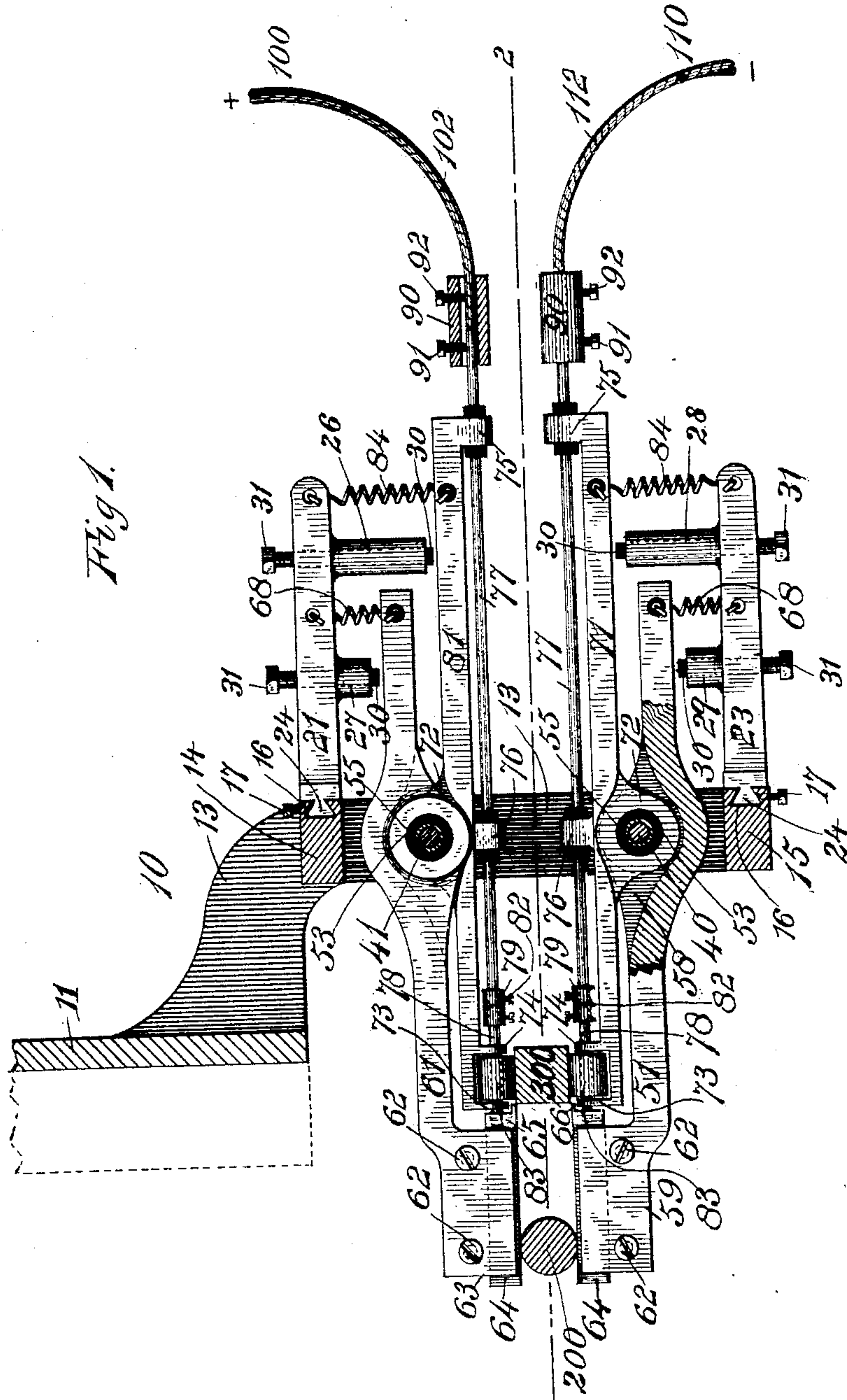


(No Model.)

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E. E. ANGELL.  
METHOD OF AND APPARATUS FOR HEATING BARS BY ELECTRICITY.  
No. 454,698. Patented June 23, 1891.



