No. 617,793. **Patented Jan. 17, 1899.**

J. J. WOOD.

REGULATOR FOR CONSTANT CURRENT DYNAMOS.

(Application filed July 8, 1898.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 2.

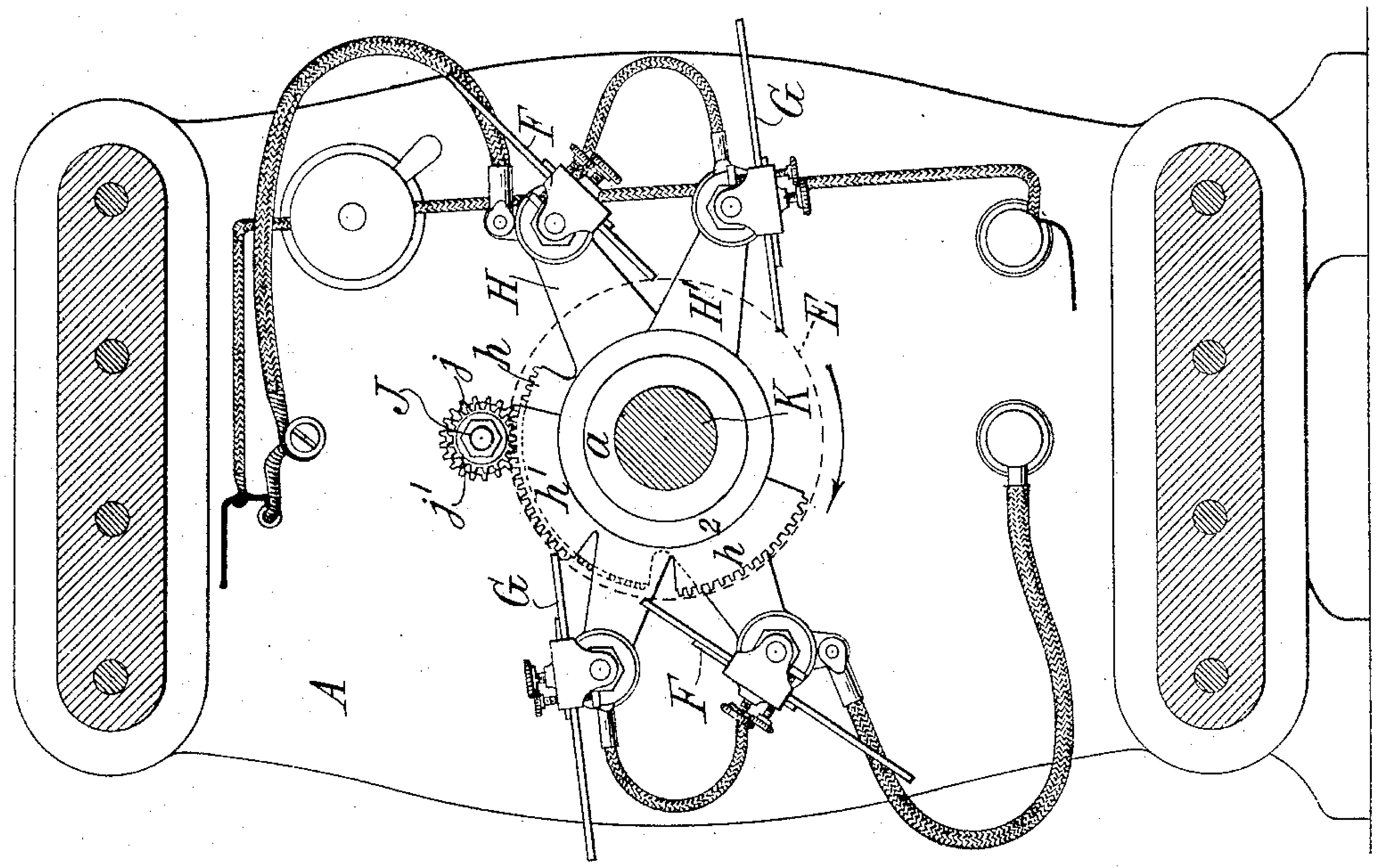
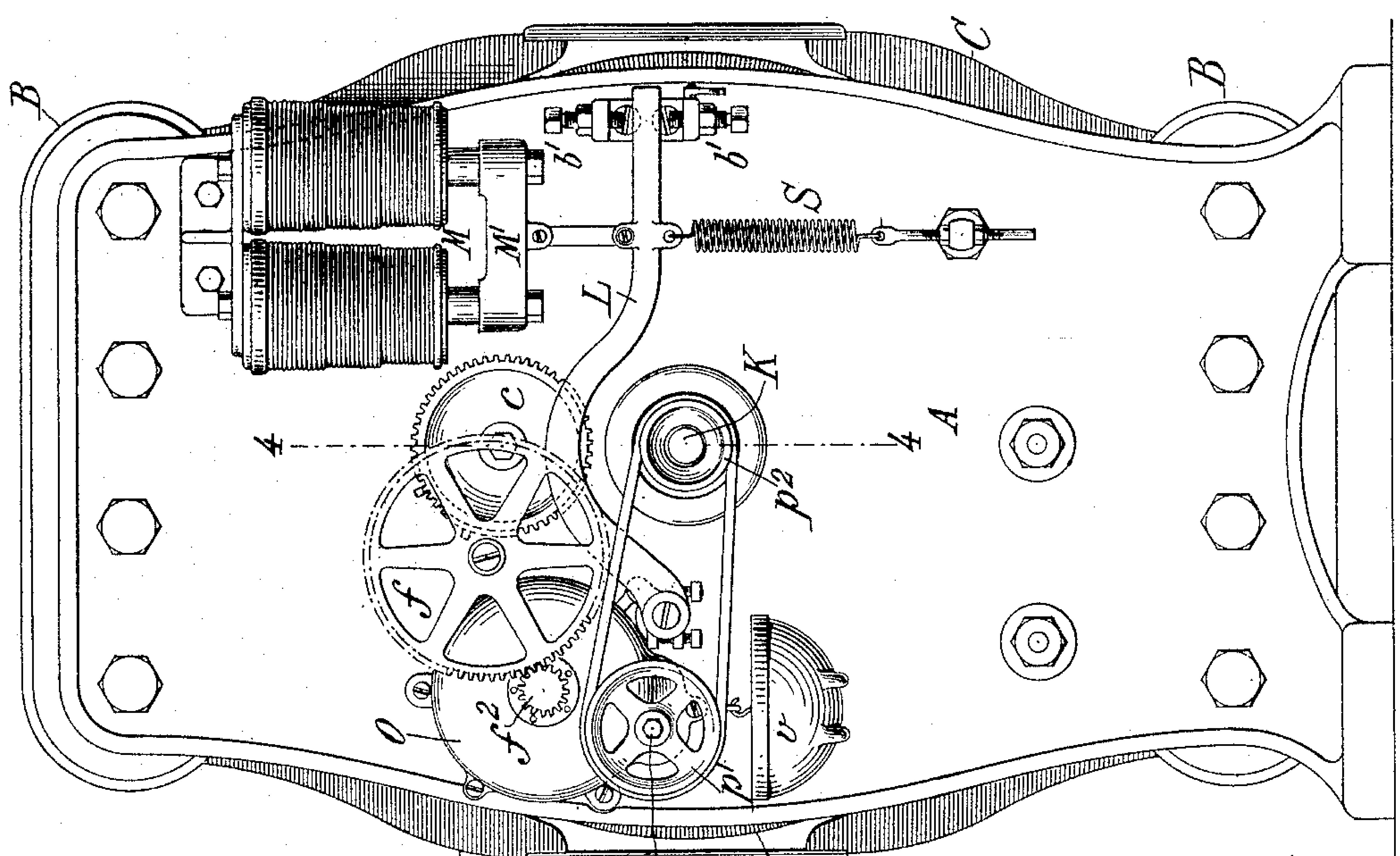


FIG. 1.



