

No. 632,816.

Patented Sept. 12, 1899.

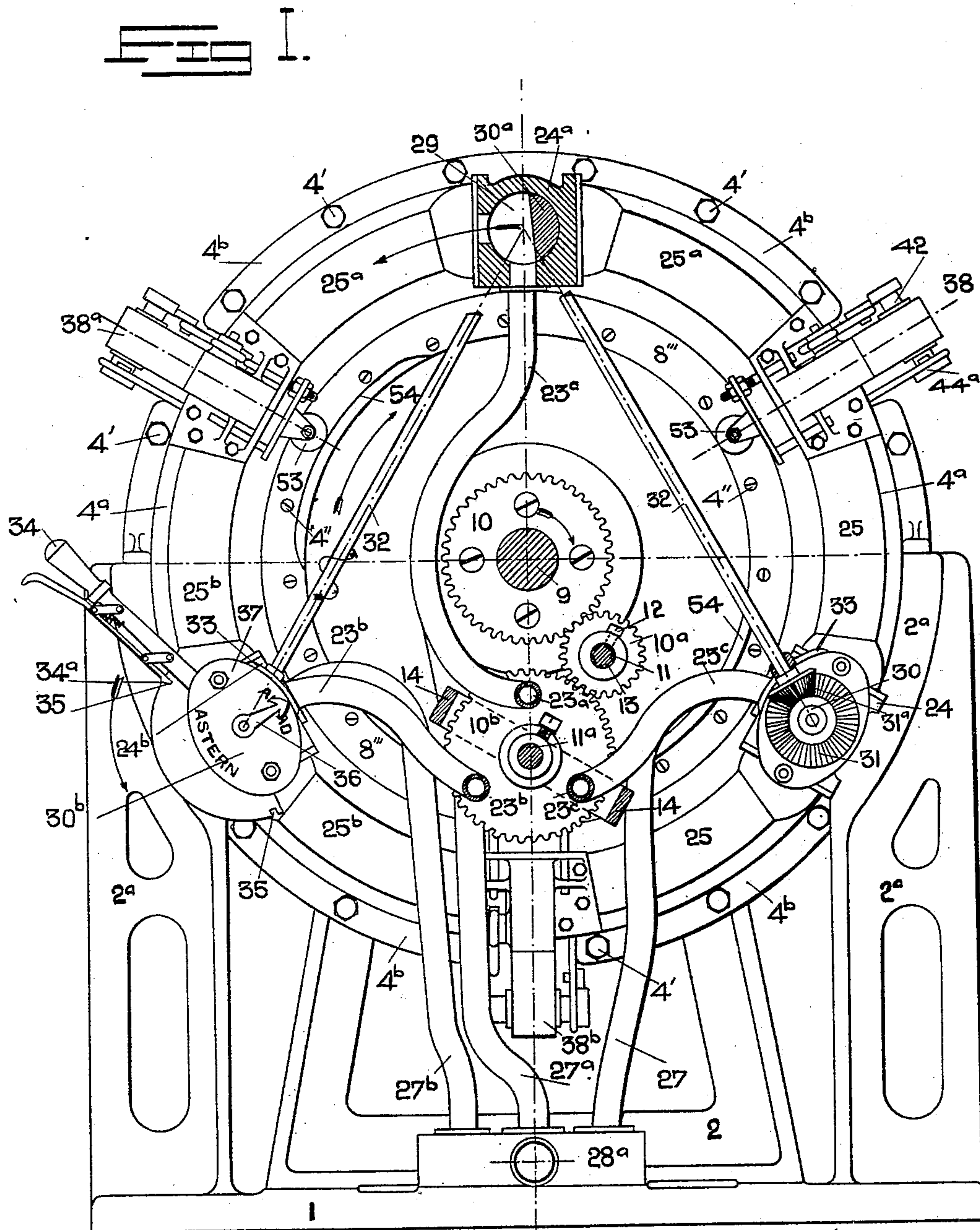
G. E. KIRBY & H. W. CROWTHER.

ROTARY ENGINE.

(Application filed May 8, 1899.)

(No Model.)

4 Sheets—Sheet 1.



Witnesses

George M Richards
J H Walmsley

G. H. Walmsley

Inventors

George Edmund Kerby
Henry William Crowther
per
Wm H Babcock
Attorney.

per

Attorney:

No. 632,816.

