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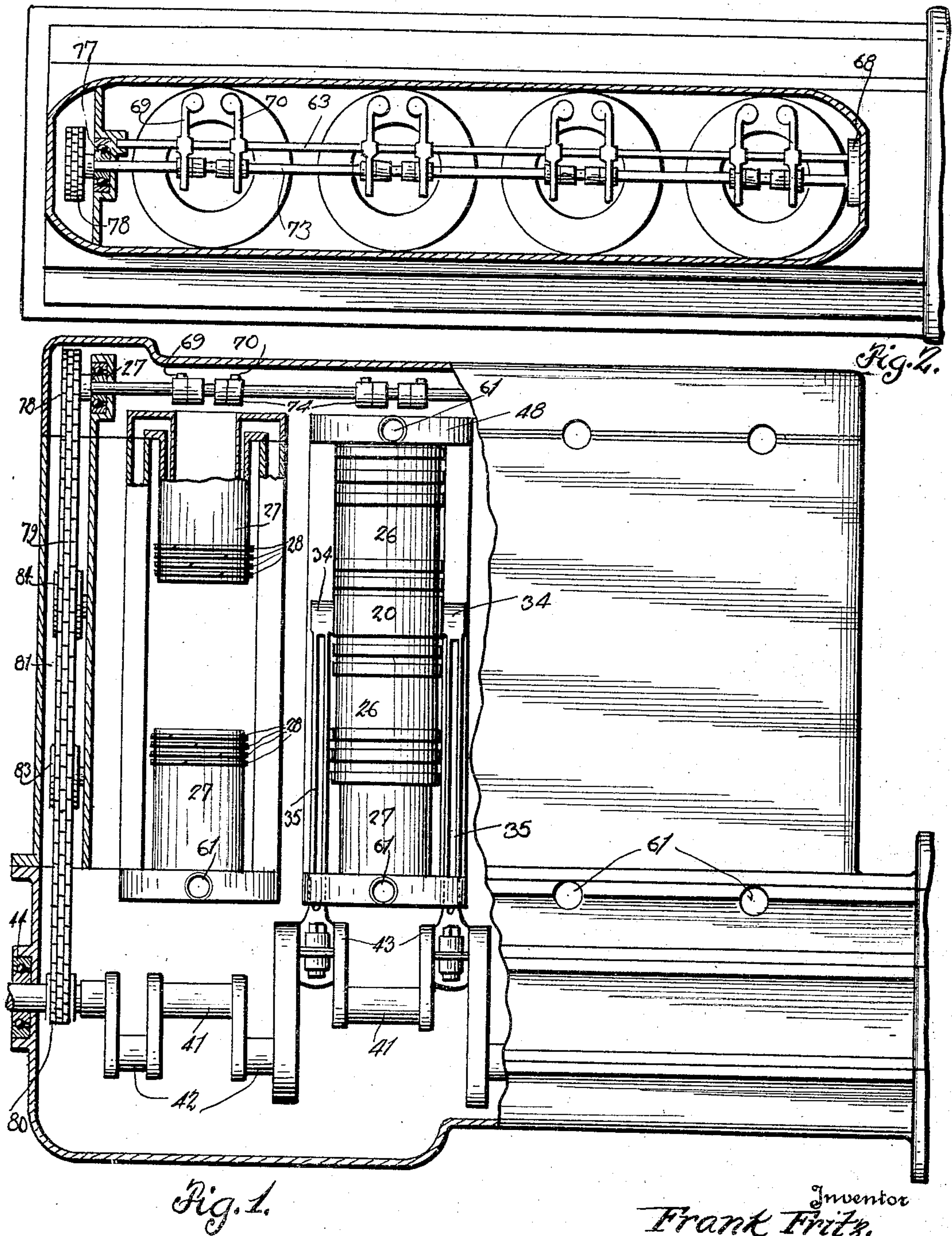
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INTERNAL COMBUSTION ENGINE

Filed Oct. 16, 1930

5 Sheets-Sheet 1



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By Bryant & Loring

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5 Sheets-Sheet 2

Fig. 3.

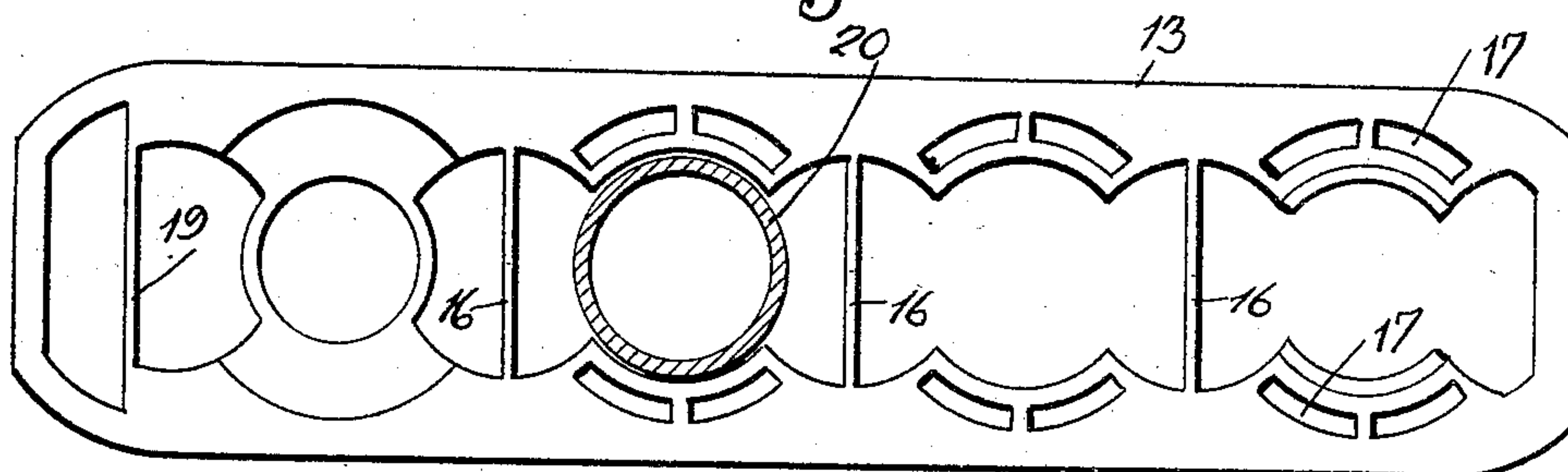
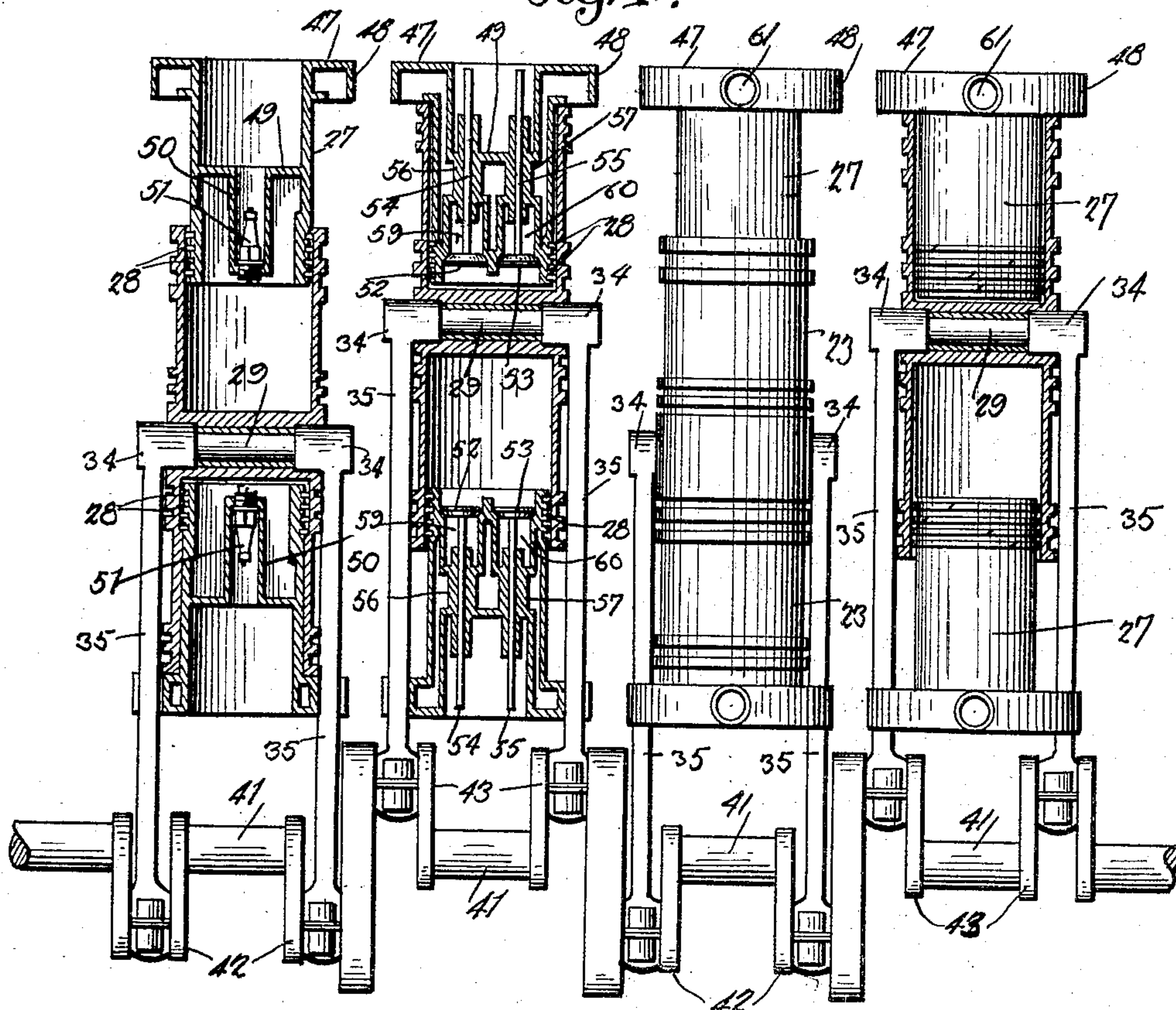