WITNESSES:

Fred White

T. F. Wallace

INVENTOR:

James J. Wood,

By his Attorneys,

Arthur C. Fraser & Co.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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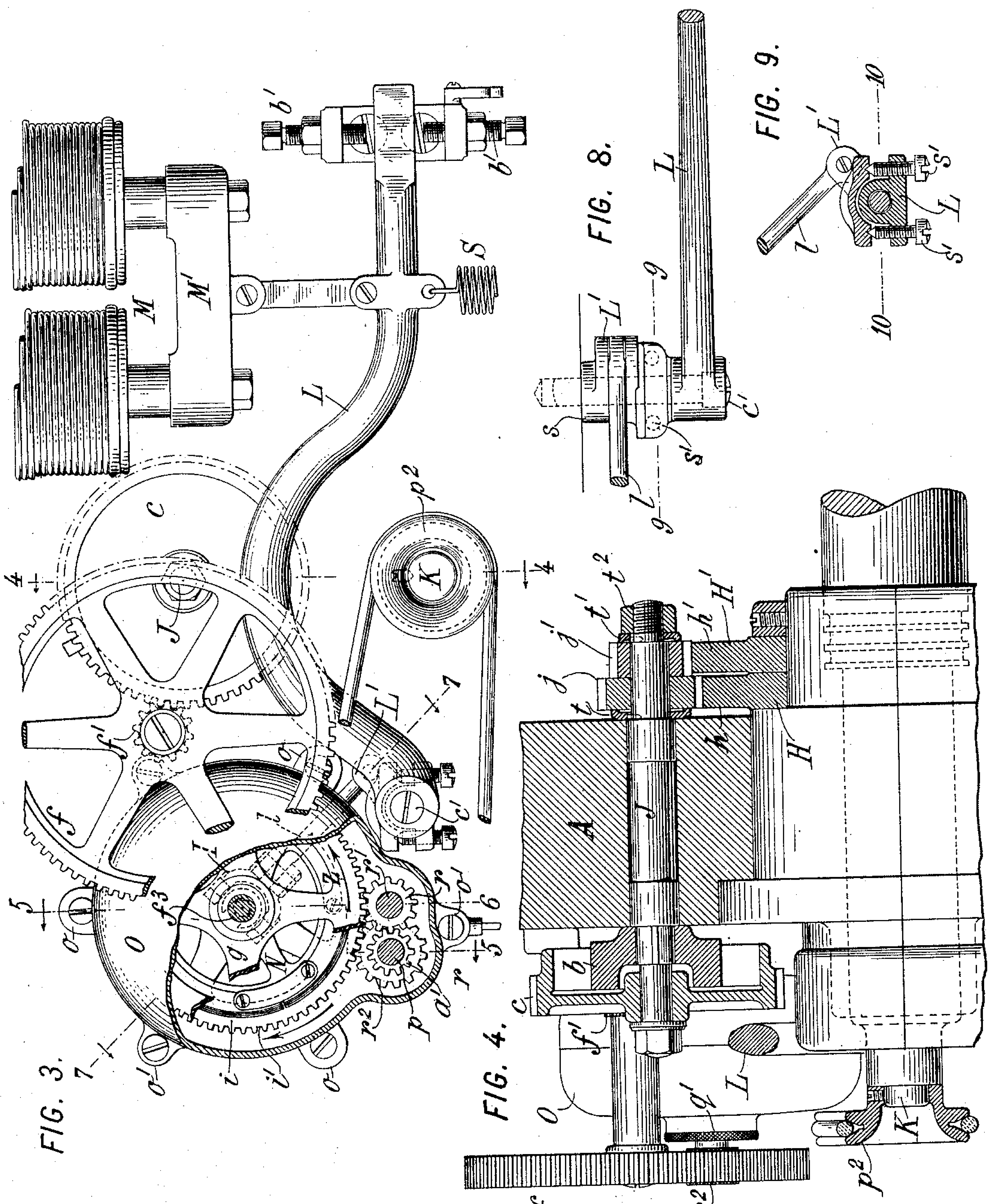

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4 Sheets—Sheet 3.

FIG. 5.

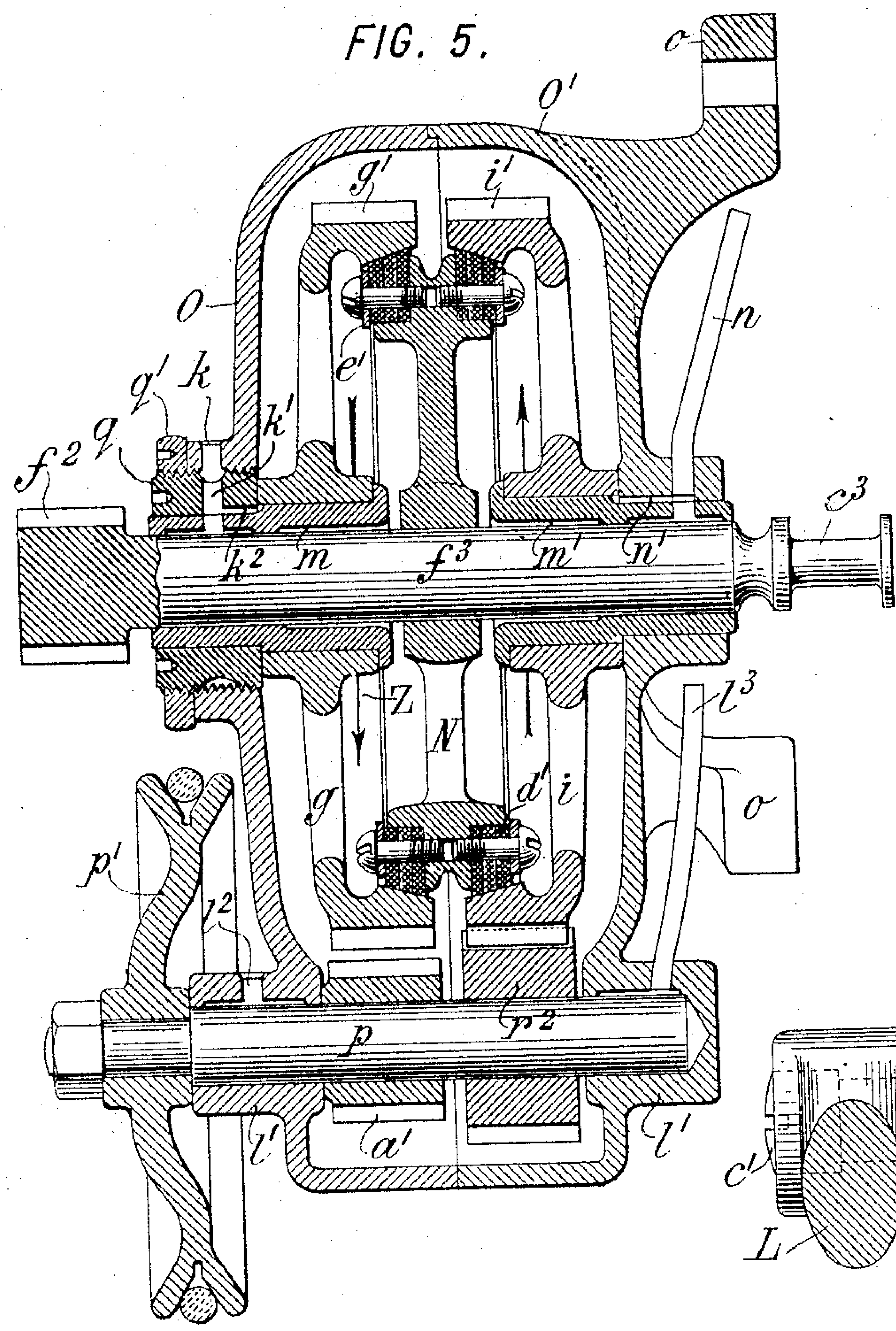


FIG. 7.

