W. S. ELLIOTT, C. A. CONN & H. B. HOLT.

ROTARY MOTOR.

APPLICATION FILED FEB. 10, 1908.

917,724. **Patented Apr. 6, 1909.**

2 SHEETS—SHEET 1.

Fig. 1.

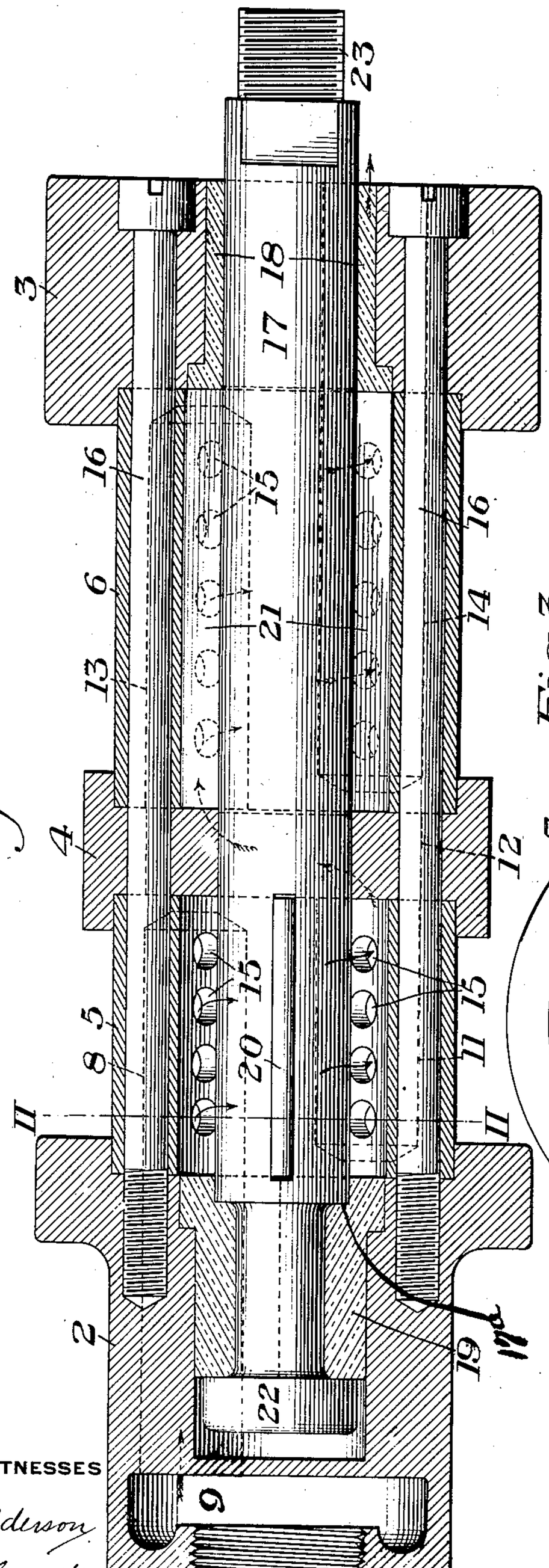


Fig. 3.

