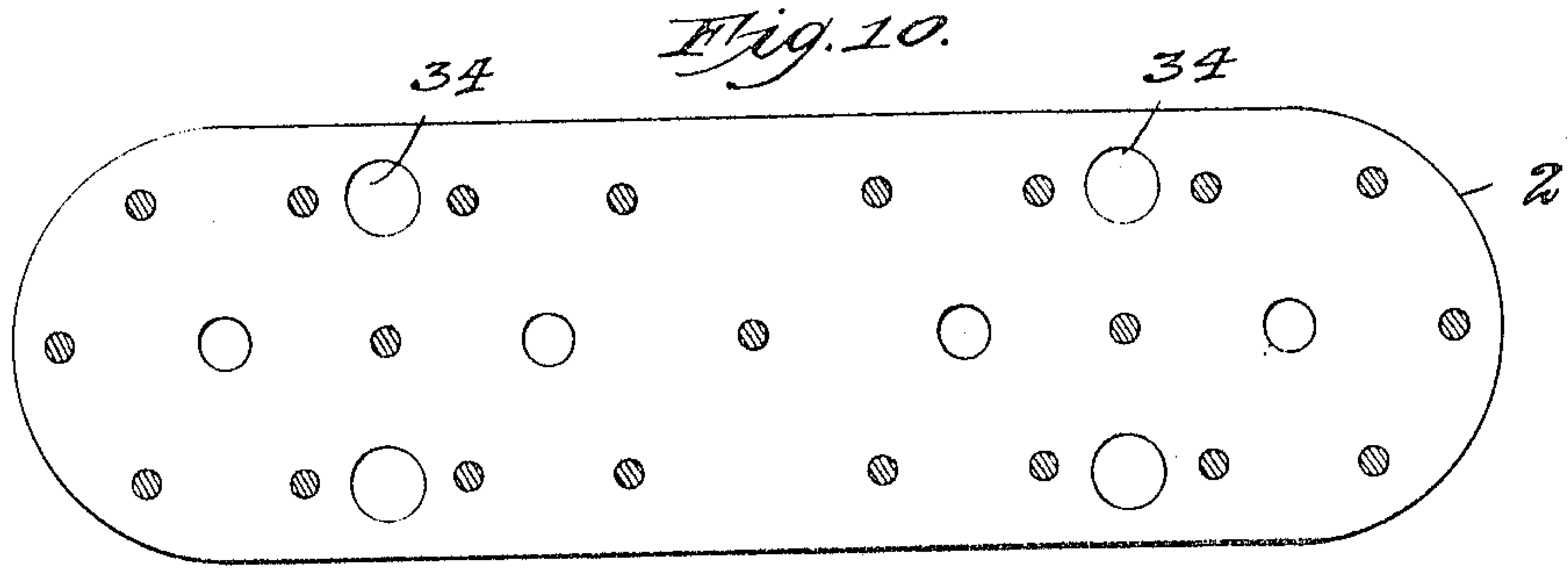
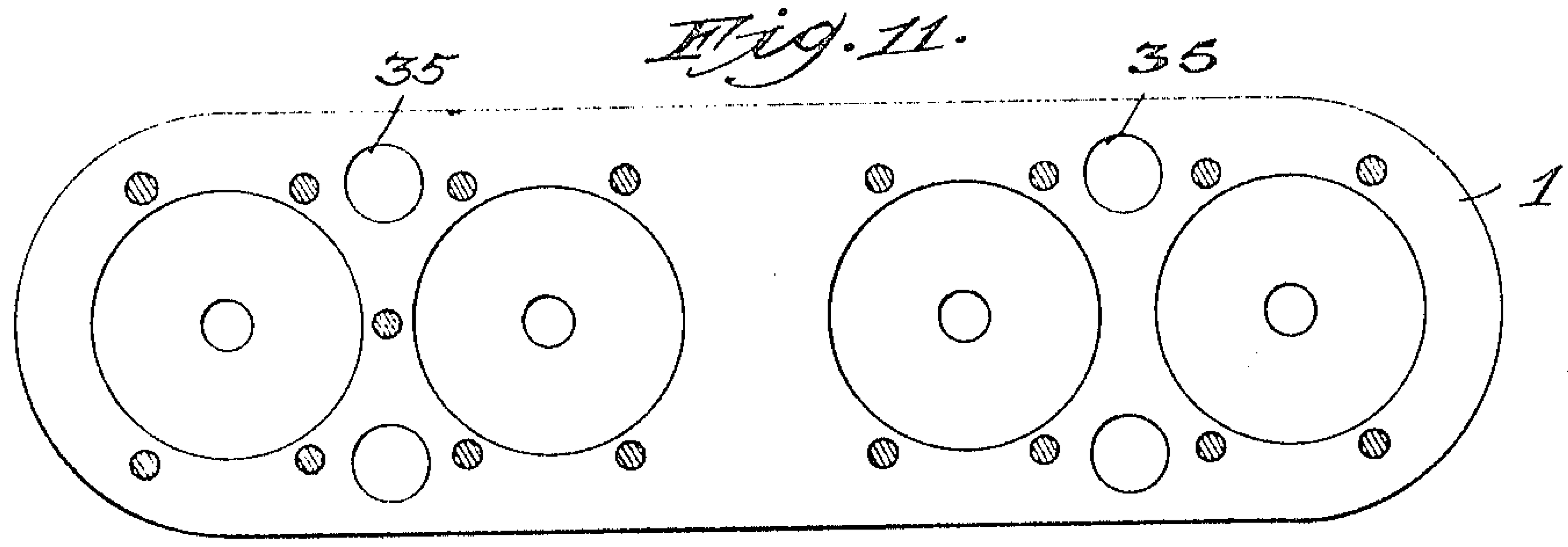


