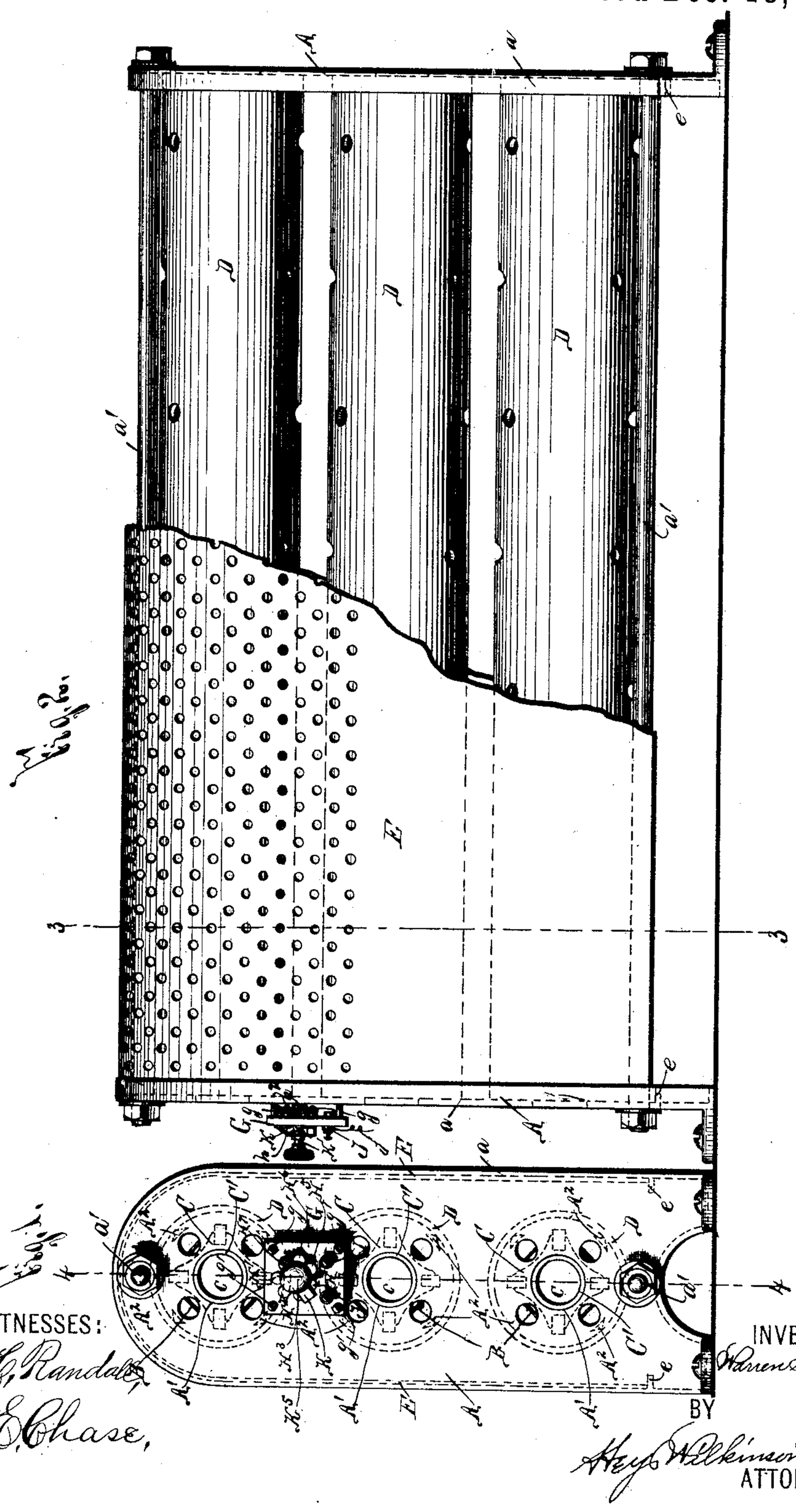
(No Model.)

5 Sheets—Sheet 1.

W. H. BOLES.

ELECTRIC HEATER.

No. 465,423. Patented Dec. 15, 1891.



WITNESSES:

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(No Model.)

5 Sheets—Sheet 2.

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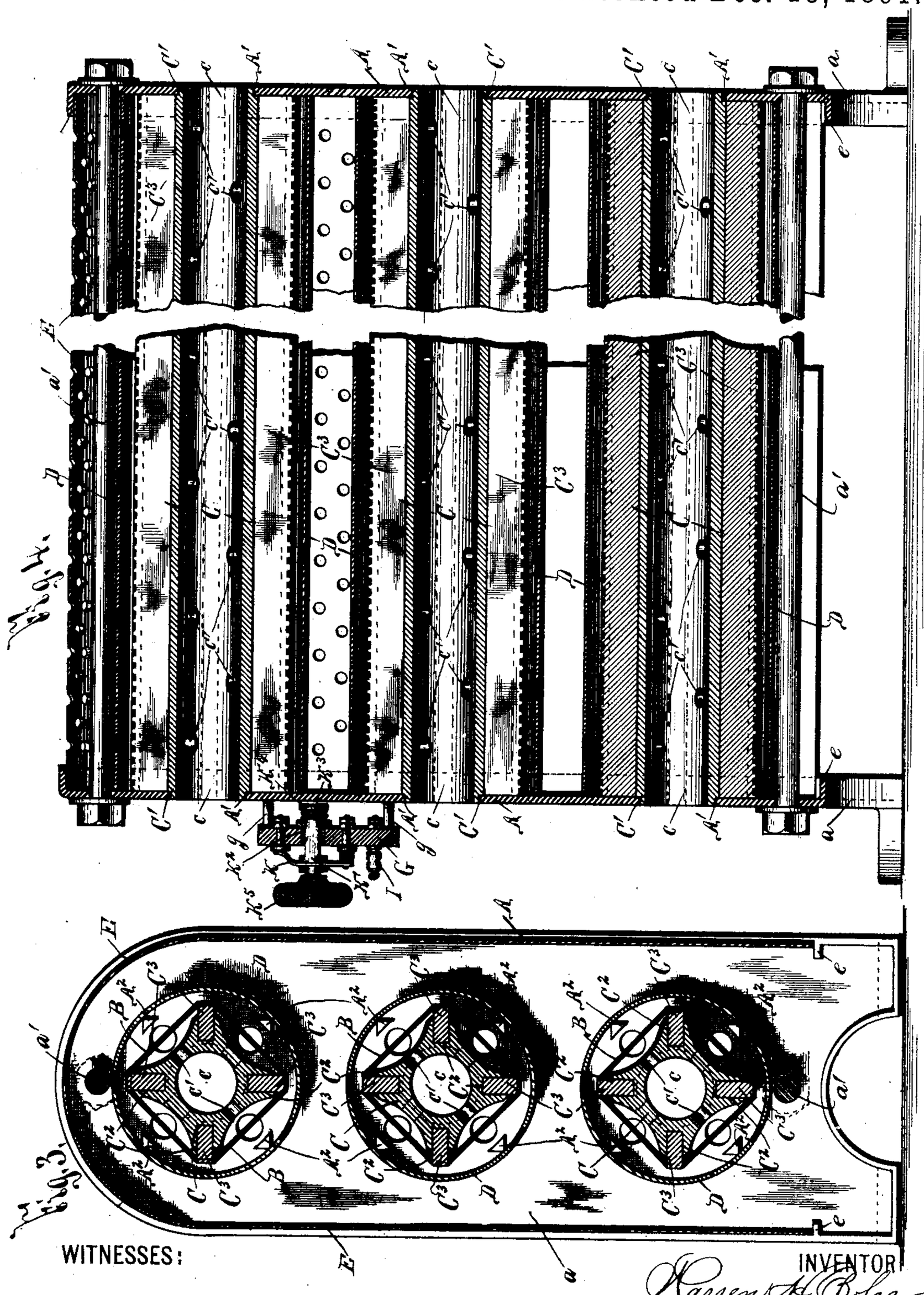
ELECTRIC HEATER.