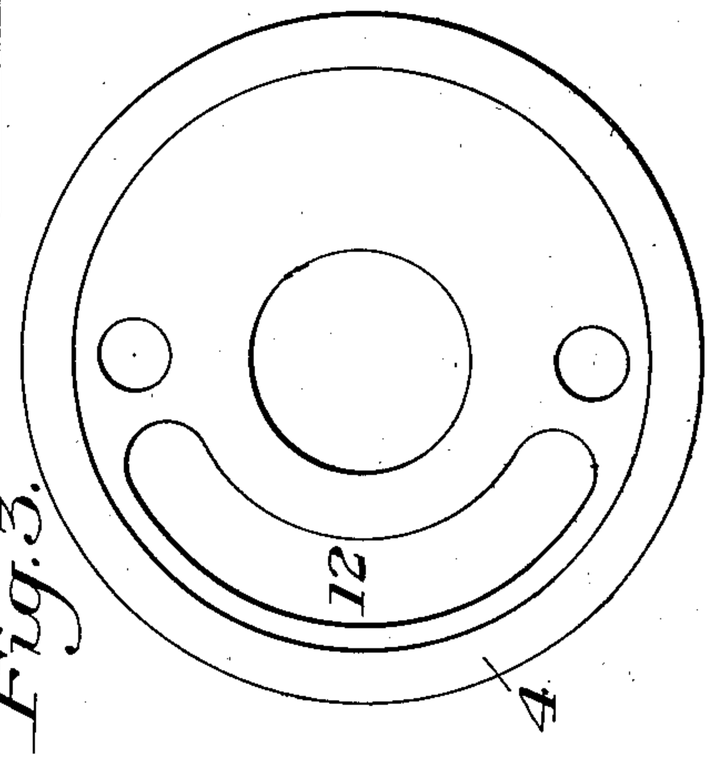
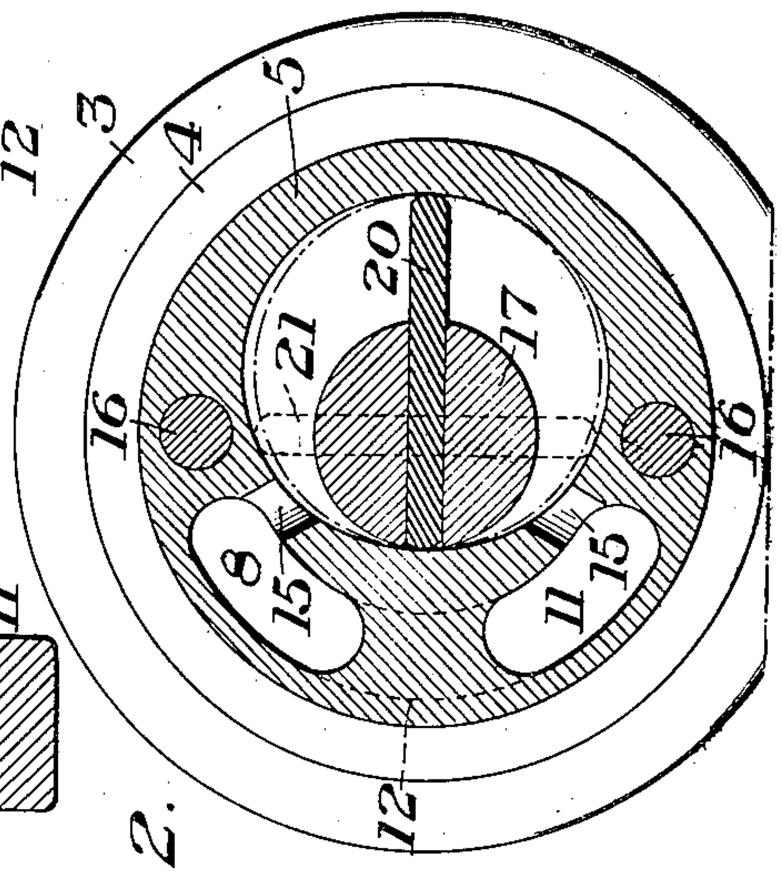


Fig. 2.



WITNESSES

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2 SHEETS—SHEET 2.