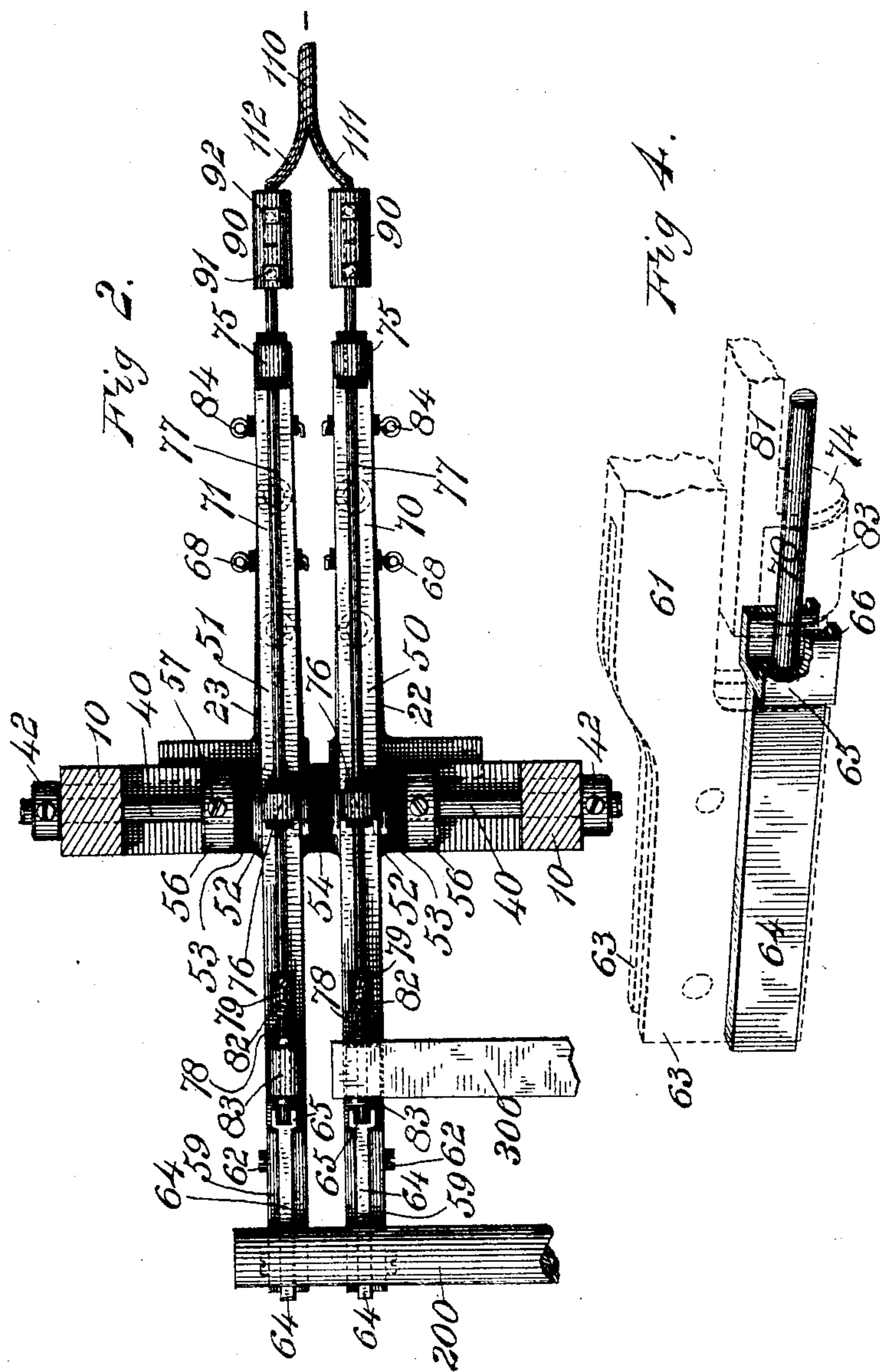
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(No Model.)

