

No. 705,489.

Patented July 22, 1902.

J. ULRICH.  
MOTOR.

(Application filed Oct. 28, 1901.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1

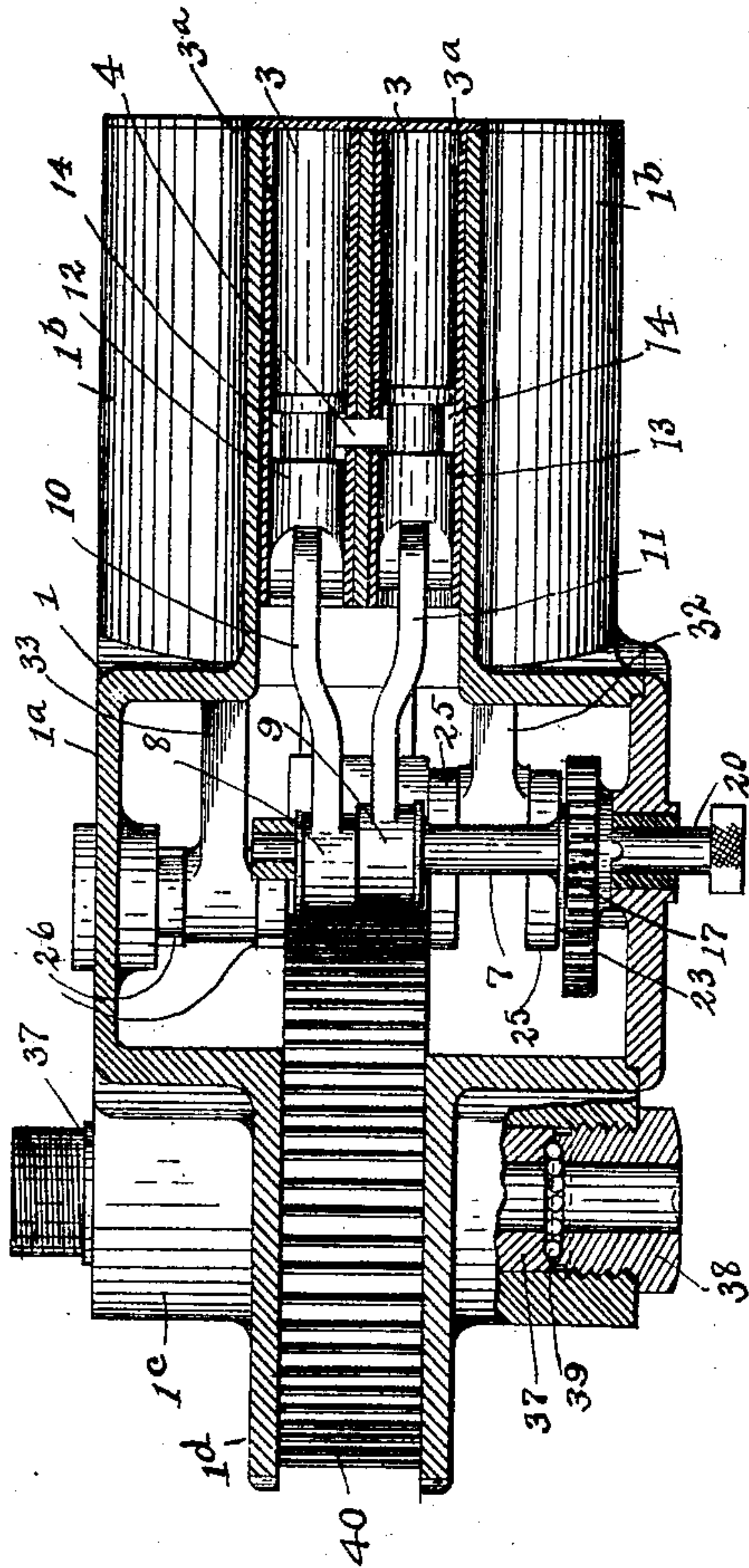
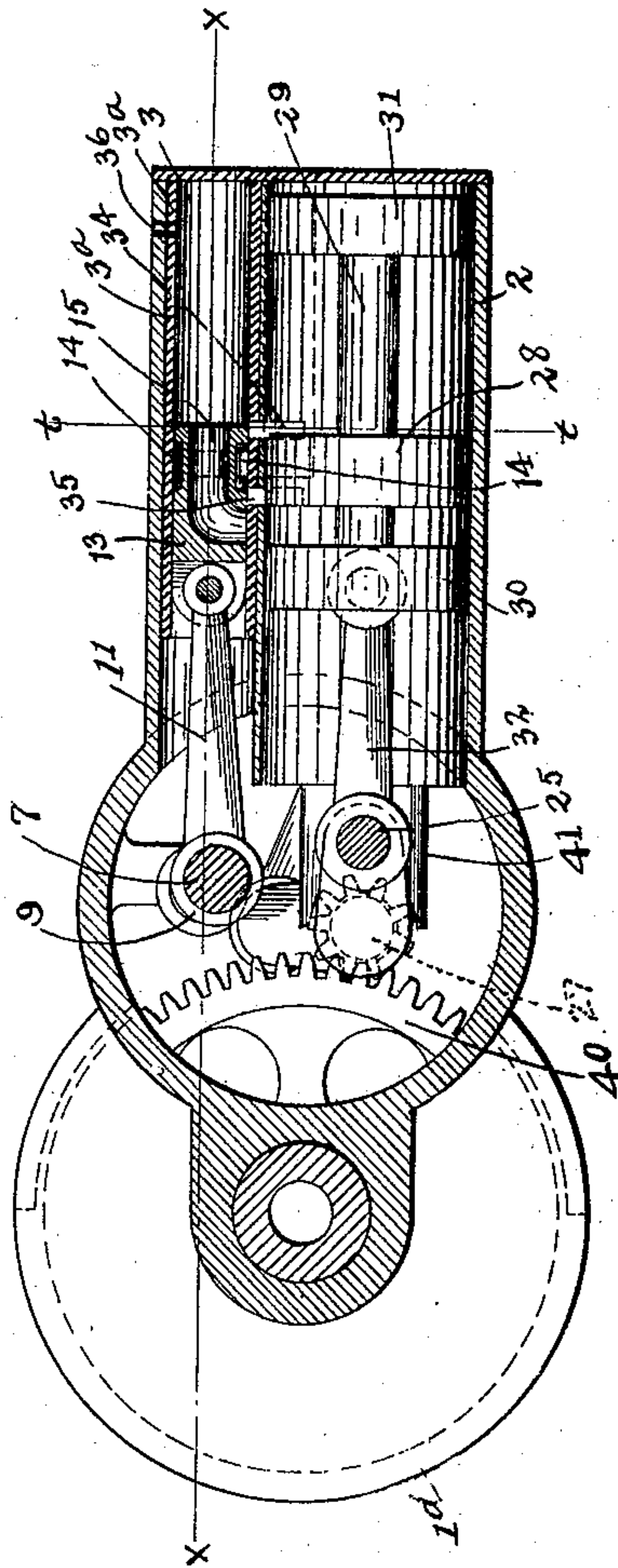