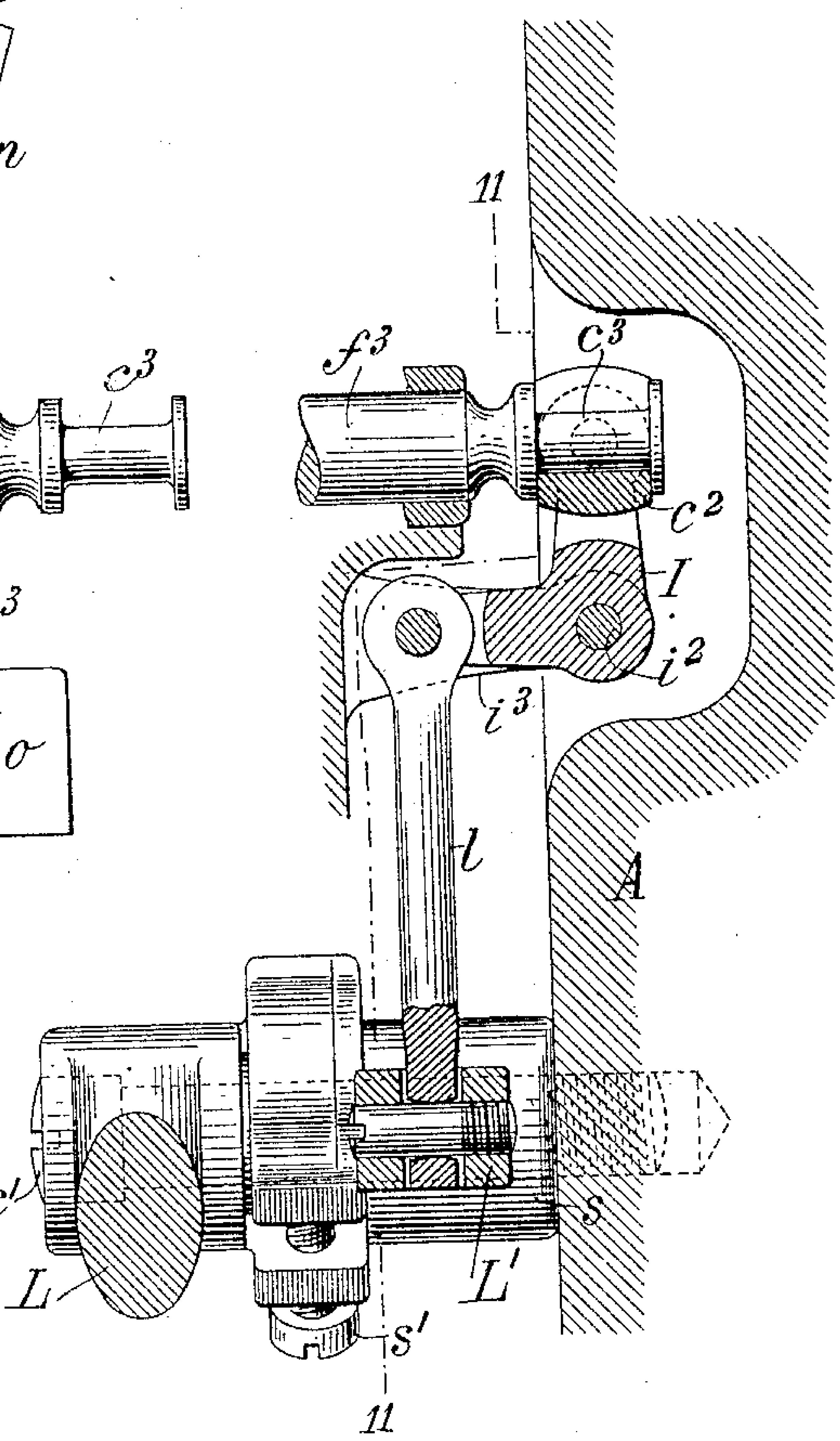


FIG. 6.

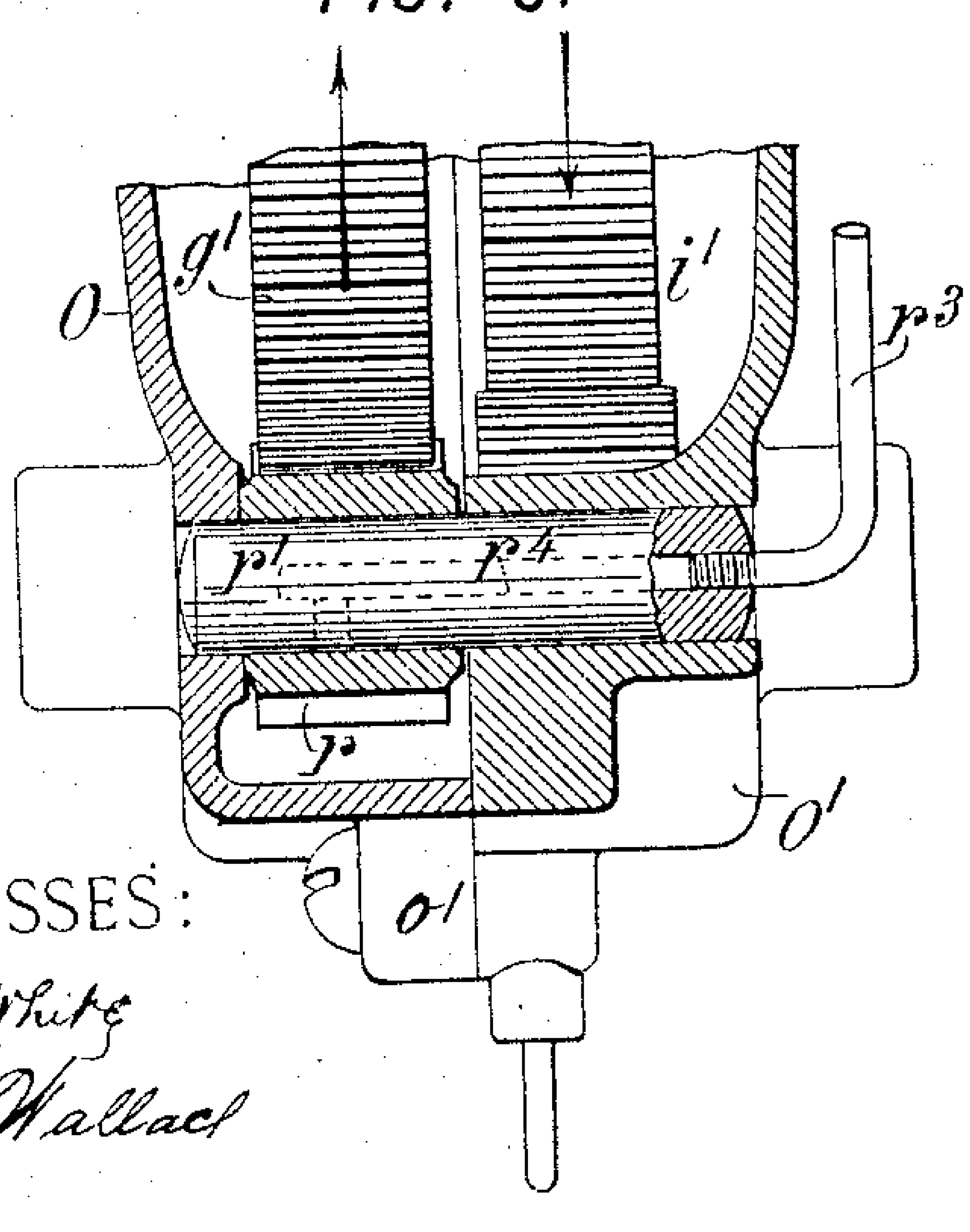
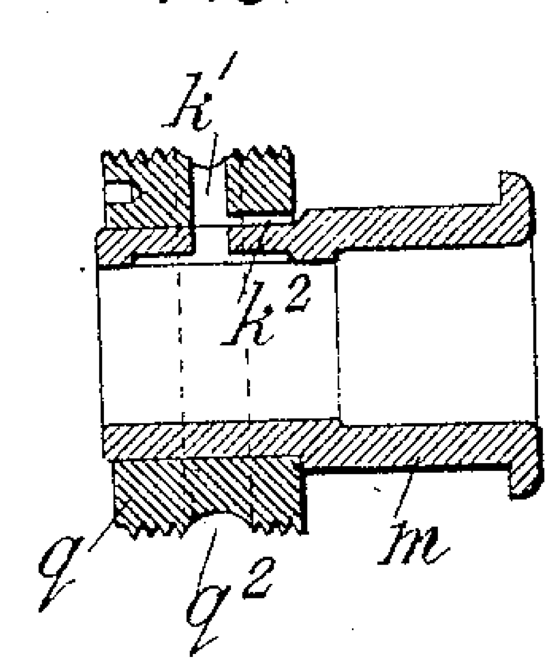


FIG 15.



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(No Model.)

FIG. 10.

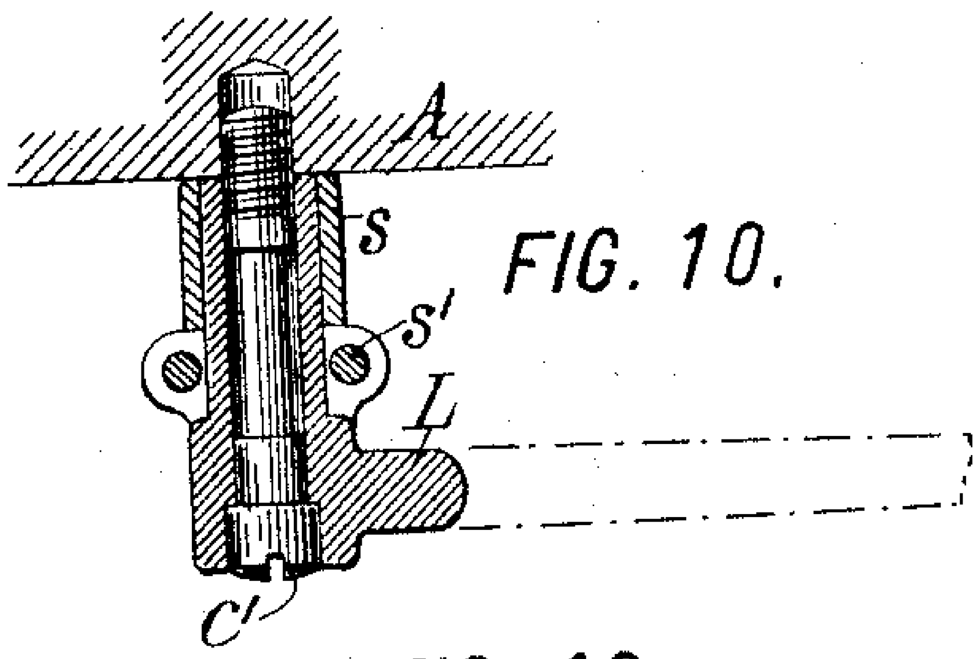


FIG. 11.

