

No. 656,373.

Patented Aug. 21, 1900.

C. ROBINSON.

MEANS FOR OPERATING AND GOVERNING ENGINES.

(Application filed Nov. 28, 1899.)

(No Model.)

3 Sheets—Sheet 1.

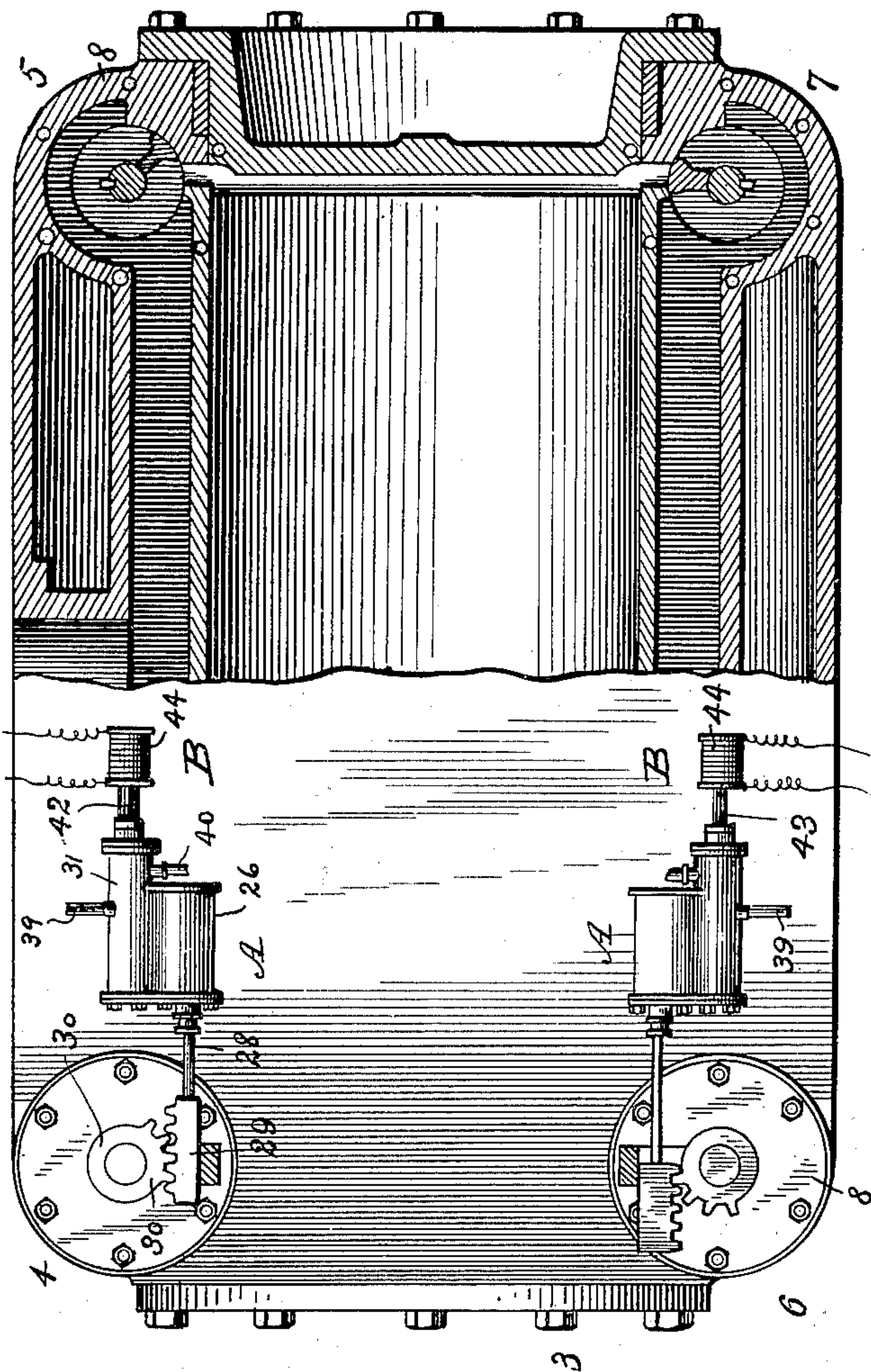


Fig. 2.

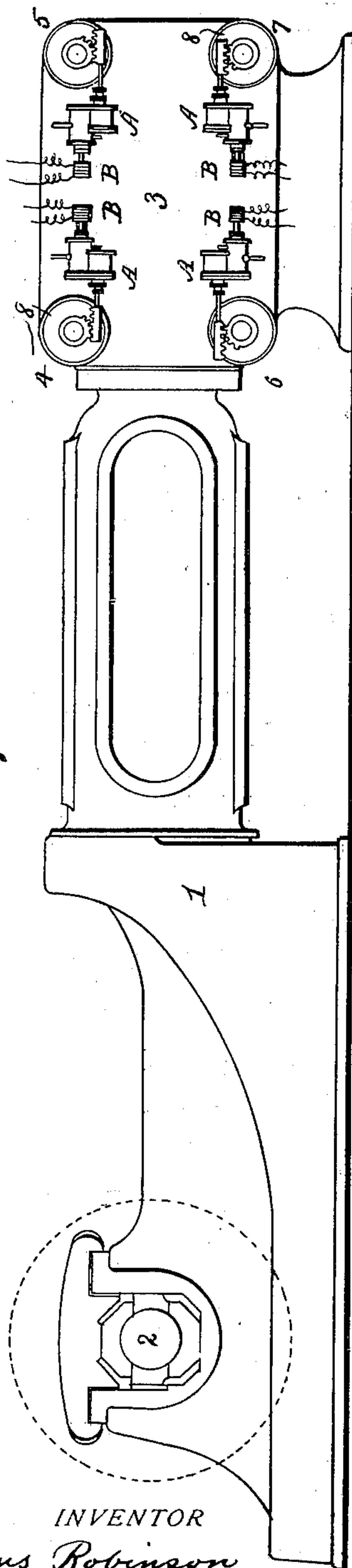


Fig. 1.

