No. 778,238. PATENTED DEC. 27, 1904.

E. R. GILL.

ELECTRIC BRAKE.

APPLICATION FILED OCT. 6, 1900.

7 SHEETS—SHEET 1.

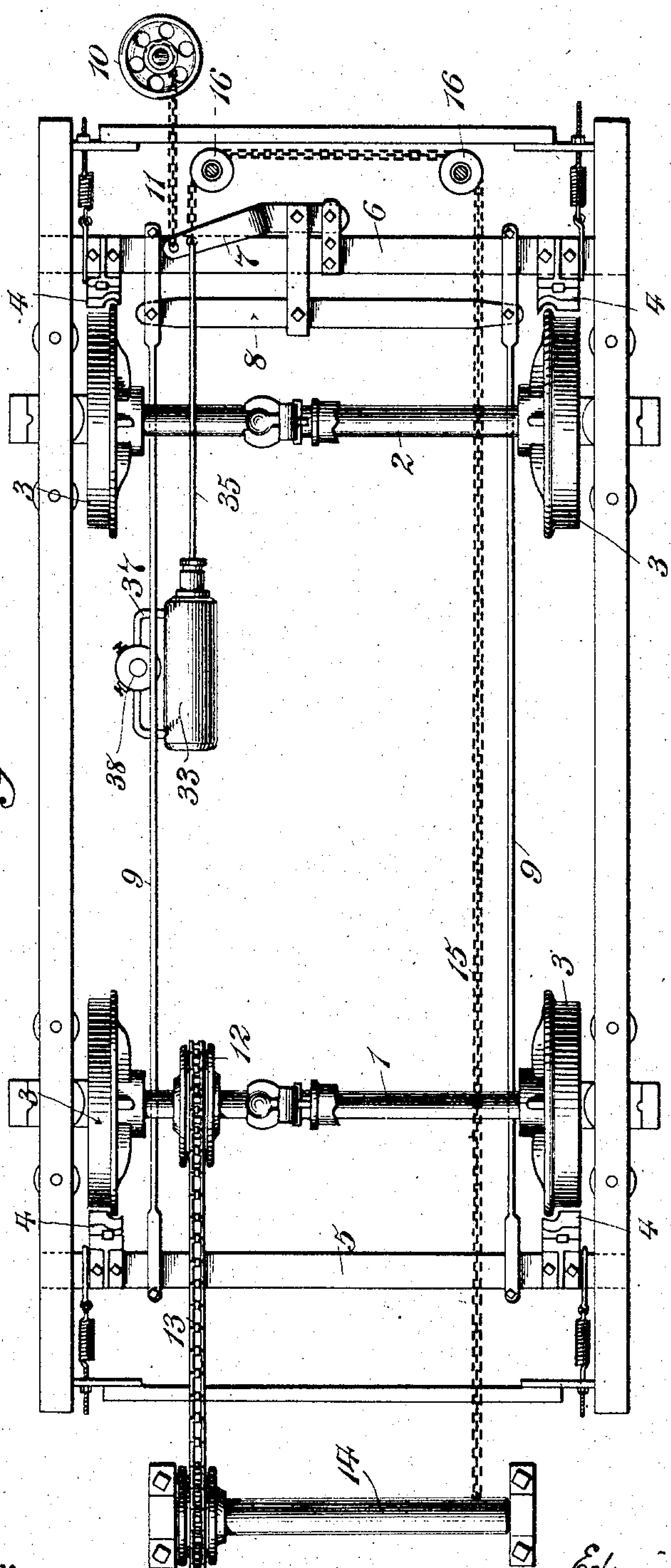

Fig. 1.

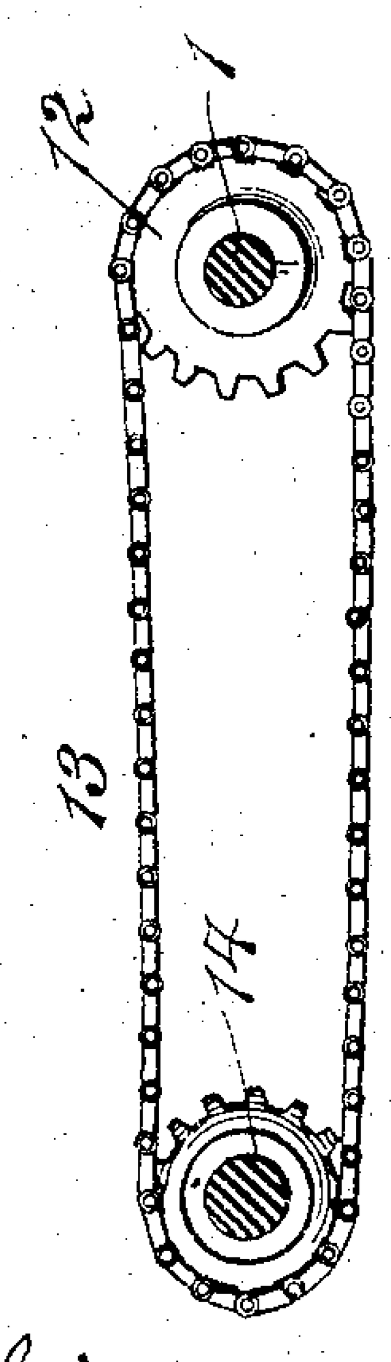

Fig. 2.

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7 SHEETS—SHEET 2.

Fig. 3.

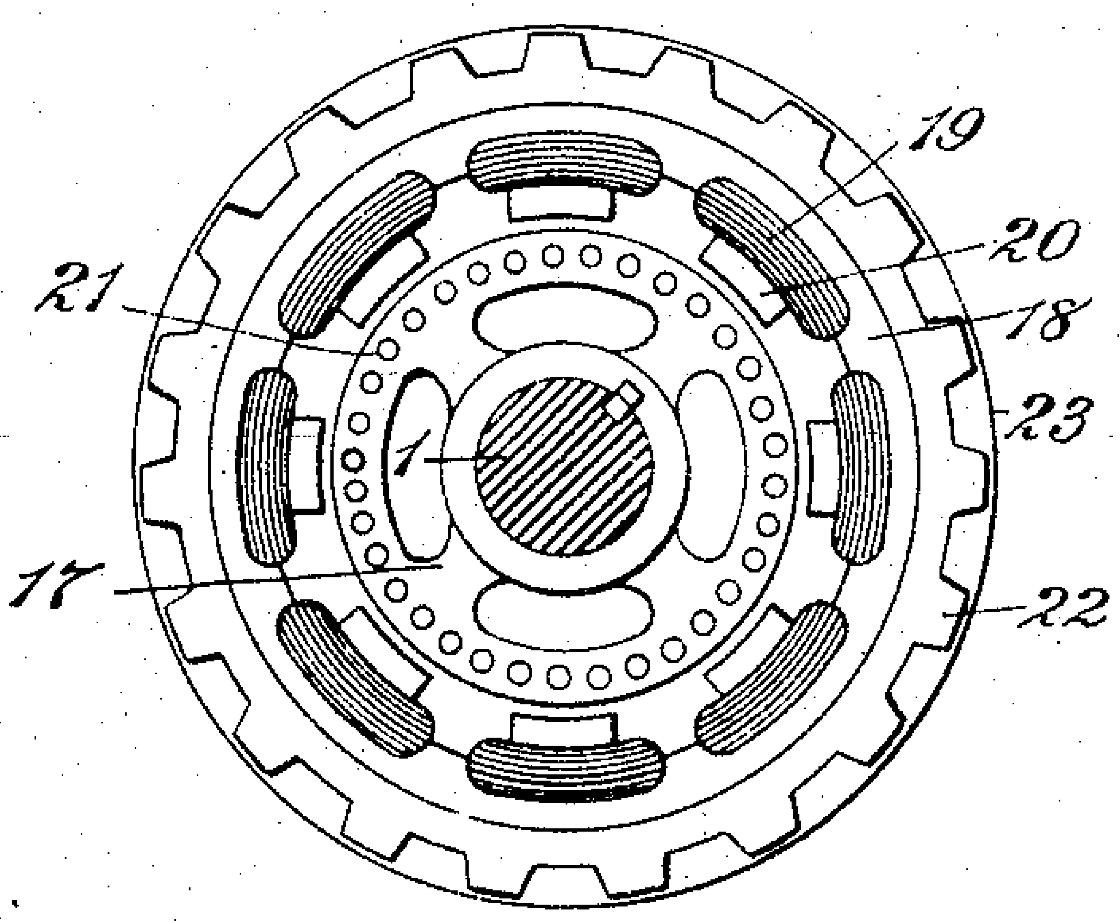


Fig. 4.