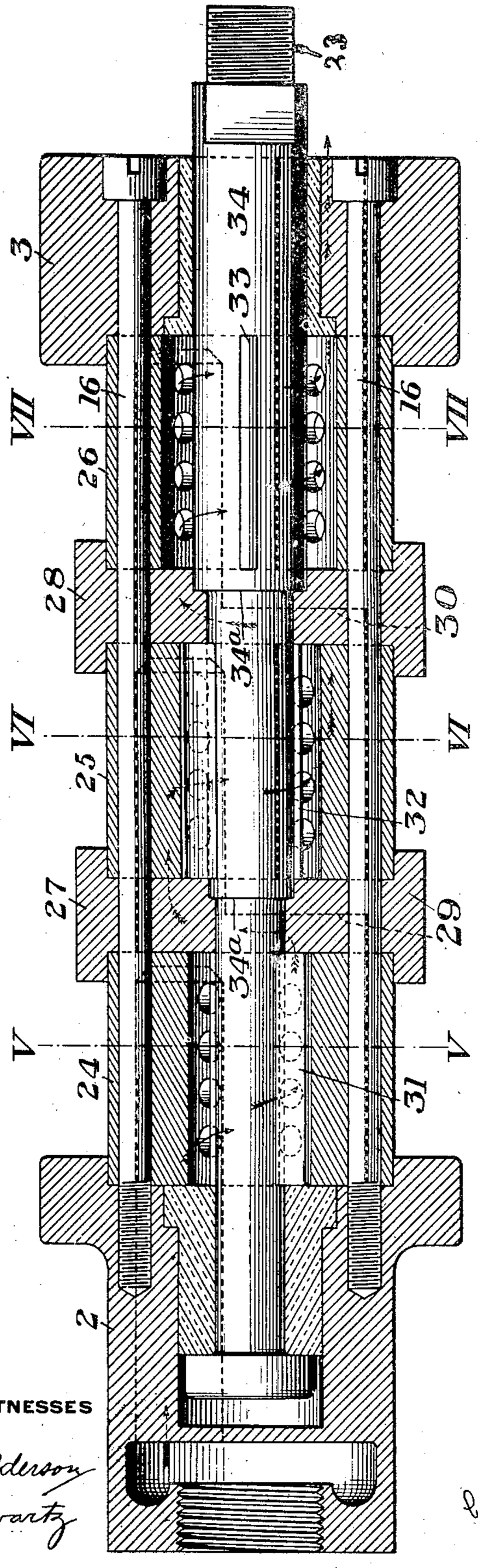

Fig. 4.

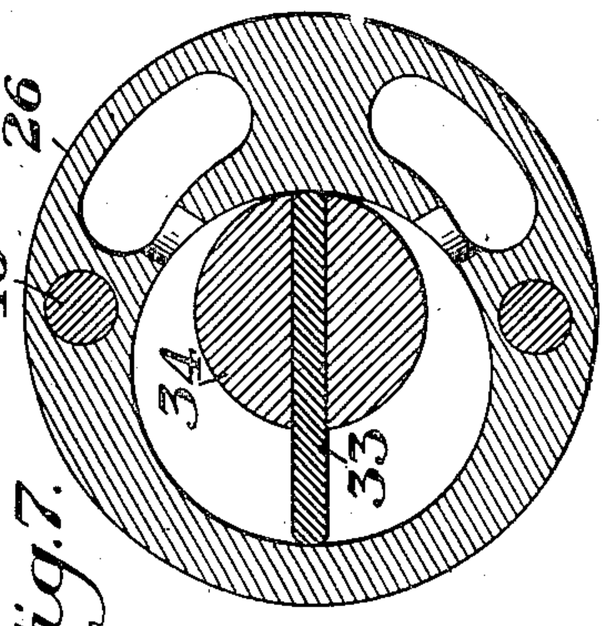

Fig. 7.

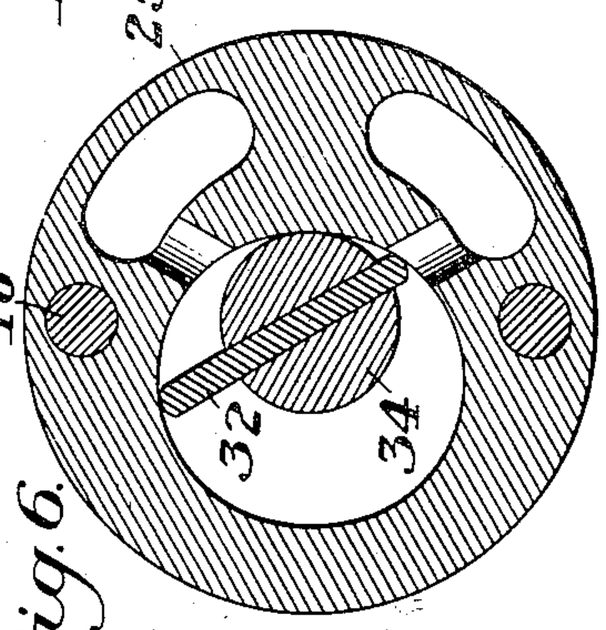

Fig. 6.

