(No Model.) 3 Sheets—Sheet 1.

W. W. HANDY.

ELECTRIC GOVERNOR.

No. 542,640. Patented July 16, 1895.

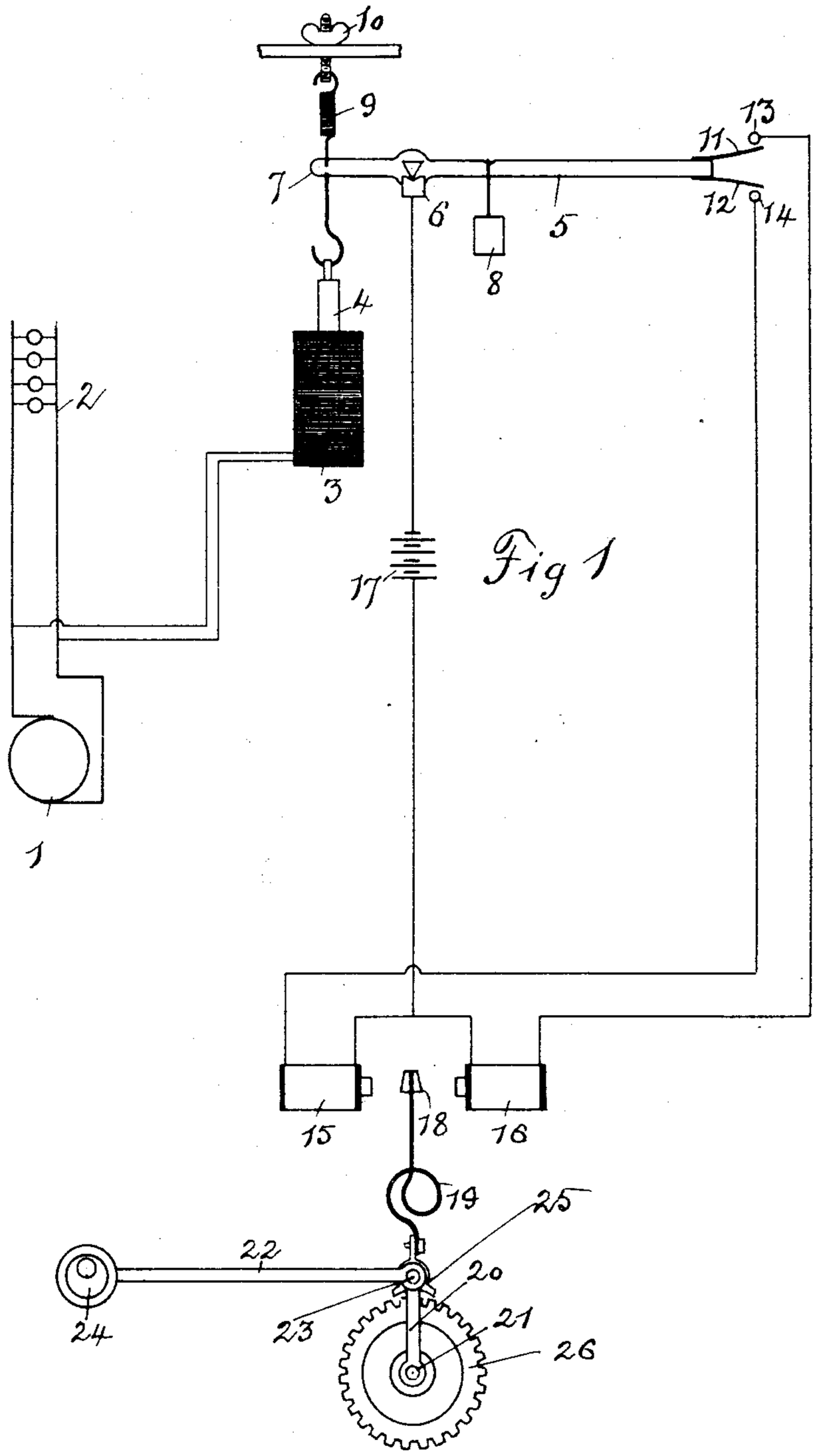

Fig 1

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(No Model.) 3 Sheets—Sheet 2.

