K. DOUGAN.

GOVERNOR.

APPLICATION FILED JULY 27, 1908.

997,279.

Patented July 11, 1911.

4 SHEETS—SHEET 1.

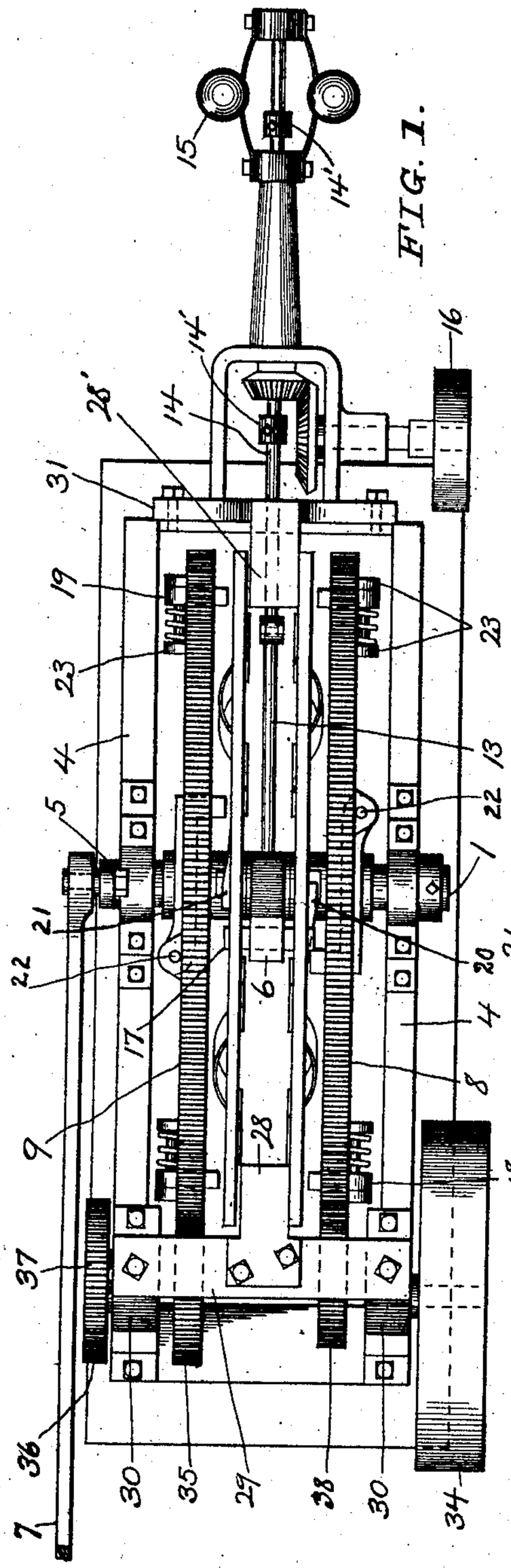

FIG. 1.

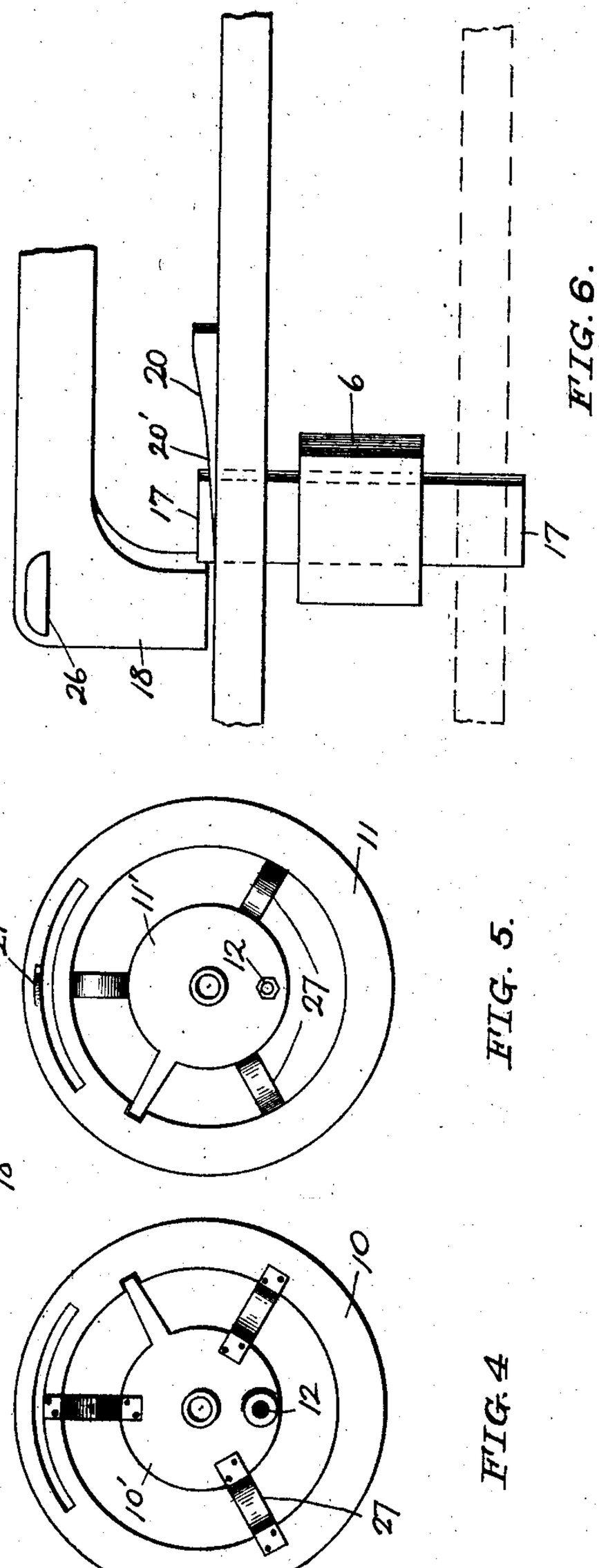

FIG. 6.

