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J. M. BRADFORD.

Electro-Magnetic Governors for Steam Drying Apparatus.

No. 154,214. Patented Aug. 18, 1874.

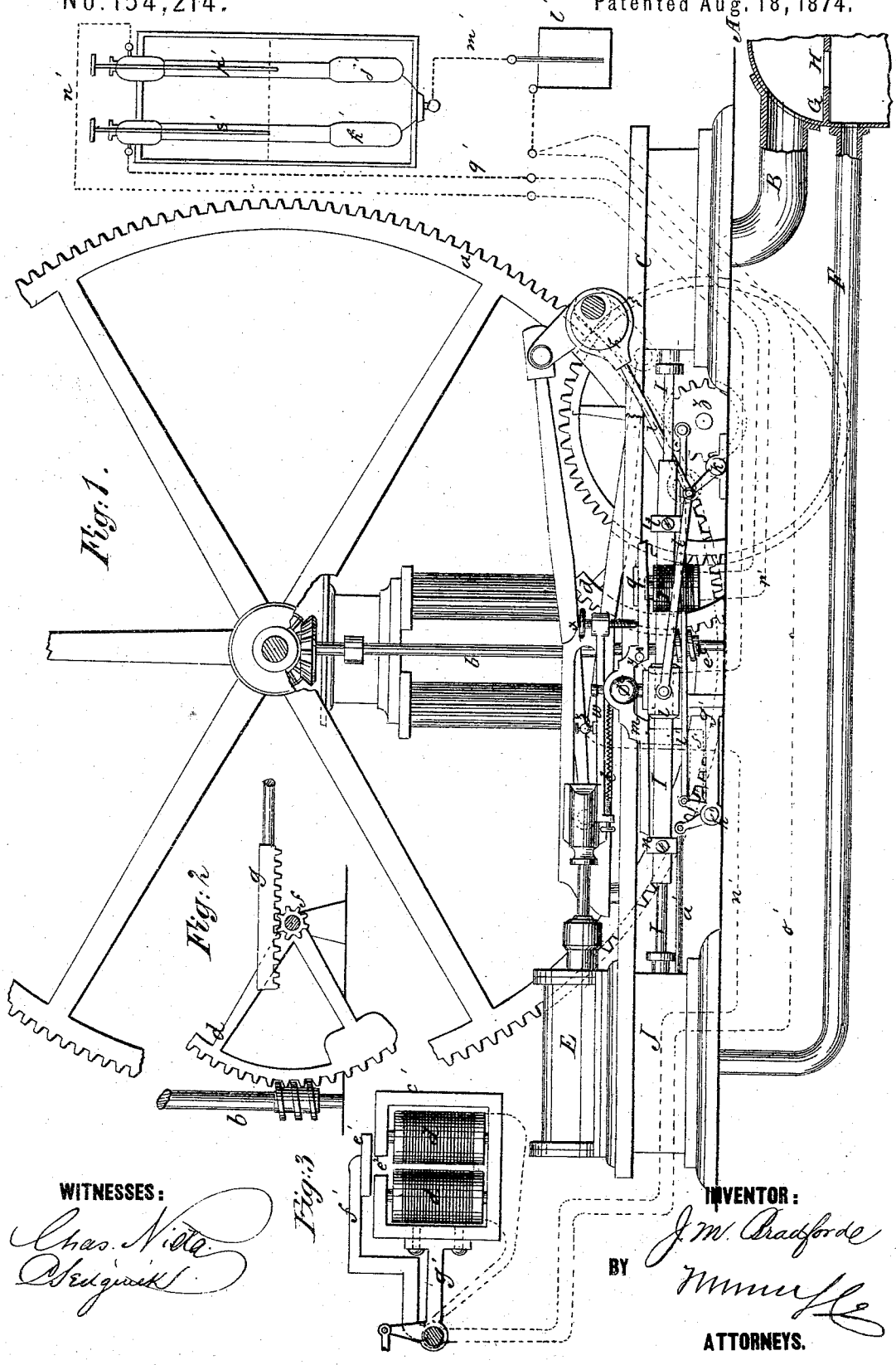

Fig. 1.

