3 Sheets—Sheet 1.

B. FITTS.

WATER-METER.

No. 178,829. Patented June 13, 1876.

Fig. 1.

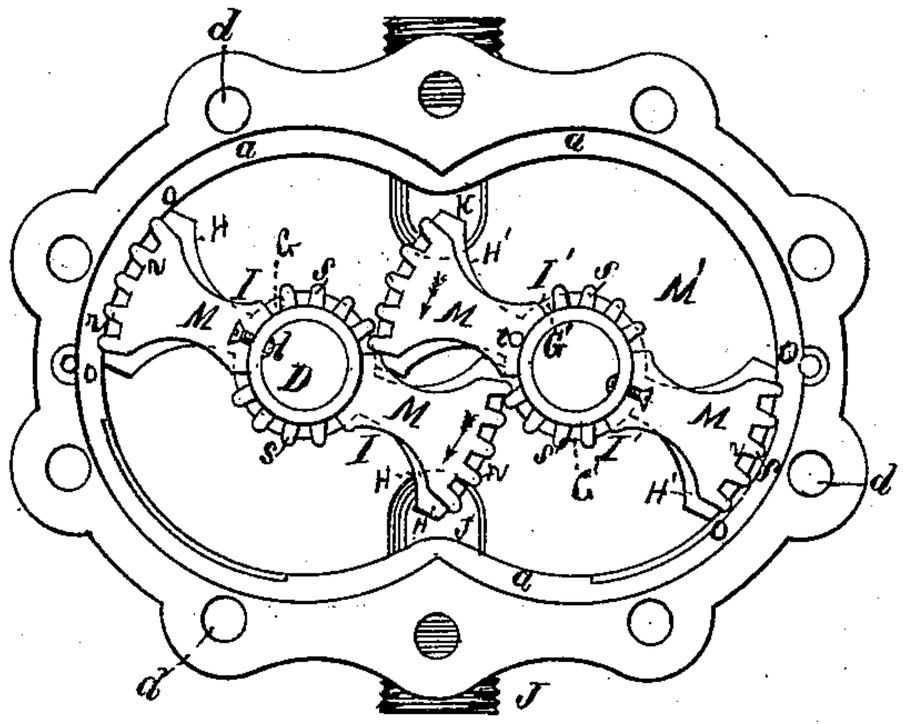


Fig. 2.

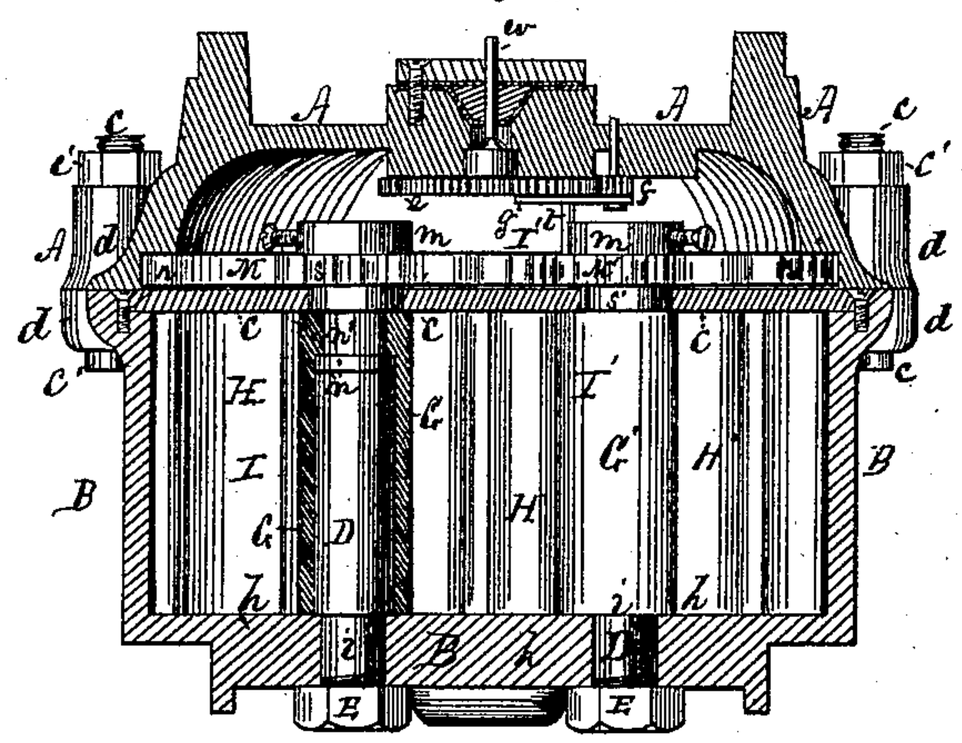


Fig. 3.