Fig. 4.



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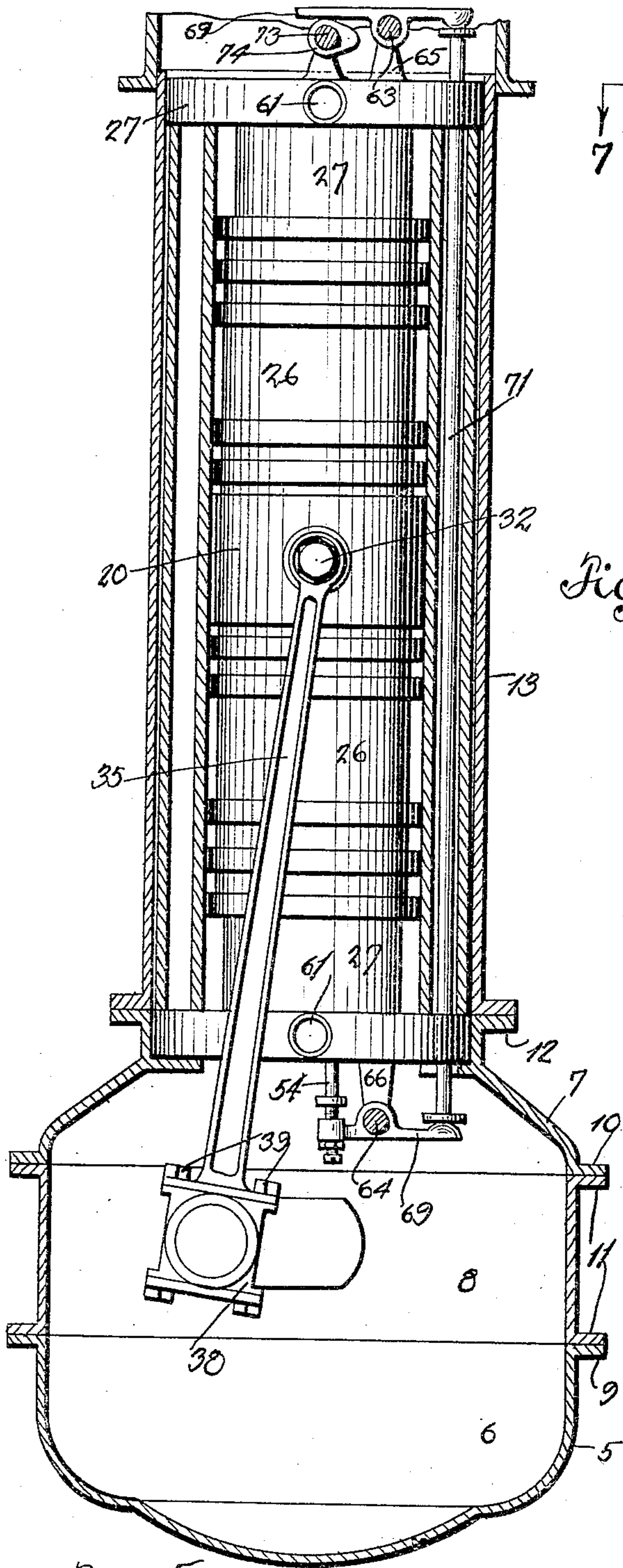


Fig. 5.

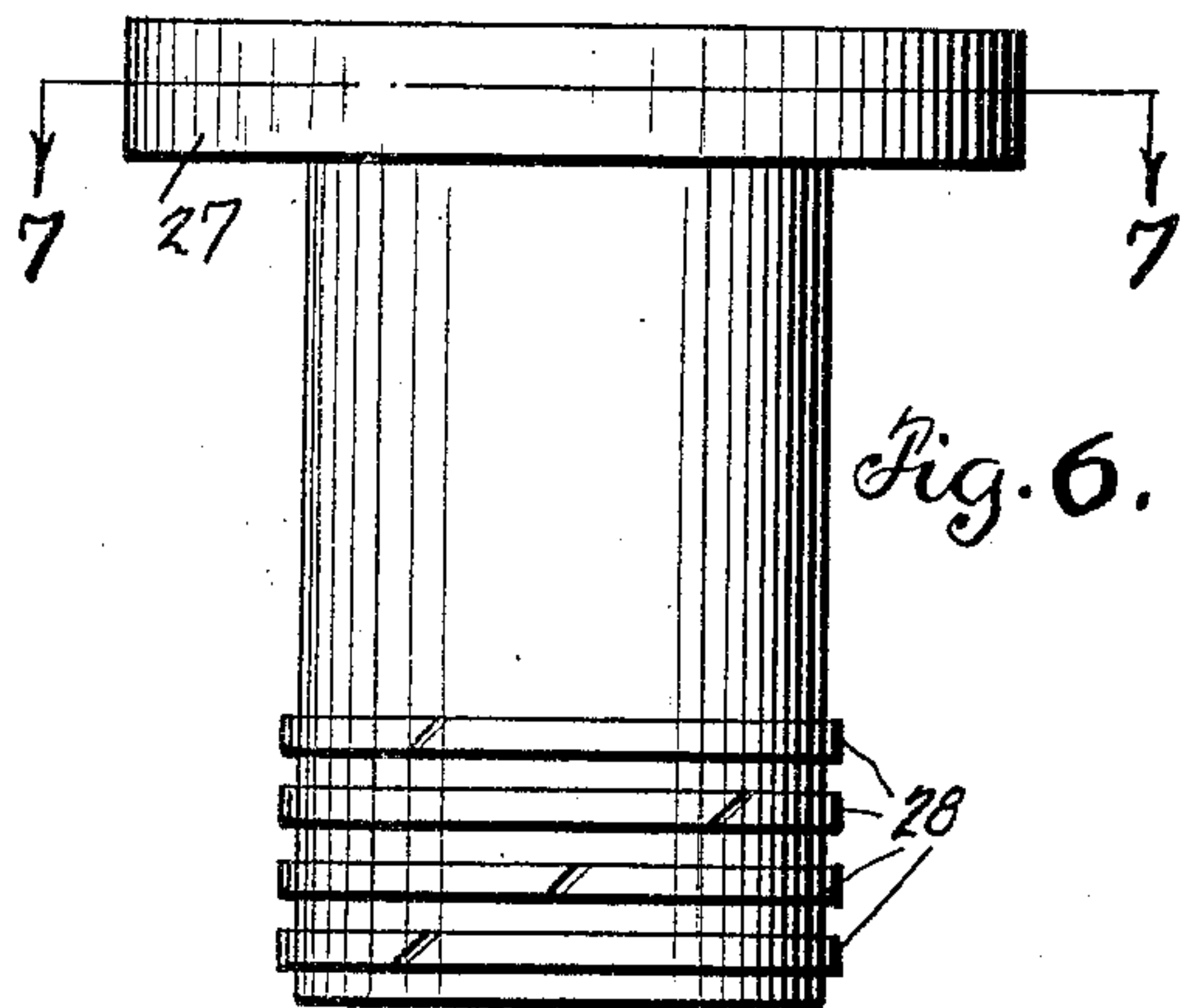


Fig. 6.

