

(No Model.)

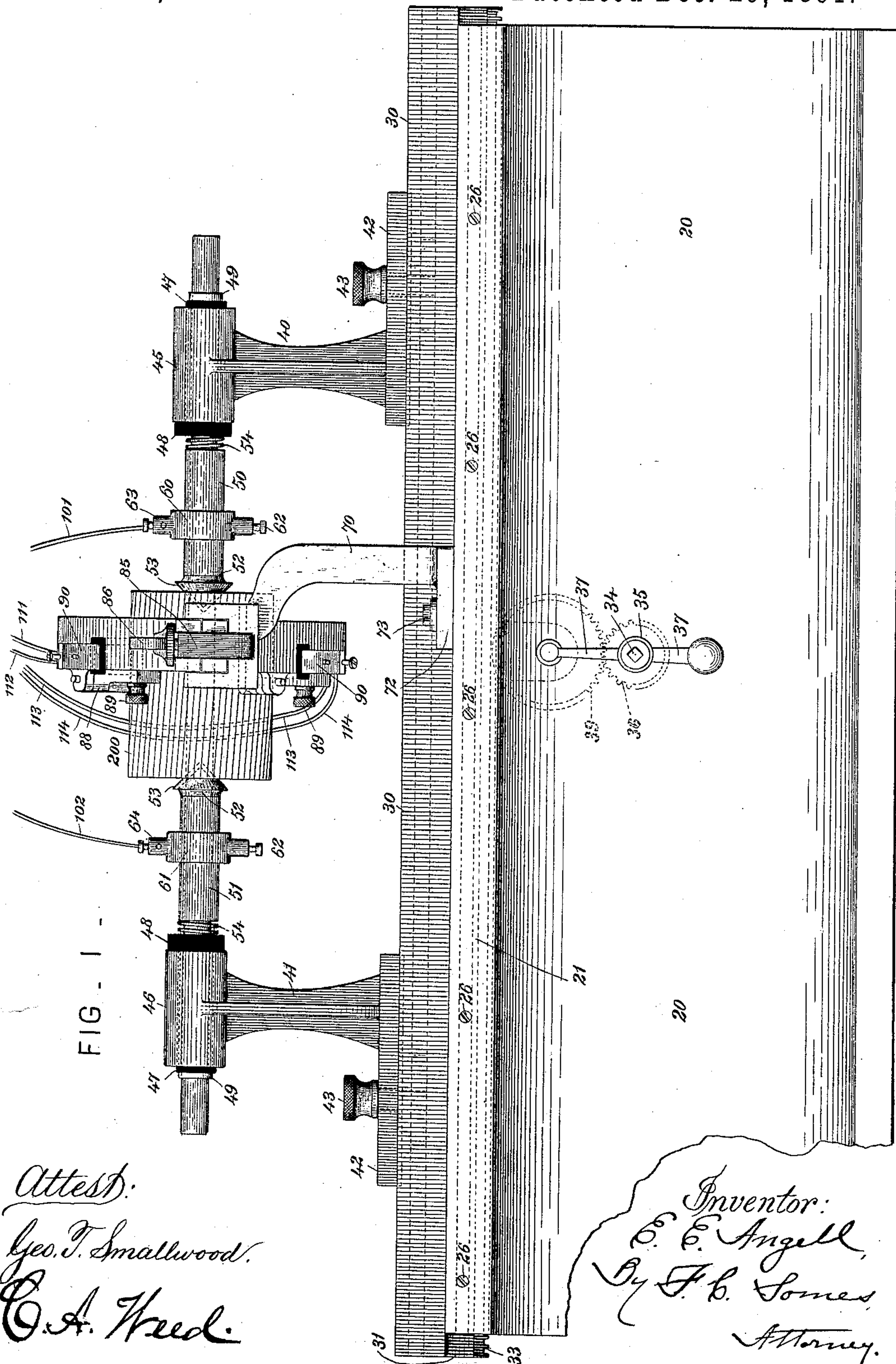
5 Sheets—Sheet 1.

E. E. ANGELL.

ART OF AND APPARATUS FOR HEATING METAL ARTICLES BY ELECTRICITY.

No. 466,131.

Patented Dec. 29, 1891.



Attest:
Geo. T. Smallwood.
C. A. Weed.

Inventor:
E. E. Angell,
By F. B. Lomes,
Attorney.

(No Model.)

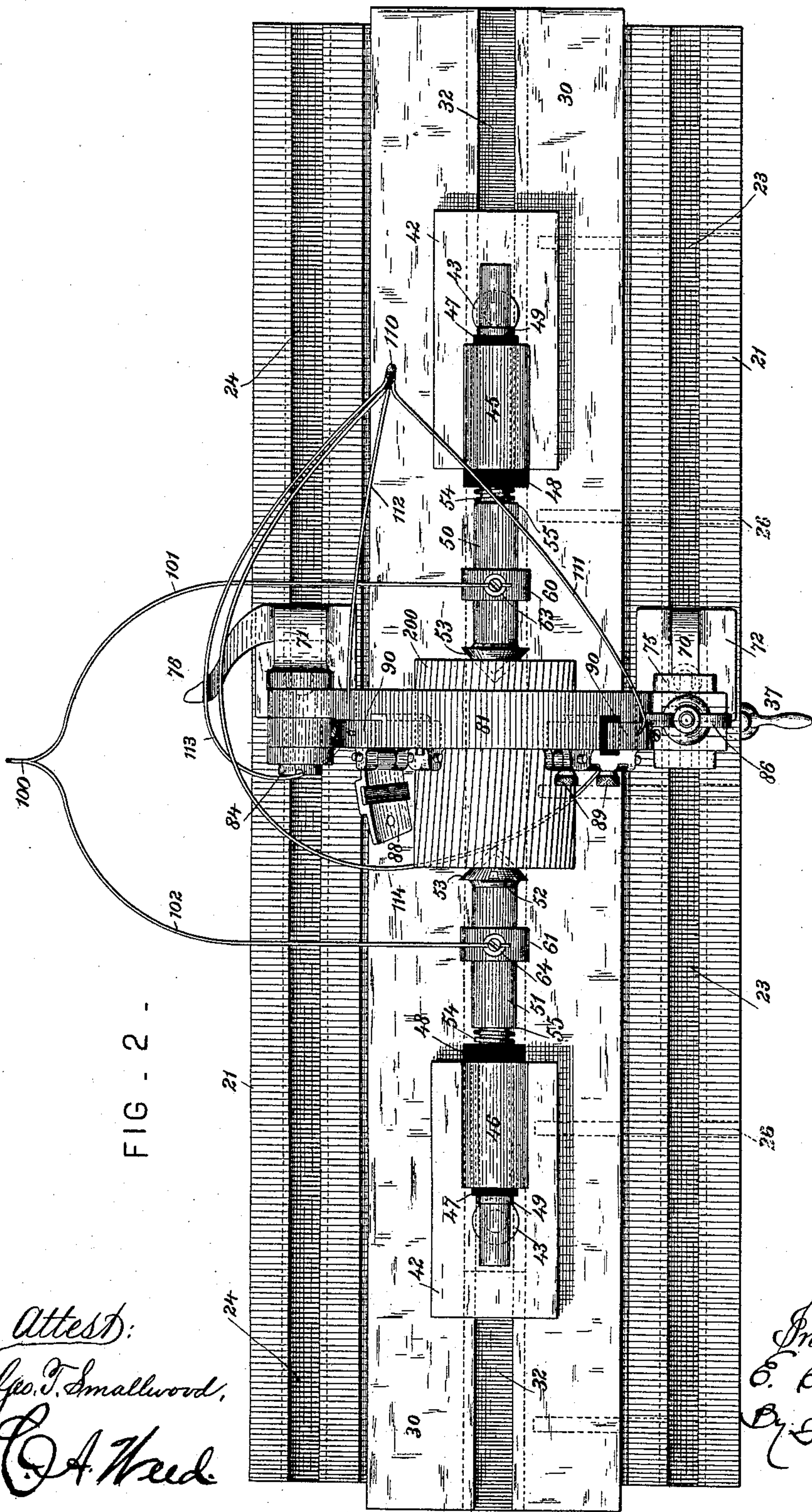
5 Sheets—Sheet 2.