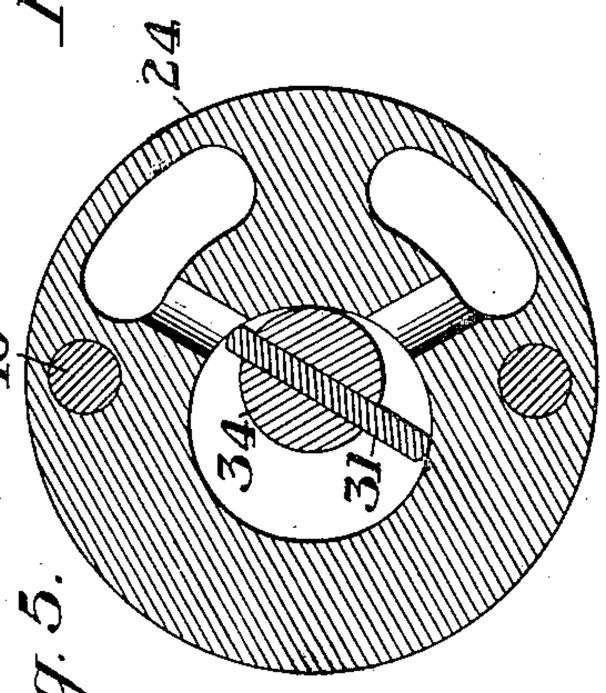

Fig. 5.

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UNITED STATES PATENT OFFICE.

WILLIAM S. ELLIOTT, CHARLES A. CONN, AND HARRIS B. HOLT, OF PITTSBURG, PENNSYLVANIA; SAID CONN AND HOLT ASSIGNORS TO SAID ELLIOTT.

ROTARY MOTOR.

No. 917,724. Specification of Letters Patent. Patented April 6, 1909.

Application filed February 10, 1908. Serial No. 415,044.

To all whom it may concern:

Be it known that we, WILLIAM S. ELLIOTT, CHARLES A. CONN, and HARRIS B. HOLT, all of Pittsburg, Allegheny county, Pennsylvania, have invented a new and useful Improvement in Rotary Motors, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a longitudinal section of one form of motor embodying our invention; Fig. 2 is a cross-section on the line II—II of Fig. 1; Fig. 3 is a plan view of the central head; Fig. 4 is a view similar to Fig. 1 showing a modification; and Figs. 5, 6 and 7 are cross-sections taken respectively on the lines V—V, VI—VI and VII—VII of Fig. 4.

Our invention has relation to rotary motors, and is designed to provide a motor of this class, in which there are no "dead" points, and in which increased efficiency of action and greater economy in the consumption of power are secured.

To this end, our invention consists broadly in a motor having a plurality of cylinders, with a piston shaft common to all the cylinders and having piston blades arranged at an angle to each other, so that at the time the admission ports of one cylinder are closed by the piston, the admission ports of another cylinder or cylinders will be open.

While we have shown our invention as applied to a motor of the compound type, it is equally applicable to motors having two or more high pressure cylinders, as will hereinafter more fully appear.

The precise nature of our invention will be best understood by reference to the accompanying drawings, in which we have shown two different embodiments thereof, it being premised, however, that various changes may be made therein without departing from the spirit and scope of our invention as defined in the appended claims.

Referring first to the form of the invention shown in Figs. 1, 2 and 3, the numeral 2 designates one of the heads of the motor, which is preferably the admission head, and the numeral 3 the head of the opposite end, which is preferably the exhaust head. 4 is an intermediate head between which and the heads 2 and 3 are secured the cylinders 5 and 6. These cylinders are each formed with an eccentrically located piston chamber extending therethrough. In the thickened wall of the cylinder 5 is an admission port 8, whose rear end opens into an admission chamber 9 formed in the rear head 2, said head being provided with a screw-threaded socket 10 or other suitable means for the connection thereto of a motive supply pipe or holders. The cylinder 5 also has a longitudinally extending exhaust port 11, which at its forward end communicates with an arcuate port 12 formed in the intermediate head 4, and which is arranged to connect the exhaust port 11 of the cylinder 5 with a longitudinally extending admission port 13 of the cylinder 6. The cylinder 6 also has a longitudinally extending exhaust port 14, which extends outwardly through the front head 3, as shown in dotted lines in Fig. 1. Each of the longitudinally extending ports 8, 11, 13 and 14 is provided with a plurality of cross-ports 15 which connect them with the respective cylinders. The several heads and the cylinders may be conveniently connected together by long tension screws 16, which extend through the front head 3, the thickened wall of the cylinder 6, the intermediate head 4, and through the thickened wall of the cylinder 5 into the rear head 2, with which they have a threaded engagement. 17 designates a piston shaft, which is journaled in a bushing 18 in the front head, and also in a bushing 19 in the rear head. This piston extends through and is common to both cylinders 5 and 6, being provided with a radially movable blade 20 in the cylinder 5, and with a similar blade 21 in the cylinder 6, the two blades being, however, arranged at different angles. Formed on the inner end of the piston shaft 17 is a thrust head or collar 22, which bears against the inner end of the bushing 19. Said shaft also has a thrust shoulder 17ª.