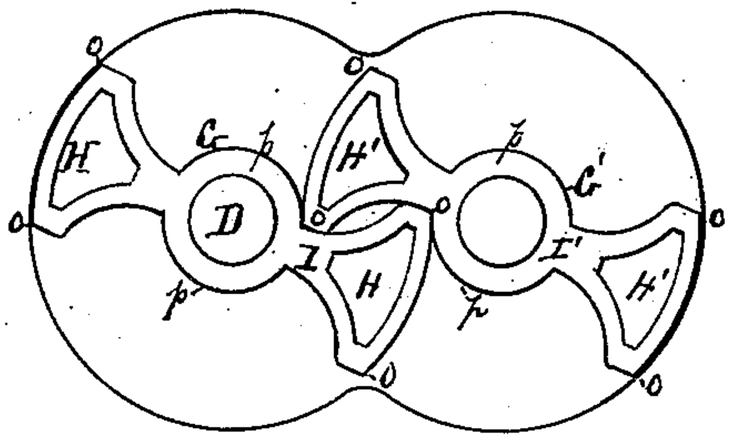
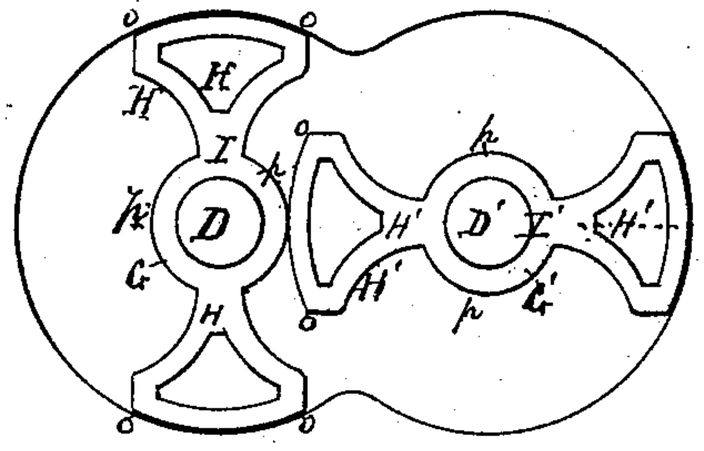


Fig. 4.



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3 Sheets—Sheet 2.

B. FITTS.

WATER-METER.

No. 178,829. Patented June 13, 1876.

Fig. 10.

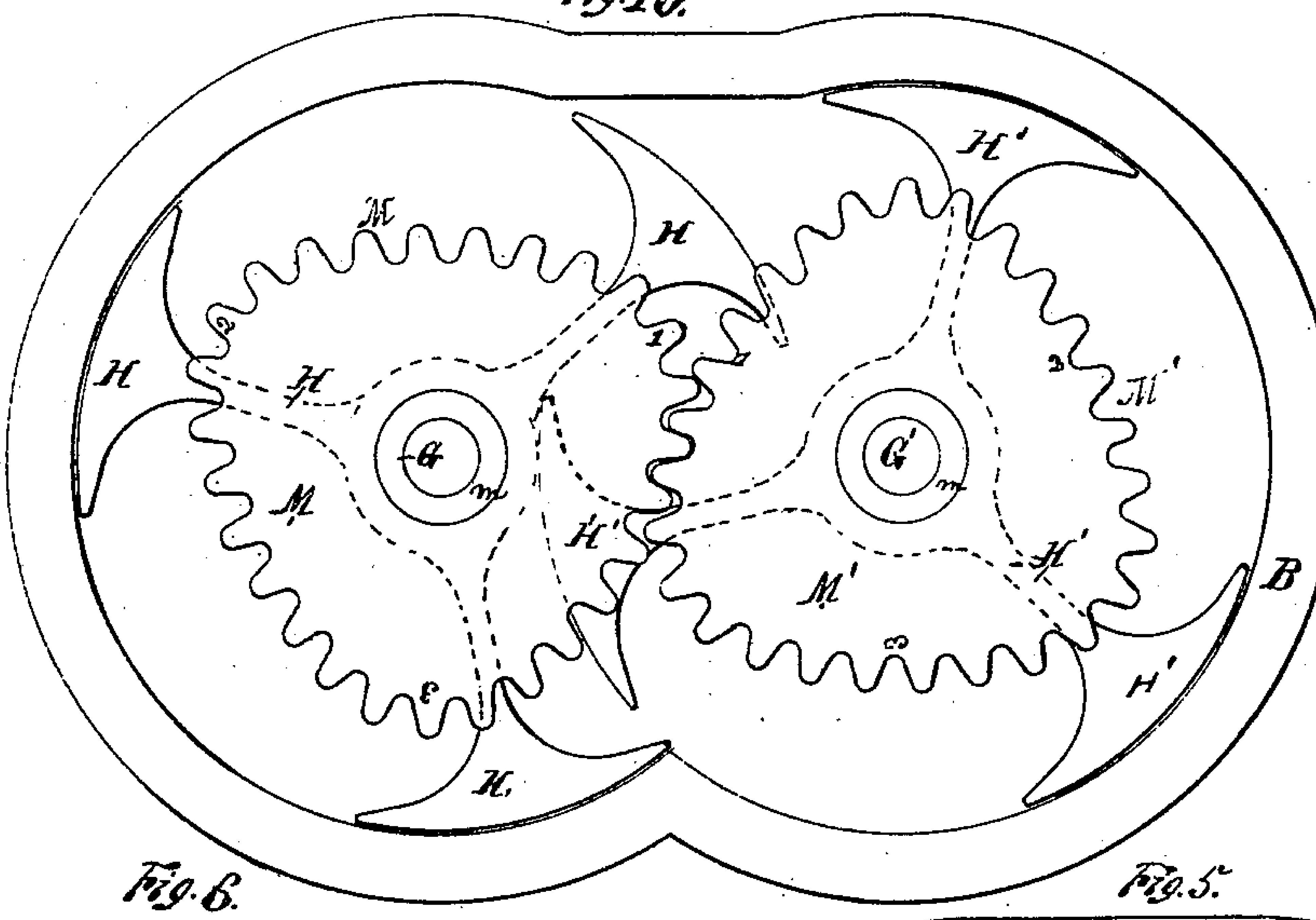


Fig. 6.