Fig. 11.



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7 SHEETS—SHEET 7.

Fig. 12.

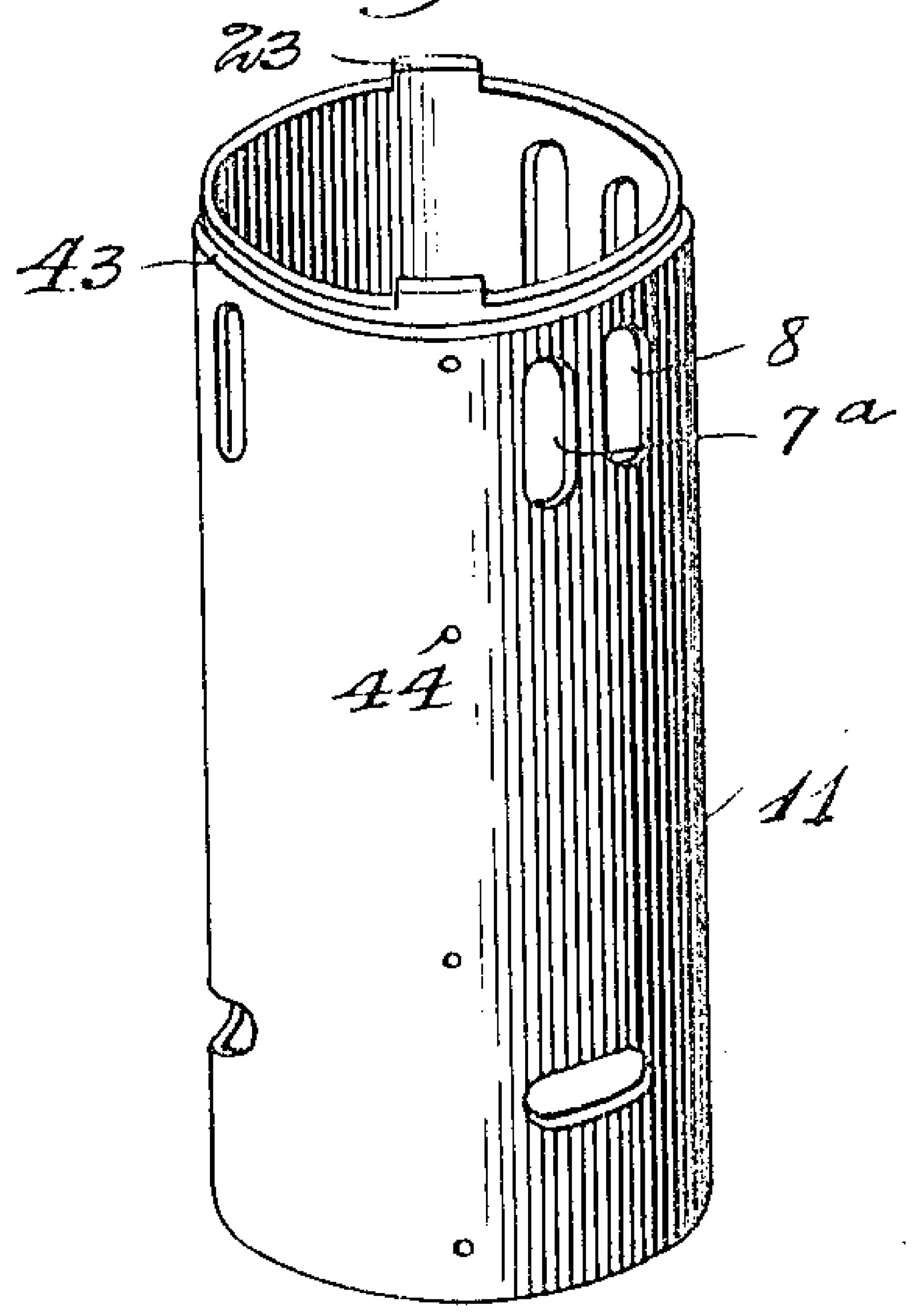


Fig. 13.