WITNESSES

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Fig. 4

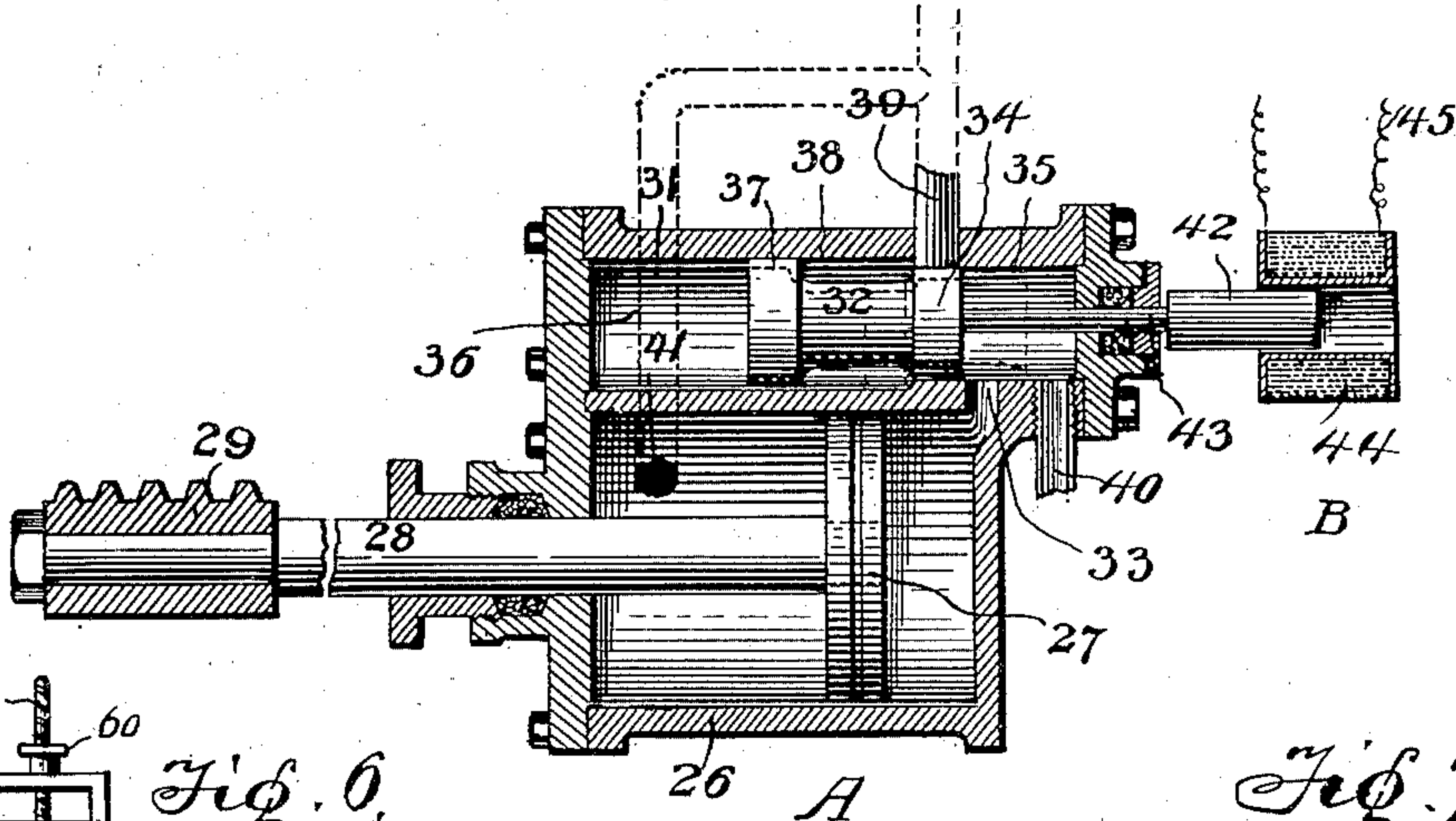


Fig. 6

