

No. 776,336.

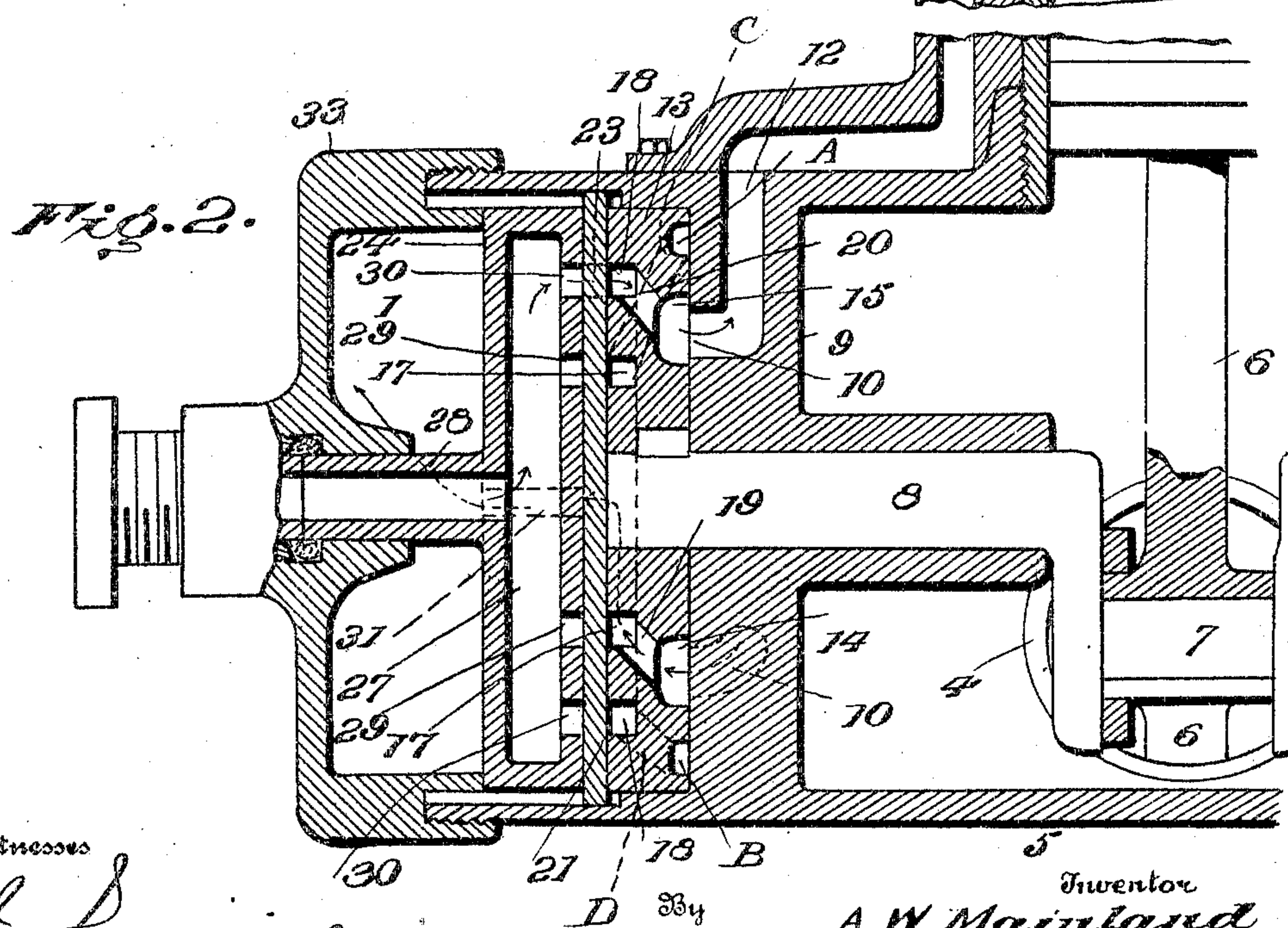
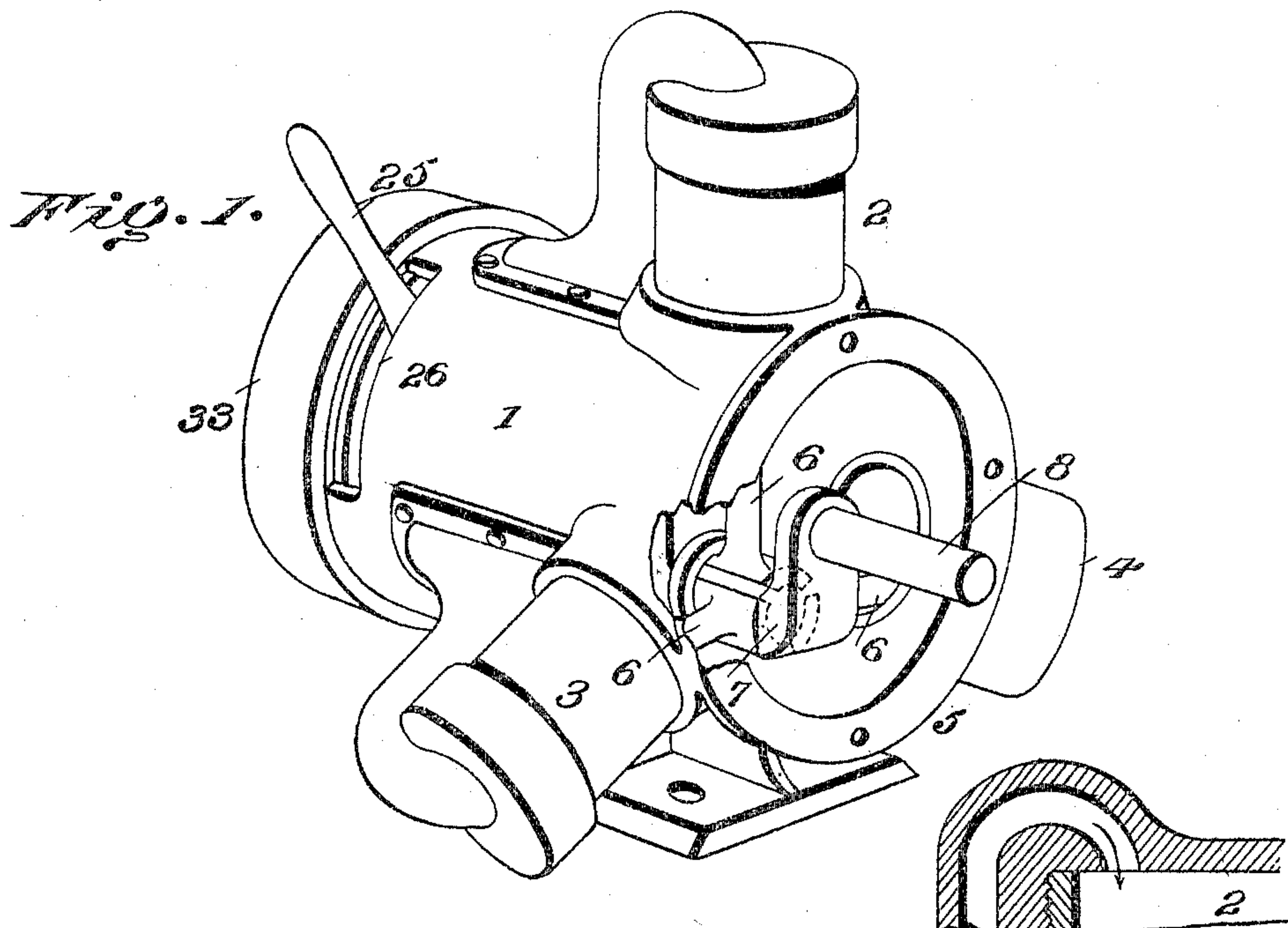
PATENTED NOV. 29, 1904.