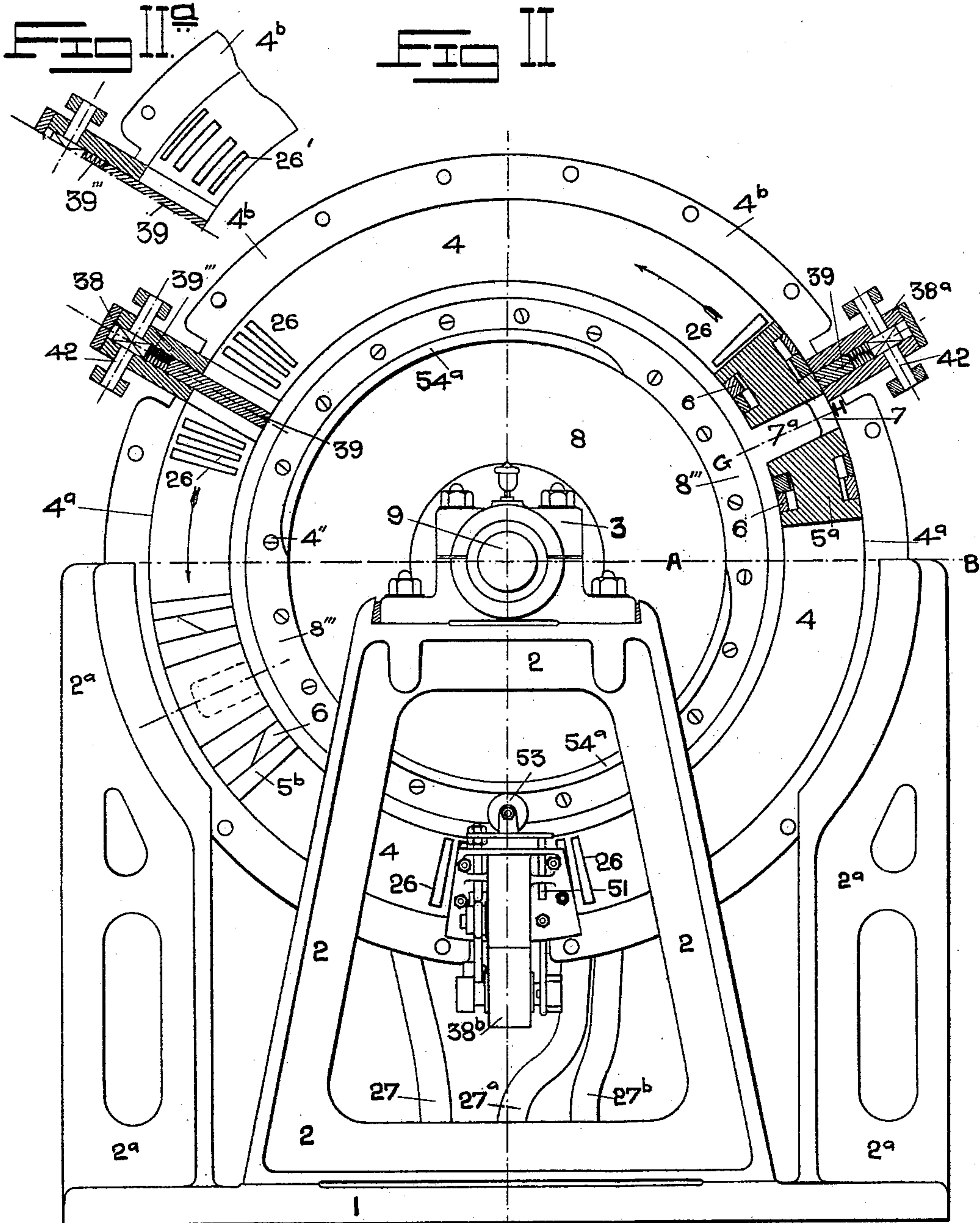
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Witnesses
George D. Richards
G. H. Walinsky

Inventors
George Edmund Kirby
Henry William Crowther
per W. H. Babcock
Attorney.

