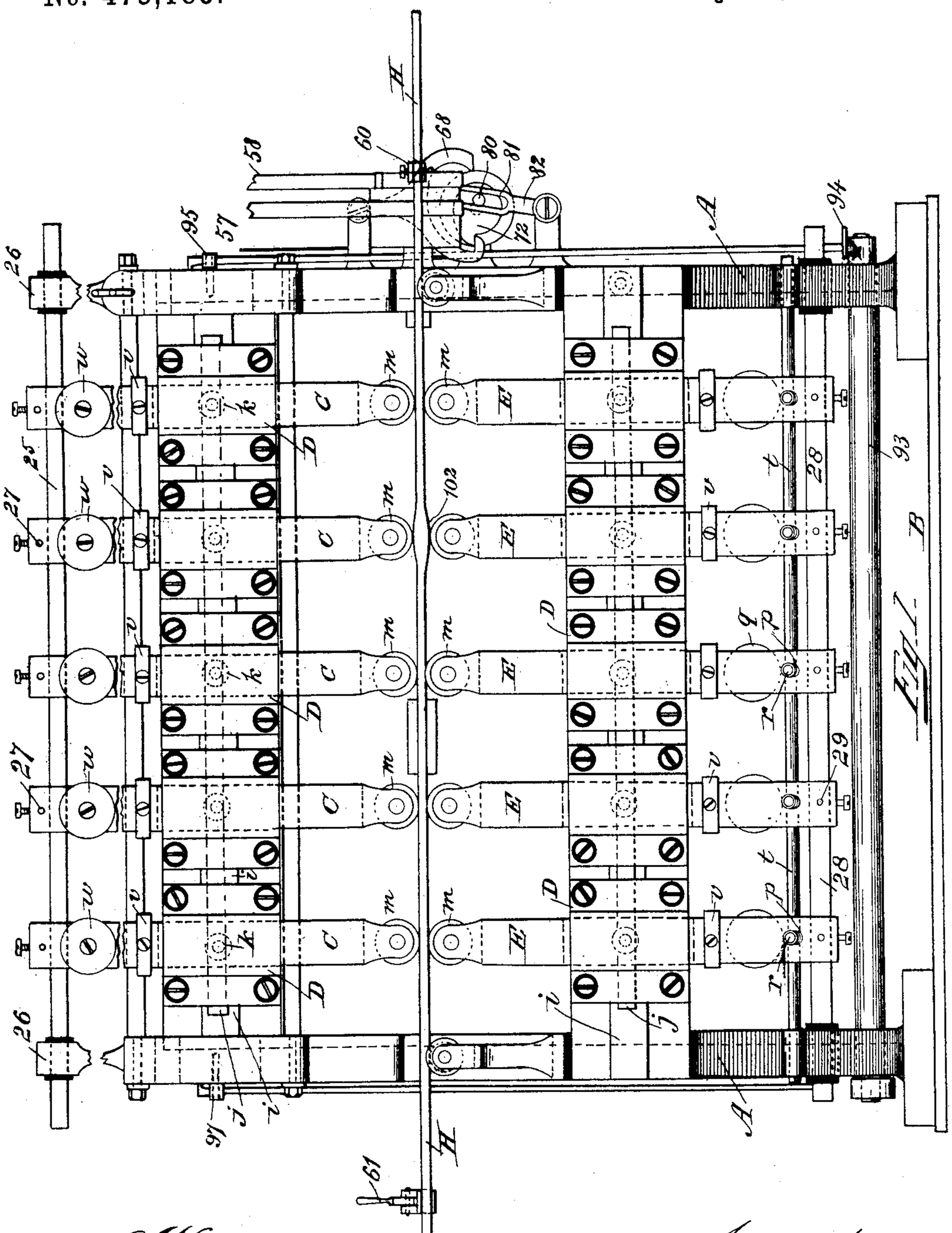
(No Model.) 6 Sheets—Sheet 1.

G. D. BURTON & E. E. ANGELL.

ELECTRIC METAL HEATER.

No. 475,185. Patented May 17, 1892.



Witnesses.
C. Weed.
L. M. Burdett

Inventors.
Geo. D. Burton
Edwin E. Angell
By F. B. Somes Attorney.

(No Model.) 6 Sheets—Sheet 2.

G. D. BURTON & E. E. ANGELL.

ELECTRIC METAL HEATER.

No. 475,185. Patented May 17, 1892.

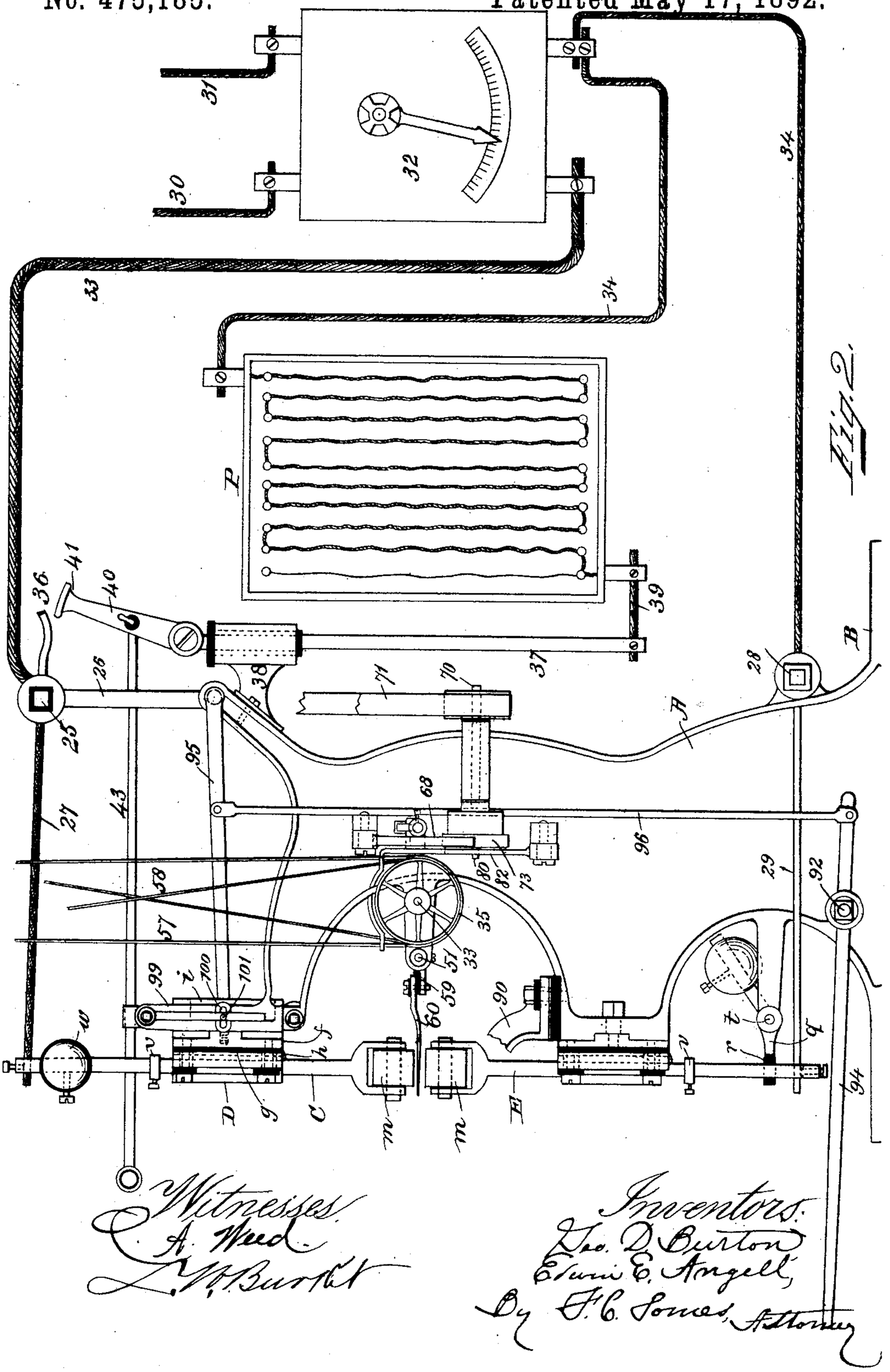


Fig. 2.