4 Sheets—Sheet 2.

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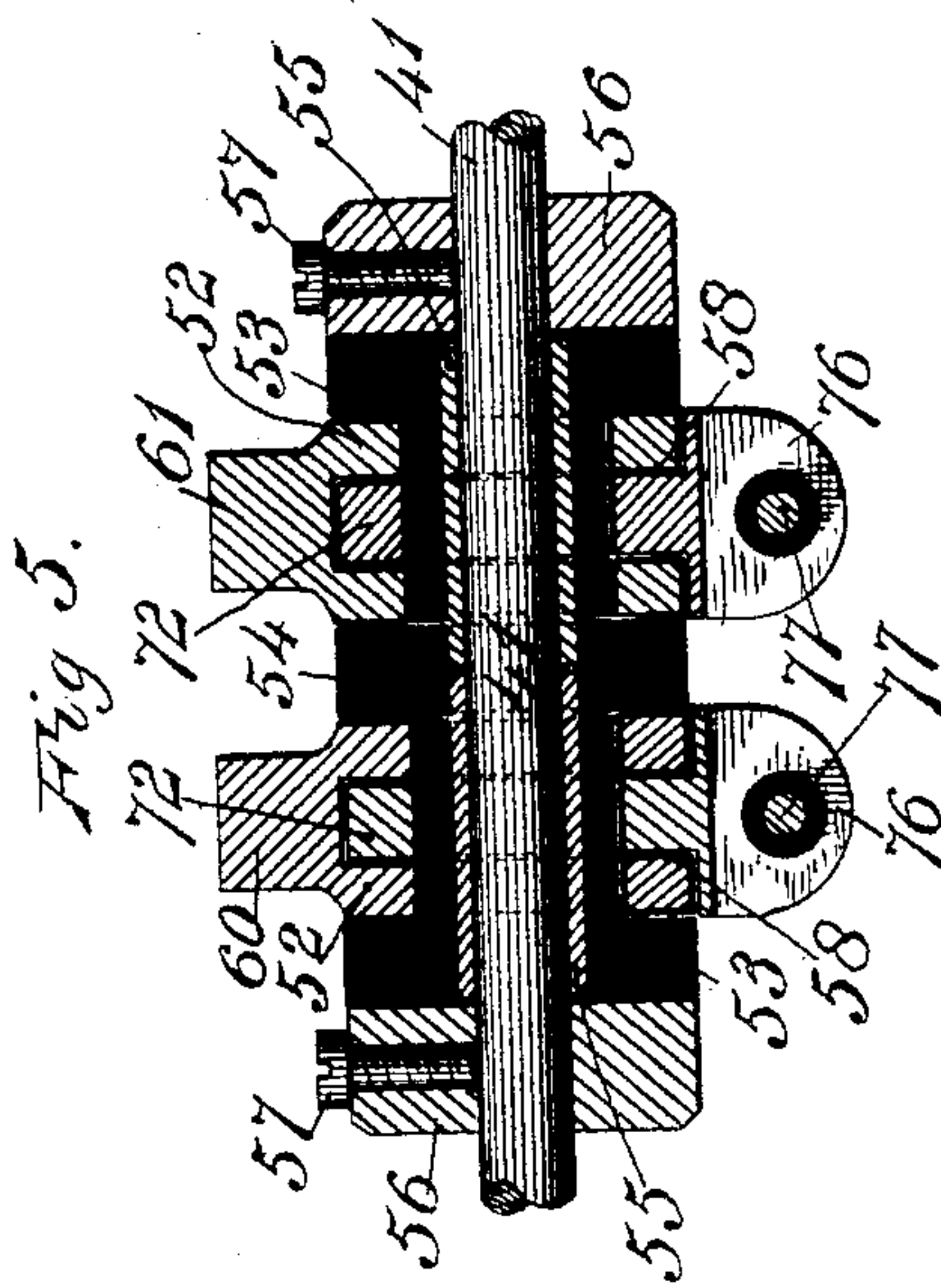
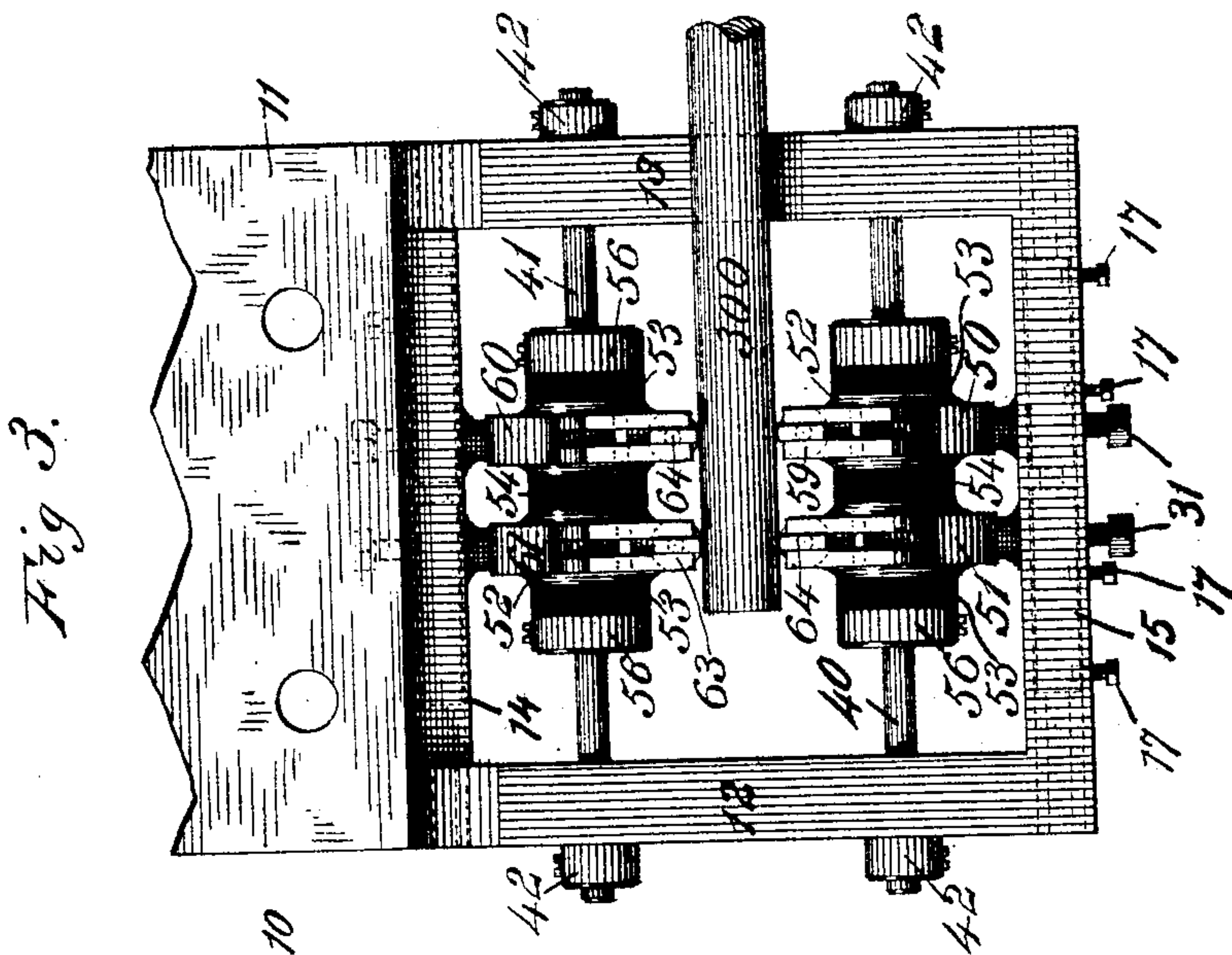
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(No Model.)