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5 Sheets—Sheet 3.

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FIG - 4 -

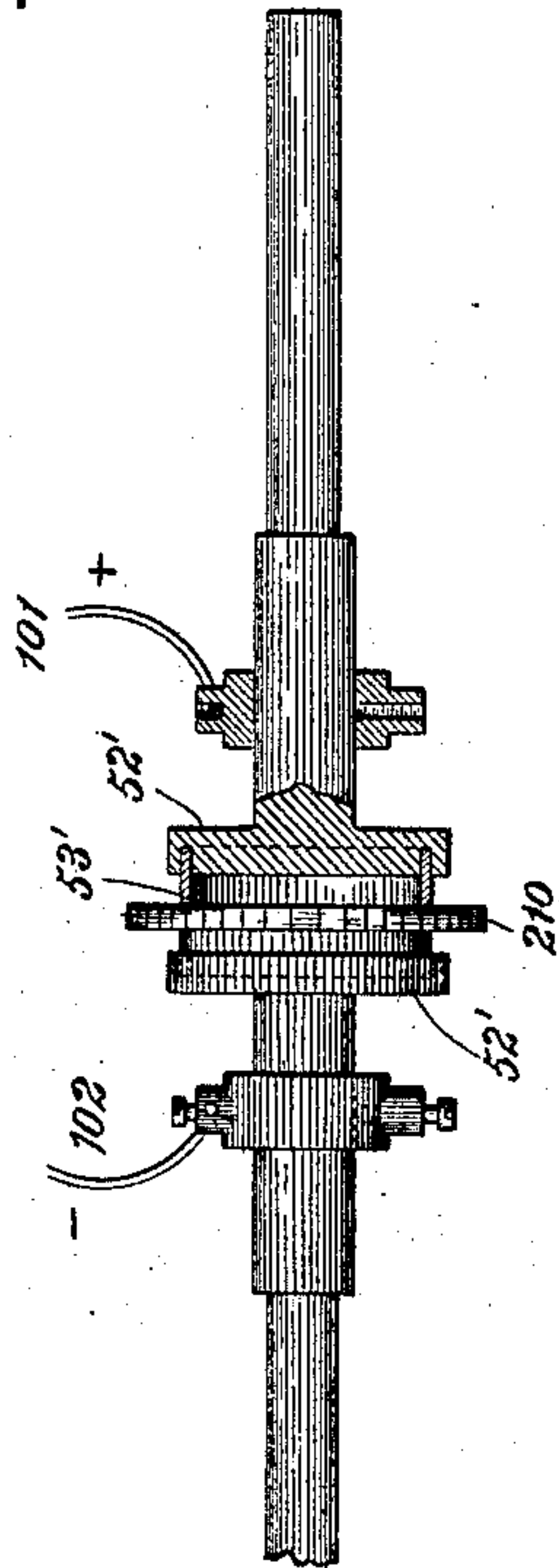


FIG - 5 -

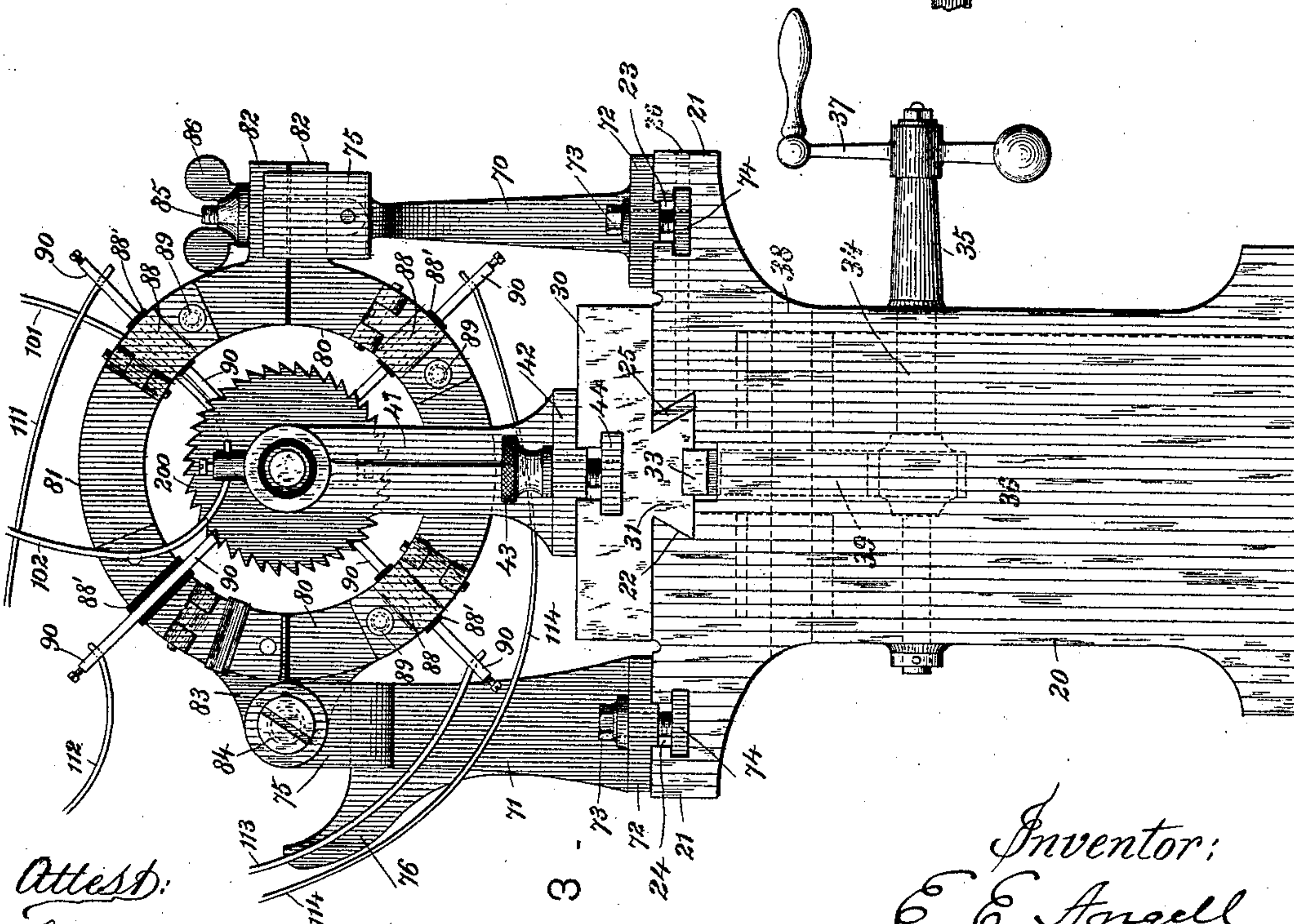
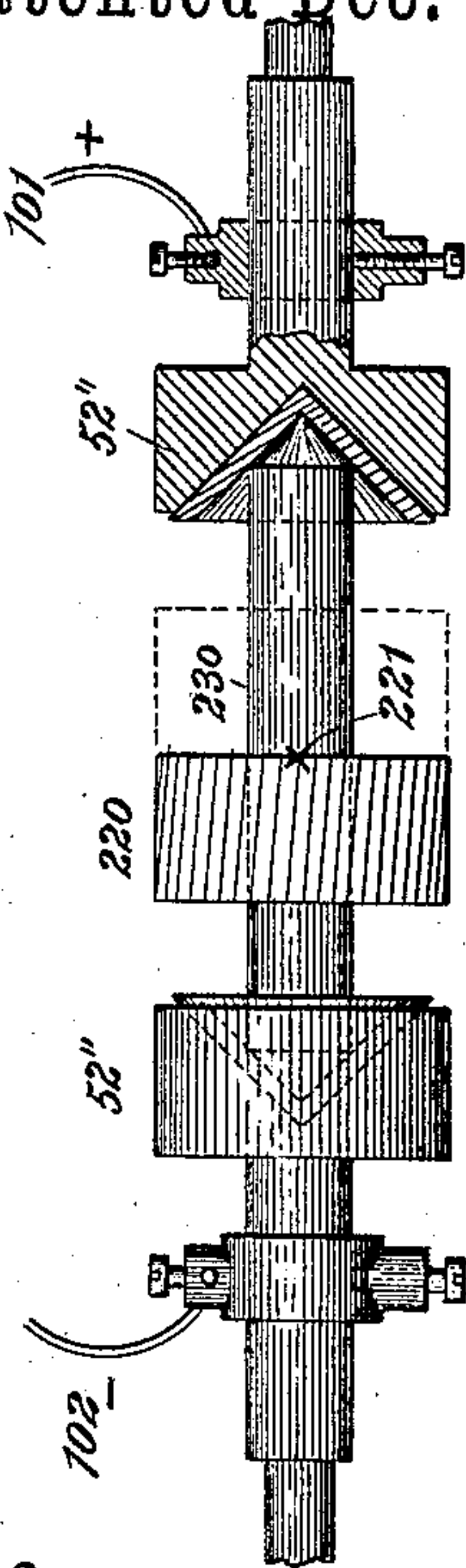


