No. 664,486. Patented Dec. 25, 1900.

A. LESTRADE.

ROTARY MOTOR.

(Application filed Sept. 25, 1900.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 1.

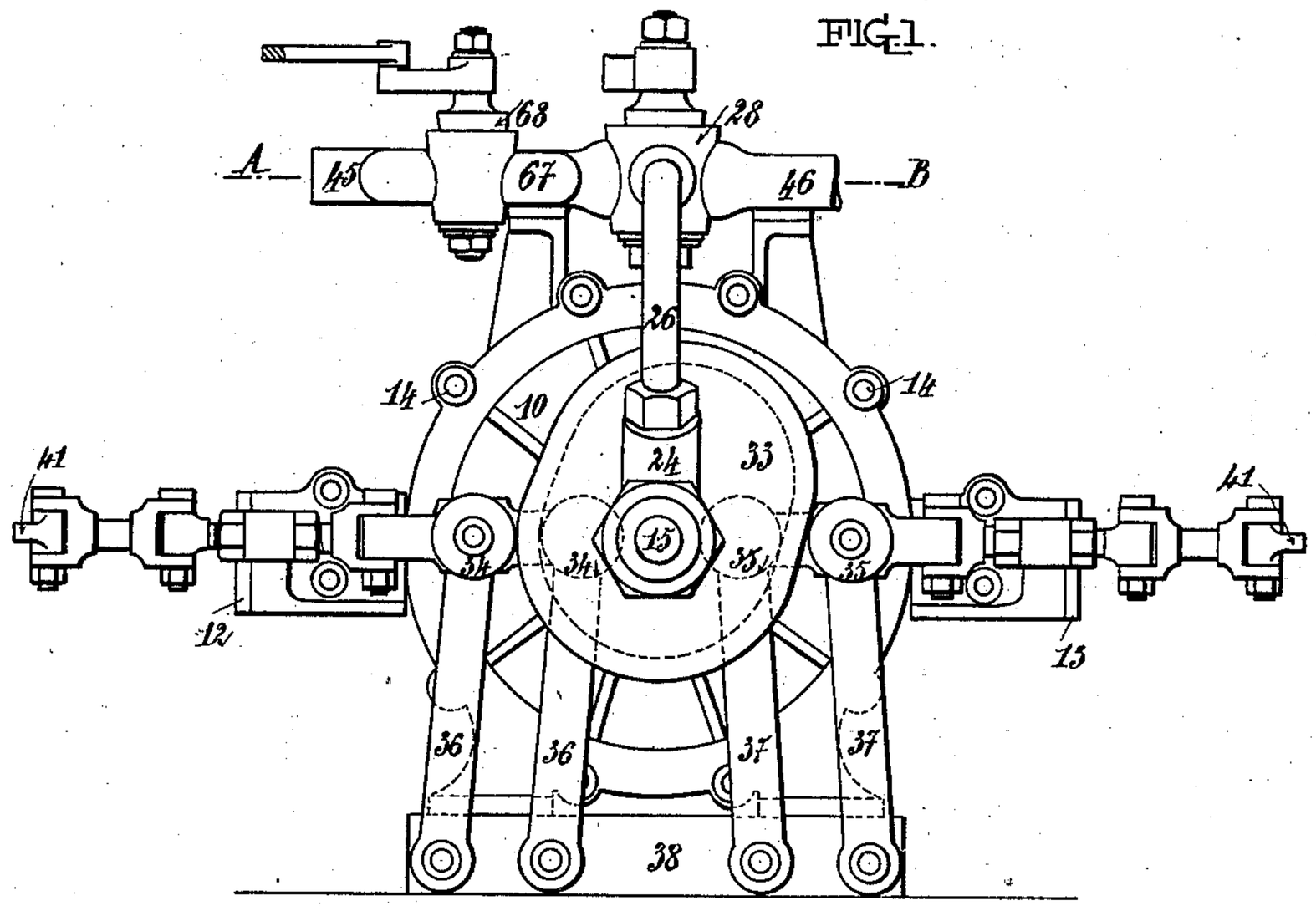

FIG. 2

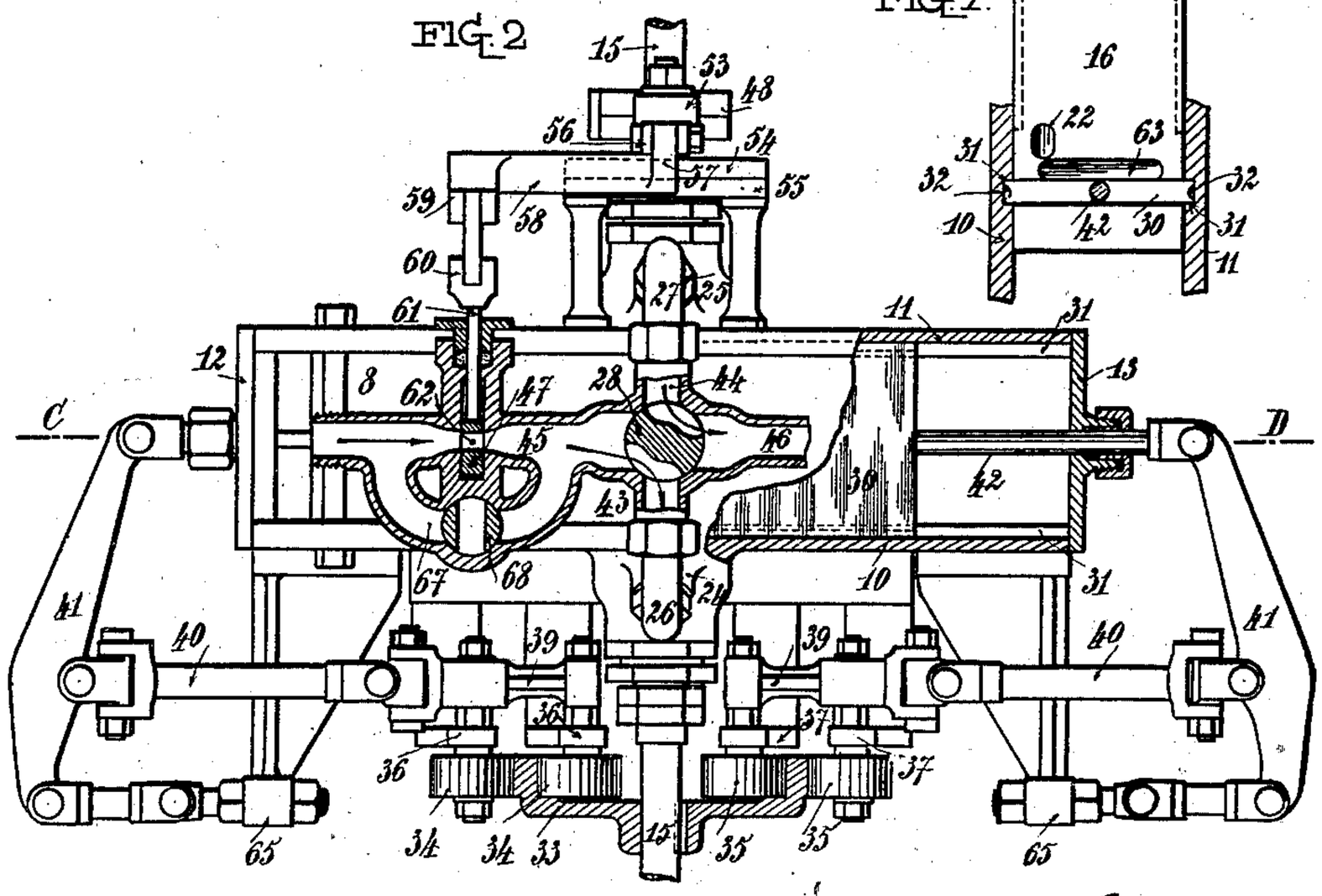

FIG. 7.

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FIG. 3. FIG. 6.