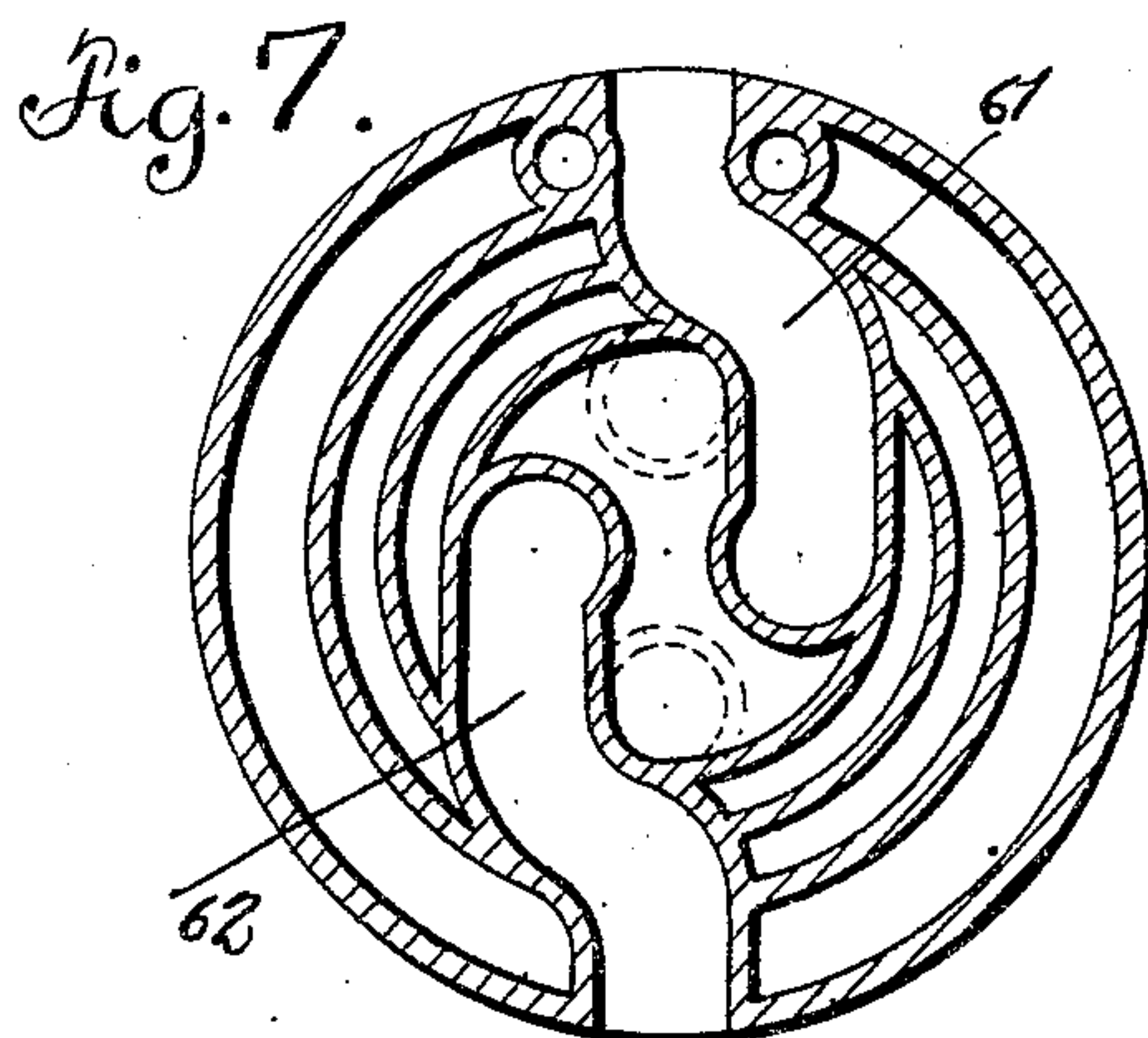


Fig. 7.

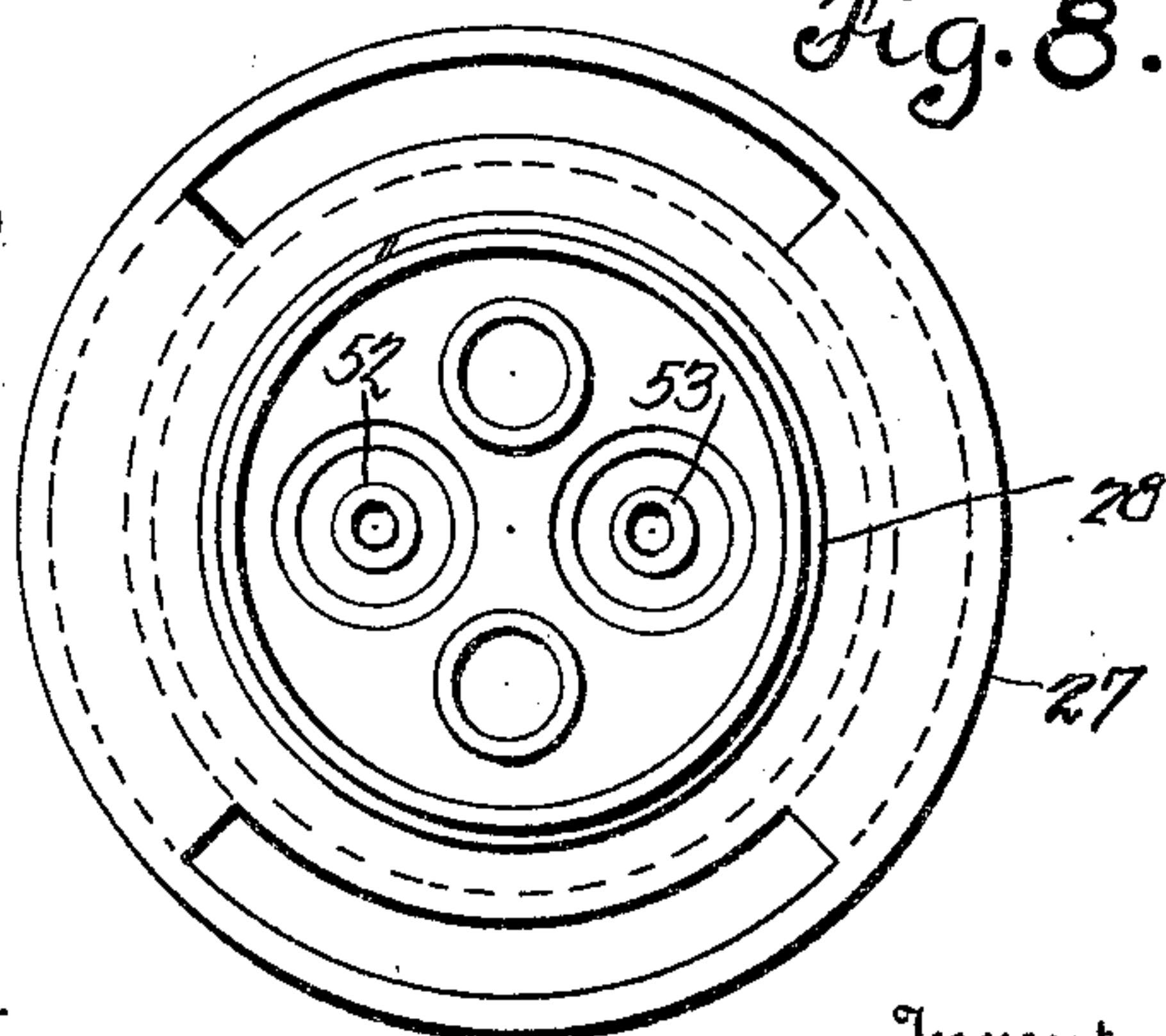


Fig. 8.