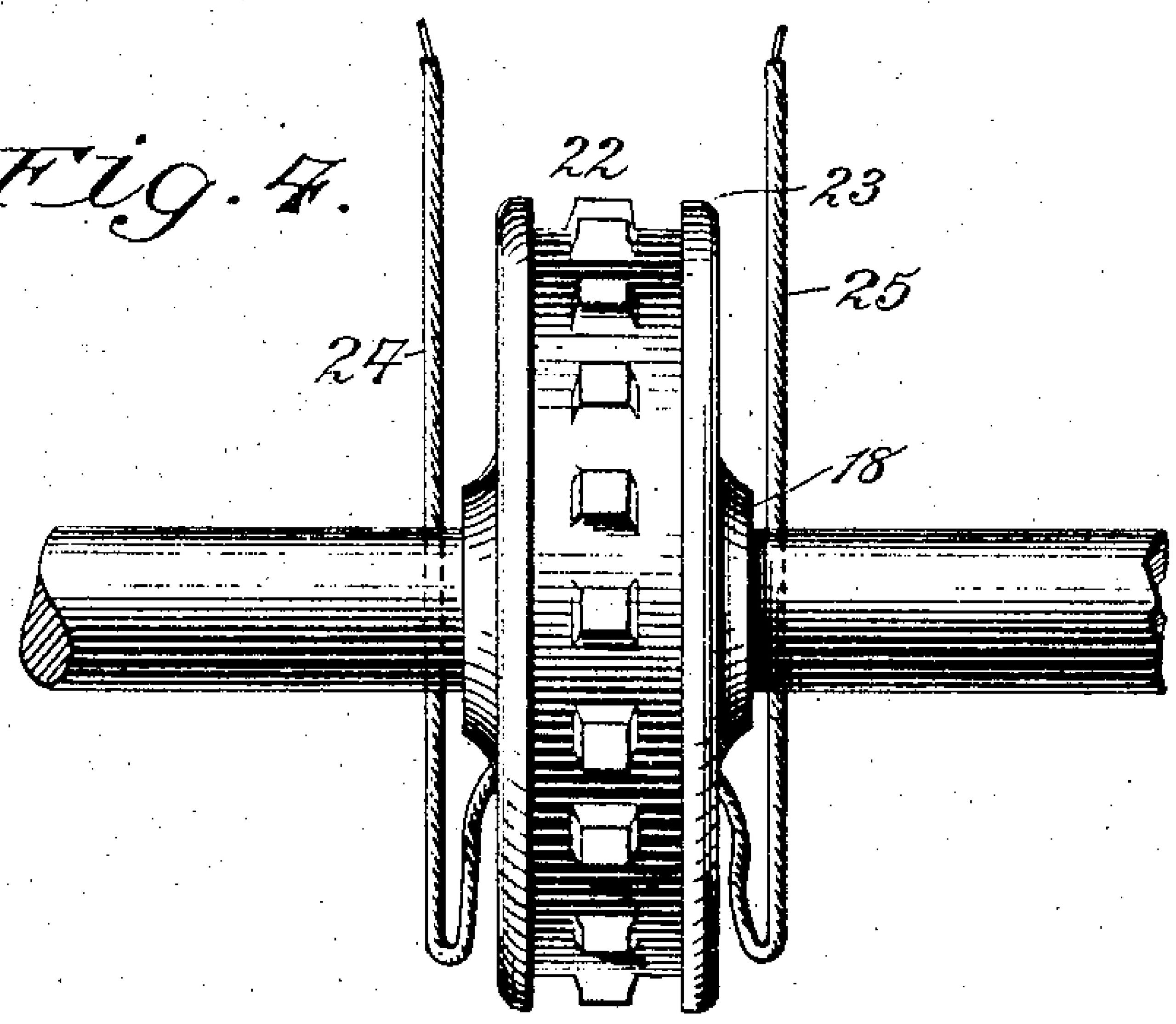
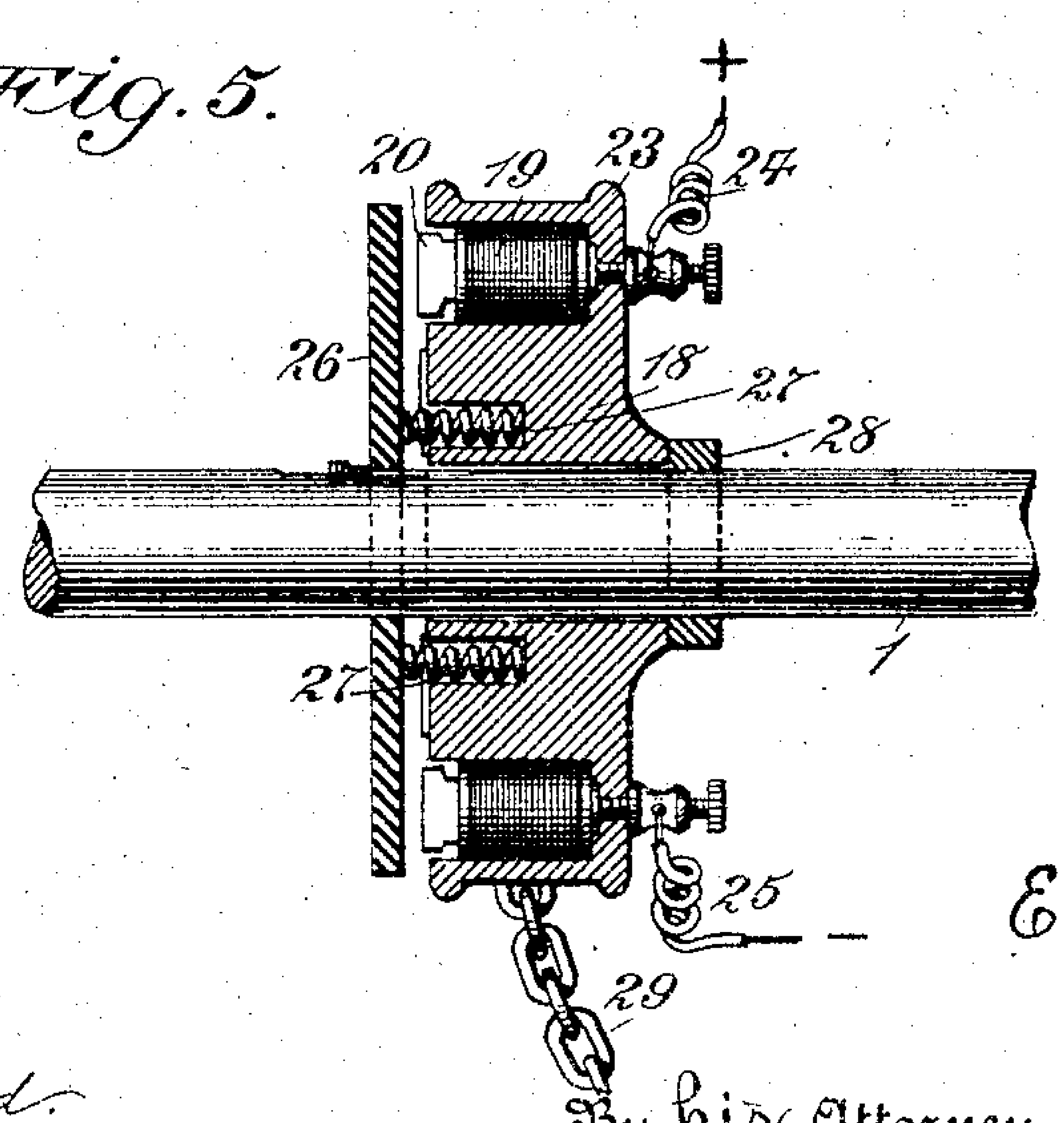


Fig. 5.



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7 SHEETS—SHEET 3.

Fig. 6.

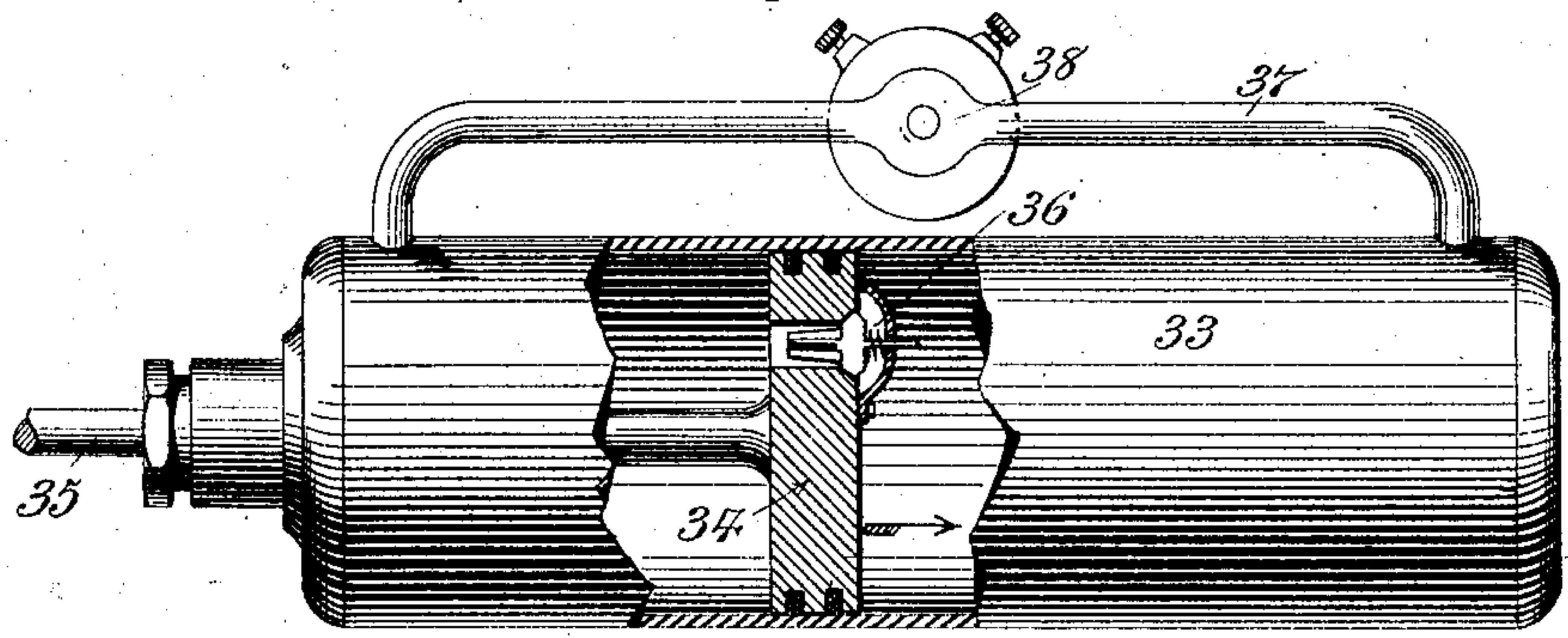


Fig. 7.