FIG - 3 -

Attest:

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5 Sheets—Sheet 4.

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FIG. 6.

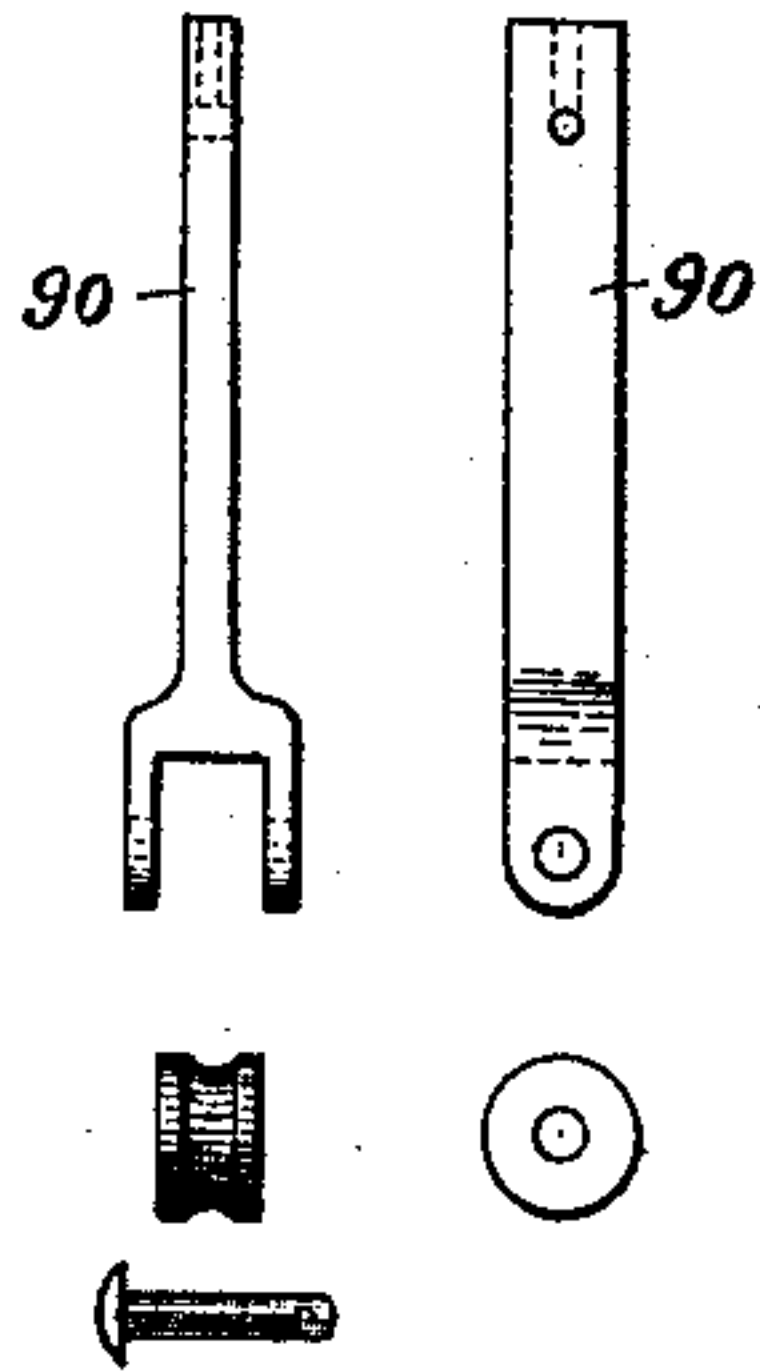


FIG. 7.