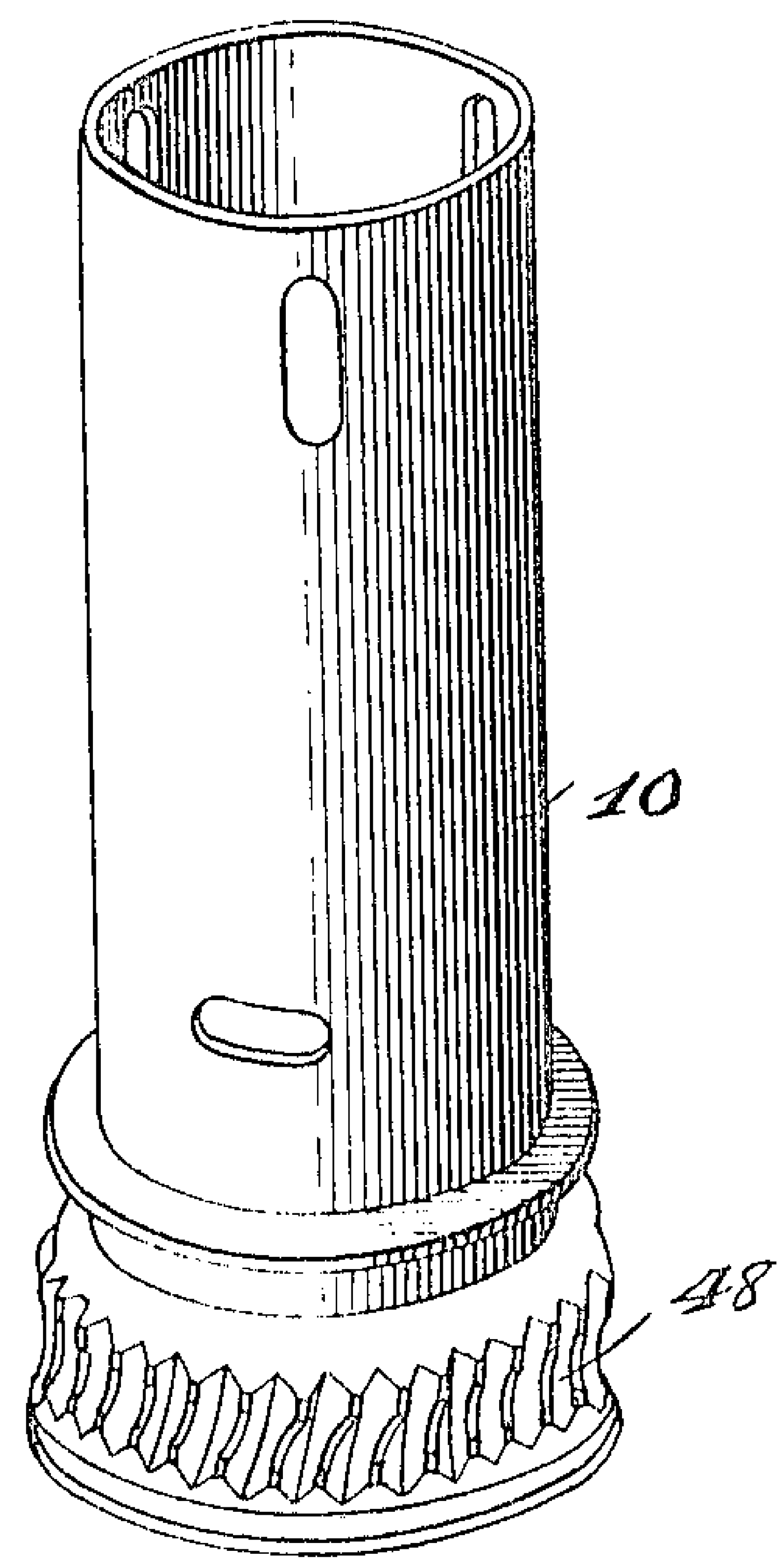