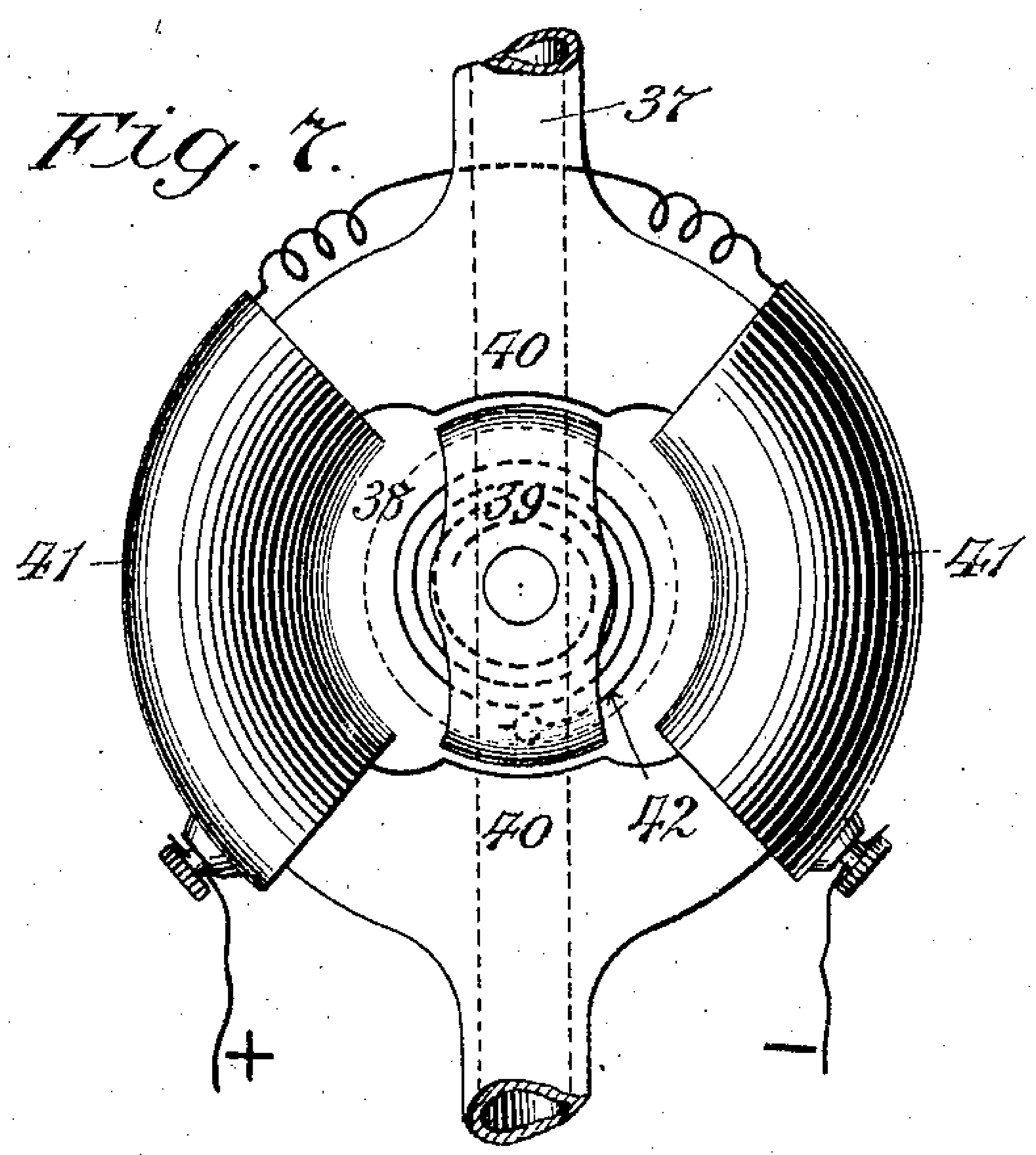
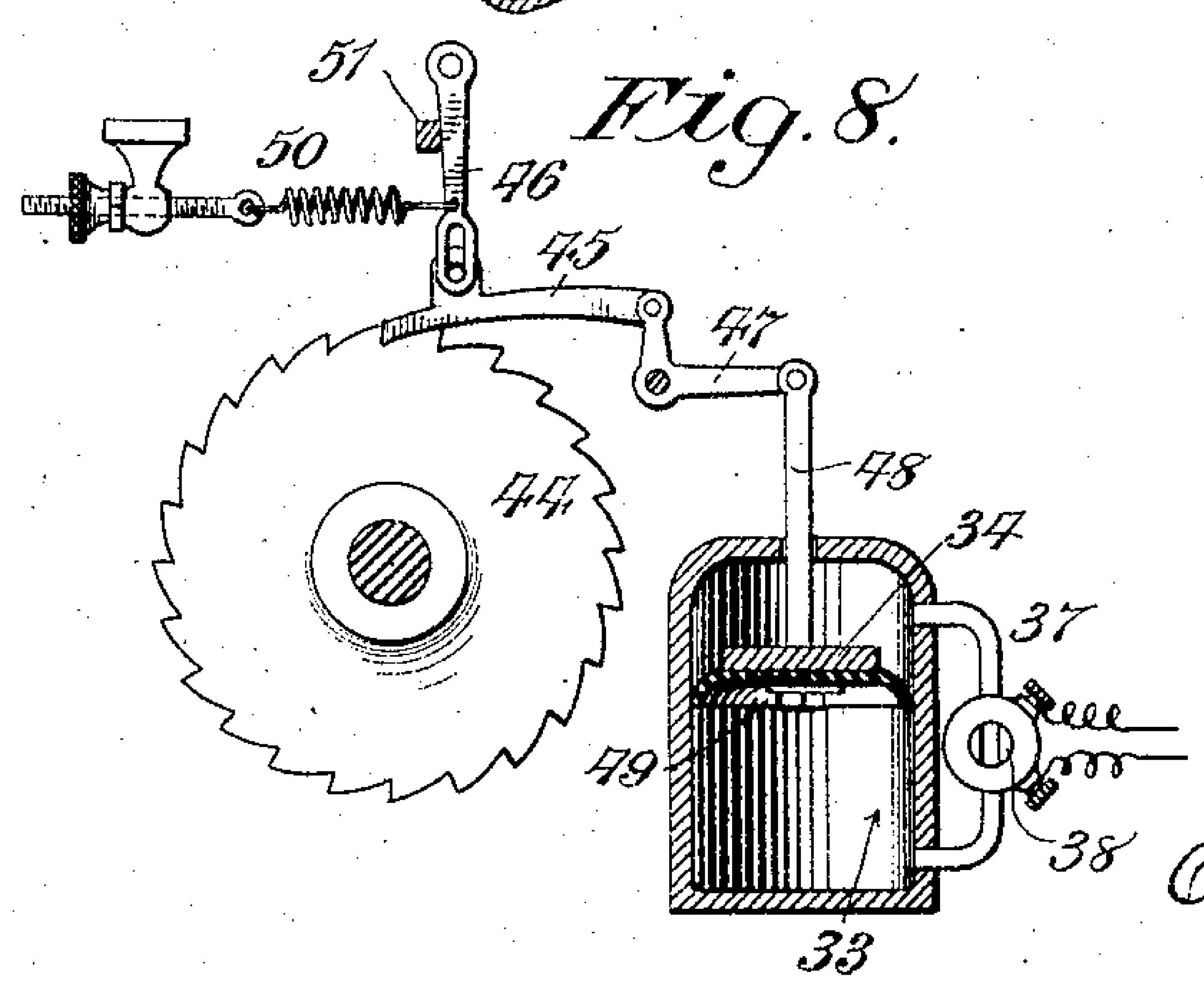


Fig. 8.



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7 SHEETS—SHEET 4.

Fig. 9.

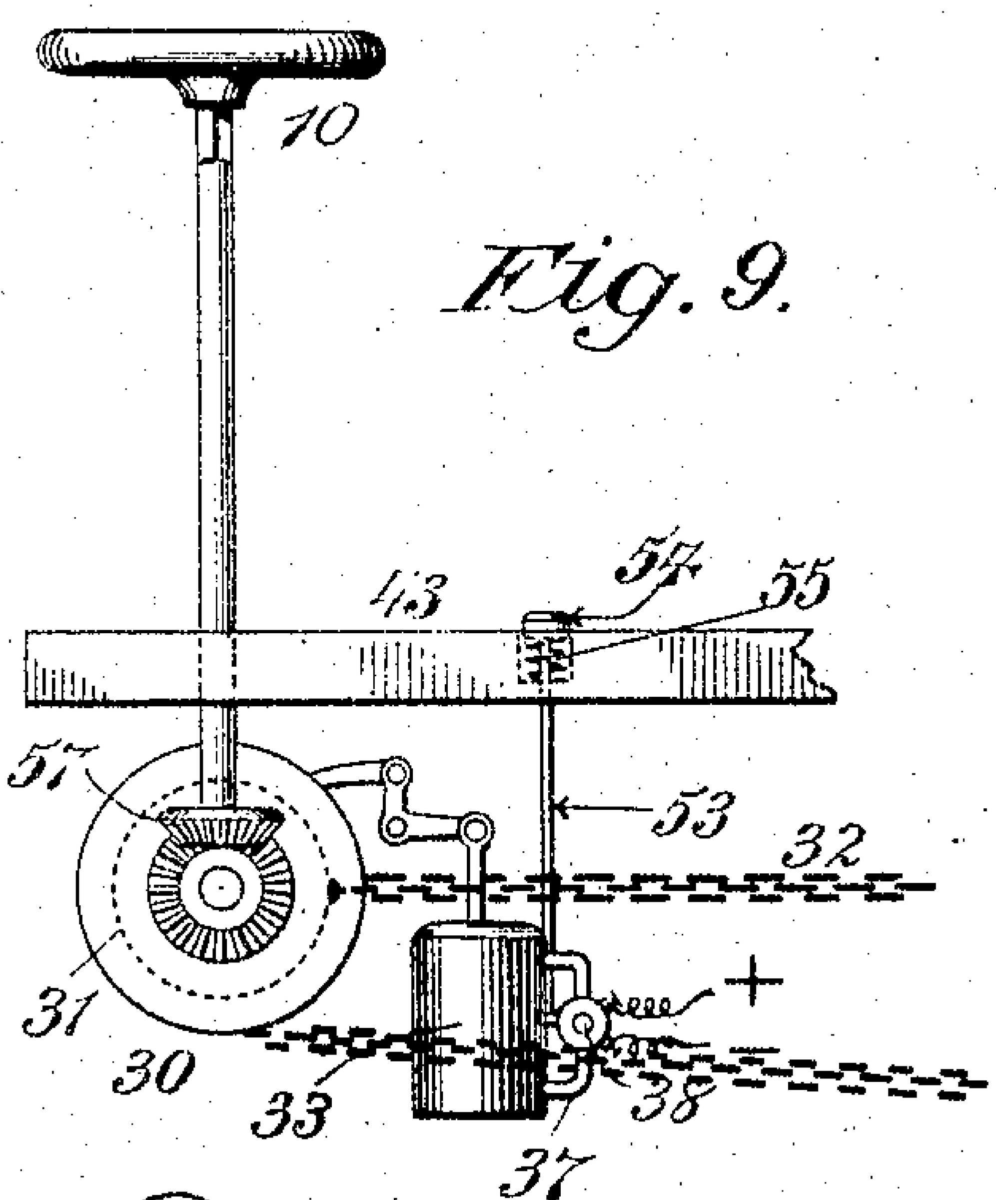


Fig. 10.

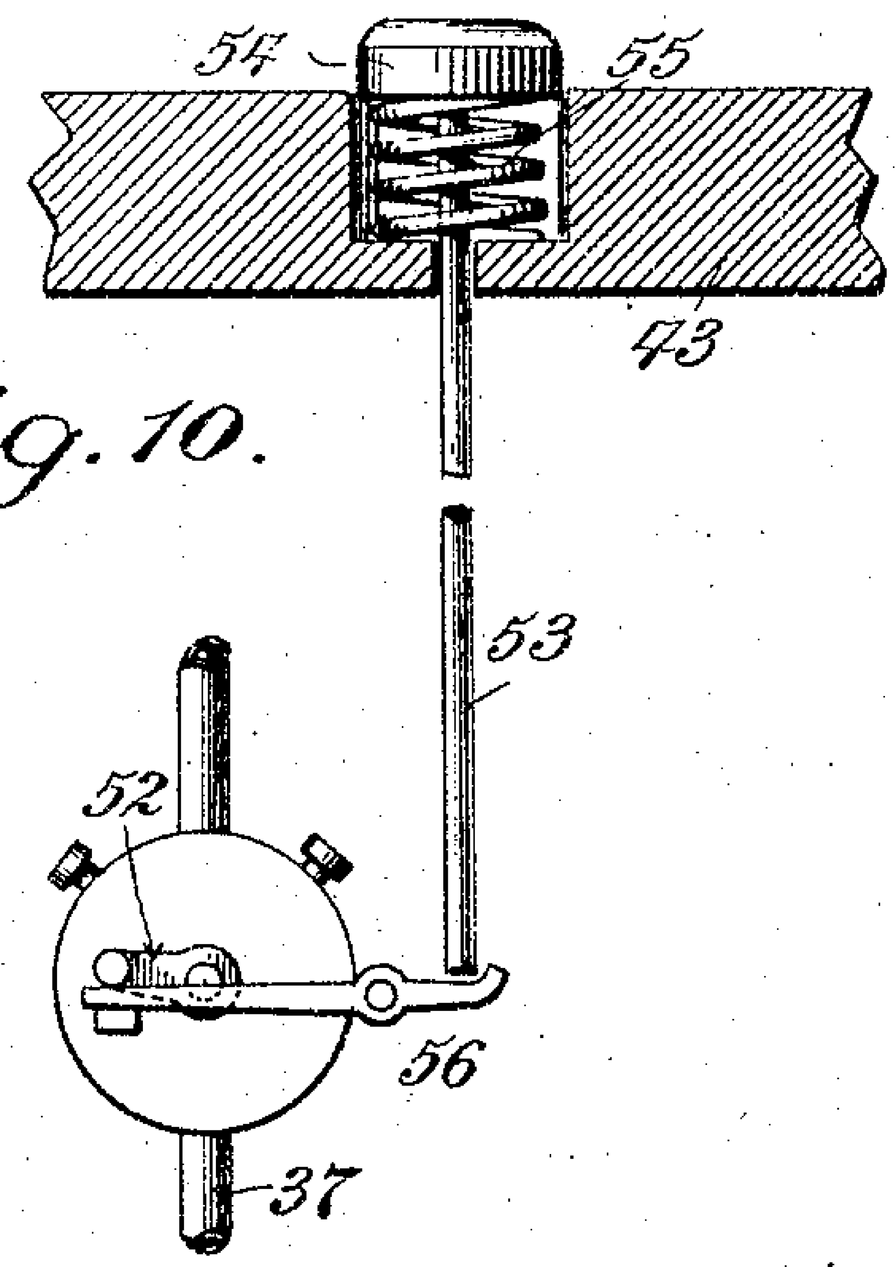


Fig. 11.