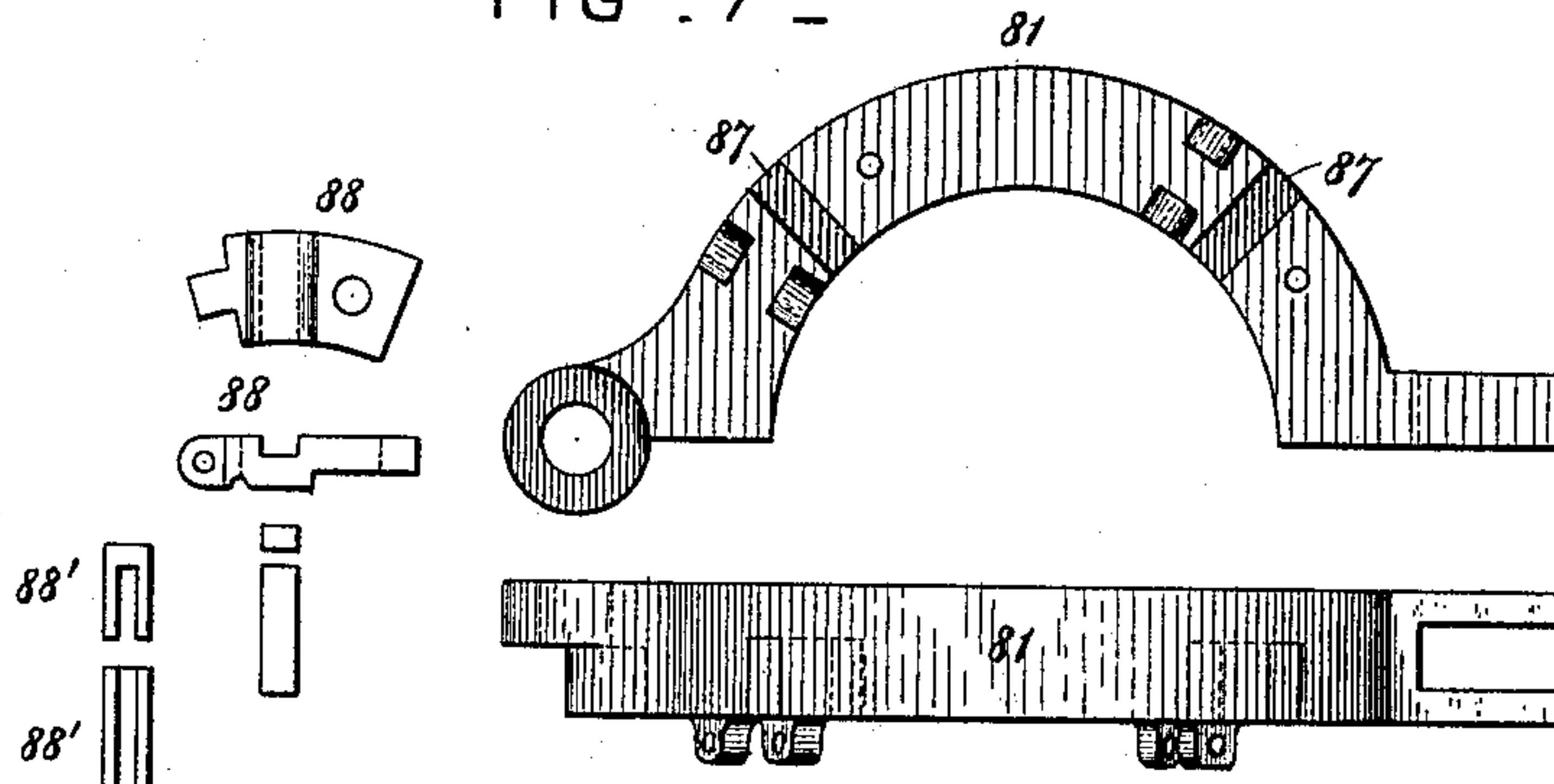


FIG. 8.

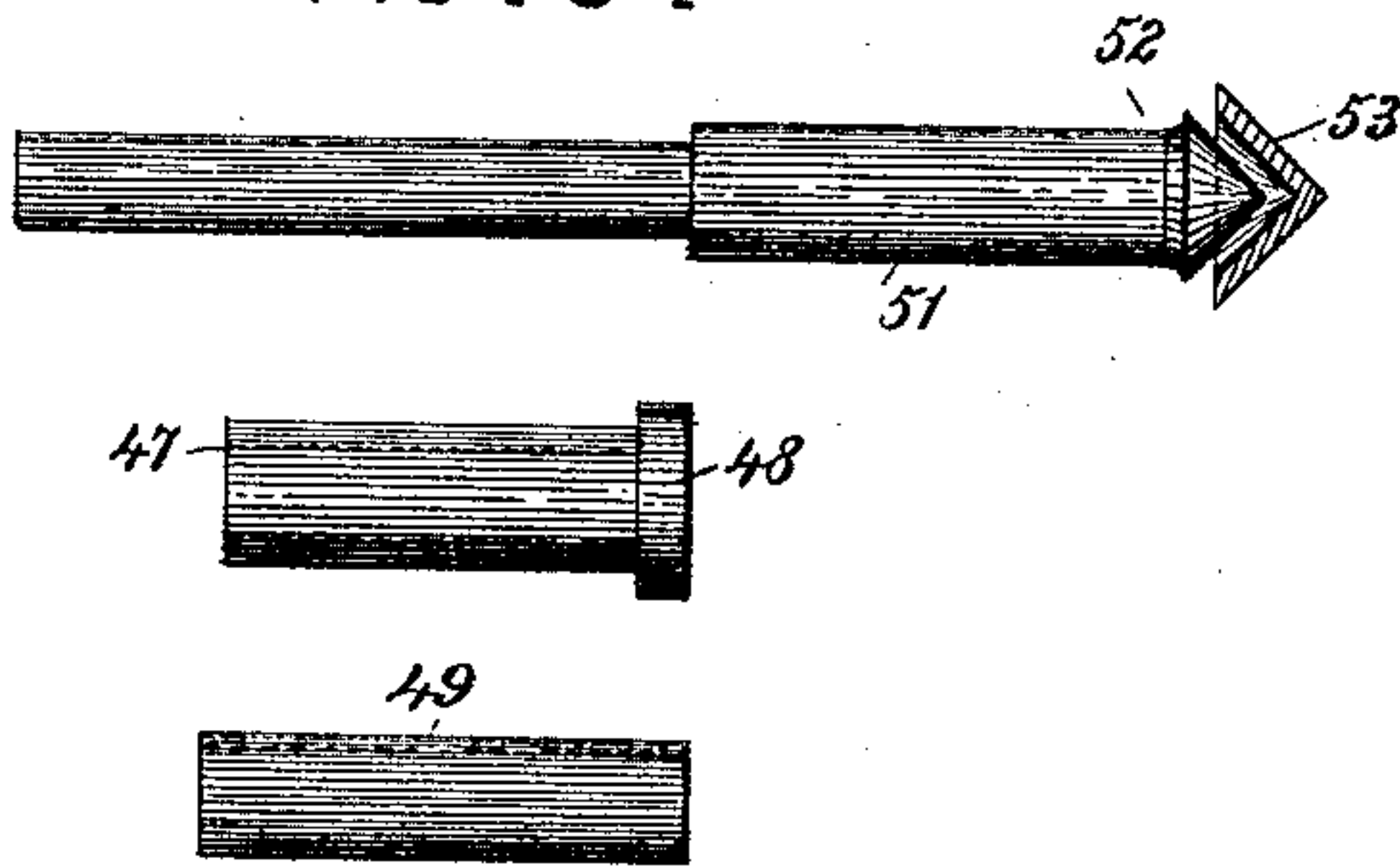


FIG. 9.