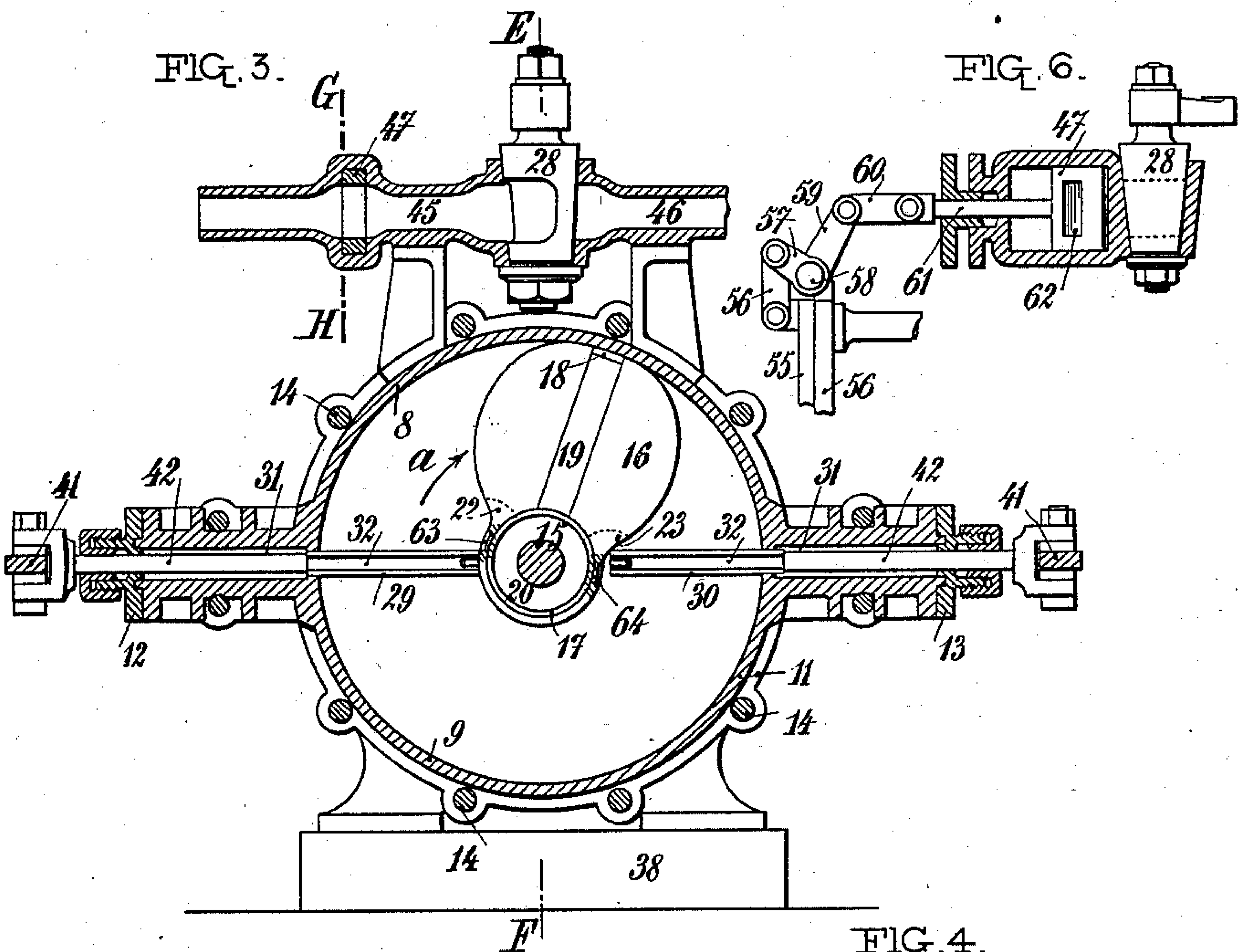


FIG. 5.