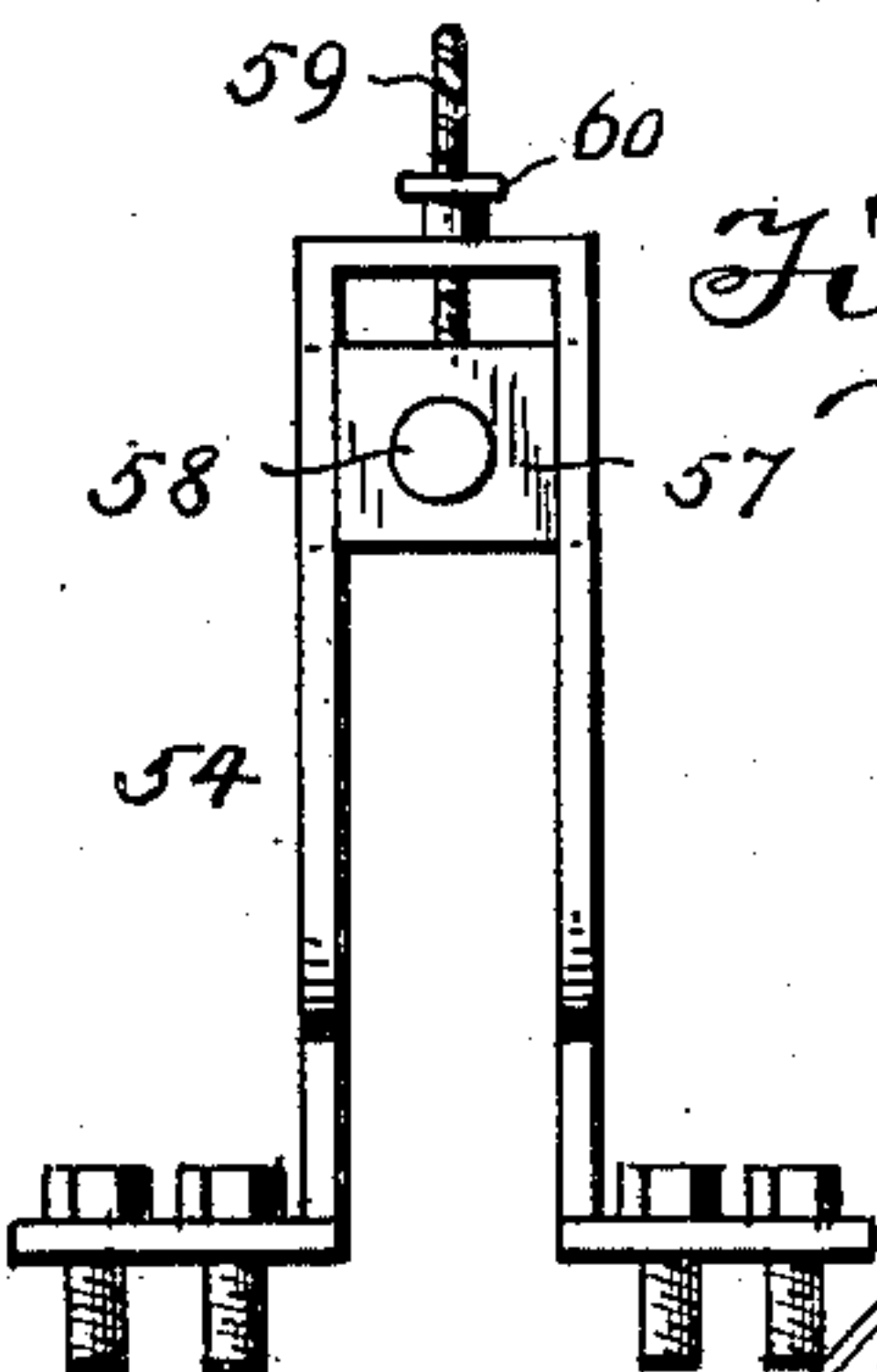


Fig. 7

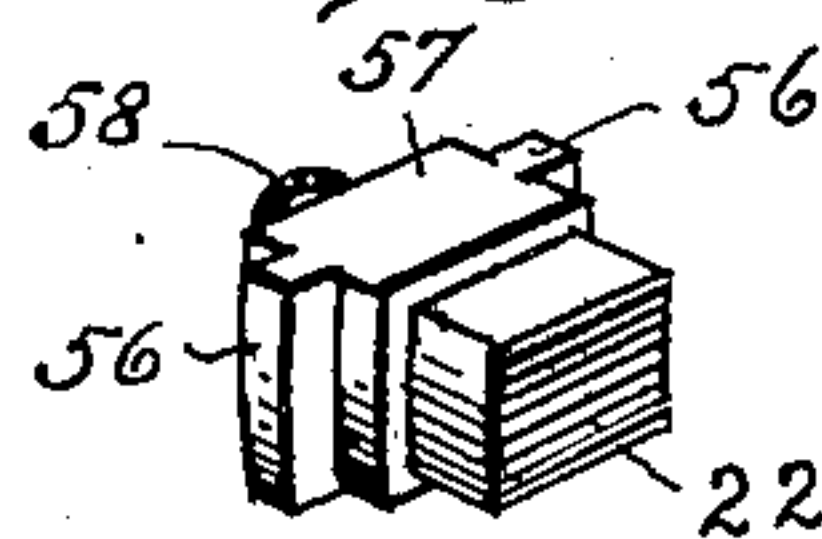
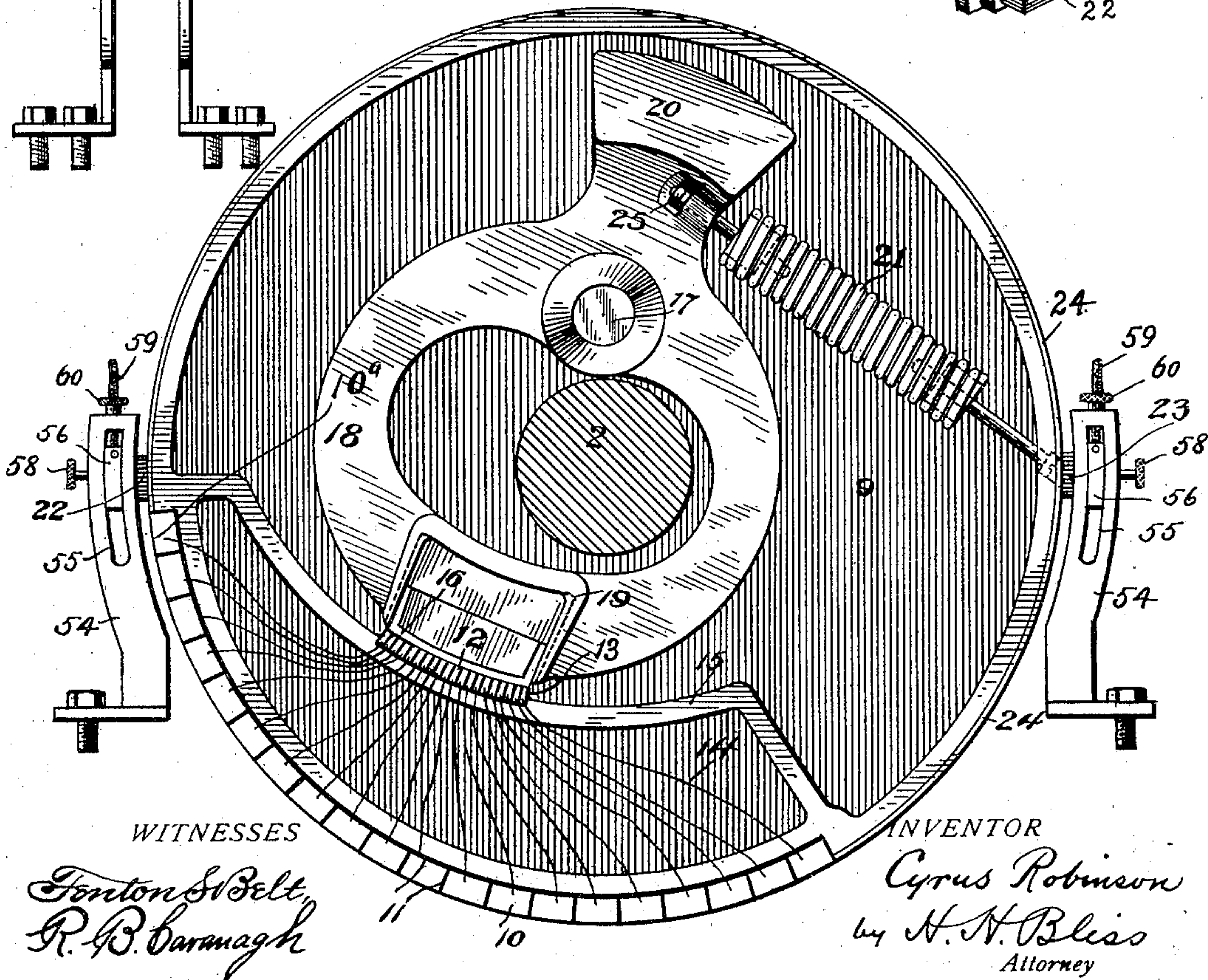