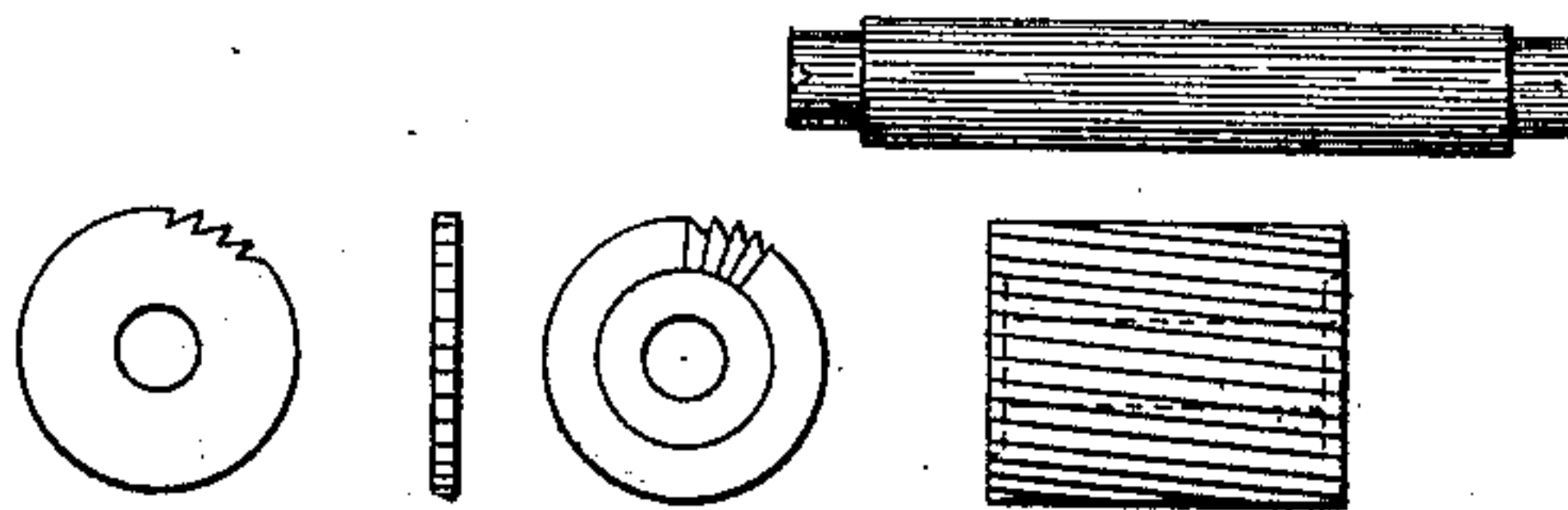
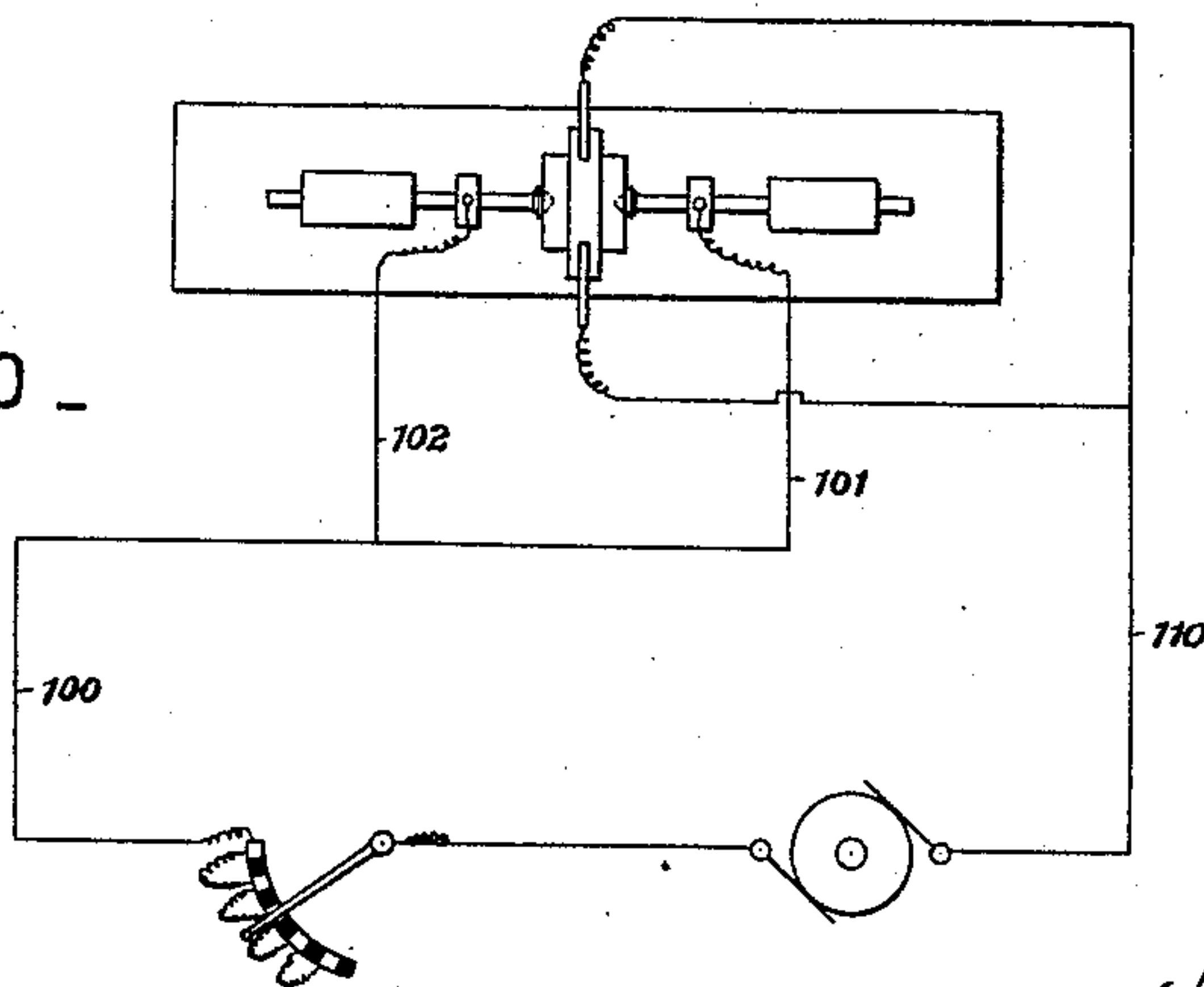


FIG. 10.