W. W. HANDY.

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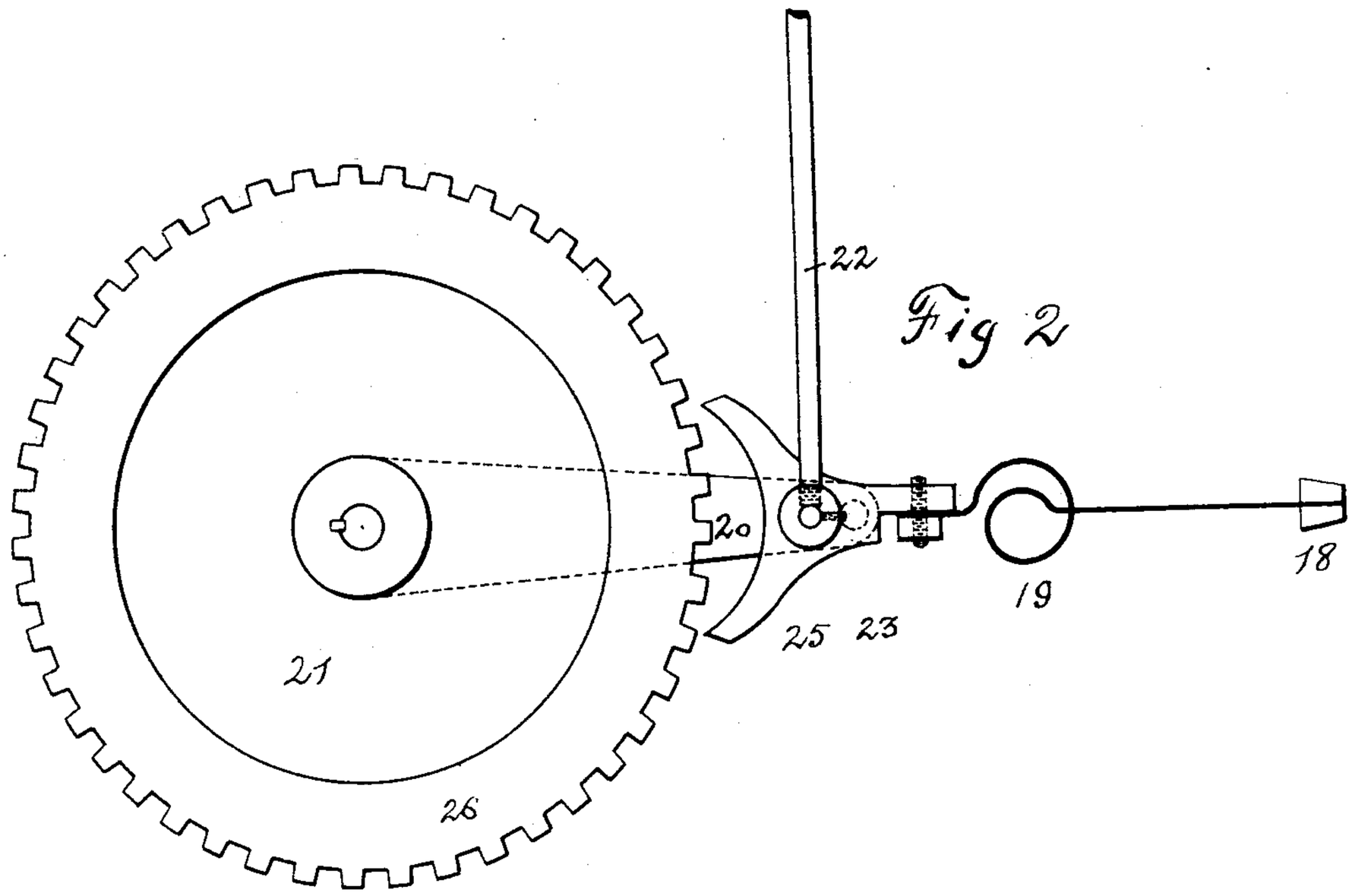