Fig. 3



WITNESSES

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3 Sheets—Sheet 3.

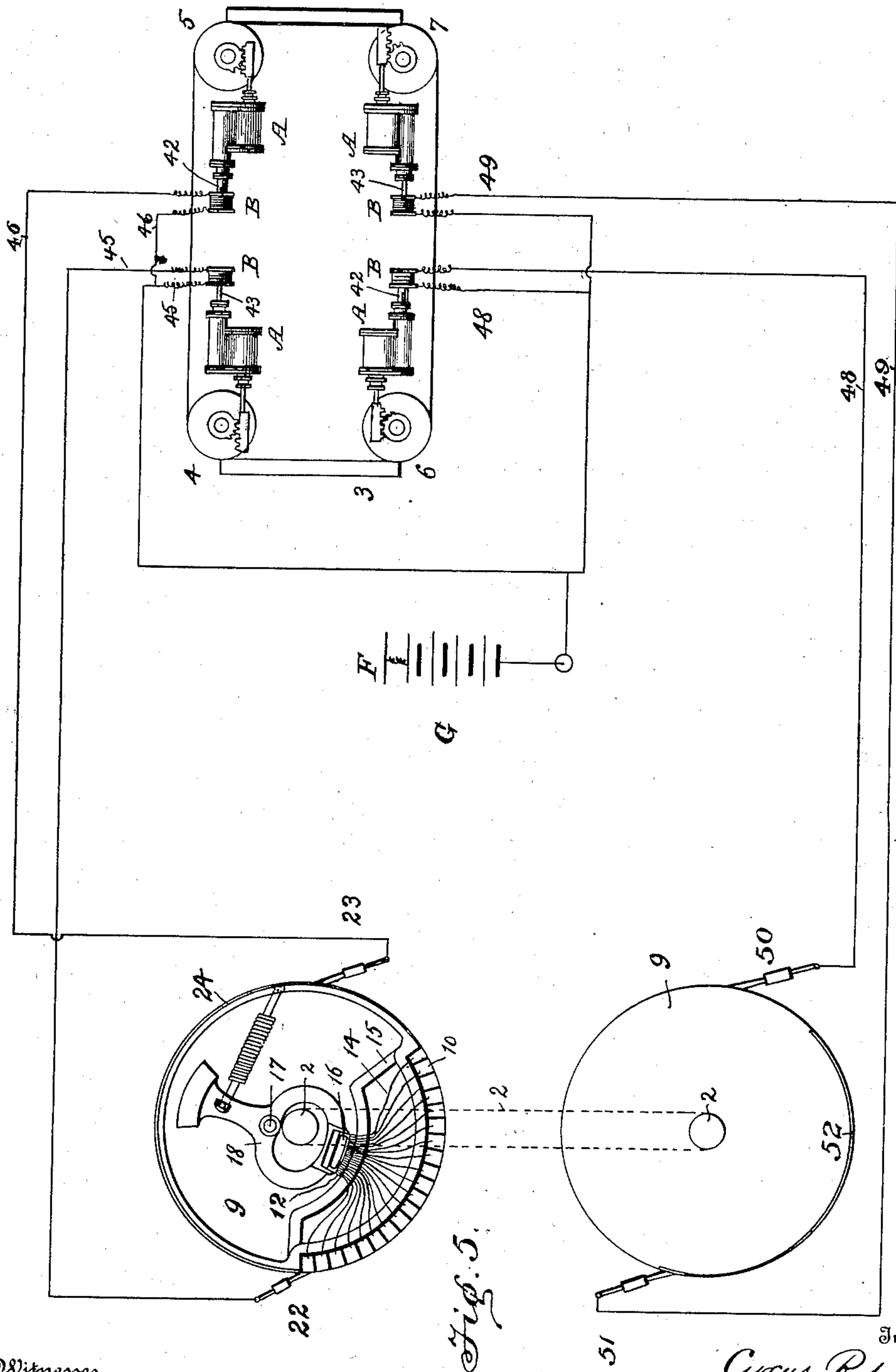


Fig. 5.

Witnesses

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# UNITED STATES PATENT OFFICE.

CYRUS ROBINSON, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, OF SAME PLACE.

## MEANS FOR OPERATING AND GOVERNING ENGINES.

SPECIFICATION forming part of Letters Patent No. 656,373, dated August 21, 1900.

Application filed November 28, 1899. Serial No. 738,572. (No model.)

*To all whom it may concern:*

Be it known that I, CYRUS ROBINSON, a subject of the Queen of Great Britain, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Means for Operating and Governing Steam or other Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

In order to make my invention more clearly understood, I have shown in the accompanying drawings means for carrying it into practical effect without limiting my improvements in their useful applications to the particular construction which, for the sake of illustration, I have delineated.

In said drawings, Figure 1 is a side view of so much of a steam-engine embodying my invention as is necessary to an understanding of the latter. Fig. 2 is a side view, partly in section, of the main cylinder and valve-operating means. Fig. 3 is an elevation of the valve-controlling wheel or drum. Fig. 4 is a longitudinal sectional view, on a larger scale, showing the valve-actuating means for one of the valves. Fig. 5 is a diagram illustrating the electric circuits and connections. Fig. 6 is an end elevation of one of the supports for the adjustable brushes. Fig. 7 is a perspective view of one of the brushes with its adjustable holder.

Referring to the drawings, 1 indicates the engine-frame, 2 the main shaft, and 3 the cylinder.

I have chosen for illustration of the invention an engine of the Corliss type; but it will be understood that my improvements are applicable to other forms of engines.

4 and 5 indicate the inner and outer steam-admission valves, and 6 and 7 the corresponding exhaust-valves. All of these valves may be constructed in any suitable or well-known manner and formed with ports corresponding with the ports of the steam-chest adapted to properly perform the functions of admitting and cutting off and allowing the exhaust of the steam when properly actuated. While these valves may be of the slide or gridiron type without departure from my invention, which relates principally to the means for actuating

the valve, I have illustrated them as of the oscillating type, turning on axes parallel with the engine-shaft in the usual boxes or seats 8.

