E. DENHAM.

FORMER FOR ARMATURE COILS.

APPLICATION FILED JAN. 5, 1907.

935,299.

Patented Sept. 28, 1909.

3 SHEETS—SHEET 1.

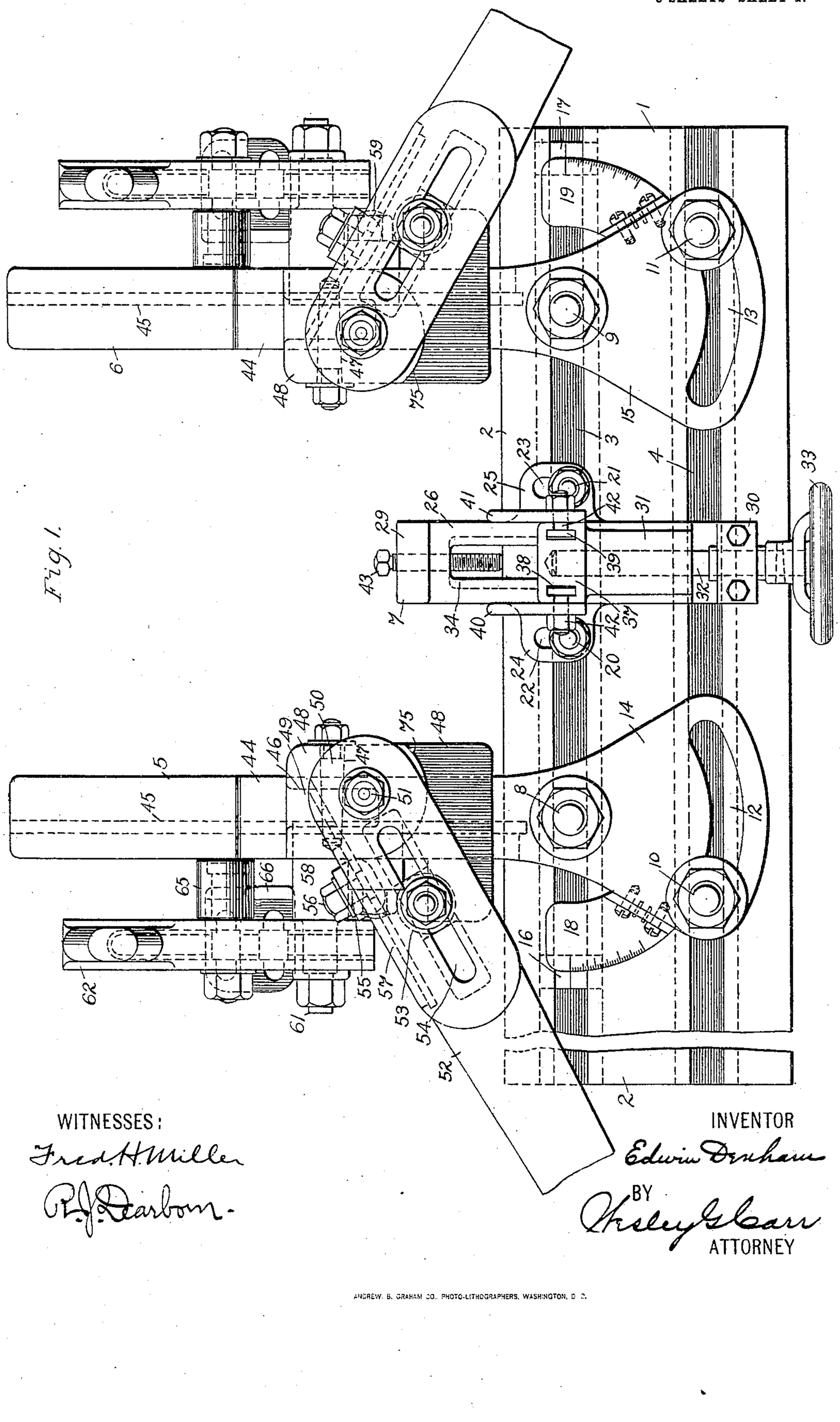

Fig. 1.

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3 SHEETS—SHEET 2.

Fig. 2.

