

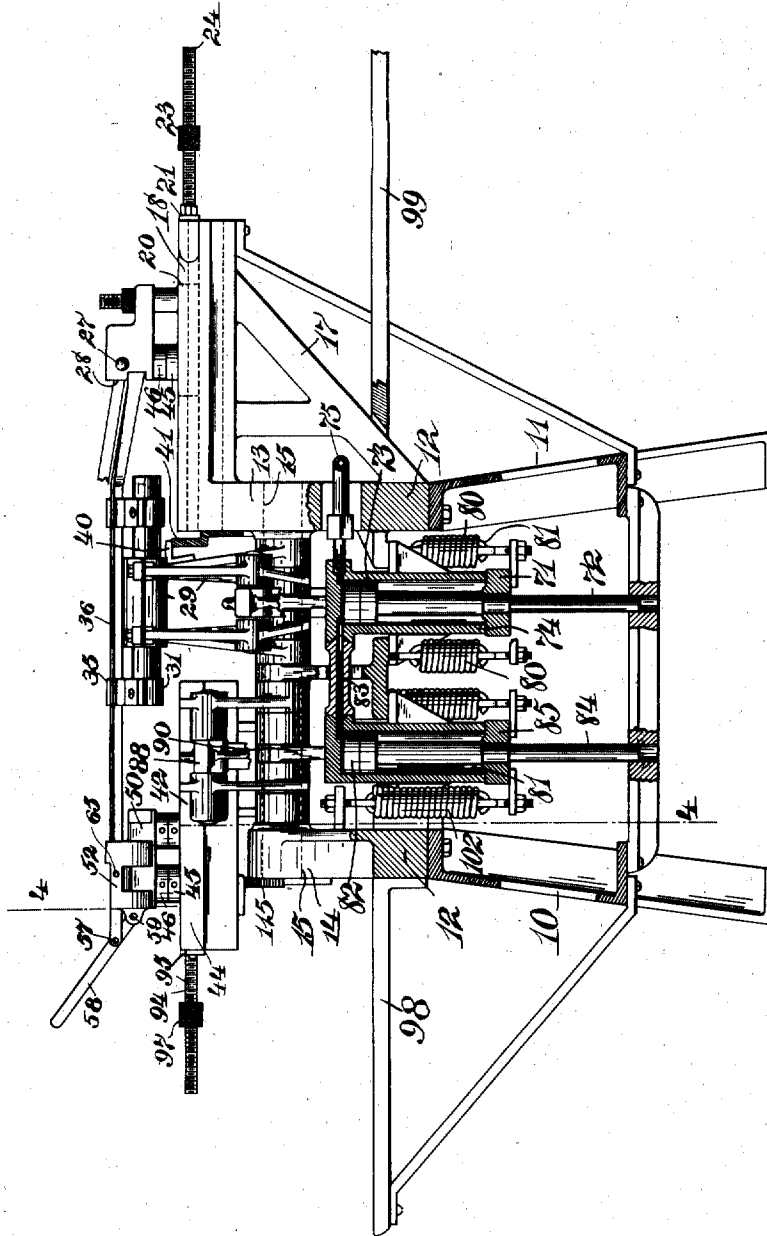
C. E. ANDERSON.
BENDING MACHINE.
APPLICATION FILED JUNE 13, 1911.

1,008,404.

Patented Nov. 14, 1911.

6 SHEETS—SHEET 1.

Fig. 1



WITNESSES:
John Kopp
Chas. A. Kelley

INVENTOR
Carl E. Anderson
BY
Wm. A. Campfield
ATTORNEY'S

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5 SHEETS—SHEET 2.

Fig. 3

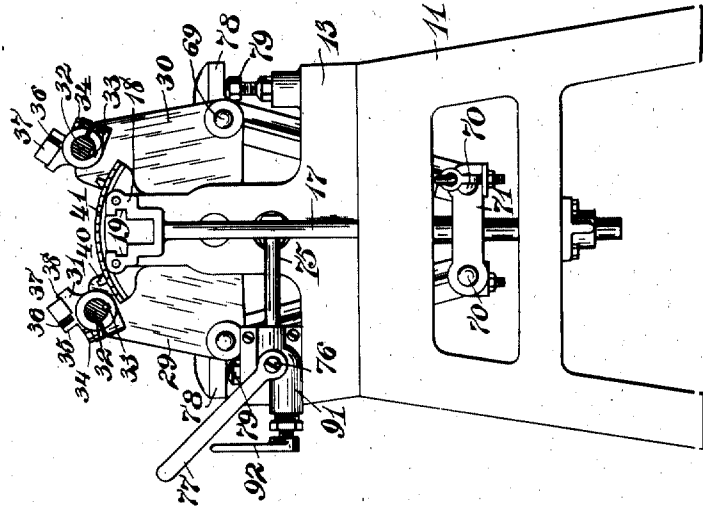
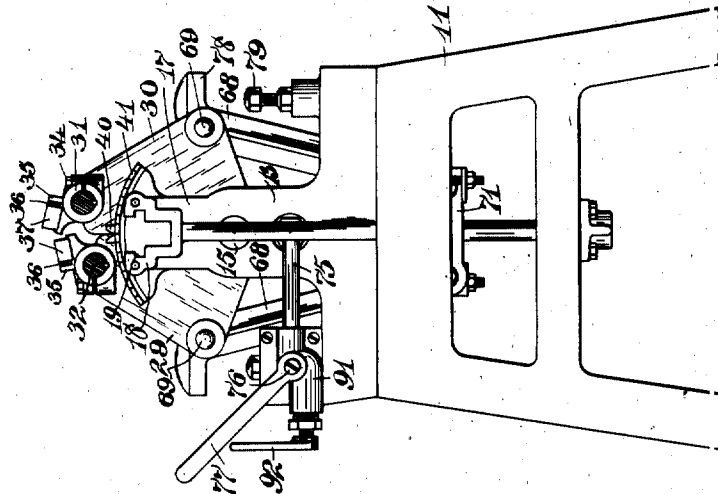


Fig. 2



WITNESSES:

John C. Koff
Chas. H. Kelley

INVENTOR

Carl E. Anderson,
BY
Wm. H. Crawford,
ATTORNEYS

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5 SHEETS—SHEET 2.