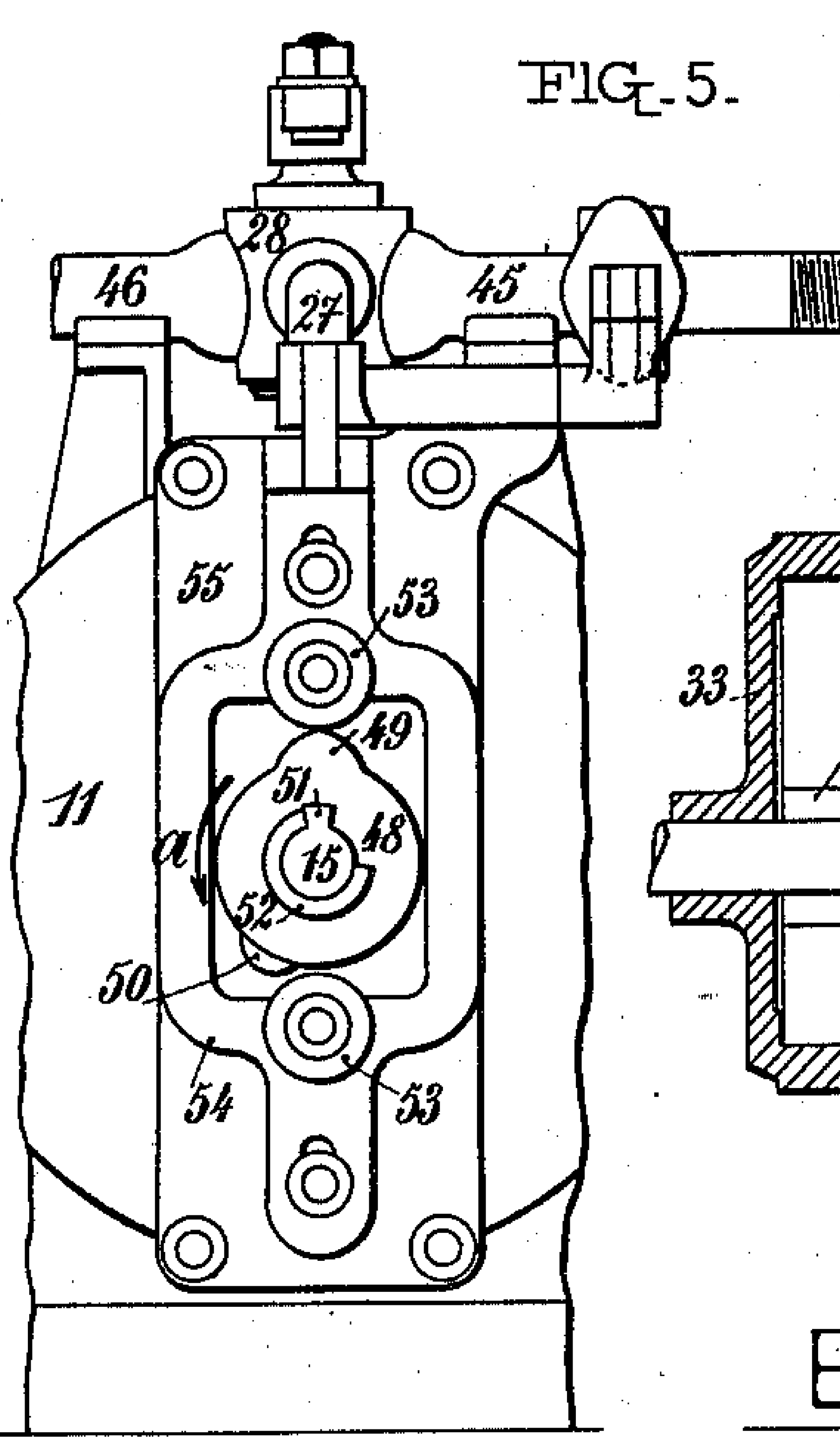
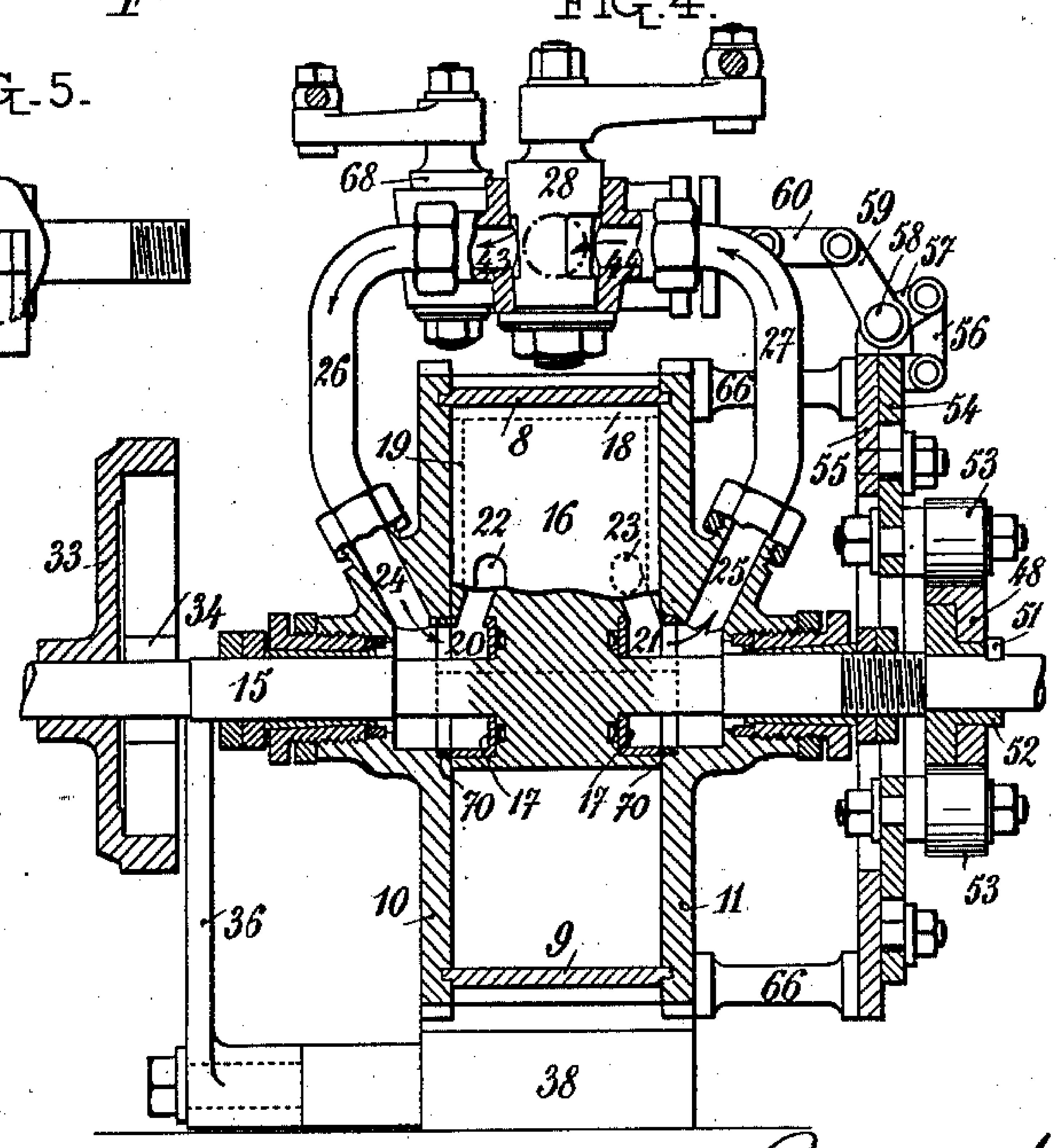