No. 465,423. Patented Dec. 15, 1891.



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(No Model.)

5 Sheets—Sheet 3.

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ELECTRIC HEATER.

No. 465,423. Patented Dec. 15, 1891.

Fig. 5.

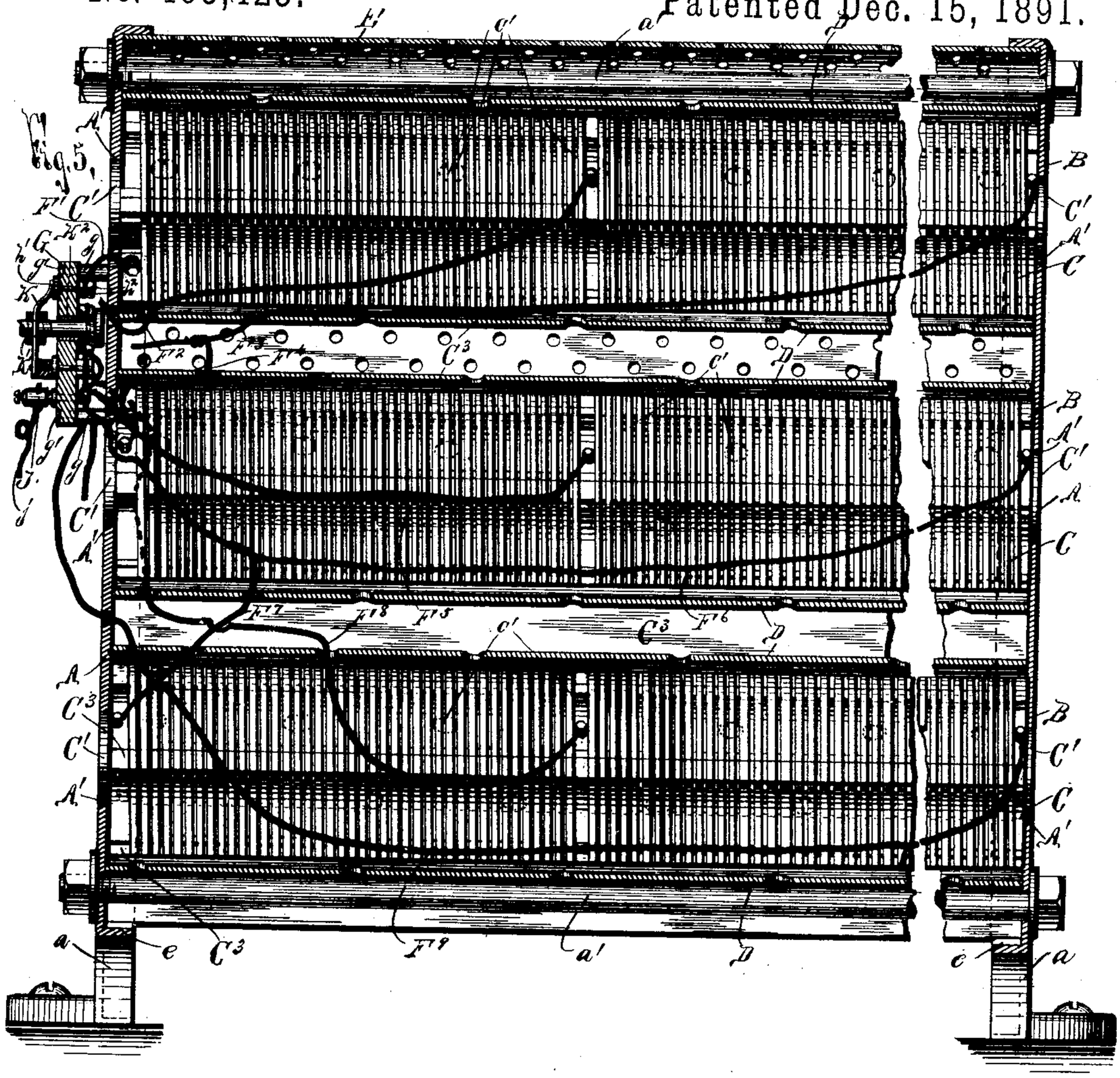
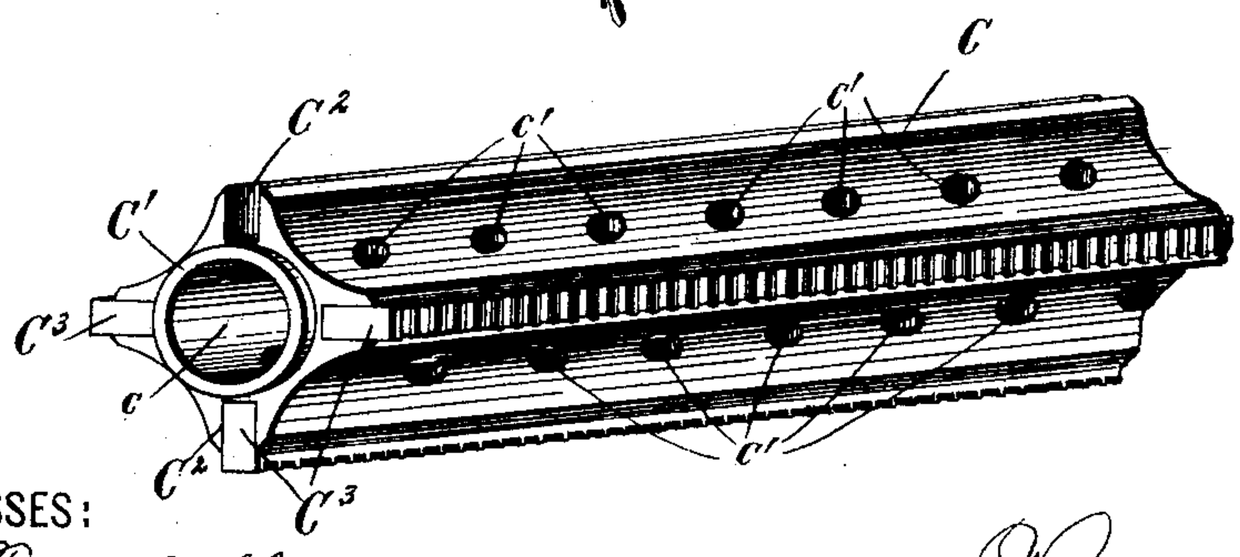