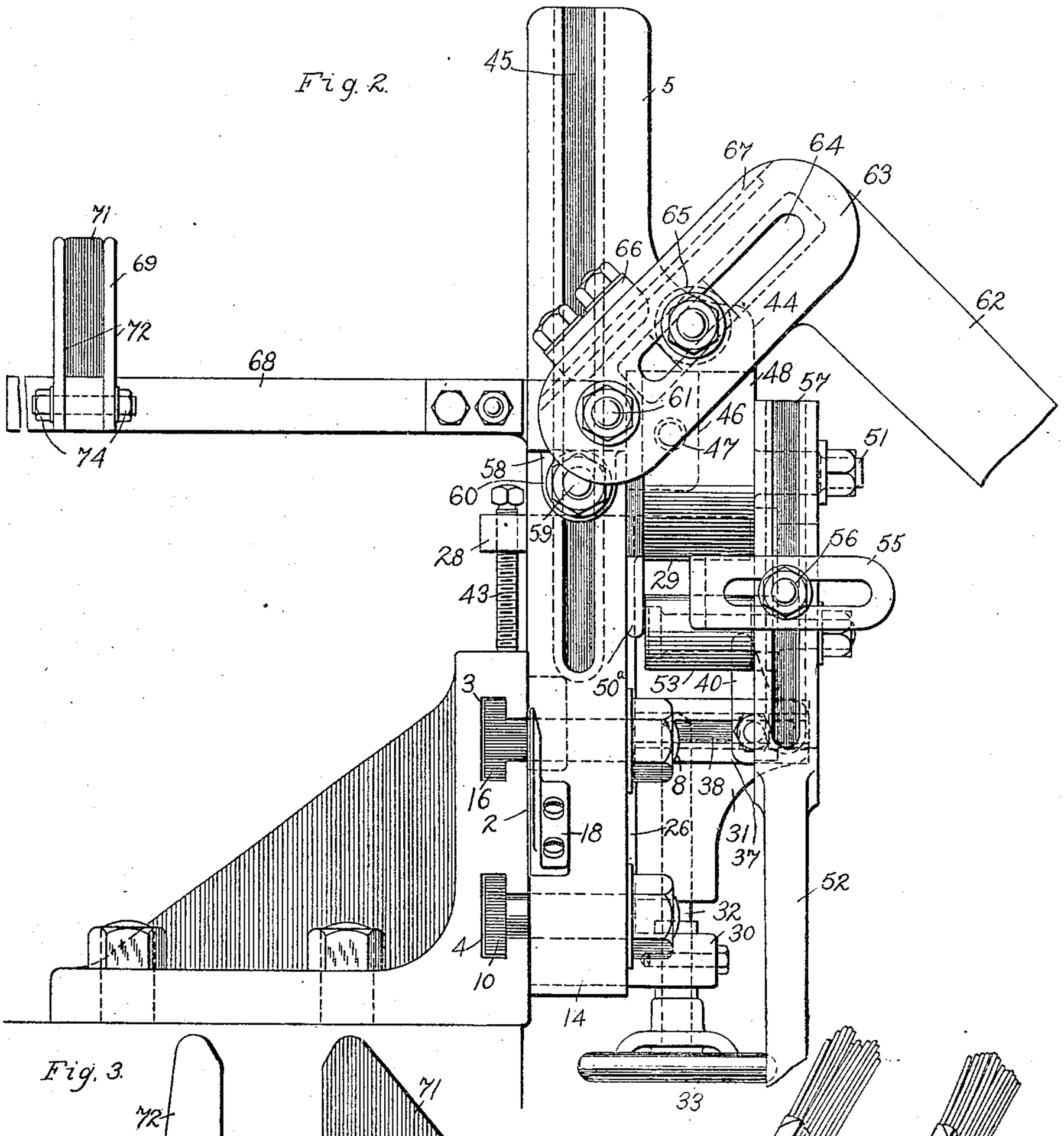


Fig. 3.