Fig. 2



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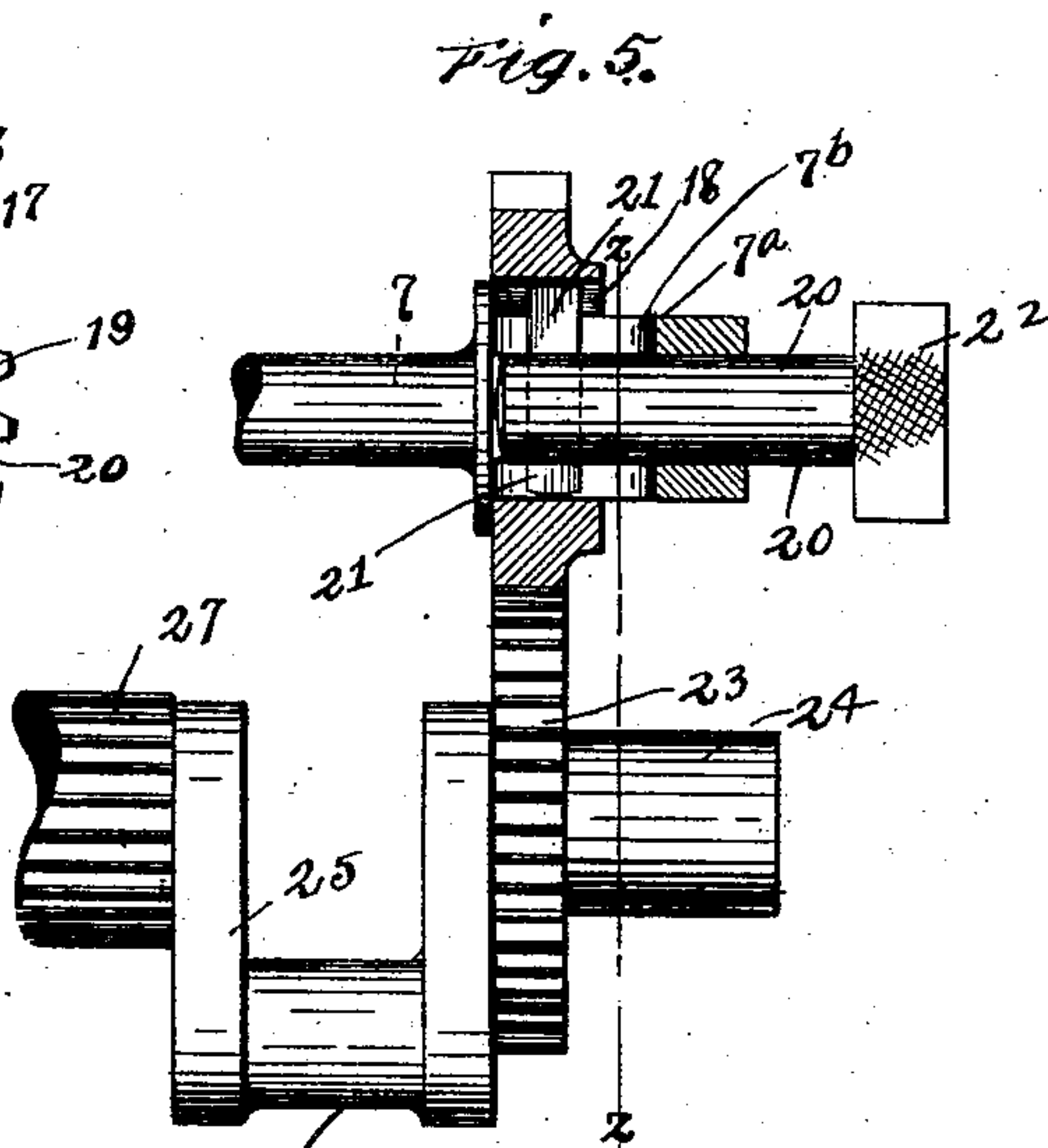
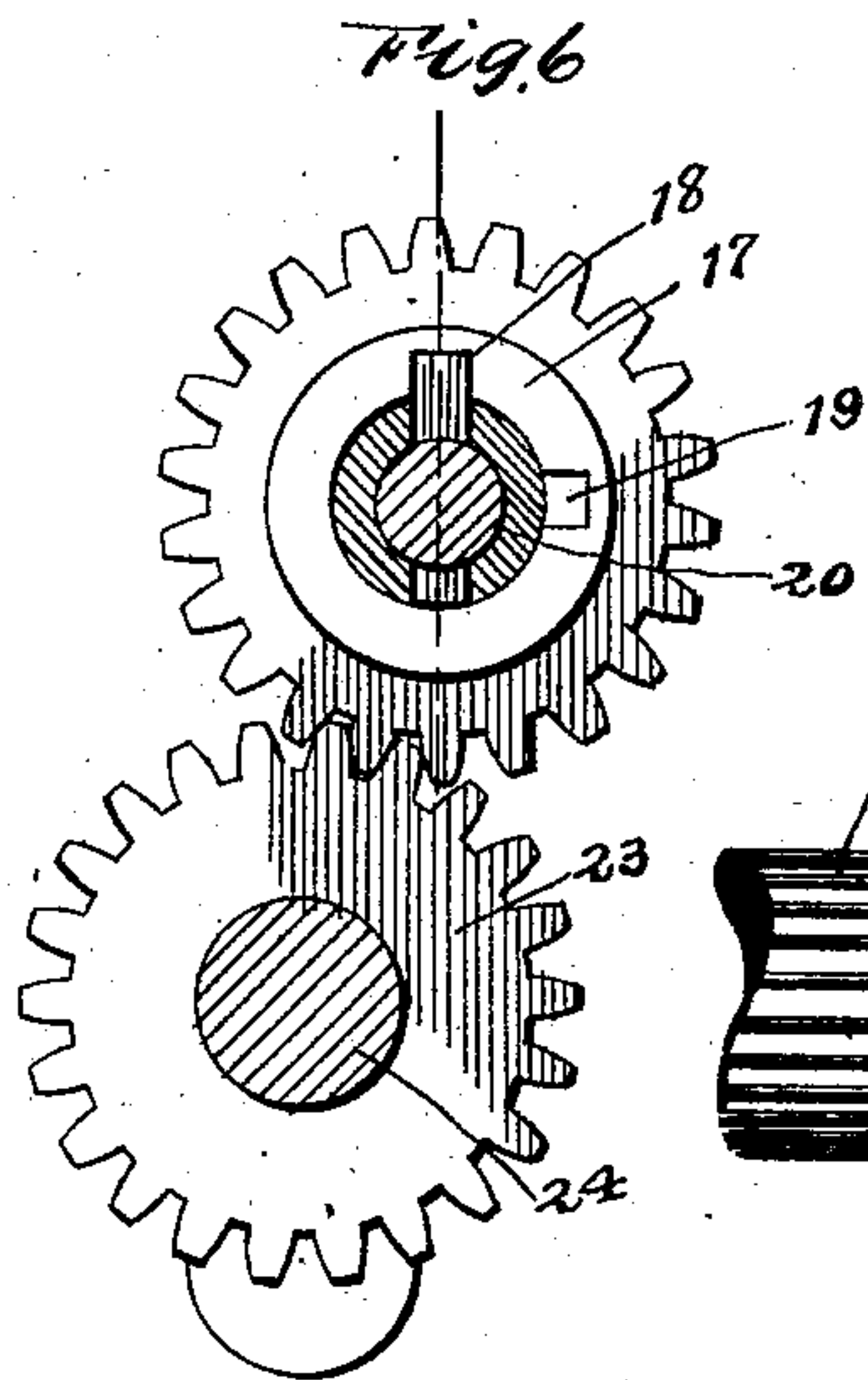