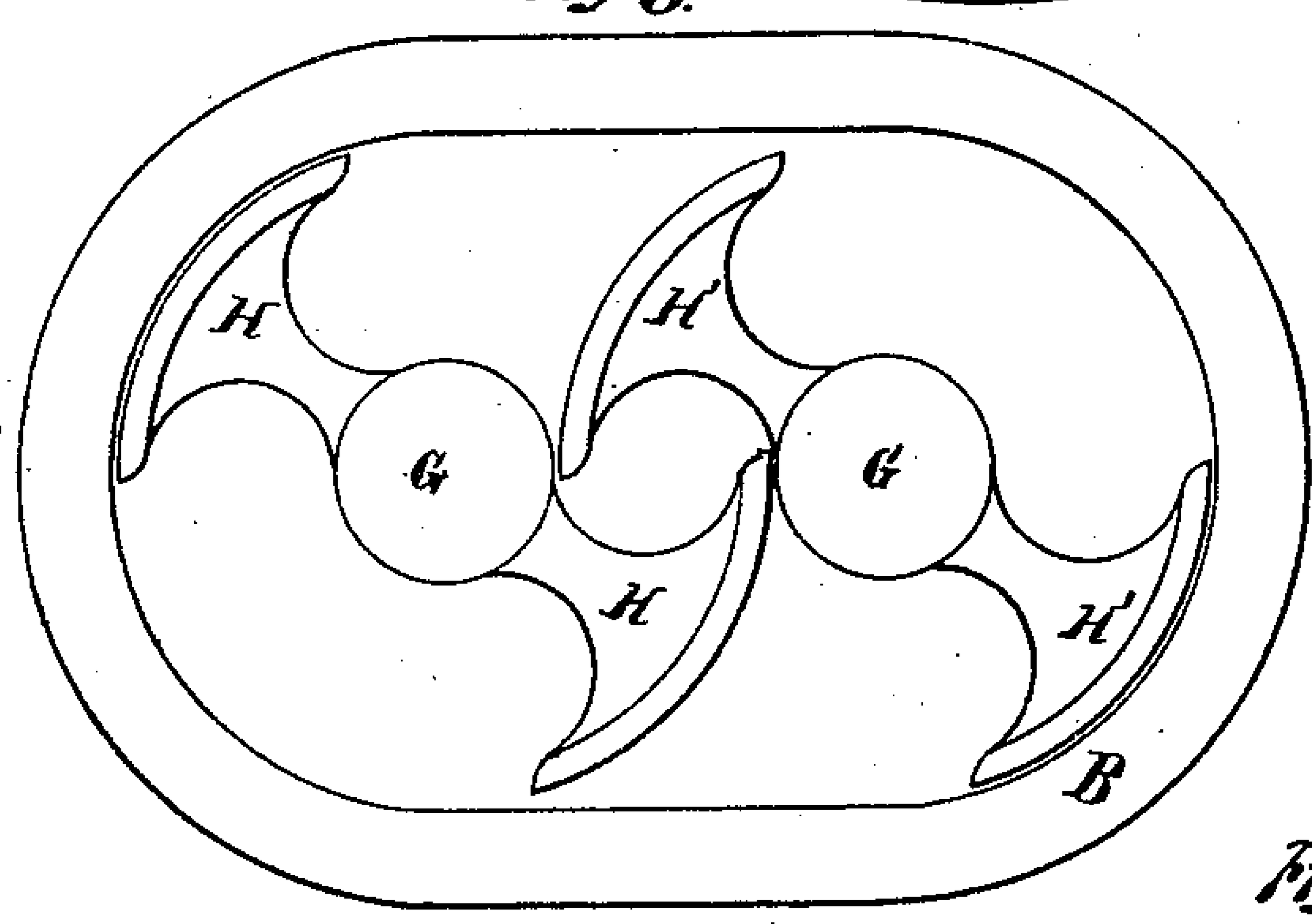


Fig. 5.