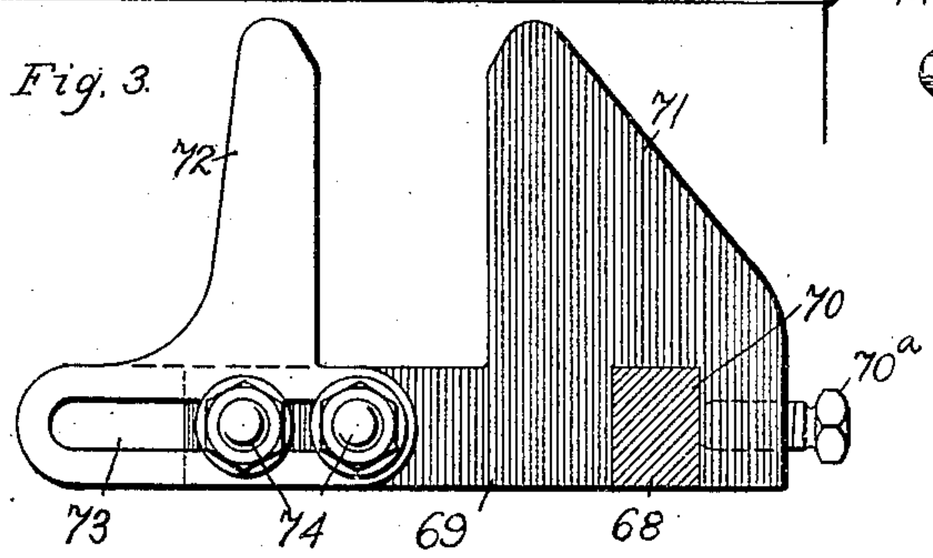
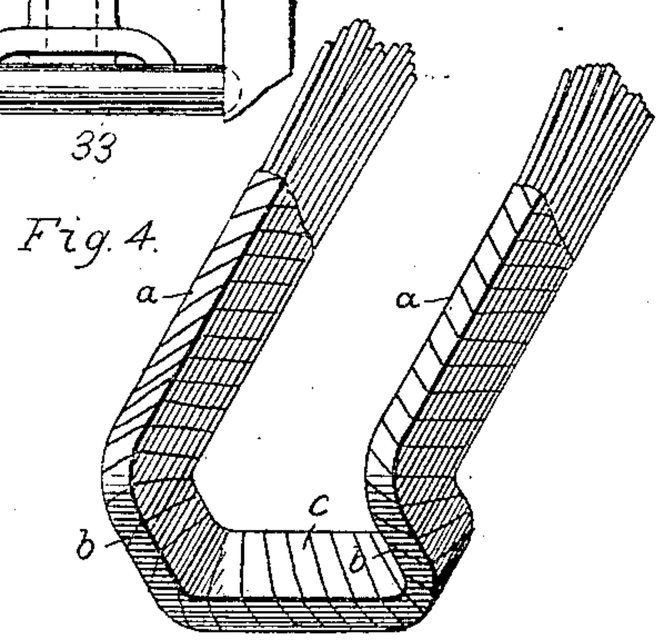


Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 5.