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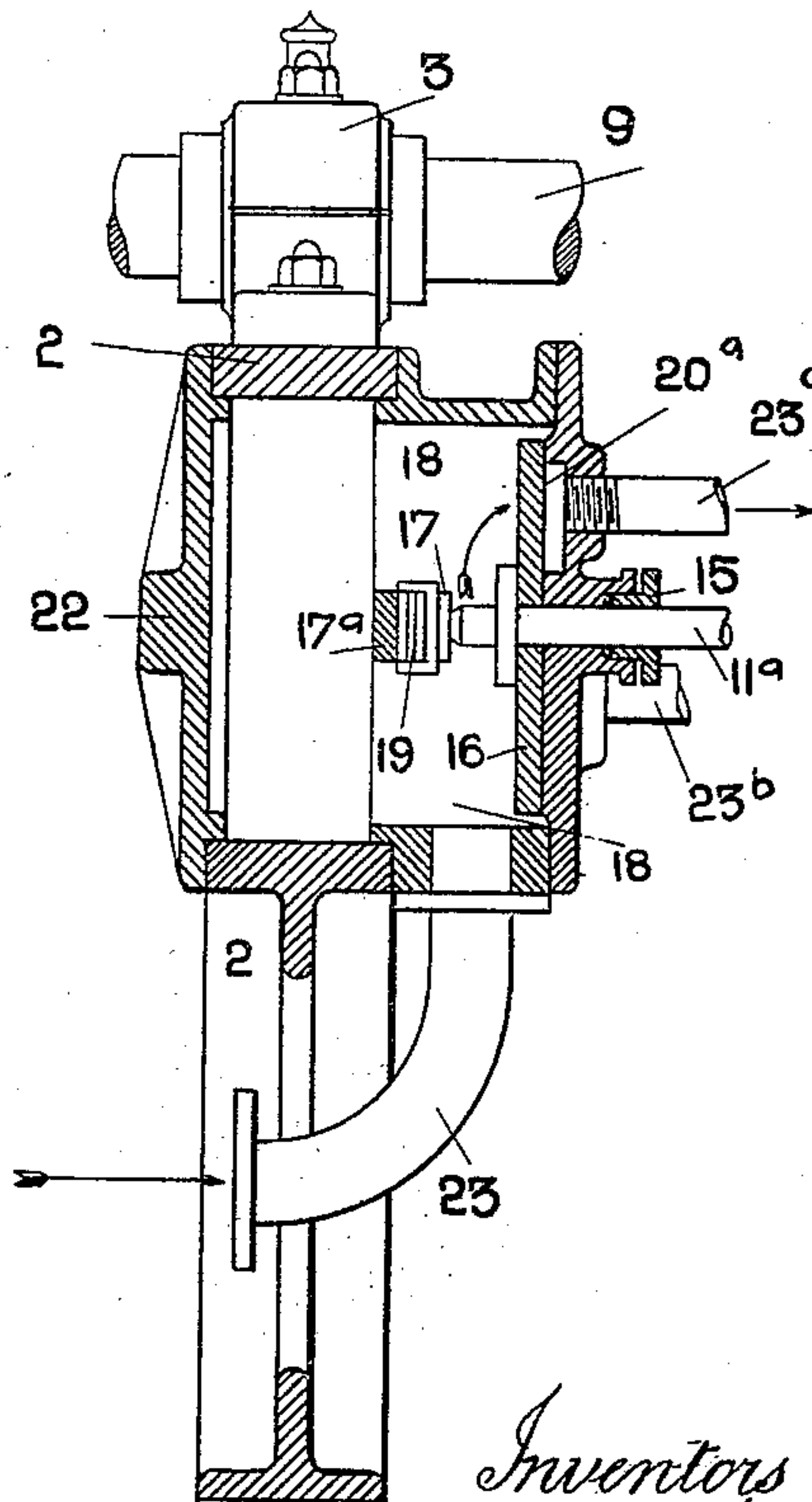