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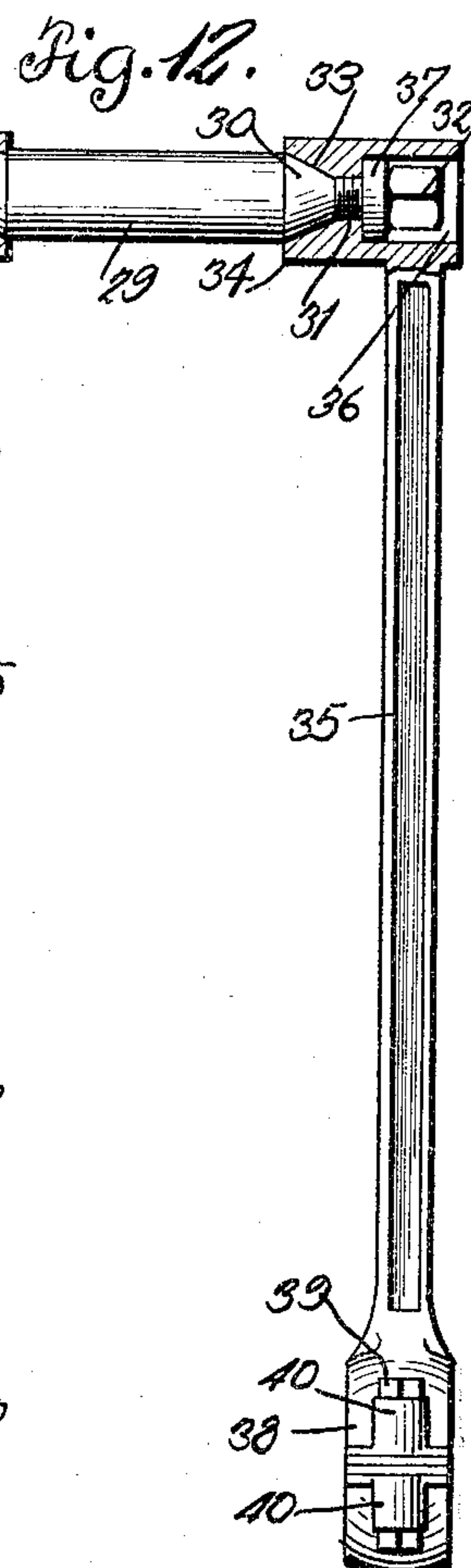
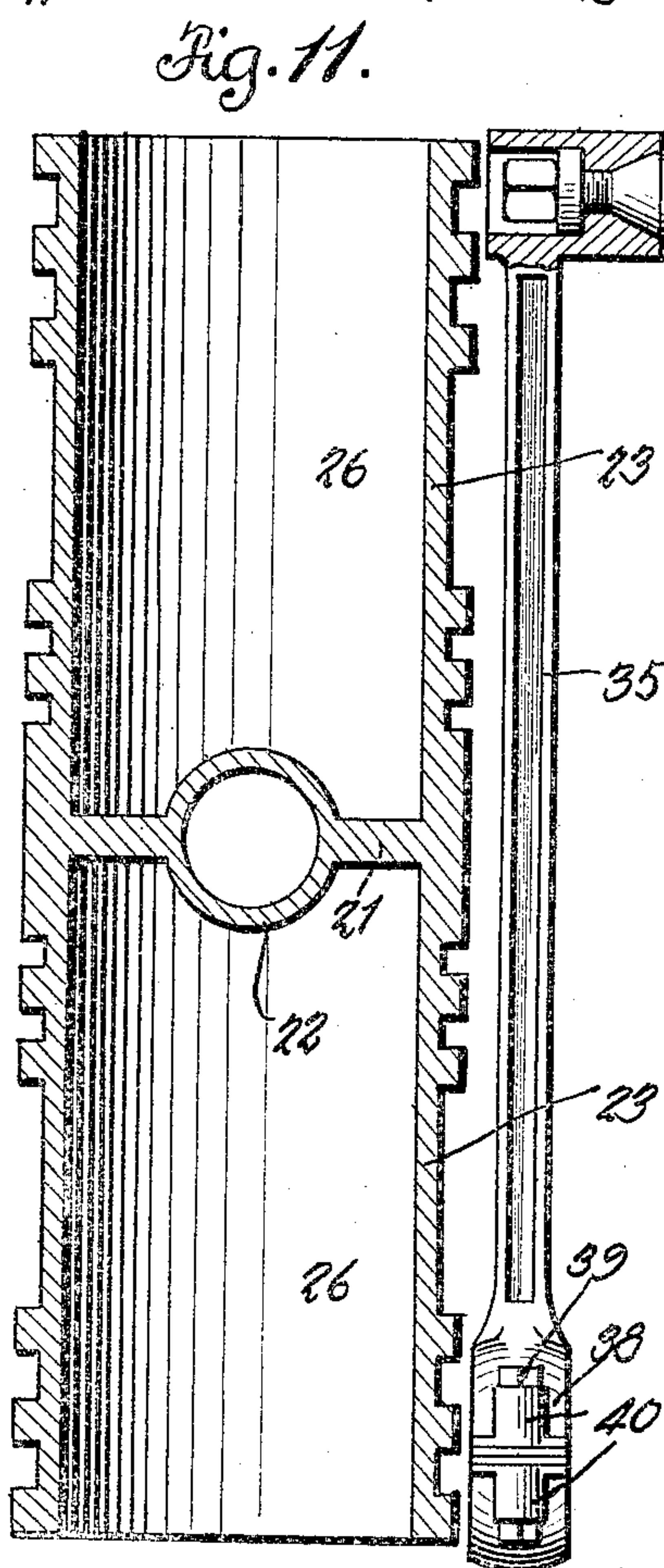
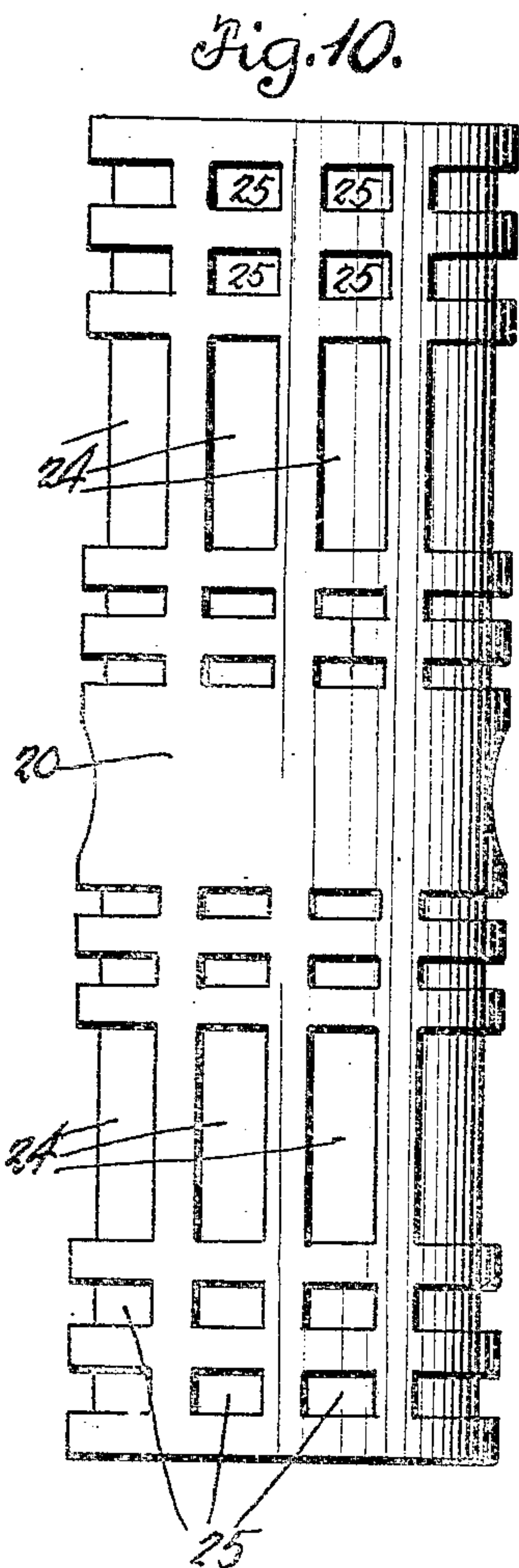
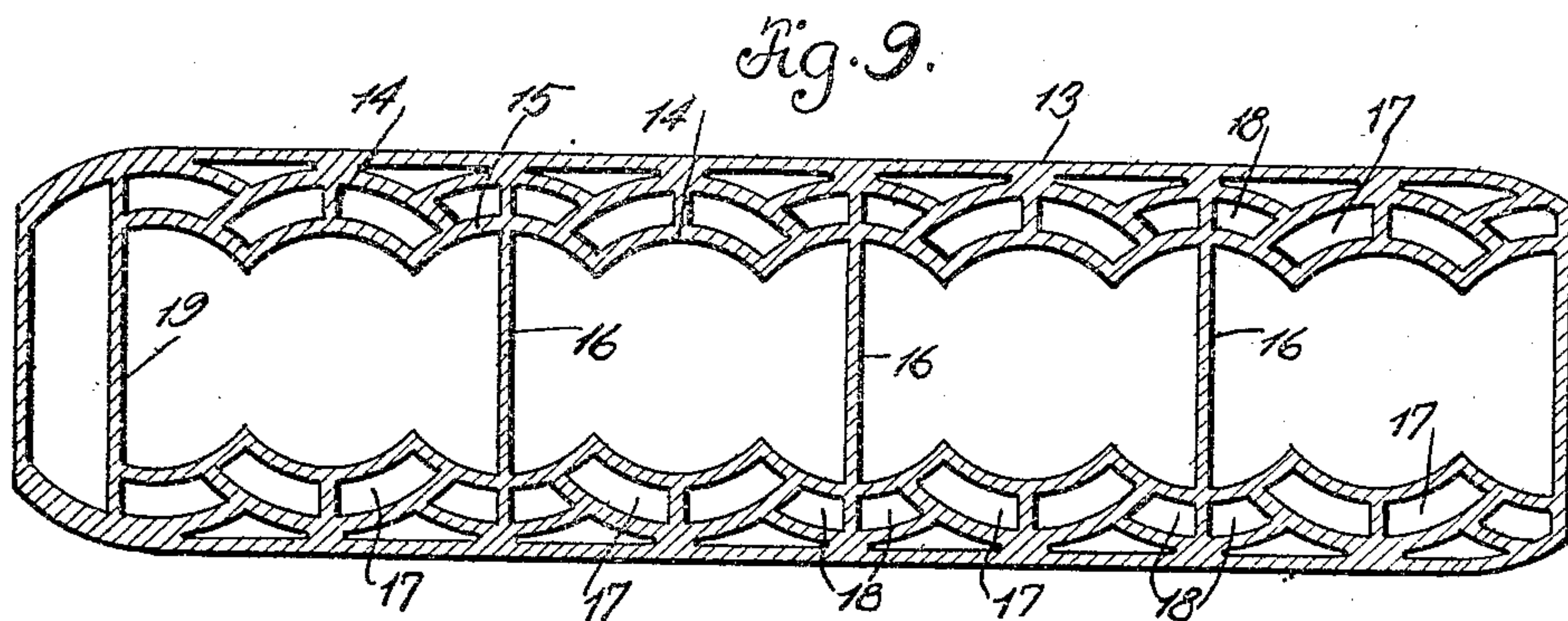
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5 Sheets-Sheet 5