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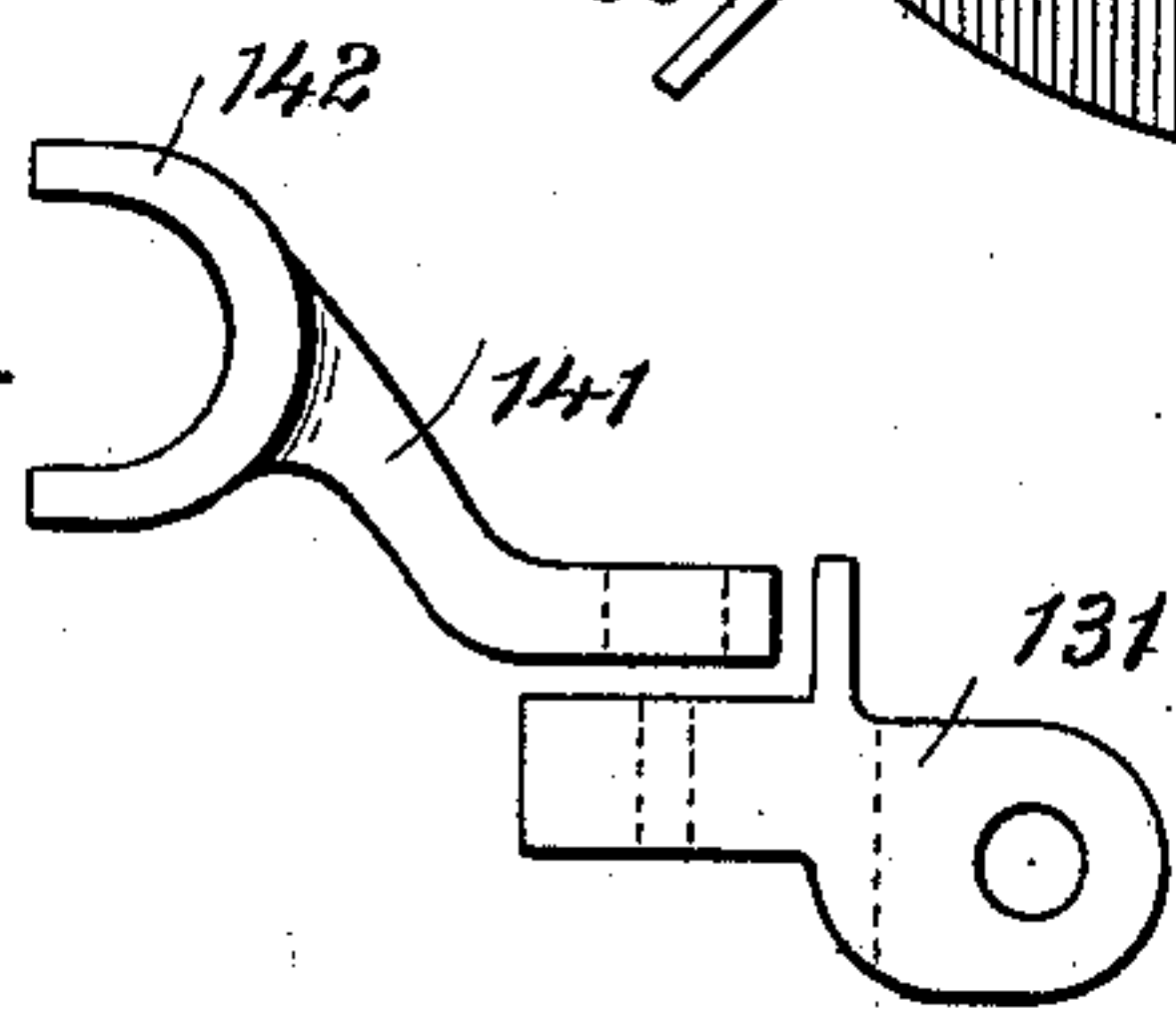
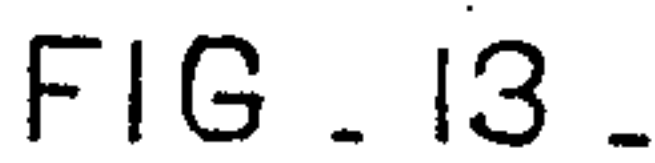
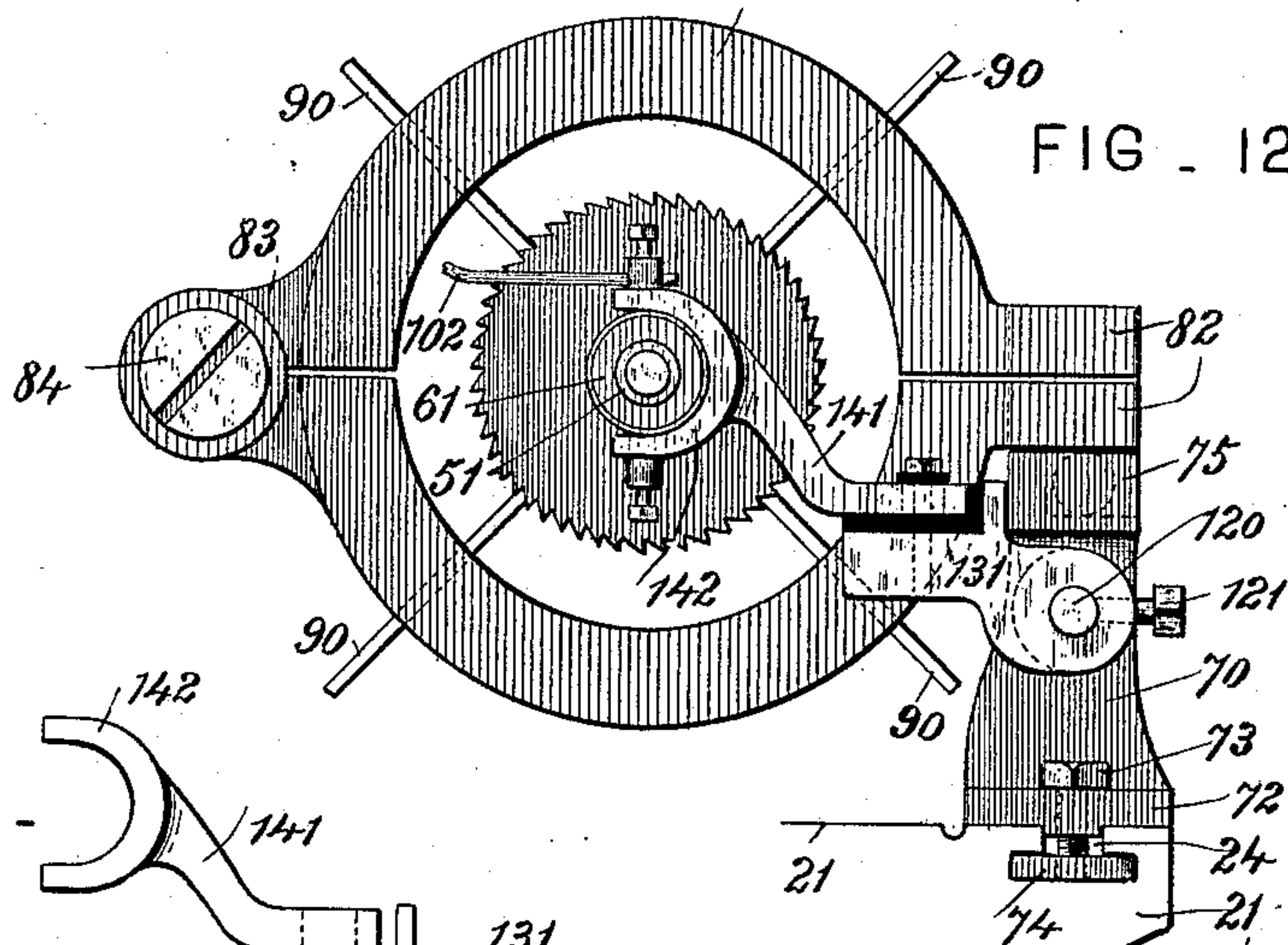
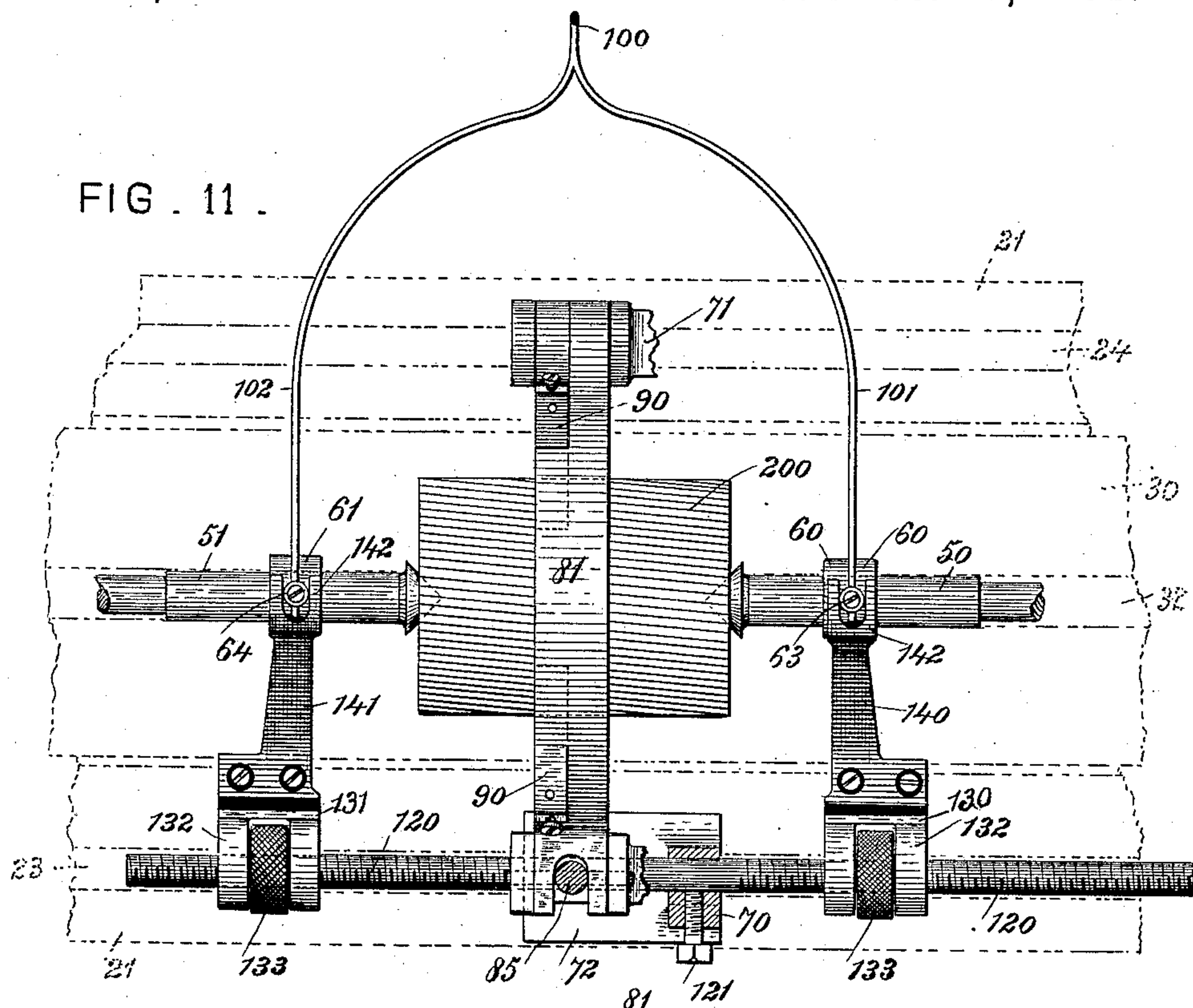
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UNITED STATES PATENT OFFICE.