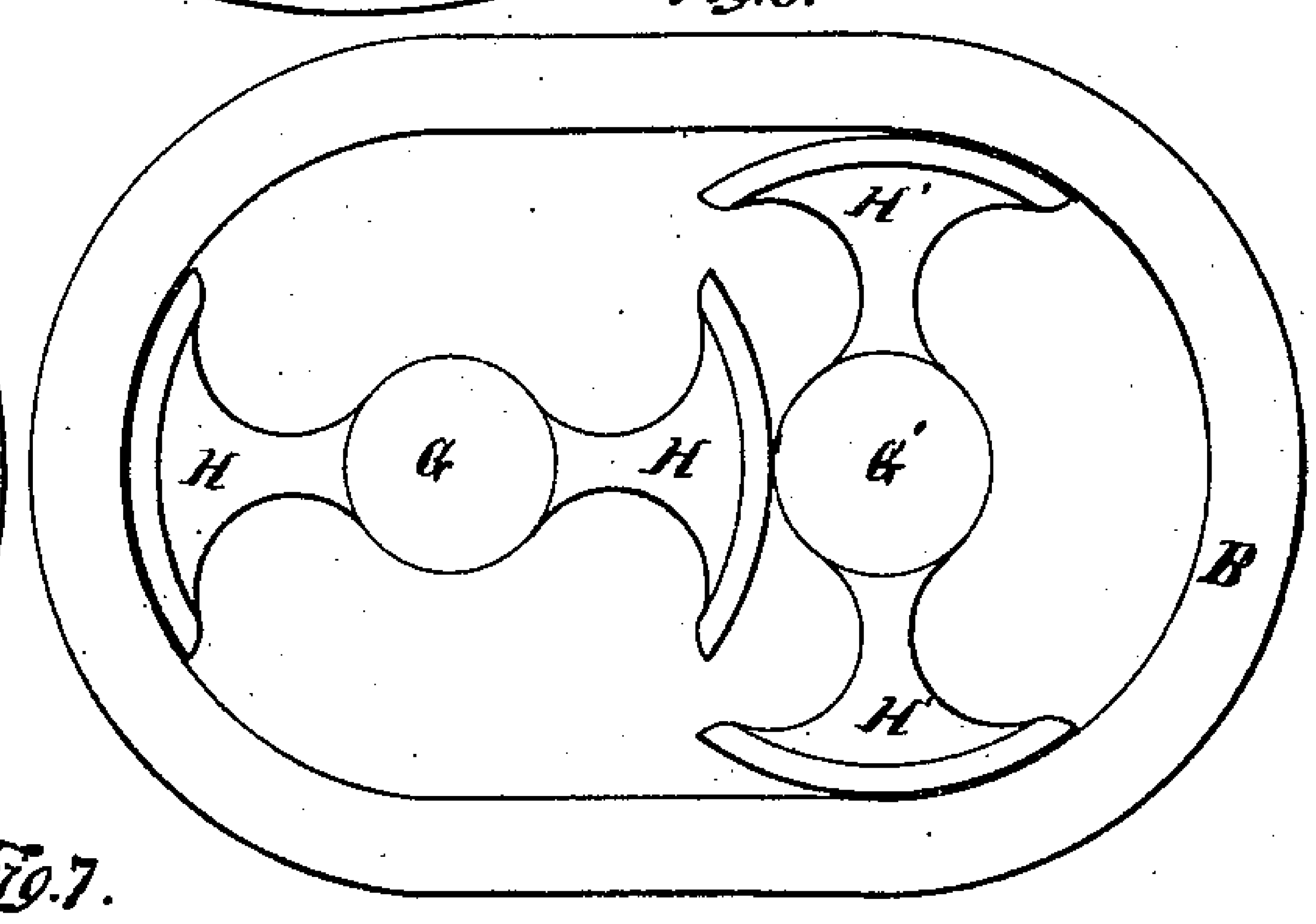
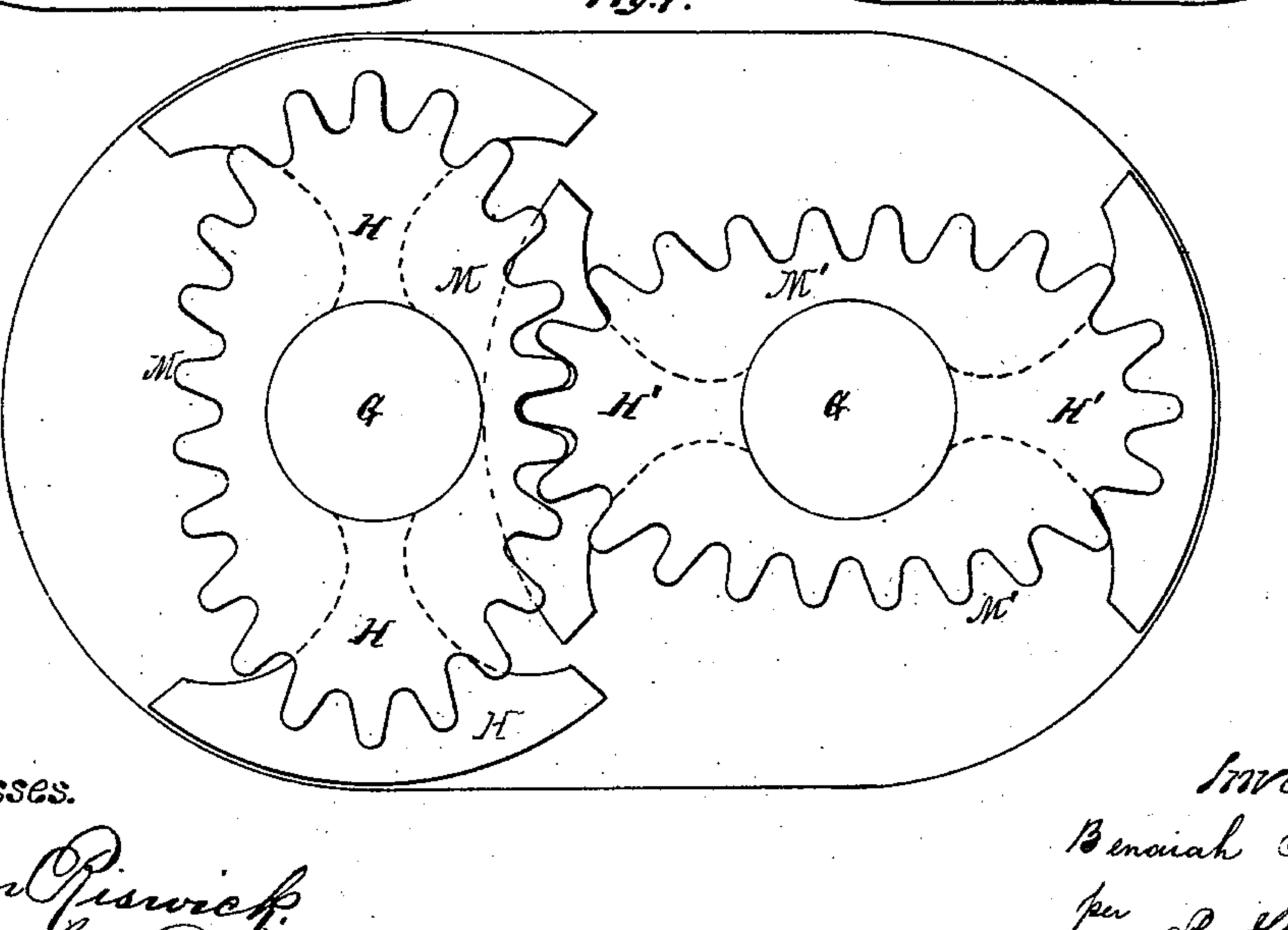