A. W. MAINLAND.
MULTIPLE CYLINDER ENGINE.

APPLICATION FILED MAY 19, 1904.

NO MODEL.

2 SHEETS—SHEET 1.



Witnesses

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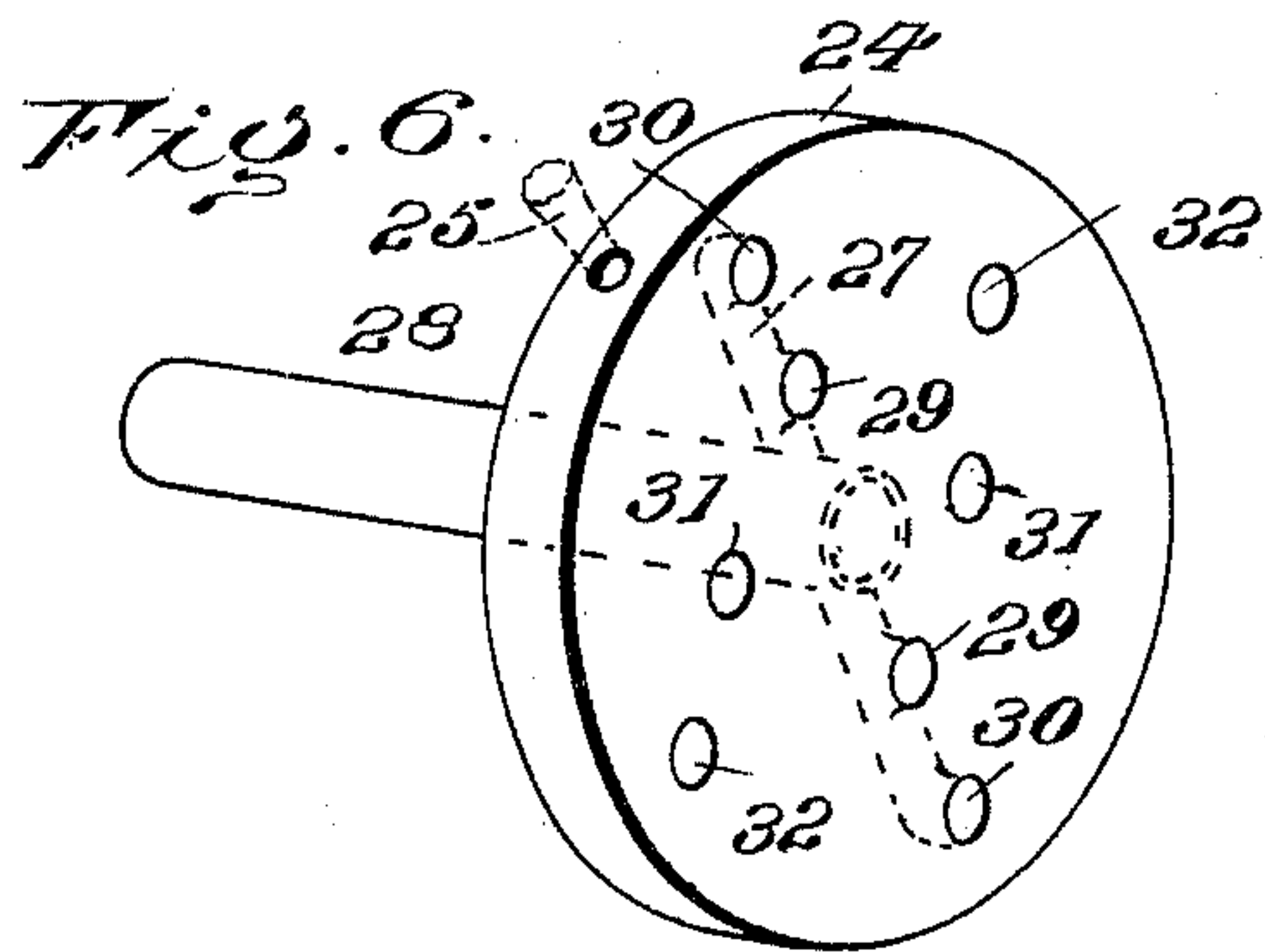
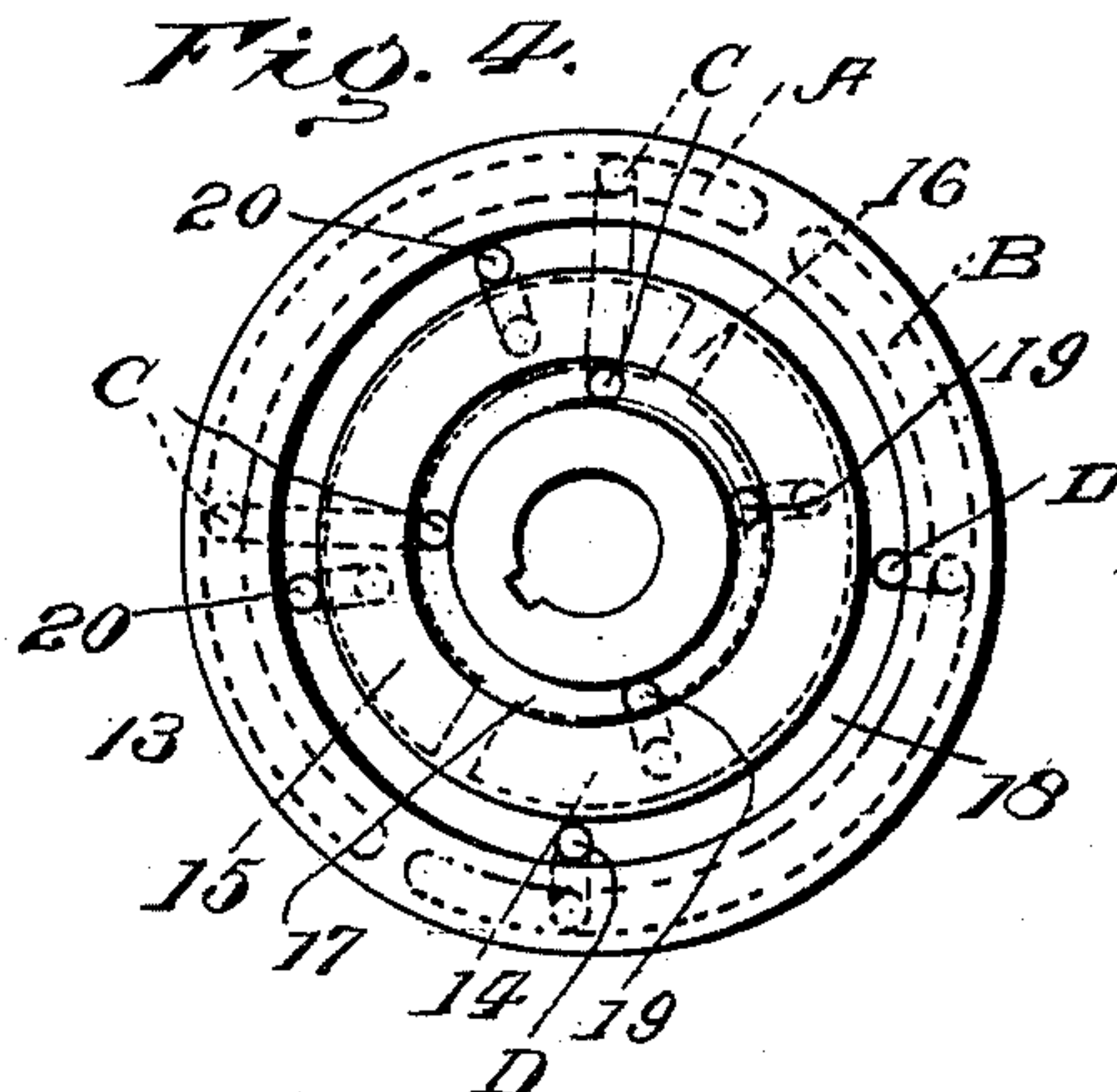
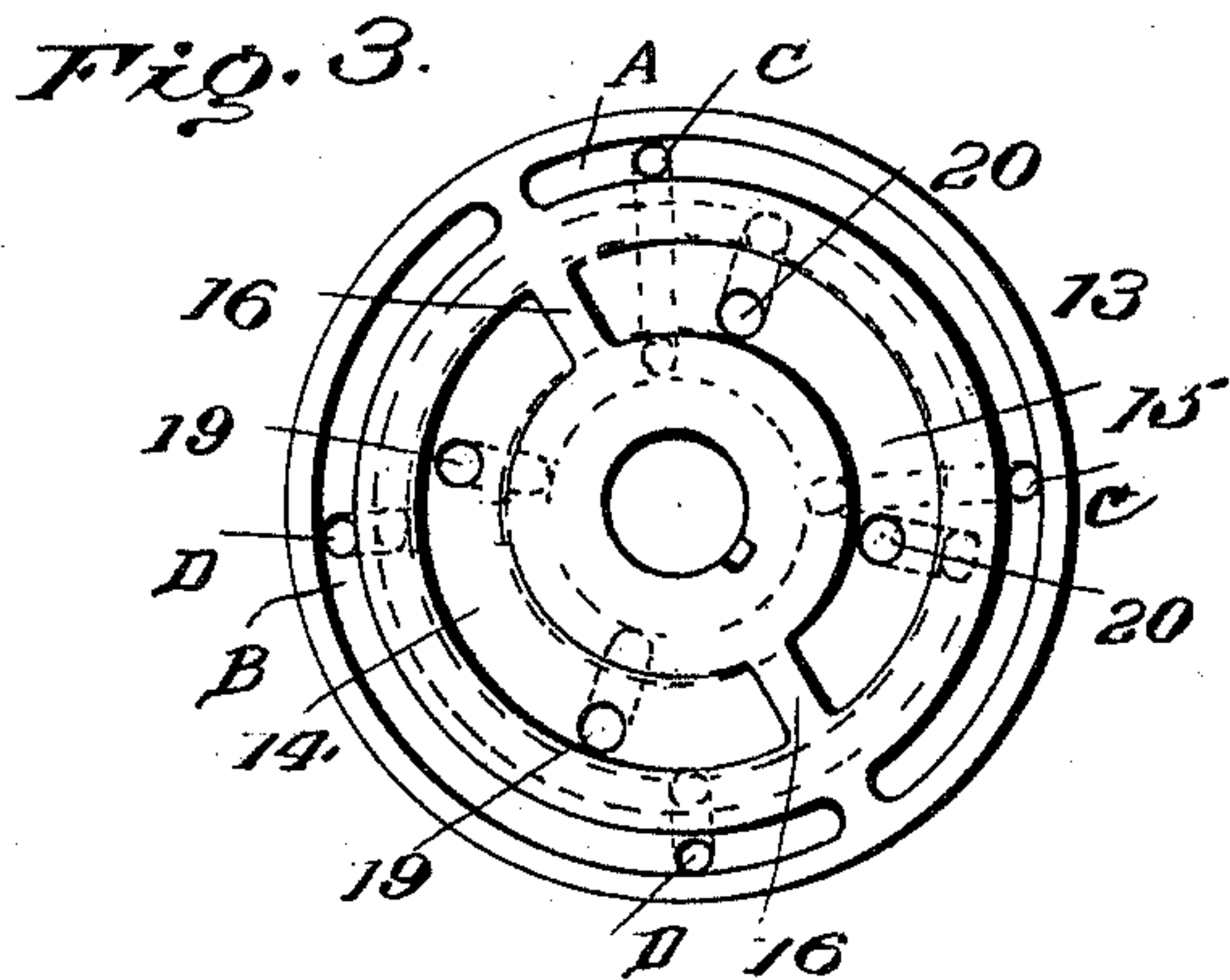