The operation is as follows:—Air or other motive fluid being supplied to the admission chamber 9 passes into the chamber 7 of the cylinder 5, through the admission port 8 and cross-ports 15, and exhausts through the cross-ports 15 into the exhaust port 11. It then passes through the connecting port 12 in the intermediate head, into the admission port 13, and thence through the cross-ports into the exhaust port 14.

It will be noted that the cylinder 6 is of greater length than the cylinder 5 to compensate for the partial expansion of the motive

fluid admitted thereto. Inasmuch as the piston blades, and their respective cylinders, are at a different angle, it will be seen that pressure is at all times acting upon at least one of the blades so that there are no dead points.

The front end of the piston shaft 17 is provided with a threaded shank 23 for the attachment thereto of the part to be driven.

In the modification shown in Figs. 4, 5, 6 and 7, three cylinders 24, 25 and 26 are arranged in tandem with two intermediate heads 27 and 28, the head 27 having a port 29 which connects the exhaust port of the cylinder 24 with the admission port of the cylinder 25, and the head 28 having a connecting port 30, which connects the exhaust port of the cylinder 25 with the admission port of the cylinder 26. It will be understood that each of these cylinders is provided with longitudinally extending admission and exhaust ports, as clearly shown in Figs. 5, 6 and 7, similar to those described in connection with Fig. 1, said ports being connected with the interiors of the respective cylinders by cross-ports similar to those of Fig. 1. The piston blades 31, 32 and 33 of the three cylinders are all carried by a common shaft 34, and are all set at different angles. This form of motor gives a triple expansion of the motive fluid. Instead of making the cylinders of different lengths, however, to accommodate the different ratios of expansion, the three cylinders are of progressively increasing interior diameters, as shown in Figs. 5, 6 and 7. It will be obvious, however, that the same result may be obtained by forming these cylinders of progressively increasing lengths, as in Fig. 1, also that in the construction shown in Fig. 1, the cylinders may be of the same lengths but of different diameters.

The main advantages of our invention result from the employment of two or more cylinders having their respective pistons arranged at different angles, whereby there are no dead points and the motor is enabled to run steadily at all times; and our invention is in this respect equally applicable to a motor in which two or more high pressure cylinders arranged in tandem are employed, as shown and described in the co-pending application of Edward R. Mills and Charles A. Conn, Serial No. 415,041, of even date herewith. A further advantage of our invention results from the simplicity of the construction and the facility with which the parts may be assembled and removed for repairs.

The motors are of exceedingly compact form, being thus rendered suitable for use in a limited space, such for instance, as for cleaning the interiors of boiler tubes where the motors are carried through the tube with the cleaning tool. These cleaning tools may be attached directly to the threaded shank 23 of the piston shaft. In this form the several heads are made cylindrical and of such a diameter as to enable them to pass through the pipes. The invention is, however, adapted for use for a variety of other purposes.

It will be obvious that our invention is susceptible of various other embodiments, and that the construction of the parts and the manner of securing them together, may be widely varied.

While we have shown the pistons as consisting of single blades, it is obvious that we may employ any suitable construction of blades with a corresponding change in the shape of the interior curves of the cylinder walls.

The motors herein described are particularly adapted for use with compressed air as a motive power, but we do not limit ourselves in this respect.