FIG. 5.

FIG. 4

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4 SHEETS—SHEET 2.

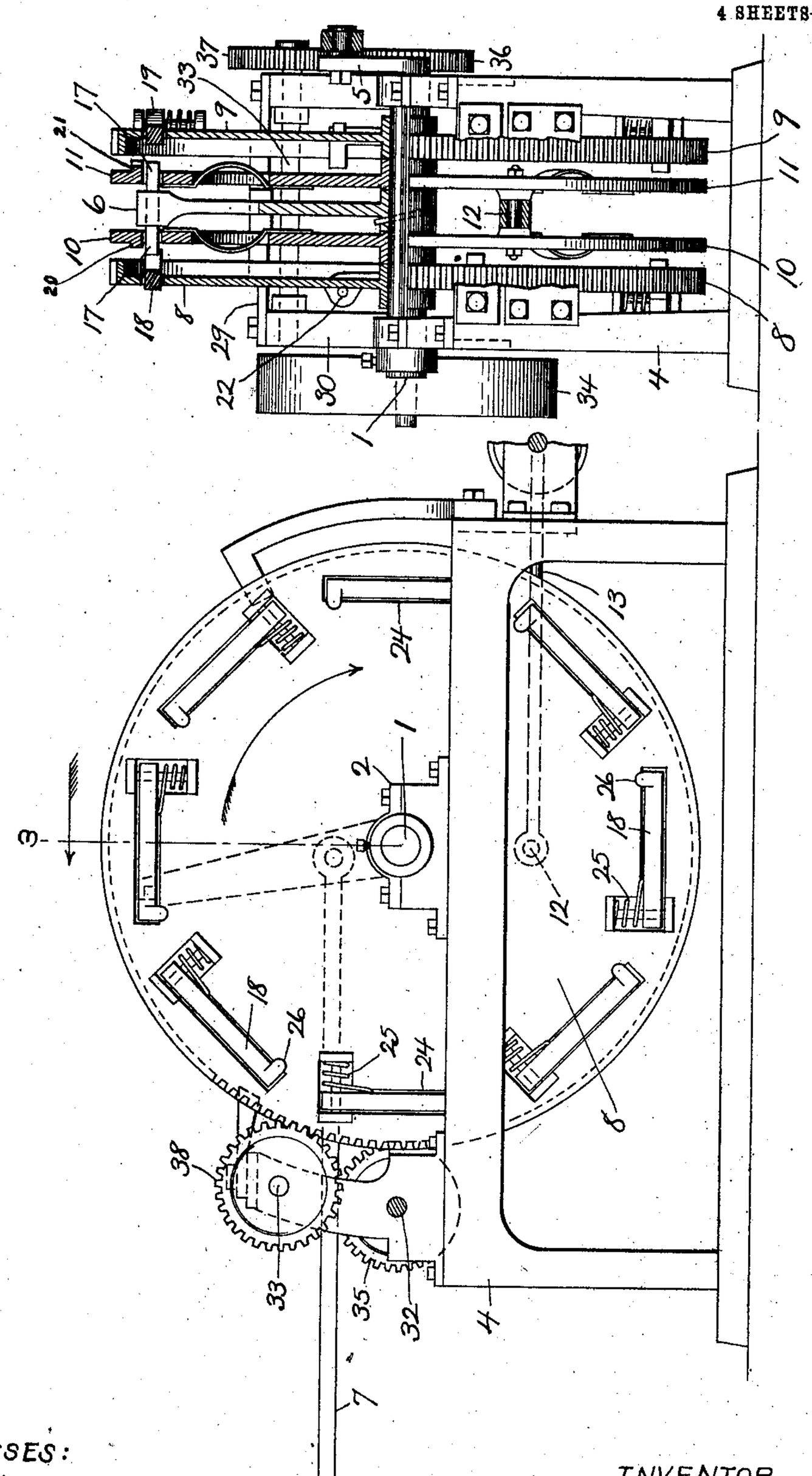

FIG. 2.

FIG. 3.

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4 SHEETS—SHEET 3.