Fig. 2.

Fig. 3.

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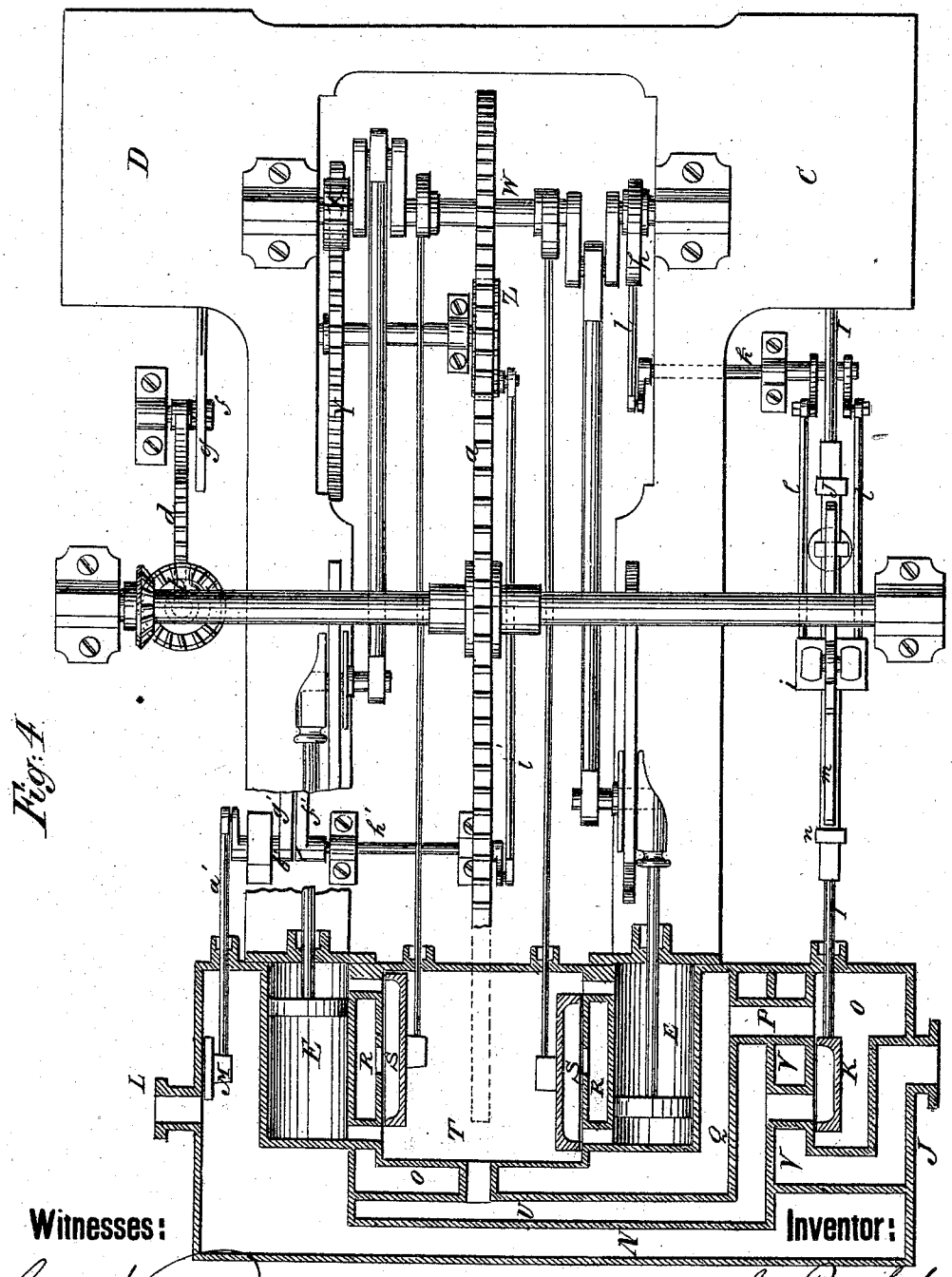

Fig: 4.

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Fig: 5.