Fig 2

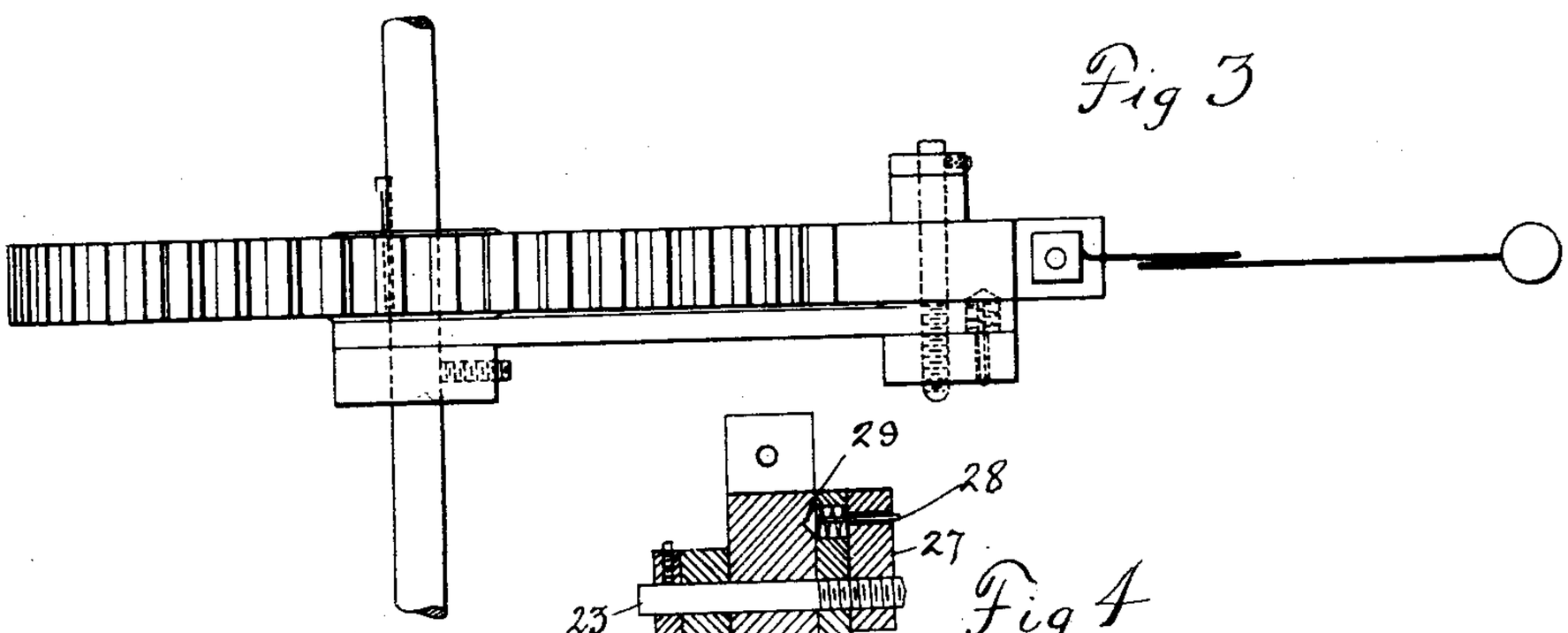

Fig 3

Fig 4

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(No Model.)

3 Sheets—Sheet 3.

W. W. HANDY.

ELECTRIC GOVERNOR.