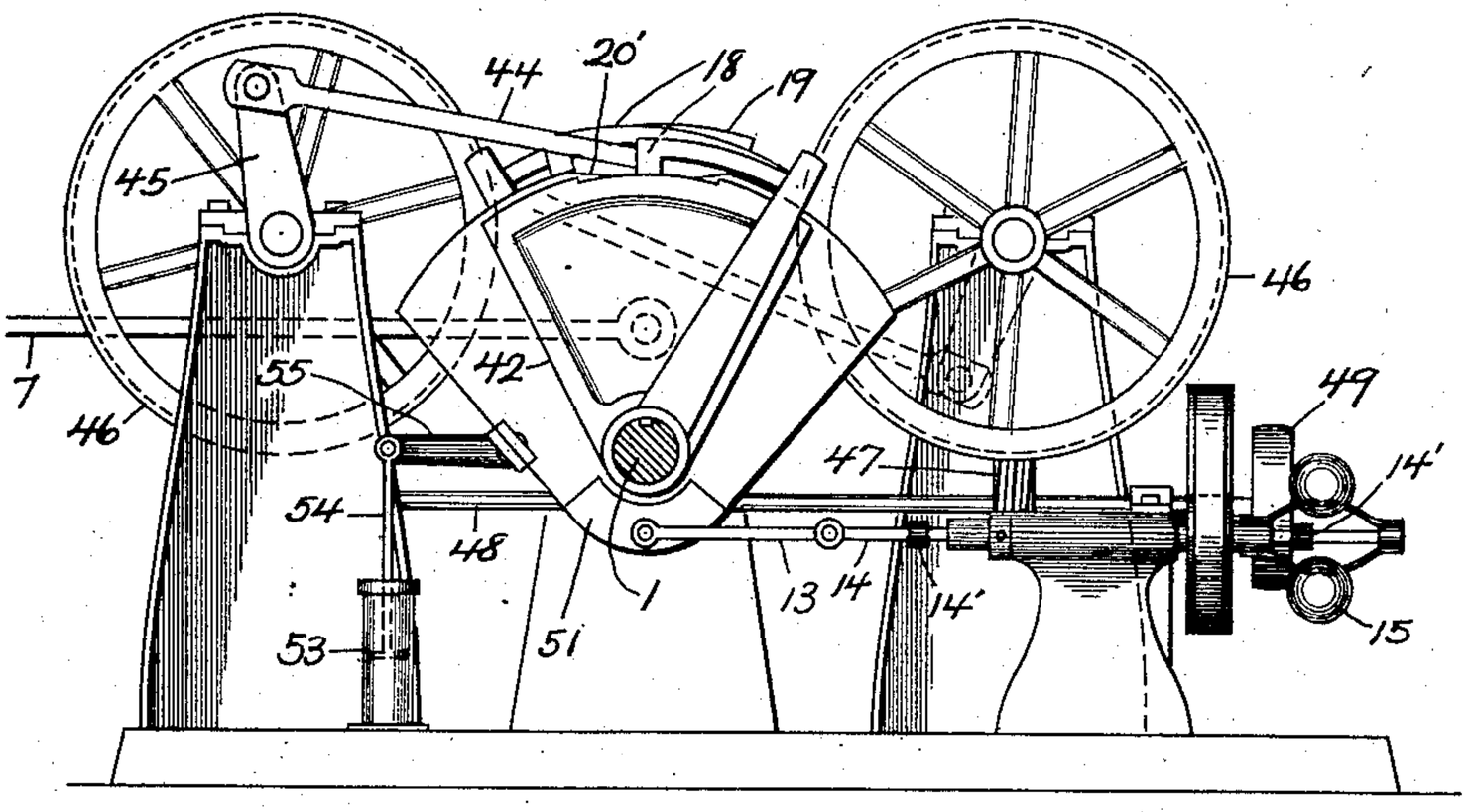


FIG. 8.

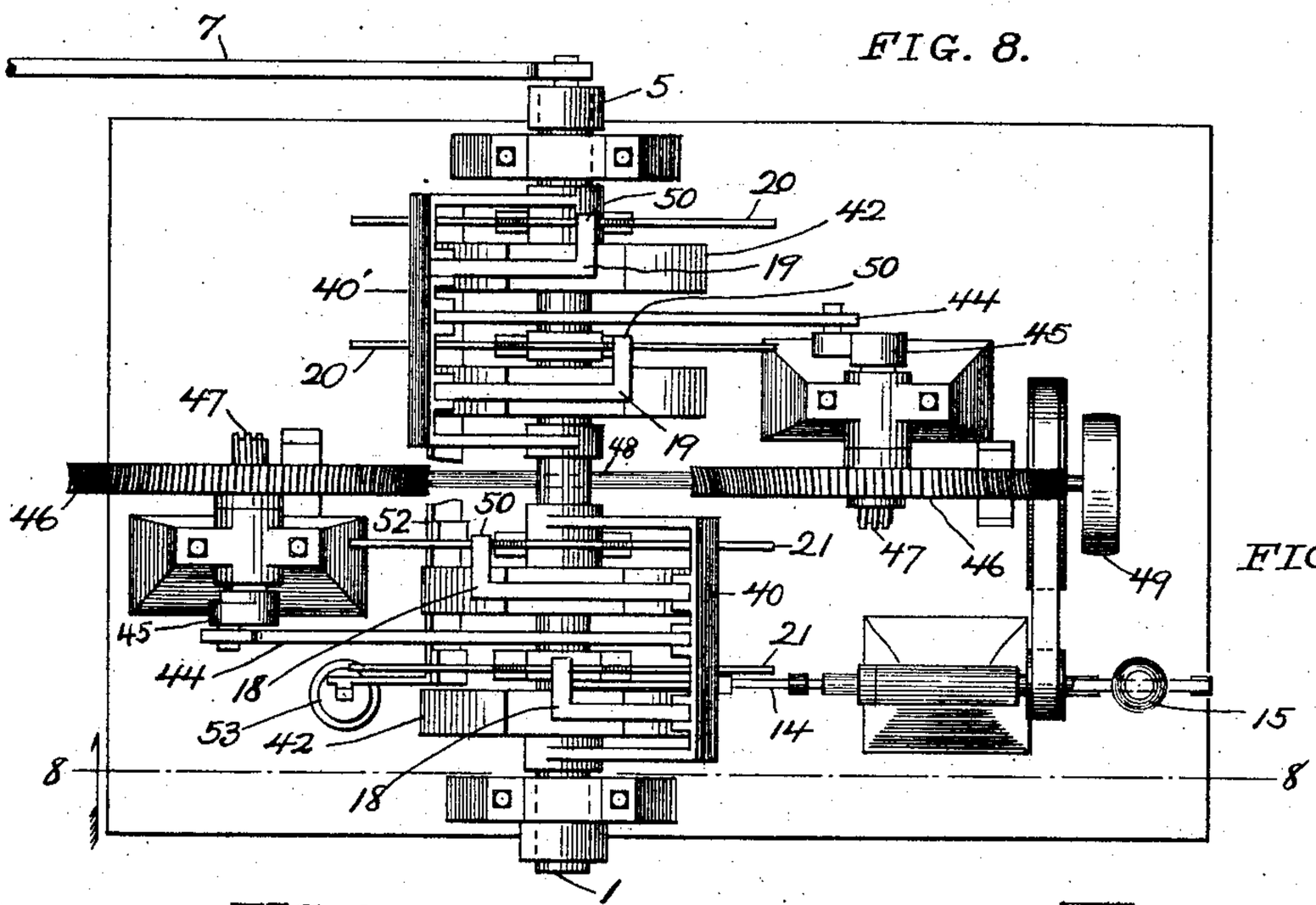
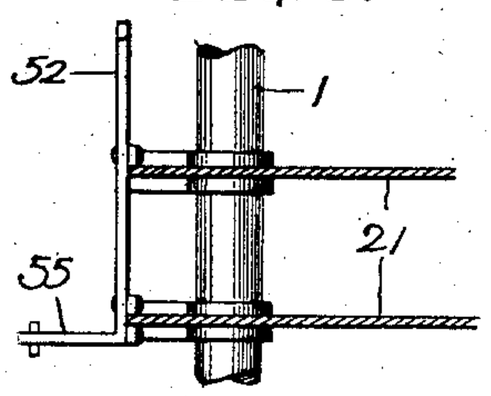