FIG. 4.



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UNITED STATES PATENT OFFICE.

AUGUSTE LESTRADE, OF VIC EN BIGORRE, FRANCE.

ROTARY MOTOR.

SPECIFICATION forming part of Letters Patent No. 664,486, dated December 25, 1900.

Application filed September 25, 1900. Serial No. 31,032. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTE LESTRADE, a citizen of the Republic of France, residing at Vic en Bigorre, Hautes-Pyréneés, France, have invented certain new and useful Improvements in or Relating to Rotary Motors, (for which I have made application for Letters Patent in France, No. 297,871, dated March 10, 1900,) of which the following is a specification.

The present invention relates to a variable expansion rotary motor and is illustrated in the accompanying drawings, in which—

Figure 1 is an elevation. Fig. 2 is a plan view, partly in section, on the line A B of Fig. 1. Fig. 3 is a longitudinal vertical section on the line C D of Fig. 2. Fig. 4 is a transverse section on the line E F of Fig. 3. Fig. 5 is a partial elevation of the opposite side of the motor to that shown in Fig. 1. Fig. 6 is a detail view taken on the line G H, Fig. 3; and Fig. 7 is a detail view.

The cylinder of the motor is formed by the combination of six parts in pairs symmetrically arranged relatively to the axis of the motor—*i. e.*, two circular walls 8 and 9, two lateral plates 10 and 11, and two head or end plates 12 and 13. The walls 8 and 9 have internally a semicircular cylindrical surface and two flat outwardly-projecting surfaces at either end, both lying in the same plane and parallel with the axis of the cylinder. These two side plates are provided with flanges or ribs which engage in corresponding grooves in each of the lateral plates 10 and 11, as shown in Fig. 4. The connection of the two walls 8 and 9 with the plates 10 and 11 is effected by means of bolts 14 in such a manner as to form a central cylinder and two rectangular spaces on opposite sides of the latter.