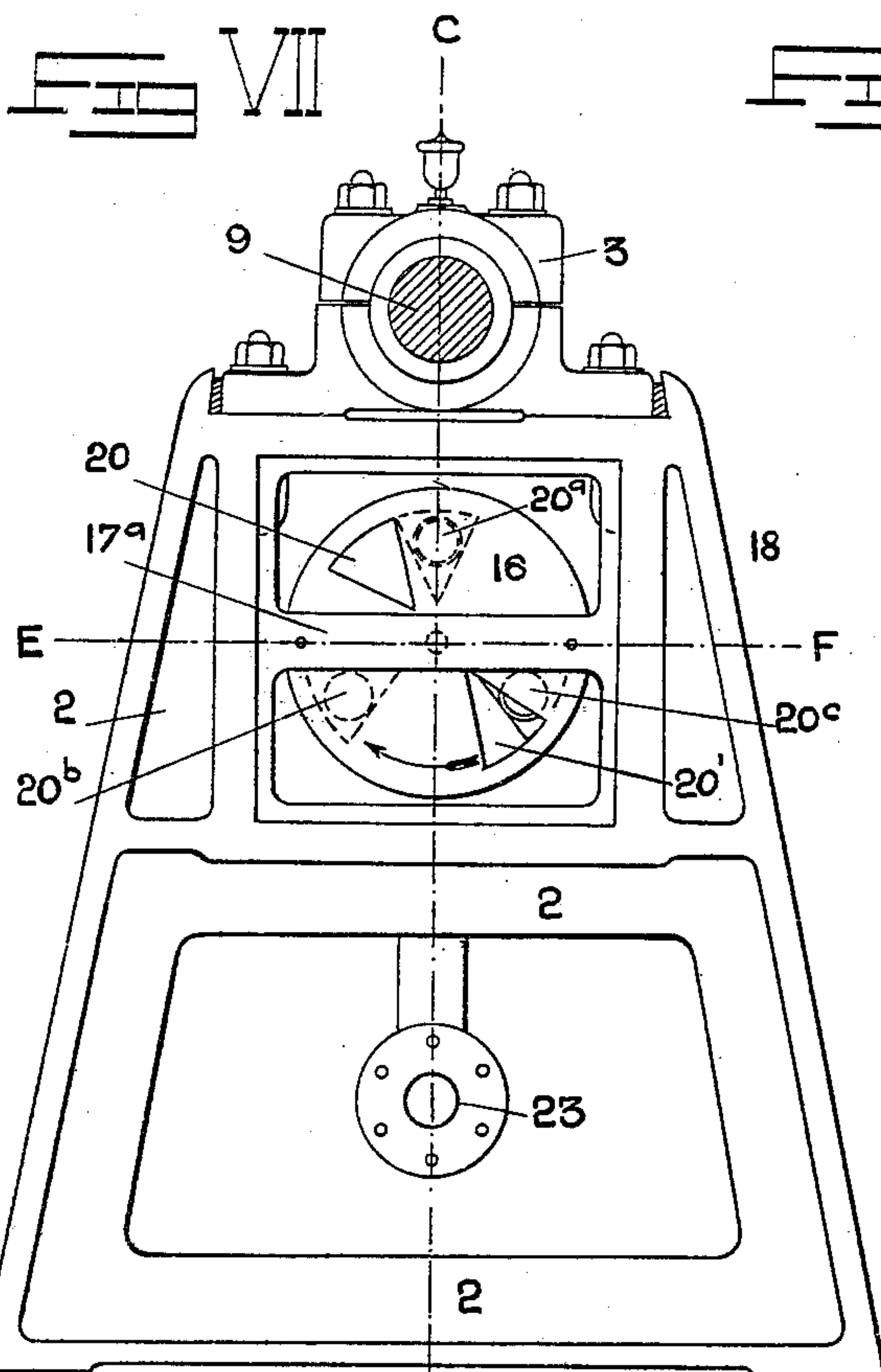
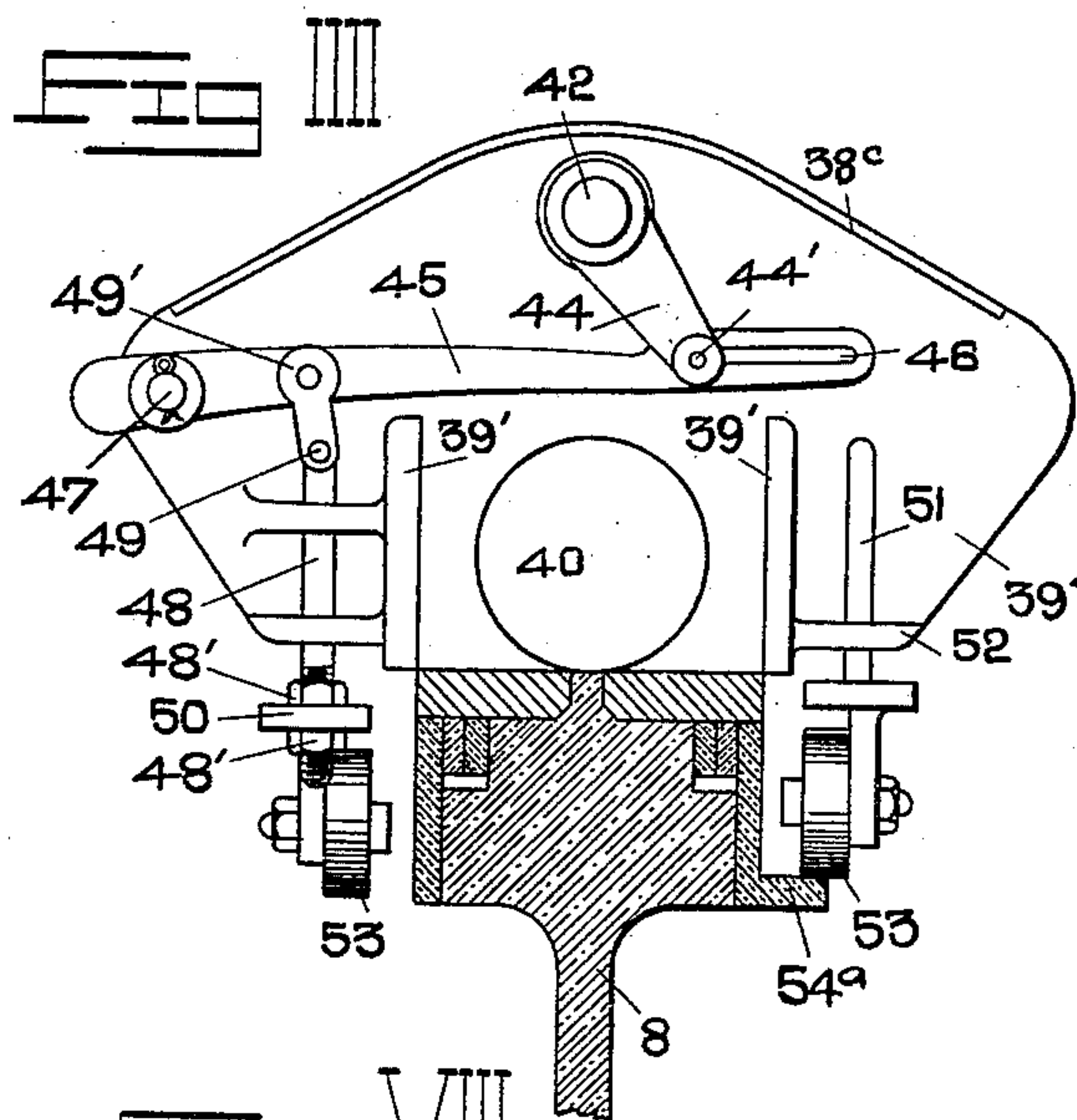