Fig. 5

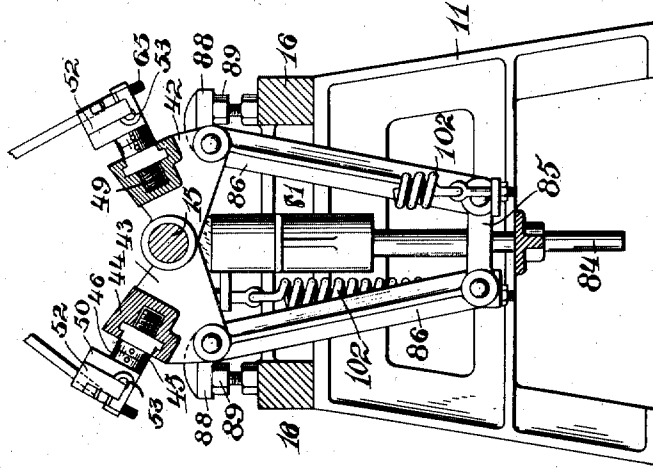
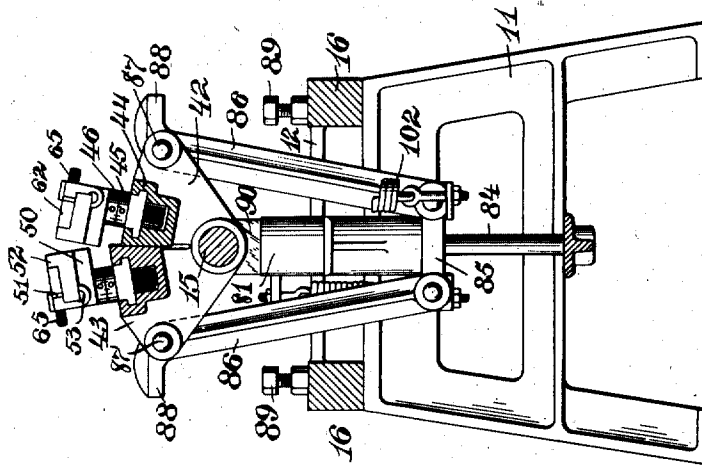


Fig. 4



WITNESSES:

John C. Kopf
Chas. H. Kelley

INVENTOR

Carl E. Anderson

BY

Wm. H. Campbell
ATTORNEYS

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5 SHEETS-SHEET 4.

Fig. 6

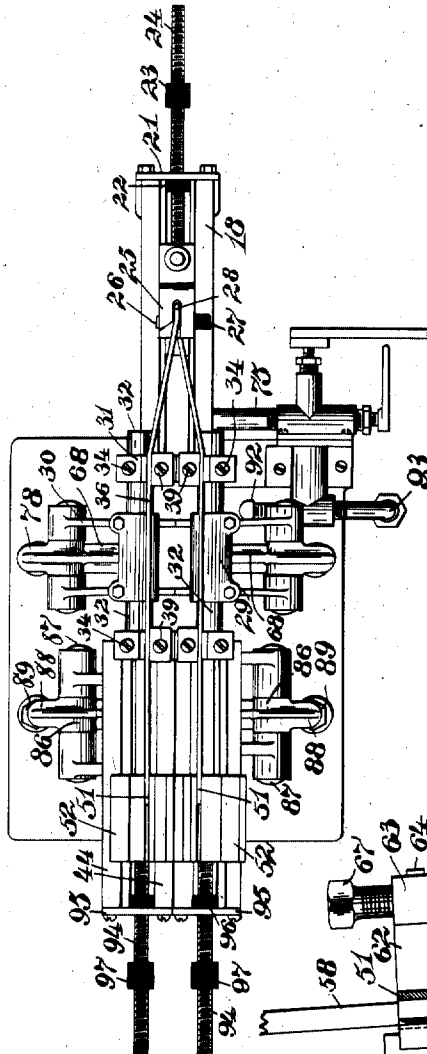


Fig. 8

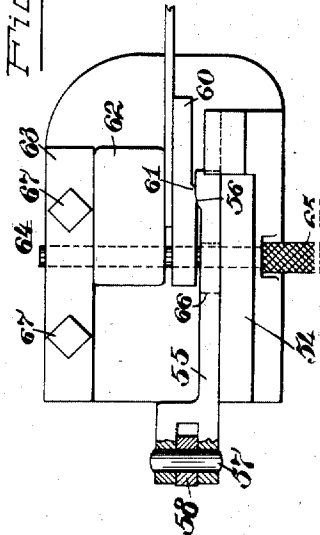
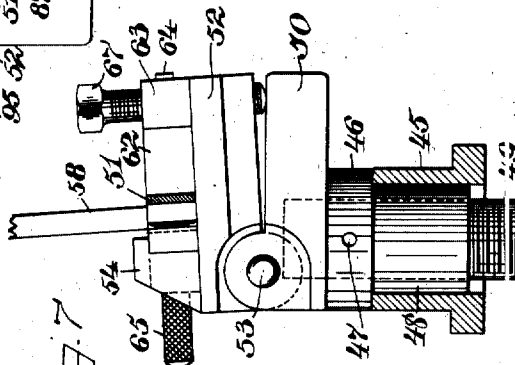