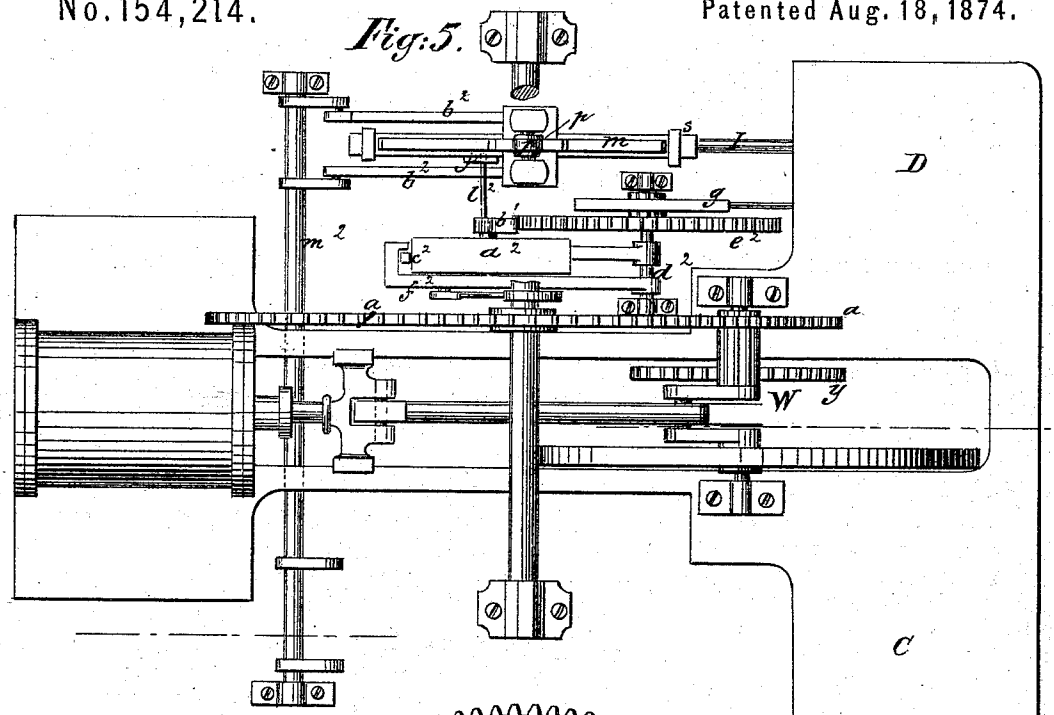

Fig: 6.