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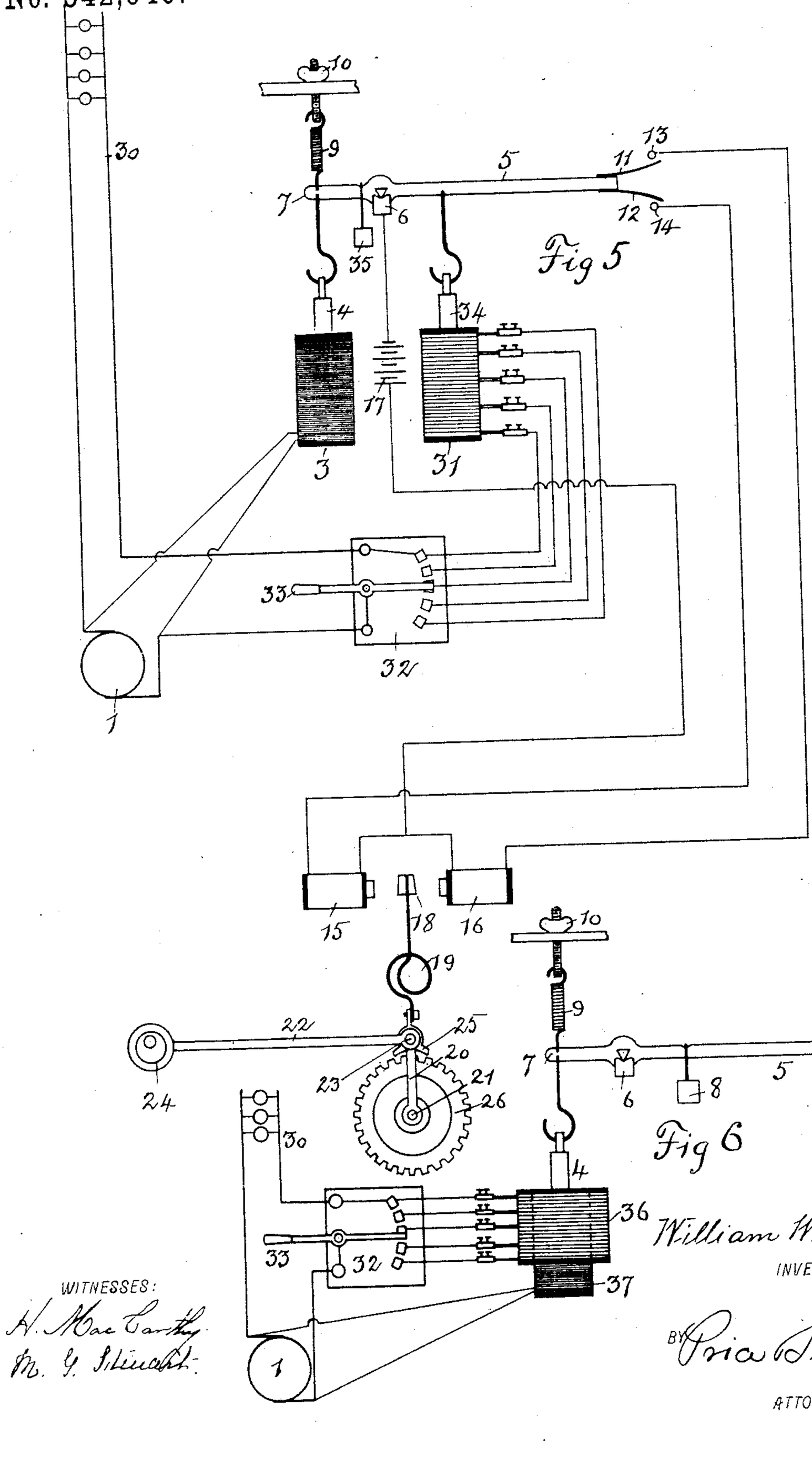

Fig 5

Fig 6

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M. G. Schmidt

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INVENTOR

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ATTORNEYS

UNITED STATES PATENT OFFICE.

WILLIAM W. HANDY, OF LAKE ROLAND, MARYLAND.

ELECTRIC GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 542,640, dated July 16, 1895.

Application filed May 1, 1895. Serial No. 547,712. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. HANDY, a citizen of the United States, and a resident of Lake Roland, in the county of Baltimore and State of Maryland, have invented a certain new and useful Electric Governor, of which the following is a specification.

My invention relates to an electric governor, and is designed to accomplish the purpose of so regulating the gates which supply water to the wheels as to maintain a constant potential in the dynamos for a short line on which there is no drop due to resistance, also where a long line is used, and therefore a considerable drop of voltage on the line to keep the potential constant at the end of the line; also if a constant-current dynamo be used to keep the current constant.

In the drawings, Figure 1 is a diagrammatic view of my governor having only a shunt-regulator as applied to a dynamo, water-wheel, and mechanism for regulating the gates. Fig. 2 is a plan of the gate-regulating mechanism. Fig. 3 is an edge elevation of the same. Fig. 4 is a vertical section of pawl and carrier. Fig. 5 is a diagrammatic view of governor having shunt and series coils. Fig. 6 is a diagrammatic view of governor having shunt and series coils wound one on the other and operating the same plunger.