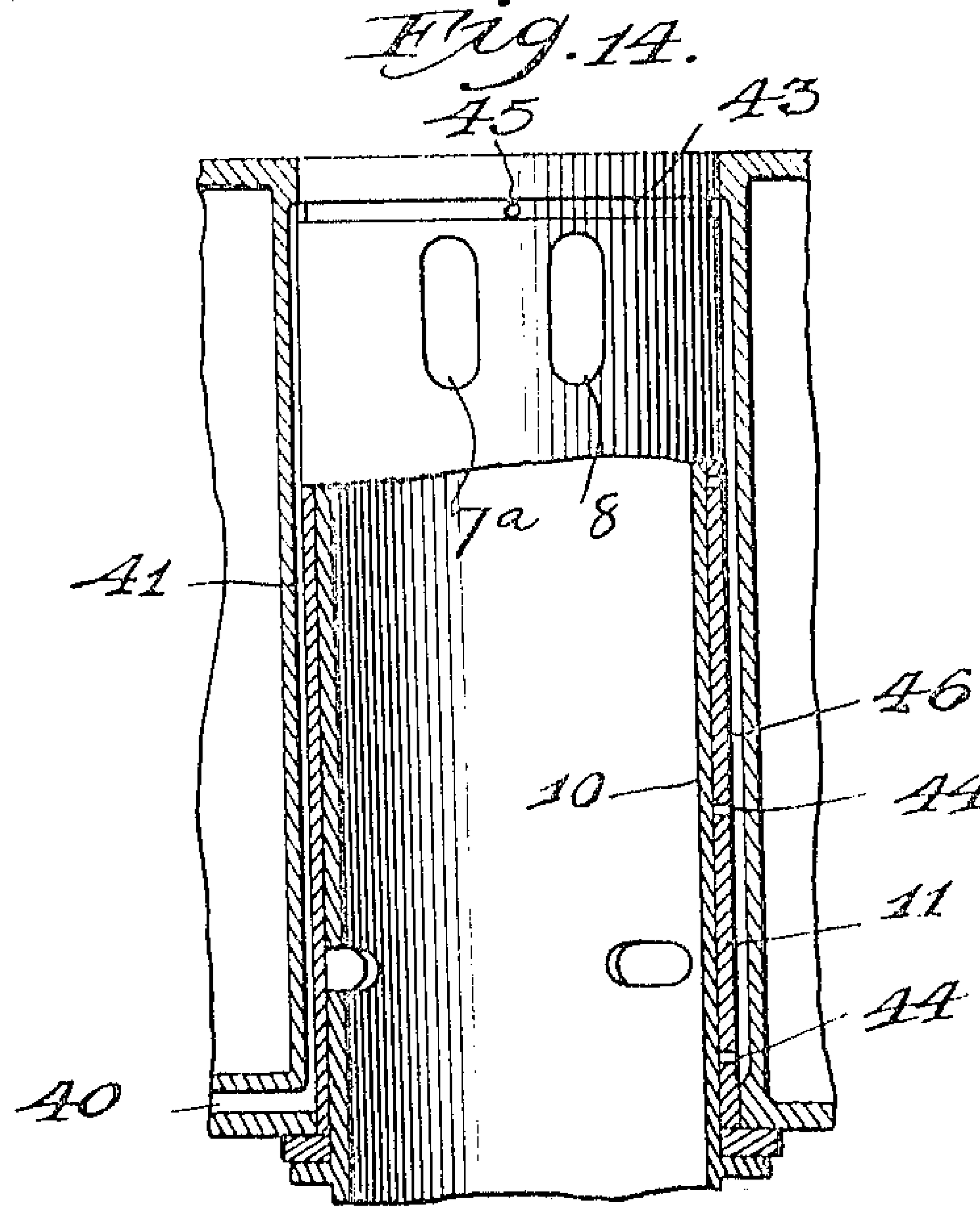