Witnesses:
A. Weed.
L. V. Burdett

Inventors:
Geo. D. Burton
Ernest E. Angell,
By F. C. Somes, Attorney

(No Model.) 6 Sheets—Sheet 3.

G. D. BURTON & E. E. ANGELL.

ELECTRIC METAL HEATER.

No. 475,185. Patented May 17, 1892.

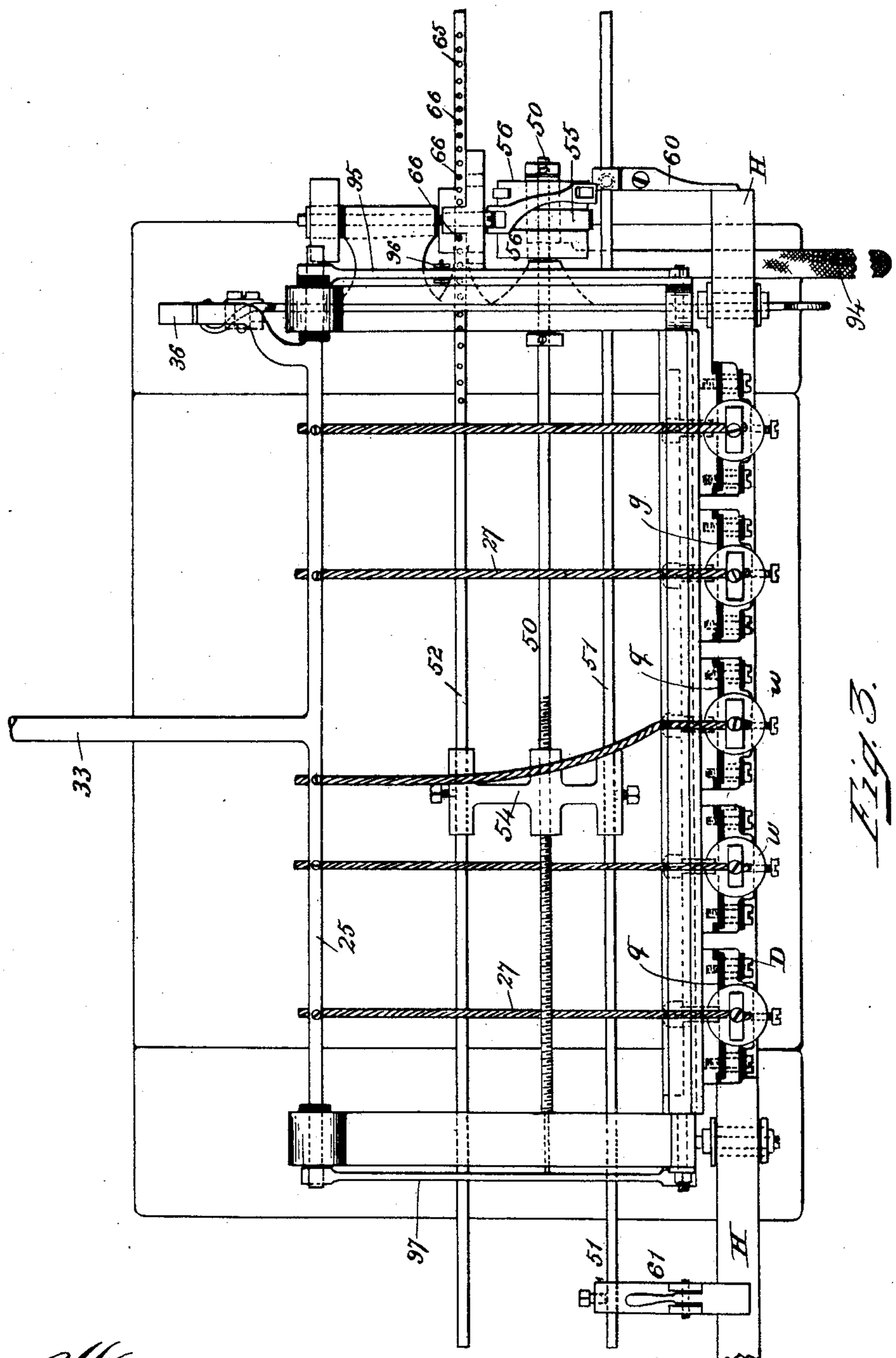


Fig. 3.

Witnesses:
L. A. Weed
L. F. Burdett

Inventors:
Geo. D. Burton
Edwin E. Angell,
By F. C. Somes Attorney

(No Model.) 6 Sheets—Sheet 4.

G. D. BURTON & E. E. ANGELL.

ELECTRIC METAL HEATER.

No. 475,185. Patented May 17, 1892.

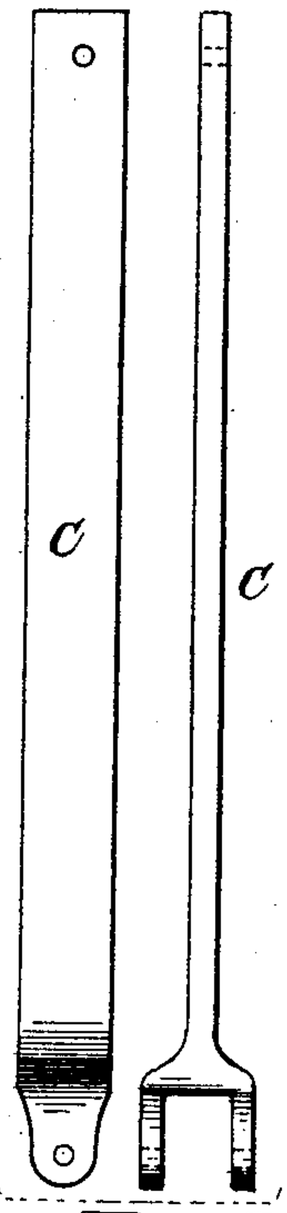


Fig. 4.

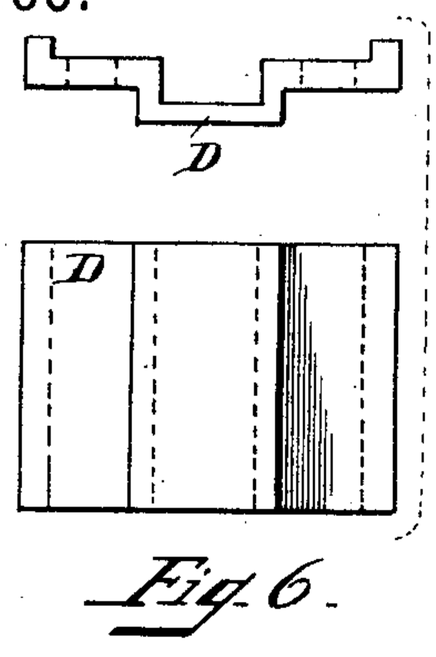


Fig. 6.