Fig. 7.



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3 Sheets—Sheet 3.

B. FITTS.

WATER-METER.

No. 178,829. Patented June 13, 1876.

Fig. 8.

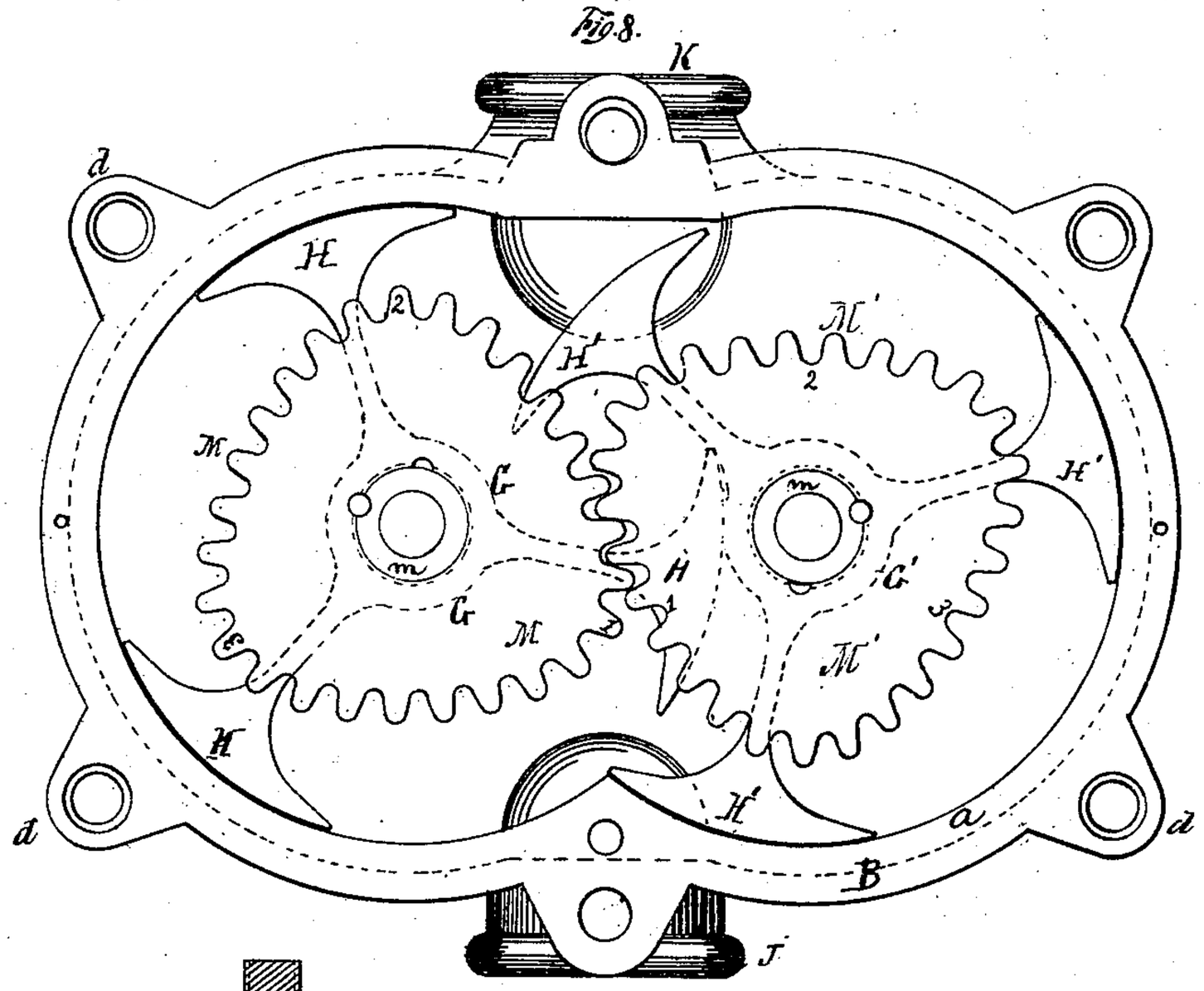
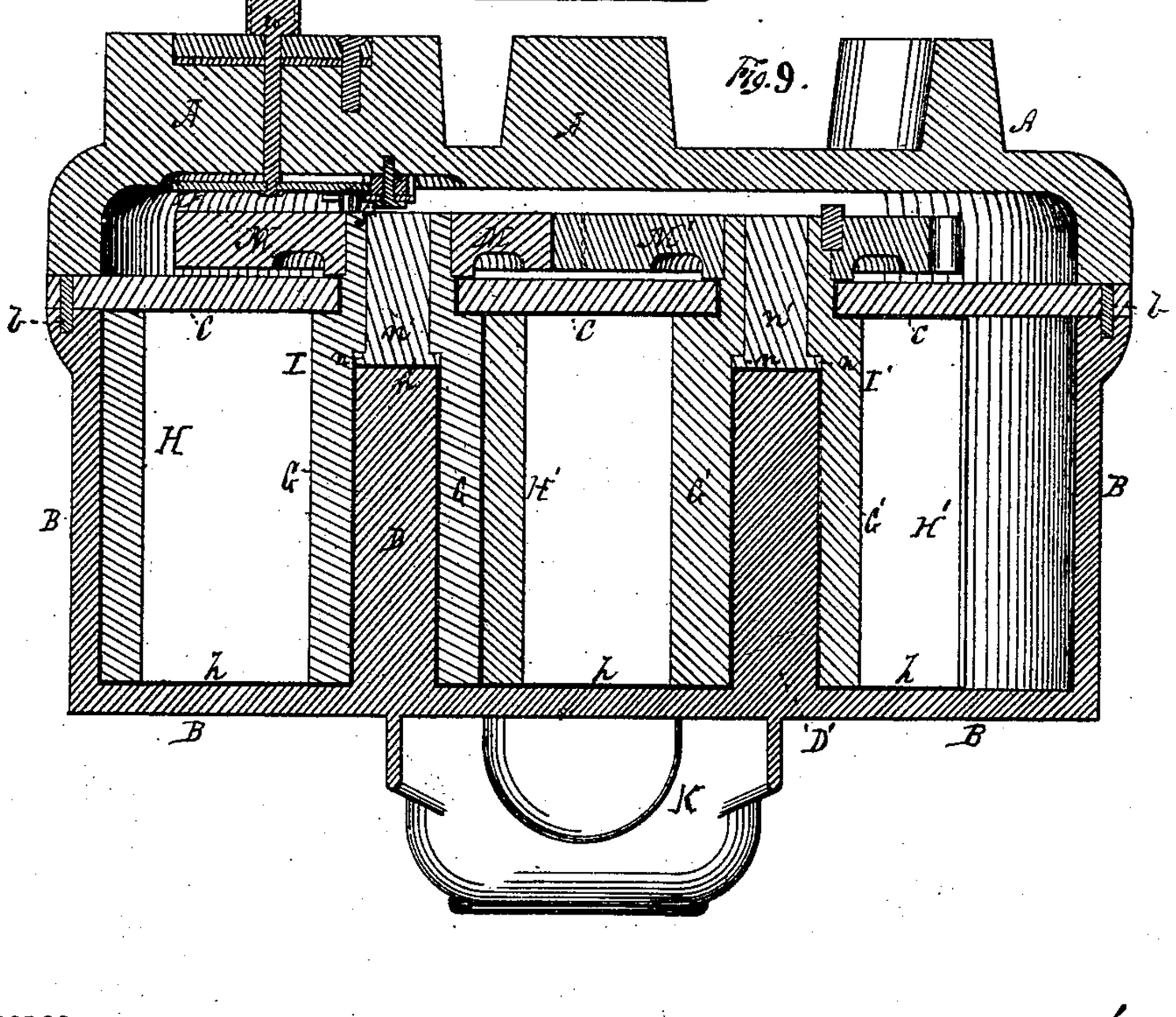