Fig. 14.



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UNITED STATES PATENT OFFICE.

MARTIN L. WILLIAMS, OF SOUTH BEND, INDIANA, AND SAMUEL E. WITT, OF CHICAGO, ILLINOIS, ASSIGNORS, BY MESNE ASSIGNMENTS, TO AMERICAN SLEEVE-VALVE MOTOR COMPANY, A CORPORATION OF DELAWARE.

ENGINE.

1,298,429. Specification of Letters Patent. Patented Mar. 25, 1919.

Original application filed August 6, 1914, Serial No. 855,458. Divided and this application filed April 3, 1915. Serial No. 19,020.

To all whom it may concern:

Be it known that we, MARTIN L. WILLIAMS, a citizen of the United States, residing in the city of South Bend, county of St. Joseph, and State of Indiana, and SAMUEL E. WITT, a citizen of the United States, residing in the city of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Engines, of which the following is a specification.

This application is a divisional application of an original filed August 6, 1914, Serial No. 855,458. The invention relates to improvements in engines such as gas, steam, air or the like, and more particularly to the novel construction of passages for the lubricant, intake and exhaust of the engine.

Among the salient objects of the invention are to provide a construction in which the main body of the engine is formed absolutely separate from its wearing parts, thus permitting the repairing or renewal of any operating part without changing the main body casting; to provide a construction in which the inlet and exhaust ports are cast on the face of the cylinder casing and are made complete as ports for intake and exhaust by the insertion of a lining or bushing; to provide a construction in which a lubricating passage is formed between the outer wall of the bushing and the inner wall of the cylinder casting, thus avoiding the necessity of outside or separate lubricating conduits; to provide a construction in which the conduits and passageways in the cylinder casting are formed with their inner faces open to permit of their being more readily cast and cleaned of obstructions formed during casting, the open faces of the passageways or conduits being closed by the bushing heretofore referred to; to provide a construction in which the exhaust ports at the upper and lower ends of the cylinders are connected by passageways formed by the cylinder wall and bushings in the manner above referred to, the main exhaust leading from the lower end of the cylinders; to provide a construction in which the cylinder is cast with the intake passages open at both the inside and the outside of the casting; to utilize the bushing above referred to for the purpose of completing the inner wall of the passage and to utilize a slab plate for completing the entire outer wall of the intake manifold; to provide a construction in which the bushing or lining, which completes the intake and exhaust ports and passages, is also used as a bearing for the rotating valve controlling communication through the ports; and in general to provide a construction in which the main body of the engine is impervious to wear and tear, in which the cost of repairs is limited to the light wearing parts, and the manufacture simplified, and greater accuracy secured at a reduced cost.

The invention consists in the matters hereinafter described, and more particularly pointed out in the appended claims.

In the drawings—

Figure 1 is a side elevation of our invention with parts broken away and shown in section;

Fig. 2 is a vertical sectional view on an enlarged scale taken on the lines 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a view similar to Fig. 2, but taken on lines 3—3 of Fig. 1, and looking in the direction of the arrows;

Fig. 4 is a rear end view with the crank case shown in section;

Fig. 5 is a horizontal sectional view taken through lines 5—5 of Fig. 1, and looking in the direction of the arrows;

Fig. 6 is a similar view taken on the lines 6—6 of Fig. 1, and looking in the direction of the arrows;

Fig. 7 is a perspective view of one of the cylinder caps;

Fig. 8 is a perspective view of one of the sealing rings;

Fig. 9 is a vertical sectional view of one of the cylinder castings;

Fig. 10 is a sectional view taken on line 10—10 of Fig. 1, and looking upward;

Fig. 11 is a similar view looking downwardly;

Fig. 12 is a perspective view of one of the stationary bushings;

Fig. 13 is a perspective view of one of the rotary valve sleeves;

Fig. 14 is a vertical sectional view showing the oiling system, taken on line 14—14 of Fig. 6.