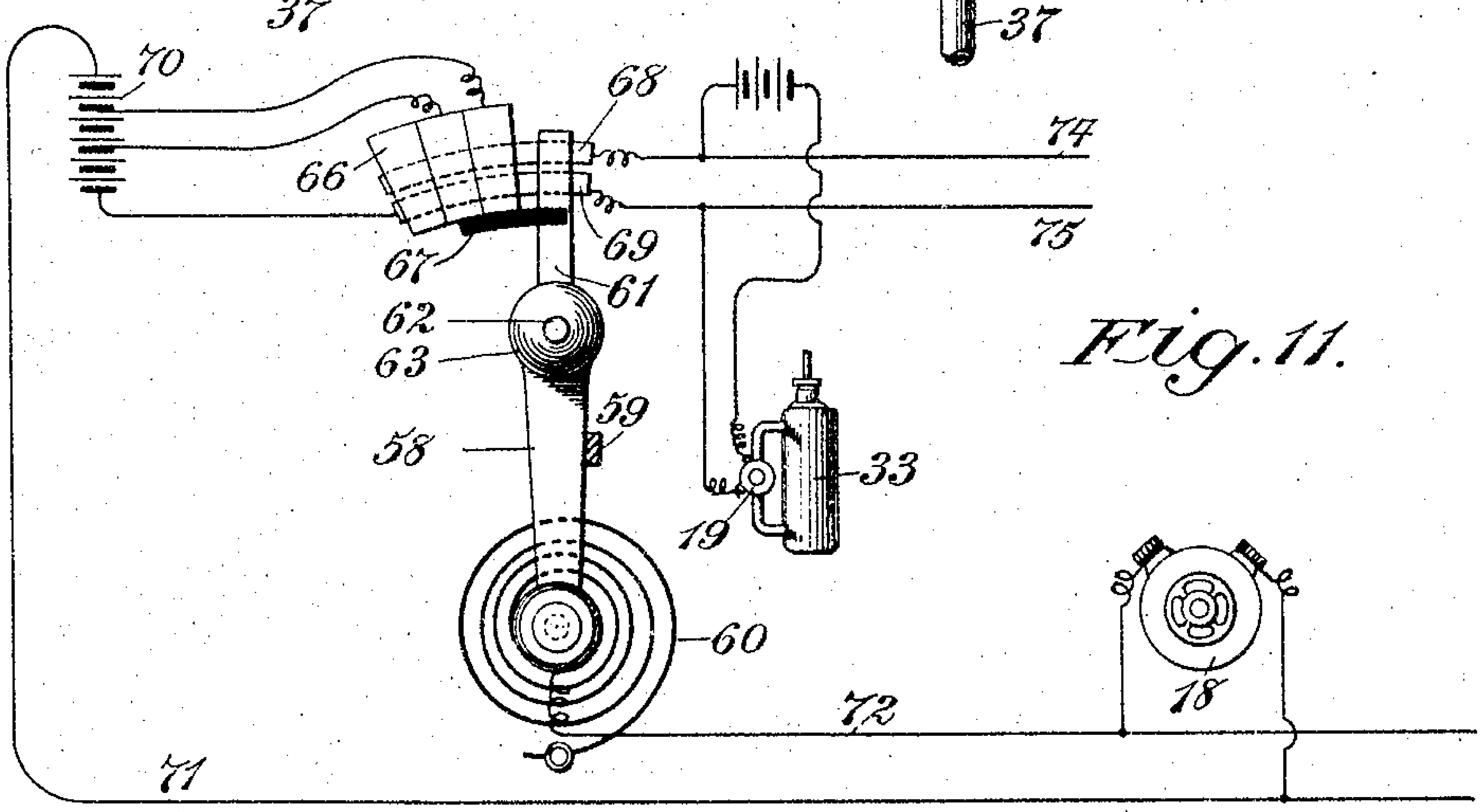
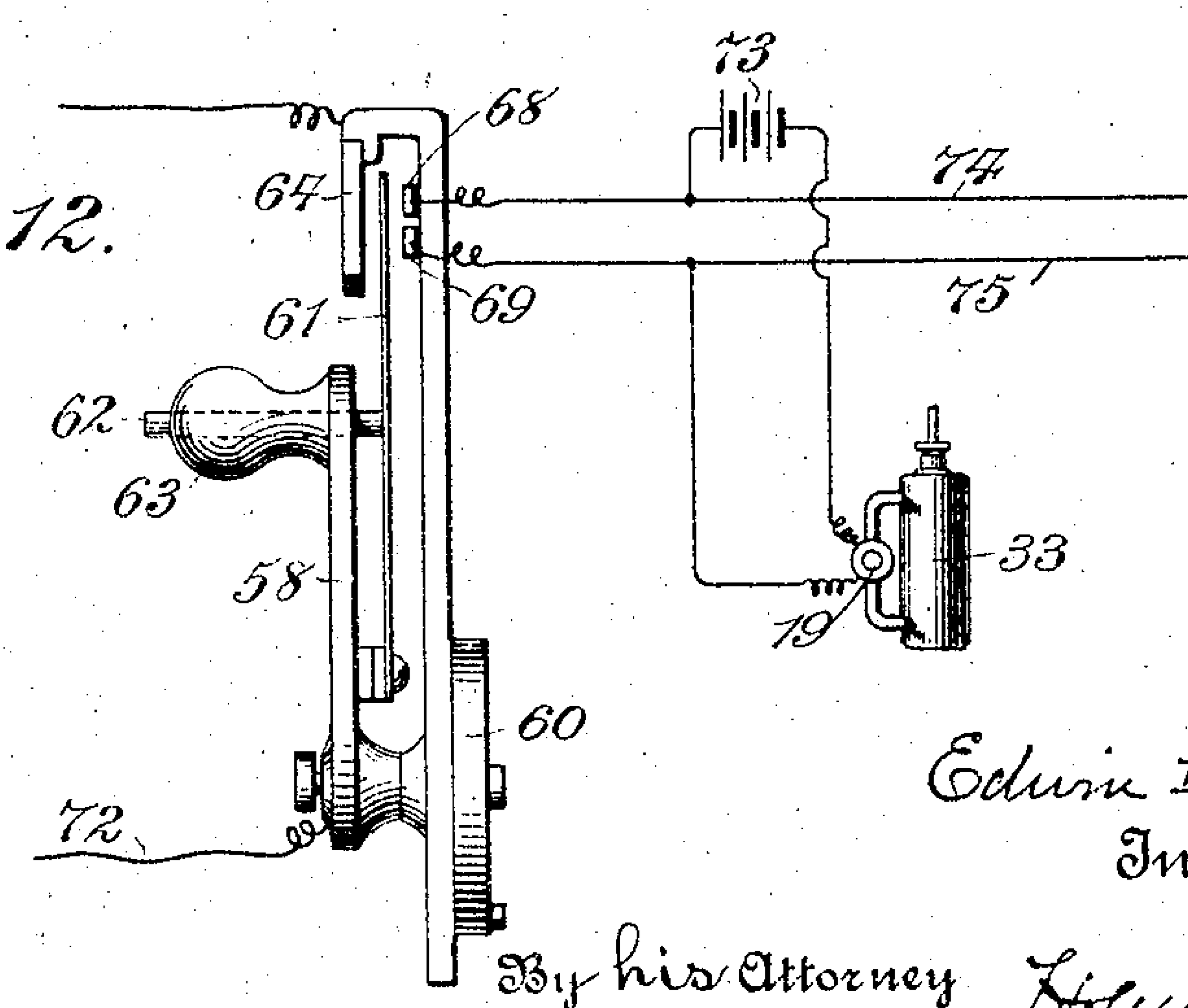


Fig. 12.



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APPLICATION FILED OCT. 6, 1900.

7 SHEETS—SHEET 5.

Fig. 13.