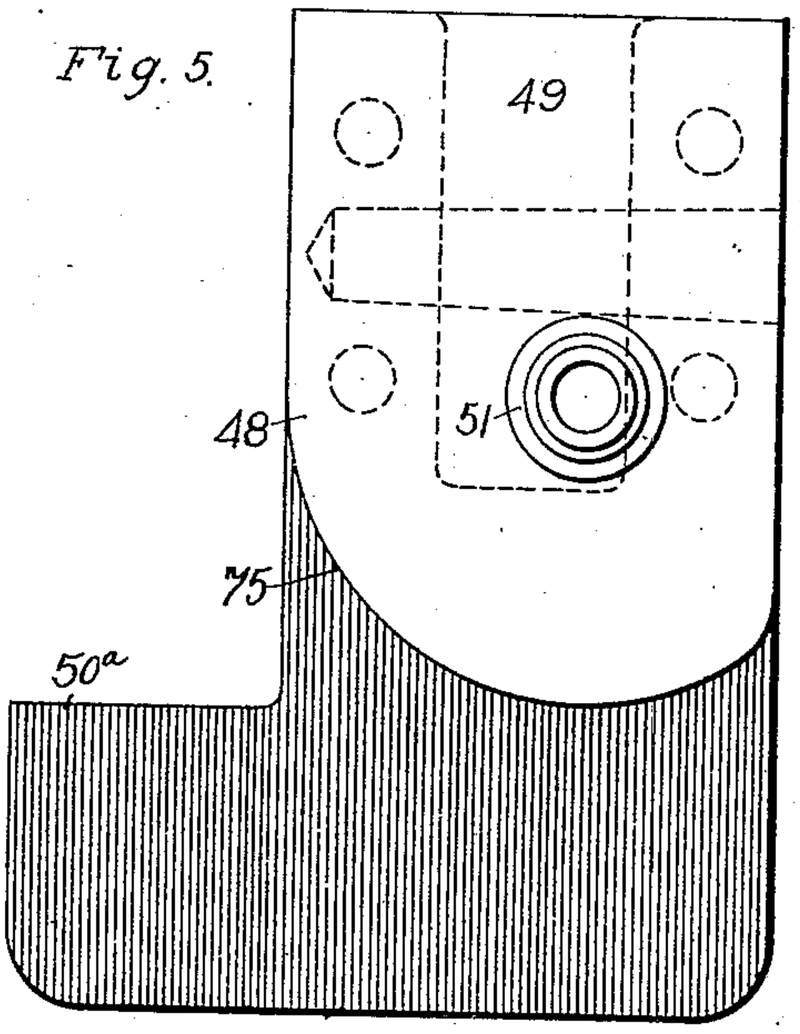


Fig. 6.

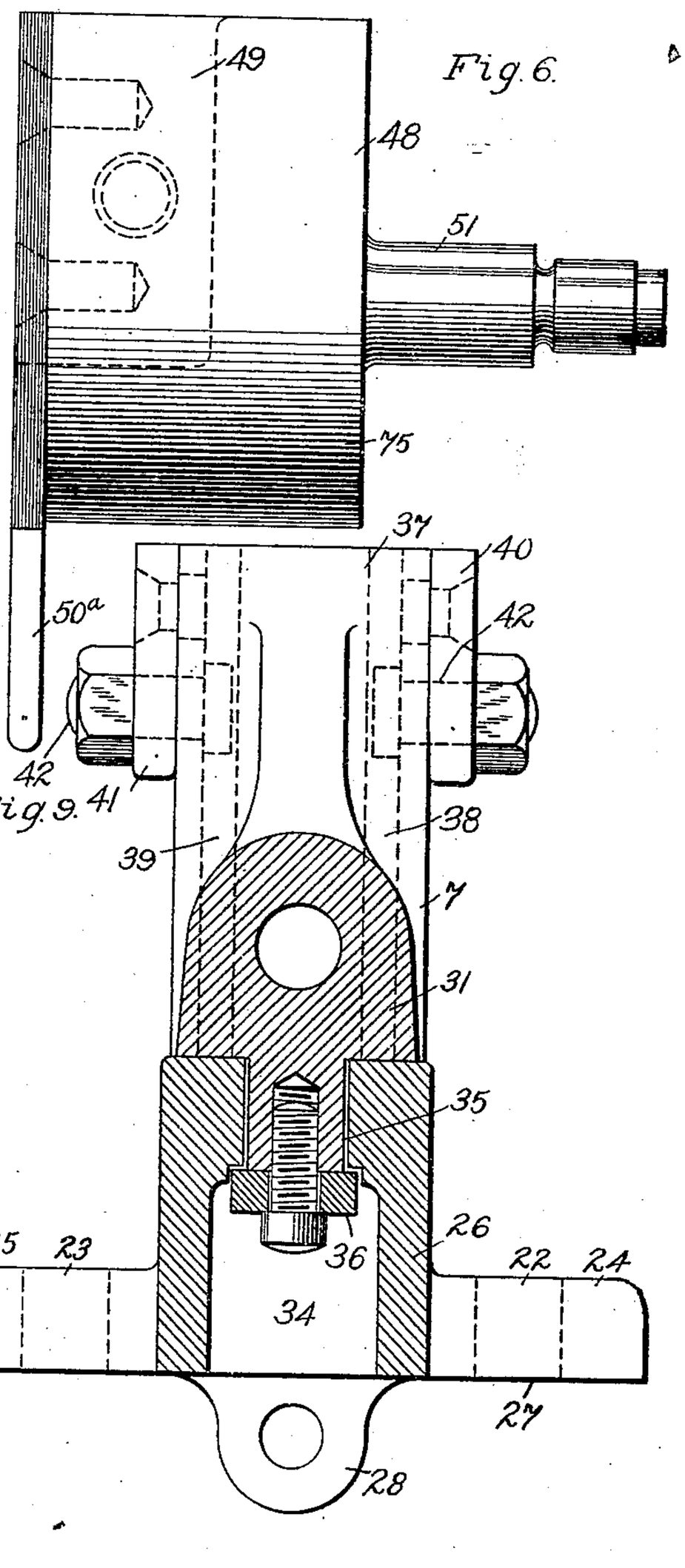


Fig. 7.