Fig. 7



Witnesses:
John C. Koff
Charles Kelley

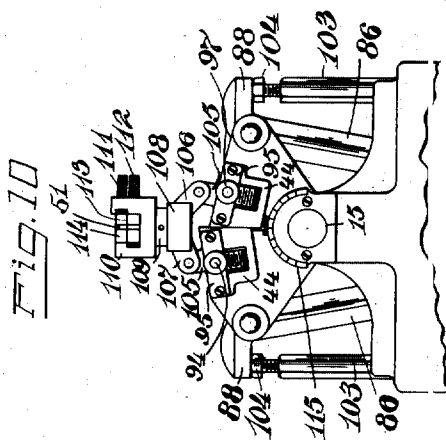
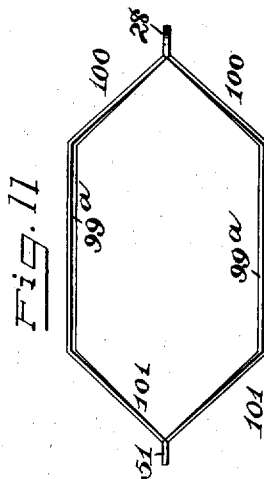
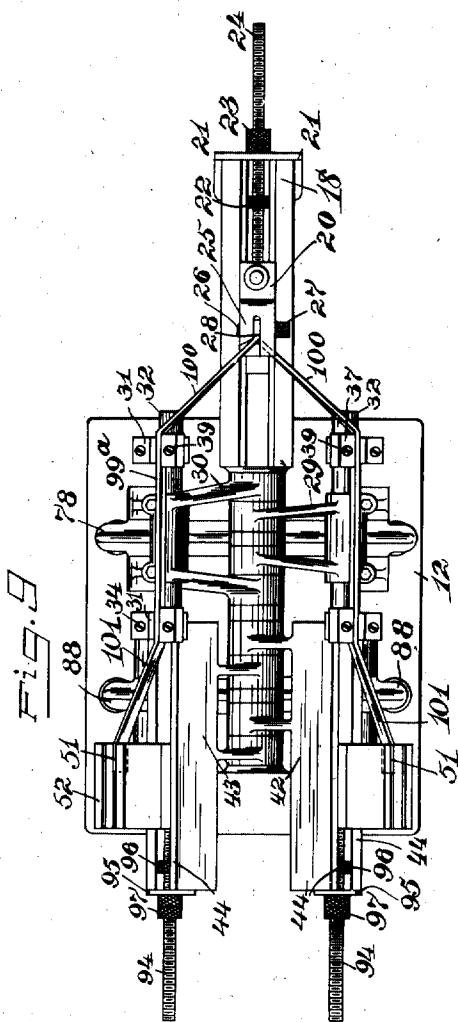
Inventor
Carl E. Anderson
By *Wm. H. H. H. H.* Attorney
Wm. H. H. H.

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5 SHEETS—SHEET 5.



WITNESSES:
John C. Kopf
Chas. A. Kelley

INVENTOR
Carl E. Anderson
BY
Wm. H. Campfield.
ATTORNEYS

UNITED STATES PATENT OFFICE.

CARL E. ANDERSON, OF EAST ORANGE, NEW JERSEY.

BENDING-MACHINE.

1,008,404.

Specification of Letters Patent.

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Application filed June 13, 1911. Serial No. 632,939.

To all whom it may concern:

Be it known that I, CARL E. ANDERSON, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Bending-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to figures of reference marked thereon, which form a part of this specification.

This invention relates to a machine which receives the substantially U-shaped strips of soft metal, preferably copper, and bends these strips into armature coils.

Armature coils are made in different forms, some diverging from their closed end and after being bent outward are brought together again at the other end, and in others the looped end of the U-shaped strip is held, and the strips are bent apart into parallel strands, and the termination of these strands are bent still farther apart and then into parallel ends. These different types of coils are used when different windings are employed in the armatures. It is necessary when making these coils to bend them apart varying distances according to the diameter of the armature, and the coils have their side strands arranged at different angles, depending on the number of coils that are placed into an armature. It has been customary heretofore in making these coils to form a block usually of metal over which the strips are placed and hammered by a hammer or mallet into the required shape. This takes time and is therefore expensive. Under this old system it has been necessary when a special type of armature is to be made to make a new block, and the block with its consequent finishing is expensive and also retards the beginning of the work.

My improved machine is adjustable so as to make different types of coils, that is, the coils that diverge from one end toward the other with the parallel strands at the sides as shown in Figure 9 of the drawing, and to also make the form of armature coil which is closed at its ends as shown in Fig. 11.

The machine is also designed to be regu-

lated so as to provide different degrees for the different coils, that is, the side strands are inclined according to the radius of the armature into which they are to be placed. The machine is also designed to take different thicknesses of metallic strips which are to be formed into coils. In this machine the insertion and removal of the strips into the machine is easy and quick and the coils can be bent in rapid succession, thereby making them cheap.

The invention is illustrated in the accompanying drawings, in which—

Fig. 1 is a side view of the machine with part of the mechanism shown in section. Fig. 2 is an end view with the lever for holding the end of the armature removed, and showing the levers for bending the strip in their closed or normal position. Fig. 3 is a view similar to Fig. 2 showing the levers drawn apart to bend the strip. Fig. 4 is a section on line 4—4, in Fig. 1 with the levers embracing the ends of the strip forming the coil in their closed positions, and Fig. 5 is a similar view with these levers forced apart. Fig. 6 is a top view of Fig. 1. Fig. 7 is a detail of one of the chucks for holding the strip and which can be adjusted to vary the angle of the side strands of the coil. Fig. 8 is a top view of Fig. 7. Fig. 9 is a top view of the machine similar to Fig. 6, but showing the strip bent into an armature coil. Fig. 10 is an end view of the top part of the machine showing the attachment which is inserted in the machine when the ends of the strip from which the coil is formed are to be held against separation. Fig. 11 is a top view of an armature coil formed from the strip when its ends are held against separation.