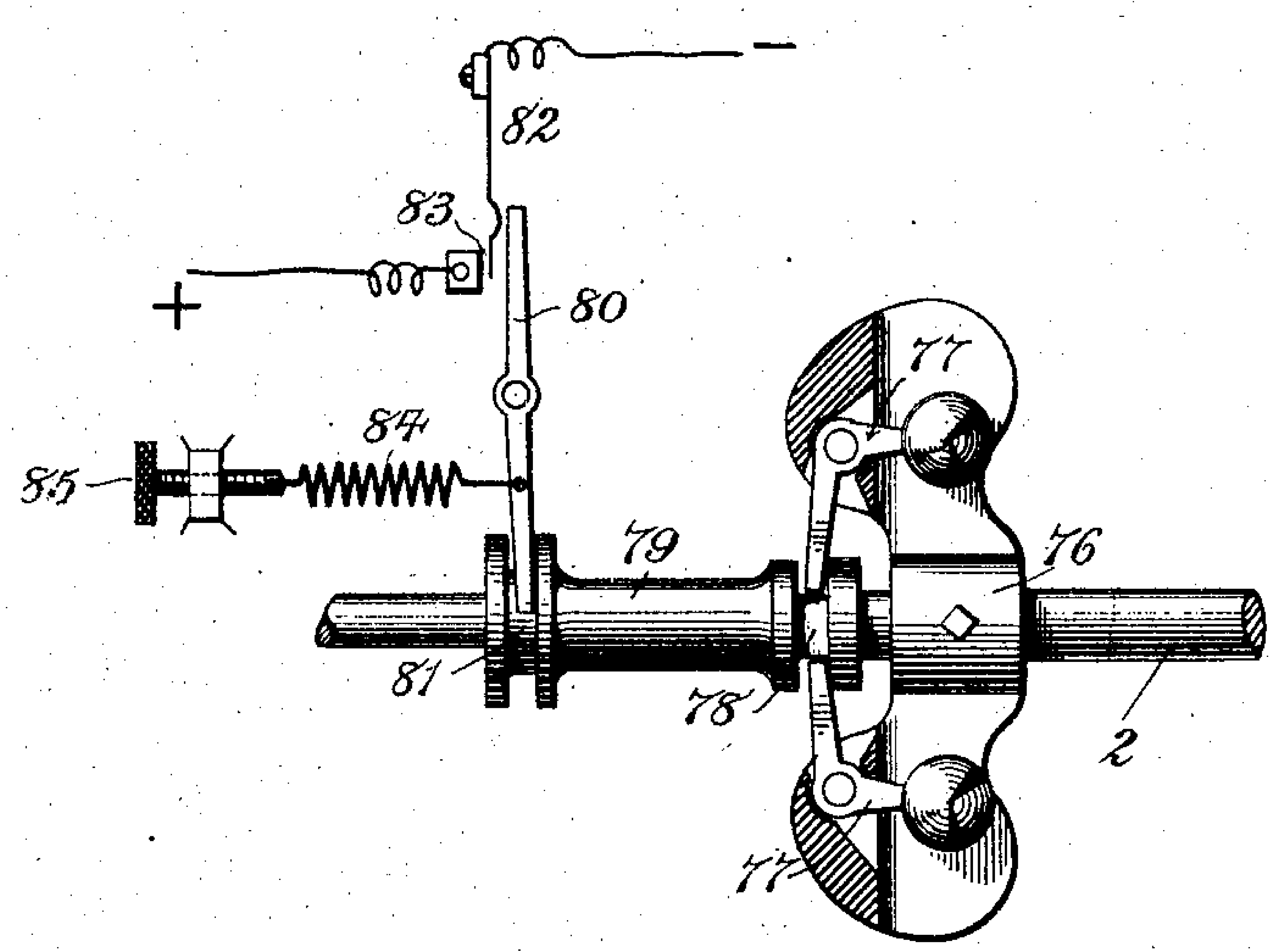
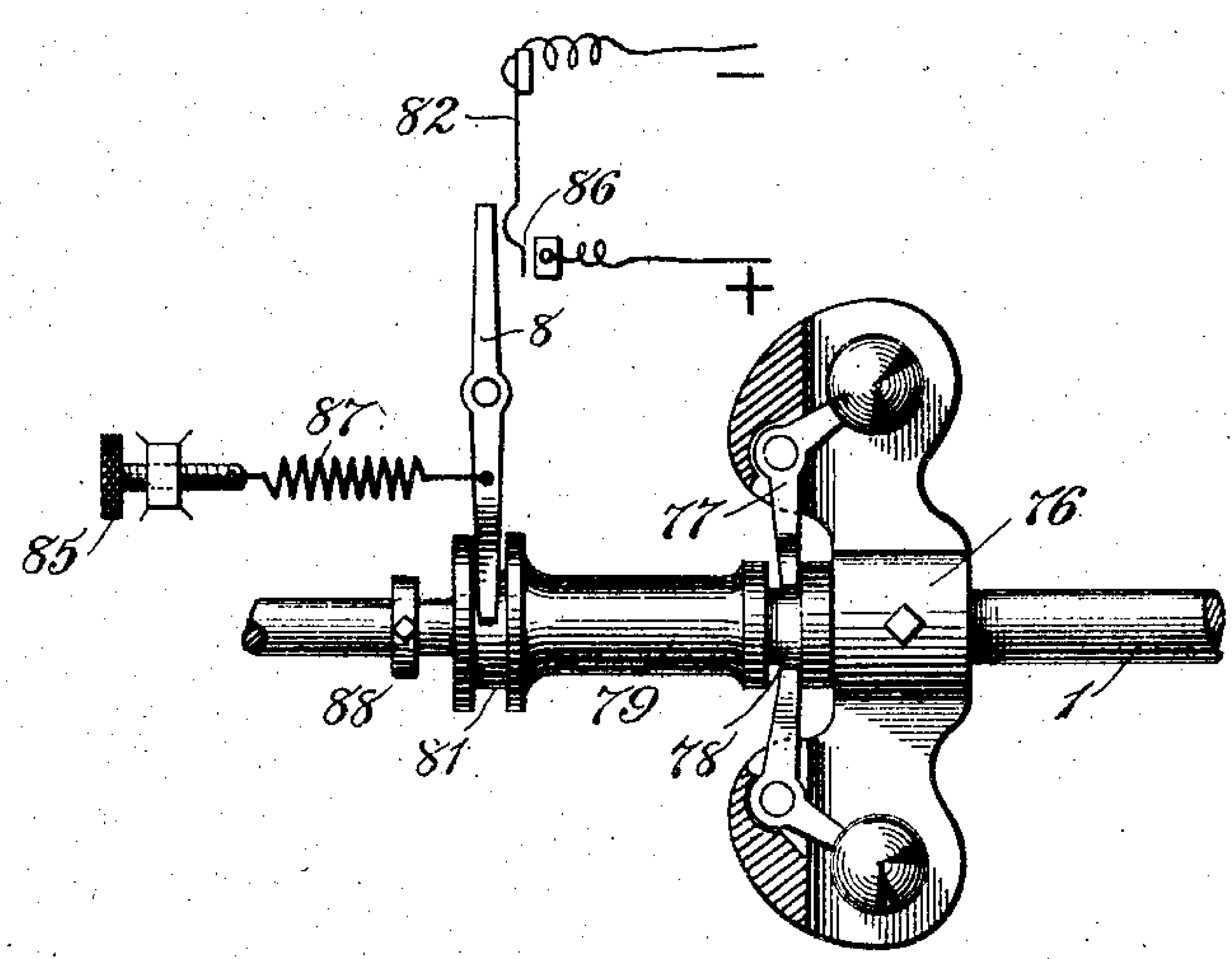


Fig. 14.



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No. 778,238. PATENTED DEC. 27, 1904.

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7 SHEETS—SHEET 6.

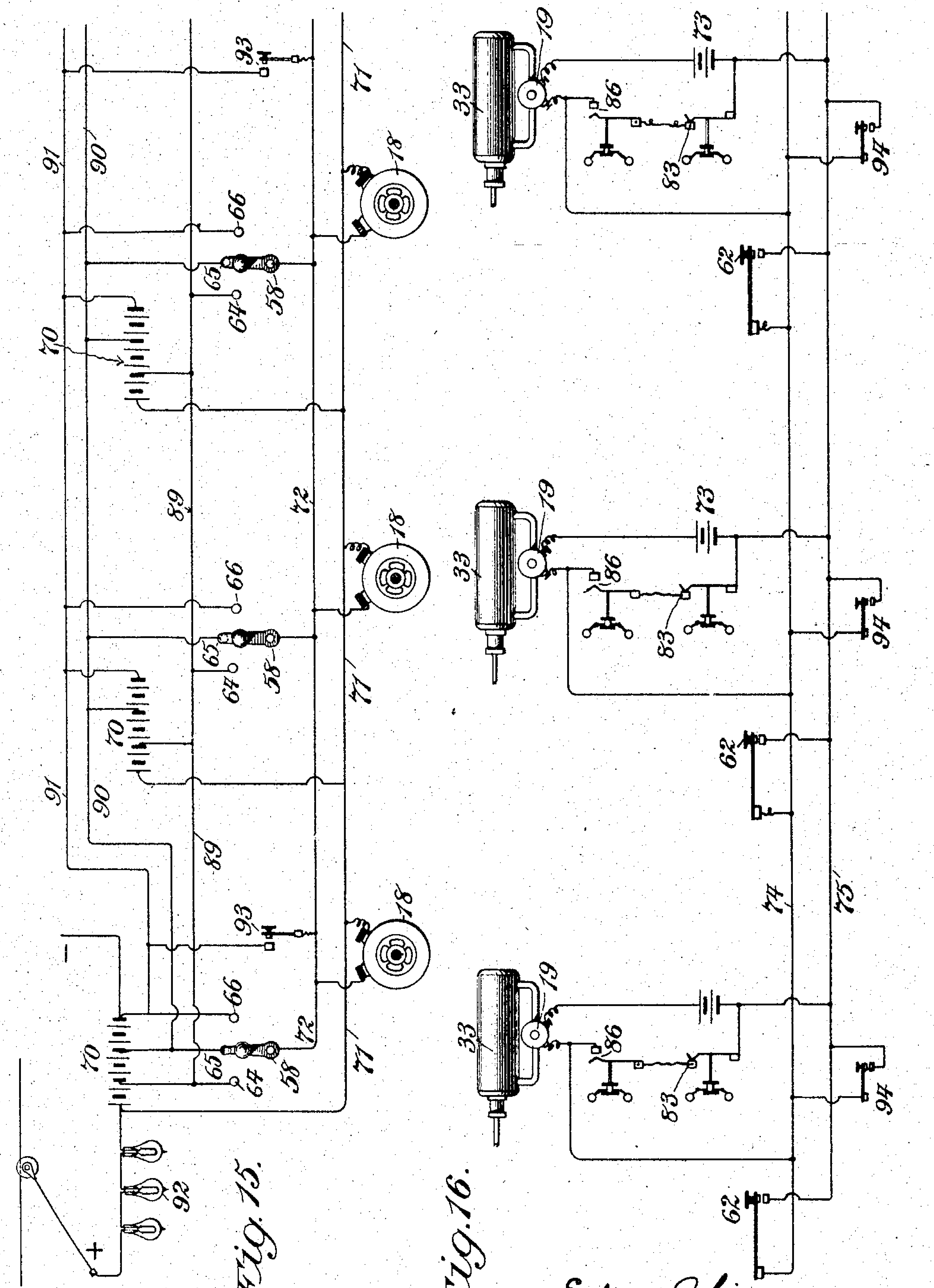

Fig. 15.

Fig. 16.

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APPLICATION FILED OCT. 6, 1900.

7 SHEETS—SHEET 7.

Fig. 17.