Referring to Fig. 1, 1 is a dynamo; 2, the line; 3, a shunt-coil; 4, its reciprocating plunger or core. 5 is a lever pivoted on a knife-edge at 6. On one end 7 of this pivoted lever is hung the plunger or core 4. The weight of the plunger 4 is counterbalanced by a suitable weight 8 in the opposite side of the fulcrum. 9 is a spring secured to the end 7 of the lever, and connected to a thumb-screw 10 and a suitable stationary part. On the opposite extremity of the lever 5 are two metallic tongues 11 and 12. These tongues are in electrical circuit with the pivot of the lever and with a source of current connected thereto. 13 and 14 are two contact-points located in the path of the fingers 11 and 12. 15 and 16 are two electromagnets, 15 being connected at one extremity with the contact-point 14, and 16 being connected with the contact-point 13, said magnets both being connected with a battery 17, which is in circuit with the pivot 6 of the lever 5. 18 is an armature mounted between the poles of the magnets 15 and 16, and in position to be attracted by either of them when they are energized. The armature 18 is mounted upon a flexible support 19, which consists of a spring in any suitable shape, so as to maintain the armature in the desired position and yet afford it sufficient freedom of motion. The spring 19 is secured at its lower end to the pawl 25, mounted upon the upper end of the arm 20. To the end of the arm 20 is pivoted a rod 22 at 23, said rod 22 being connected at its other end with an eccentric or crank 24 by which it receives reciprocating motion. The eccentric or crank 24 is connected in any suitable manner with a source of power, preferably the water-wheel, so as to insure constant reciprocating motion in the rod 22. The shaft 21 is connected in any suitable manner with mechanism for moving the gates which supply water to the water-wheel. 25 is the pawl and 26 the ratchet-wheel for turning the shaft 21.

Referring to Figs. 2, 3, and 4, Fig. 2 shows the pawl-and-ratchet-wheel mechanism in enlarged size. The rod 22 is loosely connected to the pin 23, (more fully shown in Fig. 4,) so that the pin may turn freely within the eye on the extremity of the rod 22. The pawl 25 is also mounted upon said pin 23 so that it may turn. The pin 23 is, however, screwed into the upper end of the arm 20 and a block 27 on the rear side of the upper end of said arm, so that when the armature 18 is attracted by one or the other of the magnets the relative angle of the pawl to the arm 20 will be changed and one or the other points of the pawl 20 will be thrown down into the path of the teeth of the ratchet-wheel 26 and caused to engage said teeth. 28 is a latch located in the upper end of the arm 20, consisting of a bolt having a conical head, which enters a conical hole 29 in the upper end of the pawl 25. The bolt is pressed into hole 29 by a suitable spring. The latch 28 is of such a character that when the armature 18 is attracted by either of the magnets the pawl will be rocked on the pin 23 by the spring 19 and the bolt 28 forced back directly from its socket. It will, however, remain in such a position on the edge of its conical socket that when the current is shut off from the magnets 15 or 16

and the pull of the armature relieved it will restore the pawl and armature to a middle position by being forced into the socket 29 by its spring.

As before stated the rod 22 is constantly reciprocated under the influence of the eccentric 24, but when the pawl 25 is in its middle position, as shown in Fig. 2, it will not touch the teeth of the ratchet-wheel 26, therefore will not move it. As soon, however, as the armature 18 is attracted by one or the other of the magnets 15 or 16 one or the other of the extremities of the pawl 25 will be thrown into contact with the teeth of the ratchet-wheel 26, and the continued reciprocation of the rod 22 will cause the wheel 26 to be turned in one direction or the other, thus opening or closing the gates admitting water to the water-wheels.