Fig. 6.



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(No Model.) 5 Sheets—Sheet 4.

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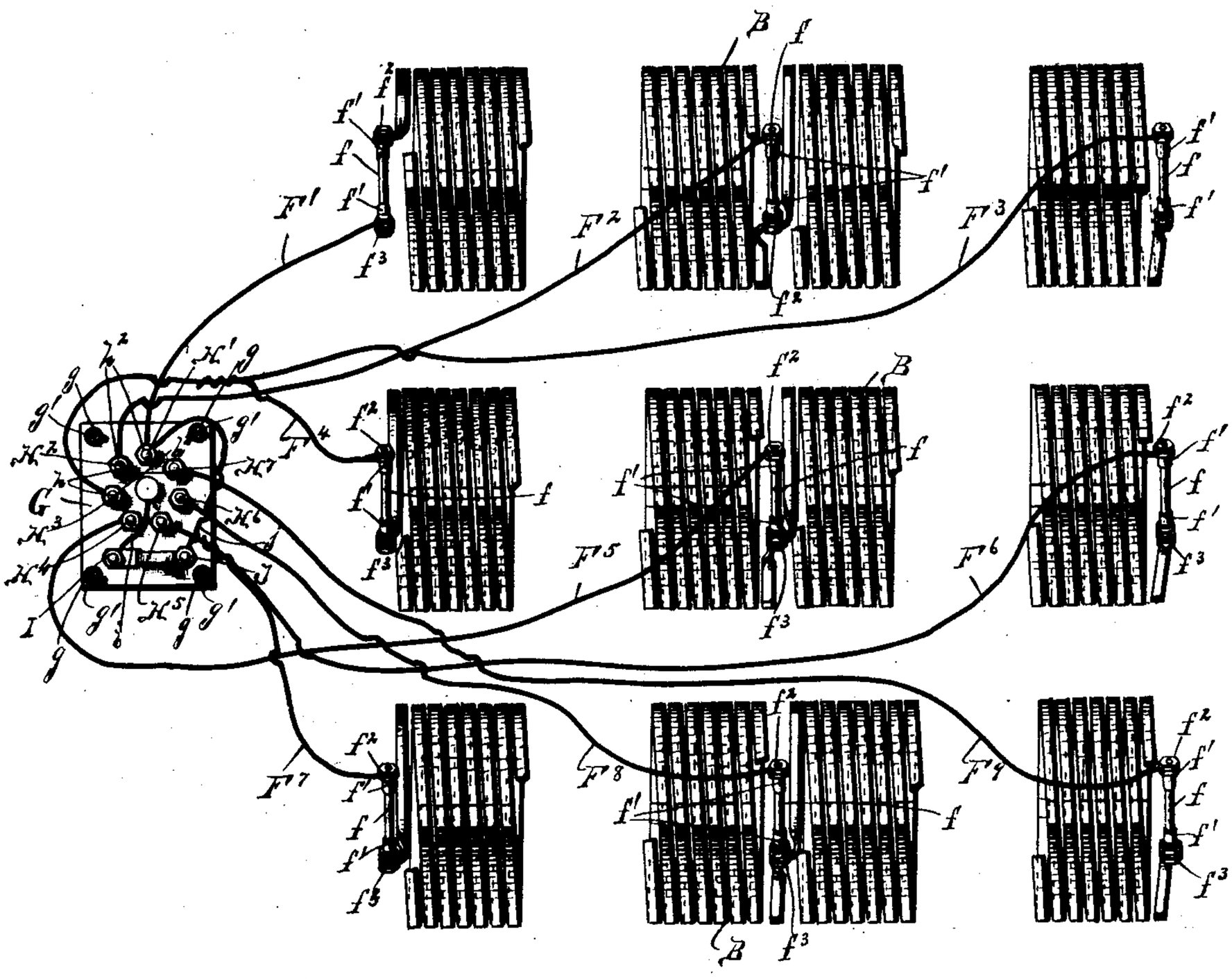
ELECTRIC HEATER.

No. 465,423. Patented Dec. 15, 1891.

Fig. 7



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(No Model.) 5 Sheets—Sheet 5.

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ELECTRIC HEATER.

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Fig. 8.