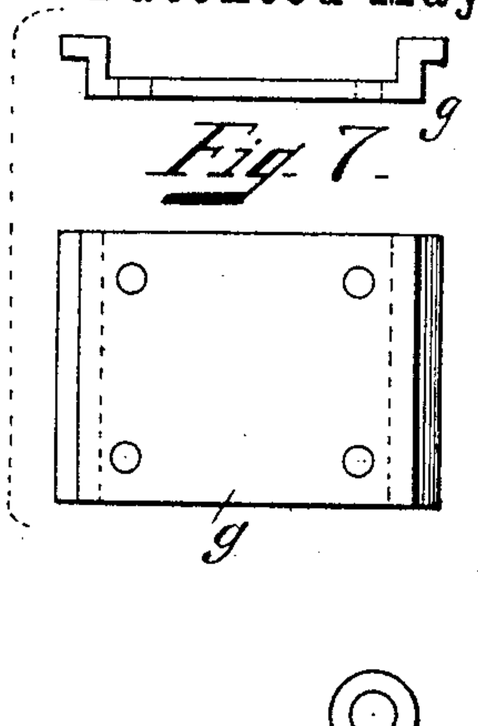


Fig. 7.

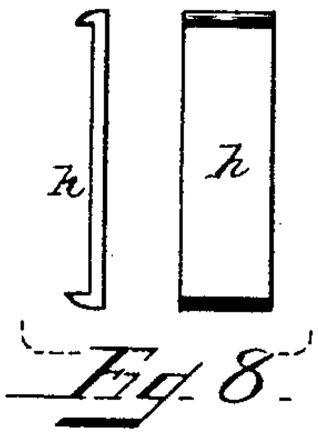


Fig. 8.

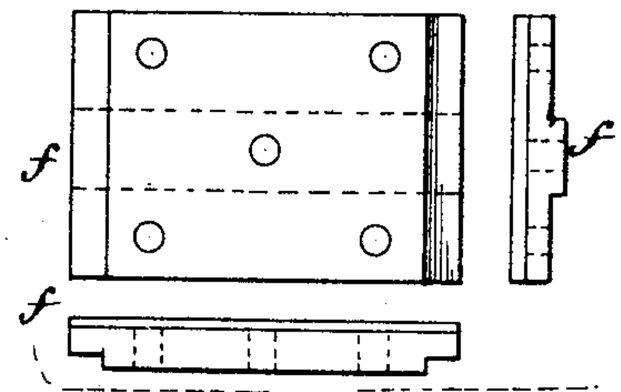


Fig. 9.

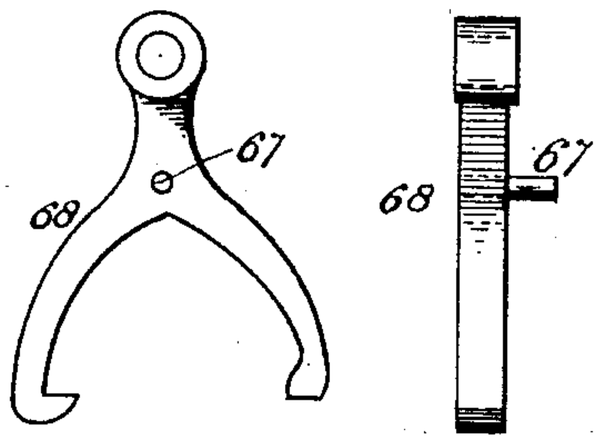


Fig. 14.

Fig. 5.

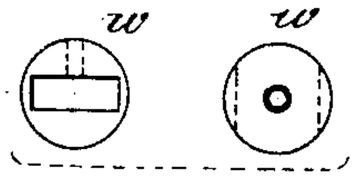


Fig. 10.

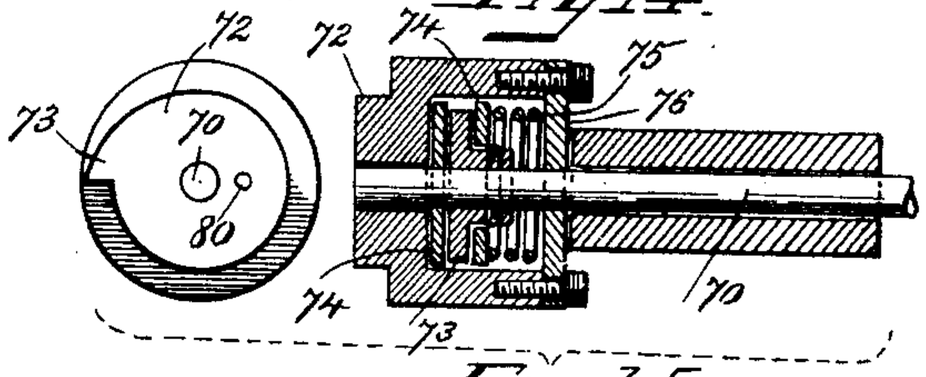


Fig. 15.

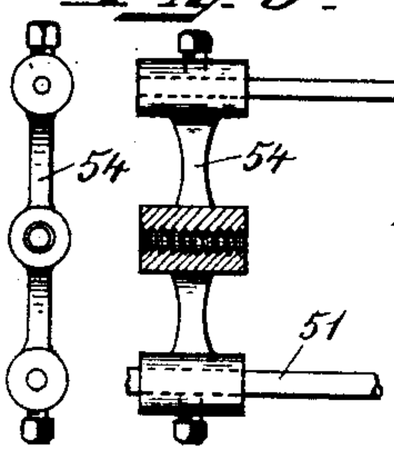


Fig. 11.

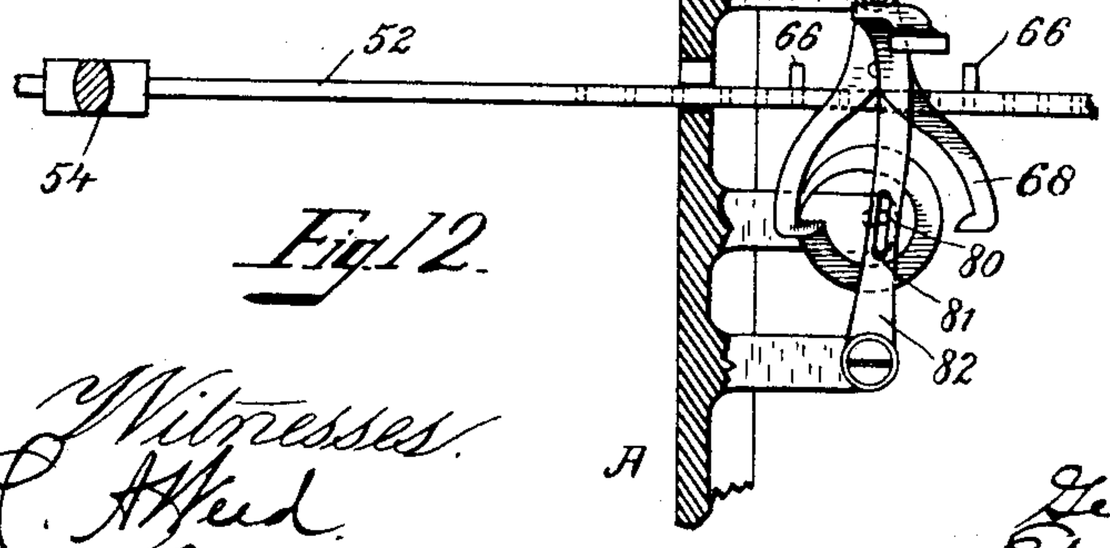


Fig. 12.