Referring to Fig. 5, the same reference-numerals in this figure represent parts which are identical with those in Fig. 1, new reference-numerals being used for parts which are either changed in position or which do not appear in Fig. 1. 30 represents a long line, say many miles in length, on which there would be a considerable drop of potential due to resistance and other causes. 31 is a coil wound in a number of sections which are connected together in such a manner that one or more of them may be thrown in the circuit by means of a switch. These coils are series coils in the main line. 32 is a switch having a series of contact-points, each of which is connected with one of the sections of the coils 31. 33 is a hand-lever connecting the main line from the dynamo with any desired one of the contact-points of the switch, thus enabling an operator at will to throw one or more of the sections or coils upon the magnet 31 into or out of circuit. 34 is a plunger or core reciprocating within the magnet 31. It is suspended from the lever 5 on the opposite side of the fulcrum 6 from the plunger 4. 35 is a counterbalance-weight on the opposite side of the fulcrum 6 from the plunger 34, used for the purpose of balancing it and the long end of the lever 5. This weight is only used for the purpose of adjustment and may be omitted. The other parts of the mechanism are the same as heretofore described.

Referring to Fig. 6, the same reference-numerals are used in this figure as in Figs. 1 and 5 to indicate parts which are identical with those figures, new reference-numerals being used to indicate new parts. In this figure the series coil is superimposed upon the shunt-coil and is adapted to oppose the action of the shunt-coil. 36 represents the series coil wound in sections as in Fig. 5. 37 is the shunt-coil wound in the same manner as in Figs. 1 and 5.

Referring to Fig. 1, the apparatus shown in this figure is designed for use on a line where there is practically no drop in the line and where it is desirable to keep the potential of the generator constant. The shunt-coil 3 is connected across the terminals of the dynamo and is so wound to have the desired amount of power which it will act upon the plunger 4 to draw it into the helix. The weight of the plunger 4 is counterbalanced by the weight 8 and the long end of the lever 5. The pull of the magnet is counterbalanced by the spring 9, which is adjusted by the screw 10, so as to maintain an open circuit in the circuit-closer. When the generator is running without any load on the line, the thumb-screw is adjusted so as to counterbalance the pull of the magnet 3 and cause the fingers 11 and 12 to occupy a middle position between the contact-points 13 and 14, thus maintaining the apparatus out of action. As soon as the load is thrown on the line the voltage at the dynamo will drop, the power of the magnet 3 will be decreased, and the pull of the spring 9 will raise the rear end of the lever 5 and cause the tongue 12 to make contact with the point 14. This will close a circuit through the magnet 15, battery 17, and fulcrum 6, attract the armature 18 into contact with pole of the magnet 15, throw the left-hand tongue of the pawl 25 into the path of the teeth of the ratchet-wheel 26 and cause said pawl to revolve the ratchet-wheel, due to the constant reciprocation of the rod 22. This will continue until sufficient water has been admitted to the wheel to increase its speed and thus increase the speed of the dynamo so as to increase its voltage and bring it back to its normal condition. The increase of the voltage of the generator will restore power of the magnet 3 and cause it again to attract its plunger 4, move the lever 5, and break contact between 12 and 14. This breaking of the circuit will demagnetize the magnet 15, cause it to let go the armature 18, which will be at once returned to its middle position by the latch 28, thus taking the tongue of the pawl 25 out of the path of the ratchet-wheel and stopping the motion of the gates. Now if the load is thrown off the dynamo, the voltage at the dynamo increases, thereby increasing the power of the coil 3. The core 4 will be drawn farther into coil, the lever 5 raised, and contact made between 11 and 13. This will energize the magnet 16 and attract the armature 18 to it and throw the right-hand tongue of the pawl into engagement with the gear-wheel 26. The wheel 26 will then begin to close the gates and shut off the water, and this operation will continue until the speed of the water-wheel is so reduced as to reduce the speed of the generator, reducing its voltage and the power of the coil 3 until the spring 9 causes the lever 5 to break the contact between 11 and 13.

When the dynamo is a constant-current machine, a series coil will be used instead of the shunt-coil. The action of the governor will in this case be exactly the same as its action with the shunt-coil for a constant potential dynamo.

Now where there is a long line with a drop of potential on the line due to resistance and other causes, the arrangement for keeping

the potential constant at the end of the line is shown in Figs. 5 and 6.