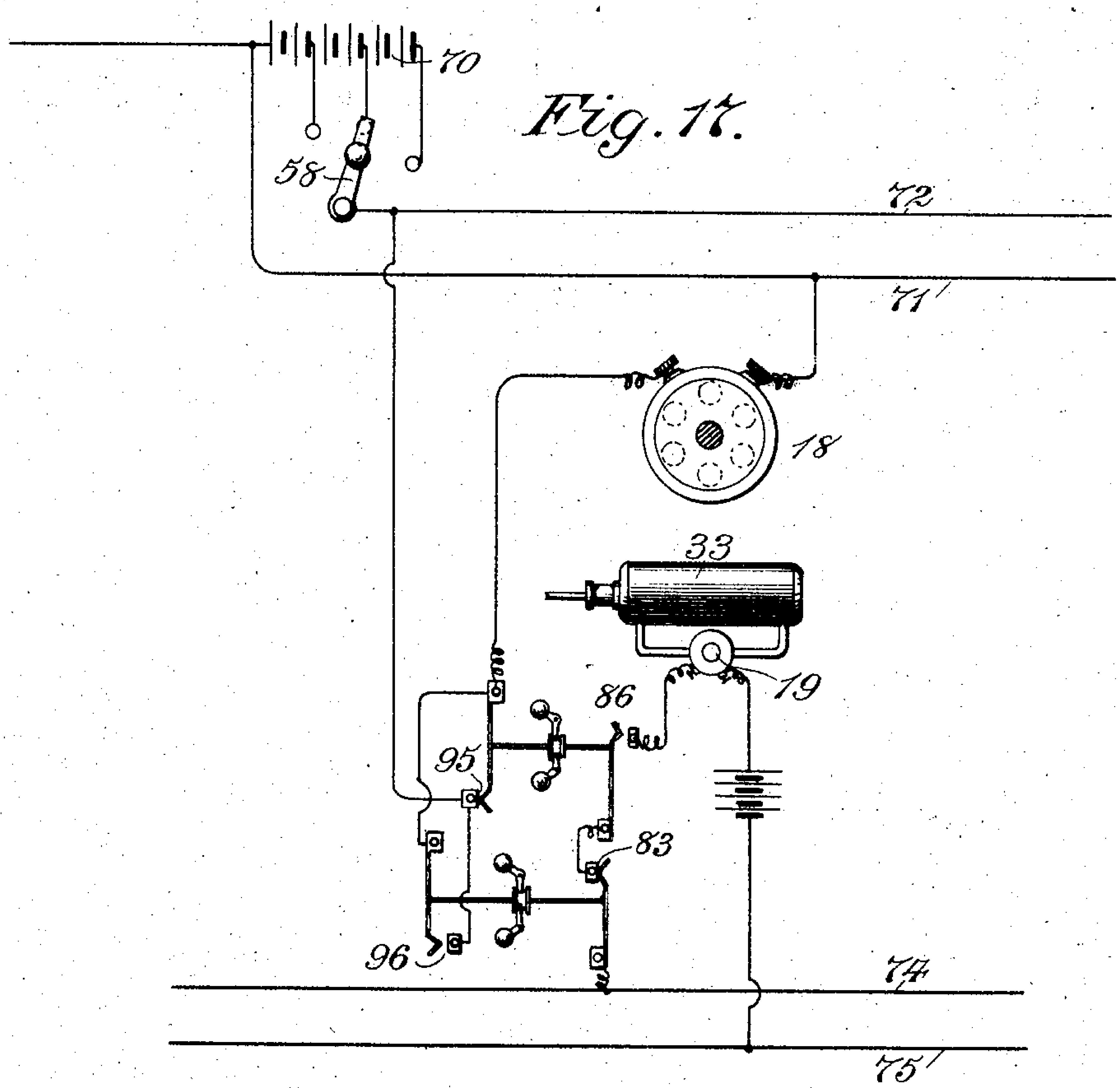
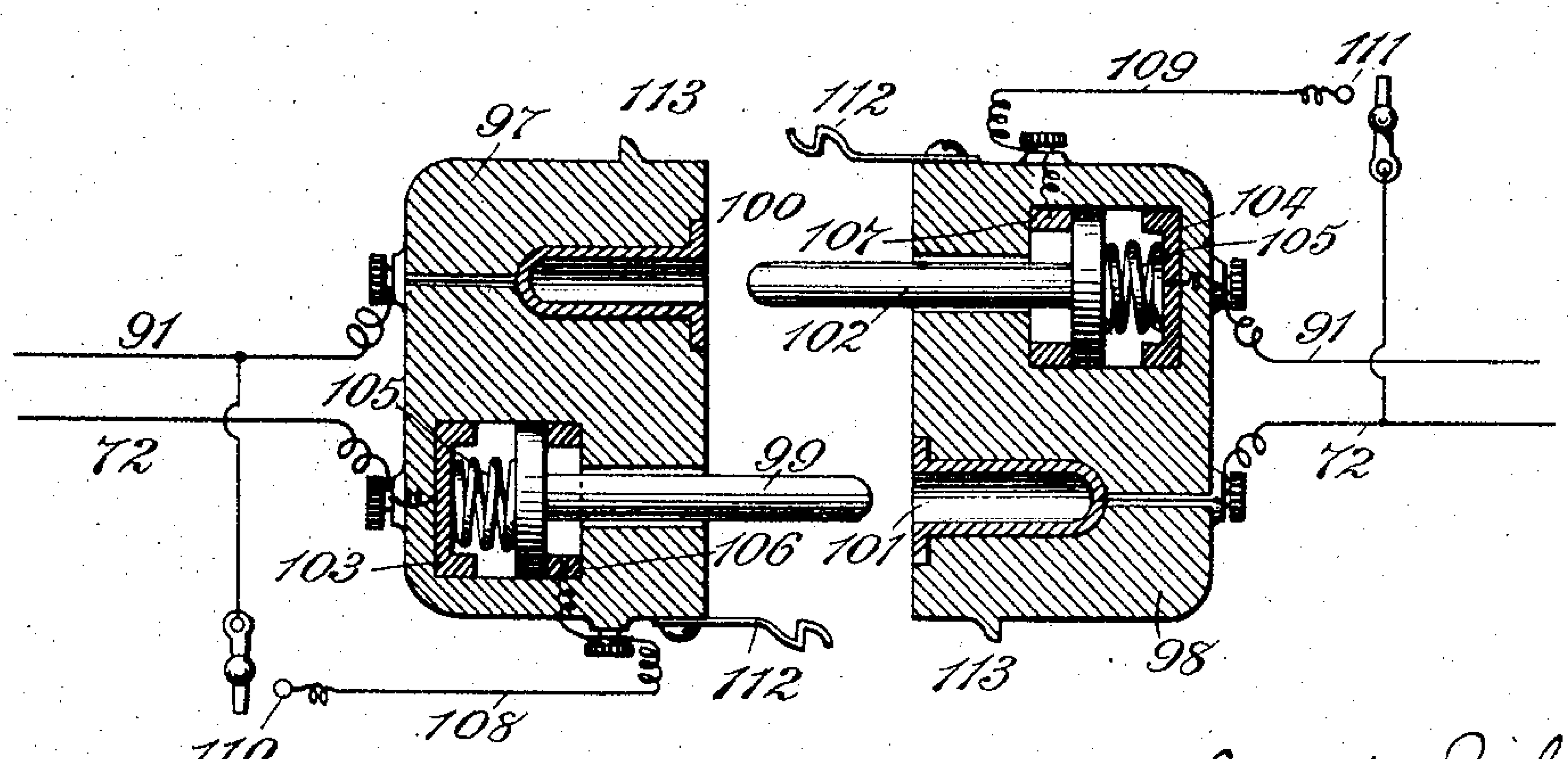


Fig. 18.



Witnesses
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Inventor

By his Attorney H. Wallace Kaye

No. 778,238. Patented December 27, 1904.

UNITED STATES PATENT OFFICE.

EDWIN R. GILL, OF NEW YORK, N. Y., ASSIGNOR TO INVENTION DEVELOPING COMPANY, A CORPORATION OF NEW JERSEY.

ELECTRIC BRAKE.

SPECIFICATION forming part of Letters Patent No. 778,238, dated December 27, 1904.

Application filed October 6, 1900. Serial No. 32,206.

To all whom it may concern:

Be it known that I, EDWIN R. GILL, a citizen of the United States, residing in the city, county, and State of New York, have invented a certain new and useful Improvement in Electric Brakes, of which the following is a specification.

The object of this invention is the provision of electrically-operated brakes for railway-cars so constructed as to combine the following advantages: Instant application of all brakes on a car or train by a single movement of a lever. Complete and immediate release of all brakes. The brakes can all be applied with full or partial force as many times a minute as desired without diminution of force. The brakes can all be applied or released either gradually or suddenly at will. When a train separates by accident, brakes are automatically applied to both parts of the train. The brakes on each car may be operated as often as desired independently of the engine. All the brakes on a train can be at once applied from any part of the train.

My invention can be applied directly to the existing brake mechanism on old cars, either passenger or freight. Derangement of brakes on one car does not interfere with the others.

My invention can be combined with the present form of hand-brake, keeping the same in order for emergencies by constant use.

The utmost braking effect is produced by combining always a slow rotation of the wheels with a sliding of their circumferences on the track. This distributes wear and prevents flat places. By the use of my invention this rotative slide is automatically insured, however hard the brakes are initially applied.

My brakes are set at small expense of electric energy, it being unnecessary to use more than momentary currents.

My invention is illustrated in the accompanying drawings, wherein—

Figure 1 is a plan view of one form of electric brake as applied to a four-wheel truck. Fig. 2 is a side view of the sprocket-chain transmission shown in Fig. 1. Fig. 3 is a section of the brake-motor shown in Fig. 1. Fig. 4 is a front view of the same, showing mode of attachment of electric wires. Fig. 5 is a section of a modified form of brake-motor suitable for use with my invention. Fig. 6 is a side view, partly in section, of the hydraulic lock shown in Fig. 1. Fig. 7 is a top view of the electric valve used with the hydraulic lock. Fig. 8 shows a modified form of hydraulic lock. Fig. 9 shows this latter lock as applied to combined power and hand brakes. Fig. 10 shows in detail the mechanical valve-opening device. Fig. 11 is a top view of the brake-operating switch with related circuits in diagram. Fig. 12 is a side view of the same. Figs. 13 and 14 are side views of the maximum and minimum centrifugal switches, respectively. Figs. 15, 16, and 17 are diagrams of operating-circuits; and Fig. 18 is a sectional view of the automatic electric couplings between cars.

The outfit shown in Fig. 7 combines my power-brake with the usual mechanism employed for hand-brakes. The two axles of a four-wheel truck are shown at 1 and 2. The braking is accomplished in the well-known way by pressure upon the wheels 3 of the shoes 4, carried upon the brake-beams 5 and 6. Simultaneous action upon the four wheels is secured by employing a brake-lever 7, acting through the equalizing-beam 8 and tie-rods 9, as shown. In applying hand-power to these elements the usual hand-wheel 10 serves to wind up the chain 11, thus pulling the lever 7.

My power-brake employs the momentum of a car or train through the axles by means of an electric clutch 12. On the periphery of this clutch a sprocket-wheel is fixed, which drives a chain 13, whereby a counter-shaft 14 is rotated. Upon this shaft there winds a chain or cable 15, which, passing to the other end of the truck and around appropriate pulleys 16, is attached to the lever 7. Thus in whichever direction the axle 1 and counter-shaft 14 move the tension on the chain 15 will set the brake.

The arrangement shown, whereby the lever 7 has its end pivoted to the brake-beam acting upon one axle, 2, while the electric clutch is fixed to the other axle, 1, is preferred, because it insures a greater pressure on the wheels attached to the axle 1, due to the lever arrangement shown. This is desirable for reasons hereïnafter pointed out.

A variety of electric clutches will be found useful in connection with my invention. I have illustrated two classes of these devices in Figs. 3 and 5.

The class of clutch shown in Fig. 3 is that wherein magnetic action is employed independently of friction or other mechanical action. Here a central magnetic member 17 is fixed to the axle 1, being surrounded by a field-magnet 18, sleeved loosely upon the axle and having windings 19 around poles 20, which are directed inwardly toward the fixed magnetic member or armature 17. This latter is preferably provided with copper bars 21, arranged to form the so-called "mouse-mill." Where the chain-and-sprocket transmission is employed, the teeth 22 of the sprocket are placed between flanges 23, directly upon the periphery of the loosely-sleeved field-magnet 18. Upon admitting electric current through the coils 19 the moving armature 17 will exert a strong rotative action upon the surrounding field-magnet 18 in a manner well understood, and the effect will be to make the field-magnet share the rotation of the axle 1 until, through the shaft 14 and chain 15, the brakes are set. While there are a number of expedients known which may be used in supplying necessary current to the windings 19, I prefer to simply hang insulated wires 24 and 25 from beneath the car, leaving such a length as permits said wires to be coiled around the axle 1 when the limited rotation of the magnets 18 occurs, which sets the brakes. This permits permanent and direct connection of the feeding-wires 24 25 to the ends of the coils 19 and does away with all need for collector-rings and brushes.

In Fig. 5 is illustrated a class of clutch wherein the loosely-sleeved member 18 slides slightly upon the axle 1 and is placed beside a magnetic disk 26, fixed to the axle. When current passes through the windings 19, the poles 20 adhere to the disk 26, and thus magnetic effort and friction unite in putting on the brakes. The springs 27 serve to break this contact when circuit through 19 is broken, and the collar 28 limits to removal distance between 26 and the poles 20. In Fig. 5 is also shown another mode of transmission of power from the body 18 to the brakes. Here the chain 29 is fastened to one point of the smooth periphery between the flanges 23. As shown in Fig. 9, this chain winds upon the pulley 30, thus acting, through the counter-shaft 31 and chain 32, to put tension upon lever 7. Thus whichever way the axle 1 is turning counter-shaft 31 turns, but in one direction. This is necessary where ratchet-and-pawl locks are used.