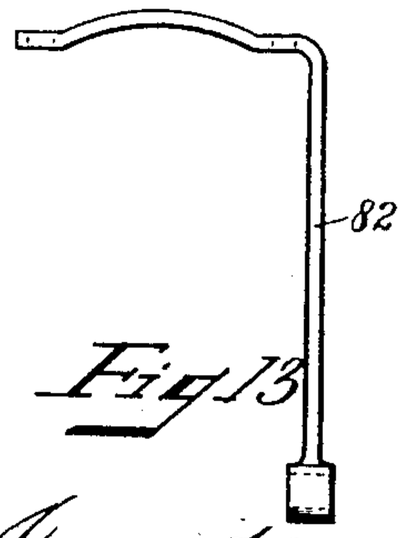


Fig. 13.

Witnesses.
A. Ford.
L. P. Burke.

Inventors:
Geo. D. Burton
Edwin E. Angell,
By F. B. Somes,
Attorney.

(No Model.) 6 Sheets—Sheet 5.

G. D. BURTON & E. E. ANGELL.

ELECTRIC METAL HEATER.

No. 475,185. Patented May 17, 1892.

Fig. 16.

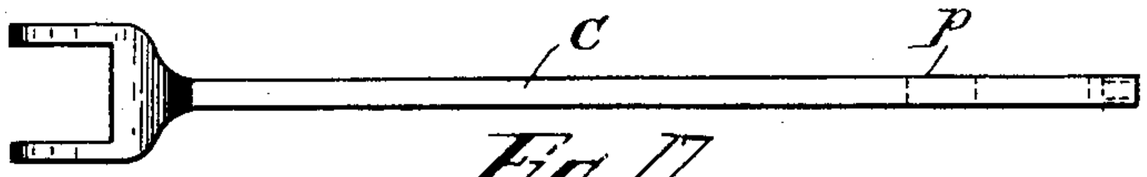


Fig. 17.

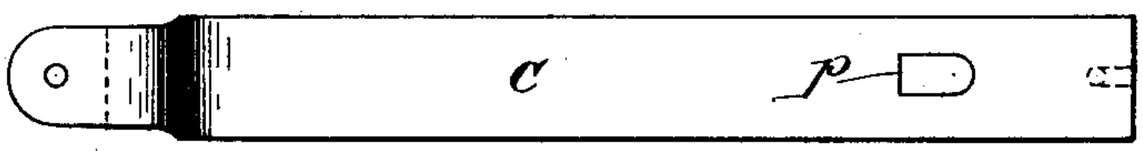
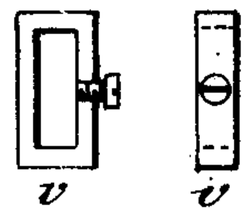


Fig. 18.



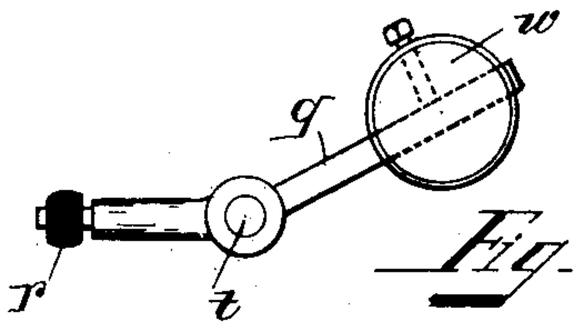


Fig. 19.

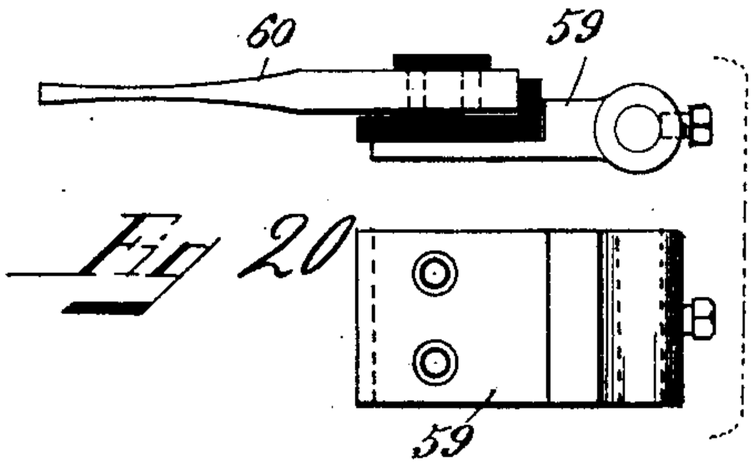


Fig. 20.

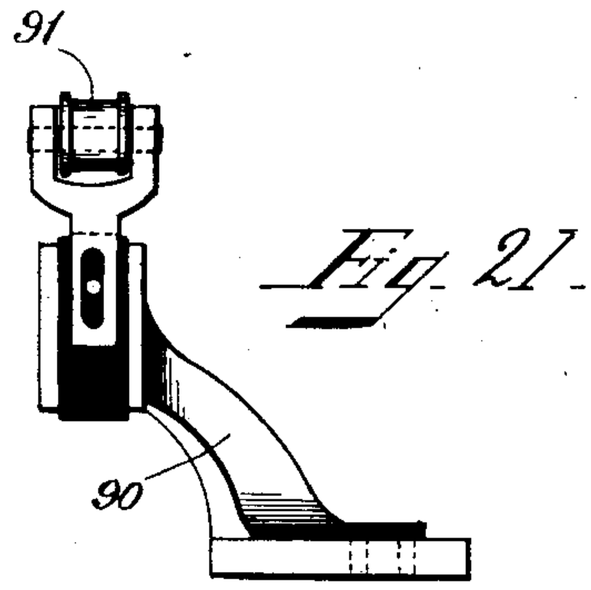


Fig. 21.