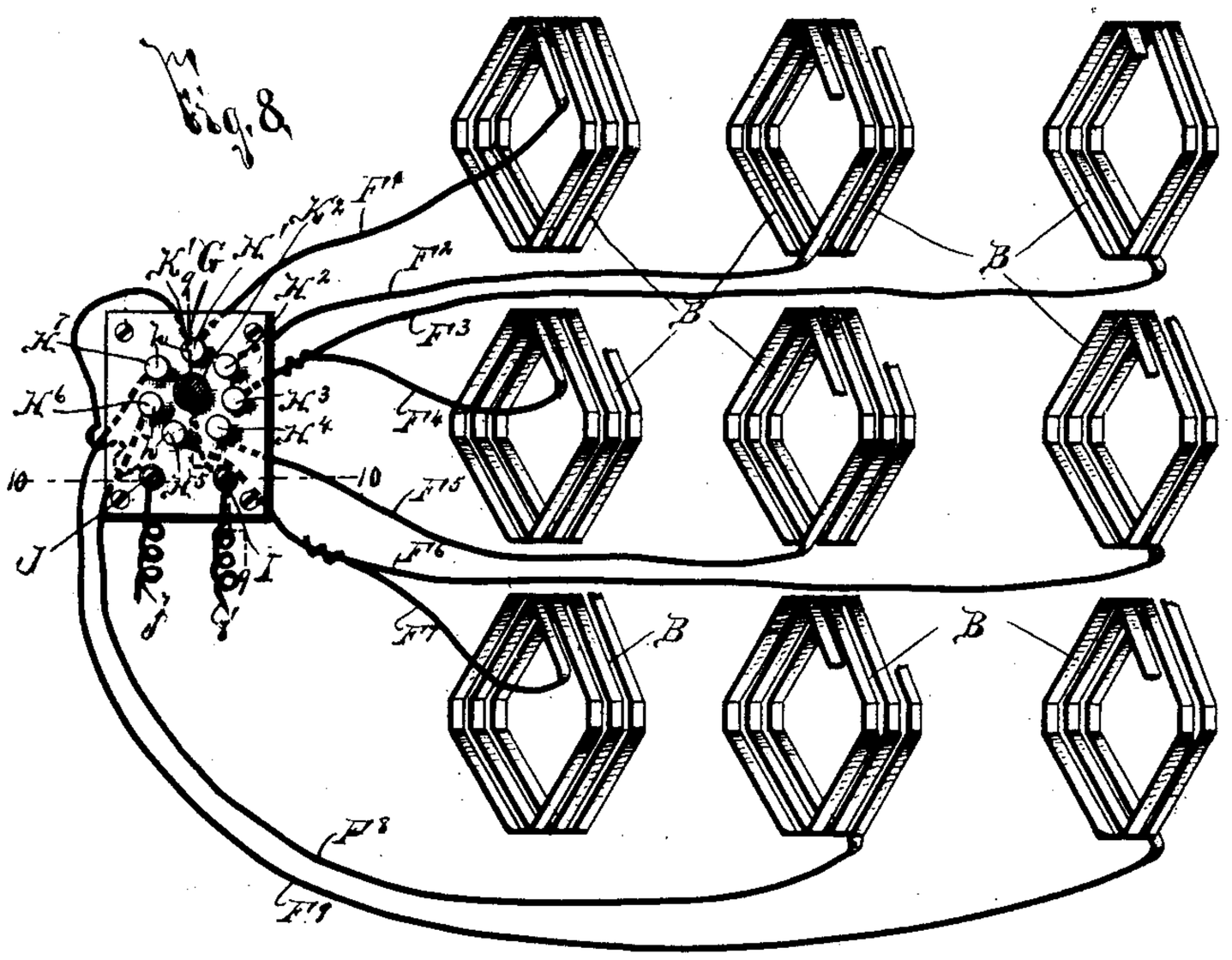


Fig. 9.

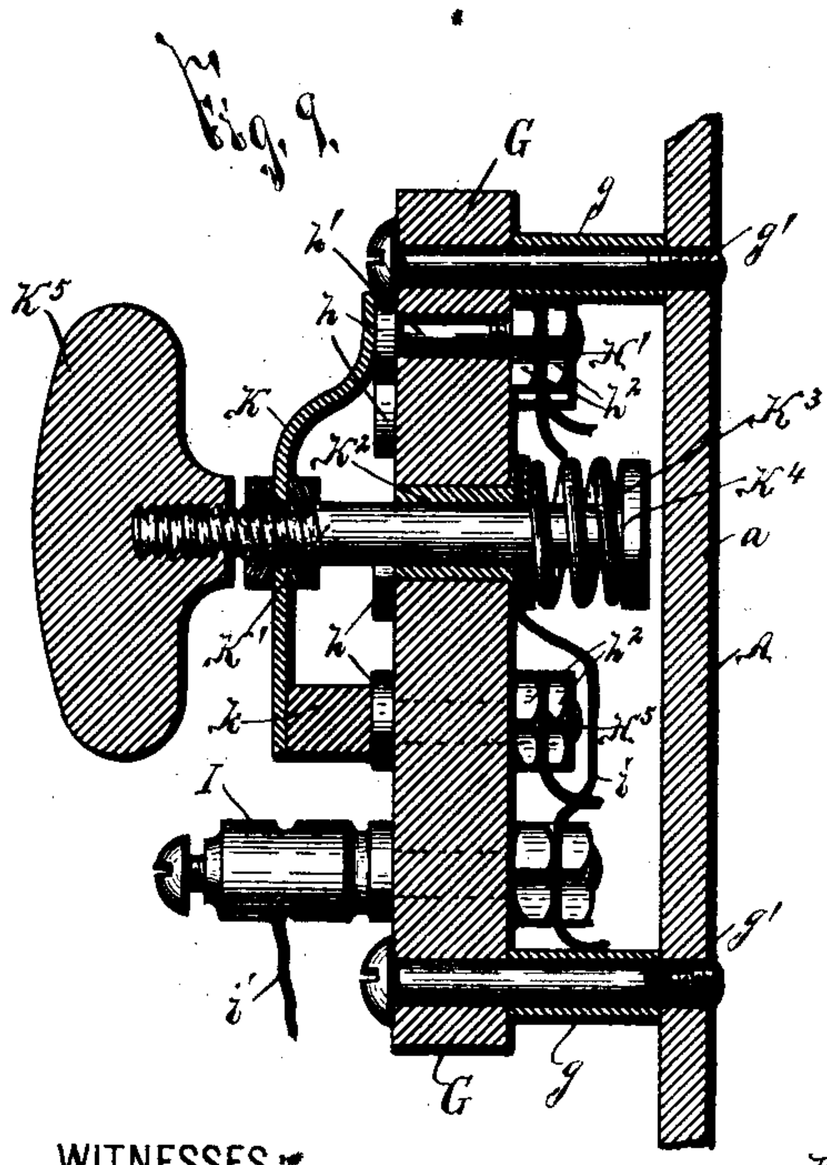


Fig. 10.