Fig. 5.

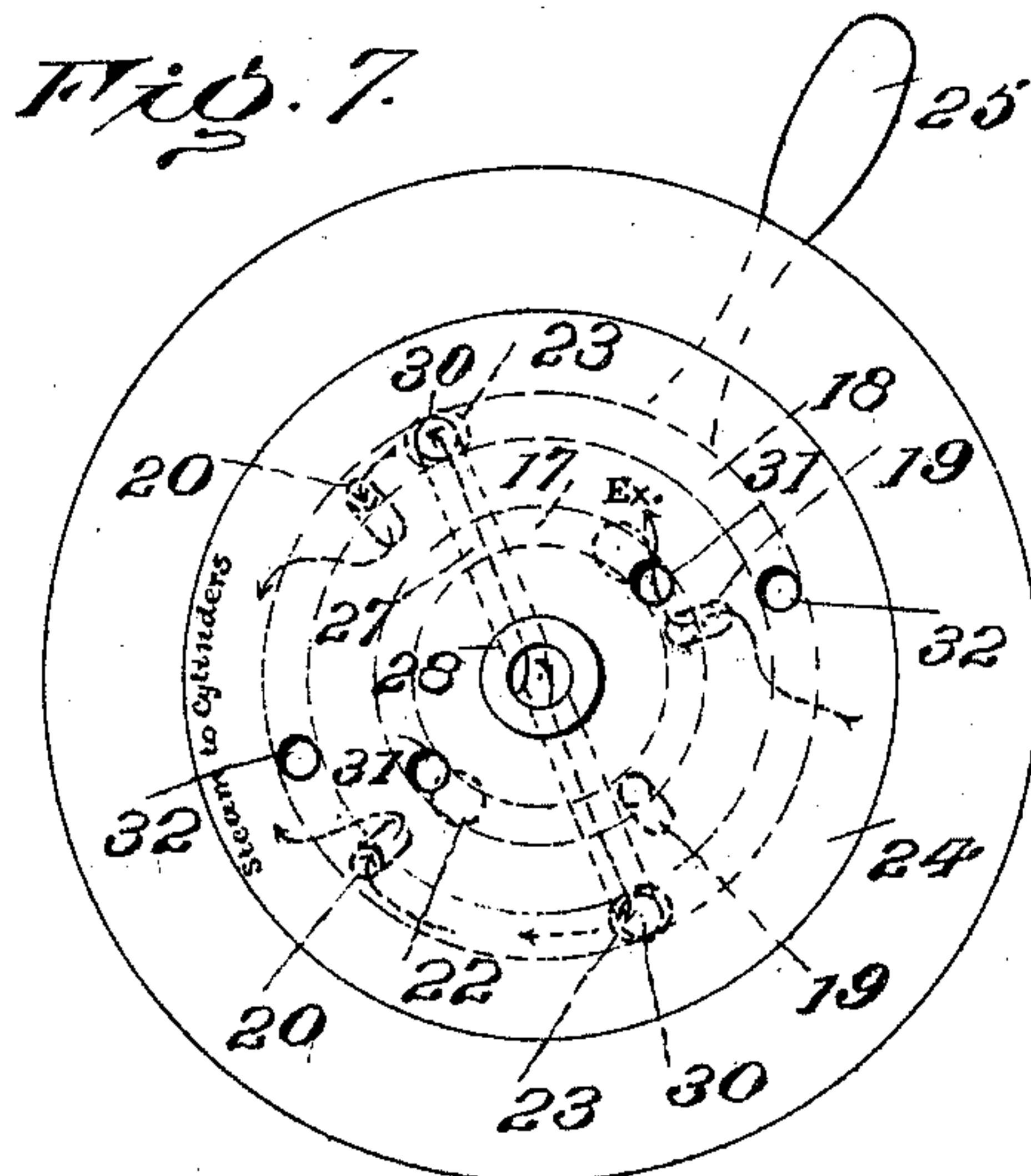