The machine comprises legs 10 and 11, one at each end of the machine, supporting a frame 12 which extends from the leg 10 to the leg 11 and rests thereon, the two upright ends of the frame 12 being formed into bearings 13 and 14, in which bearings is arranged a shaft 15, the frame also being provided with side strips 16 as shown in Figs. 4 and 5. One end of the frame 12 is formed into a bracket 17 provided with parallel guides 18 which are recessed as at 19 to hold an end-block 20 in sliding relation therewith. A stop-plate 21 bridges the ends of the guides 18, and nuts 22 and 23 are placed

on a screw 24, which screw is attached to the end-block 20 and slides freely through a perforation in the stop-plate 21, the nuts acting to limit the movement of the screw 24 and consequently of the end-block 20, a thread on the screw providing for the adjustment of the nuts according to the size and the form of armature coil to be bent, as will be hereinafter described. The end-block 20 is provided with cheek-pieces 25 which are perforated in line to receive a pin 26 having the finger-piece 27. The strip of material which is supplied in a U-shape, with a narrow loop on one end and parallel strands extending therefrom, is placed with its looped end 28 between the cheek-pieces 25 and then the pin 26 is inserted to hold that end. This insertion is done when the machine is in the position shown in Fig. 6 with the nut 22 back against the stop-plate 21 and the two strands of the strip are placed in the blocks which are adapted to separate or bend them apart.

On the shaft 15 are arranged a pair of levers 29 and 30 which are mounted on the shaft so that they swing thereon and to opposite sides of the machine, being provided with blocks 31 which are adapted to slide on the rods 32 and being held against turning by the keys 33 and held in engagement with the rods by means of the bolts 34, as will be evident. Each block 31 has a flange 35 against which the side strand 36 is placed as shown in Fig. 6, the blocks 31 being slid to their proper positions, and the strands 36 are then placed against the flanges 35 on each side, and the filler-pieces 37 are placed between the strand 36 and the ridge 38 and fastened on by the screws 39. These filler-pieces are movable on account of the different thicknesses of material used in the strands 36, and are adjustable according to the thickness of the strands. The levers 29 and 30 are each provided with a pointer 40, these pointers being adapted to travel on an index-plate 41 so as to provide for gaging the separation of the side strands 36 of the coil when the levers 29 and 30 are swung apart.

On the shaft 15 and adjacent to the levers 29 and 30 are the levers 42 and 43. Each of these levers has guides 44 in which are arranged to slide the sleeves 45, these sleeves being shown in detail in Fig. 7. In each sleeve 45 is a nut 46 which is provided with means for its engagement by a tool, preferably in the form of recesses 47 for engagement by a spanner wrench. The nut 46 has a reduced part 48 fitting into the sleeve 45, the nut being perforated and provided with a screw-thread in the perforation so as to receive the screw-threaded stud 49 which is fastened to a block 50, the block 50 providing the supporting means for engaging the end 51 of the strip from which the arma-

ture coil is to be made. The preferred form of holding the end 51 of the strip is by securing a leaf 52 at its outside edge so that it swings on the block 50, this being done by the pivotal connection 53. The leaf 52 is provided with an abutment 54 against which slides a bar 55 with the cam-face 56 thereon, the bar being pivoted as at 57 to a handle 58, which handle is shown particularly in Fig. 1 having its end secured as at 59 to the leaf 52. A bar 60 has a cam-surface 61 which is adapted to be engaged by the cam-surface 56 when the bar 55 is pulled downward by means of the handle 58, these cam-faces, when engaging each other, forcing the bar 60 sidewise to clamp the end 51 of the strip up against the filler-piece 62, which filler-piece is removable and can be of any thickness according to the thickness of the piece from which the armature coil is made. The filler-piece 62 fits against a flange 63 on the leaf 52, the flange 63, the filler-piece 62, the bar 60 and the abutment 54 all being perforated to receive a pin 64 with a finger-piece 65 thereon, the bar 55 being provided with a slot 66 through which the pin 64 passes, the slot permitting the sliding of the bar 55.

To provide for the varying angles at which the armature coils are made and to provide for the adjustment to bring about the proper angle at the end of the coil after it is bent, screws 67 are arranged in the leaf 52 and have their bottom ends bearing on the block 50 so that any adjustment on the screws will cause the leaf to swing on the pivotal connection 53 and the angle of the leaf can be adjusted so as to twist the end 51 of the strip of material of which the coil is made so that it assumes an angle to the perpendicular, irrespective of the distance the ends 51 are drawn apart. It will be evident that this adjustment as described for the leaf 52 can be applied to the blocks mounted on the rods 32 of the levers 29 and 30. Each of the levers 29 and 30 has a connecting-rod 68 pivotally connected as at 69 to each of the levers, and connected as at 70 to the crosshead 71, the crosshead in turn being mounted on a piston-rod 72 connected with the piston 73 in the cylinder 74. A pipe 75 provided with a valve 76 having a handle 77 thereon is adapted to conduct fluid under pressure when the valve 76 is opened so that the fluid under pressure passes into the cylinder 74 and forces the piston 73 down, and this carries the crosshead 71 with it and consequently the connecting-rod 68. The movement downward, caused by the admission of fluid under pressure to the cylinder, is limited by the engagement of the noses 78 on the connecting-rod 68 with the adjustable stops 79, which adjustable stops are preferably in the form of screws mounted in the side strips 16.

Springs 80 are connected with the cross-head 71 and also with the frame of the machine to return the levers, the connecting-rods and the piston to their normal positions when the fluid under pressure is shut off and the cylinder is vented, as will be hereinafter described. A cylinder 81 with a piston 82 is connected by means of the duct 83 to the cylinder 74 so that the piston 82 goes down at the same time the piston 73 goes down, the piston 82 carrying with it its piston-rod 84, the crosshead 85 and the connecting-rods 86, (see Figs. 4 and 5). The connecting-rods 86 are secured to the levers 42 and 43 by the pivotal connections 87 and have the noses 88 to engage the adjustable stops 89 which are preferably in the shape of screws fastened to the side strips 16 and adjustable so as to regulate the amount of movement of the levers 42 and 43.