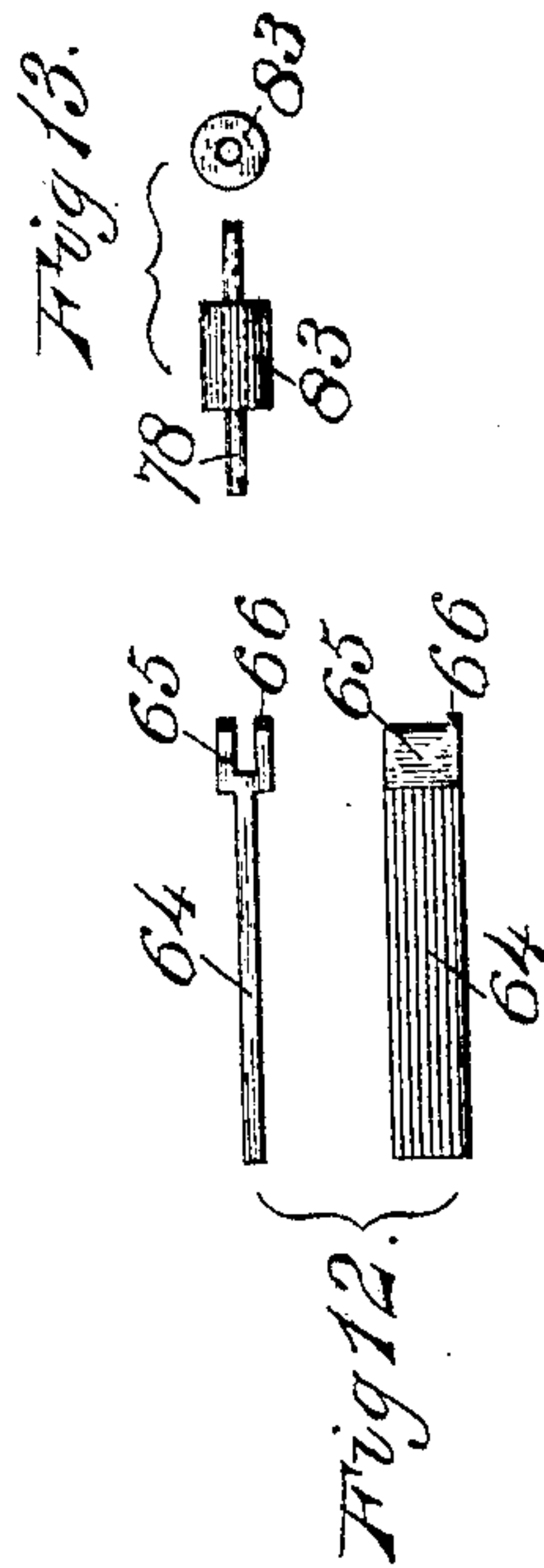
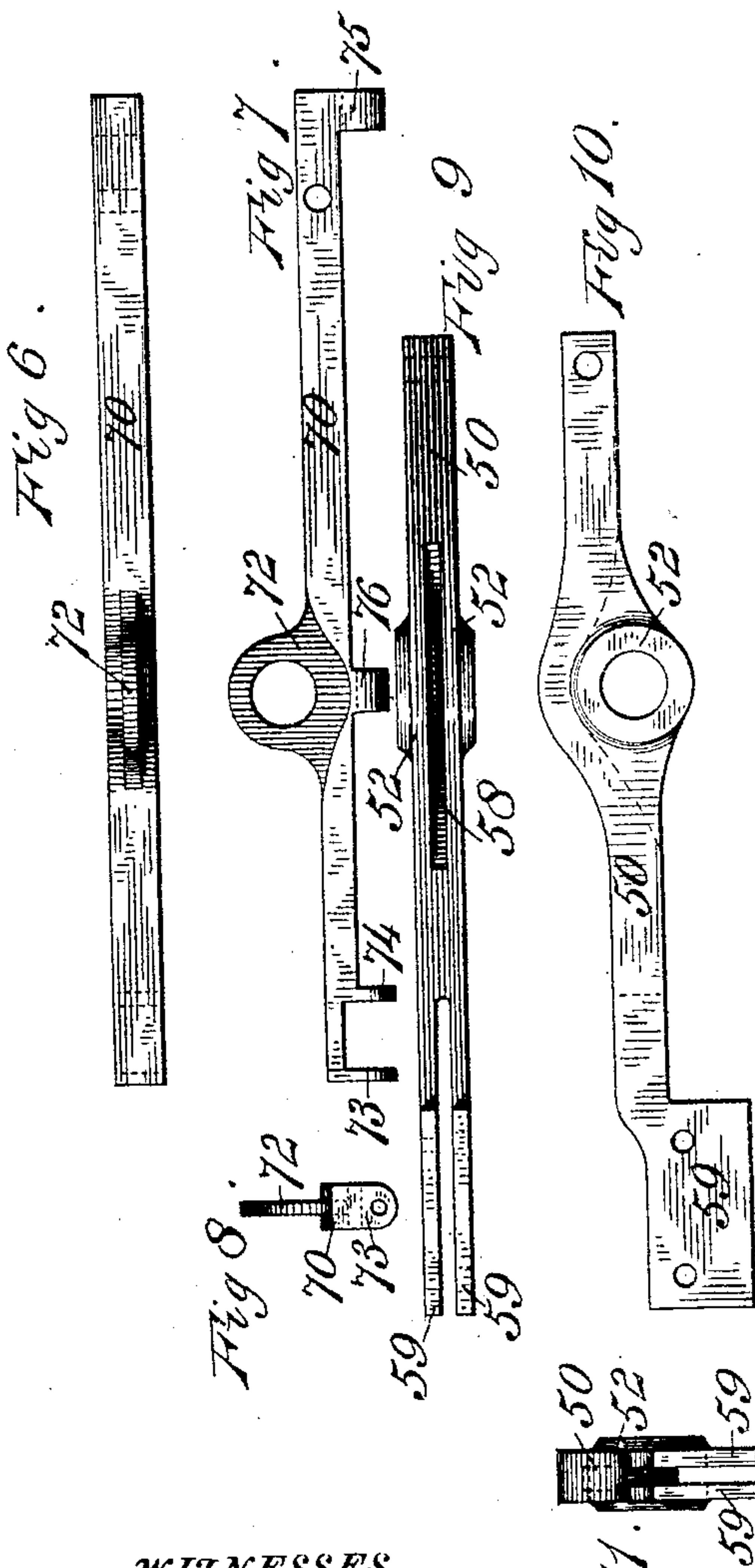