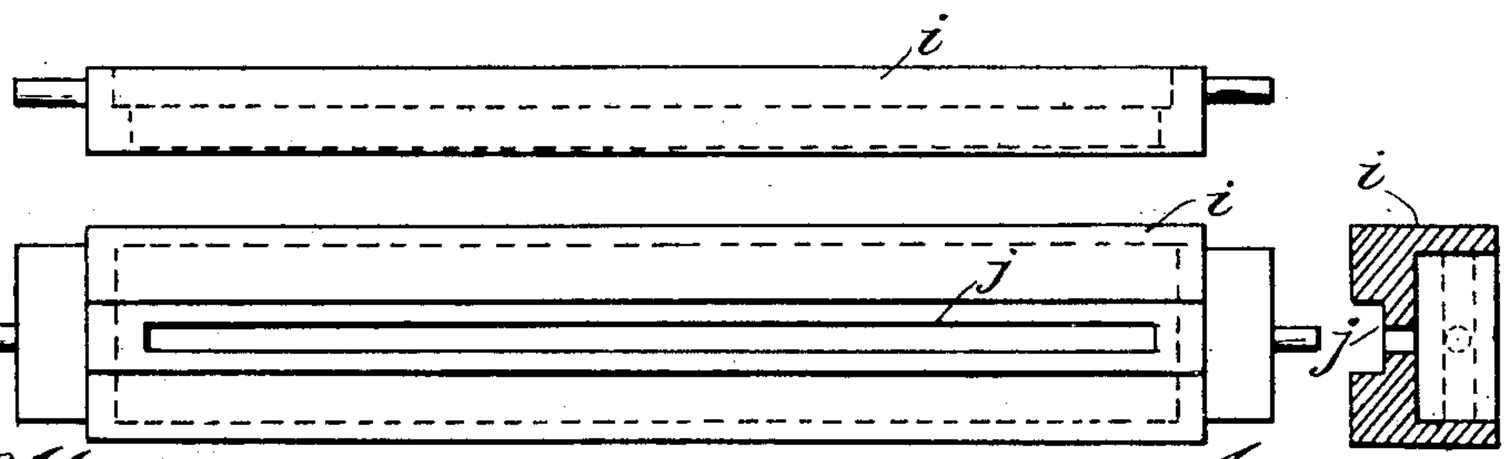


Fig. 22.

Witnesses:
A. Weed.
L. P. Burket

Inventors:
Geo. D. Burton
Edwin E. Angell
By F. G. Jones, Attorney

(No Model.) 6 Sheets—Sheet 6.

G. D. BURTON & E. E. ANGELL.

ELECTRIC METAL HEATER.

No. 475,185. Patented May 17, 1892.

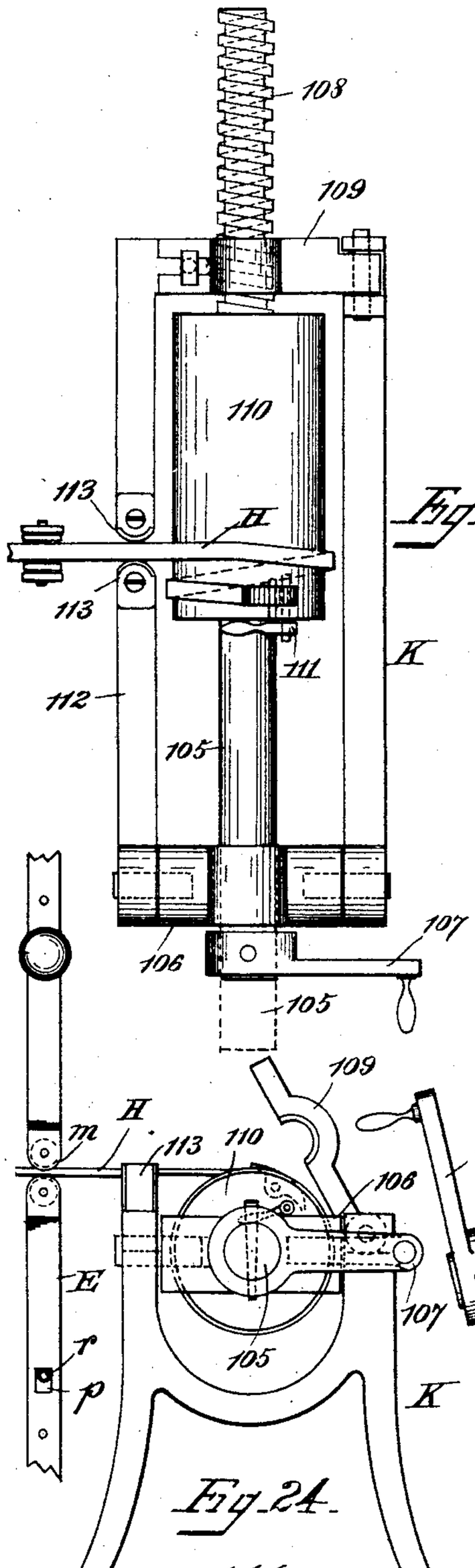


Fig. 23.

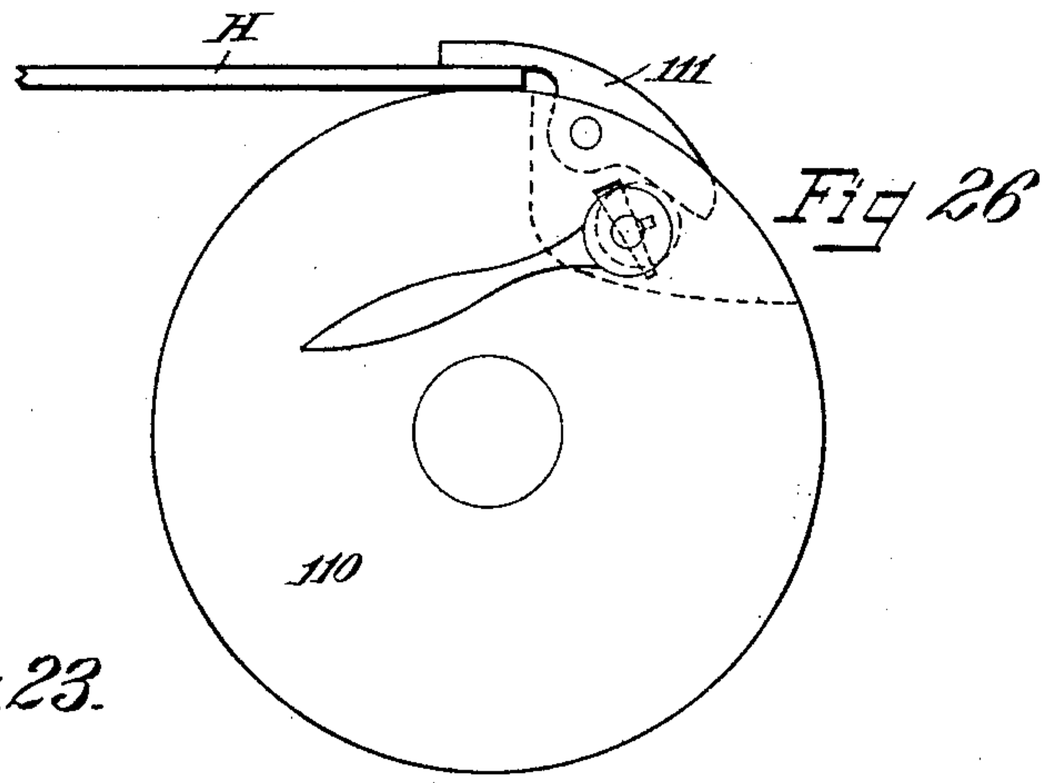


Fig 26

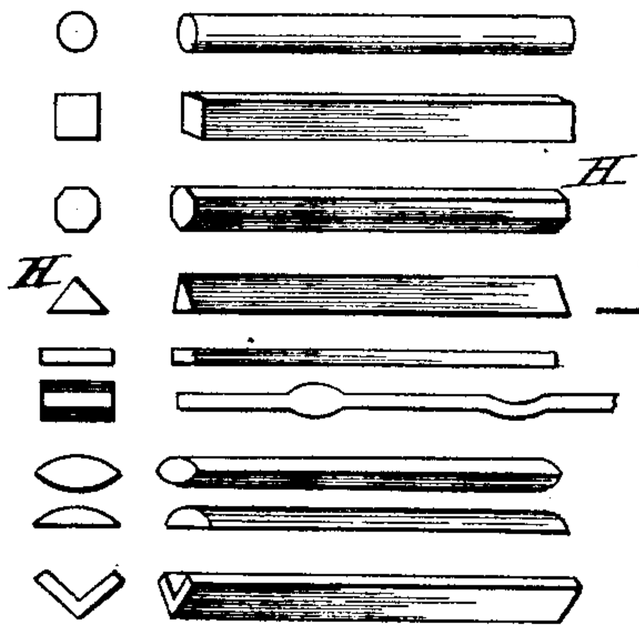


Fig. 27.