Fig. 9.



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atty.

UNITED STATES PATENT OFFICE.

BENAIAH FITTS, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO UNION WATER METER COMPANY, OF SAME PLACE.

IMPROVEMENT IN WATER-METERS.

Specification forming part of Letters Patent No. **178,829**, dated June 13, 1876; application filed May 18, 1875.

To all whom it may concern:

Be it known that I, BENAIAH FITTS, of Worcester, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Water-Meters; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings and to the letters of reference marked thereon, which form a part of this specification, in which—

Figure 1 represents a plan of my improved meter, the cover and partition-plate being removed in order to show the relation of the rotary pistons and gears to each other. Fig. 2 represents a vertical longitudinal section of the same as taken through the center of the apparatus, but showing the cover, partition-plate, and the driving portion of the registering apparatus in position, the last, as well as the gears and pistons, being shown in elevation, with the exception of the hub of one of the pistons, which is shown in section to illustrate the method of mounting the piston on its stud. Figs. 3 and 4 are diagrams illustrative of the relative movements of the rotary pistons with respect to each other at different points of their circuit, Fig. 3 being that shown in Fig. 1, and Fig. 4 when at right angles to each other. Figs. 5 and 6 represent similar diagrams of a modified form of the pistons, the relative positions of which are the same as those shown in Figs. 3 and 4. Fig. 7 illustrates, on a somewhat larger scale, a modified form of gear for driving the pistons, and well adapted to the form of pistons shown in Figs. 5 and 6, and shows the relative position of the gears to the pistons. Fig. 8 represents a similar plan to that shown in Fig. 1 of a modified form of my improved meter, each hub carrying three instead of two pistons, as in the former case. Fig. 9 represents a vertical longitudinal section of the same; and Fig. 10 a plan similar to Fig. 8, but showing one of the changes in the relative position of the pistons and gears as they perform their circuit.

My improvement relates solely to rotary fluid-meters as contradistinguished from reciprocating meters.