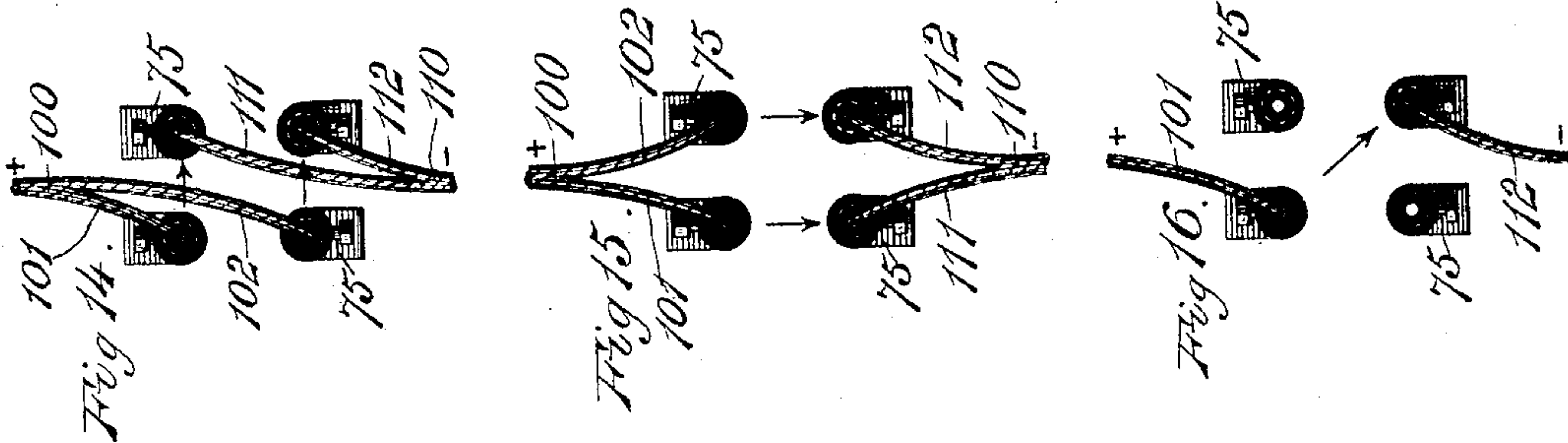
4 Sheets—Sheet 4.