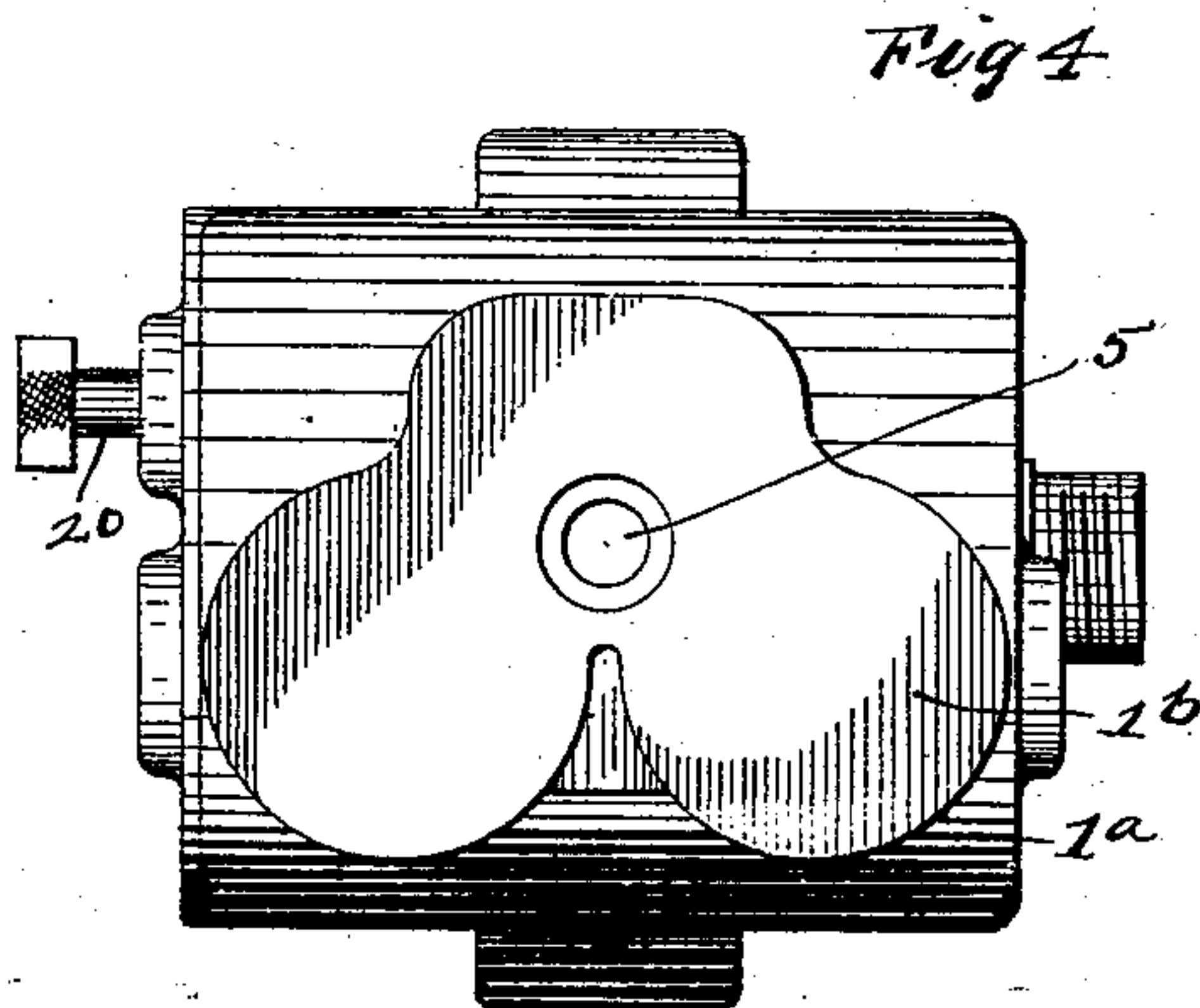
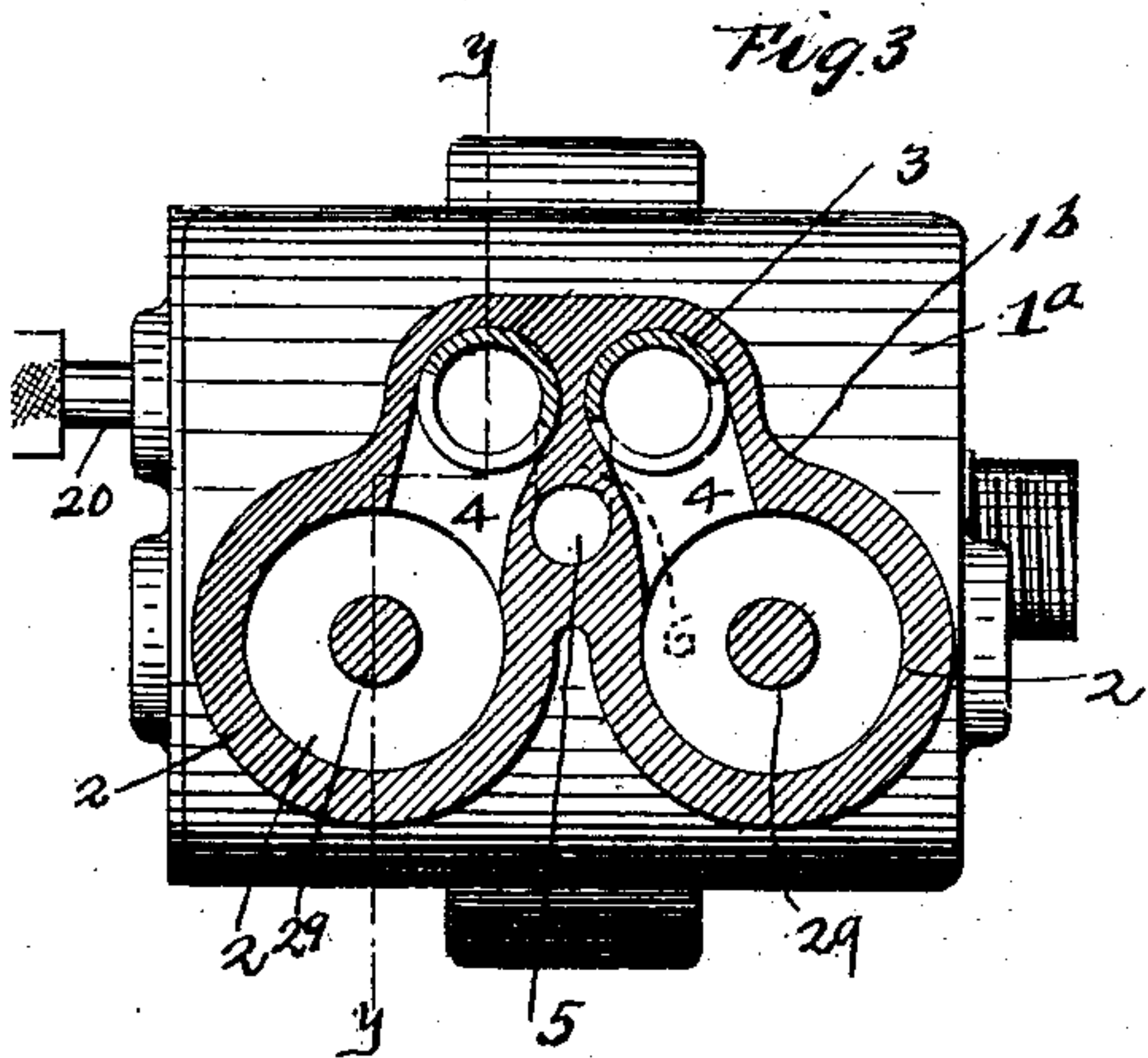
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# UNITED STATES PATENT OFFICE.