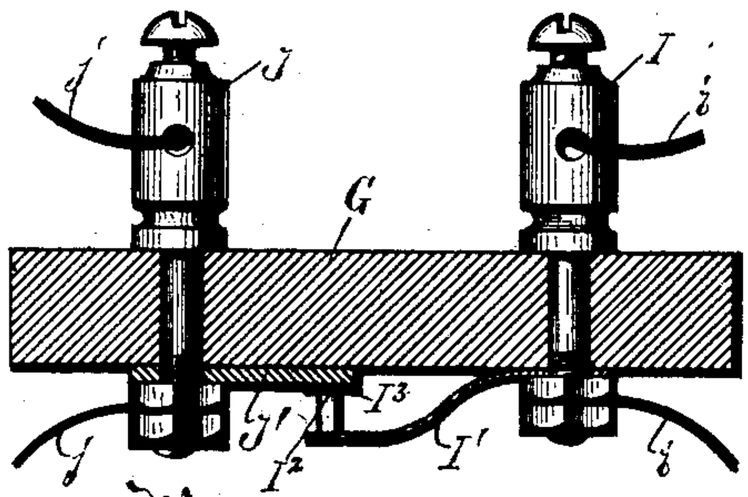
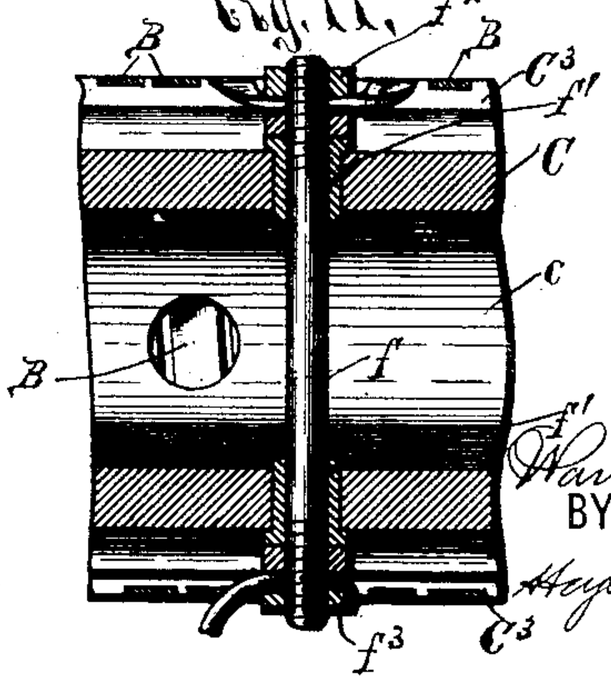


Fig. 11.



WITNESSES:

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UNITED STATES PATENT OFFICE.

WARREN H. BOLES, OF SYRACUSE, ASSIGNOR OF ONE-HALF TO GEORGE E. WALDRON AND JOHN H. REYNOLDS, OF TROY, NEW YORK.

ELECTRIC HEATER.

SPECIFICATION forming part of Letters Patent No. 465,423, dated December 15, 1891.

Application filed March 21, 1891. Serial No. 385,861. (No model.)

To all whom it may concern:

Be it known that I, WARREN H. BOLES, of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Electric Heaters, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

My invention relates to improvements in electric heaters, and has for its object the production of a simple, effective, and highly-efficient device that is adjusted at will to vary the degree of heat, and is of such construction as to produce a circulating current of the air adapted to surround the interior parts of the device for absorbing their generated heat, and then adapted to pass from the heater for transmitting the heat, whereby the greatest possible efficiency is effected and the parts of the heater prevented from injury; and it consists, essentially, in a frame, a heating or resistance coil supported by the frame, a main incoming wire, two or more incoming wires for transmitting the current from the main wire to separate points on the coil, a return-wire, and a switch movable between said wires.

The invention also consists in a perforated core having projecting ribs for supporting the heating or resistance coil, a perforated jacket around the heating-coil, and an outer perforated shell, whereby a circulation of air is caused to surround the working parts of the heater, and thus transmit the heat with the greatest degree of efficiency and prevent undue heating of the coil sufficient to burn the same and destroy its efficiency.

The invention still furthermore consists in a non-conducting plate secured to the frame, a series of posts or contact-pieces arranged in a circle and connected to the separate incoming circuit-wires, a pivoted switch forced against said posts by a spring-pressure, the opposite members of a short-circuit connection between the poles for the return-wire and the main incoming circuit-wire, and an insulator between said members, adapted to be overcome or destroyed should any portion of the heating-coil burn out, and thus cause the electricity to pass from one pole to the other for obviating an open circuit; and it still furthermore consists in the detail construction and arrangement of the parts, all as hereinafter more particularly described, and pointed out in the claims.

In describing this invention reference is had to the accompanying drawings, forming a part of this specification, in which like letters indicate corresponding parts in all the views.

Figures 1 and 2 are respectively end and front elevations of my improved heater, the outer shell being shown at Fig. 2 as partially broken away. Fig. 3 is a transverse vertical sectional view shown on line 3 3, Fig. 2. Fig. 4 is a longitudinal vertical sectional view taken on line 4 4, Fig. 1, the only wire shown being the resistance-coil. Fig. 5 is a similar sectional view to Fig. 4, illustrating the heating-coils and their supports as in elevation and their wires as operatively connected. Fig. 6 is a perspective of the detached perforated core for supporting the heating-coil. Fig. 7 is a detached view illustrating the rear face of the switch-carrying plate and showing in elevation detached portions of the separate coils as operatively connected to the poles on the switch-carrying plate. Fig. 8 illustrates a front view of the switch-carrying plate and an isometric perspective of a modified construction of resistance-coils. Fig. 9 is a sectional view taken on line 9 9, Fig. 8. Fig. 10 is a transverse sectional view taken on line 10 10, Fig. 8; and Fig. 11 is a detail sectional view.