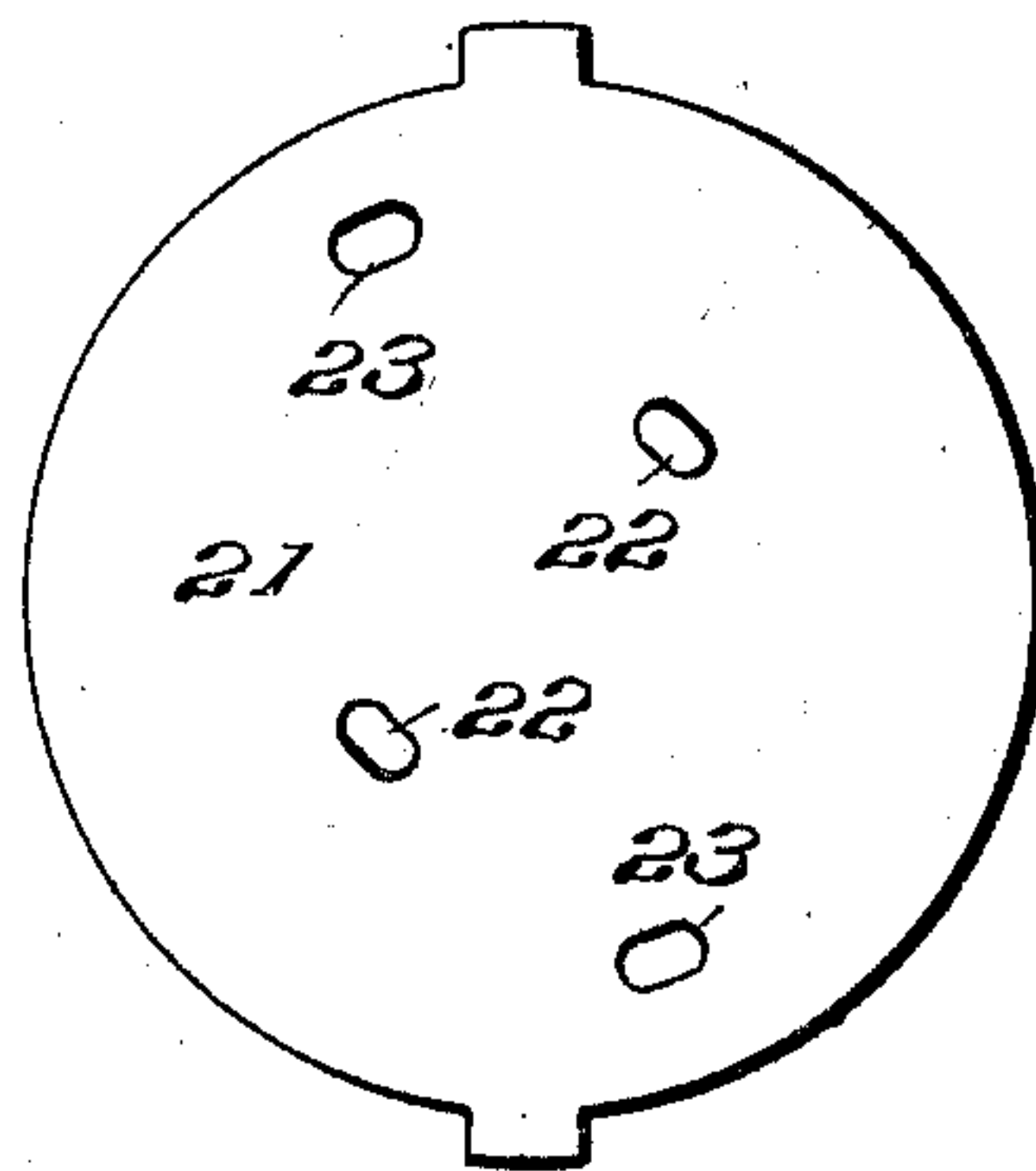
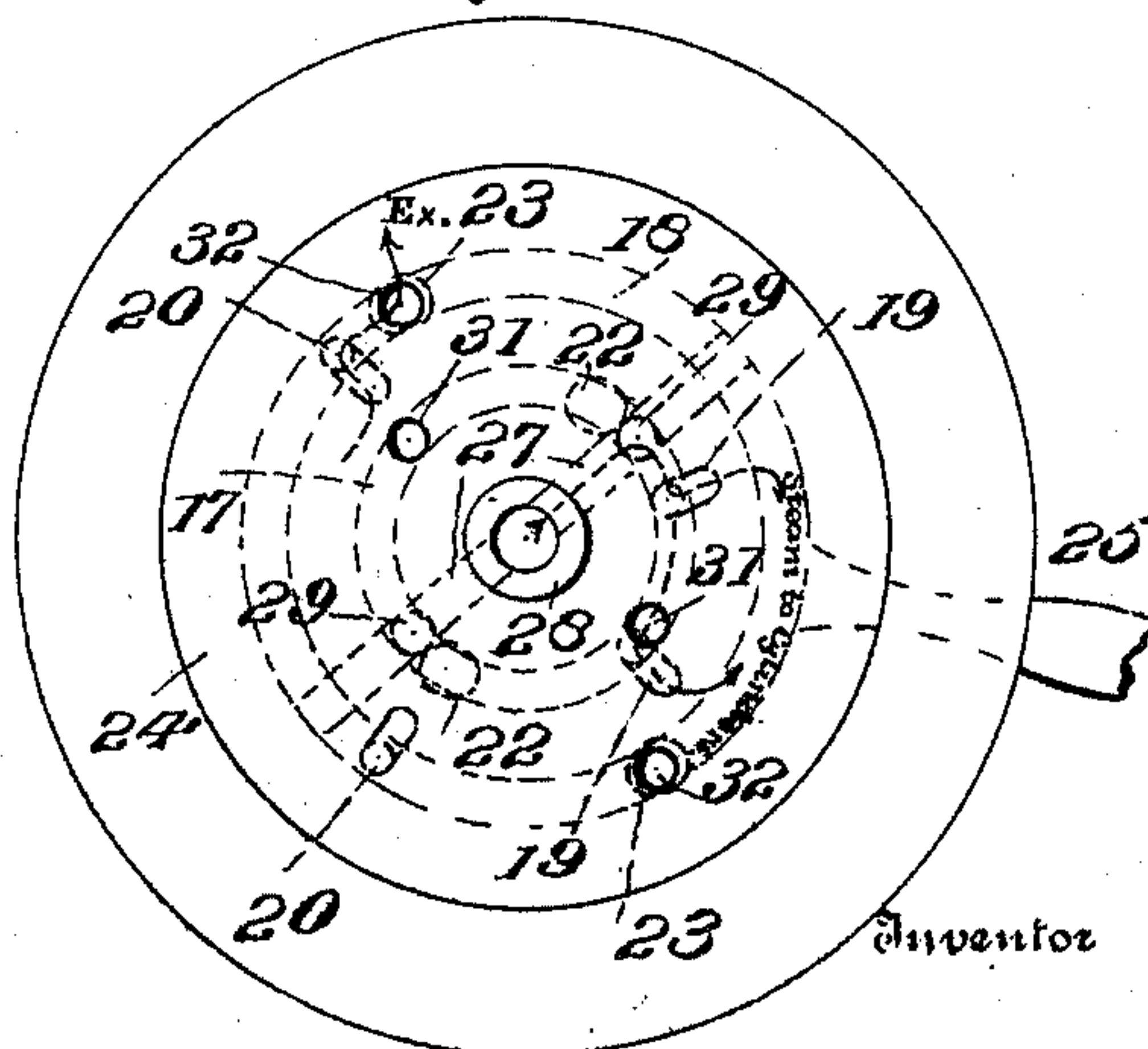