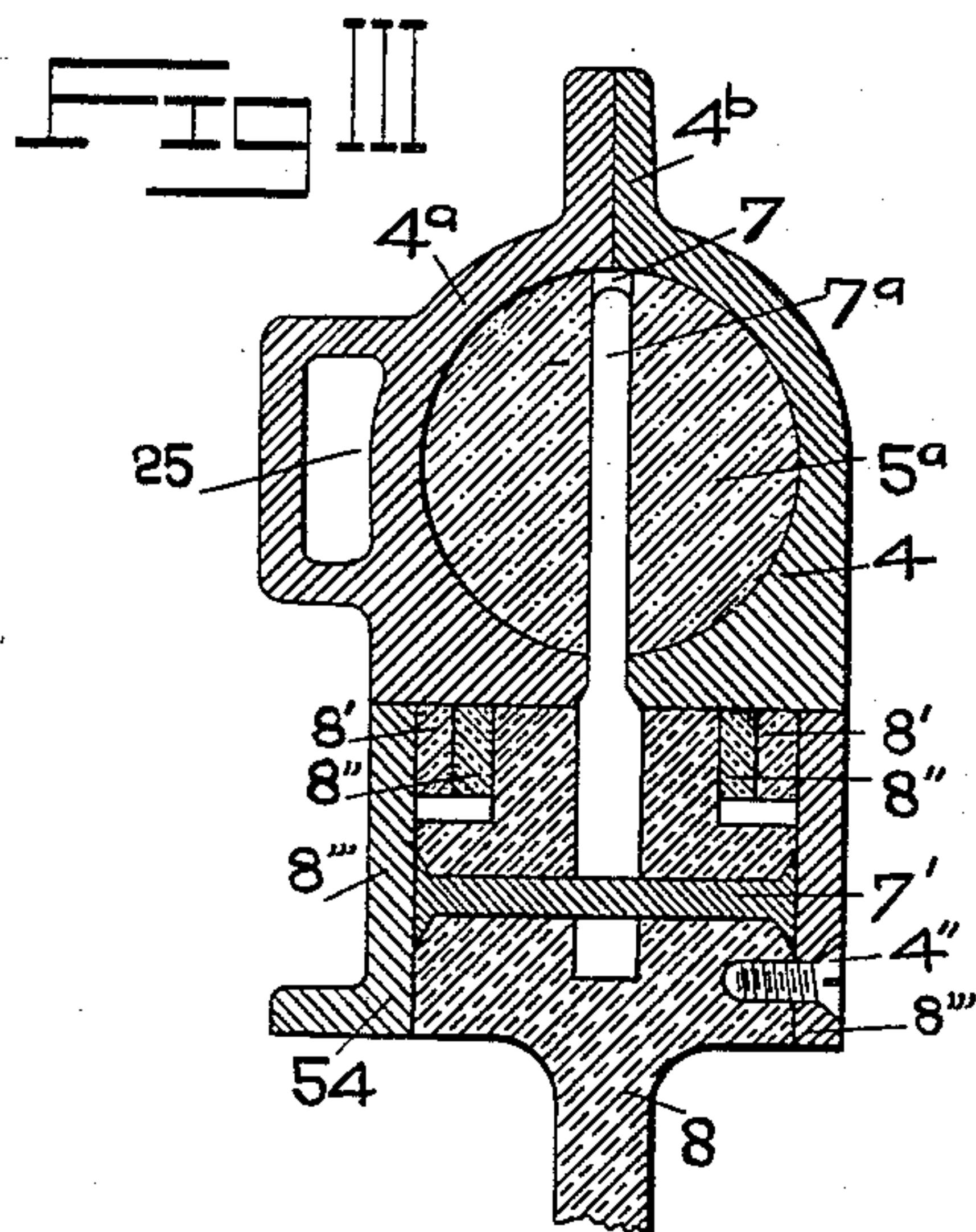
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(No Model.)