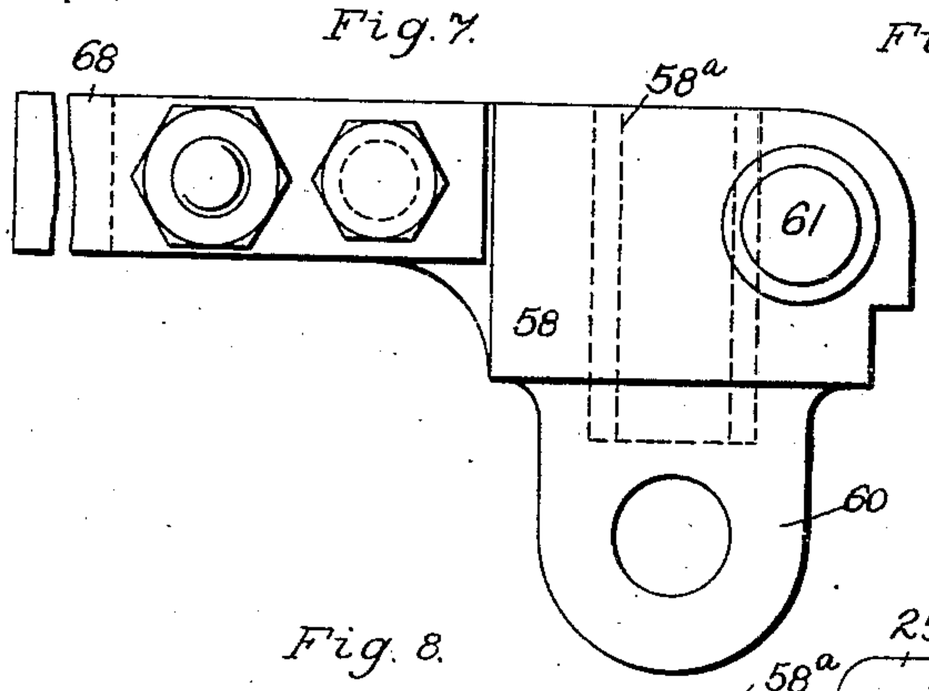
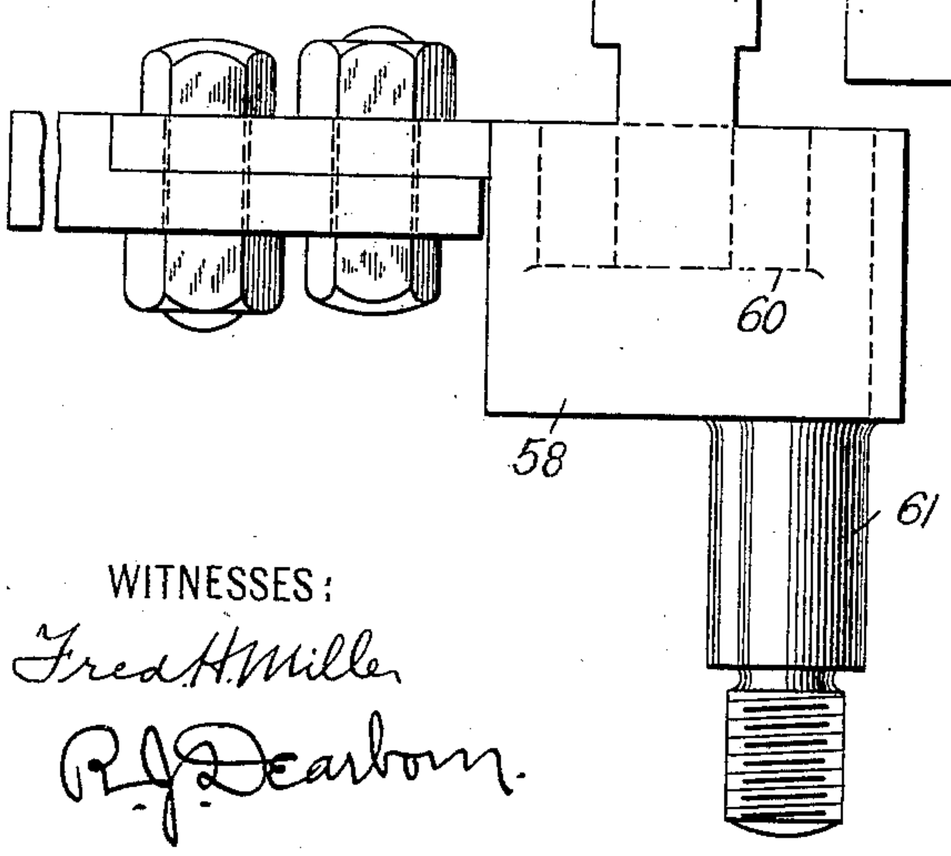


Fig. 8.