JOHN ULRICH, OF COLUMBUS, OHIO.

## MOTOR.

SPECIFICATION forming part of Letters Patent No. 705,489, dated July 22, 1902.

Application filed October 28, 1901. Serial No. 80,259. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN ULRICH, a citizen of the United States, residing at Columbus, in the county of Franklin and State of Ohio, have invented a certain new and useful Improvement in Motors, of which the following is a specification.

My invention relates to the improvement of motors, and has particular relation to air-motors; and the objects of my invention are to provide an improved drill or other tool-operating motor of superior construction and arrangement of parts, to provide improved means for reversing the motor, and to produce other improvements the details of which will be more fully pointed out hereinafter. These objects I accomplish in the manner illustrated in the accompanying drawings, in which—

Figure 1 is a sectional view on line *xx* of Fig. 2. Fig. 2 is a sectional view taken on two planes, as indicated by line *yy* of Fig. 3. Fig. 3 is a transverse section on line *tt* of Fig. 2. Fig. 4 is a rear end elevation. Fig. 5 is an enlarged detail view, partly in elevation and partly in section, illustrating the eccentric driving and reversing mechanism; and Fig. 6 is a sectional view on line *zz* of Fig. 5.

Similar numerals refer to similar parts throughout the several views.

In carrying out my invention I employ a motor-casing 1, the latter having an enlarged central portion, as indicated at 1<sup>a</sup>, and a reduced rear end portion 1<sup>b</sup>. The forwardly-extended portion of the casing in front of the portion 1<sup>a</sup> consists in a transverse shaft bearing head 1<sup>c</sup>, having its central portion, as indicated at 1<sup>d</sup>, enlarged to form a casing for a gear-wheel, which is employed for the purpose hereinafter set forth. In the construction of the rear portion 1<sup>b</sup> of the motor-casing I form the same, as indicated more clearly in Figs. 3 and 4 of the drawings, with two parallel power-cylinders 2, while above the latter are arranged two smaller parallel valve-cylinders 3, each of these valve-cylinders 3 having a fixed internal casing 3<sup>a</sup>. Each of the valve-cylinders is connected with the corresponding power-cylinder through the medium of a port 4, this port being located, as shown, about midway of the length

of said cylinders, and each of said ports communicating with an air-inlet 5, which extends through the rear end of the casing portion 1<sup>b</sup> and from which leads upward to said valve-cylinders, as shown in dotted lines in Fig. 3 of the drawings, a port 6.

Journaled transversely in the upper portion of the casing portion 1<sup>a</sup> is a shaft 7, which I will refer to as the "valve-shaft," and on this shaft are mounted eccentrically, one in advance of the other, the eccentrics or heads 8 and 9 of rearwardly-extending valve-driving arms 10 and 11, the latter extending, respectively, into the valve-cylinders 3 and being pivotally connected with valves 12 and 13, which fit and slide within said cylinders. Each of these valves 12 and 13 is formed near its rear end portion with a peripheral groove or continuous recess 14. In the construction of each of the valves 12 and 13 I form therein a central and angular port or passage 15, the latter leading through the outer end of the valve-body and having its inner end leading laterally through said valve adjacent to the inner end of the latter.

The outer end of the valve-shaft 7 is provided with an enlarged hollow extension 7<sup>a</sup>, which is shown more clearly in Fig. 5. This extension 7<sup>a</sup> is provided adjacent to the body of the shaft 7 with a slotted opening or mortise 7<sup>b</sup>, and on said slotted portion of the extension 7<sup>a</sup> is mounted loosely a gear-wheel 17, this gear-wheel having, as indicated more clearly in Fig. 6 of the drawings, formed therewith on its inner side key-receiving notches 18 and 19, the latter being arranged at right angles with each other. Within the hollow or bore of the extension 7<sup>a</sup> is inserted a close-fitting yet removable pin 20, the latter having on its inner end portion a transverse key 21, the projecting end portions of said key extending within the slotted opening 7<sup>b</sup> of the shaft extension 7, and one of said ends being sufficiently long to extend in the desired one of the gear-wheel notches 18 or 19. On the outer end of the pin 7 I provide a suitable enlargement or finger-head 22. The gear-wheel 17 gears on its under side with a gear-wheel 23, which is carried on a double-crank-carrying shaft 24, the latter being journaled below the shaft 7 and having the cranks thereof numbered, respec-



tively, as 25 and 26. These cranks are arranged one ahead of the other on the shaft and respectively opposite the power-cylinders 2. Between the cranks I provide the shaft 24 with a pinion 27, the latter being partially indicated in Figs. 5 and 2 of the drawings.

Within each of the power-cylinders 2 I provide a central fixed partition 28, the latter having a central opening therethrough, through which is adapted to work a piston-rod 29, the latter carrying on its opposite ends and on opposite sides of the partition 28 piston-heads 30 and 31. The forward piston-heads 30 are connected, through the medium of arms 32 and 33, with the crank-pins of the cranks 25 and 26. Adjoining and on opposite sides of each of the central partitions 28 each of said power-cylinders is provided with ports 34 and 35, which lead into the adjoining valve-cylinder. An exhaust-port 36 is formed in the outer end portion of each of the valve-cylinders.

Within the forward casing portion *c'* is journaled a suitable shaft 37, with the outer projecting end of which is adapted to be engaged a tool-holding chuck. Into one end of the cylindrical casing portion 1<sup>c</sup> is adjustably inserted an end-thrust bearing-block 38, between which and the adjoining end of the shaft 37 are arranged bearing-balls 39. Upon the shaft 37 and within the casing enlargement 1<sup>d</sup> is mounted a gear-wheel 40, the teeth of which mesh with those of the pinion 27. Beneath the central part of the casing portion 1<sup>a</sup> I suitably secure a block 41, the recessed outer end of which, as indicated more clearly in Fig. 2 of the drawings, is adapted to receive half the pinion-wheel 27, and through frictional engagement of the ends of the teeth of said wheel with the surface of said recessed portion the pinion 27 is prevented from being forced rearward by pressure of the teeth of the gear-wheel 40.