(Application filed May 8, 1899.)

4 Sheets—Sheet 3.



Witnesses
George M. Richards
G. H. Halsey

Inventors
George Edmund Kirby
Henry William Crowther
per W. H. Babcock
Attorney

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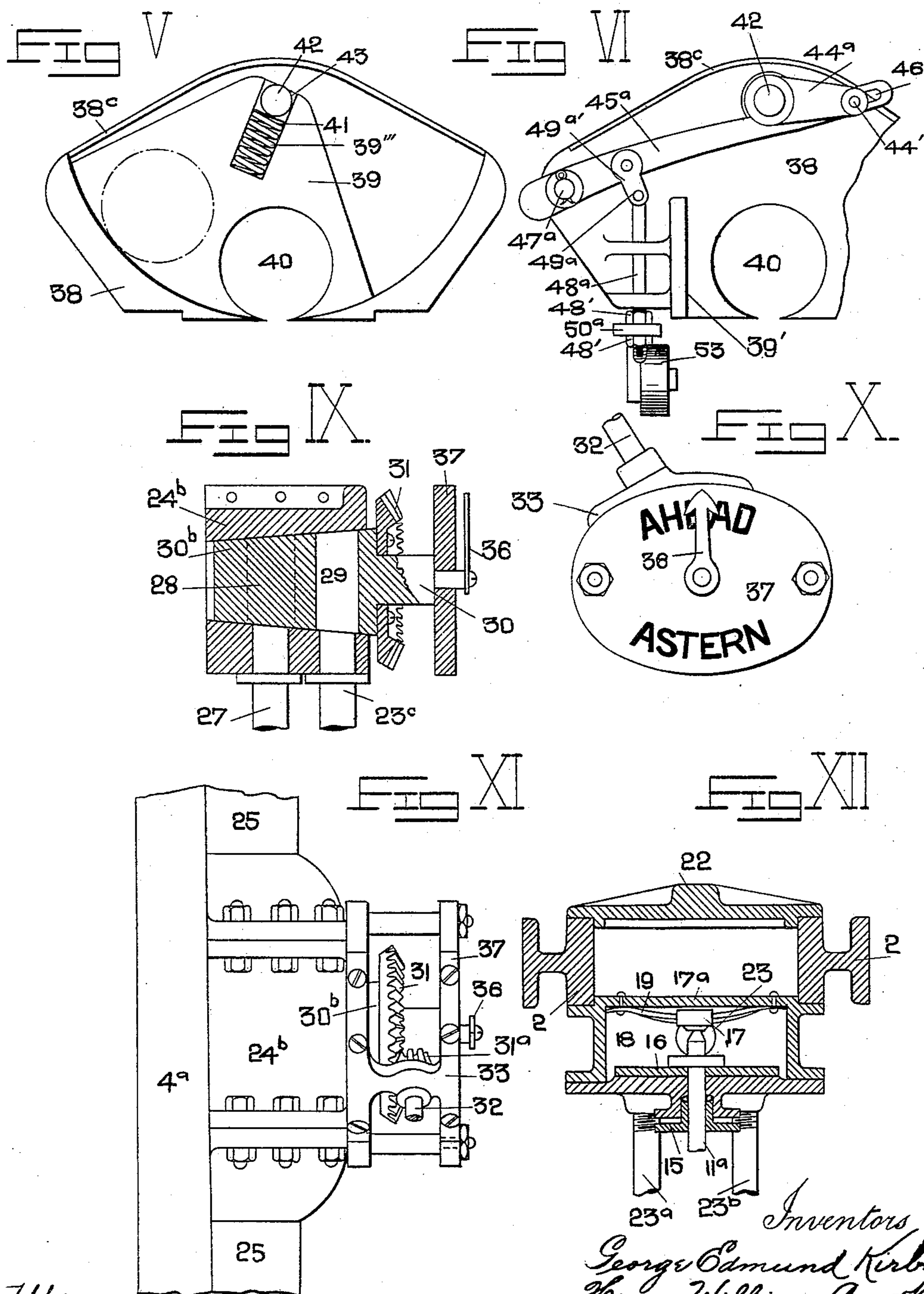
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(Application filed May 8, 1899.)

(No Model.)

4 Sheets—Sheet 4.



Witnesses
George M Richards
J H Walmsley

23^a 23^b Inventors
George Edmund Kirby
Henry William Crowther
per W H Babcock
Attorney.

UNITED STATES PATENT OFFICE.

GEORGE EDMUND KIRBY AND HENRY WILLIAM CROWTHER, OF EXETER,
ENGLAND.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 632,816, dated September 12, 1899.

Application filed May 8, 1899. Serial No. 715,998. (No model.)

To all whom it may concern:

Be it known that we, GEORGE EDMUND KIRBY, mechanical engineer, and HENRY WILLIAM CROWTHER, jeweler, subjects of Her Majesty the Queen of Great Britain, residing at 21 Montpellier Terrace, Exeter, in the county of Devon, England, have invented a new and useful Rotary Engine, of which the following is a specification.

Our invention consists in improvements in rotary engines operated by steam or similar fluid under pressure.