Fig. 8.



Witnesses

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UNITED STATES PATENT OFFICE.

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MULTIPLE-CYLINDER ENGINE.

SPECIFICATION forming part of Letters Patent No. 776,336, dated November 29, 1904.

Application filed May 19, 1904. Serial No. 208,742. (No model.)

To all whom it may concern:

Be it known that I, ALBERT W. MAINLAND, of New York, in the county of Kings and State of New York, have invented certain new and useful Improvements in Multiple-Cylinder Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to that class of multiple-cylinder engines in which the several cylinder-ports are governed by a disk valve rotating with the crank-shaft common to the pistons of the several cylinders.

The primary object of the invention is to provide improved means for effecting the lead, cut off, and exhaust of motive fluid to and from the cylinders and reversing the direction of rotation of the crank-shaft.

The invention comprehends a multiple-cylinder engine employing steam, air, gas, or other motive fluid, having a valve keyed on or otherwise movable synchronously with the crank-shaft and provided with lead and exhaust ports and a reversing device also having lead and exhaust ports and a stationary disk intermediate the valve and reversing device having passages in constant register with the lead and exhaust ports, respectively, of the valve and so coacting with the reversing device that upon operating the latter the ports of the valve supplying live steam become exhaust-passages and those through which the exhaust was conducted supply live steam.

The invention further contemplates providing in an engine equipped as stated improved means for effectively balancing the valve.

The invention will be hereinafter fully set forth, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a view in perspective, showing the engine as an entirety. Fig. 2 is a sectional view showing the valve and complementary parts and the passages leading from the valve to the cylinders. Fig. 3 is a plan view of the inner face of the valve—that is, the face adjacent the passages to the cylinders. Fig. 4 is a

plan view of the outer face of the valve. Fig. 5 shows the stationary plate. Fig. 6 shows in perspective the reversing device and steam-chest. Fig. 7 shows the lead and exhaust when the crank-shaft is rotating in one direction, and Fig. 8 shows them when the crank-shaft is rotating in the opposite direction.

Referring to the drawings, 1 designates an engine having three radially-disposed cylinders 2 3 4, mounted upon a casing 5 and having the pitmen 6 of their pistons secured to the crank 7 of a common crank 8, the latter extending through and beyond the inner wall 9 of the casing 5 and designed to rotate in suitable bearings therein. The wall 9 is provided with ports 10, from which passages 12 conduct live steam and exhaust to and from the outer ends of the cylinders.

13 designates the valve designed to rotate synchronously with the crank-shaft and shown keyed upon the latter, its inner face, Fig. 3, in contact with wall 9 of the casing. As illustrated in Fig. 3, the valve is formed on its inner face with two semicircular grooves or channels 14 15, separated by partitions 16, the grooves or channels being designed to register with ports 10 of the casing-wall. The outer face of the valve, Fig. 4, is formed with inner and outer concentric rings or grooves 17 18, forming complete circles or uninterrupted passage-ways. Ports 19 connect inner ring 17 with the semicircular groove 14 on the inner face, and ports 20 connect outer ring 18 with semicircular groove 15. Thus it will be seen that the valve is provided with independent sets of ports 19 and 20, registering through the medium of the grooves 14 and 15, respectively, with ports 10, leading to the cylinders, and that these ports 19 and 20 connect with independent rings or grooves on the outer face of the valve. Consequently if live steam is being introduced into the outer ring 18, for instance, it will be conducted through ports 20 to semicircular groove 15, and as the valve rotates the steam will pass through the successive ports 10 to the cylinders, the exhaust from the latter passing through ports 10 when semicircular groove 15 is out of register there-with into semicircular groove 14 and thence

through ports 19 to inner ring 17. It is apparent that if instead of the live steam being introduced into outer ring 18 it is introduced through inner ring 17 then the respective passages of live steam and exhaust are just reversed from that described—that is, the live steam will be conducted through ports 19 and semicircular groove 14 to the cylinders, and the exhaust will be conducted through semicircular groove 15 and ports 20 to the outer ring 18. Hence by whichever line of introduction and consequent direction of rotation of the crank-shaft such rotation may be instantly reversed by changing the line of introduction.