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UNITED STATES PATENT OFFICE.

EDWIN DENHAM, OF SWISSVALE, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

FORMER FOR ARMATURE-COILS.

935,299. Specification of Letters Patent. **Patented Sept. 28, 1909.**

Application filed January 5, 1907. Serial No. 350,966.

To all whom it may concern:

Be it known that I, EDWIN DENHAM, a citizen of the United States, and a resident of Swissvale, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Formers for Armature-Coils, of which the following is a specification.

My invention relates to formers for metal wire or strap coils and has special reference to formers for coils which are adapted for insertion in closed or partially closed armature slots for dynamo-electric machines.

The object of my invention is to provide a former, of the class above indicated, that shall be simple and durable in construction and that may be readily so adjusted as to be utilized in forming coils for armatures which are materially dissimilar in size and characteristics.

Electric generators of the stationary armature type, and other dynamo-electric machines having closed or partially closed slots, are often wound with coils that are formed apart from the machine and are then inserted into slots from one end, after which their open ends are suitably connected. Coils of this class have heretofore been made by winding a continuous coil of suitable form on a rotatable mold or jig, the closed coils being sawed open when complete to allow them to enter the armature slots. The expense and labor involved in the aforesaid method are very great since a special mold or jig must be constructed for every size and style of armature coil and it often occurs that an expensive jig may be provided for the windings of a single machine.

According to my present invention, I employ an adjustable former of improved design and construction which is adapted to make coils, by simple manual operations, from a group or bundle of straight insulated conductors of the proper length; while the adjustment of the device is so complete and so easily effected that a single former may readily be adapted for coils of machines which vary in size, speed, current capacity, and other characteristics.

My invention is illustrated in the accompanying drawings in which—

Figure 1 is a front and Fig. 2 an end elevation of a coil-former constructed in accordance therewith. Figs. 3, 5, 6, 7, 8, and 9 are detail views of the former shown in Figs. 1 and 2, and Fig. 4 is an isometric view of a coil which may be formed thereon.

Referring to the drawings, the device illustrated comprises an angle iron 1, or other suitable base, having a plain surface 2 and parallel grooves 3 and 4, adjustable arms 5 and 6 and a clamping device 7. The angle iron 1 may preferably be so supported that the surface 2 lies in a vertical plane and when this is the case the arms 5 and 6 assume upright positions. These uprights are supported by bolts 8 and 9 the heads of which are located in and are adjustable along the groove 3, said groove being enlarged at the bottom or under cut, in a well known manner, to receive the heads of the bolts. The uprights are further supported by bolts 10 and 11, the heads of which are located in the groove 4, and are rotatably adjustable about the bolts 8 and 9 as centers within limits which are determined by curved slots 12 and 13 formed in enlarged extremities 14 and 15 of the uprights to receive the bolts 10 and 11. An adjustment from the vertical is permitted by each of the slots 12 and 13 as hereinafter explained and the angle of obliquity is indicated for each upright by means of graduated blocks 16 and 17, that are also adjustable along the groove 3, in conjunction with protractors 18 and 19 that are attached to the outer edges of the respective enlargements 14 and 15.

The clamp 7, a sectional plan of which is shown in Fig. 9, comprises a base 26 having a plane surface 27 that is adapted to engage the plane surface 2, lateral projections 24 and 25 and end projections 28, 29, and 30; a sliding nut 31 and a feed screw 32 having a hand wheel 33 whereby the adjustment of the nut is effected. The base 26 is provided with a two-part slot 34, the wide part of which is adjacent to the surface 27. The

sliding nut 31 has a projection 35 which extends into the narrow part of the slot 34 and to which a gib 36 is bolted. The nut 31 extends upwardly to form a jaw projection 37, that coöperates with projection 29 and is provided with grooves 38 and 39 that are substantially perpendicular to the surface 27 and gage blocks 40 and 41, that are adjustably mounted upon the outer edges of the projection by means of bolts 42. The projection 28 extends over the upper edge of the angle iron 1 and is provided with a set screw 43 which facilitates the adjustment of the clamp in a line perpendicular to the groove 3.