The construction and operation will be clearly understood by means of the drawings, in which—

Figure 1 is a front part-sectional elevation, the standard being removed. Fig. 2 is a back part-sectional elevation. Fig. 2^a is a view showing modification of ports. Fig. 3 is a section on line A B and G H, Fig. 2. Fig. 4 is an external view of one of the slide-chests, showing part of the operating mechanism. Fig. 5 shows interior detail of slide-chest. Fig. 6 shows the operating mechanism of slide-chest on reverse side to that shown in Fig. 4. Fig. 7 is an elevation of front standard, steam-chest, and main admission-valve with cover removed. Fig. 8 is a part section on line C D, Fig. 7. Fig. 9 is sectional detail of one of the reversing-valves. Fig. 10 is a front view showing dial. Fig. 11 is a plan of Fig. 9. Fig. 12 is a section on line E F, Fig. 7, showing cover.

1 is the bed-plate, which may be formed of cast-iron or like suitable metal. Formed in one piece with it or secured to this bed-plate by bolts or the like are two standards 2, which carry the main bearings 3, and also two standards 2^a, which support the split cylinder-shrouding 4^a. This shrouding is cast, pressed, or otherwise formed in metal in two half parts and subsequently united by bolts and nuts or set-screws 4^b, which pass through the flanges 4^b. A semicircular or other-shaped core or recess 4 is formed in the position shown in each half, and this is carefully turned or otherwise tooled. Within this core, recess, or groove the elongated pistons, which consist of two Muntz metal or other metallic plungers 5^a 5^b, fitted with rings 6 or equivalent suitable packing, revolve. These pistons are

each formed with a slot 7, through which passes a spur or tongue 7^a, forming part of or secured by rivets 7^b or other suitable manner to the disk 8, which is keyed to the shaft 9, journaled in the bearings 3. The disk is made steam-tight by means of two split rings 8^a 8^b on each side, kept in position by the plate 8^c, secured by bolts or set-screws to it 4^b, or by equivalent suitable packing. Upon this shaft is keyed a spur-wheel 10, gearing into a smaller wheel 10^a, running loose upon a stud 11. This wheel is prevented from shifting its position by a set-pin 12, which engages with a groove 13, formed in the stud, and drives another wheel 10^b, the axle of which, 11^a, is pivoted in a bracket 14 at one end and after passing through the stuffing-box or gland 15 is employed for driving the main admission-valve 16, which is keyed to and revolves with it. The opposite end of the axle is preferably journaled in a spring-bearing or the like 17, mounted on a cross-bar 17^a within the steam-chest 18, which is formed with or bolted to the standard 2. To assist in keeping the disk valve 16 tight against the ported face upon which it works, we employ the spring 19. Ports 20 20^a are formed in the valve, which interact with three ports 20^a 20^b 20^c, (see dotted lines, Fig. 7,) formed in the wall of the steam-chest 18, which is fitted with a cover 22.

The pipe 23, supplying steam, compressed air, or the like, enters the chest at its base, and three distributing-pipes 23^a 23^b 23^c connect the respective ports 20^a 20^b 20^c with three reversing-valve boxes 24 24^a 24^b, formed in or mounted upon the shrouding and communicating by right and left hand passages 25 25^a 25^b with the cylindrical recess 4, in which the pistons move. These valve-boxes and passages may be cored in the shrouding, as shown at Fig. 3, or they may be bolted on, communication with the recess 4 being effected by the radial ports, as at 26, or by the modification of same 26^a, Fig. 2^a. Exhaust-pipes 27 27^a 27^b connect the exhaust-passages 28, Fig. 9, formed in the reversing-valves, with the condenser 28^a, chimney, or the like, as the case may be.

The reversing-valves 30 30^a 30^b are each formed slightly tapering and have two ports 29 28, which serve as admission and exhaust

openings in either direction as they may be rotated. The synchronous action of these three valves is effected as follows: A bevel-wheel 31 is attached to the spindle of each valve and two pinions 31^a connected to the ends of the shafts 32, supported by brackets 33. A lever 34, fitted with spring-catch 34^a, is keyed to the valve-spindle and its motion to right or left limited by the slots 35. By turning around this lever the three valves can each be made, by means of the bevel-gear, to occupy the required position, which we prefer to indicate by a pointer 36, moving over a plate or dial 37, suitably marked on the exterior of each valve. (See Figs. 9 and 10.)