We claim:—

1. In a compound rotary motor, a plurality of cylinders arranged in tandem, cylinder heads for the ends of each cylinder, a piston shaft concentric with each cylinder, an eccentrically located piston chamber extending through each cylinder, a piston in each chamber connected to the piston shaft, an inlet port extending through each cylinder and having transverse ports connecting the through port with the piston chamber, an exhaust port extending through each cylinder and having transverse ports connecting the through port with the piston chamber, an inlet port in one of the end heads connected to the through inlet port of the first cylinder, an outlet port in the other end head connected to the exhaust port of the last cylinder, and a cross port in each head between adjacent cylinders to connect the exhaust port of one cylinder with the inlet port of an adjacent cylinder; substantially as described.

2. In a compound rotary motor, a plurality of cylinders arranged in tandem, cylinder heads for the ends of each cylinder, piston shaft concentric with each cylinder, an eccentrically located piston chamber extending through each cylinder, an inlet port extending through each cylinder, and having transverse ports connecting the through ports with the piston chamber, an exhaust port extending through each cylinder and having transverse ports connecting the through ports with the piston chamber, a piston in each piston chamber connected to the piston shaft, said pistons being at different angles with relation to the transverse ports, an inlet port in one of the end heads connected to the through inlet port of the first cylinder, an outlet port in the other end head connected to the exhaust port of the last cylinder and a cross port in the head between adjacent cylinders to connect the exhaust port of the one cylinder to the inlet port of the other cylinder to compound the two cylinders; substantially as described.

3. In a compound rotary motor, a plurality of cylinders arranged in tandem, cylinder heads for the ends of each cylinder, a piston shaft concentric with each cylinder and an eccentrically located piston chamber extending through each cylinder, a piston in each chamber connected to the piston shaft, an inlet port extending through each cylinder having transverse ports connecting the through ports with the piston ports, an exhaust port extending through each cylinder, and having transverse ports connecting the through ports with the piston chamber, the said through ports and the piston chamber of each cylinder being in line with the respective ports, a piston chamber of another cylinder, an inlet port in one of the end heads connected to the inlet port of the first cylinder, an outlet port in the other end head connected to the through exhaust port of the last cylinder, and a cross port in the head between piston cylinders to connect the through exhaust port of one cylinder with the inlet port of the other cylinder; substantially as described.

4. In a compound rotary motor, a plurality of cylinders arranged in tandem, cylinder heads for the ends of each cylinder, a piston shaft concentric with each cylinder, an eccentrically located piston chamber extending through each cylinder, an inlet port extending through each cylinder, having transverse ports connecting the through port with the piston chamber, an exhaust port extending through each cylinder and having transverse ports connected with the piston chamber, the said through ports and the piston chamber of each cylinder being in line with the respective through ports, a piston chamber of an adjacent cylinder, a piston in each chamber connected to the piston shaft and at an angle to each other, an inlet port in one of the two heads connected to the through inlet port of the first cylinder, an outlet port in the other end head connected to the through exhaust port of the last cylinder, the cross ports in the head between adjacent cylinders to connect the exhaust port of one cylinder with the inlet port of the other cylinder to compound the cylinder; substantially as described.

5. In a compound rotary motor, a plurality of cylinders arranged in tandem, cylinder heads for the ends of each cylinder, a piston shaft concentric with each cylinder, an eccentrically located piston chamber extending through each cylinder, a piston in each chamber connected to the piston shaft, an inlet port extending through each cylinder and having transverse ports connecting the through ports with the piston chamber, an exhaust port extending through each cylinder and having transverse ports connecting the through ports with the piston chamber, an inlet port in one of the end heads connected to the through inlet port of the first cylinder, an outlet port in the other end heads connected to the exhaust port of the last cylinder, means to connect the exhaust port of the first cylinder with the inlet port of the next cylinder, and through bolts passing through all of the cylinders, the intermediate cylinder head, and one of the end cylinder heads, and engaging threaded seats in the other cylinder head; substantially as described.

In testimony whereof, we have hereunto set our hands.

WILLIAM S. ELLIOTT.
CHARLES A. CONN.
HARRIS B. HOLT.

Witnesses:
GEO. H. PARMELEE,
H. M. CORWIN.