An illustration of the piston and its connections with the engine-shaft being unnecessary to a description or understanding of my invention, they have been omitted.

Referring especially to Fig. 3, 9 is a wheel or drum keyed or fixed on the engine-shaft or otherwise connected with the latter to rotate therewith. 10 indicates a series of segments, of copper or good conducting material for an electric current, mounted in or on the drum and insulated from the latter and from each other by insulating material 11. 12 indicates conducting-segments, also carried by the drum and insulated from each other and from their supporting means by material 13. The segments 12 form a series corresponding with the series of segments 10 and are individually connected electrically each with one of the segments 10 by wires 14. The segments 12 are preferably narrower than the segments 10 or are otherwise suitably arranged so that in proportion to their distance from the center of the shaft the series which they compose shall be shorter than the series formed by the segment 10—in other words, shall subtend a less angle. This, however, is a matter of convenience for the purpose of obtaining a greater effect from a less movement of the governing device hereinafter described. The segments 12 are conveniently mounted upon a lateral flange 15, formed on or attached to the drum. 16 is a shoe of good conducting material and mounted on or carried by the drum in such manner that it may slide, under the control of the governing device, along the surfaces of the series of segments 12, making electrical contacts with the same. To facilitate such contact, the segments are arranged with their surfaces along which the shoe 16 slides concentric with the pivotal center 17 of the governing device, and the corresponding contacting surface of the shoe is correspondingly formed. 18 is a governing-lever pivotally connected with the drum 9 at 17 and having a slot or fork 19, which embraces the shoe 16 and is adapted to move the latter along the series of segments 12 in accordance with the movement of the



governor-lever. The latter has an eccentric weight or extended weighted portion 20 and is provided with a suitable controlling-spring 21. 22 23 indicate electrical contact-brushes 5 mounted in proximity to the periphery of the drum 9 and adapted to make contact with the same as the drum revolves. That portion of the surface of the drum, however, which is not occupied by the segments 10 and 10 which is touched by said brushes is insulated from the latter by material 24. The arrow indicates the normal direction of revolution of the drum.