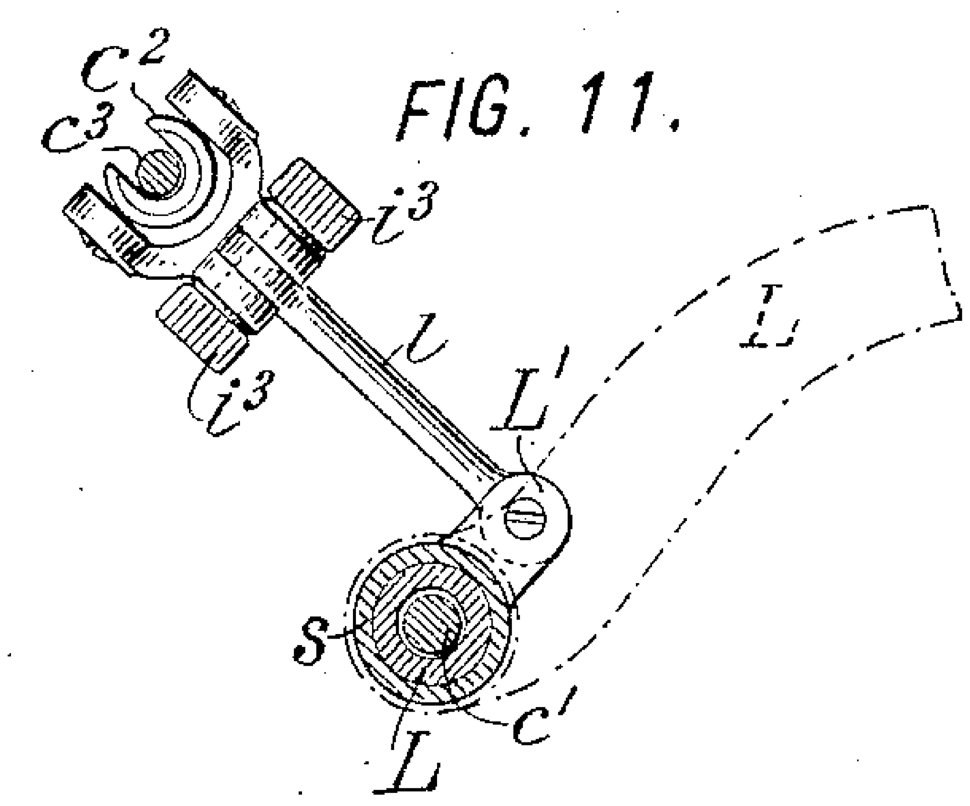


FIG. 12.

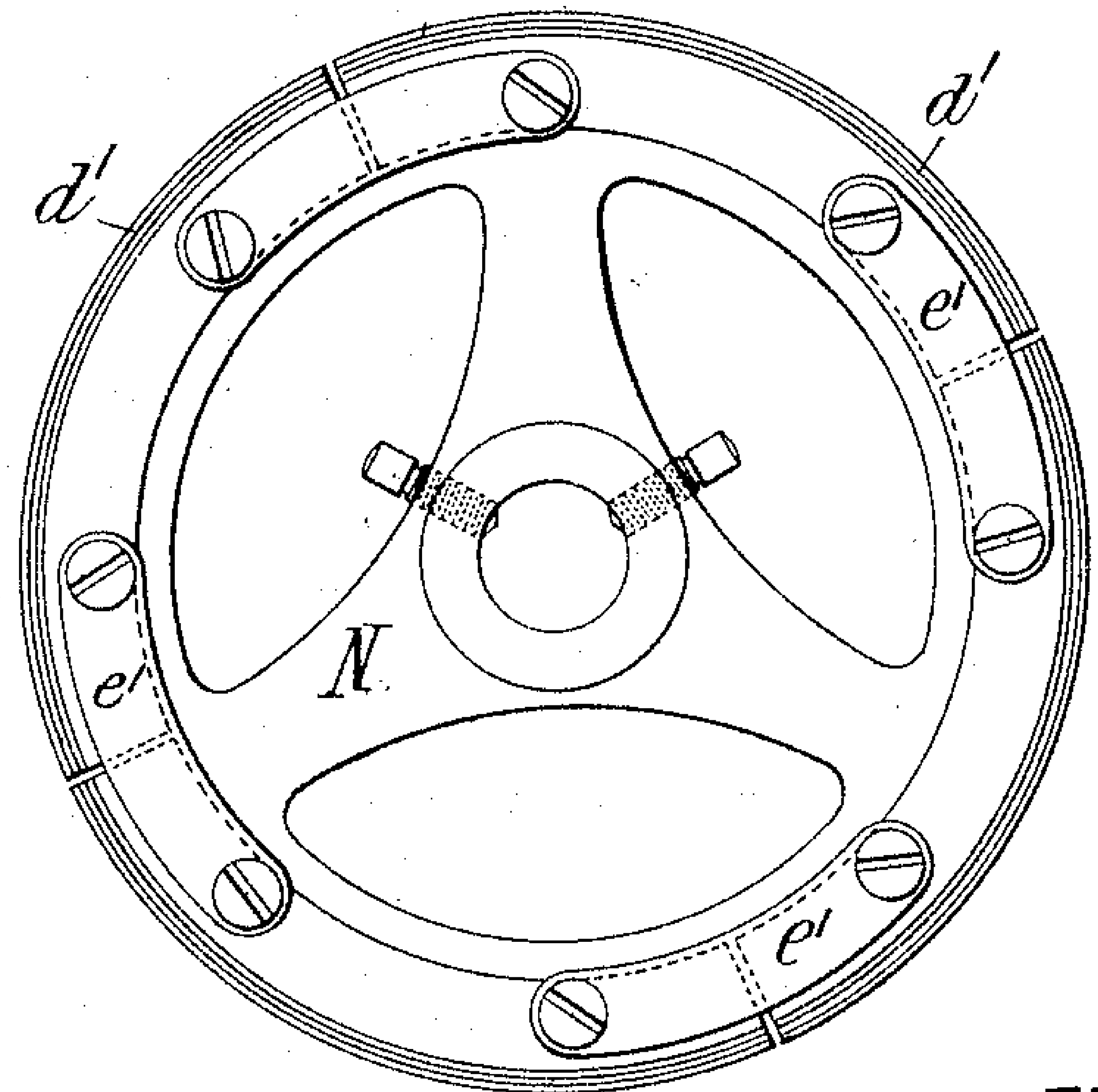


FIG. 13.

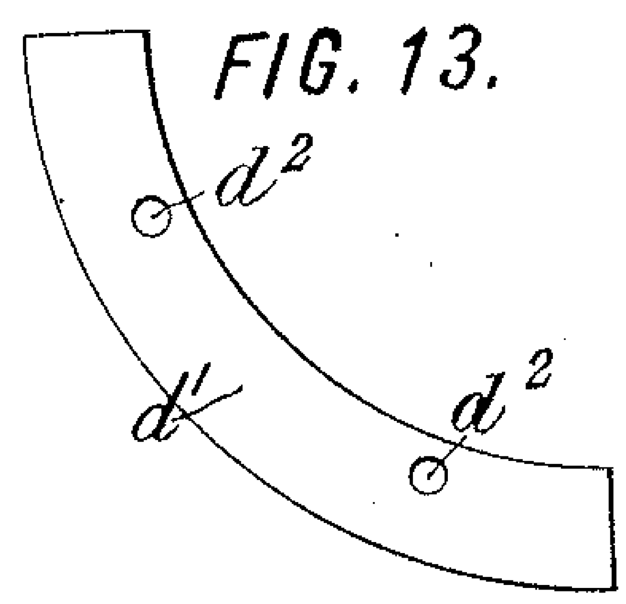


FIG. 14.