My invention consists, first, in constructing those portions of a set of radial pistons, which, when combined with another set, respectively come in contact with the relatively-corresponding portions of the other set, in segments of concentric circles.

Secondly, it consists in so arranging and combining two sets of radial pistons thus constructed that when in position the periphery of the pistons of each set shall, respectively, extend to, bear against, and form a close joint with the smaller segmental portions of each other, and in such manner that there shall always be contact during every stage of their revolution between a radial piston of the one set and the corresponding smaller segmental portion of the other set, and this alternately and successively.

Thirdly, it consists in combining with the two sets of pistons thus arranged and constructed, gears of like and suitable construction, such as those to be hereinafter described, by which not only to confine them to their proper relative positions with regard to each other, but to prevent interference between the pistons of each set as they are made to revolve by the pressure of the water or other fluid being measured.

Fourthly, it consists in mounting or supporting each set of radial pistons on steps or studs by means of a hub on which they are formed or otherwise secured, the upper or outer end of which forms the shaft on which the gears are made fast.

Fifthly, it consists in combining with two sets of measuring-pistons thus constructed and arranged suitable mechanism, such as will be hereafter described, for driving the registering apparatus.

To enable others skilled in the art to make, construct, and use my invention, I will now proceed to describe its parts in detail.

The shell of the apparatus I propose to make in two principal parts, of which the cover or cap-piece A forms one and the lower portion or casing B the other. Between the two is arranged a metallic diaphragm or partition-plate C, which fits in a depression, *a*, (see Fig. 1) formed on the upper internal edge of the casing B. Partition C is secured by screws *b* to casing, as shown in Fig. 2. Cover

A is secured to casing B by screw-bolts *c* and nuts *c'*, which are made to pass through corresponding lugs *d d*, formed on each. Cover A carries or supports the registering apparatus of the meter, of which the transmitting-gear *e*, driving-pinion *f*, and actuating-crank *g* are only represented in the drawing, as the balance is made and applied in the usual manner, and therefore unnecessary here to be described or shown. In the bottom plate *h* of casing B, at a regulated distance apart, (see Fig. 2,) are cut two openings, *i i*, for the reception of the ends of two studs, D D'. The lower end of each of these studs is made of smaller diameter than their upper end, and are made to project through the bottom plate *h* sufficiently far to receive a screw-nut, E, they being provided with a corresponding screw-thread, by which to secure them firmly to the bottom plate, and with a water-tight joint. Or, instead of making and securing them in that manner, they may be cast in one piece with bottom plate *h*, as shown in Fig. 9; but the former is preferred, as it is easier to turn them, that they may form a smooth and suitable axial stud for the hub of the piston. Upon each of these studs D D', and which are made to extend upward to within a short distance of the under side of partition C, is mounted a piston-frame, I or I', by means of a hub, G or G', each carrying two or more radial piston-blades, H or H'. In Figs. 1 and 2, stud D supports a piston-frame, consisting of a hub, G, cast in one piece, I, with two radial pistons, H H, while stud D' carries a corresponding piston-frame in every respect, consisting of hub G' and pistons H' H'. If desired, the hubs and pistons may be made separately and afterward secured to each other, but the other is preferred. In this case the pistons H H and H' H' are arranged on the diametrically opposite sides of their respective hubs. The upper end of each hub is made to extend through and for some distance above partition-plate C, so as to receive a gear, M, for hub G and gear M' for hub G'. These gears are keyed, as in Fig. 9, or otherwise made fast to the hubs, as, for instance, by means of a screw, *l*, passing through a collar, *m*, formed on them as a hub for the purpose, and into an indentation made in the side of their hubs G and G', as shown in Figs. 1 and 2. Referring to Fig. 9, where the hubs, studs, gears, and partition are all shown in section, it will be seen that the upper end of the hubs G or G' are turned down as they enter partition-plate C, so as to form a shoulder to abut against the under side of the latter, and yet further turned down as they leave it so as to form another shoulder for the under side of the gears M M' to abut and bear against when keyed or otherwise made fast thereto.

Moreover, from the same figure, it will also be seen that the cylindrical opening through the hubs, for the reception of their axial studs D or D', are not of uniform width throughout, it being made smaller at their upper end, and into which is snugly fitted a pin, *n'*, having a head, *n*, of a size equal to, or nearly so, of the diameter of the studs. The thickness of the head of pin *n'*, which forms the actual support of the whole piston-frame—*i. e.*, hub and pistons, as well as gears—is such as to just support and carry the lower edges of the pistons H or H', and their hubs G or G', clear of the inner face of the bottom plate *h* of casing B. The vertical depth or acting faces of the pistons extend from the inner faces of partition C and bottom plate *h* of casing B.

Figs. 3, 4, 5, 6, and 7 illustrate suitable external shapes of the pistons, where two are used as a full set for each of the two piston-frames; and Figs. 1 and 7 the relative arrangement of the gears, with respect to the pistons. Figs. 8 and 9 represent suitable shapes for pistons, where each piston-head carries three pistons; and Fig. 8 suitably-shaped gears, properly arranged with respect to the pistons to operate in connection therewith.

The leading features of these pistons consists in making the curved portion of the outer end or face of the pistons—say, from *o* to *o*—and the outer face of those portions—say, from *p* to *p* of the hubs—contained between the radial arms, which constitute the pistons, segments of concentric circles struck from their center of motion. By this means, when the outer curved face *o* of the pistons is brought in contact with the curved face *p* of the hubs, the joint is not affected by imperfections or wear of the outside gears.