Mounted between the admission-ports 26, opening into the recess, are three slide-chests 38 38^a 38^b. These are each fitted with a cut-off slide 39, the function of which is to form a piston back or stopped end behind the pistons in the direction of motion and to open at the proper moment to enable the pistons to pass. These chests may be fastened to the flanges by angle-plates 39' and bolts and nuts or be formed with or mounted in any other suitable manner. Each slide, which is preferably of the segmental shape shown in Fig. 5, is carefully faced and fitted to the chest and a steam-tight joint made by scraping or the like and the cover 39'' and side cover 38^c fastened by screws. At a suitable point in each slide a hole 40 of sufficient size to permit the pistons to pass is drilled or bored. A slot 41, which enables the slide 39 to be removed without disturbing the chest, is formed in the slide and a spindle 42, with a square 43, journaled in a stuffing box or bush in the casings. A spring 39''' is employed to keep slide against the base of the chest. Crank-arms 44 44^a are keyed to the ends of each of these spindles and connected by pins 44' through two links 45 45^a, slotted, as at 46, and pivoted to the studs 47 47^a. A short connecting-rod 48 48^a is pivoted, as at 49 49^a, to each of these levers through links 49' 49^a' and is adjustably fastened to a cross-head 50 50^a, each of which is fitted with a guide-spindle 51 and guide 52 and carries a roller 53, operated by two lifts 54 54^a, attached to or formed upon the sides of the packing-plates 8''' on disk 8. The stroke of the slides is adjusted by the nuts 48' on connecting-rods 48 48^a. The function of the shorter lifts 54 (shown in Figs. 1 and 3) is to open each slide at the proper moment for the pistons to pass, while that of the longer lift 54^a (shown in Figs. 2 and 4) is to close the same after the piston has passed, so as to form a piston back or cover.

The operation of our invention is as follows: Steam, compressed air, or other fluid under pressure is admitted through pipe 23 to the main valve-chest 18 and passes out through the valve 16 and by one or other of the distributing-pipes 23^a 23^b 23^c to that reversing-valve which is in position to admit steam behind the piston. At this moment the slide

39 behind and in front of this piston will be closed, the exhaust-steam being swept out of the cylinder by the advancing piston through port 26, passage 25, and through exhaust-opening 28 in valve to condenser or chimney, as the case may be. Reference to the drawings will make clear that when one of the elongated pistons is, say, in the center of its stroke the other is in the act of passing through the opening in the slide 39, so as to be ready to take steam. The engine is reversed by rotating, by means of the lever, pinions, and bevel-gear, the three valves shown so as to reverse the direction in which the steam was entering previously.

Our invention is not confined to the use of a single cylinder and components. Two or several of these may be mounted on one shaft, if desired. We may also increase the number of sections to six with four pistons, and so on, if required. The flanged recess may also be cast, pressed, or otherwise formed in several parts, if more convenient.

What we claim, and desire to secure by Letters Patent, is—

1. In a rotary engine, the combination of a rotary shaft and disk carried thereby with packing-rings 8', 8'', arranged parallel to the peripheral parts of the disk on both sides of the peripheral parts of this disk, annular plates 8''' arranged outside of the said rings and parallel to the said disk, the said plates being fastened to the latter for clamping the said rings thereon, pistons carried by the said disk, a cylinder in which the said disk revolves, inlet and exhaust valves and passages for the sections of the annular space between the cylinder and disk, slides for dividing the said space into such sections, and mechanism for operating the said valves and slides, substantially as set forth.

2. In a rotary engine, the combination of a rotary disk and an exterior cylinder concentrically arranged with respect to the same at an interval, with packing-rings arranged in pairs on each side of the peripheral part of the said disk-plates parallel to the sides of the latter, means for fastening the said plates to the said disk to hold the said packing-rings in place, pistons turning with said disk and means for applying pressure to one side of each piston in succession, substantially as set forth.

3. In combination with a rotary disk, the pistons carried thereby, and a fixed surrounding cylinder, a series of pivoted segmental slides for dividing the intervening space into sections, slide-chests through which the said slides respectively operate, a spring interposed between the said slides and their pivots, and mechanism for oscillating the said slides, each slide being provided with a hole for allowing the passage of a piston and with a slot for receiving one of the said springs and allowing the removal of the slide at will, substantially as set forth.

4. In combination with a rotary disk, the

pistons carried thereby and a surrounding cylinder, a segmental slide for dividing the intervening space into sections and provided with an opening for the passage of a piston, 5 and a series of actuating devices for each slide, consisting of the pivot-spindle 42, crank-arms on the ends of these spindles, two lifts, one being shorter than the other, means for operating the same and links, levers and other 10 intervening devices whereby the said lifts are connected to the said cranks, the function of the shorter lift being to move the slide into position for presenting the said opening to the pistons, whereas the longer lift moves the 15 slide into position to present its solid side, thereby dividing the said space into sections, substantially as set forth.

5. In a rotary engine, the combination of the main admission-valve, the rotary disk, 20 pistons and cylinder with three tapering re-

versing-valves 30, 30^a, and 30^b, and the necessary steam-passages, the said valves being adapted to serve for admission or exhaust in either direction as rotated, the bevel-wheels 31 on the spindles of these valves, the pinions 25 31^a gearing therewith, the shafts 32 carrying the said pinions, and the lever 34 provided with spring-catch 34^a and limited in its motion by a slotted fixed part, the said lever serving through the said gear-wheels to give 30 the required position to the said valves and secure synchronism, substantially as set forth.

In testimony whereof we hereunto affix our signatures in the presence of two witnesses.

GEORGE EDMUND KIRBY.
HENRY WILLIAM CROWTHER.

Witnesses:

EDMUND WILLIAM LUKE,
JOHN GALE PEDRICK.