The steam-valves 4 and 5 each has an electromagnetic operating device in an electric circuit which when completed includes one of the brushes 22 or 23, a segment 10, a wire 14, a segment 12, the shoe 16, and any suitable electrical connection from thence to the engine shaft and frame 1. This last connection may be, as shown, directly through the metallic governor-arm 18, pivot 17, and drum 9. As soon as the revolution of the drum brings the first of the segments 10 in contact 25 with the brush—say the brush 22—the corresponding steam-valve will be opened and will remain open as the remainder of said segments successively pass along the brush until the last segment is reached which is in electrical contact with, through the intermediate parts already described, the shoe 16, and as soon as such last segment—for instance, that at 10<sup>a</sup>—leaves the brush said valve will be closed and the steam cut off. 35 It will be observed that an increasing speed of the engine will so influence the governor centrifugally as to cause the fork 19 to gradually change its position relative to the shaft 2. In the position of the drum shown in Fig. 40 3 such increasing speed will move the fork and the shoe 16 toward the right hand along the series of segments 12, so that said shoe will pass out of contact with one or more of the segments at the left hand of said series. 45 The result of this will be to cut one or more of the segments 10, beginning with that at 10<sup>a</sup>, out of the electric circuit and cause the cut-off to take place earlier. As the speed of the engine is thereby decreased, the cut-out segments 50 10 are one after the other restored to the electric circuit, and the length of valve opening or length of time during which the steam-valve remains open will be correspondingly increased with an acceleration of the engine. The desired speed for which the governor may be set in any usual or preferred manner, as by regulating the tension of the spring 21 by a nut or nuts 25, may thus be maintained and a great many expensive and 60 complicated connections heretofore employed for the purpose eliminated.

With the devices thus far described may be combined any suitable magneto-electric valve-operating mechanism. I have, however, 65 devised a special apparatus for this purpose having certain advantages of construction and simplicity and certainty of opera-

tion, which I prefer to employ in connection with controlling-drum 9. According to this part of my invention each of the steam-valves 70 4 and 5 and also each of the exhaust-valves 6 and 7 is provided with a fluid-pressure actuating device A, which in turn is controlled in its operations by a magneto-electric device B. A description of the means for operating one of the valves will suffice for all four. 75 Referring especially to Fig. 4, 26 is a steam-cylinder fitted with a piston 27 and piston-rod 28. The latter is connected with the valve by any suitable means, so that the reciprocation 80 of the piston shall oscillate the valve—for instance, by a rack 29, gearing with a toothed segment 30, mounted on the valve-stem, Fig. 2. The cylinder 26 is fixed upon the cylinder or steam-chest of the engine at a proper 85 and convenient point, as shown in the latter figure. 31 is a valve-chamber formed with or bolted to the cylinder 26 and having fitted within it a hollow reciprocating valve 32. 33 is the steam-admission port for the cylinder 90 26, which is controlled by said valve by means of its cylindrical portion 34. That part of the valve-chamber indicated at 35, within which the portion 34 fits and reciprocates, is smaller than the other portion of 95 said chamber shown at 36. In the latter fits another portion 37 of the valve, leaving between said valve portions an annular space 38, with which communicates a steam-duct 39, leading from the steam-chest of the engine or other suitable source of supply. 100 40 is an exhaust port or passage leading from the valve-chamber at such point that it is adapted to be closed or cut off from the cylinder by the valve when the latter is in position to admit steam to the cylinder 26, as 105 seen in Fig. 4. 41 is a passage by which the inner end of the cylinder 26 communicates with the source of steam-pressure, such as the duct 39. When the time in the revolution 110 of the engine-shaft for the admission of steam through one of the steam-valves—say the valve 4—has arrived, the valve 32 is moved by devices hereinafter described or other suitable means into the position shown in 115 Fig. 4, opening the steam-duct 39 and port 33 and closing the exhaust-passage 40. Steam is thereby admitted through the space 38 around the valve into the cylinder 26, which 120 moves the piston 27 toward the steam-valve 4 and turns the latter to admit steam to one end of the cylinder 3. When the time for cut-off has arrived, the actuating means of the valve 32 releases the same, whereupon the excess of steam-pressure in the space 38 125 upon the valve portion 37 over that upon the portion 34 (the latter being of less area, as above described) will move the valve inward to the left in Fig. 4 and cause the passage 39 to be closed and the port 33 placed in communication with the exhaust 40. The steam-pressure on the inner side of the piston 27 will immediately move the latter to the right and cause the valve 4 to effect its cut-off. 130



While the inner or left-hand end of the cylinder 26 is in constant communication with a source of live-steam supply, such as the steam-chest, or is supplied at intervals with steam, as by a connection with the casing of valve 4, it will be observed that the piston is not balanced—that is to say, the area of the piston-rod 28 is subtracted from the pressure-surface of the left-hand side of the piston 27. Therefore when steam is admitted at the outer or right-hand side of the piston, as already described, the constant steam-pressure on the left-hand side will be overcome and the piston moved to the left, notwithstanding such constant steam-pressure. It will be understood, however, that my invention is not confined to the use of fluid-pressure for returning the piston and effecting the cut-off of the valve 4.

One form of magneto-electric device for actuating the valve 32 out of many which are suitable for the purpose is illustrated, comprising a solenoid-core 42, connected with the stem 43 of the valve 32 and adapted to be attracted within a solenoid-coil 44. The circuit-wires 45 of the latter constitute a part of the electric circuit above referred to in connection with the description of the controlling device shown in Fig. 3 and including the brush 22. Similarly the circuit-wires 46 from the actuating means of the valve 5 include the controlling-drum 9 through the brush 23. A diagram of the electrical circuits for all the valves, including the exhaust-valves, is shown in Fig. 5, in which G is typical of any suitable electrical generator connected at one pole with the engine-frame at F and at the other pole with one of the circuit-wires 45 and one of the circuit-wires 46.

The actuating means for the exhaust-valves 6 and 7 is similar to that already described in connection with the steam-valves. Their circuit-wires are shown in Fig. 5 at 48 and 49, leading at one end to the generator G and at their other ends to brushes 50 and 51. The latter make contact with a conducting-strip 52 on the drum A or on any other rotary surface turning in proper time with the engine-shaft. While the strip 52 is in contact with the brush 51 the exhaust-valve 7 is opened to correspond with the opening of the steam-valve 4 and will remain open until the strip 52 leaves the brush. Similarly the contact of said strip with the brush 50 will open the exhaust-valve 6.