Referring to the drawings: 1 designates the cylinder castings; 2, the slab head; and 3, the crank shaft suitably mounted in the crank case 5. In the drawings we have illustrated a multi-cylinder motor, the particular construction shown comprising four cylinders, 6, the individual cylinders of which are designated by reference characters A, B, C and D, though it is obvious that a greater or less number may be employed within the scope of the invention.

The cylinders, crank casing and fly-wheel housing are preferably cast integrally, and may be made of aluminum, or other relatively light material. The construction of the slab head is such that it may also be cast from aluminum, if desired, since no part of the cylinder or slab head is directly subjected to the explosion gases.

Referring first to the detailed construction of one of the cylinders, it will be noticed that the latter is provided at its upper end with inlet ports 7 and also exhaust ports 8. These last mentioned ports do not, however, discharge directly to the atmosphere, but are connected to the passages leading from the lower exhaust ports 9 in the manner hereinafter described in detail. Both the inlet and the upper and lower exhaust ports are controlled by a rotary sleeve 10, which is driven in timed relation to the crank shaft 3, and at any desired ratio. This sleeve is positioned within the cylinder casting, and extends throughout substantially its entire length. It does not, however, seat directly against the cylinder, but fits within a ported bushing 11, which also extends throughout substantially the entire length of the cylinder. This use of an insert avoids the necessity of accurate machining of the cylinder casting ports, such as would be required if the rotating sleeve contacted directly with the walls of the casting. The slab head 2 is also protected from both the shock and extreme heat of the explosion chamber by means of a cap 12, which seats on the upper edge of the bushing 11. The inner walls of the explosion chamber are thus formed by the bushing 11, cap 12 and the head 13 of the piston 14. This last mentioned element is provided with a suitable sealing ring 15, which will prevent any leakage of the gases past the piston.

Leakage is also prevented from the upper end of the cylinder, and this is preferably accomplished by means of a floating sealing ring 17 loosely supported by the cap 12. The ring 17 is provided at its upper edge with a plurality of lugs 18 extending inward and adapted to interlock with a plurality of flanges 19 secured to the under portion of the cap 12. These lugs 18 and flanges 19 are so positioned around the periphery of the ring and cap respectively that the lugs of the ring can be positioned in between the flanges of the cap, and then, upon rotation of the parts, the lugs 18 will pass into registration with the flanges 19, and can be locked in this position by means of a pin 20 extending through the cap and engaging a notch 21 in one of the lugs of the ring.

From the above description it will be obvious that in the assembled position of these parts the ring and cap are locked from rotative movement, and the cap 12 is itself locked from rotation by means of marginal slots 22, which receive the ears 23, on the bushing 11, which in turn is keyed to the cylinder casting. The arrangement of the cap and ring is such that, while the latter is held from rotative movement, it is free to adjust itself to seat tightly against the inner surface of the rotary sleeve. As shown in Fig. 8, the sealing ring 17 is split, and has its free end projecting from the portion secured by the pin 20, in the direction in which the sleeve 10 rotates. Thus, if the engine runs light on oil, or for any other reason the abnormal friction occurs between the sleeve and ring, the latter will be contracted and automatically increase the oil space between the ring and sleeve.

Inasmuch as the ring 17 extends down beyond the plane of both the inlet port and the upper exhaust ports, it is provided with suitable ports 22′ corresponding to the inlet ports 7 and the upper exhaust ports 8. These various inlet and exhaust ports are arranged in pairs in equidistantly spaced relation around the cylinders. Referring to Figs. 5 and 6, it will be noticed that there are three inlet ports 7, 7^a, and 7^b, for each cylinder, all of which open into a common inlet passage 24. In casting the cylinder this passage is left open at its outer side and is closed by a slab plate 25 secured to the cylinder casting by any suitable securing means, such as bolts 25^a. The inlet passage 24 communicates with an inlet conduit 25, and is connected to a carbureter 27, or other suitable device for supplying explosive mixtures to the engine. The inlet ports 7 and 7^a of each cylinder are provided with separate passages 28 and 28^a, but the inlet port 7^b is positioned adjacent the corresponding port of the other cylinder of the pair, and both are connected by a common passage 28^b to the main inlet passage 24.