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

ART OF AND APPARATUS FOR HEATING METAL ARTICLES BY ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 466,131, dated December 29, 1891.

Application filed March 16, 1891. Serial No. 385,328. (No model.)

To all whom it may concern:

Be it known that I, EDWIN E. ANGELL, a citizen of the United States, residing at Somerville, in the county of Middlesex, in the State of Massachusetts, have invented new and useful Improvements in the Art of and Apparatus for Heating Metal Articles by Electricity, of which the following is a specification.

10 This invention relates to the art of and apparatus for heating metals by electricity, and is especially adapted for heating mandrels, milling-cutters, taps, reamers, twist-drills, arbors, bushings, thin cutters, and similar metal-
15 working and other tools and articles preparatory to hardening and tempering them.

The objects of this invention are to provide a method and apparatus in which the advantages of the electric current as a heating agent for metals may be utilized economically and an apparatus in which the mechanism may be adjusted with facility for the proper heating of any given tool of the class above indicated and then utilized for the uniform heating to the same degree of temperature of any number of like tools.

Figure 1 of the accompanying drawings represents a side elevation of this improved electric heater. Fig. 2 represents a plan view thereof. Fig. 3 represents an end elevation thereof. Fig. 4 represents a side elevation, partly in section, of a pair of electrode-spindles adapted for use in this apparatus for heating thin pieces or disks of metal. Fig. 5 represents a side elevation, partly in section, of a pair of electrode-spindles for use in this apparatus of a construction adapted for heating arbors, reamers, bushings, and similar articles. Fig. 6 represents one form of stationary electrodes which may constitute an equivalent of the form of stationary electrodes shown in Figs. 1, 2, and 3. Fig. 7 represents details of the holder for the stationary electrodes shown in the first three figures. Fig. 8 represents details of the electrode-spindles. Fig. 9 represents the character of tools this apparatus is especially adapted to heat for the purpose of hardening and tempering. Fig. 10 is a diagram showing the apparatus in circuit. Fig. 11 represents a plan of the central portion of the apparatus including means for

equalizing the traverse of the currents conducted to opposite ends of the work. Fig. 12 represents an end view of the parts shown in Fig. 11. Fig. 13 represents in detail the arm for holding stationary one of the conductive collars of one of the electrode-spindles and the bracket for supporting said arm.

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

The frame 20 supports an elevated bed 21, which is provided with a central longitudinal guideway 22 and two longitudinal dovetail grooves 23 and 24, near the front and rear sides, respectively. A gib or strip 25 is secured in said guideway by means of lateral screws 26, and the width of the guideway is adjusted by these means. A sliding carriage 30, adapted to reciprocate on said bed, is provided on its under side with a longitudinal dovetail rib 31, which engages the dovetail guideway 22 of the bed, and on its upper face with a longitudinal dovetail groove 32. The dovetail rib of the carriage is provided on its under side with a longitudinal rack 33. A transverse shaft 34 is journaled in the frame and in a lateral sleeve 35, projecting therefrom. A pinion 36 is disposed on said shaft within the frame, and a crank 37 is disposed on said shaft outside the frame. A short transverse shaft 38 is also journaled in the frame above the shaft 34, and a gear 39 thereon meshes with the pinion 36 and with the rack 33, whereby motion is communicated from the crank to the rack, and the carriage is thereby reciprocated.

Two similar end standards 40 and 41, having elongated feet 42, are adjustably secured on the carriage 30 by means of clamping-screws 43, which extend through said feet into the dovetail-groove 32 of the carriage and take into nuts 44 disposed therein. These standards are provided at their upper ends with horizontal sleeves 45 and 46 in alignment with each other longitudinally of the machine. These sleeves are provided with insulating bushings 47, having flanges 48 at their inner ends. Steel sleeves or linings 49 are disposed in the insulating bushings to prevent wear thereof.

Two similar electrode-spindles 50 and 51 are supported in alignment with and apart

from each other in the sleeves 45 and 46, being insulated therefrom by the bushings 47, which are protected by the steel linings 49. These spindles support and center the work, pass currents into or out of the ends thereof, and are movable for shifting the work with relation to the stationary electrodes, herein-after described, for taking out or passing in currents at different points at the sides of the work. The inner ends of these spindles are provided with clamping-heads 52, between which the article of metal to be heated is supported. These clamping-heads are preferably provided with contact-faces 53, composed of platinum or other suitable electrically-conductive material. The outer portions of the spindles, which slide in the insulated sleeves, are shown of smaller diameter than the inner portions, which project toward each other inside the inner ends of the sleeves. Spiral springs 54 are disposed around said spindles between shoulders 55 thereon and the flanged ends 48 of the insulating bushings. The springs allow the spindles to yield under the expansion of the article being heated, and they also permit the spindles to yield to receive the article to be heated and cause them to close against said article to clamp it, whereby adjustment of the standards for every insertion and removal of articles of the same length is avoided. Adjustable collars 60 and 61 are disposed on the spindles, being held fast thereon by means of the set-screws 62. These collars are composed of electrically-conductive material and are provided with binding-posts 63 and 64 for clamping the electric conductors. The clamping-heads 52 of the spindles are of different forms for holding different articles, those shown in Figs. 1, 2, and 8 being in the form of cones 52 for engaging solid cylindrical articles, those shown in Fig. 4 being in the form of flat disks 52', and their contact-faces in the form of rings 53', for engaging thin cutters and the like, and those shown in Fig. 5 being funnel-shaped or flaring, as shown at 52'', to receive arbors and other articles to which they may be adapted.

A side standard 70 is adjustable longitudinally of the bed in the groove 23 at the front side thereof, and a similar side standard 71 is likewise adjustable in the groove 24 at the rear side of the bed. These standards are disposed opposite each other on opposite sides of the article or work held between the electrode-spindles of the side standards, and serve as supports for the holder of the stationary electrodes. They are provided with feet 72, through which set-screws 73 pass and take into nuts 74 in the longitudinal grooves 23 and 24 of the bed 20. They are also provided at their upper ends with flanged rests 75. The rear standard 71 has a stop-arm 76. The electrode-holder for the stationary electrodes supported by these side standards 70 and 71 is a ring-shaped device composed of two semicircular sections 80 and 81. These sections

are provided with lugs 82 and 83 at their opposite ends, which project into the rests 75 of the standards 70 and 71. The rear ends of the ring-sections are hinged to the rest of the rear standards by means of the screw-pintle 84. The front ends of said sections are locked in closed position in the rest of the front standard by means of a hinged locking-latch 85, pivoted therein at its lower end and screw-threaded and provided with a clamping-screw 86 at its upper end. The semicircular sections 80 and 81 are provided with radial recesses 87, (see Fig. 7,) and with hinged clamping-plates 88, having corresponding recesses on their inner faces. These recesses are provided with insulating-bushings 88', Fig. 7, and when the clamping-plates are closed, form radial slots through which stationary electrodes 90 project into contact with the sides of the article to be heated. The outer ends of the hinged clamping-plates 88 are provided with set-screws 89, which take into screw-threaded holes in the face of the ring-sections, whereby the hinged clamping-plates may be closed tightly against the electrodes 90 to clamp them in position.