Theoretically the distance apart from center to center of the studs D D' should be the length of any of the piston-blades H or H', from its center to its periphery—plus the length of the radius of the hub, as taken at any point between the curved portions *p p* and its center of motion; but practically it should be the veriest trifle more.

In Figs. 1 and 2, the gears are shown as consisting of the segmental variety, each gear M or M' consisting of four segmental gears concentrically arranged in pairs and conforming in their arrangement and position to the curved portions *o o* of the pistons and *p p* of the hubs, the curved form of the periphery of the pistons and hub being precisely that of the pitch-line of the gears—that is to say, gears *r r* with the curves *o o* of the pistons, and gears *s s* with the hub-curve *p p*.

By this construction of the gears, pistons, and hubs a constant tight joint between the pistons and hubs is insured, as thereby an easy rolling instead of a sliding joint is obtained; while the piston-blade that drives has the advantage at all times of its small hub-gear *s* working into the larger gear *r* of the other, and consequently the advantage of leverage. This motion also serves to make the pistons clear each other, the one for this purpose being made alternately to move faster and slower than the other, the piston whose small gear *s* is engaged with the large gear of

the other being made to move for the time being faster than the latter, thus moving its own piston away from the advance of the piston it is then driving. Let us take, for instance, the position of the pistons, as shown in Fig. 1, they moving in the direction of the arrows. The outer piston I, by its small gear *s*, is now driving the inner piston I′ through its large gear *r*; and, consequently, to do so must move relatively faster than the latter piston, thus moving its own opposite piston I away from the advance of piston I′ faster than the latter can advance, because of the greater arc its gear *r* has to traverse, than the smaller arc of gear *s* with which it is in gear.

Ordinarily, either of the ports J and K may be the eduction or induction ports of the meter; but in this instance, the pistons moving in the direction of the arrow, port J forms the induction and K the eduction ports.

To the upper side of gear-plate M′ that carries the segmental gears *r* and *s*, and immediately adjoining its hub or collar *m′*, is secured a crank-pin, *t*, which, engaging with crank-arm *g* of the driving-pinion *f*, imparts motion to gear *e*. On the inner end of the spindle *w* is mounted the pinion that drives the train of gears, the spindles of which carry the index-fingers of an ordinary registering apparatus, and which it is deemed unnecessary to be further referred to or described, as such may be of any improved, known, and suitable variety.

In Fig. 7 is shown a somewhat different style of variable gears, in which but two are used, they also being intended to be employed in connection with hubs G and G′, which carry two radial arms or pistons, I I′, constructed substantially like those in Figs. 1 and 2. In this case, with the same distance from center to center of the studs D D′, the hubs G G′ are relatively larger, and pistons smaller, than the hubs and pistons in the former case, and are connected and operated in connection with gears of correspondingly greater and less minor and major axes or diameters, resulting in oval-shaped gears of uniform size and number of teeth; the latter being suitably shaped to adapt them to their change of form. With those gears the longer diameter corresponds with the length of the pistons, and their shorter or conjugate axis with that of the hubs, and are so combined that the teeth at the end of the longer axis mesh with those of the shorter, thereby producing substantially the same effect as that produced by the segmental gears, in the apparatus shown in Figs. 1 and 2. The difference is, the latter can be made to operate with a lower head or smaller stream of water than can be done by the former.

In Figs. 8 and 10 a meter having my improvement applied thereto is shown in connection with two hubs, G G′, each of which carry three radial blades or pistons, I I′. Such a construction requires a corresponding change in the variable gears, in order that the pistons may properly clear and operate each other. A suitable form for this purpose is shown, consisting of triangular gears M M′ provided with teeth of suitable pitch. These gears are arranged with respect to each other and to their respective pistons on precisely the same principles as those already described and shown in Figs. 1 and 7, and operate on the same plan, the teeth at the apices of the angles being respectively in a line, or nearly so, with the radial arms, and with respect to each other, so that the apex or longest radial tooth of the one—say, No. 1 of gear M—shall take into the shortest corresponding radial depression, No. 1, of the other, M′, and so on, producing substantially the same effect as in the others.

Again, by placing the studs D D′ somewhat further apart, and then making the curved parts *p p* of the hub of each correspondingly larger, then circular gears may be used, but it would not shed nearly as much water, although it would make a good motor.

In all cases the working portions of the inner face of the casing B are made to conform to the sweep of the pistons, with the exception of that portion adjoining the mouths of the induction and eduction openings J and K, which do not absolutely conform.

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

1. The combination of two eccentric gears, M and M′, with two rotary pistons, I I′, each consisting of two or more radial piston-blades having a curved outer end, *o*, and of a hub, G, provided with two or more curved portions, *p p*, substantially as and for the purposes set forth.

2. The combination of two pistons, I I′, constructed and arranged substantially as described, with two gear-plates, I I′, each carrying four concentric segmental gears, *r r* and *s s*, in the manner and for the purposes set forth.

3. The combination of a rotary piston provided with two or more radial piston-blades and a hollow hub, with a stud formed on or otherwise rigidly secured to the bottom plate *h* of the casing, in the manner substantially as and for the purposes set forth.

4. In combination, with the two rotary pistons and gears of a meter, the pin *t*, spindle *v*, and its crank *g*, as a means of imparting motion to the mechanism of a registering apparatus, substantially as described.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

BENAIAH FITTS.

Witnesses:
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S. AUGUSTUS WELCH,