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# UNITED STATES PATENT OFFICE.

EDWIN E. ANGELL, OF SOMERVILLE, MASSACHUSETTS, ASSIGNOR TO THE  
ELECTRICAL FORGING COMPANY, OF MAINE.

METHOD OF AND APPARATUS FOR HEATING BARS BY ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 454,698, dated June 23, 1891.

Application filed March 16, 1891. Serial No. 385,329. (No model.)

*To all whom it may concern:*

Be it known that I, EDWIN E. ANGELL, of Somerville, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Methods of and Apparatus for Heating Bars or Blanks by Electricity, of which the following is a description.

This invention relates to methods of and apparatus for heating metal bars or blanks for the manufacture of forgings and other purposes.

The object of this invention is to heat a succession of metallic bars or blanks in an economical manner.

The invention consists in the method of heating metallic bars or blanks by inserting a bar or blank in an electric circuit, then inserting another bar or blank in parallel in the same circuit side by side with the first blank, and then withdrawing one of said bars or blanks from said circuit, the other bar or blank remaining in circuit during such withdrawal.

The invention consists, further, in the apparatus hereinafter described and claimed, in which this method may be carried out.

Figure 1 of the accompanying drawings represents a longitudinal vertical section of this improved electric heater. Fig. 2 represents a longitudinal horizontal section thereof on line 2 2 of Fig. 1. Fig. 3 represents an elevation of the rear end thereof. Fig. 4 represents a perspective view of the conductive contact-piece of one of the split electrode-jaws and the short conducting-rod for conveying the current thereto, the split end of the jaw, the end of one of the auxiliary-lever electrodes, and the conducting contact-roller journaled therein being indicated in dotted lines. Fig. 5 represents a vertical section taken longitudinally of the upper transverse shaft between the supporting-frame, showing the bushings and adjustable collars thereon and the upper main and auxiliary electrode-levers. Fig. 6 represents a top plan of the upper or a bottom plan of one of the lower auxiliary-lever electrodes. Fig. 7 represents a side elevation thereof. Fig. 8 represents an end elevation thereof. Fig. 9 represents a plan of the inner face of one of the main-

lever electrodes. Fig. 10 represents a side elevation thereof. Fig. 11 represents an elevation of the jaw end thereof. Fig. 12 represents a plan and side view of the conductive contact-piece of one of the split jaws. Fig. 13 represents side and end views of the conducting-roller of one of the auxiliary electrode-levers. Fig. 14 represents the conducting-cables for the electric current, so connected with the apparatus as to pass currents longitudinally of the bar or blank to be heated. Fig. 15 represents the conducting-cables so connected with the apparatus as to pass currents transversely through the blank to be heated. Fig. 16 represents the conducting-cables adjusted so as to pass a current diagonally through the blank to be heated.

Similar numerals of reference indicate corresponding parts in all the different figures.