The clamping device 7 is adjustable on the plane surface 2, along the groove 3, between the uprights 5 and 6 by means of bolts 20 and 21 which extend through parallel slots 22 and 23 in projections 24 and 25. The slots 22 and 23 are substantially perpendicular to the slot 3 so that a double adjustment of the clamping device is permitted.

The uprights 5 and 6 are similar to each other and are similarly equipped with oppositely disposed bender blocks and levers and, since the two sets of devices have the same mode of operation, the description hereinafter given will be confined to one upright and the parts attached thereto.

The upright 5 is provided with a longitudinal under-cut groove 45 in its outer edge and with a projection 44. The width of the projection 44 is the same as that of the body of the upright but a block 46, which is materially narrower, is located in the corner formed by the upright and the projection 44 and is provided with a taper hole 47.

A bender block 48, having a blind-mortise 49 which engages the block projection 46, is held in position by means of a taper plug 50 that extends through the mortise projections and through the taper hole 47. A guide plate 50^a is attached to the bender block and separates it from the upright 5. The bender block is provided with a pin-projection 51 upon which a lever 52 is rotatably mounted.

A bender roll 53 is adjustably mounted upon the lever 52, which is provided with a longitudinal slot 54 for this purpose, and a guide strip 55 for preventing the conductors from sliding laterally off of the roll 53 during the bending operation, is also adjustably mounted on the lever by means of a bolt 56 which engages an under-cut groove 57 in its edge.

A second bender block 58 is provided with a projection 58^a of T-shape in section that is adapted to engage the groove 45 in the outer edge of the upright 5 so that it may be adjusted along the upright and may be fixed in any desired position by a clamping bolt 59 which passes through a projection 60 upon the block to engage the groove. The bender block 58 is provided with a pin-projection 61 which corresponds to the projection 51 upon the block 48, but the arrangement of parts is such that vertical planes through the center lines of the two projections are substantially perpendicular to each other.

A bending lever 62 comprising a head 63, in which a slot 64 is provided, is rotatably mounted upon the pin-projection 61 and a bender roll 65 is adjustably attached to the slotted head 63. A guide 66, which corresponds to the guide 55 on the lever 52 and holds the conductors on the roll 65, is adjustably mounted in a groove 67 with which the head 63 is provided.

An arm 68 is attached to, and projects from, the bender block 58, and a clamping device 69 having a notch 70, which engages the strip 68, and is provided with a set screw 70^a is adjustably mounted thereon. The clamping device 69 comprises an angle block 71 and a pair of coil supports 72 that are provided with slots 73 and are adjustably attached to the angle block 71 by means of bolts 74, or other suitable means. (See Figs. 2 and 3).

The heads of the bolts that have been hereinbefore described as engaging the grooves, with which several parts of the coil former are provided, are preferably, but not necessarily, square or rectangular, finished enlargements which fit loosely into the undercut portions of the grooves. This means of adjustably attaching the parts to plane surfaces is well known in the art and is similar to that ordinarily employed for securing castings to planer beds and in other similar relations.

Coils of the type illustrated in Fig. 4 consist of two parallel straight portions *a* which are ultimately included in the core slots, two relatively short radial portions *b* which are at right angles to the portions *a* and an end connecting portion *c* which, in the assembled machine, has substantially the form of an arc, the center of which lies in the axis of the machine. The process of constructing a coil of this variety by means of the former illustrated in the drawings may be traced as follows: A bundle of conductors from which the coil may be constructed are first cut to a predetermined length and are then supported by the clamping device 7. The jaws of the clamp 7 formed by the parts 29 and 37, as above indicated, are adjusted by the hand wheel 33 to form an opening which is similar to the section of the slots in which the coil is to be located and to engage the conductors substantially at the middle point. The ends of the conductors extend, at this step in the operation, between surfaces 75 of the bender blocks 48 and the

bender rolls 53. The first bends in the coil between the portions *b* and *c* are now formed by rotating the lever 52 about the pin shaft 51 through an angle of substantially 90°, the position of the roll being first suitably adjusted relative to the surface of the bender block. As above stated, the portions *b* of the coil lie in substantially radial planes when assembled in the usual core slots of dynamo-electric machines so that the angle between the portions *b* and a chord connecting the juncture of these portions with the portion *c* varies somewhat from a 90° angle and, consequently, inasmuch as the portion *c*, as first formed, is straight, the uprights 5 and 6 are set at a suitable angle relative to the slot 3, which is indicated by protractors 18 and 19. The bends between the portions *a* and *b* are now formed in a similar manner by means of the lever 62, the bender roll and coil support of which are, of course, adjusted to the section of the completed coil. The ends of the bundle of conductors which form the portions *a* of the coil are now held in position by means of the clamp 69 until they may be tied together or wrapped with tape or other suitable insulating means.