A cable 100, connected with the positive pole of a dynamo or other suitable source of electricity, is provided with branches 101 and 102, and these branches are connected respectively, with the binding-posts 63 and 64 of the collars 60 and 61 on the electrode-spindles 50 and 51, which support the work. A cable 110, connected with the negative pole of the same source of electricity, is provided with branches 111, 112, 113, and 114, which are severally connected with the stationary electrodes 90, supported in the ring-shaped holder 80 and 81, surrounding the work, and upheld by the side standards 70 and 71. The polarity of the cables may be reversed, and alternating currents may be employed.

In the use of the apparatus having stationary electrodes, as shown in the first three figures, the upper section 81 of the ring-shaped electrode-support is swung back into contact with the stop 76 on the side of the rear standard 71, and a milling-cutter, as 200, or other device to be heated, is placed endwise between the electrode-spindles 50 and 51, said spindle yielding slightly under the action of the springs 54 to permit the adjustment of the article to be heated. The upper section of the ring-shaped holder is then closed and locked by the locking device hereinbefore described. The electrodes 90 are then adjusted, so that their ends come in contact with the sides of the article to be heated, and clamped in position by means of the hinged clamping-plates 88. The electric currents are then switched on and enter the ends of the article through the supporting electrode-spindles 50 and 51 and pass out laterally or radially through the sides of the article by means of the stationary electrodes 90. In order to heat the article uniformly throughout its length the operator turns the crank 37 alternately in

opposite directions, whereby the carriage 30, carrying said electrode-spindles, is reciprocated, causing the work to be moved back and forth and the points of lateral contact of the stationary electrodes to be shifted longitudinally along the work. The direction of the currents may be reversed or shifted. Preferably alternating currents are employed. To avoid short-circuiting of the entire current through either of the branches of the positive cable 100 during the reciprocation of the carriage and the electrode-spindles, means are provided for equalizing the distance through which the currents passing through the branches 101 and 102 travel. The means herein shown for this purpose consist of mechanism for holding the rings 60 and 61 stationary, while the electrode-spindles slide back and forth through them during the reciprocation of the carriage. For this purpose a screw-rod 120 is supported horizontally of the machine in the standard 70, being clamped therein by a set-screw 121. Two brackets 130 and 131, provided with forked ends 132, are disposed on the screw-rod 120 opposite the electrode-spindles 50 and 51, respectively. Adjusting-nuts 133 are disposed on the screw-rod between the forks of the brackets and serve to adjust said brackets on said rod. Arms 140 and 141 are fastened at their lower ends to the brackets 130 and 131, being insulated therefrom. These arms are provided with semicircular forked ends 142, which engage the binding-posts of the collars 60 and 61 and hold the latter stationary during the reciprocations of the electrode-spindles, whereby an equal distance is maintained between each branch of the positive cable and the negative electrode.

The electrodes 90 for some kinds of work are preferably provided at their contact ends with anti-friction rollers of copper, platinum, or other suitable material, as illustrated in Fig. 6.

In some cases the electrodes 90 may be dispensed with and the opposite electrode-spindles 50 and 51 connected with opposite poles of the dynamo, as shown in Figs. 4 and 5.

In Fig. 4 a disk-shaped cutter 210 is interposed between the ring-shaped faces of the flat-headed electrode-spindles.

In Fig. 5 a cutter or other article 220, having a central aperture, is disposed on the arbor 230, which is supported endwise between the flaring-headed spindle. In this case the heating-point is developed midway between the electrode-spindles at the point 221, and the cutter or article 220 may be shifted on the arbor 230, as indicated by dotted lines, in order to distribute the heat uniformly throughout the cutter for the purpose of drawing the temper therein.

Rheostats may be used for regulating the currents.

I claim as my invention—

1. In an electric heater, the combination of

two electrodes disposed in position for contact with opposite ends of the article to be heated, and an electrode or electrodes disposed in position for contact with the sides of said article.

2. In an electric heater, the combination of two electrode-spindles disposed in alignment and adapted to support the work, and an electrode or electrodes disposed in position for contact with the work at points between the contact of the electrode-spindles.

3. In an electric heater, the combination of stationary electrodes, a bed, a sliding carriage thereon, electrode-spindles supported on said carriage, and means for reciprocating said carriage between the stationary electrodes.

4. In an electric heater, the combination of a bed, standards disposed at opposite sides of said bed, an electrode-holder supported on said standards, a stationary electrode or electrodes disposed in said holder, a sliding carriage on said bed, standards on said carriage provided with insulated sleeves, electrode-spindles disposed in said sleeves in alignment with each other for supporting the work, and means for reciprocating said carriage between the stationary electrodes.

5. In an electric heater, the combination of two standards provided with insulated sleeves, two electrode-spindles disposed in alignment and having their bearings in said sleeves, and springs for permitting the spindles to yield.

6. In an electric heater, the combination of a bed, standards disposed at opposite sides thereof and longitudinally adjustable thereon, an electrode-holder supported on said standards, electrodes disposed in said holder, a sliding carriage on said bed, end standards adjustable longitudinally on said carriage, electrode-spindles supported on said standards, and means for reciprocating the carriage.

7. In an electric heater, an electrode-holder consisting of a ring provided with insulated radial slots for containing the electrodes.

8. In an electric heater, an electrode-holder consisting of a ring composed of two sections hinged together and provided with insulated slots for containing the electrodes.

9. In an electric heater, an electrode-holder consisting of a ring provided with radial recesses and with hinged clamping-plates having corresponding radial recesses, said recesses forming insulated radial slots for containing the electrodes.

10. In an electric heater, the combination of two end standards provided with sleeves, flanged bushings disposed in said sleeves, and electrode-spindles the outer portions of which are of reduced diameters adapted to fit within the bushed sleeves, springs interposed between the flanges of the bushings and the shoulders of the spindles.

11. In an electric heater, the combination of two standards or supports provided with

insulated sleeves, two electrode-spindles disposed in said sleeves, and adjustable collars on said sleeves, provided with binding-posts.

12. In an electric heater, the combination of two electrode-spindles provided with flaring heads and supports for said spindles.

13. The method of heating an article by electricity which consists in subjecting the article to the action of electric currents entering in opposite directions at the ends of the article and passing out at the sides thereof.

14. The method of heating an article by electricity which consists in subjecting the article to the action of electric currents entering in opposite directions at the ends of the article and passing out at the sides thereof, the lateral meeting or impinging point of the currents being shifted longitudinally of the article during the passage thereof.

15. The method of heating an article by electricity which consists in subjecting it to the action of electric currents traversing the article in lines passing through the ends thereof and meeting or impinging at the sides thereof, the lateral meeting or impinging point or points of the currents being shifted longitudinally of the article during their passage therethrough.

16. In an electric heater, the combination of two electrode-spindles for contact with the work to be heated, an electrode or electrodes disposed in position for contact with the work at points between the contact of the electrode-

spindles, means for reciprocating the electrode-spindles and the work, and means for equalizing the distance between each branch of the positive cable and the negative electrode.

17. In an electric heater, the combination of stationary electrodes, a bed, a sliding carriage thereon, electrode-spindles supported on said carriage, conductive contact-pieces or rings on said spindles, cable connections therefor, and arms engaging said contact-pieces for holding them stationary during the reciprocation of the spindles.

18. In an electric heater, the combination of stationary electrodes, a bed, a sliding carriage thereon, electrode-spindles supported on said carriage, conductive contact-pieces or rings on said spindles, cable connections therefor, means for reciprocating said carriage between the stationary electrodes, a screw-rod supported parallel with said electrode-spindles, brackets disposed on said rod opposite said spindles, arms attached to said brackets and engaging said contact-pieces, and adjusting-nuts on said rod for adjusting said brackets and arms.

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. BENTON,
CHESTER MARR.