Struts 90 are mounted on the shaft 15 and bear on the tops of the cylinders 74 and 81 and thus equalize the pressure and transmit the pressure so that the shaft 15 is not subjected to undue strain, neither is the head of either of the cylinders, as the upward pressure from the head of each cylinder is communicated to its strut 90, and this transmits an upward pressure against the shaft 15 to counteract the downward pressure caused by the pull on the levers 29, 30, 42 and 43 to swing them apart. When the fluid under pressure is shut off by the valve 76 the cylinder can be vented by the valve 91 operated by the handle 92, and the fluid in the cylinders 74 and 81 is forced out by the pistons through the pipe 75, the valve 91 and the outlet pipe 92. (Fig. 6).

93 is the supply pipe which provides for the supply of fluid under pressure to the machine.

The interior construction of the valves is not shown because they are of the common form as used under conditions as above described.

Each block 50 is provided with a screw 94, each screw being adapted to pass freely through a perforation in the end-plates 95 secured to the ends of the levers 42 and 43. Stop-nuts 96 providing means for limiting the movement of the blocks are placed on the screw 94, the nuts 96 limiting the outward movement of the blocks and the nuts 97 limiting the inward movement of the blocks when they slide on their levers. Suitable tables 98 and 99 can be conveniently placed on the machine for holding the partly prepared and the finished products of the machine.

The operation of the machine for bending armature coils that are divergent at one end and closed at the other end is as follows: The armature coil which comes flat and U-shaped, the two branches of the U being

separated by a very slight opening and having a loop on one end, is placed with its loop 28 held by the pin 26 between the check-pieces 25 of the end-block 20, the end-block 20 being slid back as shown in Fig. 6, and the two strands of the strip are separated and placed between the filler-pieces 37 and the flanges 35 on each of the blocks 31, one being raised slightly higher than the other because when the armature coils are placed in an armature they must nest, that is, one strand of one goes over the adjacent strand of the other, and the coils for this reason do not have their opposite sides aligned circumferentially. Each of the screws 39 is screwed down to hold the strip securely, and each of the blocks is fastened by means of its bolt or screw 34 at the proper place on the rod 32 on each of the levers 29 and 30, and then the ends 51 of the strip are placed securely in each of the leaves 52. By first pushing in the handle 58, which releases the two cam-surfaces 56 and 61 of the bars 55 and 60, this being shown in Fig. 8, each of the leaves 52 and its block 50 has been previously slid forward in the guides 44 as shown in Fig. 6 and then the handle 58 on each of the leaves is pulled out to securely clamp the end 51 tightly in place. The strip is then in the position shown in Fig. 6. The operator then opens the valve 76 by means of the lever 77 and fluid under pressure is admitted through the passage 75 into the cylinders 74 and 81, and this causes the crossheads 71 and 85 to be forced downward carrying the connecting-rods 68 and 86, the rod 68 being forced down to the position shown in Fig. 3, spreading the sides of the coil to form the side strands 99^a shown in Fig. 9, connected by the divergent strands 100 which lead from the loop 28, this operation having drawn the end-block 20 inward, the movement of the block being limited by the nuts 22 and 23. At the same time the connecting-rods 86 have drawn back the levers 42 and 43 from the positions shown in Fig. 4 to the positions shown in Fig. 5 and as also illustrated in Fig. 9. The ends 51 of the strip of material from which the armature coil is being made are bent outward the required distance and also at the required angle, being connected to the side strands 99^a by the oblique strands 101. This movement of the ends has been permitted by the sliding of the blocks 50 with their leaves 52, this sliding being limited by the nuts 97 on the screws 94 engaging the end-plates 95. This completes the operation of bending the armature coil, and by throwing forward the two levers 58, one on each leaf 52, and pulling out the pin 26 by its finger-piece 27, the bent coil can be removed from the machine while it is in the position shown in Fig. 9. The vent valve 91 is then opened, the fluid under pressure

is permitted to pass from the cylinders 74 and 81, the springs 80 and 102 return the levers to their normal positions shown in Fig. 2 and Fig. 4, and the machine is ready for receiving another strip of material. It will be noted that when the filler-pieces 37 have been once adjusted for a certain size strip they need not be changed when each strip is inserted, since the strip can be easily slipped down behind each filler-piece.

When it is desired to bend an armature coil as shown in Fig. 11 I first lock the levers 42 and 43 against any movement by reason of the standards 103 and the stop-pieces 104 being placed under each nose 88 of the connecting-rods 86, thereby holding these levers against movement. I then replace each of the sleeves 45 by a plate 105, these plates supporting, by means of the arms 106 and 107, the block 108, which block receives a nut 109 similar to the nut 46 shown in Fig. 7, providing for the vertical adjustment of the block 110 which is provided with pins 111 and 112 which are employed to hold the filler-pieces 113 and 114 to bind the two ends 51 one above the other, and then when the machine is operated by the introduction of fluid under pressure the plates 105 can move inward and the block 20 can move inward, and the center of the coil being spread apart, it is shaped as shown in Fig. 11 with the side strands 99^a and the divergent strands 100 being bent as previously illustrated, but the oblique strands 101 being formed to converge with the ends 51 together as shown in Fig. 11, instead of diverging to throw the ends 51 apart as shown in Fig. 9.

The index-plate 41 and also the index-plate 115 (see Fig. 10) are used to indicate the throw of the levers and permit their being stopped at the proper point by the adjustable stops 79 and 89. These index-plates can have their top surfaces provided with the distance between the strands indicated, and the front of the plates can be indexed by degrees.

It will be evident from this description that the strips can be bent into coils quickly and cheaply and the angle of the side strands and the ends 51 can be regulated by means of the screws 67 tilting the leaves 52 to the required angle. In this way it is not necessary to always have each of the side strands 99^a, when bent apart, radial to the shaft 15, but by means of this adjustment they can be made to assume an angle tangential to the shaft 15, and the coils can be bent to fit different diameters of armature and also to have different spread so as to provide for different numbers of coils for armatures.