Opening in the same horizontal plane as the inlet ports 7, 7^a and 7^b, is a corresponding number of exhaust ports, 8^a, 8^b and 8^c, for each cylinder. As previously stated, these upper exhaust ports do not lead directly to the atmosphere, but are connected by vertically extending pasageways with the lower exhaust ports 9, 9^a and 9^b, and discharge therewith into the common exhaust passage 29, which extends substantially along the entire one side of the cylinder casting. The exhaust ports, which are adjacent to this side of the cylinder casting, are connected directly to the common exhaust passage 29, while the exhaust ports 9^a, which are adjacent to the other side of the cylinder casting, are connected to the exhaust outlet by means of a second exhaust passage 30. The exhaust passage 29 is formed in the cylinder casting with its outer face open in a manner similar to that in which the inlet passage 24 is formed, and is also provided with a slab plate 29^a, which coöperates therewith to form a conduit through which the exhaust gases are led to the atmosphere.

The space surrounding the explosion chamber, which is not utilized by the inlet and exhaust passages, is employed for cooling purposes, there being a plurality of vertically extending water passages 31 distributed around each of the cylinders. At the lower end these water passages connect with a water chamber 32 at their upper end open into the water chamber 33, through registering ports 34 and 35, in the cylinder head and casing, respectively. This upper water chamber 33 has a connection 34′, which leads to a radiator, or other cooling device (not shown). It will be noticed that the water in passing through the elongated chamber 32 is separated from the oil deck 35 by a thin wall 36, and the water thus serves to cool the oil as well as the cylinder casing.

The oiling system is as follows:

A suitable supply of oil is carried in the crank case 5, fly-wheel housing 4, and oil pan 4′, and from the latter it is fed by centrifugal force through the passage 37 into the oil deck 35, leading from which is a plurality of conduits 38 which lubricate the crank shaft bearings 39. From this deck the oil is fed under pressure to lubricate the moving parts of the cylinder in the following manner: At the lower end of each cylinder is an oil inlet 40, which registers with the lower end of a vertical oil channel 41, which is formed by leaving a vertically extending open face recess 42 in the wall of the cylinder casting, the open face of such recess being closed by the outer wall of the bushing 11.

At its upper end the oil channel 41 connects with a circumferential groove 43 formed in the outer wall of the bushing 11, and spaced a slight distance from the upper edge of this bushing. The oil forced up the channel 41 discharges into the circumferential groove 43 and passes along this groove both to the right and to the left, and is discharged into a similarly formed channel 46 on the opposite side of the cylinder. At different points in its circumference the bushing 11 is provided with perforations 45, which conduct the oil from the circumferential groove to the inner surface of the bushing. The remaining oil is discharged into the return channel 46, and from this channel is fed through apertures 44 to the rotary sleeve, the oil being carried around the surface of the latter by the rotation of the sleeve itself; and any surplus oil is drained back into the crank case through the filter 47.

As previously stated, these rotary sleeves 10 are driven from the crank shaft in timed relation and in any desired ratio of speed relative to the crank shaft speed, the particular ratio in the construction illustrated being six to one. Any suitable train of step-down gearing may be employed, but the particular construction employed is as follows: At the lower end of each of the sleeves 10 is a worm wheel 48. Each of these worm wheels is driven from a horizontally extending worm shaft 49 extending along one side of the cylinder casting. This worm shaft 49 is driven from the crank shaft 3 by a chain 50′, as indicated by dotted lines in Fig. 4, the speed of these two shafts being equal. The step-down is obtained through the worm gearing, the engaging teeth of the worm shaft and worm wheel being such that the latter is driven at one-sixth of the speed of the worm shaft. In place of forming the worm grooves directly in the worm shaft 49, I have formed the latter on a plurality of bearings 50 and 51, each of which is keyed to the shaft 49, as indicated at 52, and locked from longitudinal movement by adjustable members 53 and 54. This novel arangement permits of the bearings being normally set to turn the rotary sleeves in approximately the proper timed relation, and then by adjusting the bearings 50 and 51 longitudinally on the shaft 49, the rotary sleeves can be very accurately set to register in proper sequence. It is to be understood that the worms 50 are arranged to turn the rotary sleeves D and B in clockwise direction while the worms 51 turn the cylinders C and A in the opposite direction—that is, anti-clockwise. The arrangement of the gears is obvious and need not be more definitely described or shown.