The support for this electric heater may consist of a rectangular frame or bracket 10, adapted for attachment to a wall or to a forging-machine. The rectangular frame shown in the drawings comprises an attaching-plate 11, dependent arms 12 and 13, which curve outwardly from said plate and then extend vertically downward, a cross-bar 14, connecting said dependent arms at the upper ends of their straight portions, and a cross-bar 15, connecting said bars to their lower ends. The cross-bars 14 and 15 are provided with dovetail guide-grooves 16 and with set-screws 17 opposite said grooves. Two adjustable arms extend horizontally and longitudinally of the machine from the upper cross-bar 14. One of these arms on the rear side is numbered 21 in the drawings, and the other, which is correspondingly disposed on the front side and which is hereinafter referred to as arm 20, does not appear in the views represented in the drawings. These arms are provided with T-heads having dovetail tongues 24, fitting the dovetail grooves of said cross-bar, and two similar adjustable arms 22 and 23 are secured in a similar manner to the lower cross-bar 15, being adjustable therein by means of set-screws 17. Each of the upper adjustable arms is provided near its outer end with an elongated dependent tubular lug 26 and near its inner end with a short dependent tubular lug 27, and the lower adjust-



able arms 22 and 23 are provided near their outer ends with elongated upright tubular lugs 28, and near their inner ends with short upright tubular lugs 29. Adjustable stops 30, 5 composed of insulating material, are severally disposed in these tubular lugs and rendered adjustable therein by means of adjusting-screws 31.

Two transverse shafts or rods 40 and 41 are 10 disposed one above the other in the frame 10. These shafts are provided at their outer ends outside the frame with collars 42. Two electrode-levers 50 and 51 are pivoted on the lower shaft 40 and two similar electrode-levers 15 60 and 61 are pivoted on the upper shaft 41. These four electrode-levers are all provided with short hollow trunnions 52, through which the shafts pass, said trunnions having flanged bushings 53, composed of insulating material, 20 and the trunnions on the same shaft being separated from each other by ring-bushings 54. Steel sleeves 55 serve as linings for the bushings to prevent wear thereof. Adjustable collars 56 are disposed on the shafts 25 outside the trunnions and insulated therefrom by the flanges of the flanged bushings 53. These collars may be adjusted on the shaft by means of set-screws 57.

The main electrode-levers 50, 51, 60, and 61 30 are of similar construction, and are provided with longitudinal vertical slots 58 opposite their trunnions. The lower lever-electrodes 50 and 51 are provided at their rear ends with upwardly-projecting horizontally-elongated 35 split jaws 59, having tightening-screws 62, and the upper lever-electrodes 60 and 61 are provided at their rear ends with downwardly-projecting horizontally-elongated clamping-jaws 63, provided also with tightening-screws 40 62. These jaws are provided with conductive contact-pieces 64, composed of metal of high conductive power having a high fusing-point. These contact-pieces are clamped in the split jaws, and are provided at their inner 45 ends with contact-boxes 65 and with lugs 66 in line with their contact-faces. Contractile springs 68 connect the front ends of these lever-electrodes with the adjustable arms 20, 21, 22, and 23 and tend to close the jaws 50 thereof toward each other. This movement of the levers is regulated by the adjustable stops 30 of the short lugs 27 and 29 on said arms. Two auxiliary-lever electrodes 70 and 71 are also pivoted on the lower shaft 40, and 55 two similar auxiliary-lever electrodes 80 and 81 are pivoted on the upper shaft 41. These auxiliary levers are provided with perforated pivot-ears 72, through which the shafts pass and which fit into slots 58 of the main-lever electrodes. The rear ends of these levers terminate at points opposite the inner ends of the jaws on the main levers, and are provided at said ends with inwardly-projecting perforated lugs 73 and 74. At their opposite 60 ends they are provided with perforated lugs 75, having insulated bushings, and opposite their pivots they are provided with perforated

similarly-bushed lugs 76. Conducting-rods 77, of copper or other suitable material, extend 70 parallel with the lever-electrodes, and are supported in the lugs 75 and 76 thereof. Shorter conducting-rods 78 are supported in the lugs 73 and 74, and are connected with the rods 77 by means of connecting-sleeves 79, provided with set-screws 82. Contact-roll- 75 ers 83, composed of conducting comparatively non-fusible material, are disposed on the rods 78 between the lugs 73 and 74, and serve the triple purpose of feed-rolls, clamping-jaws, and electric conductors. The outer ends of 80 the conducting-rods 78 enter the boxed ends of the conductive contact-pieces 64 at the inner ends of the jaws of the main levers. Springs 84 connect the auxiliary levers with the outer ends of the adjustable arms and 85 tend to move the upper and lower auxiliary levers toward each other, this movement being regulated by the adjustable stops of the elongated lugs of said arms. The lugs 65 of the conducting contact-pieces bridge the 90 spaces between the contact-faces of the jaws of the main and the auxiliary electrode-levers.

The outer ends of the conducting-rods 77 are provided with clamping-sleeves 90, having set-screws 91 and 92 for connecting the 95 branches of the cables with the rods.

The positive cable 100 is provided with branches 101 and 102, which may be connected with the rods of the two upper auxiliary electrodes. A negative cable 110, connected with 100 a dynamo or current-transformer, is provided with branches 111 and 112, which may be connected with the conducting-rods of the lower lever-electrodes, as shown in Fig. 3.