It will be readily understood that when the adjustment of the former is once effected a large number of similar coils may readily be formed in a comparatively short time and when a sufficient number have been formed it may readily be readjusted to form some other desirable size and form of coil.

I desire that variations which do not depart from the spirit of my invention shall be included within its scope and that only such limitations be imposed as are indicated in the appended claims.

I claim as my invention:

1. In a coil-bender or former, the combination with a clamping device and a pair of rotatably adjustable substantially parallel arms, of two sets of bending means which are attached to the arms and act in perpendicular planes.

2. In a coil-bending machine, the combination with a bed plate, a clamping device located near the middle of the plate, and a pair of rotatably adjustable arms, of bending levers attached to the arms to act in perpendicular planes.

3. In a coil-bending machine, the combination with a clamping device, and a pair of rotatably adjustable arms, of levers pivotally attached to each of the arms to act in planes perpendicular to each other, bender rolls attached to the respective levers, and stationary guide or bender blocks which cooperate with the rolls.

4. In a coil-bending machine, the combination with a clamping device and a vertical bed plate, of a pair of arms attached thereto and longitudinally and rotatably adjustable thereon, and protractors for indicating their angles from the vertical.

5. In a coil-bending machine, the combination with a clamping device, vertical bed plate, and a pair of arms attached thereto and longitudinally and rotatably adjustable thereon, and protractors for indicating their angles from the vertical, of stationary bender blocks attached to the arms, levers rotatable in perpendicular planes and rolls which coöperate with the blocks and are mounted on the levers.

6. In a coil-bending machine, the combination with a bed plate, a clamping device thereon, a pair of arms supported by said bed plate and longitudinally and rotatably adjustable thereon, and means for indicating their angles of adjustment, of a pair of levers rotatably attached to the arms and acting in the plane of the bed plate, a second pair of levers acting in planes perpendicular to that of the bed plate, rolls mounted on the levers, and stationary bender blocks that coöperate with the rolls.

7. In a coil-bending machine, the combination with a vertical bed plate, a clamping device thereon, a pair of uprights attached to said bed plate and longitudinally and rotatably adjustable thereon, and means for indicating their angles of adjustment, of a pair of levers rotatably attached to the uprights and acting in the plane of the bed plate, a second pair of levers acting in planes perpendicular to that of the bed plate, rolls mounted on the levers, stationary bender blocks to coöperate with the rolls, and coil supports that project from the levers.

8. In a coil-bending machine, the combination with a bed plate, a clamping device thereon, a pair of arms attached to said bed plate and longitudinally and rotatably adjustable thereon, and means for indicating their angle of adjustment, of a pair of levers rotatably attached to the arms and acting in the plane of the bed plate, a second pair of levers acting in planes perpendicular to that of the bed plate, bender rolls adjustably mounted on the levers, and stationary bender blocks that coöperate with the rolls.

9. In a coil-bending machine, the combination with a bed plate, a clamping device thereon, a pair of arms attached to said bed plate and longitudinally and rotatably adjustable thereon, and means for indicating their angles of adjustment, of a pair of levers rotatably attached to the arms and acting in the plane of the bed plate, a second pair of levers acting in the planes perpendicular to that of the bed plate, rolls mounted on the levers, stationary bender blocks that coöperate with the rolls, and coil sup-

ports that project from the levers and are adjustably attached thereto.

10. In a coil-bender or former, the combination with a pair of arms rotatably adjustable in the same plane, of two sets of bending means attached to the arm and acting in perpendicular planes.

11. In a coil-bender or former, the combination with a pair of arms rotatably and longitudinally adjustable in the same plane, of two sets of bending means one of which acts in the adjusting plane of the arms and the other of which acts in a plane perpendicular thereto.

In testimony whereof, I have hereunto subscribed my name this 31st day of December, 1906.

EDWIN DENHAM.

Witnesses:
FRED. H. MILLER,
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