Referring now in detail to the manner in which the inlet and exhaust of the engine are controlled by the rotary sleeves, attention is particularly called to Figs. 5 and 6. The order of firing of the cylinders is as follows: A, C, D and B. In Fig. 5 the cylinder D is shown in the act of firing, while the cylinder B, which is next in order, has just closed its intake, and is starting its compression stroke. The cylinder A, which follows the cylinder B in order of firing, has just closed its exhaust ports, and is about to open the intake ports. The cylinder C has opened its lower exhaust ports, as shown in Fig. 6, and is on the point of opening its upper exhaust ports.

The piston 14 is on its down stroke in cylinder C, and is starting to uncover the lower exhaust ports, which are practically entirely open, at the same time that the upper exhaust ports start to open.

It is obvious from this arrangement that a remarkably quick and thorough exhaust is obtained, and that both the inlet and exhaust ports of the cylinders can be governed by a single rotary sleeve for each cylinder. Moreover, this advantage is obtained without the use of complicated castings, and the inlet, exhaust and oil passages are cast as open-faced channels, which are completed by the bushings, and if at any time the cylinders become scored, a new bushing can be readily inserted. In case it is desired to remove one of the bushings, or other parts, it is only necessary to remove the slab head 2, and lift the caps 12 off the cylinders. The spark plugs 55 are accessible through a cap 56 carried by the slab head 2 and secured thereto by means of members 57, the construction being such that this cap can be removed without interfering with the main slab head. It will also be noticed that the intake conduit 26 is so formed that the carbureter 27 may be located at the rear end of the motor at a relatively high point, whereby it can be conveniently positioned for adjustment.

By supporting the sealing ring from the cap 12 in the manner above described, we not only maintain a self-adjusting tight seal between the ring and the sleeve, but are enabled to position all meeting portions of the cylinder construction and the slab head in a single horizontal plane. The same single plane arrangement is maintained with respect to the engaging portions of the intake and exhaust slabs, which close the passages on the outside of the cylinder casing, and the machining and assembling of parts is thus greatly simplified. Moreover, by using the ported bushing the ports can be very accurately machined in the latter prior to the insertion of the bushing within the cylinder.

From the above description it will be seen that the entire working parts of the engine are absolutely separate from the main body of the engine. Thus, any working part can be removed and repaired or renewed without affecting the remainder of the engine. Also the accurate machining of the main casting is avoided and the construction as an entity reduces both the cost of manufacture and the cost of upkeep to a minimum. The formation of the intake and exhaust ports and the leads as open-faced recesses in the main casting, which recesses are made complete as conduits by the outer surfaces of the removable lining, the interior surface of which lining serves as a bearing for the valve-controlling sleeve, forms an important feature of our invention. The oil conduits are also similarly formed, and while we have shown them formed by leaving recesses in the cylinder casting, it is obvious that they could be formed as recesses in the bushing with the open faces closed by the casting. Also various other changes in construction and combinations of parts can be made without departing from the scope of our invention, and we, therefore, do not desire to limit it except as specified in the appended claims.

We claim as our invention:

1. In a gas engine, the combination with a cylinder casing having circumferentially extending ports, of a ported bushing mounted in said casing, a rotary valve sleeve in said bushing, vertically extending oil channels formed between the cylinder casing and opposed wall of the bushing, said channels being formed in and as a part of the cylinder casing.

2. In a gas engine, the combination with a cylinder casing provided with a plurality of vertically extending cylinder openings, the side wall of each opening having open-faced conduits, a bushing mounted in each opening and having ports over and above the open faced portions of the cylinder casing, a ported rotary valve sleeve in said bushing, a slab head mounted above and over the cylinder openings and formed as a substantially single piece structure.

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