FIG. 7.

FIG. 9.



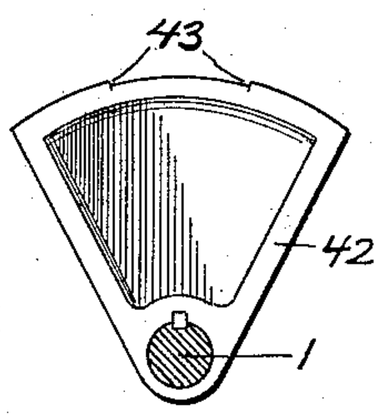


FIG. 10.

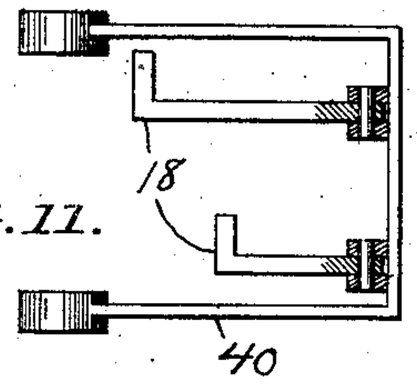


FIG. 11.

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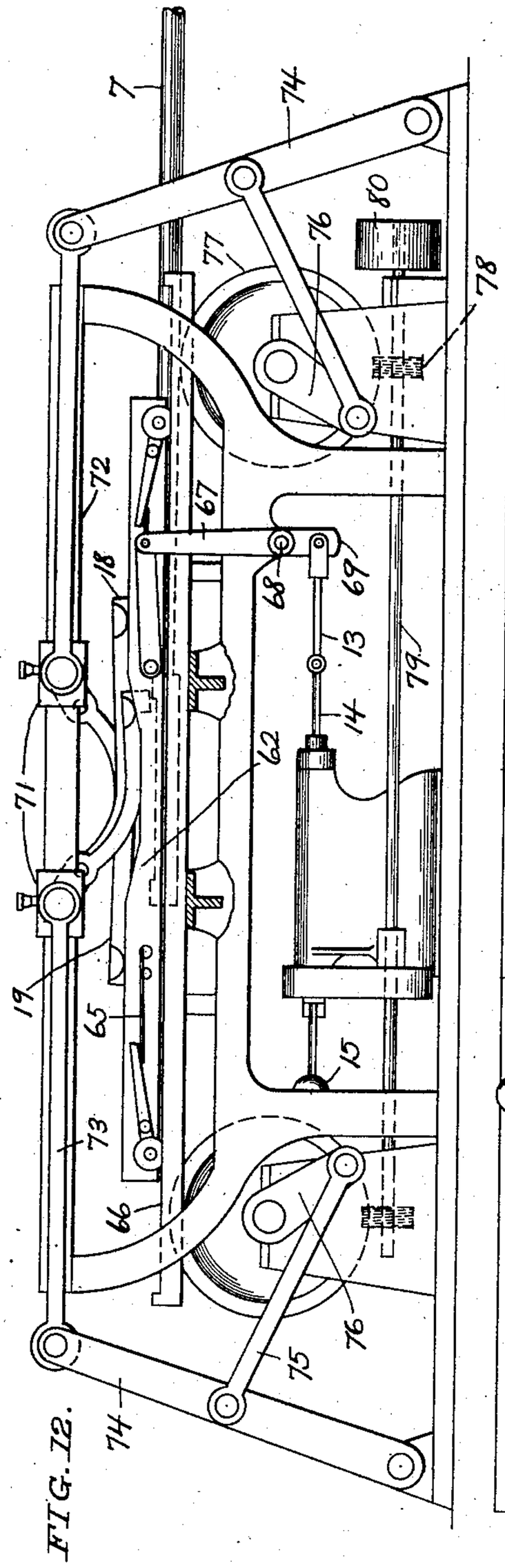

FIG. 12.