It will be observed that this invention dispenses with the eccentrics, wrist-plates, mechanical releasing-gears, vacuum-pots, pendulum-regulators, &c., common to Corliss and other engines. Moreover, the leading segment 10 being always in electrical communication with the shoe 16, the steam-valves are always opened at a predetermined time independent of the cut-off, thus giving the very desirable combination of a fixed lead for the steam-valve and a variable cut-off.

My invention is adapted for use in pumps

and compressors as well as in engines generally.

I further prefer to make the brushes 22 23 50 51 adjustable to determine the times of opening of the valves, especially of the steam-valves 4 5, to obtain the desired lead. A description of the construction shown in Figs. 3, 6, and 7 will suffice for an understanding of a means of adjusting all of the brushes. 54 is a bracket or stand mounted on any convenient part of the engine-frame 1 or other suitable support. This bracket is formed with guides 55, concentric with the drum 9, in which fit the lugs 56 of a brush-holder 57. The necessary insulation is effected by insulating the bracket 54 or by making the holder 57 of insulating material. The brush 22 (or 23, 51, or 50) is mounted in said holder, Fig. 7, and is adjustable therein toward and from the drum by a screw 58. 59 60 indicate a screw and nut, the former connected with the holder and the latter bearing on the bracket for adjusting the brush circumferentially of the drum to determine when the electric contact between the brush and the leading segment 10 shall first take place and the opening of the valve shall begin. In the case of the main steam-valves this will determine the lead in an obvious manner. Thereafter the lead remains fixed and the cut-off will be determined by the governor, as already described.

It will be understood that my invention is not limited to interposing a fluid-pressure or other secondary valve operating means between the magneto-electric device and the valve.

What I claim is—

1. In a means for operating and governing steam and other engines, the combination, with an admission-valve of said engine, of a rotary part such as a drum or wheel, having an electric conducting-surface, a brush for contacting with the latter, a governing or controlling device on the same axis as said drum for varying the operative or effective length of said surface, suitable circuit connections including said brush and surface when they are in contact, an electromagnetic device in the circuit, and means for causing the operation of said valve from said electromagnetic device, substantially as set forth.

2. In a means for operating and governing steam and other engines, the combination, with a valve of said engine, of a rotary part such as a drum or wheel, having an electric conducting-surface, a brush for contacting with the latter, a centrifugal governing device on the same axis as said drum for varying the operative or effective length of such surface, suitable circuit connections including said brush and surface when they are in contact, an electromagnetic device in the circuit, and means for causing the operation of the valve from said electromagnetic device, substantially as set forth.

3. In a means for operating and governing



steam and other engines, the combination, with a valve of such engine, of a rotary part such as a drum or wheel having an electric conducting-surface consisting of a series of  
 5 individually-insulated conducting blocks or pieces said series extending in directions transverse to the axis of said drum, a brush for contacting with the latter, a governing device adapted to effect the electrical connection of more or less of said pieces according  
 10 to the speed of the engine, suitable circuit connections adapted to include said brush and the pieces so connected by the governing device, an electromagnetic device in the circuit, and means for causing the operation of  
 15 the valve from said electromagnetic device, substantially as described.

4. In a means for operating and governing steam and other engines, the combination,  
 20 with a valve of said engine, of a rotary part such as a drum or wheel having a surface consisting of a series of individually-insulated conducting pieces or segments, a brush for contacting with the latter, a second series of  
 25 individually-insulated conducting pieces or segments, each connected electrically with one of the segments of the first series, a governing device adapted to effect the electrical connection of more or less of said segments  
 30 composing the second series, according to the speed of the engine, suitable circuit connections adapted to include said brush and segments, an electromagnetic device in the circuit, and means for causing the operation of  
 35 the valve from said electromagnetic device, substantially as described.

5. In an engine, the combination with the several steam and exhaust valves and means for actuating the same, of electromagnetic  
 40 devices for causing the operation of said actuating means, an electric circuit and a single electrical generator in said circuit for energizing said devices, electrical contacts in said circuit, one or more of which is actuated by  
 45 the engine, and a governing means operated by the engine for determining and varying the duration of electrical contact, substantially as set forth.

6. In an engine, the combination, with the  
 50 rotary valve or valves, of fluid-pressure-operating devices, mechanism whereby said devices are connected with the valves, electromagnetic devices for causing the operation of said fluid-pressure devices, an electric circuit  
 55 and source of electrical force for energizing said electromagnetic devices, electrical contacts in said circuit, and a governing means operated by the engine for determining and varying the duration of electrical contact,  
 60 substantially as set forth.

7. In a means for operating steam and other engines, the combination, with a valve, or valves of said engine, of fluid-pressure-operating devices connected with the same, a rotary  
 65 part such as a drum or wheel having an electric conducting-surface, a brush for con-

tacting with the latter, means for varying the operative or effective length of said surface, comprising an electric contact movable in  
 70 directions transverse to the axis of the drum, suitable circuit connections adapted to include said brush and surface, and electromagnetic devices in the circuit adapted to cause the operation of said fluid-pressure-operating devices, substantially as set forth. 75

8. In a means for operating and governing steam and other engines, the combination, with a valve or valves of said engine, of a fluid-pressure-operating device connected with the valve eccentrically to rotate the  
 80 same, and having a controlling-valve, an electromagnetic actuating device controlling the latter valve, an electric circuit including said electromagnetic device, and means for opening and closing said circuit, substantially  
 85 as set forth.