A and B designate balancing-grooves in the inner face of the valve 13 and leading, respectively, through ports C and D to the inner and outer rings or grooves 17 18 on the outer face of the valve. These balancing-grooves are relatively separated similarly to semicircular grooves 14 15, and their ports C and D are so arranged relatively to ports 19 and 20 that one balancing-groove will contain live steam when the adjacent semicircular groove is containing exhaust, and vice versa. When groove 14, for instance, contains live steam, the balancing-groove A on the opposite side of the face of the valve is also supplied with live steam, the exhaust being conducted to groove 15 and balancing-groove B. Thus whether live steam is being supplied to inner ring 17 and exhaust is being conducted to outer ring 18, or vice versa, the grooves A and B are always containing one live steam and the other exhaust, whereby an even balance of the valve is maintained and the possibility of canting or binding obviated.

21 designates a plate keyed within the casing and fitting against the valve. It is provided with inner and outer concentric apertures 22 23, constantly in register, respectively, with inner and outer rings 17 18 of the valve.

24 designates the combined reversing device and steam-chest. It is shown in Fig. 6 as a disk designed to be accommodated within the casing 5 against the outer face of the plate 21 and capable of being turned axially through the medium of a handle 25, extending through a slot 26 in the casing. Extending transversely of the disk is a steam-chamber 27 in communication with a hollow stem 28, extending from the outer face of the disk and designed to be connected with the source of steam, air, gas, or other motive fluid. Leading from the steam-chamber 27 to the inner face of the disk are inner and outer ports 29 30.

31 and 32 designate, respectively, inner and outer exhaust-ports extending entirely through the disk.

As stated, the valve 13 rotates with the crank-shaft and the plate 21 is stationary, its apertures being constantly in alinement with the rings in the outer face of the valve. The

reversing device 24 is designed to be positional, so that either its steam-ports 30 will register with outer apertures 23 of the plate 21 and its exhaust-ports 31 with inner apertures 22 of the plate, or the disk is positioned so that its steam-ports 29 will register with the inner apertures 22 of the plate 21, its exhaust-ports 32 registering with outer apertures 23 of the plate. The former position is indicated in Fig. 7 and the latter in Fig. 8. Referring to Fig. 7 and the section shown in Fig. 2, steam passes from chamber 27 through ports 30 and apertures 23 of the plate into outer ring 18 of the valve and thence through ports 20 to semicircular groove 15, from which it is supplied to the cylinders successively through ports 10 and channels 12 as the valve rotates with the crank-shaft. At this time live steam is passing from ring 18 through port D to balancing-groove B. Upon semicircular groove 15 passing out of register successively with each of the ports 10 the piston within the cylinder with which said port 10 communicates will be on its return stroke and the exhaust will pass out through port 10 to semicircular groove 14, through ports 19 to inner ring 17, and thence out through apertures 22 of the plate and exhaust-ports 31 of the reversing device 24. A portion of the exhaust, however, will pass from ring 17 through port C to balancing-groove A. When the reversing device is thus positioned, its steam-ports 29 and exhaust-ports 32 are closed by contact with the face of plate 21.

To reverse the direction of rotation of the crank-shaft, the reversing device is turned axially into the position shown in Fig. 8. Now its steam-ports 30 and exhaust-ports 31, through which the live steam and exhaust were respectively conducted in the former position, are closed by contact with the face of plate 21 and steam-ports 29 are brought into register with apertures 22 of the plate, while exhaust-ports 32 register with apertures 23 of the plate. The consequent supply of live steam to the inner ring 17 of the valve and thence to the cylinders and the passage of the exhaust from the latter to outer ring 18 will be readily understood, as well as the supply of live steam and exhaust to the balancing-grooves A B. The cylinders, which in Fig. 7 may have been taking steam, are in Fig. 8 exhausting, and vice versa. The reversing may be done while the engine is under full speed, since it is impossible to change the ports through which the steam is conducted from chamber 27 without simultaneously opening up a corresponding passage for exhaust.

When it is desired to stop the rotation of the crank-shaft, the reversing device 24 is given a partial turn to a point intermediate those shown in Figs. 7 and 8, when all of its steam and exhaust ports will be closed by contact with the face of plate 21.

From the foregoing it will be seen that any mechanical contrivance may be adopted for indicating the position of the valve to determine to which of the cylinders steam will be supplied upon opening up communication therefor through the inner or outer ring and the consequent direction of rotation of the shaft. For this purpose a keyway upon some exposed portion of the shaft may indicate the position of the crank and corresponding position of one of the semicircular grooves 14 or 15. Hence with the reversing device at the midway or cut-off point the lever may be shifted to rotate the shaft in the same or opposite direction to that of the lever movement.

I have indicated at 33 a hood extending from the casing 5 and forming a chamber from which the exhaust may be conducted through a pipe tapped therein at any suitable point.

It will be understood that any preferred device may be employed for bearing upon the outer face of the reversing device 24 to hold the parts in position. The means I have shown for balancing the valve, however, has been found in practice to lessen the necessity for such device. It will further be understood that while I have shown and described my invention as applied to an engine having single-acting multiple cylinders radially disposed, yet it is equally adapted to one in which the cylinders are arranged in parallelism having single or double action. Likewise instead of the valve rotating on and at the same speed as the crank-shaft the two may by suitable gearing be driven at differential speeds, as in a four-cycle gas-engine action, when the crank is desired to make two revolutions to one of the valve.

I claim as my invention—

1. In a multiple-cylinder engine, having a crank-shaft common to the pitmen of the pistons of the several cylinders, and provided with ports communicating with the cylinders, a valve designed to operate synchronously with the crank-shaft and successively establish communication for live steam and exhaust with the several cylinders, and having independent admission-grooves on its inner face, and independent lines of communication from its outer face to each of said admission-grooves, a stationary plate adjacent the outer face of said valve having apertures constantly in alinement with the respective independent lines of communication through said valve, and a reversing device having separate sets of steam-ports and complementary exhaust-passages, one of said sets being designed, in one operative position of said reversing device to supply live steam through apertures of said plate to one of said lines of communication of the valve and one admission-groove, the exhaust being conducted from the other groove and line of communication, and the other of

said sets being designed, in the other position of said reversing device, to supply live steam through other apertures of said plate to the line of communication and groove which were previously conducting the exhaust, and conducting the exhaust from the groove and line of communication to which live steam was previously supplied.