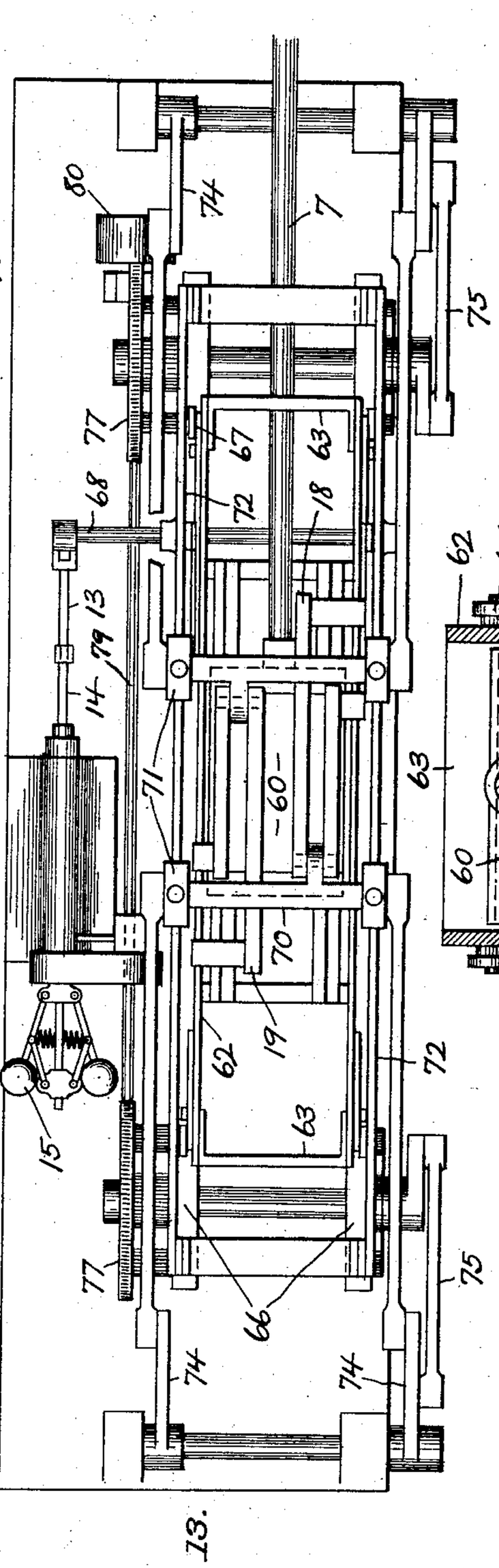

FIG. 13.

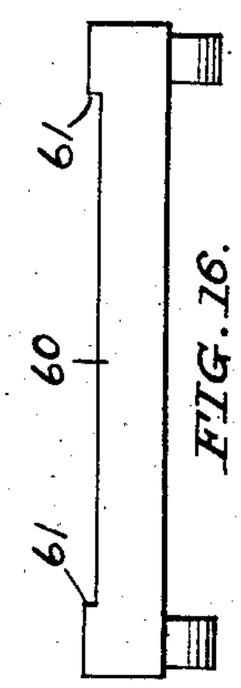

FIG. 16.

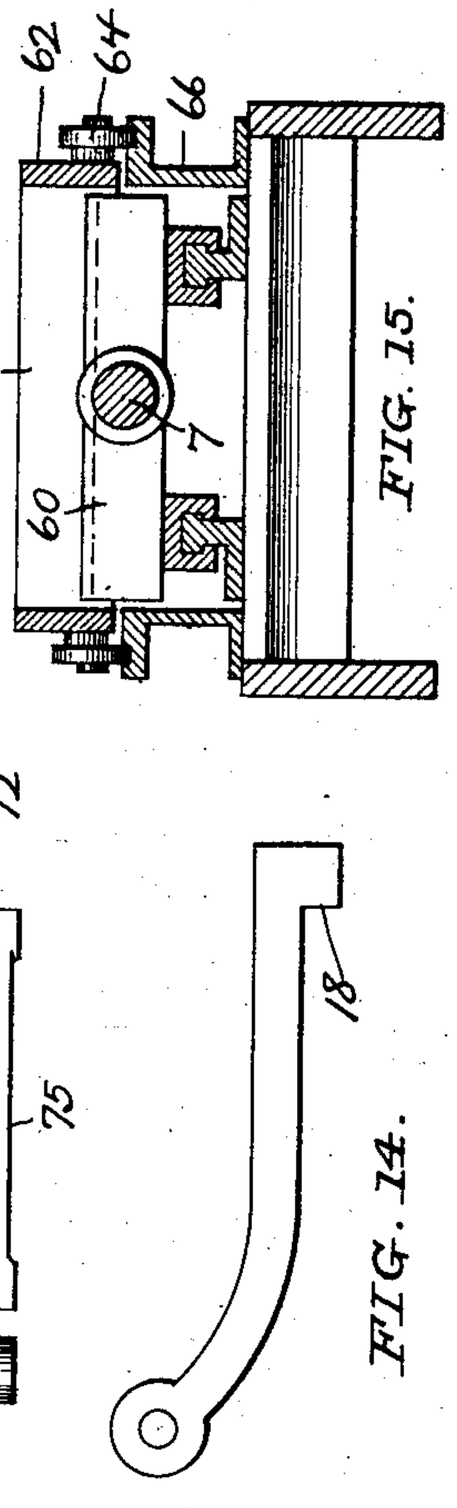

FIG. 15.