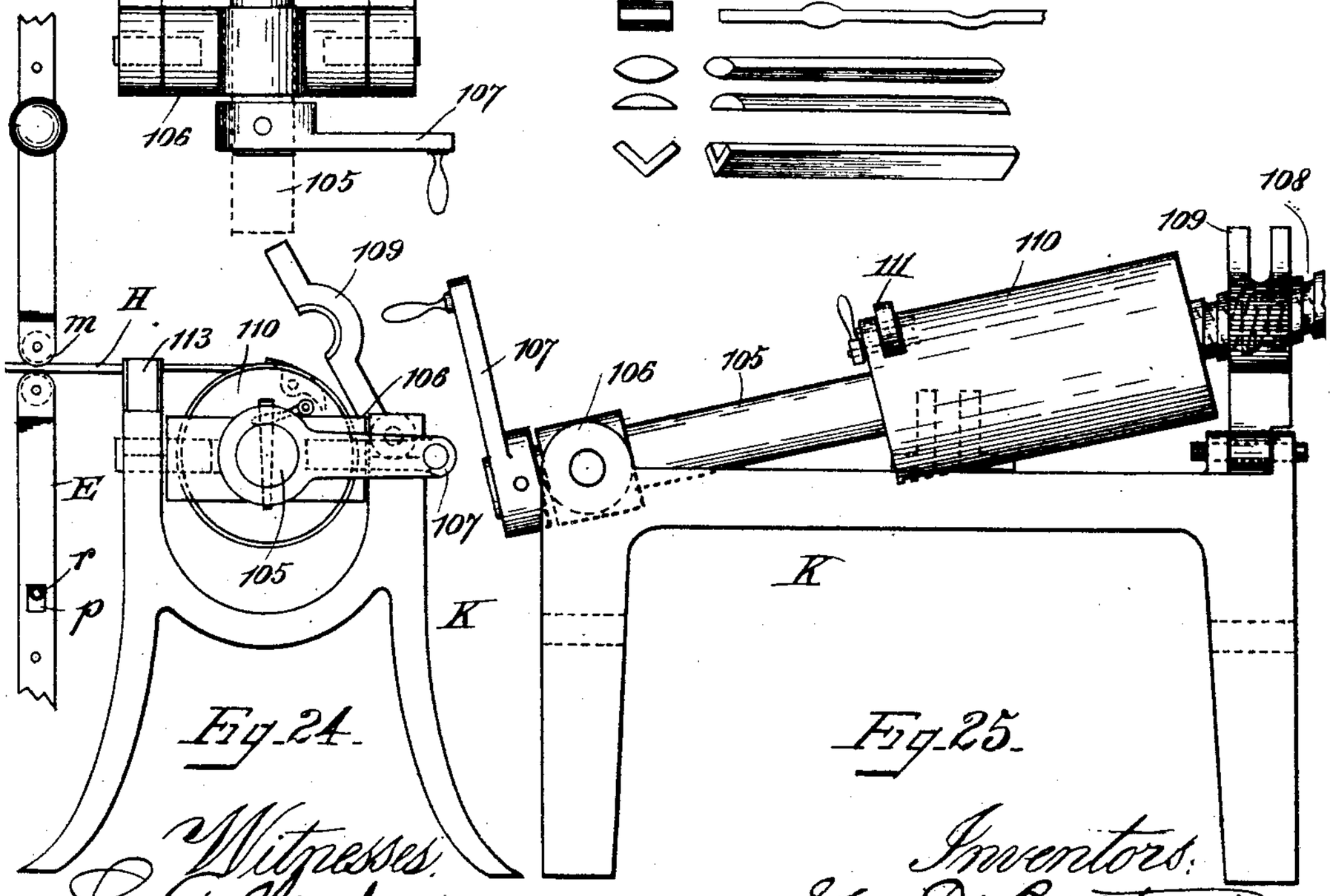


Fig. 24.

Fig. 25.

Witnesses.
C. A. Weed
L. Burdett

Inventors.
Geo. D. Burton
Edwin E. Angell,
By F. B. Lowes, Attorney

UNITED STATES PATENT OFFICE.

GEORGE D. BURTON, OF BOSTON, AND EDWIN E. ANGELL, OF SOMERVILLE, MASSACHUSETTS, ASSIGNORS TO THE ELECTRICAL FORGING COMPANY, OF MAINE.

ELECTRIC METAL-HEATER.

SPECIFICATION forming part of Letters Patent No. 475,185, dated May 17, 1892.

Application filed February 14, 1891. Serial No. 382,127. (No model.)

To all whom it may concern:

Be it known that we, GEORGE D. BURTON, of Boston, in the county of Suffolk, and EDWIN E. ANGELL, of Somerville, in the county of Middlesex, State of Massachusetts, have invented certain new and useful Improvements in Machines for Heating Metal by Electricity, of which the following is a description sufficiently full, clear, and exact to enable any person skilled in the art or science to which said invention appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a front elevation of our improved machine; Fig. 2, an end elevation of the same, showing the resistance and switch-boxes; Fig. 3, a top plan view; Fig. 4, elevations of the electrode-arms; Fig. 5, views of the platinum rolls mounted in said arms; Fig. 6, elevations of the supporting-casting for the electrodes; Fig. 7, elevations showing insulating-plates for said castings; Fig. 8, like views of metallic gibs or wear-plates for the electrodes; Fig. 9, elevations of the companion electrode-supporting castings secured to those shown in Fig. 6; Fig. 10, elevations of the counterbalance of weights attached to the electrode-arms; Fig. 11, a top plan view of the feed mechanism; Fig. 12, a face view of the same; Fig. 13, an end view of the belt-shipper; Fig. 14, the frictional stopping-pallet shown in face and edge elevations; Fig. 15, the friction-clutch shown in longitudinal section and the stop-cam shown in end elevation; Fig. 16, an elevation, partly broken away, of the screw-shaft; Fig. 17, edge and face views of the lower electrode-arms, showing lever-slot; Fig. 18, like views of stop-collar for electrode-arms; Fig. 19, an elevation of the weighted lifting-lever of the lower electrode-arms; Fig. 20, edge and face views of the insulated feed-finger and carrying-piece; Fig. 21, an elevation of the roll-support for the heating metal; Fig. 22, edge, face, and sectional views of the support for the upper electrode-arm holder; Figs. 23, 24, and 25, respectively, a top plan view and end and side elevation of the winding-drum, support, and actuating mechanism for forming the metal into car-springs or springs for other uses, as described, from the heater; Fig. 26, an end elevation of the drum, showing the clamp; and Fig. 27 end and side views showing various forms of metallic bars which the machine is adapted to heat.