2. In a multiple-cylinder engine having a crank-shaft common to the pitmen of the pistons of the several cylinders and provided with ports communicating with the cylinders, a valve designed to operate synchronously with the crank-shaft and successively establish communication for live steam and exhaust with the several cylinders, said valve having two independent semicircular grooves on its inner face registering with said cylinder-ports, and inner and outer rings or circular grooves on its outer face and ports leading from one of said rings to one of said semicircular grooves, and from the other of said rings to the other of said semicircular grooves, a stationary plate adjacent the outer face of said valve and having inner and outer apertures respectively in alinement with the said inner and outer rings of the valve, means for supplying live steam to said outer ring and conducting the exhaust from said inner ring, and means for reversing said former means whereby live steam will be supplied to said inner ring and the exhaust conducted from said outer ring.

3. In a multiple-cylinder engine having a crank-shaft common to the pitmen of the pistons of the several cylinders and provided with ports communicating with the cylinders, a valve designed to operate synchronously with the crank-shaft and successively establish communication for live steam and exhaust with the several cylinders, said valve having two independent semicircular grooves on its inner face registering with said cylinder-ports, and inner and outer rings or circular grooves on its outer face and ports leading from one of said rings to one of said semicircular grooves, and from the other of said rings to the other of said semicircular grooves, a stationary plate adjacent the outer face of said valve and having inner and outer apertures respectively in alinement with the said inner and outer rings of the valve, and a reversing device having separate sets of steam-ports and complementary exhaust-passages, one of said sets being designed in one operative position of said reversing device to supply live steam through the outer apertures of said plate to the outer ring of the valve, the exhaust being conducted from the inner ring, and the other of said sets being designed in the other operative position of said reversing device to supply live steam to the inner ring of the valve, the exhaust being conducted from the outer ring.

4. The combination with the casing of a multiple-cylinder engine having ports communicating with the several cylinders, and a crank-

shaft, of a valve within the casing and rotatable synchronously with said shaft, designed to successively establish communication for live steam and exhaust with the several cylinders, said valve having two independent semicircular grooves on its inner face registering with said cylinder-ports, and inner and outer rings or circular grooves on its outer face, and ports leading from one of said rings to one of said semicircular grooves, and from the other of said rings to the other of said semicircular grooves, a plate keyed within said casing against the outer face of said valve and having inner and outer apertures respectively in alinement with said inner and outer rings of the valve, a reversing device also accommodated within said casing against the outer face of said plate, and capable of being turned axially, said reversing device having inner and outer exhaust-passages extending therethrough, a steam-chamber designed to be connected with a source of motive-fluid supply, and inner and outer steam-ports leading from said chamber, said reversing device being designed to be turned axially to bring the outer steam-ports into register with the outer aperture of said plate and the inner exhaust-passages into register with the inner apertures of said plate, or to be turned to bring the inner steam-ports into register with the inner apertures of said plate and the outer exhaust-passages into register with the outer apertures of said plate, or to be turned to a point intermediate the two stated to cut off communication to and from the reversing device, substantially as and for the purpose set forth.

5. In a multiple-cylinder engine having a crank-shaft common to the pitmen of the pistons of the several cylinders and provided with ports communicating with the cylinders, a valve designed to operate synchronously with the crank-shaft and successively establish communication for live steam and exhaust with the several cylinders, said valve having two independent semicircular grooves on its inner face registering with said cylinder-ports, and inner and outer rings or circular grooves on its outer face and ports leading from one of said rings to one of said semicircular grooves, and from the other of said rings to the other of said semicircular grooves, said valve also having independent balancing-grooves on its inner face and ports connecting one of said balancing-grooves with the inner ring on the outer face of the valve, and the other balancing-groove with the outer ring, means for supplying live steam to said outer ring and

conducting the exhaust from said inner ring, and means for reversing said former means to supply live steam to said inner ring and conduct the exhaust from said outer ring, whereby each of said balancing-grooves will be supplied with live steam or exhaust.

6. In an engine, the combination with the casing having a series of radial cylinders thereon, such casing having a hood, and provided with a slot, and having ports communicating with the several cylinders, and a crank-shaft, of a valve within the casing keyed to said crank-shaft and movable therewith, said valve having on its inner face grooves for establishing lead and exhaust communication with said cylinders, balancing-grooves also being provided on the inner face of said valve, said valve having two rings on its outer face, one in communication with one of said lead and exhaust grooves and one of said balancing-grooves, and the other ring in communication with the other of said lead and exhaust, and balancing grooves, respectively, a plate keyed in the casing and having apertures constantly in register with said rings, a disk comprising a steam-chest and reversing device also within said casing and having a lever projecting through said slot in the casing, said disk having a transverse steam-chamber and ports leading from the latter to the inner face of the disk, exhaust-ports being provided in said disk communicating with said hood, and a hollow stem extending from said steam-chamber through said hood, as and for the purposes stated.

7. In a multiple-cylinder engine having ports communicating with the several cylinders, a valve having on its inner face two independent admission-grooves designed to register with said ports, and two independent balancing-grooves, one admission-groove and one balancing-groove being on each side of the inner face of said valve, said valve having independent lines of communication extending therethrough, one of said lines leading to one of said admission-grooves and its opposite complementary balancing-groove, and the other line leading to the other of said admission-grooves and its opposite complementary balancing-groove.

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

ALBERT W. MAINLAND.

Witnesses:

ABIJAH E. GREENE,
MAY HARRIS MAINLAND.