FIG. 14.

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997,279. Specification of Letters Patent. **Patented July 11, 1911.**

Application filed July 27, 1908. Serial No. 445,679.

To all whom it may concern.

Be it known that I, KENNEDY DOUGAN, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Governors, of which the following is a specification, reference being had therein to the accompanying drawings.

The object of this invention is to provide a power-driven mechanism adapted to be controlled by an automatic temperature, volume or speed-indicating device, and adapted to transmit the movement of such indicating device in exact proportion, and with multiplied force, to temperature, volume, or speed-controlling means, to the end that temperature, volume, or speed may be governed regardless of the amount of power required to operate said controlling means.

This invention differs from other governors intended for similar purposes in the following particular: In all the other power-driven governing mechanisms, of which I have knowledge, there is no fixed relation between the position of the regulating valve and the position of the fly-balls. In the invention herein disclosed, the position of the fly-balls and the gates is relatively the same, except at the instant adjustment is taking place.

In the accompanying drawings—Figure 1 is a plan view of a speed governor of preferred construction; Fig. 2 is a side elevation, omitting the centrifugal governor and the main drive pulley; Fig. 3 is an end elevation, partly in section on line 3 of Fig. 2; Figs. 4 and 5 are an inside and outside elevation of one of the cam-wheels; Fig. 6 is a detail view of one of the shifter dogs, its cam, and the part actuated by the dog; Fig. 7 is a plan of a modified speed governor; Fig. 8 is a sectional elevation viewed on line 8—8 of Fig. 7; Figs. 9, 10 and 11 are details; Fig. 12 is an elevational view of another modified speed governor; Fig. 13 is a plan view of the same; Figs. 14, 15 and 16 are details.

Referring to Figs 1, 2 and 3, this machine consists essentially of a plurality of power-driven shifter-dogs, an element adapted to be shifted thereby, cams which hold said dogs inoperative at all times when the speed of the engine or motor governed is normal, and a pair of fly-balls connected with the cams to control the position of the latter. Said shifted element is connected by a rod, or otherwise, with the gate of a water wheel (not shown), or with the reversing lever of the valve motion of an "automatic" engine (not shown). In Figs. 1, 2 and 3, the shifter-dogs are carried by two wheels that are continuously revolved in opposite directions, the dogs on one wheel acting to open the valve or gate, and those on the other wheel acting to close the valve or gate.

1 designates a rock-shaft, journaled in bearings 2 on the frame 4. Fixed upon shaft 1 are two arms or cranks, 5 and 6. Arm 5 is connected to a rod, or bar 7 which leads to and actuates the valve or gate (not shown) of the engine or motor whose speed is to be governed. The dog-wheels 8 and 9, also the cam-wheels 10 and 11, are mounted on shaft 1 and turn freely thereon. The arc of rotation of the cam-wheels is limited. They are placed on opposite sides of arm or crank 6, and are connected by a shouldered bolt 12 which also forms a wrist-pin which is connected by a connecting-rod 13 with the sliding stem 14 of a centrifugal governor 15, of which 16 is the drive-pulley. This pulley is, of course, driven by the engine or motor whose speed is to be governed. The arm or crank 6 carries a transverse pin 17 projecting equally from the sides of the crank. The ends of this pin lie in the paths of the two series of shifter-dogs 18 and 19 which revolve in different directions.

In Figs. 1 and 3, alternate dogs are omitted for clearness of showing.

20 and 21 designate throw-off cams carried by the respective cam-wheels 10, 11.

As a shifter-dog moves into close proximity to the pin 17, it rides over the cam 20 or 21, and is thereby caused to pass the pin 17 without moving it. The shifter-dogs are pivoted on pins 22 held by lugs 23 and lie in slots 24. They are pressed inwardly by suitable springs 25. The inward movement of each dog is limited by a stop 26, which may be cast on the dog (as shown) or on the wheel itself.

Each cam-wheel 10, 11 is constructed in two concentric parts, connected by hinges or springs; Fig. 4 shows the inner part 10′ connected to the outer part 10 by radially disposed springs 27. Arranged between the cam-wheels 10, 11, and almost in contact with their inner faces, are two or more stops 28 and 28′. Stop 28 is held by a crossbar 29 connecting the tops of bearings 30, 30.

The other stop 28′ is provided with a spreading foot 31 bolted to one end of the frame 4. Journaled in said bearings 30 are the driving shafts 32 and 33, the former having the pulley 34, also two spur pinions 35, 36. Pinion 35 meshes with teeth on the periphery of wheel 9 and drives same. Pinion 36 drives a pinion 37 of equal size on shaft 33, which carries the second drive-pinion 38 which drives the other wheel 8 in a direction opposite to that of wheel 9.