Referring to Fig. 5, in this figure the shunt-coil 3, its core 4, lever 5, the circuit with the contact-points, the magnets 15 16, and the gate-controlling mechanism are all identical with Fig. 1. 31 is a series coil, however, wound in sections and connected to a switch 32, having a hand-lever 33, by which one or more of these sections may be thrown in circuit. The series coil 31 is wound so as to oppose the action of the coil 3 by pulling the lever 5 in an opposite direction. The switch 32 is used so as to adjust the power of the coil 31 for lines of different resistance. The switch may therefore be set for any particular line on which the apparatus is to be used constantly and need not be again altered so long as the resistance of the line remains constant. If, however, a different line is thrown into circuit with the machine, the handle 33 of the switch must be turned so as to cause the number of series coils or the magnet 31 to suit the resistance of the line used. If, now, the dynamo has no load, the voltage will be the same at the end of the line as the dynamo and there will be no current through the coil 31. The voltage will be at its proper value and the core 4 will be attracted by coil 3 just sufficient to cause the contact-fingers 11 and 12 to maintain a middle position between the contact-points 13 and 14. Now if a load be thrown on the line the voltage at the end of the line will decrease. The current passing through the coil 31 will attract its cores 34 and make contact between 12 and 14. This will actuate the magnet 15 and cause the gate-moving apparatus to open the gates and admit more water to the wheel. As the speed of the wheel increases, the voltage of the generator will be increased, and with it the power of the magnet 3, which will be increased until the plunger 4 has caused the lever 5 to break contact at 12 and 14, at which time, if the switch 32 is in the right position, the voltage at the end of the line will be what it was for no load.

If the load should be decreased the drop on the line will decrease and voltage at the end of the line increase, less current will follow through the coil 31, and its plunger 34 will be drawn out by the plunger of the magnet 3 and contact made between 11 and 13, which will start the gate-controlling apparatus to close the gate and decrease the speed of the generator. This decrease of speed of the generator will continue until the drop in the potential of the generator and the consequent drop of the potential in the core 3 will be sufficient to decrease its power and counterbalance the pull of the magnet 31, thus breaking the circuit at 11 and 13 and stopping the gate-moving mechanism.

Referring to Fig. 6, I have shown the series coil wound on top of the shunt-coil. This mechanism has the advantage of compactness. The action of the series coil, being opposed to that of the shunt-coil, decreases the power of the shunt-coil and thus accomplishes the result of moving lever 5 in the same manner as it is moved under the influence of the magnets 3 and 31.

The apparatus which I have described contemplates the use of direct-current generator, but it will be readily understood that the same apparatus may be employed with an alternating generator by the introduction of converters between the coils and their sources of current.

It will be readily understood that my invention is applicable to all classes of water-wheels—both those which are regulated by increasing and decreasing the supply of water to the wheels through the medium of gates and valves, and also to such wheels as the Pelham wheels, in which the speed of the wheel is regulated by changing the direction of the nozzles by which water is thrown against the periphery of the wheel. In fact, the apparatus is applicable to any means of governing a water-wheel by which the wheel is caused to increase or decrease its speed.

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

1. In an electric governor the combination of a dynamo, a prime motor and mechanism for regulating the force applied to the motor, a shunt coil, and a series coil in the same circuit and mechanism operated by said coils, and a mechanism controlled thereby to regulate the force applied to the motor.

2. In an electric governor the combination of a dynamo, a prime motor and mechanism for regulating the force applied to the motor, a shunt coil, a series coil, in the same circuit and a reciprocating core in each of said coils with mechanism controlled by the motion of said cores to regulate the force applied to the motor.

3. In an electric governor the combination of a dynamo, a prime motor and mechanism for regulating the force applied to the motor, a shunt coil, a series coil wound in sections and connected with a switch mechanism by which one or more of said sections may be thrown into circuit, a reciprocating core or cores within the shunt and series coils operated thereby, and mechanism controlled by the motion of the core or cores to regulate the force applied to the motor.

Signed at Baltimore city, in the State of Maryland, this 29th day of April, A. D. 1895.

WILLIAM W. HANDY.

Witnesses:
JOHN L. HEBB,
HORATIO A. FOSTER.