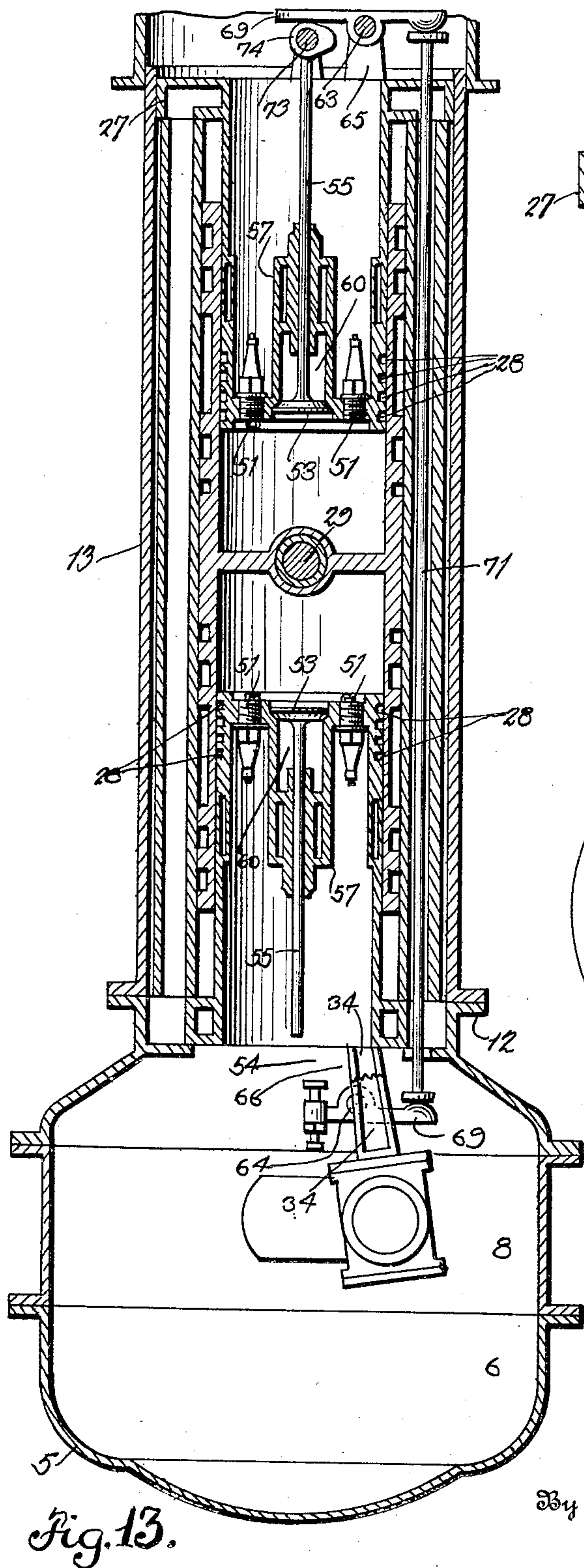


Fig. 13.