Like letters and figures of reference indicate corresponding parts in the different figures of the drawings.

Our invention relates especially to a machine for heating metallic bodies of any shape or size or heating determined points thereof by electricity; and it consists in certain novel features hereinafter fully set forth and claimed, the object being to produce a simple and effective device of this character.

The nature and operation of the improvement will be readily understood by all conversant with such matters from the following explanation.

In the drawings, A A represent the end frames or standards of the machine, which are mounted on a base B. A series of vertically-arranged electrode-arms C (see Figs. 1 and 4) are mounted to slide in angular castings D, (see Fig. 6,) secured to castings *f*, Figs. 9 and 2. These castings are insulated by hard-rubber pieces *g*. (See Fig. 7.) Gibs *h* (see Fig. 8) are disposed at the back of the electrode-arms to prevent them from wearing into the rubber insulator. A supporting-bar *i* is secured in the standards and is slotted longitudinally at *j*. Screws *k* pass through said slot into the castings *f*, whereby the electrode-arms are rendered laterally adjustable. Each arm C is forked at its lower end and a conductive roll *m* of a shape suitable to conform to the shape of the bar or rod to be heated is journaled in said fork. The lower electrode-arms E are of like construction. The several pairs, whether the electrodes of each pair be or be not in alignment, are disposed in succession or one in advance of the other, so that the bar or metal to be heated may be in contact with two or more pairs of electrodes at the same time with the upper electrodes C being mounted in similar castings and provided with conductive rolls *m*. These lower electrodes are paired with the upper electrodes and preferably arranged in alignment, respectively, with the upper arms and are provided with slots *p*. (See Fig. 17.) Weighted levers *q*, (see Fig. 19,) provided with an insu-

lated arm *r*, which projects into the electrode-slots *p*, are pivoted on a rod *t*, mounted in the frame. Said levers tend to hold the lower electrode-rolls *m* in engagement with the rod H being heated. Stop-collars *v* are adjustably mounted on the electrode-arms C E to determine their vertical movements. Ball-castings *w* (see Fig. 10) are mounted on each upper arm C to weight them and force their rolls *m* firmly against the rod H.

An electrical distributing-rod 25 is mounted in arms 26 (see Fig. 3) at the rear of the standards and insulated therefrom. Said rod is connected by wires 27 with the top of each electrode-arm C. These wires may be coiled and of different lengths to equalize the resistance to the current for the different electrodes. A similar distributer 28 is connected by wires 29 with the lower electrode-arms E. Line-wires 30 and 31 lead from a generator to a switch-box 32 (see Fig. 2) of any suitable construction, from the contacts of which wires 33 and 34 connect, respectively, with the distributer-rods 25 and 28.

A resistance-box P (see Fig. 2) is interposed in the circuit between the switch and distributer-bar 25. The coil in the box is of sufficient resistance to receive the entire current which is directed thereto when it is desired to break the current from the heated bar H before the rolls *m* are disengaged therefrom. For this purpose a contact-arm 36 (see Fig. 2) is projected from the distributer-rod 25. A vertical bar 37 is fitted to slide in insulated bushing in a lug 38 on one frame end A. The lower end of said rod is connected by wire 39 with the resistance-box. To the upper end thereof a lever 40 is pivoted provided with a head 41, disposed in position to engage the contact-arm 36. The lever is actuated by a rod 43, passing to the front of the machine. In the position shown in Fig. 2 contact is broken and the current passes to the electrodes. When the lever-head 41 is brought into engagement with the contact 36, the current passes into the resistance-box in a manner readily understood by all conversant with such matters.

The bar to be heated may be of any suitable form, a variety of which are shown in Fig. 27. Said bar is passed between the upper and lower electrodes *m*, contacting therewith and rapidly heated thereby when the current is turned on. To obtain an even heat on all parts of said bar H it is found necessary to reciprocate the same longitudinally a distance equal to a space between succeeding electrodes. For this purpose we employ a feed of uniform speed. A screw-shaft 50 (see Fig. 3) is fitted to rotate in the frame ends. Rods 51 and 52 are mounted to slide in said frame parallel with the shaft and projecting beyond the end thereof. A head 54 is secured on said rods by set-screws and is tapped centrally to travel on said worm-shaft 50. A tight pulley 55 and loose pulley 56 are mounted on the outer end of said shaft. An open belt 57 and cross-belt 58 connect the loose pulley with suitable power-supply. As the shaft is driven in either direction the head 54 is caused to travel thereon in corresponding direction, carrying the rods 51 and 52 with it. On one end of the rod 51 an arm 59 is secured provided with an insulated finger 60, which projects toward the front of the machine sufficiently to engage the end of the heated bar H, as shown in Fig. 3. The arm 59 may be adjusted at will on the rod 51, its position being determined by the length of the bar H. At the opposite end of the rod 51 a clamp 61 of construction suitable to firmly secure the bar II is secured, and causes said bar to move conjointly with the rods 51 and 52 when actuated by the worm. Instead of said clamp, a finger corresponding to the finger 60 may be employed.

The rod 52 is provided at one end with a series of holes 65. (See Fig. 3.) Pins 66 are disposed in said holes a determined distance apart. As said rod is moved by the head 54 these pins are brought into engagement with a pin 67 on a tripping-pallet 68, (see Figs. 12 and 14,) pivoted on the frame A. A cam-shaft 70 is journaled on the frame end and is rotated continuously in one direction by a belt 71. (See Fig. 2.) A stop-cam 72 (see Fig. 15) is disposed loosely on said shaft, its point 73 being engaged by either of the points of the pallet 68. To permit the cam to be moved in direction opposite to its shaft, a friction device is disposed in the chamber of the cam-hub. This consists of a disk 73′, on each side of which a washer 74 is disposed. A coiled spring 75 is compressed between said washers and a collar 76 secured to the cam-bub. Sufficient friction is thus supplied to turn the cam when released from its pallet 68 and not interfere with the rotation of shaft 70. Said pallet, being moved by the pins 66 in bar 52, releases said cam, which makes a semi-revolution when it is caught by the opposite arm of said pallet. A pin 80 in the face of the cam works in a slot 81 in a shipping-lever 82, (see Figs. 12 and 13,) pivoted on the frame. The half-revolution of the cam oscillates the lever 82, shipping the belt 57 or 58 and reversing the movement of the worm-shaft. This drives the rod 52 in the opposite direction until its opposite pin engages the pallets, releasing the cam and again reversing the movement of the worm-shaft by shipping the belts. The friction device described enables the bar II to be fed at uniform speed by the reciprocating rods, at all times the length of the movement being determined by the position of the pins 66 in the rod 52. To the frame a bracket 90 (see Fig. 21) is mounted, bearing a supporting-roll 91 for the bar II, said roll being vertically adjustable in and insulated from said bracket. In the frame near the base a horizontal treadle-shaft 93 is journaled, to one end of which a treadle-lever 94 is secured. One end of a horizontal lever 95 (see Fig. 2) is pivoted at its rear end to the frame, and a

rod 96 connects it with the treadle. A similar lever 97 is pivoted to the opposite frame end and a connecting-rod 98 (see Fig. 1) joins it to a crank on the treadle-lever. The supporting-casting *i* for the upper electrodes is fitted to slide vertically in suitable ways 99 in the frame-standards. The ends of the levers 95 and 97 are slotted, as at 100, Fig. 2, and play on pins 101 on the castings. By actuating the treadle 94 the top electrodes may be elevated to adjust the bar H between the two sets of electrodes. By the vertical play allowed the electrode-arms in their castings and said arms being weight-tensioned, as described, variations in the diameter, as at 102 in Fig. 1, or unevenness of surface of the bar H being operated on is readily compensated for. It will be understood that springs may be substituted for weights on said arms to hold the electrodes against the bar. The upper and lower electrode-arms may be of any suitable length and weight. The upper electrodes may be arranged to alternate with those in the lower set and any desired number may be used. By imparting endwise thrust to the bar H when heated it may be enlarged at points desired between the electrodes.