Having thus described my invention, what I claim is:—

1. A bending machine comprising mov-

able blocks for grasping the ends of a U-shaped strip of material, blocks for holding the two strands of the strip intermediate of its ends, and means for moving the last-mentioned blocks away from each other to separate the strands intermediate of their ends.

2. A bending machine comprising movable blocks for grasping the loop and the free ends of a U-shaped strip of material, means for limiting the movement of the blocks toward and from each other, blocks for holding the strands of the strip between the ends and the loop, and means for moving the last mentioned blocks away from each other to separate the strands and cause the strands to move the first-mentioned blocks toward each other.

3. A bending machine comprising end blocks movable toward and from each other, said blocks grasping a U-shaped strip at its loop and at its free ends, levers swinging transversely between the end-blocks, means on the levers for holding the strands between the end-blocks, and means for swinging the levers apart.

4. A bending machine comprising end-blocks movable toward and from each other, said blocks grasping a U-shaped strip at its loop and at its free ends, means for limiting the movement of the blocks toward and from each other, levers swinging transversely between the end-blocks, means on the levers for holding the strands between the end-blocks, means for regulating the swing of the levers, and means for swinging the levers apart.

5. A bending machine comprising end-blocks movable toward and from each other, said blocks grasping a U-shaped strip at its loop and at its free ends when moved to their limit of movement away from each other, levers swinging transversely between the end-blocks, means on the levers for holding the strands between the end-blocks, adjusting means for the holding means for regulating the points at which the holding means engages the strands, and means for swinging the levers apart.

6. A bending machine comprising end-blocks movable toward and from each other, said blocks grasping a U-shaped strip at its loop and at its free ends when moved to their limit of movement away from each other, levers swinging transversely between the end-blocks, means on the levers for holding the strands between the end-blocks, adjusting means for the holding means for regulating the points at which the holding means engages the strands, means for limiting the swing of the levers away from each other, and means for swinging the levers apart, the transverse movement of the strands from each other caused by the swinging of the levers acting through the strands to pull the end-blocks toward each other.

7. A bending machine comprising end-blocks movable toward and from each other, said blocks grasping a U-shaped strip at its loop and at its free ends, the blocks which
 5 grasp the strip at its free ends being also movable transversely, means for moving the last-mentioned end-blocks transversely, blocks for holding the strands intermediate of the free ends and the loop, means for moving
 10 the holding means transversely, and means for limiting the movement of the holding means.

8. A bending machine comprising a movable end-block for receiving the loop of a U-shaped strip, a pair of movable end-blocks for engaging the free ends of said strip, levers supporting the last-mentioned blocks for swinging them apart, means for limiting the swing of the levers, a second set of levers,
 10 blocks on the second set of levers for holding the strands of the strip between the loop and its ends, means for swinging the second set of levers apart, means for limiting the movement of the second set of levers, and
 15 means for returning the levers to their normal position when the lever-operating mechanisms are inoperative.

9. A bending machine comprising a frame, a block mounted to slide in one end of the
 20 frame, means on the block for grasping the loop of the U-shaped strip, a pair of sliding blocks mounted on the end of the machine opposite the first-mentioned block, means on the last-mentioned pair of blocks for grasping
 25 the free ends of the strip, a shaft mounted in the frame, levers pivoted on the shaft and arranged to swing apart, blocks on the levers for holding the strands between the loop and the free ends, means for adjust-
 30 ably securing the blocks on the levers, and means for swinging the levers apart to separate the strands transversely to cause the end-blocks at the opposite ends of the machine to move toward each other.

10. A bending machine comprising a frame, a block slidably mounted in one end of the frame, means on the block for receiving the loop of a U-shaped strip, blocks slidably mounted in the end of the machine
 35 opposite the first-mentioned block, said last-mentioned blocks having means for grasping the free ends of the strip, a shaft, a cylinder mounted beneath the shaft, a piston in the cylinder, a piston-rod on the piston, levers
 40 arranged to swing on the shaft adapted to be moved toward and from each other, means on the levers for holding the strands between the free ends and the loop, connecting-rods secured to the levers, an operative
 45 connection between the connecting-rods and the piston-rod of the cylinder, and means for admitting fluid under pressure to the cylinder to force the levers apart.

11. A bending machine comprising a frame,
 5 a block slidably mounted in one end of the

frame, means on the block for receiving the loop of a U-shaped strip, blocks slidably mounted in the end of the machine opposite the first-mentioned block, said last-mentioned blocks having means for grasping the
 70 free ends of the strip, a shaft, a cylinder mounted beneath the shaft, a piston in the cylinder, a piston-rod on the piston, levers arranged to swing on the shaft adapted to be moved toward and from each other,
 75 means on the levers for holding the strands between the free ends and the loop, connecting-rods secured to the levers, an operative connection between the connecting-rods and the piston-rod of the cylinder, means for ad-
 80 mitting fluid under pressure to the cylinder to force the levers apart, means for venting the cylinder, and means for returning the levers and their operating mechanism to normal position when the cylinder is vented.

12. A bending machine comprising a frame, an end-block slidably mounted in one end of the frame, means in the end-block for grasping the loop of the U-shaped strip, a pair of blocks mounted to slide in the end of the frame
 90 opposite the first-mentioned block, means on the pair of blocks for grasping the free ends of the strip, means for limiting the sliding movement of the blocks at opposite ends of the machine toward each other, means for
 95 swinging the pair of blocks which grasp the ends of the strip from each other, means for limiting the swinging of the blocks, a pair of levers adapted to swing apart, blocks on the levers, means for adjustably securing
 100 the blocks on the levers so as to vary the distance between the blocks and the same lever, and means for swinging the levers apart.