It is of course to be understood that the transmission means just explained may be employed in connection with either of the two classes of electric clutch above described.

In order that when the brakes are applied they may be secured until it is desired to release them, I employ a locking means in conjunction with the construction above described. In the form shown in Fig. 1 this lock consists of the hydraulic cylinder 33, within which moves a piston 34 on the end of the rod 35, moving with some portion of the brake mechanism—as, for instance, the lever 7. As shown in Fig. 6, the piston is provided with a valve 36, which permits passage of liquid in the direction of the arrow when the piston moves outward. This corresponds to the movement whereby brakes are applied. The brakes once applied, however, movement for their release is prevented by the piston and the water or other liquid in the cylinder 33, since the valve 36 prevents passage of water against the direction of the arrow. A by-pass pipe 37 is employed to let the liquid pass when it is desired to release the brakes. In this pipe there is a valve 38, controlled electromagnetically. The details of this valve are shown in Figs. 7 and 8. On the stem of the valve an armature 39 is placed, which is adapted to turn between the two poles 40 of the electromagnet 41. A spiral spring 42 tends to hold the valve closed; but when the magnet 41 is energized the valve is opened, as shown in Figs. 7 and 8. In Fig. 1 this electrohydraulic lock is shown applied directly to the brake mechanism by means of the rod 35.

In Figs. 8, 9, and 10 I have shown another form of lock as applied to combined power and hand brakes. Here the cylinder 33 is shown placed vertically beneath the platform 43. The counter-shaft 31, which operates as above described to apply the brake, is provided with a ratchet-wheel 44. The pawl 45, supported by a slotted link 46, permits passage of the wheel 44 in the direction of the arrow to set the brake, but opposes return motion, being supported by the bell-crank 47, to which the piston-rod 48 is pivoted. To the lower end of this piston-rod is fixed the piston 34, to which is attached a cup-packing 49, coöperating with a contained liquid in a well-known manner to permit motion upward, but not downward. The spring 50 acts to normally bring the ratchet 45 forward against the stop 51. When the brake is applied, this forward movement is permitted as the ratchet turns in the direction of the arrow; but once applied the reaction tending to release the brakes presses a tooth of the ratchet against the end of the pawl 45, this reaction being resisted by the liquid in the cylinder 33 under the piston 34. If it is desired to release the brake in whole or in part, the valve 38 is opened long enough to permit of passage of liquid around the by-pass, thus yielding to the releasing tendency of the brakes. The opening of the valve 38 may be accomplished either electromagnetically, as heretofore described, or mechanically. For this latter purpose the lever 52 on the valve is controlled by a vertical push-rod 53, which projects upward through the platform to a push-button 54. The rod is normally sustained by the spring 55, but on being pushed down with the foot touches the lever 56, which opens the valve 38 by means of the lever 52. The usual hand-wheel stands above the countershaft 31, which it operates by means of the gear 57. It will be seen that the hand-wheel may be operated in connection with the button 54 for putting on or releasing the brakes.

The description thus far given makes it clear that in order to apply the brakes current is admitted to the magnets 18, (whether of the type shown in Fig. 3 or of that shown in Fig. 5,) and to release the brakes current is applied to the valve-magnet 19 on the lock 33. I prefer to employ a controlling means whereby either of these operations may be instantly carried out by one hand, and one embodiment of my device for this purpose is shown in Figs. 11 and 12. The pivoted lever 58 is normally held against the stop 59 by the spring 60. This lever carries a conducting leaf-spring 61, upon which bears an insulating-pin 62, which passes through the handle 63 on the lever 58. The spring 61 tends normally to press upward under the three contact-plates 64 65 66, and when out of contact, as in Fig. 11, the spring is prevented from rising above the level of these plates by the restraining-bar 67 of insulating material. Directly beneath the leaf-spring 61 are two parallel contact-rails 68 and 69, extending along under the whole arc of movement of said spring 61. These rails are so placed that on pressing the pin 62 the spring 61 is made to establish electric connection between them.

At 70 is shown a suitable source of current, preferably a battery, divided, say, into three sections, as shown. One end of the battery 70 is connected to a main wire 71, the other main wire, 72, being connected to the lever 58 and spring 61. The successive plates 64, 65, and 66 are connected, as shown, to successive points in the battery, so that as the spring 61 makes contact with one of these plates after the other a successively-higher potential is established on the mains 71 and 72. Since the brake-motor clutch 18 is permanently connected across these mains, the brakes are thus applied with three increasing degrees of force. The lock 33 is released by current which may, if desired, come from the battery 70; but for greater clearness I have shown a separate battery 73 for this purpose. The mains 74 and 75 I term the "releasing-mains," as opposed to the "applying-mains" 71 and 72. The wires 74 and 75 are respectively connected to the rails 68 69, and the lock-magnet 19 and its battery are in series across the mains 74 and 75. It is evident, therefore, that whenever the pin 62 is depressed by the brakeman's thumb the spring 61 closes circuit through the magnet 19 and releases the brake to an extent dependent upon the length of time the circuit is maintained. This releasing action can be accomplished in all positions of the handle 58, and therefore whether the brake-motor clutch has just been energized or not. It is clear, however, that the spring 61 cannot touch plates 64, 65, or 66 at the same time as rails 68 and 69 and that therefore release of the lock 33 is always accompanied by idleness of the brake-clutch 18. My brake is thus applied by merely momentary use of current, since the application of the brake is maintained by the locking mechanism, and this latter is instantly effected by opening of the valve 38. I can therefore accomplish my purpose by means of relatively small and cheap batteries and with a minimum of renewals.

One of the principal difficulties encountered in the use of the old forms of brake lies in the fact that when they are applied with full force they are apt to lock the wheels, thus causing the still-moving train to wear flat places upon the peripheries. This results in much disagreeable noise, unevenness of travel, and danger to rails and switches through the pounding of these flat places.

By the use of my invention I obviate all danger of locking the wheels. At the same time I insure what I term a "rotative sliding action," whereby the wheel is brought to a minimum slow speed less than corresponds to the accompanying forward movement of the car and is kept at that speed until danger from locking is past. This action insures even greater retarding effect than the locked wheel affords, since new surface for creating friction is continually presented. At the same time the production of flat places is of course avoided. I accomplish this end by providing a governing device whereby the reduction in speed of the axles itself automatically sets up a partial release of the brakes, which release is interrupted as soon as the axle regains a portion of its rotative speed. My invention covers, broadly, this organization of parts, however constructed in detail; but in Figs. 13 and 14 I have shown a preferred embodiment of this feature of my invention. This embodiment comprises a minimum-speed circuit-closer combined with a neutralizing maximum-speed circuit-closer and circuits requiring to be closed at both points for releasing the brake. Circuit-closing means whose action depends upon the speed of the car-axles may be constructed for this purpose in a variety of ways which will occur to those skilled in this art. In the drawings I have shown these devices constructed for operation by centrifugal force and designed to coöperate with the electromagnetic valves on the locks 33.

In Fig. 13 is shown the maximum-speed circuit-closer on the axle 2 of Fig. 1. The frame 76, fixed to the axle, carries the weighted bell-crank arms 77, one branch of each of which extends into the peripheral groove 78 on the sliding sleeve 79. The pivoted lever 80 extends into the peripheral groove 81 at the opposite end of said sleeve 79. The tendency of the arms 77, due to centrifugal action, is to press the lever 80 against the spring-contact 82 and close a circuit at 83. This tendency is opposed by the spring 84, made adjustable by the set-screw 85. By suitable adjustment of the spring 84 the contact 83 is made and circuit closed at a certain maximum speed and at all speeds above it.

The minimum-speed circuit-closer is shown in Fig. 14 and comprises parts similar to those shown in Fig. 13, save that the closing of circuit at the point 86 is made to occur when the speed of rotation of the axle 1 and frame 76 reach a minimum determined by the adjustment of the spring 87. The collar 88 prevents excessive movement to the left of the sleeve 79 when the car stops. The mode of operation of this governor I shall describe after setting forth the details of electrical connections. These details as employed on a train of three cars are shown in Figs. 15 and 16. Besides the main wires 71 72 and 74 75 (shown in Figs. 11 and 12) the train provided with brakes of three different speeds must be equipped with three main wires 89, 90, and 91, corresponding, respectively, with the contact-plates 64, 65, and 66. These seven main wires extend the whole length of the train in the arrangement shown, and the electric clutches 18 and valve-magnets 19 are electrically connected thereto in the manner hitherto described. It is to be understood that the number of wires used may be varied according to the judgment of those skilled in the art without departing from my invention.

At one end of Fig. 15 I have shown a secondary battery 70 in series with lamps 92 or other resistance across the trolley-circuit of an electric car. Any kind of battery, primary or secondary, may be employed, however, without departing from my invention.

I prefer to supply each car with its own battery, since the braking energy is then kept always proportional to the size of the train being hauled.

It is clear from Figs. 15 and 16, taken in connection with the above description of Figs. 11 and 12, that by manipulation of any switch 58 on any car the whole train can be braked; also, that by use of any switch-pin 62 on any car all the brakes on the train can at once be released. By distributing auxiliary switches 93 94 at desired points through the train the brakes can at once be applied or released from any point in case of emergencies.

In Fig. 16 are shown the connections for operation of the governing circuit-closers 83 and 86. These points of circuit control are placed in series with each other and with the magnet 19 on each brake-lock in a branch circuit supplied by the battery 73 on each car. The spring 87 is so adjusted that the minimum-speed circuit-closer is operated when its axle reaches a predetermined critical velocity—as, for instance, that corresponding to a five-mile-an-hour speed of the train. The spring 84 is adjusted to operate the maximum-speed circuit-closer at an axle velocity suitably greater than the critical speed of axle No. 1—say a six-mile speed. The braking energy should be so distributed that the axle 1 is always slowed down more rapidly than the axle 2, and this difference should exceed in amount the difference between the critical speeds of the two circuit-closers. The reason for this will appear hereinafter. Supposing now that a swiftly-moving train is to be stopped as quickly as possible and without locking the wheels, the circuit being closed at any point upon the mains 71 72 the electric clutches 18 become active, and the brakes are at once applied with great force and automatically locked. The circuit can then be opened and the batteries 70 relieved from work. Both axles 1 and 2 on each truck are retarded; but as soon as No. 1 reaches its critical speed, corresponding to five miles an hour, as above assumed, the gap is closed at 86; but by this time the axle 2 must not have been retarded to its critical speed, as assumed, (six miles an hour;) otherwise the gap 83 would open and no current would pass on closure at 86. This is the reason that the axle 2 should undergo a less braking action than axle 1 and be retarded more slowly. Thus adjusted, then, closure at the gap 86 energizes the magnet 19 on the same truck and there is a partial release of the brake. This partial release at once causes the still onrushing train to speed up the axle 1, and thus the gap 86 is reopened, causing the releasing movement to cease. By this alternate action the axles are brought to a low actual rate of revolution, but are never allowed to lock. As soon as the train reaches an actual speed corresponding to the critical speed of the axle 2 (six miles an hour) the gap 83 is opened and subsequent closure at 86 becomes inoperative to further release the brakes. The speed chosen should be such that at that speed the clutches 18 will not be strong enough to lock the wheels. My governing system therefore implies a minimum-speed circuit-closer which may become active for partial release of the brakes, said device being operated by and depending on the speed of an axle subject to a maximum retardation in combination with a neutralizing device operated by a more-swiftly-moving axle and becoming active to open the circuit on the train reaching a certain reduced speed. This second member of my governor is preferably a maximum-speed circuit-closer. It is not essential that the axle which operates this neutralizing device should be subject to any braking action; but it may run always at a speed corresponding to that of the train.