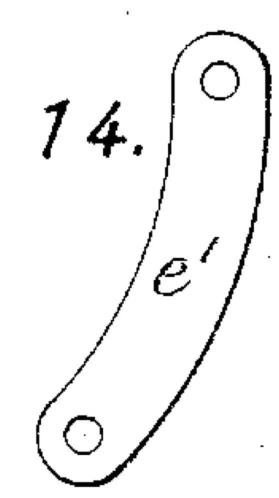


FIG. 16.

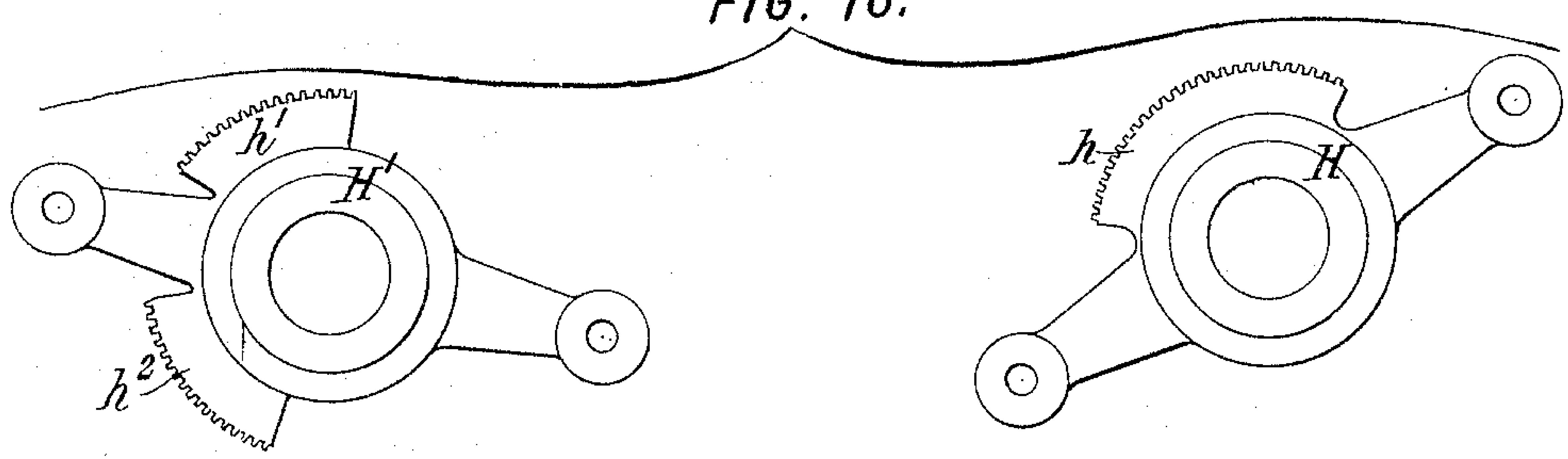
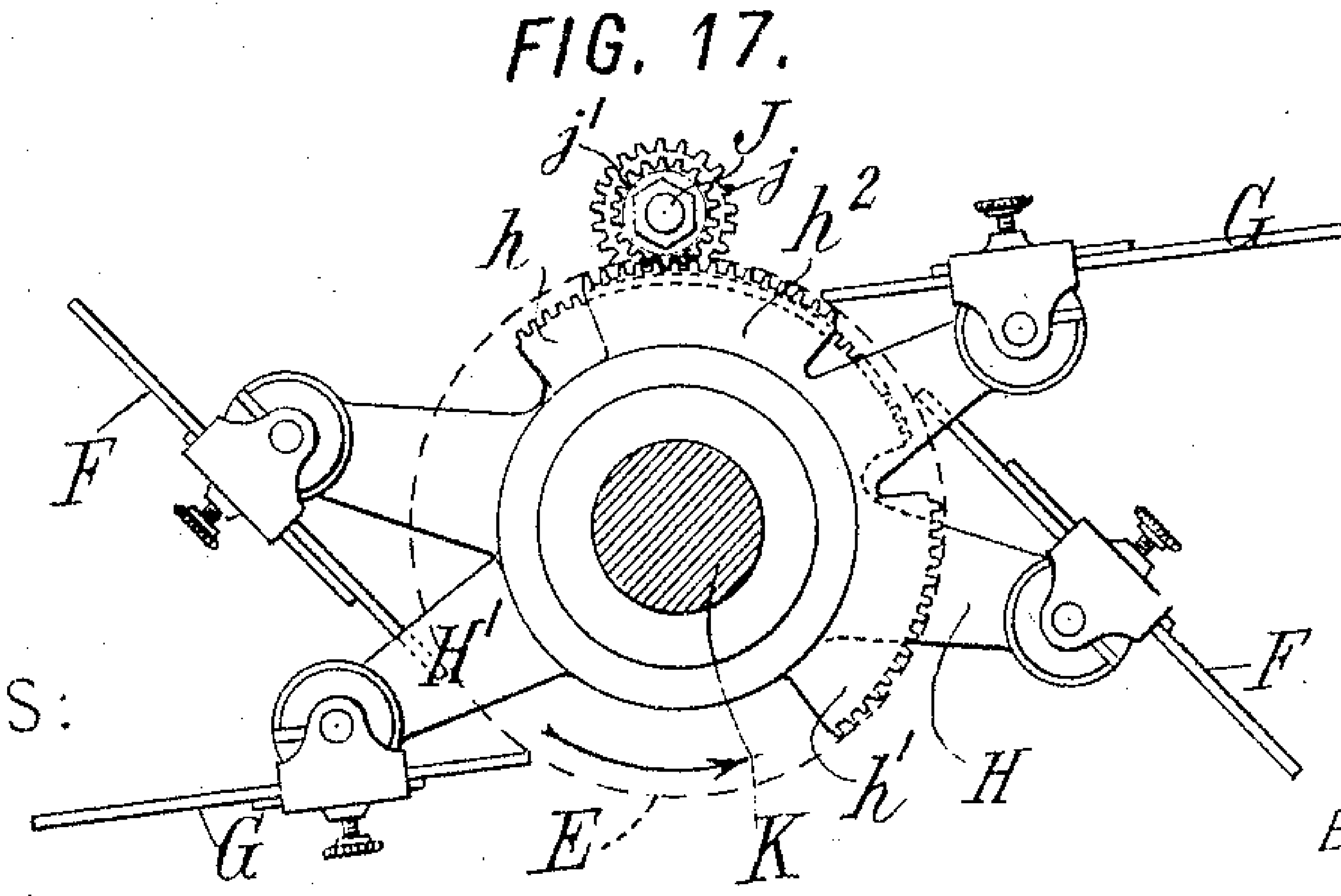


FIG. 17.



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UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF FORT WAYNE, INDIANA.

REGULATOR FOR CONSTANT-CURRENT DYNAMOS.

SPECIFICATION forming part of Letters Patent No. 617,793, dated January 17, 1899.

Application filed July 8, 1898. Serial No. 685,389. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing at Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Regulators for Constant-Current Dynamos, of which the following is a specification.

This invention relates to automatic regulators for governing the output of dynamo-electric machines designed to generate a constant current against a varying line resistance, being what are commonly called "arc-light" dynamos and usually employed for feeding a circuit of arc-lamps in series.

My invention provides a development or modification of the well-known Wood regulator for arc-light dynamos, disclosed in my Patent No. 418,302, dated December 31, 1889. An improvement thereon, designed especially for the larger sizes of arc-light dynamos, is disclosed in my Patent No. 531,821, dated January 1, 1895. My present invention is designed to improve upon the construction disclosed in both of said patents.

I will proceed to describe the preferred construction of my improved regulator, with reference to the accompanying drawings, wherein—

Figure 1 is an end elevation of the dynamo, to which my improved regulator is applied, being the commutator end. Fig. 2 is a transverse section cut between the commutator and armature, with the commutator removed and looking in the contrary direction to Fig. 1. Fig. 3 is an elevation of the regulating mechanism shown in Fig. 1, on a larger scale and partly broken away in vertical section. Fig. 4 is a fragmentary vertical section longitudinally of the machine on the line 4 4 in Figs. 1 and 3. Fig. 5 is a vertical transverse section, on a larger scale, on the line 5 5 in Fig. 3. Fig. 6 shows the lower portion of Fig. 5 cut in the plane of the line 5 6 in Fig. 3. Fig. 7 is an oblique elevation, partly in section, on the line 7 7 in Fig. 3. Fig. 8 is a plan of a fragment of the controlling-lever. Fig. 9 is a transverse section thereof on the line 9 9 in Fig. 8. Fig. 10 is a horizontal section of said controlling-lever in the plane of the line 10 10 in Fig. 9. Fig. 11 is a sectional fragmentary elevation of the levers, partly in section, on the line 11 11 in Fig. 7. Fig. 12 is an elevation of the clutch-wheel removed, and Figs. 13 and 14 show parts thereof. Fig. 15 is a fragment of Fig. 5. Fig. 16 shows the brush-yokes removed. Fig. 17 is a fragment of Fig. 2, showing the brushes reversed.