In electric heaters as heretofore devised the heating or resistance coils have been more or less covered by absorbent material, and it has been sought to transmit the heat by radiation from the closed frame inclosing the heating-coils and the various absorbent and radiating materials, such as oil, soapstone, &c. With this construction of heater there is no circulation of air around the resistance-coil. Consequently the wire is heated to an undue degree, since its radiation is limited, and, owing to the increase in resistance occasioned by the heated condition of the wire, greater power is required than would otherwise be the case. Moreover, the wire is injured by the undue heat, and more or less of the absorbent material, as oil, &c., becomes

baked, thereupon further decreasing the radiation of the heat. My invention is radically different from this type of electric heaters, in that a circulation of air developed by the heater is passed through the same and around its various parts and particularly the resistance-coil, thus rendering it as cool as possible, increasing its durability and efficiency, and producing the greatest possible degree of radiation. The supporting-frame A may be of any desirable form, size, and construction, but preferably consists of two standards *a a* and bolts *a' a'* for drawing together the opposite extremities of said standards. The heater proper B is also of desirable form and construction, consisting, preferably, of one or more wire resistance-coils, three being herein illustrated and described. It will be particularly noted that I have shown the wire as flat, and this construction of a resistance-coil of flat wire I regard as an essential part of my invention.

It is well known that a square or rectangular body has more outer or radiating surface in proportion to its cross-sectional area than a round body of equal cross-sectional area. Therefore having in view the urgency of rapid and increased radiation I form the wire thin and wide, thus increasing its radiating-surface to a maximum. Consequently the heat is thrown off more rapidly than would otherwise be the case, the undue heating of the wire is obviated, owing to the ratio of the radiating-surface to the cross-sectional area, and less power is required to produce the same amount of heat because of the rapid radiation.

The heating or resistance coils B are preferably mounted upon a support C, also of desirable form and construction. As illustrated, however, the support C consists of a hollow shell having an internal cavity *c* extending from end to end and perforations *c'* in its top and bottom, whereby a current of air can pass from end to end through the support and also from top to bottom or transversely through the same. The core or support C is held in position by means of a circular flange C', extending from its opposite extremities and adapted to be registered with openings A' in the standards *a a*, whereby the current of air passing through the core passes entirely through the heater. Formed in the periphery of the core are seats C^2 for receiving a bar of slate or other non-conducting material C^3, formed, preferably, with grooves for receiving the wire, as best seen at Fig. 6. These bars or ribs of slate C^3 project beyond the periphery of the support C, and the intervening portion of the periphery of said support is concaved, in order that the air may circulate on all sides of the wire, except the small portion resting upon said bars C^3, and thus cause the heat to be radiated with the greatest possible rapidity.

Surrounding the heating-coils are tubular shells D, the opposite ends of which are supported on angular projections A^2, extending inwardly from the inner sides of the standards *a a*. These shells are also preferably perforated in order to permit of an upward current of air through my improved heater. On the outside of the shells D is the outer casing E, having its opposite ends supported on projections *e* on the standard *a a* and its upper portion provided with a series of perforations. It will thus be seen that the air is drawn from beneath the end of the outer casing E, passes vertically through the cores C and casings D, around the heating-coils B, and outwardly through the top and ends of the outer casing.

The extreme simplicity of the described construction of the parts is evident, the standards *a a* and the core C are readily cast of the desired form without the necessity of fitting, the slate or non-conducting bars C^3 are then placed in position and formed with the grooves for receiving the wire, which is then wound upon the cores, the shells D and the outer casing E are formed from sheet metal, and the aforesaid parts are assembled and retained in operative position by the bolts *a' a'*. It is thus obvious that should any of the coils become burned out or worn, so as to prevent development of an efficient degree of heat, the bolts may be loosened and the said coil readily removed and replaced, whereupon the heater is brought to its operative position with great ease and without the necessity of skilled labor. It is evident, however, that, if desired, the outer shells D may be entirely dispensed with, and that the arrangement of the perforations in the various parts of the invention may be also changed at will.

For the purpose of enabling adjustment of the heater, in order that the degree of heat produced may be varied at will to suit requirement, I provide for each coil two or more incoming circuit-wires F^2, F^3, F^4, F^5, F^6, F^7, F^8, and F^9, connected thereto at separate points, as best seen at Figs. 5, 7, and 8. The inner ends of these wires may be secured directly to the resistance-coils, as shown at Fig. 8, but are preferably mounted upon posts *f*, secured to the supports C and adapted to support the ends of the coils B, as shown in Fig. 7. The preferable form of post consists of a bar passed through the supports C, with its opposite ends mounted in insulators *f'* for preventing direct contact with the wall of the support C.

Clamps f^2 and f^3 secure, respectively, the resistance-coils and the incoming circuit-wires to the posts *f*, and I thereby produce a simple, cheap, and practical connection between said wires.

G represents a support, preferably of slate or other non-conducting material, for the free ends of said incoming circuit-wires. This support G is preferably separated from the adjacent wall of the shell by means of sleeves or tubes *g*, and is held in position by screws

g', passing through said support, sleeves g, and standard a.

H′, H², H³, H⁴, H⁵, H⁶, and H⁷ represent the posts or contact-points, to which are secured the free ends of the separate incoming circuit-wires F², F³, F⁵, F⁶, F⁸, and F⁹ and the like end of the return-wire F′. These posts or contact-pieces consist of a shoulder h on the outer face of said support, a spindle h', passed through the support, and a pair of clamping-nuts h^2, between which the end of the wire is held.

I and J represent, respectively, the positive and negative poles, to the outer ends of which are respectively secured the main incoming circuit-wire i and the return circuit-wire j.

K represents a switch movable between the poles H′, H², H³, H⁴, H⁵, H⁶, and H⁷ for throwing in circuit the required amount of the resistance-coils for producing the desired heat. This switch preferably consists of a revoluble plate secured to a spindle K′ and formed with one extremity adapted to rest upon said contact pieces or shoulders h, and the other provided with an insulator k, also adapted to rest upon the shoulders h, and thus prevent cramping of said finger. The spindle K′ passes through a bushing K², inserted in the plate G, and is constantly drawn inward to make a close contact of the switch K and the shoulder h by means of a spring K³, interposed between the adjacent faces of the sleeve K², and a shoulder K⁴, provided on the inner end of said spindle.