In carrying out this method by this appa- 105 ratus a bar, as 200, to be heated and softened for a forging operation or for other purposes, is passed endwise between the pair of roller-jaws of the upper and lower auxiliary electrode-levers 70 and 80 at one side of the heater 110 and across to and between the pair of jaws 71 and 81 at the other side of the heater, spanning the space between said pairs. When the conducting-cables are connected, as shown in Figs. 2 and 15, two currents are passed 115 transversely through the bar, one from the electrode 80 to the electrode 70 and another from the electrode 81 to the electrode 71. When the cables are connected, as shown in Fig. 14, two currents are passed longitudinally of the 120 bar, one from the electrode 70 to the electrode 71 and another from the electrode 80 to the electrode 81. The electrodes may be so adjusted on the shafts as to increase or diminish the distance between the two pairs of 125 jaws; but when transverse currents are passed through the bar the distance between the pairs of jaws should not greatly exceed the diameter of the bar to be heated. In that case the part between the jaws is heated by 130 conduction. The bar or blank is then moved outward between the conductive contact-pieces 64 of the jaws 59 and another bar, as 300, is inserted between the jaws of the aux-



iliary electrodes. These jaws yield independently of the main electrodes to permit the insertion of the bar, and the rods 78 play in and remain in contact with the contact-boxes 65 of the conducting-pieces 64, whereby the current is maintained through the main jaws during the insertion of a bar or blank between the auxiliary jaws. After the insertion of the bar 300 between the jaws of the auxiliary electrodes the bar 200 can be removed from between the jaws of the main electrodes without breaking the main electric circuit which continues through the bar 300. The bar 300 is then moved outward and another bar inserted, and the operation may thus be continued indefinitely without breaking the current. Two or more bars or blanks may be held at the same time between the jaws of the main lever.

I claim as my invention—

1. The method of heating metallic bars or blanks, which consists in inserting a bar or blank in an electric circuit, then inserting another bar or blank in parallel in the same circuit side by side with the first blank, and then withdrawing one of said bars or blanks from said circuit, the other bar or blank remaining in the circuit during such withdrawal, substantially as described.

2. In an electric heater, the combination of two pairs of electrode-levers disposed apart from each other and having elongated clamping-jaws adapted to receive two or more bars or blanks, substantially as described.

3. In an electric heater, the combination of a supporting-frame, two pairs of lever-electrodes pivoted therein and provided with clamping-jaws, and arms extending from said frame and provided with insulated stops for said electrodes.

4. In an electric heater, the combination of a supporting-frame, two pairs of lever-electrodes pivoted therein and provided with clamping-jaws, arms extending from said frame and provided with insulated stops for said electrodes, and springs connecting said electrodes with said arms.

5. In an electric heater, the combination of a supporting-frame, two shafts disposed in said frame one above the other, two lever-electrodes pivoted on the upper shaft and adjustable toward or from each other, and two lever-electrodes pivoted on the lower shaft and adjustable thereon.

6. In an electric heater, the combination of a pair of pivoted electrode-levers provided with clamping-jaws, and a pair of pivoted auxiliary electrode-levers having clamping-jaws disposed in line with the clamping-jaws of the main levers and adapted to open and close independently thereof.

7. In an electric heater, the combination of a pair of pivoted electrode-levers provided with clamping-jaws, and a pair of pivoted auxiliary electrode-levers having clamping-jaws disposed in line with the clamping-jaws of the main levers and adapted to open and close independently thereof, the clamping-jaws of the auxiliary levers being provided with conductive feed-rollers.

8. In an electric heater, the combination of a supporting-frame, two shafts therein, horizontal arms adjustable on said frame, electrode-levers adjustable on said shafts, springs connecting said arms with said levers, and adjustable stops on said arms for regulating the movements of the electrode-levers.

9. In an electric heater, the combination of a frame, two shafts supported therein, two main levers provided with hollow trunnions through which said shafts pass, and with longitudinal slots traversing said trunnions, and auxiliary electrode-levers provided with perforated pivot-ears hung on said shafts within said slots.

10. In an electric heater, the combination of two pairs of electrode-levers disposed apart from each other and provided with electro-conductive clamping-jaws, and two pairs of auxiliary electrode-levers provided with conductive clamping-jaws in line with the jaws of the main electrode-levers.

11. In an electric heater, the combination of a pair of electrode-levers having jaws provided with conductive contact-pieces, a pair of auxiliary electrode-levers provided with conductive jaws and with perforated lugs, conductive rods disposed in said lugs and insulated therefrom, the rear ends of the rods being in contact with the contact-pieces of the main jaws.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

EDWIN E. ANGELL.

Witnesses:

GEO. D. BURTON,  
CHESTER MARR.