13. A bending machine comprising a frame,
 105 an end-block slidably mounted in one end of the frame, means in the end-block for grasping the loop of the U-shaped strip, a pair of blocks mounted to slide in the end of the frame opposite the first-mentioned block,
 110 means on the pair of blocks for grasping the free ends of the strip, means for limiting the sliding movement of the blocks at opposite ends of the machine toward each other, means for swinging the pair of blocks which
 115 grasp the ends of the strip from each other, means for limiting the swinging of the blocks, a pair of levers adapted to swing apart, blocks on the levers, means for adjustably securing the blocks on the levers so
 120 as to vary the distance between the blocks and the same lever, means for swinging the levers apart, means for limiting the movement of the levers away from each other, and means for returning the levers to their
 125 normal position when the swinging means of the levers is inoperative.

14. A bending machine comprising a frame, a block sliding in one end of the frame, adjust-
 130 able means for limiting the sliding

- movement of the block, levers mounted to swing in the end of the machine opposed to the block, a block on each lever, adjustable means for limiting the movement of each block on its lever toward and from the first-mentioned block, means for swinging the levers apart, a second set of levers, means for swinging the second set of levers apart, and means for returning all the levers to their normal position when the lever-operating mechanisms are inoperative.
15. A bending machine comprising a frame, a block slidably mounted in one end of the frame, means in the block for securing a strip, a shaft in the frame, levers on the shaft, a block sliding on each lever, means for limiting the movement of the first-mentioned block, means for limiting the movement of the blocks on the levers, the blocks being adapted to be moved toward and from each other, a second set of levers, blocks on the second set of levers, cylinders, operative connections between the cylinders and the levers for forcing them apart, means for admitting fluid under pressure to the cylinders, and means for returning the levers to their normal positions when the fluid under pressure is shut off and the cylinders are vented.
16. A bending machine comprising a frame, a block slidably mounted in one end of the frame, means in the block for securing a strip, a shaft in the frame, levers on the shaft, a block sliding on each lever, means for limiting the movement of the first-mentioned block, means for limiting the movement of the blocks on the levers, the blocks moving in a direction toward and from each other, a second set of levers, blocks on the second set of levers, cylinders, crossheads on the cylinders, means for controlling the admission of fluid under pressure to and from the cylinders, connecting-rods secured to the crossheads and to the levers to swing the levers apart when fluid is admitted to the cylinders, and springs for forcing all the levers to their closed positions when the cylinders are inoperative.
17. A bending machine comprising a frame, a block slidably mounted in one end of the frame, means in the block for securing a strip, a shaft in the frame, levers on the shaft, a block sliding on each lever, means for limiting the movement of the first-mentioned block, means for limiting the movement of the blocks on the levers, the blocks moving in a direction toward and from each other, a second set of levers, blocks on the second set of levers, cylinders, crossheads on the cylinders, means for controlling the admission of fluid under pressure to and from the cylinders, connecting-rods secured to the crossheads and to the levers to swing the levers apart when fluid is admitted to the cylinders, springs for forcing all the levers to their closed positions when the cylinders are inoperative, and adjustable means on the frame for regulating and limiting the outward swing of the levers.
18. A bending machine comprising a frame, levers mounted on the frame and adapted to swing apart, means on the levers for engaging the sides of a U-shaped strand, means for swinging the levers apart, and yielding means for holding the loop and the free ends of the U-shaped strand to permit the spreading of the intermediate portion of the strip by the levers.
19. A bending machine comprising a frame, a shaft in the frame, levers swinging on the shaft, blocks adjustably secured on the levers for engaging the strands of a U-shaped strip, means for swinging the levers apart, means for normally returning the levers to their closed position, means for limiting the outward swing of the levers, and yielding means for holding the loop and the free ends of the U-shaped strand.
20. A bending machine comprising a frame, a shaft on the frame, levers arranged to swing on the shaft, blocks on the levers, means for adjusting the blocks on the levers longitudinal with the shaft, a cylinder under the levers, connecting-rods secured to the levers and connected with the cylinder to be operated thereby when fluid under pressure is admitted to the cylinder, means for limiting the movement of the connecting-rods, means for returning the levers to their normal position when the cylinder is vented, and yielding means for holding the loop and the free ends of a U-shaped strip engaged by the blocks on the levers.
21. A bending machine comprising a frame, a shaft on the frame, levers arranged to swing on the shaft, blocks on the levers, means for adjusting the blocks on the levers longitudinal with the shaft, a cylinder under the levers, connecting-rods secured to the levers and connected with the cylinder to be operated thereby when fluid under pressure is admitted to the cylinder, means for limiting the movement of the connecting-rods, means for returning the levers to their normal position when the cylinder is vented, blocks sliding in the machine, stop-plates on the frame, screw-threaded rods on the blocks, nuts on the rods for engaging the stop-plate thereby limiting the movement of the blocks toward and from each other, and means on the blocks for engaging the loop and the free ends of a U-shaped strip.
22. A bending machine comprising a frame, a shaft in the frame, levers swinging on the shaft, blocks on the levers for engaging the side strands of a U-shaped strip, a movable block for engaging the loop of the strip, means for forcing the levers apart, swinging leaves on the blocks for engaging the side strands, means for adjusting the

swinging leaves to regulate the angle of the side strands, and means for forcing the levers apart.

23. A bending machine comprising a frame, a shaft in the frame, levers swinging on the shaft, blocks on the levers for engaging the side strands of a U-shaped strip, a movable block for engaging the loop of the strip, means for forcing the levers apart, swinging leaves on the blocks for engaging the side strands, means for adjusting the swinging leaves to regulate the angle of the side strands, means for forcing the levers apart, and means for limiting the outward movement of the levers.

24. A bending machine comprising a frame, a shaft in the frame, a block on one end of the frame and sliding therein, means on the block for grasping the loop of a U-shaped strip, levers on the shaft, means on the levers for grasping the side strands of the strip, means for tilting the grasping means, and means for swinging the levers apart.