A special application of our machine is for heating bars to be wound into car-springs. In Figs. 23 to 26, inclusive, a device for forming such springs is illustrated. Much difficulty is ordinarily experienced in retaining sufficient heat in the metal while on the mandrel, the usual process frequently necessitating numerous reheatings, which detract seriously from the temper of the metal and tend to form brittle or soft places therein. These and other objections are overcome by our device, in which the spring can be quickly formed without reheating. Moreover, the action of the electricity on the metal is found to greatly toughen it and add to its tensile strength. A stand K is disposed in convenient position to receive the bar H as it leaves the electrodes. A vertically-inclined screw-shaft 105 is mounted in a pivoted bearing 106 at one end of said stand, in which it is fitted to slide longitudinally, as indicated by dotted lines in Fig. 23. Said shaft is provided with a crank-handle 107 for rotating it. Its threaded end 108 works in a suitably-tapped support 109 at the opposite end of the stand. Said support has a hinged upper section, which may be thrown up, as in Fig. 24, to release the screw for removing the spring when formed. A drum 110 is disposed on the shaft and is provided at one end with a cam-actuated clamp 111 of any suitable construction for securing an end of the bar H thereon. On one side bar 112 of the stand insulated guides 113 are arranged in alignment with the electrode-rolls *m*. As the heated bar H leaves the electrode its end is secured in the drum-clamp 111. The shaft 105 being rotated carries with the drum and is driven longitudinally by its screw. The bar H is thus quickly wound on said drum into a spring, the coil of which is determined by the pitch of the thread 108. By means of the hinged bearing 109 the drum may readily be removed and the spring tempered in the ordinary manner, the necessity of reheating being overcome.

Having thus explained our invention, what we claim is—

1. In a machine for heating metal, the combination of an upper series of adjustable arms bearing electrodes all of the same polarity, a lower series of similar arms of opposite polarity to the upper series and disposed in alignment therewith, an electric circuit, and mechanism for adjusting said upper arms, substantially as described.

2. In a machine for heating metal, two series of electrodes disposed in an electric circuit, in combination with mechanism for automatically reciprocating the metal to be heated between said electrodes, substantially as described.

3. In a machine for heating metal, two series of spring or weight tensioned electrodes disposed in an electric circuit and adapted to contact with the metal to be heated, in combination with a resistance-coil and mechanism for shunting the electric current through said coil, substantially as and for the purpose set forth.

4. In a machine for heating metal, the combination of an electric circuit, adjustable arms and bearing electrode-rolls, mechanism for reciprocating a metal bar between said rolls, a current-switch, a resistance-coil in said circuit, and mechanism for shunting the current thereto, substantially as described.

5. The weight-tensioned arms C E, mounted to slide on the machine-frame and disposed in an electric circuit, in combination with electrode-rolls, as *m*, and a treadle-actuated mechanism for elevating the arms C, substantially as and for the purpose set forth.

6. In a machine for heating metal, the frame and adjustable electrodes mounted in an electric circuit, in combination, a shaft belted to a power-supply, a belt-shipping mechanism for reciprocating said shaft, and conjunctive mechanism actuated thereby for reciprocating the metal between said electrodes, substantially as described.

7. In a machine for heating metal, two series of adjustable electrodes disposed in alignment and an electric circuit, in combination with mechanism for automatically reciprocating the metal to be heated between said electrodes and mechanism for shunting the current therefrom, substantially as described.

8. In a machine for heating metal, the frame and tensioned electrodes, in combination with an electric circuit, a screw-shaft mounted in said frame, mechanism for automatically reciprocating said shaft, a head traveling on said screw, a rod secured to the head, and insulated arms on said rod for engaging opposite ends of the metal to be heated, whereby it may be reciprocated between said electrodes, substantially as described.

9. In a machine of the character described, the combination of heating electrodes and a feed mechanism for reciprocating the metal between the heating-electrodes comprising a screw-shaft belted to a power source, a head traveling on said shaft, a rod on said head provided with clamps or arms for moving the metal, a companion rod on said head, and a belt-shipping mechanism actuated by said rod, whereby the screw-shaft may be reciprocated, substantially as set forth.

10. In a machine for heating metal by electricity, the combination of two or more pairs of electrodes disposed in proximity in succession and adapted to engage the metal to be heated, the electrodes of each pair being of opposite polarity, electric conductors connected with said electrodes for conveying the heating-current, and means for reciprocating the metal to be heated between two or more pairs of electrodes.

11. In a machine for heating metal by electricity, the combination of two series of adjustable electrode-arms adapted to receive the metal between them, the arms of each series being disposed in succession, the contact ends of the arms of one series being disposed opposite the contact ends of the arms of the other series, and electric conductors connecting all the arms of one series with one electric pole and all the arms of the other series with the other electric pole.

12. In a machine for heating metal by electricity, two series of weight-tensioned electrodes mounted in the same vertical plane, mechanism for elevating the upper series, an electric circuit, mechanism for reciprocating the metal between said electrodes, an electric switch, a resistance-coil, and mechanism for shunting the current into said coil, all being arranged to operate substantially as described.

13. In a machine for heating metal by electricity, the combination of a series of movable electrode-arms adapted for contact with one side of the metal to be heated, a series of supports therefor adjustable in a direction at right angles to the movement of the arms, a series of electrodes adapted for contact with the other side of said metal, and electric conductors connected with said arms.

14. In a machine for heating metal by electricity, the combination of a frame, a series of horizontally-adjustable guideways supported thereon, a series of electrode-arms vertically movable in said guideways and adapted for contact with one side of the metal to be heated, a series of electrodes adapted for contact with the other side of said metal, and electric conductors in connection with said electrodes and electrode-arms.

15. In a machine for heating metal by electricity, the combination of two series of horizontally-adjustable guideways supported on said frame, two series of electrode-arms vertically movable in said guideways and adapted to receive between them the metal to be heated, and electric conductors in connection with said electrode-arms.

16. In a machine for heating metal by electricity, the combination of a series of vertically-movable electrode-arms, a series of guideways therefor, and a series of weighted lifting-levers engaging said arms.

17. In a machine for heating metal by electricity, the combination of a series of vertically-movable electrode-arms, a series of guideways therefor, and adjustable stop-collars on said arms.

18. In a machine for heating metal by electricity, the combination of two series of electrodes adapted to receive the metal between them, the electrodes of each series being disposed in succession, and electric conductors connecting all the electrodes of one series with one electric pole and all the electrodes of the other series with the other electric pole.

GEO. D. BURTON.
EDWIN E. ANGELL.

Witnesses:
CHAS. FOLLEN ADAMS,
R. W. GALLUPE.