It will be observed that by proper proportions in the hydraulic lock the partial release occurring on each contact at 86 may be so small as always to leave a sufficient pressure to serve at the speed which operates the neutralizing device. By this means the brakes will not be entirely released below said speed. On the other hand, the clutch 18 is always under command, so that the braking energy can, if desired, be increased at any time.

In the matter of preventing the locking of the wheels the two forms of clutch shown in Figs. 3 and 5, respectively, present different behaviors. It is evident that the purely electromagnetic clutch shown in Fig. 3 can be so adjusted as to power that whatever the speed of the train the brakes will not lock the wheels. Moreover, since this form of clutch creates a pressure which diminishes with the axle speed an initial very high pressure is gradually reduced as the train slows down, so that at no speed does locking of the wheels occur. It is thus clear that this form of clutch may be employed without any brake-locking device whatever, it being only necessary for the current to be maintained in the coils 19 during the whole process of braking. In order to avoid this wasteful use of current, however, the locking device should in practice be employed even with the form of clutch shown in Fig. 3. In this connection it will be seen that there is a distinct utility even independently of the operation of my governing devices in so regulating the leverage applied to the various axles that the axle carrying the working clutch shall be subjected to a somewhat greater braking effect than is applied to the other axles. This is to provide for natural unavoidable differences in wheel resistance, whereby if the brake efforts were equal some axle not carrying a working clutch might be locked while yet the working axle 1 had not sufficiently slowed down to prevent such locking by decrease of pressure.

Turning now to the behavior of the disk-clutch shown in Fig. 5, it will be seen that as long as current is maintained through its coils 19 friction on the disk is added to pure electromagnetic effect. Consequently the power is greatly increased with a given current and does not greatly vary with the speed. In other words, even though this brake were adjusted not to lock the wheels when running at maximum velocity as the train slowed down the power would not be automatically reduced so as not to lock a slower-moving wheel. The auxiliary locking device is therefore more essential with the frictional clutch shown in Fig. 5; but the fact that this frictional clutch maintains high power even at low velocity implies the advisability of employing means to insure opening of its energizing-circuit whenever the governors produce partial release. Of course if the brakeman is careful to let the handle 58 return to open circuit as soon as the brake is set this precaution is unnecessary; but this care cannot always be relied upon. In Fig. 17 I have shown one means for insuring this required condition. Here the circuit of the frictional clutch 18 includes two breaks 95 and 96 in multiple arc, the former normally closed when the train runs at high speed, the latter normally closed when the train runs below the critical speed of the neutralizing-governor. It is evident that since the critical speed which closes gap 86 and opens break 95 is less than that which closes break 96 and opens the gap 83 one or both breaks 95 96 is always closed when the axles carrying the two governors are running at the same speed, which is the case when the train is running free. As soon as the brakes are set, however, it is evident that every closure of the break 86 which occurs above critical speed of the neutralizing-governor will result in an open circuit at both 95 and 96 and will therefore prevent action of the clutch 18 during release at the brake-lock 33. At all velocities below the critical speed of the neutralizing-governor there will be closed circuit at 96, and therefore the brakes will be under the command of the brakeman. It is to be understood that although this device is more desirable where the frictional clutch 18 is used, it is adapted to be used with any type of electric brake device.

It is desirable that where a train provided with my brakes accidentally breaks apart between any two cars the brakes shall be immediately and automatically applied on both sections. I accomplish this by so constructing the joining devices for the main circuit-wires between cars that when they are pulled apart appropriate wires are joined for closing circuit through the magnetic clutches 18. In Fig. 18 I have shown one form of device appropriate to this end. The sockets and plugs employed between cars, whatever their construction, must provide for the separate joining of corresponding wires throughout. In the form of device illustrated in Fig. 15 the wires 71, 72, 89, 90, and 91 are needed for the gradual application of brakes. As shown, the switches 93 by joining wires 72 and 91 apply the full force of the battery 70 to magnetic clutch 18. In Fig. 18 I have therefore shown only so much of the necessary plug-and-socket arrangement as includes these two wires. The insulating-bodies 97 and 98 carry, respectively, the plug and socket 99 100 and the opposed socket and plug 101 102. The plugs are free to reciprocate within their bearings, and behind each is a metal plate or cup 103 104, respectively connected to the wire 72 on one car and to wire 91 on the other car. Resting between the enlarged rear end of each plug is a spring 105, whereby said plugs are normally kept pressed forward and are always in electric connection with their respective wires 72 and 91. In front of the enlargements on the plugs are two metal rings or shoulders 106 107, respectively connected by branch circuits 108 109 to the wires 91 and 72. When the bodies 97 and 98 are separated, as with uncoupled cars, the contact between the rings 106 and 107 with the plugs 99 and 102 respectively tends to close the branches 108 109 from 91 to 72, and thus put on the brakes. In normal action this is prevented at each plug and socket by opening the branch circuits at 110 and 111; but when cars are coupled these breaks are closed at contiguous couplings. On bringing the bodies 97 and 98 together the plugs enter their opposing sockets and are forced back, thus breaking the branch circuits 108 109 at the rings 106 107. The springs and ears 112 113 hold the plugs and sockets together in a well-known manner. Thus by a single operation the branch circuits 108 109 are opened, and each wire 91 and 72 on the two cars is brought into connection with its fellow. The breaks at 110 and 111 being then closed, it is clear that if any joint pulls apart the energizing-circuit of the clutch 18 is made by contact at the rings 106 and 107 in both sections of the train and the brakes thus set.

A variety of changes might be made in the constructions herein shown and described without departing from the spirit of my invention, and I do not wish to be understood as limiting myself to the details herein shown and described save in so far as these are specifically called for in my separate claims.

What I claim is—

1. In combination with the usual brake-gear underneath a car for applying brakes to a plurality of axles, an electromagnetic clutch having one member fixed to a car-axle and the other member loosely sleeved thereon, said members always operating without actual contact, a mechanical connection between said loose member and said brake-gear including means for insuring a greater braking effect at the axle bearing said clutch than at any other axle affected by the same brake-gear, and means for closing an electric circuit for energizing said clutch at will.

2. In combination with the usual brake-gear underneath a car, an operating counter-shaft, a hand-wheel for turning said counter-shaft, a brake-chain connected to said brake-gear and adapted to be wound on said counter-shaft, an electromagnetic clutch on a car-axle and a chain attached to the loose member of said clutch and to said counter-shaft, said chain being wound upon said counter-shaft in the opposite direction to the aforesaid brake-chain.

3. In an electric brake an electromagnetic clutch on a car-axle, means whereby said clutch operates the braking-gear, an energizing-circuit for said clutch, a circuit-controller in said circuit and means tending to throw said circuit-controller to open-circuit position when the same is released by the operator.

4. In an electric brake apparatus, electric means for applying the brakes, a lock for the brakes, electric means for releasing said lock, a manipulating-lever, a leaf-spring attached to said lever and projecting beyond it, a series of contacts opposite one side of the end of said spring, a pair of contacts extending along the path of movement of said spring on the opposite side thereof, circuits for said brake-applying means including said first-named series of contacts, circuits for said releasing means including said pair of extended contacts and means whereby said spring is made to touch the contacts on either side at will.

5. In a braking apparatus, electromagnetic means for applying the brake, a hand-wheel for applying the brake, a pawl-and-ratchet lock for the brake, a hydraulic device for controlling said pawl-and-ratchet lock, a valve for releasing said lock, electromagnetic means for operating said valve and a mechanical means for operating said valve.

6. In a braking apparatus for cars a working axle, means actuated thereby for applying the brakes, means for releasing the brakes, means operated by said working axle for actuating said releasing means when the speed of said axle reaches a prearranged minimum and means operated by another axle for neutralizing said releasing action when said second axle is slowed down below a predetermined critical speed.

7. In a braking apparatus for cars, a working axle, an electromagnetic means operated thereby for applying the brakes, an electromagnetic means for releasing said brakes, a device operated by said working axle for closing circuit through said releasing means when the speed of said axle reaches a prearranged minimum, and a device operated by another axle for opening a gap in series with the aforesaid circuit-closer and in said releasing-circuit when said second axle is slowed down below a predetermined critical speed.

8. In an electric brake for cars and in combination with an electromagnetic releasing means, two controllable circuit-breaks in series in the circuit operating said releasing means, a centrifugal governor upon one axle adapted to close one of said breaks when said axle is slowed down below its critical speed, a centrifugal governor upon a second axle

adapted to open the other break when slowed down to a somewhat higher critical speed, and means whereby the braking force acts more strongly on the former of said two axles than on the latter.

9. In an electric brake for cars, electromagnetic means for applying the brake, locking means for the brake, electromagnetic means for releasing said locking means, a circuit for operating said applying means, a circuit for operating said releasing means, two controllable circuit-breaks in series in the latter circuit and two controllable circuit-breaks in multiple in the brake-applying circuit, in combination with means operated by a car-axle for simultaneously opening one of said breaks in the applying-circuit and closing one of the breaks in said releasing-circuit at and below a critical speed of said axle, and means operated by a second axle for simultaneously closing the second break in the applying-circuit and opening the second break in said releasing-circuit at and below a critical speed of said second axle higher than the critical speed of the first axle.

10. In a braking system for trains, a battery on each car of the train, electromagnetic brake-applying means on each car, a main conductor extending along said train, connections between said conductor and one terminal of each brake-applying means and one terminal of each battery, a second main conductor extending along said train and connected to the second terminal of each brake-applying means a third main conductor extending along said train and connected to the second terminal of each battery and means for opening and closing electric connection between said second and third wire at will.

11. In a braking system for trains, means for applying the brake on each car, a locking means for said brakes, electromagnetic releasing means for said locks, a battery on each car for each releasing means and means for applying the current of all said batteries to all of said releasing means simultaneously.

12. In a braking system for trains, an electromagnetic brake on each car, a battery on each car, conductors extending along said train adapted when connected to throw the current of said batteries onto said braking means, couplings introduced into said conductors between cars and means whereby when said couplings are separated said conductors become connected electrically for applying the brakes on both sides of said separated coupling.

13. A liquid or fluid lock for a railway-brake comprising a cylinder and piston, a check-valve controlling the flow of liquid from one side of the piston to the other, a release-valve controlling the flow of liquid past the check-valve and manually-operating means for controlling said last-named valve.

14. In an electric braking apparatus, the combination with the brakes and operating devices therefor, of a fluid-lock, an operating-magnet therefor and a manual device also controlling the said lock.

15. In an electric braking apparatus, the combination with the brakes and operating devices therefor, of a fluid-lock comprising a cylinder and piston, and both electrical and manual devices for controlling the flow of liquid between the opposite ends of said cylinder.

16. In a fluid-locking device for an electric brake, the combination with a piston and cylinder of a by-pass tube connecting the opposite ends of the cylinder, an automatic check-valve, a controlled valve, an operating-magnet therefor and a manual operating device acting upon the same valve.

EDWIN R. GILL.

Witnesses:
H. S. MacKaye,
James S. Laing.