My present invention operates upon the same principle as the regulator set forth in my said Patent No. 418,302, to which reference is made for a full description of the mode of operation. In certain respects my present mechanism more resembles that shown in my said Patent No. 531,821, to which reference may also be made.

I will now proceed to describe the precise form of my invention which is shown in the drawings, remarking, however, that my invention is by no means limited to the precise constructions and details set forth.

Those features of my invention which are believed to be new, with such limitations as are essential thereto, will be set forth in the claims at the end of this specification.

In the drawings, A designates the frame of the machine constituting the magnetic circuit. B B are the field-magnet coils; C C, the field-magnet pole-pieces; D, the armature; E, the commutator, (shown only by a dotted circle in Fig. 2;) F F, the main commutator-brushes, and G G the auxiliary or supplemental commutator-brushes.

The main commutator-brushes F F are carried, as usual, in insulated holders mounted in opposite arms of the main brush-carrying yoke H. The supplemental brushes G G are in like manner carried in opposite arms of a supplemental carrier-yoke H'. The yokes H H' turn around a bearing boss or hub *a* on the inner side of the end frame A, as usual. The brush yokes or carriers H H' are formed, respectively, with two sectors *h* and *h'*, which mesh, respectively, with pinions *j* and *j'*, Figs. 2 and 4, which are fixed on a shaft J, which passes through the main frame A, as shown in Fig. 4, and has keyed or otherwise fixed on its projecting portion a disk *b*, while a gear-wheel *c* is mounted to turn loosely on the shaft J in front of the disk *b*, being normally locked thereto, so as to be forced to turn therewith. For the purpose of my present invention the disk *b* and gear *c* may be treated as one part, although in practice they are locked together by clutches, as set forth in my said Patent No. 418,302, but which are not herein shown, as they form no part of my present invention. The gear-wheel c is geared or connected directly or indirectly to a friction-wheel or clutch-cone N. This connection is preferably made through the medium of a pinion f', with which the gear c meshes and which is fixed to a gear-wheel f, the teeth of which mesh with a pinion f^2 on a shaft or spindle f^3, on which the clutch-wheel N is fixed. The clutch wheel or cone N is mounted between two clutch-wheels g and i, as shown in Fig. 5, which wheels have coned flanges adapted to frictionally engage the wheel N. The wheels g i are revolved constantly in opposite directions, as indicated by the arrows in Figs. 3 and 5, the wheel i turning, preferably, at a somewhat faster speed than the wheel g. They are thus driven from a constantly-revolving shaft p, which is driven from any suitable source of power, but preferably from the armature-shaft K. I prefer to drive it by means of a belt from a pulley p^2 on the armature-shaft to a pulley p' on the shaft p. The latter shaft has fixed on it two pinions a' and r^2, of which a' drives an idler-pinion r, turning on a stud r' and meshing with gear-teeth g' on the exterior of the wheel g, while the other pinion, r^2, meshes with gear-teeth i' on the wheel i. The pinion r^2, being made of larger diameter than the pinion a', drives the clutch-wheel i at a higher speed than the wheel j, as stated.

The shaft f^3 is capable of a short longitudinal sliding movement in order to carry the friction-wheel or cone N from its mid-position, where its coned surfaces are barely out of contact with those of the wheels g i, toward either side sufficiently to bring its surfaces into engagement with those of either wheel to cause it to be driven in one direction or the other thereby. Hence the regulating mechanism is controlled by the endwise displacement of this shaft f^3. This displacement is effected by the action of the regulating-magnet or solenoid M, to the movable member or armature M' of which the shaft f^3 is in some manner connected. As shown, this armature is connected by a link to an operating-lever L, as heretofore, to which also is connected a retracting-spring S, adjustable to exactly counterbalance the normal pull of the magnet, so that under normal conditions the lever occupies a mid-position between stop-screws b', as shown. This lever L is pivoted on a screw or stud c' and has a short arm L', which is connected by a link l to one arm of a small elbow-lever I, which is pivoted at i^2, and the other arm of which is forked and swiveled to a collar c^2, Figs. 7 and 11, which engages in a neck c^3, Fig. 5, formed between flanges on the shaft f^3.

The operation may now be understood. Assuming that the dynamo is running normally at proper speed and generating its normal current, the pull exerted by the magnet exactly balances the tension to which the spring S is set, so that the lever L occupies its mid-position, as shown, and the regulator is out of action, the friction-wheel or cone N being in its mid-position, so that it is not frictionally engaged by either the wheels g or i, and hence the commutator-brushes remain stationary. Under these circumstances the only moving parts of the regulator are the oppositely-revolving clutch-wheels g and i and the parts by which they are driven, all of which revolve continuously. If the current should decrease in volume, (caused either by increasing the resistance of the line by turning in more lamps or by a lowering of the speed of rotation of the dynamo,) the attraction of the magnet M will become less and the tension of the spring S preponderating will draw the lever L downward, thereby pulling down the link l, tilting the elbow-lever I, and forcing the shaft f^3 toward the left in Figs. 5 and 7, thereby placing the friction-wheel N in contact with the clutch-wheel g. Instantly the wheel N and shaft f^3 are driven in the same direction as the wheel g—that is, in the direction of the arrow z in Figs. 3 or 5—and this rotation is communicated through the train f c to the shaft J and through pinions j j' to the brush-carrying yokes H H', thereby causing both the main commutator-brushes F F and the supplemental brushes G G to travel backward over the commutator toward the position of maximum current. This travel of the brushes will continue until the increase of the current restores it to the normal volume or until the position of maximum current is reached. In the former case the magnet M regains its normal power, thereby restoring the friction-wheel N to its mid-position, which stops the movement of the brushes. In the latter case the brush-propelling mechanism is thrown out of engagement by disconnecting the disk b from the wheel c in the manner now well known, and which is fully described in my said Patents Nos. 418,302 and 531,821. If, on the other hand, the current should increase in volume, (owing to a decrease of the resistance in the circuit by cutting out one or more lamps or the dynamo running too fast,) the increased attraction of the magnet M will pull the lever L toward it and displace the shaft f^3 toward the right in Fig. 5, pressing the friction-wheel N into contact with the wheel i, whereupon the brush-propelling mechanism is driven in the contrary direction to that last described, thereby causing the brushes to advance along the commutator toward the position of minimum current, which will continue until the current is reduced to the normal, whereupon the magnet is sufficiently weakened to permit the spring to pull back the lever L and friction-wheel N to the normal mid-position and the brush-propelling mechanism is stopped, or until the position of minimum current is reached, whereupon again the connection between disk b and wheel c is interrupted, as described in my said patents. By reason of the more rapid rotation of the wheel i the movement last described occurs more quickly than that first described, so that the regulator operates more rapidly to cut down an excessive current than to build up a deficient one.

It will be observed that in principle of operation my regulating mechanism as just described essentially resembles that claimed in my said Patent No. 531,821. It differs therefrom in being wholly reconstructed to adapt it to a dynamo in which the armature-shaft extends parallel with the vertical plane of the field-magnet and has bearings in the opposite end frames which form the connecting-pieces or yokes of the field-magnet. In these respects the arrangement of the mechanism is similar to that in my Patent No. 418,302. As compared with the mechanism of that patent my present mechanism has the advantage that the friction-wheel being driven around its entire circumference can under no circumstances have grooves worn in its surfaces, also that the friction-surfaces instead of engaging less efficiently after wear actually improve their fit, so that the longer they wear the less pressure is required to engage them and change the direction of rotation, also that the driving friction-wheels or clutch-wheels instead of being driven from the armature-shaft wholly through spur-gearing receive their motion through a belt, which in case any of the mechanism sticks permits of slipping and avoids any damage to the machinery. I have thus applied to a regulator for this type of dynamo the same advantages as are inherent in the regulator of my Patent No. 531,821. My invention further provides certain improvements over the mechanism set forth in my last-named patent and which I will now describe.