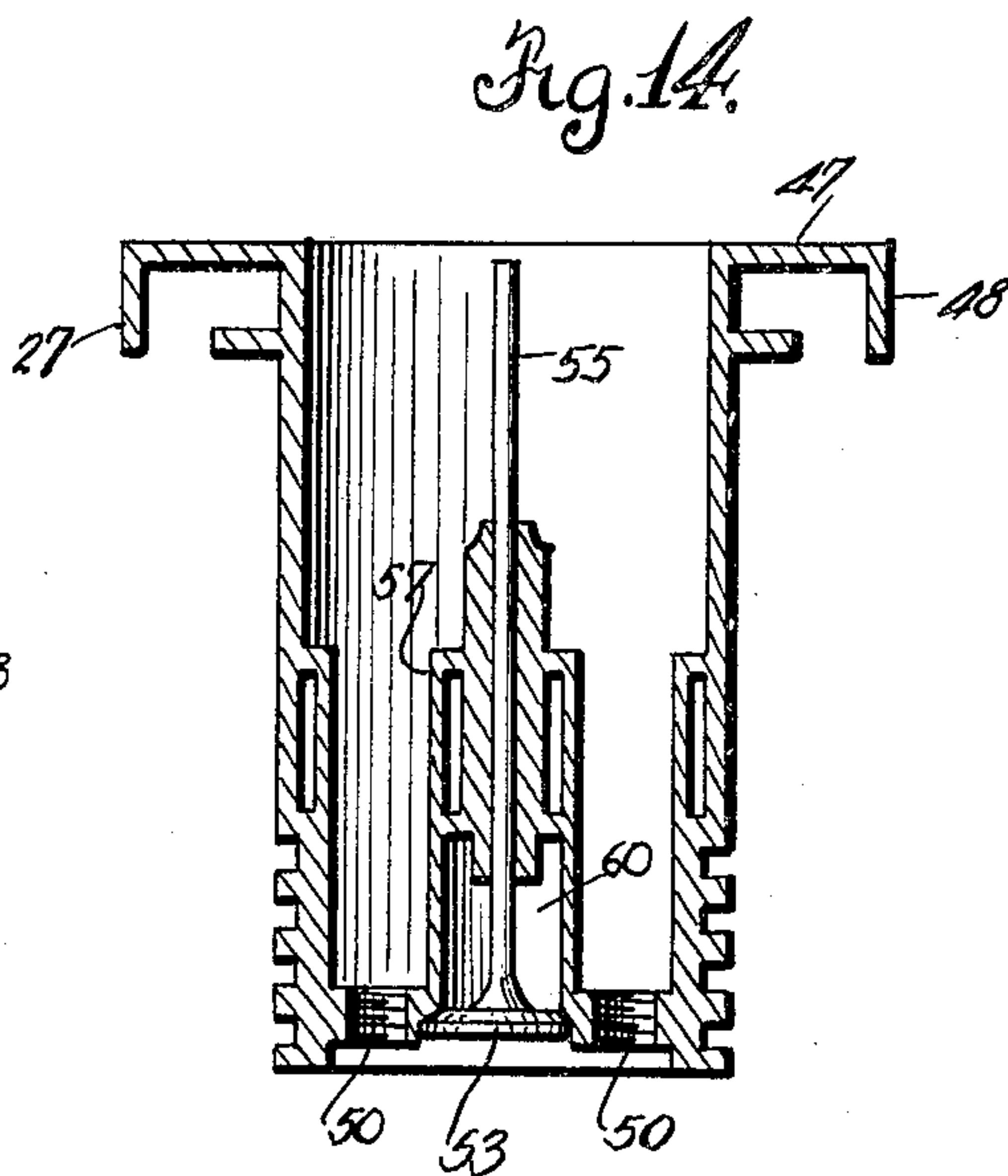


Fig. 14.

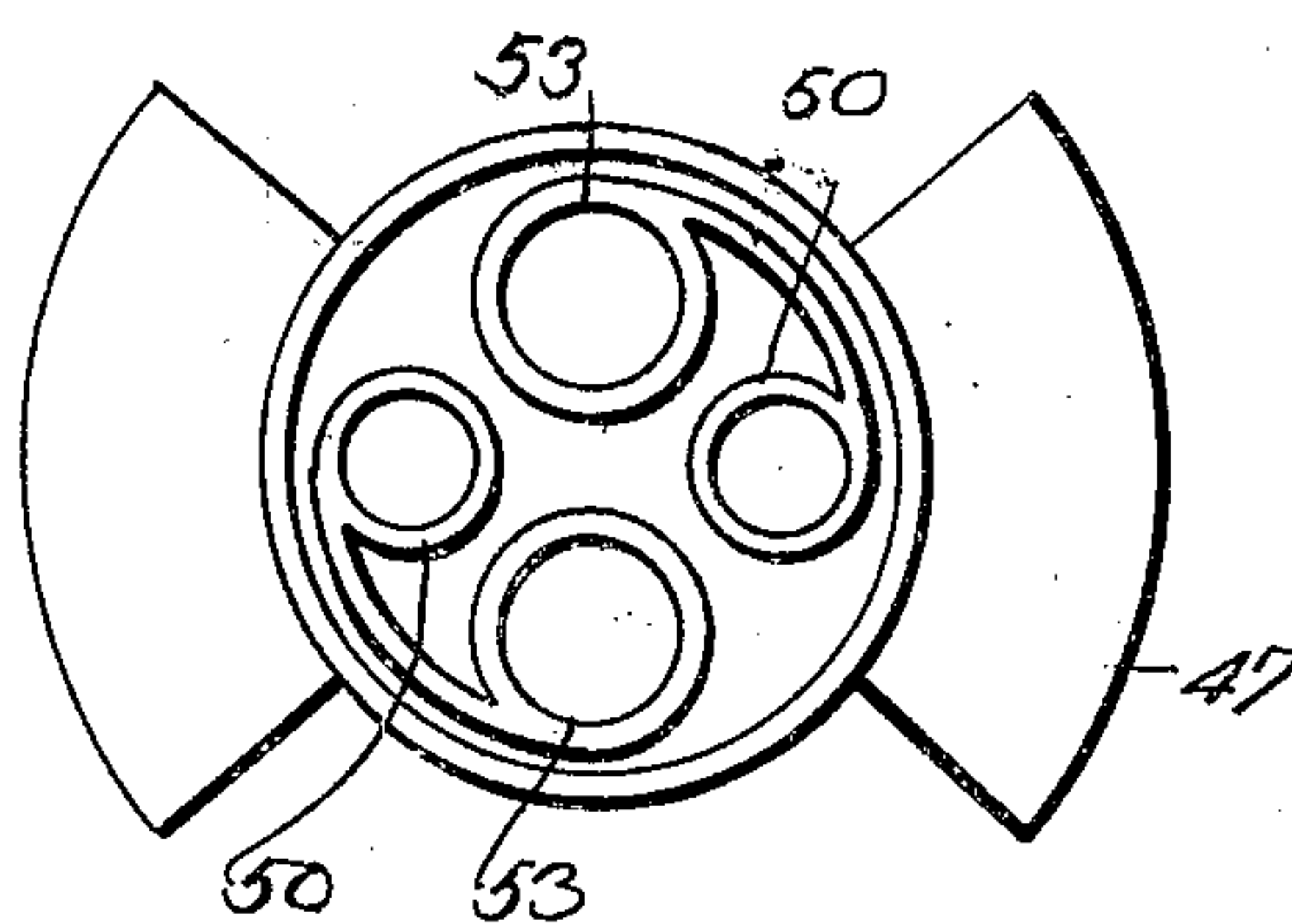


Fig. 15.

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UNITED STATES PATENT OFFICE

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INTERNAL COMBUSTION ENGINE

Application filed October 16, 1930. Serial No. 489,159.

This invention relates to improvements in internal combustion engines of the type including a multiplicity of cylinders arranged in tandem and the invention comprises a single piston for each of the tandem cylinders adapted to be alternately acted upon by impluses from the explosion taken into the cylinders by suction.

The invention further contemplates a novel wrist pin construction for each of the pistons and connecting rods secured to each end of the wrist pins and having their opposite ends connected to throws on the crank shaft whereby vibration and torsional strain on the crank shaft will be prevented. The invention also comprises a water pump mounted parallel with the tandem cylinders for forcing a cooling liquid through the water jackets of the cylinders and preventing overheating which is a common objection to this type of engine.

Another object of this invention is to provide a novel form of valve gearing including exhaust and intake valves in each of the tandem cylinders and the provision of a cam shaft driven from the crank shaft for causing the alternate operation of the valves whereby one cylinder will be taking in a fresh charge of fuel supply while the opposite cylinder will be exhausting the burned gases.

A still further object of this invention, is to provide a novel form of cylinder block having overlapping bores for allowing space between the working cylinders for accommodating the free ends of the wrist pins and the connecting rods. This form of cylinder block also presents novel advantages for readily removing the valve gearing for repairs or for removing the pistons for the purpose of cleaning the carbon thereon and replacement of parts.

The novel construction of the cylinder block also affords openings for the reception of the ignition cables from opposite ends of the tandem cylinders to the distributor whereby the same will be protected against water and oil which has been found to be very detrimental to internal combustion engines.

Other objects and advantages of the invention will be apparent during the course of the following description forming a part of this specification and in which

Figure I is a longitudinal side elevation partly in section illustrating the cylinder block and the manner in which the tandem cylinders are disposed therein relative to the working pistons. The cam shaft connection to the crank shaft is also illustrated at one end of the view illustrating the manner in which the connecting chain is housed within a portion of the cylinder block.

Figure II is a longitudinal front elevation illustrating the upper portion of a cylinder block broken away to illustrate the manner of arranging the cam shaft and valve rocker arm.

Figure III is a top elevation illustrating the arrangement of the cylinders relative to the block and showing the water cooling jackets adjacent the cylinders for cooling the same.

Figure IV is a longitudinal side elevation illustrating the pistons and cylinder heads removed from the block and also illustrating in cross sectional detail the manner in which the pistons are arranged for sliding engagement with the heads.

Figure V is a vertical cross section through the cylinder block showing the invention enlarged and the arrangement of the double acting pistons relative to the cylinder block and tandem heads.

Figure VI is an enlarged side elevation illustrating in detail one of the tandem cylinder heads removed from the cylinder block for the purpose of illustrating the sealing or packing rings.