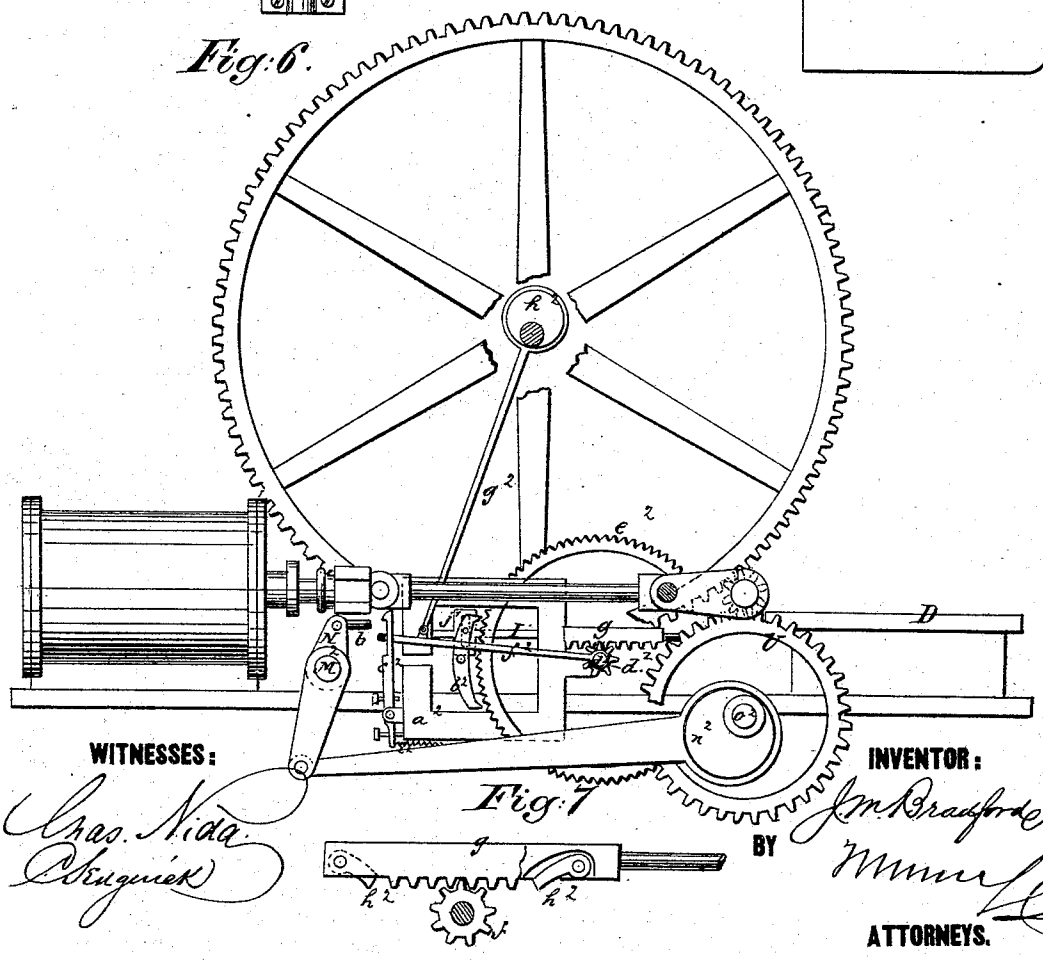

Fig: 7

WITNESSES:

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UNITED STATES PATENT OFFICE.

JULIEN M. BRADFORD, OF PORTLAND, MAINE, ASSIGNOR OF ONE-THIRD HIS RIGHT TO ZEBULON K. HARMON, OF SAME PLACE.

IMPROVEMENT IN ELECTRO-MAGNETIC GOVERNORS FOR STEAM DRYING APPARATUS.

Specification forming part of Letters Patent No. **154,214**, dated August 18, 1874; application filed January 31, 1874.

To all whom it may concern:

Be it known that I, JULIEN M. BRADFORD, of Portland, in the county of Cumberland and State of Maine, have invented a new and Improved Electro-Magnetic Governor, of which the following is a specification:

The invention comprises an engine for working a cut-off valve and a throttle-valve of steam heating apparatus, with automatic apparatus for opening and closing the valves, also for reversing and stopping and starting the engine, controlled by electric currents, closed and broken by the variations of the heat through the medium of thermometers in the heated room, the arrangement being adapted to insure a uniform temperature of any required degree.

The machine is designed for use in connection with drying and heating rooms of all kinds and purposes.

Figure 1 is a side elevation of the apparatus with a part sectioned. Fig. 2 is a detail of the apparatus for working the regulating-valve in side elevation. Fig. 3 is a detail of the apparatus for working the valve for stopping and starting the engine, also in side elevation. Fig. 4 is a horizontal section of Fig. 1. Fig. 5 is a plan view of a different arrangement of apparatus that may be used upon the same plan for working the regulating-valve. Fig. 6 is a side view of Fig. 5. Fig. 7 is a detail of a portion of said apparatus, partly in side elevation and partly in section.

Similar letters of reference indicate corresponding parts.