By my present construction I inclose the friction-clutch and the gearing for oppositely driving the clutch-wheels in a practically air-tight casing, which excludes dust and moisture and protects the working surfaces from injury. This casing O is a cast shell made in two parts fitting closely together, the rear half O′ having feet o o, preferably three, for fastening it to the frame A, while the two halves are fastened together by screws passing through lugs o'. This casing includes the clutch-wheels g, i, and N and the gearing a' r r^2 g' i'. The wheels g and i turn on sleeves or bushings m m', respectively, which are held in concentric bosses on the respective halves of the shell. The bushing m' is made a tight fit with the rear boss, the hub of the wheel i being confined between a flange on the front end of the bushing and the rear wall of the shell. The bearing thus formed is non-adjustable. For lubricating the wheel i a tube n is provided, the upper end of which projects to a position where it can be easily reached with an oil-can, while its lower end is fitted in the hub and communicates with grooves n' in the upper side of the bushing leading to the bearing. The opposite bushing m is made a tight fit with a ring q, (see Fig. 15,) which is screw-threaded on its exterior and screws into the boss on the front of the shell. The wheel g is confined between the flange on the rear end of the bushing and the ring q, and by screwing the ring q out or in the wheel g is made adjustable toward and from the wheel i. When the desired adjustment is attained, the parts are set fast by screwing up a set-nut q'. For lubricating the wheel g an oil-hole k is provided in the front boss, which communicates with an oil-groove q^2 in the ring q, and from this groove an oil-hole k' passes through the ring and communicates with a lateral groove k^2 in the bushing leading to the bearing. If the holes k and k' could be kept in line, the groove k^2 would not be required; but since the adjustment is made by turning the ring q the groove q^2 maintains communication between the two oil-holes to whatever position they may have been adjusted. Whenever by reason of wear of the coned surfaces it is found that the lever L requires to be displaced too far to either side from its central position in order to engage the clutch, the wear should be taken up by screwing in the ring q, so as to bring the two clutch-wheels g i closer together. They should not, however, be so close that the friction-wheel N when in its mid-position will be in frictional contact simultaneously with both wheels, since this would occasion constant wear of the frictional surfaces. In its mid-position the friction-wheel should be barely out of contact with the rims of both clutch-wheels.

The shaft f^3 has bearings in the two bushings m m'. It is lubricated through the oil-hole k and oil-tube n, which communicate through holes in the respective bushings with the bearings for the opposite ends of the shaft. The shaft p has bearings in bosses l' l' formed on the shell and is lubricated through an oil-hole l^2 at front and an oil-tube l^3 at the rear. The idler-pinion r, which turns around a fixed stud r', Fig. 6, is lubricated by means of an oil-tube r^3, which enters the rear end of said stud and communicates with an oil-duct r^4, which leads to the bearing-surface. Thus the casing or shell O incloses all the working parts of the clutch and clutch-gearing, except the protruding ends of the shafts f^3 and p, and affords ample facility for oiling all the working surfaces and for effecting the only adjustment that is required. The oil used in lubricating fills all the cracks or joints, including the joint between the two halves of the shell O, and practically excludes the air, thereby protecting the frictional surfaces of the clutch from moisture and atmospheric changes.

By adopting a single friction-wheel N, working between two clutch-wheels, I have simplified and rendered more compact the construction in my Patent No. 531,821. I have still further improved the construction of the clutch by making the coned friction-surfaces of different materials. In place of both coned surfaces being of metal I now make one of metal and the opposite one of vulcanized or compressed fiber. I prefer to make the convex surfaces carried by the wheel N of fiber, so that the coned flanges on the wheels *g i* may be made integrally of the same metal as the wheels. The construction of the friction-wheel N is best shown in Figs. 5 and 12. The friction-surfaces are composed of thin layers of fiber d', so applied that they expand and contract without changing their diameter. To this end the fiber is cut first into segmental arcs, preferably of a quarter-circle, as shown in Fig. 13, and punched with holes d^2 at some distance back from their ends. The segments of fiber are assembled in the manner shown in Fig. 12, arc-shaped metal plates e' (shown separately in Fig. 14) being arranged to bridge across their joints and having holes in their ends coinciding with the holes d^2 and fastening-screws being put through the coinciding holes and screwed into the central rim of the wheel N. The segments d' are cut short enough so that they do not quite touch each other, as shown in Fig. 12, thus leaving room for expansion and contraction. If they were fastened by screws at their ends, their expansion or contraction would cause them to bow or swell between their ends to varying diameters; but by confining them at the holes d^2, so as to leave their end portions free, their expansion and contraction is practically all taken up in the movement of these end portions without perceptible change in diameter. Any curling or warping of the unattached end portions is prevented by their being confined between the central rim of the wheel and the strips or cheek-pieces e'. I prefer to employ several layers of fiber, all the sections being punched alike, and after all are fastened in place the outer edges are turned off to form the conical friction-surfaces. By means of this construction the friction-wheel is given a very effective frictional surface, which remains true under all conditions, is practically homogeneous, and is free from any disadvantageous warping or change.

After any adjustment of the position of the clutch-wheel *g* a new adjustment is required for the friction-wheel N, the mid-position of which has thus been altered. It is desirable to effect this adjustment without changing the normal or mid position of the main operating-lever L, and to accomplish this it is necessary to adjust the relative position of the wheel N with its shaft f^3 with relation to the lever L. A similar adjustment is effected in each of my said previous patents by making the link *l*, connecting the levers L and I, adjustable in length. The same expedient could be adopted in my present construction; but I have devised a better and more convenient means, which consists in moving the arm L' relatively to the remainder of the lever L. To accomplish this, the arm L' is constructed to be movable around some part of the lever L, preferably the hub of the latter, which turns on its pivot-screw c'. Accordingly this hub is made to pass through the hub or collar *s* of the arm L', and some suitable means is provided for locking the two together in any relative position to which they may be adjusted. The preferred means for this purpose consists of screws s' s', which screw through ears on the one part and bear against lugs on the other. Preferably they screw through ears on the hub of the lever L and engage lugs on the hub *s* of the arm L', as clearly shown in Fig. 9. Thus their heads may easily be reached by a screw-driver from beneath, so that by first slacking one and then tightening the other the arm L' may be moved in either direction relatively to the lever L. An important advantage of this construction is that the screws s' act mutually as set-screws for locking or jamming one another tightly in place. The lever I is pivoted on a pin i^2, between lugs i^3, projecting rearwardly from the rear half O' of the shell or casing.

My present invention provides means for facilitating the setting of the brush-yokes, in order that their relative positions may be adjusted. This I accomplish by mounting the pinions *j* j' loosely upon the shaft J, with provision for clamping them thereon in any desired position. The pinions are clamped between disks *t* t', which are mounted on the shaft J, so as to be compelled to rotate therewith, preferably by providing keys or pins projecting from the shaft into notches in the disks. The end of the shaft is screw-threaded and receives a nut t^2, by tightening which the disk t' is forced against the pinions, which are clamped between this and the disk *t*, which itself is seated against a shoulder. To adjust the brush-yokes H H' to any relative position, it is only necessary to loosen the nut t^2, thereby freeing the pinions, and then to turn the yokes to the position desired, whereupon the clamp-nut t^2 is tightened to clamp the pinions immovably upon the shaft J.

My invention also provides means by which the machine may be adapted to be driven in either direction. It is sometimes found desirable or necessary when setting up a dynamo to arrange it to drive in the contrary direction from that for which the builder designed it. A means for enabling the user to reverse the direction of rotation at will is set forth in my said Patent No. 531,821. My present invention provides a simpler means. The brush-holder yokes H H' are constructed as shown in Fig. 16. The yoke H has its sector *h* extended somewhat beyond the arc which would engage with the pinion *j* when running in one direction, so that by reversing the yoke to the position for running in the contrary direction the sector shall be long enough to remain in mesh with the pinion. The yoke H', in addition to the sector h', which is used when running toward the right, Fig. 2, as already described, is provided with another sector h^2, which when the yoke is reversed for running toward the left comes into mesh with the pinion j'. Hence in order to reverse the direction of rotation of the machine it is only necessary to remove the brush-holders, reverse them on their studs, and swing the brush-yokes around from the position shown in Fig. 2 to that shown in Fig. 17, the yoke H being but little displaced, while the yoke H' is thrown around until its opposite sector h^2 meshes with the pinion.

I prefer to suspend an oil-cup *v* beneath the clutch-casing O to catch any excess of oil that may fall therefrom.

It will be understood that my invention is subject to certain modifications without departing from its essential features. In place of the electromagnet or solenoid M any other electromotive device responding to current changes may be used. The reversing-clutch *g* N *i* may be regarded as a single clutch having oppositely-revolving driving members *g i* and a single driven member; or it may be regarded as two clutches for driving in opposite directions, the one consisting of the wheel *g* and the adjacent part of the wheel N, and the other consisting of the wheel *i* and the part of the wheel N with which it coöperates. The particular gearing for communicating an opposite rotation to the wheels *g i* may be varied, my present arrangement being a slight variation of the gearing shown in my Patent No. 531,821, but a mechanical equivalent thereof.