In operation the air under pressure enters the inlet-passage 5, passing out through the port 4 and about the reduced or recessed portions 14 of the valves 12 and 13. While it is obvious that the reciprocating motion of the valves 12 and 13, as well as the pistons of the power-cylinders, move successively, I will describe only in detail the operation of that power-piston which is shown in Fig. 2 of the drawings. Assuming that the port 35 is in communication with the recess 14 of the valve 13 and that said port 35 is also in communication with the cylinder 2 in front of the partition 28 and that the port 34 is by the valve 13 cut off from communication with the recess 14, but in communication with the cylinder 3, it is obvious that the air which passes into the cylinder 2 through the port 35 will force the head 30 forward. This forward movement of the head 30 will, through the movement of the arm 32 and its connection with the crank 25, result in imparting a rotary motion to the crank-shaft 24, which through the gear connection

of the valve-shaft 7 will result in moving the valve 13 rearward until its recess 14 is in communication with the port 34 and the port 35 is in communication with the passage 15. This operation admits the air to the cylinder 2 in rear of the partition 28 and serves to drive the outer piston-head 31 toward the rear end of the cylinder and to impart an outward movement to the crank-operating arm 32. As the piston-head 30 reaches its outward limit and begins its return movement it is obvious that the air behind said head may exhaust through the port 35 and communicating valve-passage 15, the exhaust thence passing outward through the port 36. In the forward movement of the head 31 the air contained in the cylinder in rear of the partition 28 is permitted to exhaust through the port 34 into the cylinder 3, and thence out through the port 36. It will readily be understood that the rearward or inward movement of the piston 29 will result in finally closing the exhaust-passage 15 and again opening the port 35 to communication with the recess 14, and thereby driving the piston 29 forward again. It will thus be seen that through the successive operations of the pistons of the air-cylinders the valves 12 and 13 will be caused to control the inlet of air to said power-cylinders. The rotary motion imparted to the crank-shaft, and consequently to its pinion 27, results in a rotation of the gear-wheel 40 and in a consequent rotation of the tool-carrying shaft 37.

In order to change the relative positions of the valve-eccentrics 8 and 9 with the cranks, and thereby provide for a reversal of motion, the pin 20, which is illustrated more clearly in Fig. 5 of the drawings, may be pulled outward until its key 21 is out of engagement with the notch 18 and the wheel 17, after which said pin may be turned until by the inward movement of said pin its key may be made to engage the notch 19.

From the construction herein shown and described it will be seen that a duplex air-motor is provided through the operation of which a rapid and uniform rotation may be imparted to a tool-holding shaft.

Having now fully described my invention, what I claim, and desire to secure by Letters Patent, is—

In a motor, the combination with a casing having a pair of power-cylinders and a pair of valve-cylinders, the former provided with a central fixed partition and ports on each side of said partition connecting the valve-cylinders with the corresponding power-cylinders and each of said valve-cylinders having an exhaust-port 36 and an inlet-air port connecting with both said valve-cylinders, of a journaled shaft 7, valves 12 and 13 working in said valve-cylinders and having peripheral recesses 14, arms 10 and 11 eccentrically connecting said valves with said shaft 7, a journaled crank-shaft having a gear connection with said shaft 7 and provided with two



cranks, a piston within each of the cylinders  
2, said piston carrying a head on opposite  
sides of the central partition and driving-  
arms connecting said pistons with said cranks,  
5 a rotatably-mounted tool carrying shaft 37 in  
the forward portion of said casing, a gear-  
wheel carried on said shaft and a pinion-

wheel on said crank-shaft gearing therewith,  
substantially as specified.

JOHN ULRICH.

In presence of—

A. L. PHELPS,  
W. L. MORROW.