A represents the boiler, from which steam is to be conducted by the large pipe B to the dry-house through the cut-off-valve chest C and the regulating-valve chest D; steam is also to be taken from it to the engines E, for working said valves, by the small pipe F. This latter pipe is connected with the boiler below the partition G, which, in practice, will be provided with a valve at H in low-pressure apparatus, to shut off the steam temporarily from the dry-house in case it may be necessary to raise the pressure at any time it may fall so low as not to be capable of running the engine. The cut-off valve in chest C may be of the ordinary slide-valve pattern, or any other approved form; but it will probably be best to have the regulating-valve control a number of different passages to different coils of small pipe rather than one coil of large pipe, because one large coil will not cool as quickly when heated as several smaller ones of the same capacity in the aggregate, so that by the use of the small coils, with a valve so arranged as to shut off some of them entirely, while others are left open, something will be gained by the quicker action. This cut-off valve is connected to the rod I, which extends into the valve-chest of the steam-engines, and is also connected to the reversing-valve K, so that whenever the cut-off valve is either opened or closed the engines can be reversed to shift the regulating-valve accordingly. The steam enters chest J from pipe F at L through the stopping and starting valve M, which, in practice, will probably be a balanced valve; thence the steam passes along N into chamber O of the reversing-valve, and when the cut-off valve in chamber C is opened, and the reversing-valve shifted to the left, it enters the cylinders through P, Q, R, and S, and exhausts through T, U, and V; and when the cut-off valve is closed, and the reversing-valve K is shifted to the right, the steam enters through U and T, and exhausts through S, R, O, P, and V.

In practice the valves in chamber T will be arranged so as not to lift when steam enters through P, Q, R, and S. These engines turn the crank-shaft W, which, by its pinion X, turns the wheel Y, which, by its pinion Z, turns the large wheel *a*, from which motion is obtained through the shaft *b* to work the segmental wheel *d* by a worm, *e*. This segment is thus turned very slowly for the purpose of working the regulating-valve in chest D, with which it gears by the pinion *f* and rack *g*, as slow as may be needed, to correspond as nearly as may be with the changes of temperature in the dry-house. The crank-shaft W has an eccentric, *h*, which works a reciprocating sleeve, *i*, on the rod I, by the rock-shaft *j*, rods *k*, and cranks *l*. This sleeve slides freely on the rod, and it carries a pawl, *m*, which is pivoted at *p*, and carries an armature near the end next to the cut-off valve, to be pulled down so as

to catch collar t when the valve is to be closed by the electro-magnet r; it also has a spring, l, for pulling the other end down to catch collar n when the cut-off is to be opened. Above the pawl m is a small bar, w, which is insulated from the pawl on which it rests by a piece of vulcanized rubber; it carries a screw, x, with a platinum point, which touches a platinum disk, when the pawl is free from the magnet r, with which the binding-screw y connects. This bar also carries another binding-screw, z, which, with screw x, includes the pawl in the electrical circuit for controlling the stopping and starting valve M, which is connected by its rod a^1 with the rock-shaft b^1, on which is a frame of soft iron, c^1, carrying a magnet, d^1, supported by the arm g^1. Directly over this magnet is an armature, e^1, on a lever, f^1, of a rock-shaft, h^1, in the axis of shaft b^1, and connected by the rod i^1 with a wrist-pin on the pinion Z, by which to obtain its motion. This magnetic frame is cut or separated, as seen at e^2, Fig. 2, for the armature to make the connection between the poles, by which its lifting power is greatly enhanced. j^1 and k' represent two thermometers, which are supposed to be in the room to be heated. j^1 is included in the circuit of the battery l^1, pawl m, and the magnet d^1 by the lines m^1, n^1, and o^1, and the steel wire p'. k' is included in the circuit of the battery l^1 and the magnet r by the lines m^1 q' r', and the steel wire s'. The wire p' stands a little lower than wire s', and is supposed to indicate by its lower end the degree of heat wanted.

When steam is let on by opening the cut-off valve, the regulating-valve being partly open and the engine in motion, the regulating-valve will gradually open till the heat rises to the required point, when it should be open just enough to allow enough steam to pass to maintain the heat thereat, and then stop. The engine will then be stopped to allow said valve to remain at rest by the closing of the circuit through magnet d^1 by the mercury touching the steel rod, which will cause the frame c^1 to be attracted by the armature e^1, and held so that when the lever f^1 is forced up by wheel Z the frame c^1 will be drawn up with it, and will close the valve M, which is connected to its rock-shaft. Should the heat then fall the circuit will be broken by the mercury falling away from the steel rod p', when the frame c^1 will fall away from lever f^1, and set the engine in motion to open the regulating-valve still more. On the other hand, should the heat continue to rise after the stopping of the regulating-valve, the mercury in thermometer k' will, by touching steel wire s', open the circuit through magnet p, which will pull down pawl m and also break the circuit through magnet d^1, so that it will fall and set the engine in motion, and the pawl will close the cut-off valve and reverse the engine, which will close the regulating-valve also and insure the falling of heat directly; but, as soon as it falls so that the circuit through magnet p is broken, the pawl m will be released by the magnet and pulled down by its spring against collar n, so that it will open the cut-off valve and again reverse the engine for again opening the regulator, and so on.