The "brush-shifting mechanism" is that portion of the mechanism between the driven member of the clutch and the brush-yokes by which the movement is communicated from the clutch to the brushes.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. In a current-regulator, the combination with movable commutator-brushes and a shifting mechanism therefor, of a friction-clutch the driven member of which drives said shifting mechanism, means for rotating the driving members thereof continuously in opposite directions, an electromotive device controlling said clutch, and a casing inclosing said clutch formed with bearings for the working parts and excluding dust and moisture from the working surfaces.

2. In a current-regulator, the combination with movable commutator-brushes and a shifting mechanism therefor, of a friction-clutch comprising two oppositely-revolving coned wheels and means for continuously driving them, and a driven member consisting of a friction-wheel mounted on a shaft between said wheels, connected to said shifting mechanism and movable into contact with either wheel to drive said mechanism in either direction, and an electromotive device connected to said friction-wheel for so moving it and a casing inclosing said clutch, formed with bearings for the working parts, and excluding dust and moisture from the working surfaces.

3. In a current-regulator, the combination with movable commutator-brushes and a shifting mechanism therefor, of a friction-clutch comprising two oppositely-revolving coned wheels and means for continuously driving them, and a driven member consisting of a friction-wheel mounted on a shaft between said wheels, connected to said shifting mechanism and movable into contact with either wheel to drive said mechanism in either direction, and means for adjusting said clutch to take up wear, consisting of a movable bearing for one of said clutch-wheels, whereby it is adjustable toward the other.

4. The combination with a brush-shifting mechanism and electromotive device, of a friction-clutch comprising oppositely-revolving clutch-wheels and means for driving them, an interposed friction-wheel movable into contact with either clutch-wheel, tubular bushings forming bearings for said clutch-wheels and through which the shaft of said friction-wheel passes, a casing supporting said bushings, and one of said bushings constructed to screw in said casing to adjust its clutch-wheel toward or from the other.

5. The combination with a brush-shifting mechanism and electromotive device, of a friction-clutch comprising a driven wheel N and oppositely-revolving driving-wheels *g i*, means for continuously revolving said wheels comprising a driving-shaft *p* and pinions for communicating direct and reverse rotation to said wheels *g i*, and a casing O inclosing said clutch and driving pinions formed with bearings for the revolving parts, and excluding dust and moisture from the working surfaces.

6. The combination with a brush-shifting mechanism and electromotive device, of a friction-clutch comprising a driven wheel N and oppositely-revolving driving-wheels *g i*, means for continuously revolving said wheels comprising a driving-shaft *p*, a pinion thereon meshing with one of said wheels, an idler-pinion driven therefrom and meshing with the other of said wheels, and a casing O inclosing and supporting the moving parts of said clutch, and having oil-passages communicating with the several bearing-surfaces thereof.

7. The combination with a brush-shifting mechanism and electromotive device, of a friction-clutch comprising a driven wheel N and oppositely-revolving driving-wheels *g i*, means for continuously revolving said wheels comprising a driving-shaft *p*, a pinion thereon meshing with one of said wheels, an idler-pinion driven therefrom and meshing with the other of said wheels, a stud on which said pinion turns, a casing O inclosing and supporting the moving parts of said clutch, having oil-passages leading to the bearing-surfaces therein, and an oil tube or duct leading to said stud to conduct oil to said idler-pinion.

8. The combination with a brush-shifting mechanism and electromotive device, of a friction-clutch comprising a driven wheel N and oppositely-revolving driving-wheels *g i*, means for continuously revolving said wheels, and a casing O inclosing and supporting the moving parts of said clutch, bushings *m m'* therein forming bearings for said wheels *g* and *i*, and a screw-threaded ring *q* in which the bushing *m* is fixed, screwing in the casing to render said wheel *g* adjustable, and having a peripheral oil-groove q^2 affording communication between an oil-inlet *k* in the casing and an oil-hole *k'* through said ring.

9. The combination with a brush-shifting mechanism and electromotive device, of a friction-clutch comprising oppositely-revolving driving-wheels and means for driving them, and a driven wheel fixed on a shaft and connected to said brush-shifting mechanism, adapted by the longitudinal displacement of said shaft to make contact with either of said driving-wheels, a lever connected to said electromotive device, moving in a plane perpendicular to the axis of said friction-wheel shaft, an elbow-lever engaging said shaft, and a link connecting said levers.

10. The combination with a brush-shifting mechanism and electromotive device, of a friction-clutch comprising oppositely-revolving driving-wheels and means for driving them, and a driven wheel fixed on a shaft and connected to said brush-shifting mechanism, adapted by the longitudinal displacement of said shaft to make contact with either of said driving-wheels, a casing inclosing and supporting the moving parts of said clutch, said friction-wheel shaft projecting beyond said casing, an elbow-lever engaging the projecting end of said shaft, and a main operating-lever connected thereto and actuated by said electromotive device.

11. The combination with a brush-shifting mechanism and electromotive device, of a friction-clutch comprising oppositely-revolving wheels *g i* and means for driving them continuously, interposed friction-wheel N, shaft f^3 therefor, casing O inclosing said clutch, said shaft f^3 projecting beyond said casing, elbow-lever I engaging the protruding end of said shaft, operating-lever L controlled by said electromotive device, and link *l* connecting said levers.

12. The combination with a brush-shifting mechanism and electromotive device, of a friction-clutch comprising oppositely-revolving driving-wheels, and means for driving them, and a driven wheel fixed on a shaft and connected to said brush-shifting mechanism, adapted by the longitudinal displacement of said shaft to make contact with either of said driving-wheels, an operating-lever having two arms the one actuated by said electromotive device and the other connected to said friction-wheel shaft for communicating endwise displacement thereto, and means for relatively adjusting said arms.

13. The combination with a brush-shifting mechanism, an electromotive device, and a clutch, of an operating-lever L connected to said electromotive device and having an adjustable arm L' connected to said clutch, with an interposed screw adjustment for varying the relative angular position of said lever and arm.

14. In a dynamo-regulator, an operating-lever L having an adjustable arm L', combined with oppositely-acting set-screws *s'* for adjusting and setting said arm.

15. In a dynamo-regulator, an operating-lever L having an adjustable arm L', formed with a sleeve *s* encircling the hub of said lever, said hub and sleeve having opposite ears and set-screws *s'* screwing through one pair of ears and engaging the opposite pair for adjusting and setting said arm.

16. In a dynamo-regulator, the combination of a brush-shifting mechanism, an electromotive device and a clutch, the latter comprising a clutch-wheel N having its frictional surface formed of segments *d'* attached to it at points remote from their ends, with spaces between the ends of successive segments to admit of expansion and contraction of the segments, whereby warping or change of diameter of the friction-face constituted by the periphery of said segments is avoided.

17. In a dynamo-regulator, the combination of a brush-shifting mechanism, an electromotive device and a clutch, the latter comprising a clutch-wheel N having its frictional surface formed of segments *d'* attached to it at points remote from their ends, with spaces between the ends of successive segments to admit of expansion and contraction of the segments, and bridge-pieces crossing said spaces and confining said segments to the wheel.

18. In a dynamo-regulator, the combination of a brush-shifting mechanism, an electromotive device and a clutch, the latter comprising a clutch-wheel N having its frictional surface formed of segments *d'* having holes d^2 remote from their ends, bridge-pieces *e'* crossing the end portions of said segments, having holes coinciding with said holes d^2, and screws passing through said holes in said bridge-pieces and segments for fastening them to said wheel.

19. In a dynamo-regulator, the combination with brush-yokes H H' having toothed sectors, of a brush-shifting mechanism comprising a shaft J having pinions *j* and *j'* engaging said sectors, said pinions free to turn on said shaft, and a clamp for securing them to said shaft comprising disks embracing said pinions and keyed to said shaft, and means for forcing said disks together to confine said pinions between them, whereby by freeing said clamp the yokes may be adjusted to any relative position, the pinions turning freely on said shaft.

20. In a dynamo, the combination with main and supplemental brushes and yokes and a brush-shifting mechanism comprising a ro-

tary shaft having differential pinions engaging sectors on said yokes, the construction of said brush-yokes to be reversible to admit of reversing the direction of rotation of the dynamo, the main yoke H having its toothed sector h elongated beyond its range of movement when running in one direction to cover its combined range of movement when running in the other direction, and the supplemental brush-yoke H′ having two sectors h' h^2, the one adapted to engage the pinion when running in one direction, and the other when running in the reverse direction.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES J. WOOD.

Witnesses:
CHARLES C. MILLER,
EDW. F. DALMAN.