Figure VII is a transverse cross sectional view taken on line VII—VII of Figure VI looking in the direction of the arrows showing the construction of the cylinder heads and the arrangement of the intake and exhaust ports therein.

Figure VIII is a top elevation of the piston head removed from the cylinders showing the same enlarged and illustrating the arrangement of the intake and exhaust valves.

Figure IX is a longitudinal cross sectional

view through the centralmost portion of the block illustrating the arrangement of the cylinders and the corresponding water jacket for dissipating the heat from the cylinders.

5 Figure X is an enlarged side elevation of one of the double acting pistons removed from the cylinder block for the purpose of illustrating the honeycomb arrangement on the periphery thereof.

10 Figure XI is a vertical cross section of one of the pistons illustrating the wrist pin bearing and the opposite skirted section of the pistons.

Figure XII is a side elevation illustrating the wrist pin and connecting rod in detail and showing the same enlarged.

15 Figure XIII is a vertical cross sectional view taken through the cylinder block, double acting pistons, and the removable cylinder heads for illustrating the positioning of the intake and exhaust valves and spark plugs in the removable heads and also the water pump formed by the rings on the double acting piston skirts.

20 Figure XIV is a vertical cross sectional view of one of the removable cylinder heads further illustrating the arrangement of the intake and exhaust valves and showing the same enlarged, and

25 Figure XV is a bottom elevation of one of the piston heads removed showing in enlarged detail the construction of the frame.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of the invention and wherein like reference characters are employed throughout the several views, the reference character 5 will generally be employed to designate an engine crank case formed of a bottom section 6, a top section 7, and an intermediate section 8. The three sections 6, 7, and 8 are held together by the adjoining flanges 9, 10, and 11, on the respective sections 6, 7, and 8. Formed on the upper edge of the crank case section 7 is a flange 12 to which is bolted a cylinder block 13 having a series of overlapping bores 14 and 15 which extend from the bottom of the block to the top thereof. The vertical bores 15 form the working surface for the pistons while the overlapping bores 14 are provided with vertical partitions 16 for accommodating ignition wires and the connecting rods for the pistons.

As illustrated in Figures III and IX, the 55 cylinder 13 is provided with a series of water jackets 17 on opposite sides of the working pistons while interconnecting water jackets 18 are formed adjacent the overlapping vertical bores. At one end of the cylinder block 13 is provided a partition 19 which extends from the bottom of the cylinder block to the top thereof for forming a housing for the valve gear driving chain which extends from the crank shaft to the cam shaft extending across the top of the cylinder block.

Reciprocally mounted within each of the working cylinders 14 is a double acting piston 20 having a central dividing wall 21, which is provided with a wrist pin bearing 22. Extending in opposite directions from the dividing wall 21 are piston skirts 23 having on their peripheries a series of rectangular cut-away portions 24. Between the rectangular cut-away portions 24 are a series of smaller rectangular cut-away portions 25 which are 75 adapted to contain a lubricating medium for reducing friction between the cylinder walls and the pistons. The inner periphery of each piston skirt 23 is provided with a smooth working surface for receiving a plug-shaped 80 cylinder head 27 having a series of circumferential slots or grooves for receiving piston or packing rings 28. The packing rings 28 are mounted on the lower portion of the plug-shaped cylinder head 27 in order that the 85 travel of the piston 20 may allow the skirted section 23 thereof to work over the oil sealing rings 28 and form combustion chambers on opposite sides of the piston 20. It is to be understood, that the plug-shaped cylinder 90 heads 27 are inserted in the working bores 14 of the cylinder block 13 at the top and bottom thereof for forming opposite combustion chambers on opposite sides of the dividing partition 21. 95

Passing through each wrist pin bearing 22 is a wrist pin 29 having tapered end portions 30 which are reduced and screw threaded as at 31 for the reception of holding nuts 32. The conical or tapered portions are received 100 in corresponding openings 33 in the bosses 34 formed on the upper ends of the connecting rods 35. An opening 36 is also formed in the opposite end of the boss 34 for allowing a washer 37 to be passed over the screw 105 threaded section 31 whereupon the holding nut 32 is threaded thereon for rigidly connecting the boss 34 to the wrist pin 29. The lower ends of the connecting rods 35 are provided with crank shaft bearings 38 which are 110 formed in section and held together in the usual manner by bolts 39 passing through bosses 40. The crank shaft designated by the reference character 41 is provided with opposite throws 42 and 43 to which is secured 115 the crank shaft bearings 38. The ends of the crank shaft 41 may be journaled in anti-friction bearings 44 in opposite ends of the crank case section 8 as illustrated in Figure 1.

Each of the plug-shaped cylinder heads 27 120 is provided with a radially extending flange 47 having a downwardly turned annular flange 48 at the extremities thereof. The flange 48 is adapted to be seated upon the top wall of the cylinder block 13 as illustrated 125 in Figure V and to the bottom wall of the cylinder block also illustrated in Figure 5. Bolts or the like may be provided for retaining the plug-shaped cylinder heads 27 in place whereby a plug-shaped cylinder head will 130

be rigidly carried at each end of each cylinder. Each plug-shaped cylinder head also comprises a partition 49 having downwardly extending tubular members 50 open at their bottoms and screw threaded to receive a conventional form of spark plug 51. The downwardly extending tubular members 50 are mounted relative to the partition 49 adjacent the walls of the plug-shaped cylinder head 27.

At right angles to the downwardly extending tubular members 50 are arranged intake and exhaust valves 52 and 53, respectively, which have their guide stems 54 and 55 slidably mounted in blocks 56 and 57, respectively. The blocks 56 and 57 are supported by the partition 49 while the intake and exhaust chambers 59 and 60 are also formed integral with the partition 49 and depend downwardly therefrom. The intake chamber 59 communicates with an intake port 61 formed in the upper portion of the plug-shaped cylinder head while the exhaust chamber 60 communicates with an exhaust port 62 by means of communicating channel ways extending downwardly through the plug-shaped cylinder heads 27.

The valve operating mechanism includes a rocker arm shaft 63 extending across the top of the cylinder block 13 and a rocker arm shaft 64 extending across the bottom of the cylinder block having supporting means such as fulcrum supports 65 and 66, respectively, which may be mounted on top of the plug-shaped cylinder heads 27 or may be formed integral with the cylinder block as illustrated in Figure II wherein the bearings for the rocker arm shaft 63 are illustrated as at 67 and 68 whereby the ends of the rocker shaft 63 may be journaled in the bearings 67 and 68, respectively, for supporting the same. At spaced intervals on the rocker arm shaft 63 are cams operating rocker arms 69 and 70 for the intake and exhaust valves, respectively, which are adapted to operate push rods 71 which have their lower ends bearing against the lower rocker arm 69 for causing the alternate opening and closing of the intake and exhaust valves 54 and 55. While the lower set of intake and exhaust valves 54 and 55 are operated by the push rods 71 the upper set of the intake and exhaust valves are operated by correctly positioned cam members 74 rigidly secured to a cam shaft 73 which has its ends journaled in anti-friction bearings 77 adjacent the cam shaft bearings 67 and 68. One end of the cam shaft 73 extends through the anti-friction bearing 77 in the cylinder block and is provided with a sprocket wheel 78 over which is adapted to pass a sprocket chain 79 for operative connection to a sprocket wheel 80 rigidly secured to the crank shaft 41. It will be readily observed that the vertical opening 81 in the cylinder block 13 through which the

sprocket chain 79 passes forms a convenient housing for the same and that power or rotary motion applied to the cam shaft 73 by means of the sprocket chain 79 causes the cam member 74 to engage the valve stems 54 and 55 of the upper set of intake and exhaust valves 54 and 55, respectively, are operated by the push rods 71 communicating reciprocating motion between the upper and lower rocker arms 69.

Intake and exhaust manifolds may be attached to the intake and exhaust ports 61 and 62, respectively, and these may be of any form desired to accomplish the desired results.

The ignition timing system may be operated from the sprocket chain 79 by means of a timing sprocket gear 83 engaging the sprocket chain 79 while a water pump may be operated from the sprocket chain 79 by means of a sprocket wheel 84 also engaging the sprocket chain 79.