The plates 10 and 11 are provided in the center with holes through which extends the motor-shaft 15, to which a piston or blade 16 is attached and which revolves in the cylinder. This piston 16 is formed of a hollow or solid mass connected with the shaft 15. This mass from its periphery or outer end has a determined curvature extending from above the center of the nave to the inner surface of the walls of the cylinder. The width of the piston 16 is such that it can just move between the two plates 10 and 11, while its hub carries segments 17, combining with rings 70 on which they bear, these rings being located in recesses in the plates 10 11 in order to prevent the fluid from escaping, as will be explained hereinafter. The part of the periphery of the piston 16, Fig. 7, in contact with the cylinder is provided with segments 18, other segments 19 being arranged radially on the other side of the piston in contact with the plates 10 and 11. These segments 17, 18, and 19 insure the fluid-tightness of the chamber containing the fluid.

In the hub of the piston 16 two annular recesses are arranged which coincide with two similar annular recesses in the side plates 10 and 11, thus forming spaces 20 and 21, into one or other of which, according to the direction of motion of the motor, the driving fluid is admitted. One of these spaces 20 communicates with the interior of the cylinder through a passage 22, made in one side of the piston near the hub. The other space 21 communicates with the cylinder through another passage 23, made on the opposite side of the piston to the orifice 22. The annular spaces 20 and 21 are provided externally to the plates 10 and 11 with tubes 24 and 25, which communicate, respectively, by means of pipes 26 and 27 with a distributing-tap 28, the action of which will be described hereinafter.

In the rectangular spaces formed by the walls 8 and 9 of the cylinder slides 29 and 30 are arranged. The length of these slides in a direction perpendicular to the shaft 15 of the piston is a little greater than the distance between the hub and the internal periphery of the cylinder. They are guided in their movements in groove 31 in the plates 10 and 11, Figs. 2 and 7. Grooves 32 are formed in the sides of the slides themselves to facilitate the movement of the latter by the free circulation of fluid in the rectangular spaces in which they work. The rectangular spaces adjoining the cylinder wherein the slides 29 and 30 work are closed at their ends by the end plates 12 and 13, provided with stuffing-boxes for the spindles of said slides. These slides 29 and 30 bear at their inner ends against the rings 70, with the object of preventing the fluid from passing between the annular spaces 20 and 21 and the grooves 32

of the said slides. The movement of the slides is such that they close and open alternately to allow the passage of the piston and so that the corresponding surface of one of them is always in perfect contact with the cylindrical periphery of the hub of the piston during the period of admission of the fluid, so as to form a chamber, the fixed parts of which are constituted, first, by the walls of the cylinder and, secondly, by one of the slides and the movable part by the side of the piston upon which the fluid acts.

The movement of the slides is produced in the following manner: On the motor-shaft 15, outside the plate 10, a double-faced cam 33 is keyed, against which bear inner and outer pairs of friction-rollers 34 34 and 35 35, carried by levers 36 36 and 37 37, articulated at their other ends to the base 38 of the motor. The friction-roller supports are connected together by means of a link 39, which in turn is connected to another link 40, attached to a balance-beam 41, one arm of which is connected with the rod 42 of the slides 29 and 30 and the other to a support 65, fixed to a convenient part of the plate 10. It will now be seen that the movement imparted by the cam 33 to the friction-rollers is transmitted to the beam 41, and thereby to the slides 29 and 30, to an extent which corresponds with the extent of movement imparted to the beam. Furthermore, it is evident that the displacement movement of the slides 29 and 30 is preferably synchronous with the rotation of the piston, the curve of the periphery of which being such as to obtain this result without there being any friction of the slides upon the piston, since they only form a hermetical joint upon the cylindrical part of the hub.