A knob of non-conducting material K⁵ is provided on the outer end of the spindle K′ for enabling the attendant to shift the switch with impunity.

As best seen at Figs. 7 and 9, the wire i passes from the positive pole to the sleeve K², and the wire j from the post J to the post H′. Consequently when the end of the switch unprovided with the insulator is in direct contact with the contact-piece H′ the current is not passed through the heater, but merely through the poles I and J and the wires i and j. When the switch is shifted to the contact-piece H², the current passes through the wire F² and one-half of the upper heating-coil is thrown into action. Upon shifting the switch to the contact-piece H³ the entire upper coil is thrown in action, and upon then shifting the same to the contact-piece H⁴ the entire upper coil and half of the next lower coil are thrown into action. It is thus evident that my improved heater may be regulated at will to vary the amount of heat generated by means of the switch K, which varies the amount of surface to which the electricity is conducted. This is an essential feature of my invention and adds greatly to the practicability of my improved heater.

Should one of the coils become injured or burned out, it is extremely desirable that the electric current may be automatically short-circuited without passing through the injured or inoperative coil. Accordingly I provide between the poles I and J the opposite members I′ and J′ of a short circuit. One of these members I′ is forced toward the other with a spring-pressure, being preferably composed of a spring, and formed with a contact-face I², between which and the adjacent face of the member J′ is a small piece of tissue-paper I³, or other non-conducting material of a resistance sufficiently weak to be readily overcome by the current of electricity, which is necessarily forced through the short-circuit member I′, when one of the coils is burned out and unable to transmit the electricity.

The operation of my electric heater will be readily perceived from the foregoing description and upon reference to the drawings, and it will be particularly noted that the same is extremely practical, can be cheaply manufactured, readily assembled and repaired; that the liability of the coils becoming burned or oxidized is reduced to a minimum, owing to the presence of a constantly-circulating current of air whenever the heater is in operation, whereby the heater is rendered extremely effective, since the entire amount of heat is conducted from the heater without the necessity of indirect radiation, and that the amount of heat generated can be regulated at will by the attendant, and upon damage to any of the coils the electric current is automatically passed through a short circuit without transmission to the heating-coils of the heater. It is evident, however, that the detail construction and arrangement of my heater may be somewhat changed from that shown and described without departing from the spirit of my invention. Hence I do not limit myself to the precise detail construction of the parts of my heater.

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

1. In an electric heater, the combination of a tube having a solid peripheral wall formed with perforations therethrough and a resistance-conductor wound spirally around said tube, substantially as and for the purpose specified.

2. In an electric heater, the combination of a tube having a solid peripheral wall formed with perforations therethrough, a resistance-conductor wound spirally around said tube, two or more positive or incoming circuit wires connected to different points on said coil, a return-wire, and a switch for registering with the positive wires, substantially as described.

3. In an electric heater, the combination of a tube having a solid peripheral wall formed with perforations therethrough, projecting bearings on the periphery of said tube, and a resistance-conductor wound spirally around said tube, substantially as set forth.

4. In an electric heater, the combination of a metallic cylinder having seats, insulator-ribs mounted in said seats and projecting from the peripheral wall of the cylinder, spirally-arranged seats on the ribs, and a resist-

ance-conductor spirally wound around said tube and supported in the seats of the insulator-ribs, substantially as and for the purpose set forth.

5. In an electric heater, the combination of a cylinder having lengthwise grooves in its peripheral wall, insulator-ribs seated in said grooves, and a resistance-coil wound spirally around said tube, substantially as and for the purpose described.

6. In an electric heater, the combination of a tube having a solid peripheral wall formed with perforations therethrough, longitudinal grooves in the peripheral wall of the tube, insulator-ribs seated in said grooves, and a resistance-coil wound spirally around said tube, substantially as and for the purpose set forth.

7. In an electric heater, the combination of a cylinder, longitudinal grooves in the outer peripheral wall of the cylinder, a concavity in said peripheral wall between the walls of two adjacent grooves, insulator-ribs seated in said grooves, and a coil wound spirally around said tube, substantially as and for the purpose specified.

8. In an electric heater, the combination of a cylinder, longitudinal grooves in the outer peripheral wall of the cylinder, a concavity in said peripheral wall between the walls of two adjacent grooves, insulator-ribs seated in said grooves, a coil wound spirally around said tube, and perforations between two adjacent grooves for permitting circulation of the air, substantially as set forth.

9. In an electric heater, the combination of a metallic tube having openings at one extremity, longitudinal grooves in the peripheral wall of the tube, insulator-ribs mounted in said grooves, a concavity in said peripheral wall between the walls of two adjacent grooves, alternate perforations between two adjacent grooves, and a coil wound spirally around said tube, substantially as and for the purpose specified.

10. In an electric heater, the combination of a cylinder having lengthwise grooves in its peripheral wall, insulator-ribs seated in said grooves, a resistance-coil wound spirally around said tube, two or more positive or incoming circuit-wires connected to different points on said coil, a return-wire, and a switch for registering with the positive wires, substantially as described.

11. In an electric heater, the combination of a tube having a solid peripheral wall formed with perforations therethrough, insulator-ribs seated on said wall, a resistance-conductor spirally wound around the tube upon said insulator-ribs, and an outer perforated shell on the outside of the conductor, substantially as described.

12. In an electric heater, the combination of a tube having a solid peripheral wall formed with perforations therethrough, a resistance-conductor wound spirally around said tube, and an outer shell consisting of a plate having its extremities folded upon each other in a U-shaped form, with an opening between the two extremities of said plate, and perforations in the central part of the plate, substantially as set forth.

13. In an electric heater, the combination of a perforated core, a heating or resistance coil wound upon said core, an outer shell around the heating-coil, and an outer perforated shell on the outside of said former shell for effecting a circulation therethrough, substantially as specified.

14. In an electric heater, the combination of a pair of standards, a core having its opposite extremities supported by the standards and its peripheral wall provided with perforations for permitting passage of the air, and a resistance-conductor wound spirally around said core, substantially as and for the purpose set forth.

15. In an electric heater, the combination of a pair of uprights having seats in their adjacent sides, a core having perforations through its peripheral wall and having its opposite extremities provided with projections mounted in said seats, and a resistance-conductor wound spirally around said core, and an outer shell on the outside side of said conductor, having its opposite extremities supported by said uprights, substantially as and for the purpose described.