For a consideration of the operation of the invention attention is directed to Figure IV wherein is illustrated more or less a diagrammatic arrangement of the position of the pistons for the order of their functioning. The crank shaft 41 is rotated by a starter motor or the like in order to cause fuel to be drawn into the combustion chamber on either side of the partition 21 through the intake valve 52. The gas is compressed on the reverse movement of the pistons and it is fired by the spark plug 51 whereby the exhaust valve 53 operates to exhaust the burned gases. This cycle of operation is intended to be carried out on opposite sides of the partition 21 alternately in order that the upper combustion chamber will be drawing in the gas or fuel supply while the lower combustion chamber is being exhausted and on the up stroke of the piston 26 the fuel in the upper combustion chamber will be compressed while a fresh charge of fuel is being drawn into the lower combustion chamber. At this point an explosion occurs causing an impulse to be applied to the crank throws of the crank shaft 43 and causing compression of the fuel supply in the lower combustion chamber whereby the same is exploded by the spark plug 51 causing the upward travel of the piston 23 and the exhaust of the gas occurs upon the next downward travel of the piston. This cycle of operation may be timed as desired to provide the advantages of a four cycle type of engine or a two cycle type employing scavenging means, not shown.

It is to be understood, that various forms of valve systems or ignition systems may be employed with this type of engine and that no claim is made for the particular form of valve gearing or ignition system and the same is merely shown for the purpose of illustration in accordance with this type of engine. It is also to be understood that various

changes in the shape, size and arrangement of the parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

5 Having thus described the invention, what I claim is:

1. An internal combustion engine of the character described, comprising a crank case, a crank shaft extending longitudinally through the crank case, a cylinder block mounted on the crank case, vertical cylinders formed in spaced relation in the cylinder block, said cylinders being overlapped by vertical bores, a piston reciprocally mounted in each of the cylinders, oppositely extending skirt portions formed on each of the pistons, a removable cylinder head for each of the cylinders having an extension formed integral therewith extending into the cylinder and into the skirted portions of the pistons, packing rings mounted on the lower end of the cylinder head extension for forming a combustion chamber on opposite sides of the pistons, intake and exhaust valves having communicating ports located in the cylinder head extensions, a wrist pin for each of the pistons, a connecting rod connected to each end of the wrist pin for being connected to the crank shaft, said connecting rods extending through the overlapping bores in the cylinder block, spark plugs mounted in the cylinder head extensions, and timing mechanism for causing the correct intake, compression, explosion and exhaust of the motive fluid whereby the pistons will be reciprocated and the crank shaft will be caused to rotate.

2. An internal combustion engine of the character described, comprising a crank case, a crank shaft extending longitudinally of the crank case and having its ends journaled therein, a cylinder block mounted rigidly to the crank case, said cylinder block having a series of overlapping vertical bores, a partition for every other vertical bore, a piston reciprocally mounted in one of the vertical bores between the partitions, oppositely extending skirt portions formed on each of the pistons, a removable cylinder head for each of the working cylinders, an extension formed on each of the cylinder heads extending into the working cylinders and into the skirted portions of the pistons, packing rings carried by the extensions of the cylinder heads for engaging the inner periphery of the skirted portions of the pistons, a wrist pin for each of the pistons, a connecting rod connecting the wrist pins to the crank shaft, said connecting rods extending into the overlapping vertical bores of the cylinder block adjacent to the partition, intake and exhaust valves mounted within the extensions of each of the cylinder heads, corresponding ports for the intake and exhaust valves communicating with the upper portion of the cylinder heads, spark

plugs mounted in the extensions of the removable cylinder heads, water spaces formed in the cylinder block for dissipating the heat thereof, and timing mechanism for causing the intake and exhaust valves to open and close with the cycle of the engine.

3. An internal combustion engine of the character described, comprising a sectional crank case, a crank shaft extending longitudinally of the crank case and having its ends journaled therein, a cylinder block mounted upon the crank case having a series of overlapping vertical bores, a vertically extending partition between every other vertical bore whereby a working cylinder will be provided having slotted walls communicating with a vertical housing portion, a piston reciprocally mounted in each of the working cylinders, oppositely extending skirts formed on the pistons, a removable cylinder head inserted in the top and bottom of the cylinder block, an inwardly extending extension formed on each of the cylinder heads adapted to extend into the cylinder and into the skirted portion of each of the pistons, piston rings carried by the lower portion of the extensions adapted to form an air tight sliding connection between the skirted portions of the pistons and the extensions of the cylinder heads, intake and exhaust valves mounted in the lower portion of the extensions, communicating chambers within the cylinder head extensions for allowing the inflow and outflow of the gases, spark plugs mounted in the cylinder head extensions, a wrist pin for each of the pistons, a connecting rod having one of its ends connected to the wrist pin and its opposite end connected to a throw of the crank shaft, whereby the connecting rod will be housed in the vertical overlapping bore in the cylinder block, lubricant retaining openings formed in the outer periphery of the piston skirt sections whereby the surface between the cylinder block and the outer periphery of the piston skirted sections will be lubricated, water openings formed adjacent the cylinders within the cylinder block for dissipating the heat from the cylinders, and timing mechanism for causing the correct opening and closing of the intake and exhaust valves.

4. An internal combustion engine of the character described, comprising a crank case, a crank shaft extending longitudinally of the crank case having its ends journaled therein, a cylinder block mounted on the crank case having a series of overlapping vertical bores, a separating partition extending across alternating vertically extending cylinder bores whereby adjoining housings are formed opposite each working cylinder, a piston reciprocally mounted within each working cylinder and having oppositely extending skirt portions, lubricant openings formed in the outer peripheral walls of the

piston and piston skirt sections for lubricating the surface between the working cylinder and the piston, a wrist pin carried by the piston having its ends extending into the vertical housing adjacent the partition, each wrist pin having connected to its end a connecting rod adapted to lie in the same plane with the partition and in the housings, the opposite end of the connecting rod being adapted to be secured to similar throws of the crank shaft, a removable cylinder head for each end of the working cylinder, an extension formed on each of the cylinder heads extending into the cylinder and into the skirted portion of the pistons, piston packing rings carried by the lower end of each of the extensions adapted to seal the lower end of the extension within the skirted portion of the pistons, intake and exhaust valves carried by the lower portion of the cylinder head extensions, ports and chambers for each of the valves communicating with the upper portion of the cylinder heads adapted to be associated with corresponding manifolds, and spark plugs mounted in the cylinder head extensions.

In testimony whereof I affix my signature. 70
FRANK FRITZ.

5 piston and piston skirt sections for lubricating the surface between the working cylinder and the piston, a wrist pin carried by the piston having its ends extending into the vertical housing adjacent the partition, each wrist pin having connected to its end a connecting rod adapted to lie in the same plane with the partition and in the housings, the opposite end of the connecting rod being adapted to be secured to similar throws of the crank shaft, a removable cylinder head for each end of the working cylinder, an extension formed on each of the cylinder heads extending into the cylinder and into the skirted portion of the pistons, piston packing rings carried by the lower end of each of the extensions adapted to seal the lower end of the extension within the skirted portion of the pistons, intake and exhaust valves carried by the lower portion of the cylinder head extensions, ports and chambers for each of the valves communicating with the upper portion of the cylinder heads adapted to be associated with corresponding manifolds, and spark plugs mounted in the cylinder head extensions.

10 5. An internal combustion engine of the character described, comprising a sectional crank case, a crank shaft having its ends journaled in one section of the crank case, a cylinder block having a series of vertical overlapping bores mounted on the crank case, a piston reciprocably mounted within each of the alternate overlapping bores, lubricant openings formed on the piston, oppositely extending skirt sections formed on the piston, a wrist pin extending through the piston, a connecting rod for each end of the wrist pin having one of its ends secured thereto and its opposite end secure to a double throw of the crank shaft, whereby each of the connecting rods will be housed within alternate vertical bores in the cylinder block, a removable cylinder head for each of the working cylinders of the cylinder block, an inwardly extending cylindrical member formed integral with each of the cylinder heads, a partition mounted within the cylindrical member adapted to form a support for valve gearing, said valve gearing including intake and exhaust valves suitably journaled in the partition, intake and exhaust ports communicating with the intake and exhaust valves, and spark plugs mounted in the partitions.

15 6. An internal combustion engine of the character described, comprising a crank case, a crank shaft having its ends journaled in the crank case, a cylinder block having overlapping vertical bores open at both ends, alternate bores being provided with transverse partitions, pistons reciprocably mounted in the other bores, oppositely extending skirts formed on the pistons, a cylinder head for each open end of the working cylinders having an extension projecting into the cylinder

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