This motor is constructed with variable expansion, and the distribution of the fluid takes place as follows: The distribution-tap 28 is provided not only with tubular passages 43 and 44, connected, respectively, to the tubes 26 and 27, but also with other connections, one of which, 45, is for admission, and the other, 46, for discharge, of motive fluid. Within the tube 45 there is arranged a damper or slide 47, which has an intermittent motion given to it by the following arrangement: On the shaft 15 is mounted a cam 48 with two projections 49 and 50 at a variable angle, according to the direction of rotation of the motor, Fig. 5. This cam 48 is involved in the rotary movement of the shaft 15 by a shoulder or projection 51, integral with or rigidly secured to the shaft 15 and adapted to engage one or the other side of a stop or projection 52, which projects from the cam 48, according to the direction of rotation of the shaft. This arrangement of the cam 48 upon the shaft 15 enables the action of the projections 49 and 50 to be reversed by changing their angle with respect to the position of the piston 16. In their rotating movement the cam-surfaces 49 50 engage with friction-rollers 53, mounted on a slotted guide 54, which latter is movable upon a guide-plate 55, connected to the motor-cylinder by rods 56. Upon the upper end of the guide-plate 54 a connecting-rod 56 is attached, which by means of levers 57 and 59, mounted upon a shaft 58, together with a link 60, transmits the movement caused by the displacement of the guide 54 to the rod 61 of the slide 47. The action of one of the cam-surfaces 48 upon the guide 54 will correspond to a certain position of the piston 16, whereby the passage of the fluid through the opening 62 of the slide is permitted, which passage will be closed when the other cam-surface acts upon the guide in the opposite direction. The passage of the steam or other fluid for working the motor in the direction indicated by the arrows in Figs. 3 and 5 is indicated by arrows in Figs. 2 and 4, according to which the admission of the fluid takes place through the conduit 26, chamber 20, and passage 22 of the piston 16 and the escape of the fluid through the passage 23, chamber 21, conduit 25, and discharge-pipe 46, Figs. 2 and 4.

In order to facilitate the escape of the fluid which after its action is shut in behind the piston 16, the latter is provided with grooves 63 64 for this purpose, which are arranged parallel to the shaft 15 and in the cylindrical part of the piston-hub. These grooves 63 64 are symmetrically arranged on each side of the shaft 15 in such a manner that their stops opposite to the mass of the piston are brought into a plane perpendicular to the plane passing through the axis of the said mass, so as to be situated entirely to the side of the space, the latter therefore being open for the free escape of the fluid. Suppose the piston 16 is in its upper position—*i. e.*, at right angles to the plane of the slides 29 30—the fluid which has acted will be shut in between the face of the piston and the lower face of the slide 30. The slide 29 can then close without effort, since the steam acts upon both of its faces with equal pressure, which, however, will not evidently be the same with the slide 30, the upper face of which being subject only to atmospheric pressure, while its lower face is subject to the same pressure as the piston 16. Thus, naturally, a great wear of the groove 31 would result, and a great effort would be necessary to cause the cam 33 to operate the slide 30 when it is to be opened. Owing to the arrangements of the grooves 63 64 upon the piston-hub 60, however, one of them, 64, comes into operation when the piston 16 turns during a short interval before the slide 30 moves back. During this time the steam contained in the cylinder-space situated beneath the slide 30 escapes through the passage 64 and passes above the slide 30. Hence an immediate balance of pressure takes place upon both sides of the slide 30, which can then be moved without effort by the cam 33. It will be understood that as the parts of this motor are arranged

symmetrically it will be sufficient to turn the tap 28 in the opposite direction to that already described in order to reverse the direction of rotation of the motor.

In order to start the motor, whatever the position of the piston may be and in the case when the passage of fluid is cut off by the slide 47, the two parts of the tube 45, which are separated by the slide 47, are connected by a conduit 67, in the center of which is a tap 68 or a valve, which can be actuated at will when the motor is to be started.

In order to regulate the speed of the motor, the slide 47 for the admission of driving fluid can be controlled by a governor device of any kind, interposed between the cam 48 and the rod 61 of the slide 47. By this means the width of the opening for the admission of driving fluid could be varied according to the work to be performed by the motor.

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

A rotary motor with variable expansion comprising a piston rotating in a cylinder formed by two connected similar casings, two radially-acting slides in the cylinder, a cam on the motor-shaft for actuating said slides to bear against and form a tight joint with the hub of the piston, a second cam on the motor-shaft, having two projections, a slotted slide around said cam and means connected thereto for operating a slide in the driving-fluid-admission conduit and a two-way cock in the latter for admitting the driving fluid to the cylinder to drive the motor in one or the other direction, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

AUGUSTE LESTRADE.

Witnesses:

ALBERT LEVESSEM,

LOUIS NELLIGER.