The operation is as follows: Pulleys 16 and 34 are driven by the engine or motor to be governed, though pulley 34 may be driven from another source. The positions of the fly-balls 15, stem 14 and cams 20, 21 are, of course, controlled by the speed at which the engine or motor runs. Except when the speed is changing, the cams 20, 21 shield the ends of pin 17 from the action of the shifter-dogs 18 and 19. When the speed changes, the governor 15 shifts rod 13, 14, cam-wheels 10, 11 and both cams 20, 21. This movement uncovers one end of said pin 17, and permits it to be engaged and shifted by the next dog 18 or 19. The amplitude of the movement of pin 17 must always equal that of the previous movement of the cams, and be in the same direction. The operation of the mechanism is such that the pin 17 follows the cams, and at all times when the speed is normal it is shielded by said cams.

The design and construction of the mechanism is such that the movements of the part 7, while not exactly simultaneous with the movements of the fly-balls, are so nearly so that the result is practically the same as if movement of balls and gates were simultaneous. It will be obvious, therefore, that the same quickness and accuracy of regulation may be obtained by the use of this mechanism in governing water wheels that is now obtainable in an ordinary slide valve engine, the speed of which is regulated by a throttling governor.

As each dog impinges upon the cam 20, or 21, the dog tends to carry the cam with it. This tendency is resisted by the inertia of the revolving weights 15, and each cam is formed with a very slight initial incline 20′ or 21′, as shown in Fig. 6. Following the incline 20′ the angle of the cam becomes greater, as shown at 20. When the cam has receded, thus permitting the dog to engage the pin 17, the dog shifts said bar until it is disengaged therefrom by riding over the cam. Owing to the load actuated through the medium of pin 17, crank 6, shaft 1, etc., there will be considerable friction between the parts 18 and 17, which friction must be overcome by the cam. I have utilized this friction to operate a device by which the cam-wheel is locked against rotation during the passage of the engaged dog over the steeper part of the cam. Said device comprises the aforesaid stops 28, 28′ and the cam-wheel made with the laterally yielding periphery. When the dog, engaging pin 17, impinges on the cam at 20′, the friction between parts 17 and 18 causes the dog to bear inwardly on the cam and cam-wheel periphery. The springs 27 yield to said pressure thereby permitting the cam-wheel periphery to be forced against the lateral stops 28, 28′. Thus the cam-wheel is frictionally held against rotation during the passage of the dog over the steeper part of the cam. The cam-wheels, or the governor stem 14, may be connected with a piston working loosely in a cylinder containing a heavy liquid, if found desirable, in addition to the means above described and for the purpose above described. As soon as the dog is disengaged from the pin 17, the springs 27 draw the cam-wheel periphery away from the stops 28, 28′.

Under this principle of operation, many modified governing mechanisms may be constructed. One such modified construction, which I have in mind, is to locate the part 17 out of the normal path of the shifter-dogs, and provide cams to throw the dogs into and out of engagement with said part. Two such modifications are illustrated herein. In Figs. 7 and 8, the numeral 1 designates the rock-shaft; 5, the arm or crank governing the throttle or gate through rod or bar 7; 18, 19 the shifter-dogs; 20, 21 the cams; 15, the fly-balls; 14, the stem actuated thereby. In this machine the shifter-dogs are oscillated in the arcs of circles, they being hinged to swinging yokes 40, 40′ mounted on shaft 1. Quick regulation requires the use of at least four dogs, 18, 19, having shanks of different lengths, as shown. The sectors, 42, keyed on shaft 1, are each formed with opposed shoulders 43, 43. Each dog may engage either shoulder of the corresponding sector, and will push or pull, according to its direction. The shoulders of all four sectors are preferably in alinement, as shown. The yokes 40, 40′ are actuated by pitmen 44, cranks 45, worm gears 46, worms 47, shaft 48 and pulley 49. The cams are equal in number to the dogs, 41, and are fan or sector shaped. Each cam has a recess 20′ cut in the center of its working face, as shown in Fig. 7. Each dog 41 is formed with a lateral lug 50 that rides to and fro upon the surface of its cam. The high parts of the cams are so disposed as to prevent the dogs from engaging the shoulders 43 when the speed of the motor is normal, the position of the cams being controlled by the governor 15 through stem 14 and connecting rod 13. Said cams have counterweights 51, if formed as sectors of a wheel. All the cams are rigidly tied together by a bar 52. Fig. 9 shows in detail one mode of

attaching said bar. Fig. 11 shows one of the yokes 40 with the dogs 41, 41′ carried thereby. 53 indicates a dashpot containing a liquid. The piston rod 54 carries a loose piston, and is connected to an arm 55 on the bar 52 connecting the cams. The dashpot assists in preventing improper movements of the cams. The mechanism actuating the dogs is so arranged that two of the dogs are always moving in the opposite direction from the other two. The purpose of this is to equalize the tractive forces of the dogs upon the cams, due to friction. Thus, the movement of the governor stem is as free as if there were no friction upon the cams. The purpose of the unequal lengths of the dogs will be clear without explanation. All of the shifter dogs may be actuated by one yoke, but the construction shown is preferred.

Operation: When the speed rises, the stem 14 shifts all of the cams. This permits one of the dogs to shift the sector below it in the proper direction to cause a reduction of speed.