A spring may be placed under the segment, so that, in case it may be turned so far down that the worm will escape from the teeth at the top, said spring will cause it to rise and engage with the worm again when the latter reverses.

The regulating-valve may be operated by the engine, and reversed without reversing the latter, by the following method: A frame, a^2, with a magnet, a pawl, b^2, and a latch, c^2, may be pivoted on the axis d^2 of a wheel, e^2, which takes the place of the segmental wheel d, and a lever, f^2, also pivoted on said axis, and connected, by a rod, g^2, with an eccentric, h^2, on the shaft of wheel a, may be arranged relatively to the latch c^2, so that when the latter is thrown outwardly from the frame a^2 by a spring, i^2, the lever will be caught by the latch, and will thus move the frame and pawl up and down to turn the wheel, which will thus be turned either to the right or left, according to which end of the pawl acts upon it, and this will be determined by the position of the rod I of the cut-off valve, by a little slotted piece, j^2, on said rod, into which a pin, l^2, projects, so that when said valve is open and its rod I shifted to the left the lower end of the pawl will engage the wheel, and when shifted the other way the upper end will engage the wheel. In this case the mechanism for working the rod I will be the same in all respects as in the other, except the rod b, connected to the sleeve i, will be worked by the rock-shaft m^2, which is worked by an eccentric, n^2, on the shaft o^2, which is turned by the crank-shaft. This shaft m^2 may be employed for working any number of regulators for different dry-rooms to be maintained at the same or different temperatures, a cut-off and a regulating-valve being used for each room, and being in electrical connection with a thermometer therein. By preference the valves will be arranged close together, as in chest D, so that the other, C, may be employed for another regulator, of which the valves may be connected to said shaft m^2, the same as the others. The shaft m^2 and the valve-chests may be extended as needed for the number of regulators it is desired to connect.

The wheel a will be geared directly to the crank-shaft, as its motion is required to be faster than in the other case, and an ordinary non-reversing engine will be used.

When the current passes through the magnet in frame a^2 from the thermometer j^1 the latch will be pulled back and the lever f^2 will pass it without effect.

To allow the rack to be disengaged when moved to the ends of its range, while the wheel e^2 continues to move and to be engaged again when the motion of the wheel is reversed, the

pawls h^2 are arranged on the rack, as shown in Fig. 6, to drop into the teeth of the pinion f when it reverses. In this arrangement both the cut-off and regulating-valve are represented as chest D.

Both circuits may be maintained with one thermometer, provided it be made large enough for both wires.

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

1. The combination of a regulating-valve, a reversing-engine, and mechanism for working the valve, and an electrical circuit for controlling the reversing apparatus, with the feed-pipe of a steam heating apparatus and a thermometer in the heating-chamber, substantially as specified.

2. The combination of a cut-off valve with the regulating-valve, reversing-engine, electrical reversing-circuit, feed-pipe to the heating apparatus, and a thermometer in the heating-chamber, substantially as specified.

3. The combination of stopping and starting mechanism, substantially as described, and an electrical circuit for controlling it, with the engine, regulating-valve, and a thermometer in the heating-chamber, substantially as specified.

4. The combination of the cut-off valve and reversing-valve, rod I, collars s n, pawl m, magnet r, armature q, and thermometer k', substantially as specified.

5. The combination of the circuit for controlling the stop-valve mechanism with cut-off valve and reversing-valve mechanism, substantially as specified.

6. The combination of the magnet d, lever g^1, and armature-lever f^1 with the stopping and starting valve M, substantially as specified.

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