16. In an electric heater, the combination of a pair of standards, a core having its opposite extremities supported by said standards, a resistance-coil wound around said core, and an outer case between said standards, having perforations for permitting the circulation of air, substantially as specified.

17. In an electric heater, the combination of a pair of standards having openings therethrough, a hollow core having its opposite extremities supported by said standards and registered with said openings, and a heating or resistance coil wound around said core, substantially as described.

18. In an electric heater, the combination of a pair of standards having openings therethrough, a hollow core having its opposite extremities supported by said standards and registered with said openings, a heating or resistance coil wound around said core, and an outer case between said standards, having perforations for permitting the circulation of air, substantially as and for the purpose specified.

19. In an electric heater, the combination of a pair of standards, a core having its opposite extremities supported by said standards, a resistance-coil wound around said core, a perforated shell surrounding said coil, and an outer shell surrounding the perforated shell, substantially as specified.

20. In an electric heater, the combination, with a pair of upright standards and clamps for drawing said standards together, of a core having its peripheral wall provided with perforations and its opposite extremities supported by said standards, insulator-ribs mounted

on the core, and a resistance-coil wound around said core upon said ribs, substantially as specified.

21. In an electric heater, the combination, with a pair of upright standards and clamps for drawing said standards together, of a core having its peripheral wall provided with perforations and its opposite extremities supported by said standards, insulator-ribs mounted on the core, a resistance-coil wound around said core upon said ribs, an outer shell on the outside of said coil, a plate secured to said frame, incoming circuit-wires connected at separate points to said coil and supported at separate points on the plate, and a switch adapted to register with said coils, substantially as set forth.

22. In an electric heater, the combination of a frame, a supporting-cylinder mounted on said frame, a resistance-coil wound spirally around the cylinder, a plate secured to said frame, incoming circuit-wires connected at separate points to said coil and supported at separate points on said plate, and a switch adapted to register with said coils, substantially as and for the purpose specified.

23. In an electric heater, the combination of a pair of upright standards, bolts for drawing the standards together, seats on the inner sides of the standards, a core having its opposite extremities supported by the seats, a resistance-coil wound spirally around the core, an outer shell surrounding the coil, and projections on the standards for supporting the opposite extremities of said outer shell, substantially as and for the purpose specified.

24. In an electric heater, the combination of a pair of standards, a hollow core supported by the standards and having perforations through its peripheral wall for permitting passage of the air, raised ribs on the core, and a resistance-coil wound spirally around said core and seated on said ribs, substantially as set forth.

25. In an electric heater, the combination of an upright supporting-frame, a horizontal cylinder supported by said frame, a heating or resistance coil, a return circuit-wire wound around the cylinder, incoming circuit-wires connected to separate points of said coil, a non-conductor plate secured to the frame, posts for the outer ends of said wires, a main incoming circuit-wire, and a switch pivoted to said plate with one extremity connected to the main incoming circuit-wire and the other adapted to be connected to the separate incoming circuit-wires, substantially as and for the purpose set forth.

26. In an electric heater, the combination of an upright supporting-frame, a horizontal cylinder supported by said frame, a heating or resistance coil, a return circuit-wire wound around the cylinder, incoming circuit-wires connected to separate points of said coil, an upright non-conductor plate, posts for the outer ends of said wires, a main-circuit wire, and a switch pivoted to said plate with one extremity connected to the main incoming circuit-wire and the other adapted to be connected to the separate incoming circuit-wires, and a spring mounted on the inner end of the finger pivotal pin for drawing said switch into position, substantially as and for the purpose described.

27. In an electric heater, the combination of a supporting-frame, a heating or resistance coil or coils, separate incoming circuit-wires connected to separate points of said coil, a non-conductor plate supported by the frame, posts arranged in a circle on said plate and extending through the same, clamps on their inner extremities for the inner ends of the incoming circuit-wires, a main incoming circuit-wire and a return-wire, a spindle movable in the plate, a switch-lever secured to the outer extremity of said spindle, with its opposite extremities projecting therefrom and adapted to be registered with the separate posts, an insulator on one extremity of the switch, and a spring mounted on the inner end of the spindle for forcing the switch-lever toward the posts, substantially as set forth.

28. In an electric heater, the combination of a frame, a core removably secured to the frame, a heating or resistance coil or coils wound around the core, separate incoming circuit-wires connected to said coil, a return circuit-wire and a main incoming circuit-wire, a movable switch adapted to complete the circuit between said wires, the opposite members of a short-circuit connection between the return and the main incoming circuit-wires, and an insulator between the opposite members of said short circuit, adapted to automatically permit the passage of the electric current through said members when a portion of the coil is burned out or inoperative, substantially as and for the purpose set forth.

29. In an electric heater, the combination of a tube having a solid peripheral wall formed with perforations therethrough, and a resistance-conductor consisting of a wire, of greater width than thickness, spirally wound around said tube, substantially as and for the purpose specified.

30. In an electric heater, the combination of a tube having a solid peripheral wall formed with perforations therethrough, a resistance-conductor consisting of a wire, of greater width than thickness, spirally wound around said tube, an outer perforated shell on the outside of said resistance-conductor, two or more positive or incoming circuit-wires connected to different points on said conductor, a return-wire, and a switch for registering with the positive wire, substantially as set forth.

31. In an electric heater, the combination of a tube having a peripheral wall formed with perforations therethrough, a pin or bar extending through an aperture in the core, shoulders on the opposite ends of the pin or bar for engaging opposite points on the pe-

riphery of the core, a resistance-conductor spirally wound upon the core, a clamp for securing one end of said conductor to one end of the pin or bar, a second wire, and a clamp for securing the latter wire to the opposite end of said pin or bar, substantially as and for the purpose set forth.

32. In an electric heater, the combination of a cylindrical core having an aperture, a resistance-coil spirally wound upon the core, a pin or bar mounted in the aperture in the core, a shoulder on the pin for engaging with the core, and clamps for securing the wire to said pin or bar, substantially as and for the purpose described.

In testimony whereof I have hereunto signed my name, in the presence of two attesting witnesses, at Syracuse, in the county of Onondaga, in the State of New York, this 12th day of March, 1891.

WARREN H. BOLES.

Witnesses:

CLARK H. NORTON,

L. M. BAXTER.