The mechanism shown in Figs. 12 and 13 is the same as that just described, except that the dogs and cams have a straight-line motion. The sectors, shaft 1 and crank 5, are thus dispensed with. The sectors 42 are replaced by a single flat plate 60 having the shoulders 61 (Fig. 16). The cams 62 are two in number and have the form of straight bars, rigidly connected across their ends by bars 63. The cams are provided with spring-depressed rollers 64 that travel on grooved ways 66. The cams are actuated by rock-arms 67, rock-shaft 68, arm 69, connecting rod 13, and governor stem 14. The dog-frame bars 70 terminate in crossheads 71, sliding on guides 72, and are actuated by connecting rods 73, rock-arms 74, connecting rods 75, cranks 76, gears 77, worms 78, shaft 79, and pulley 80. The rod 7, corresponding to rod 7 of the other figures, is secured directly to the slide 60.

The operation is precisely the same as that described for Figs. 7 and 8, with the additional feature that the cams 62 are locked against movement while either cam is disengaging a dog from a shoulder 61 of the slide 60. This is effected by the downward pressure upon the cams, overcoming the springs 65, causing the cams to bear flat upon the cam tracks 66. After disengagement, said springs lift the cams out of contact with said tracks, and the cams are again free to be moved by the governor 15.

In the accompanying drawings the invention is shown in connection with a pair of fly balls, but any device for automatically recognizing and indicating change in speed, temperature, or volume, may be substituted for the fly balls.

The invention may be used for governing the speed of a water wheel, or for governing the speed of a railroad locomotive, or other engine having a link motion, or the equivalent of a link motion, by having the mechanism connected to the reversing lever; or it may be used for maintaining water in a reservoir at a uniform height by having a float connected to the mechanism; or the temperature of a room may be governed by having the temperature indicator control the mechanism.

In the claims, the term "condition to be governed" is to be understood as meaning speed, temperature, or volume. "Element adapted to control the condition to be governed" refers to the element actuated by the shifting devices 18, 19.

I claim:

1. In a governing mechanism, a movable element provided with shoulders and adapted to control the condition to be governed, a governing device actuated by changes in the condition to be governed, power driven shifters, a movable cam connected to said governing device and moving in unison therewith and normally shielding the shoulders of the movable element against the action of said shifters, the cam disengaging said shifters when the shouldered element has been moved the same distance as the governor moves the cam.

2. In a governing mechanism, a movable element provided with shoulders and adapted to control the condition to be governed, a governing device actuated by changes in the condition to be governed, power driven shifters, a movable cam connected to said governing device and moving in unison therewith and normally shielding the shoulders of the movable element against the action of said shifters, the cam disengaging said shifters when the shouldered element has been moved the same distance as the governor moves the cam, and means to prevent said cam from being disturbed by said shifters.

3. In a governing mechanism a movable element provided with shoulders and adapted to control the condition to be governed; a governing device actuated by changes in the condition to be governed; a yieldably mounted movable cam connected to said device, moving in unison therewith and normally shielding the shoulders of the first-named element; power-driven shifters moving in the same direction as the cam and adapted to shift said element, and to be disengaged by said cam when said governing element has been moved into corresponding position with said cam; and a fixed stop adapted to be frictionally engaged by said cam for the purpose described.

4. A governing mechanism comprising a movable element having two opposed shoulders adapted to be engaged by a shifter, a

continuously power driven shifter adapted to engage said shoulders and shift said movable element, a cam actuated by changes in the condition to be governed, said cam holding said power driven element inoperative when the condition to be governed is normal, said movable element being adjusted by a single stroke of the shifter, the cam disengaging the shifter when the shouldered element has been moved the same distance as the governor moves the cam.

5. A governing mechanism comprising an element having two opposed shoulders adapted to be engaged by a shifter; a revolving power-driven wheel carrying a plurality of shifters each adapted to engage said shoulders and shift said element; and a cam actuated by changes in the condition to be governed, said cam holding said power-driven element inoperative when the condition to be governed is normal, said shifted element being adjusted by a single stroke of the shifter.

6. A governing mechanism comprising an element having two opposed shoulders adapted to be engaged by a shifter; two wheels revolved in opposite directions, each wheel carrying a plurality of shifters adapted to shift said element; and a cam actuated by changes in the condition to be governed, said cam holding said power-driven element inoperative when the condition to be governed is normal, said shifted element being adjusted by a single stroke of the shifter.

7. A governing mechanism comprising an element having two opposed shoulders adapted to be engaged by a shifter; two wheels continuously revolved in opposite directions, each wheel carrying a plurality of shifters adapted to shift said element; and a cam actuated by changes in the condition to be governed, said cam holding said shifters inoperative normally, and means to prevent movement of said cam by said shifters.

8. A governing mechanism comprising an element having two opposed shoulders adapted to be engaged by a shifter; two wheels revolved in opposite directions, each wheel carrying a plurality of shifters adapted to shift said element; a yieldably mounted cam actuated by changes in the condition to be governed; and a fixed stop positioned in close proximity to said cam to limit the yielding motion of said cam.

9. A governing mechanism comprising a movable member having opposite projections adapted to be engaged by a shifter; two wheels disposed at opposite sides of said member and revolved in opposite directions, each wheel carrying a plurality of shifters adapted to shift said member; and a pair of cams actuated by changes in the condition to be governed, said cams holding said shifters inoperative when the condition to be governed is normal, said shifted member being adjusted by a single stroke of the shifter.

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