25. A bending machine comprising a frame, a shaft in the frame, a block on one end of the frame and sliding therein, means on the block for grasping the loop of a U-shaped strip, levers on the shaft, means on the levers for grasping the side strands of the strip, means for tilting the grasping means, means for swinging the levers apart, means for limiting the outward movement of the levers, and means for returning the levers to their closed position when the swinging means is inoperative.

26. A bending machine comprising a frame, a shaft in the frame, blocks on the opposite ends of the machine, means on the blocks for grasping the loop and the free ends of a U-shaped strip, levers for supporting the blocks on the free ends of the strip, a second set of levers, adjustable blocks on the second set of levers for grasping the side strands of the strip, side strips on the machine, adjustable stops on the side strips of the machine, cylinders mounted beneath the shaft, pistons and piston-rods in the cylinders, crossheads on the piston-rods, connecting-rods secured to the crossheads and to the levers, means for admitting fluid under pressure to the cylinders, means for venting the cylinders, and means on the connecting-rods for engaging the adjustable stops for limiting the swing of the levers.

27. A bending machine comprising a frame, a shaft in the frame, blocks on the opposite ends of the machine, means on the blocks for grasping the loop and the free ends of a U-shaped strip, levers for supporting the blocks on the free ends of the strip, a second set of levers, adjustable blocks on the second set of levers for grasping the side strands of the strip, side strips on the machine, adjustable stops on the side strips

of the machine, cylinders mounted beneath the shaft, pistons and piston-rods in the cylinders, crossheads on the piston-rods, connecting-rods secured to the crossheads and to the levers, means for admitting fluid under pressure to the cylinders, means for venting the cylinders, means on the connecting-rods for engaging the adjustable stops for limiting the swing of the levers, and springs connected to the frame and to the crossheads for returning the levers to their normal positions when the cylinders are vented.

28. A bending machine comprising a frame, a shaft in the frame, blocks on the opposite ends of the machine, means on the blocks for grasping the loop and the free ends of a U-shaped strip, levers for supporting the blocks on the free ends of the strip, a second set of levers, adjustable blocks on the second set of levers for grasping the side strands of the strip, side strips on the machine, adjustable stops on the side strips of the machine, cylinders mounted beneath the shaft, pistons and piston-rods in the cylinders, crossheads on the piston-rods, connecting-rods secured to the crossheads and to the levers, means for admitting fluid under pressure to the cylinders, means for venting the cylinders, means on the connecting-rods for engaging the adjustable stops for limiting the swing of the levers, springs connected to the frame and to the crossheads for returning the levers to their normal positions when the cylinders are vented, and struts bearing on the ends of the cylinders and on the shaft.

29. A bending machine comprising a frame, a block sliding in one end of the frame, cheek-pieces on the block having aligned perforations, a detachable pin in the perforations, the cheek-pieces and the pin cooperating to secure the loop of a U-shaped strip, sliding blocks mounted on the end of the machine opposite the first-mentioned block, manually operated means on the last-mentioned blocks for grasping the free ends of the strip, screw-threaded bolts projecting from the blocks, nuts on the bolts, stop-plates adapted to be engaged by the nuts for limiting the movement of the blocks, a shaft in the machine extending substantially parallel with the strip when it is in the blocks, a set of levers mounted on the shaft and supporting the blocks securing the ends of the strand, a second set of levers, each of the second set of levers having a shaft thereon parallel with the first shaft, blocks mounted on the second set of levers for grasping the side strands of the strip, means for adjusting the blocks on their shafts, cylinders mounted beneath the shaft, pistons in the cylinders with downwardly extending piston-rods, crossheads on the piston-rods of the cylinders, connecting-rods secured to the crossheads and to the levers,

means for controlling the admission and outlet of fluid under pressure to the cylinders, springs for returning the levers to their normal position when the cylinders are vented, and adjustable means on the frame for engaging the levers for limiting their outward movement.

30. A bending machine comprising a frame, a block sliding in one end of the frame, cheek-pieces on the block having aligned perforations, a detachable pin in the perforations, the cheek-pieces and the pin cooperating to secure the loop of a U-shaped strip, sliding blocks mounted on the end of the machine opposite the first-mentioned block, manually operated means on the last-mentioned blocks for grasping the free ends of the strip, screw-threaded bolts projecting from the blocks, nuts on the bolts, stop-plates adapted to be engaged by the nuts for limiting the movement of the blocks, a shaft in the machine extending substantially parallel with the strip when it is in the blocks, a set of levers mounted on the shaft and supporting the blocks securing the ends of the strand, a second set of levers, each of the second set of levers having a shaft thereon parallel with the first shaft, blocks mounted on the second set of levers for grasping the side strands of the strip, means for adjusting the blocks on their shafts, cylinders mounted beneath the shaft, pistons in the cylinder with downwardly extending piston-rods, crossheads on the piston-rods of the cylinders, connecting-rods secured to

the crossheads and to the levers, means for controlling the admission and outlet of fluid under pressure to the cylinders, springs for returning the levers to their normal position when the cylinders are vented, adjustable means on the frame for engaging the levers for limiting their outward movement, and means on the blocks on the levers for tilting the strands.

31. A bending machine comprising a frame, blocks arranged to slide on the frame, means for moving the blocks apart, a sliding bar on each block, a handle for operating the sliding bar, a fixed bar on each block, cam-surfaces on the opposed bars adapted to engage each other when the sliding bar is operated, a filler-piece adjustably secured on the block, the fixed bar and the filler-piece being adapted to grasp the free ends of a U-shaped strip, yielding means for holding the loop of the U-shaped strip, blocks for engaging the strands of the strip between its free ends and its loop, and means for operating the last-mentioned blocks to pull the strands apart intermediate of the free ends and the loop of the strip.

In testimony, that I claim the foregoing, I have hereunto set my hand this 10th day of June 1911.

CARL E. ANDERSON.

Witnesses:

WM. H. CAMFIELD,
M. A. JOHNSON.