9. In a valve operating or controlling mechanism, the combination, with a valve, of a fluid-pressure-operating device connected with the valve eccentrically to rotate the  
 90 same, and having a controlling-valve, an electromagnetic actuating device controlling the latter valve, an electric circuit including said electromagnetic device, means for opening and closing said circuit, and a centrifugal  
 95 governing device for determining the duration of the closing of said circuit, substantially as set forth.

10. In a means for operating and governing steam and other engines, the combination,  
 100 with a valve or valves of said engine, of a fluid-pressure-operating device connected with the valve eccentrically to rotate the same and having a controlling-valve, an electromagnetic actuating device controlling the  
 105 latter valve, an electric circuit including said electromagnetic device, a rotary part such as a wheel or drum actuated by the engine, and having an electric conducting-surface, a brush for contacting with the latter, and a  
 110 centrifugal governing device for determining the operative or effective length of said surface, substantially as set forth.

11. In a valve-operating mechanism for steam-engines and other purposes, the combination of a main valve, a cylinder having  
 115 a piston connected with said valve, an unbalanced controlling-valve governing the admission to and exhaust from said cylinder, and held normally by the actuating fluid-pressure to cut off the admission to said cylinder and open the latter to the exhaust,  
 120 means for returning said piston when the controlling-valve is in the latter position, and means for actuating the controlling-valve to cut off the exhaust and admit fluid-pressure to the cylinder, substantially as set forth. 125

12. In a valve-operating mechanism for steam-engines and other purposes, the combination of a main valve, a cylinder having  
 130 an unbalanced piston connected with said valve, an unbalanced controlling-valve gov-



erning the admission to and exhaust from said cylinder, and held normally by the actuating fluid-pressure to cut off the admission to said cylinder and open the latter to the exhaust, means for causing the actuating fluid-pressure to act on the side of less area of said piston, and means for actuating the controlling-valve to cut off the exhaust and admit fluid-pressure to the cylinder, substantially as set forth.

13. In a means for operating and governing steam and other engines and devices, the combination, with a valve or valves of said engine, of a rotary part such as a drum or wheel having an electric conducting-surface, a brush for contacting with the latter, suitable circuit connections including said brush and surface when they are in contact, an electromagnetic device in the circuit, and means connected eccentrically with the valves for causing the rotation of the same from said electromagnetic device, substantially as set forth.

14. In a valve-controlling mechanism, the combination with an engine and its valve, of an electric circuit, an electromagnetic valve-operating device in said circuit and connected with the valve, eccentrically to rotate the same and means for making and breaking said circuit operated by said engine.

15. The combination of a steam-engine having a steam-controlling valve, an electromagnetic device controlling said valve, an electric circuit including said electromagnetic device, and a current-controller for said circuit actuated by said engine.

16. In an engine, the combination with a cylinder, and valve for the same, of a fluid-pressure-valve-operating device connected with the valve eccentrically to rotate the same, and means for causing the operation of said fluid-pressure device.

17. In a valve-controlling mechanism, the combination, with an engine and its valve, of an electric circuit, an electromagnetic valve-operating device in said circuit and connected with the valve, means operated by the said engine for making and breaking said circuit, and an adjusting means for determining the time of making said circuit comprising a rotary contact-drum, a governor rotary in planes transverse to the axis of said drum, and an electric contact moved relative to the drum by said governor.

18. In a valve-controlling mechanism, the combination, with an engine and its valve, of an electric circuit, an electromagnetic valve-operating device in said circuit and connected with the valve, and means for making and breaking said circuit comprising a rotary or other movable part in said circuit operated in proper time with the engine and a brush or

contact adjustable parallel with the movement of said movable part.

19. In a valve-actuating mechanism the combination with a valve, of a fluid-pressure-operating device connected with the valve, and having a cylinder, one end of which is normally open to the exhaust to effect the closure of said valve, means for admitting fluid-pressure to the same end of said cylinder to open the valve, and an electromagnetic device controlled by the engine and controlling said admitting means.

20. In a valve-actuating mechanism the combination with a valve, of a fluid-pressure-operating device connected with the valve, a controlling-valve for said fluid-pressure device, an electromagnetic device for moving said controlling-valve in one direction and means for causing a fractional part of the normal live-steam pressure to move said valve in the other direction.

21. In a valve-actuating mechanism the combination with a valve, of a fluid-pressure-operating device connected with the valve, a controlling-valve 32 for said fluid-pressure device having the parts 34, 37 of different area, a corresponding valve-casing, and an electromagnetic device connected with the controlling-valve and controlled by the engine.

22. In a valve-governing mechanism for engines the combination with a valve, of an electromagnetic device for operating the same, an electric circuit including said electromagnetic device, and a governor having electric contacts rotating therewith, one of which is movable relative to the governor-shaft according to the speed of rotation, said rotary contacts being included in said circuit.

23. The combination with a drum or disk having an electric contact, of a centrifugal governing device on said disk, and an electric contact carried with said disk and movable relative to the first-mentioned contact, and actuated by said governing device according to the speed of revolution of the disk.

24. The combination with the engine, and a valve thereof, of a centrifugal governor, a movable electric contact thereon connected with the centrifugal weight of the governor and shifted thereby, an electric circuit including suitable contacts and including said movable contact on the governor, and an electromagnetic device in said circuit and controlling said engine-valve.

In testimony whereof I affix my signature in presence of two witnesses.

CYRUS ROBINSON.

Witnesses:

E. E. ARNOLD,  
H. HORNE.