Nov. 19, 1929. H. W. NORDENDALE 1,736,049

DIE PUNCHING APPARATUS

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Fig. 1.

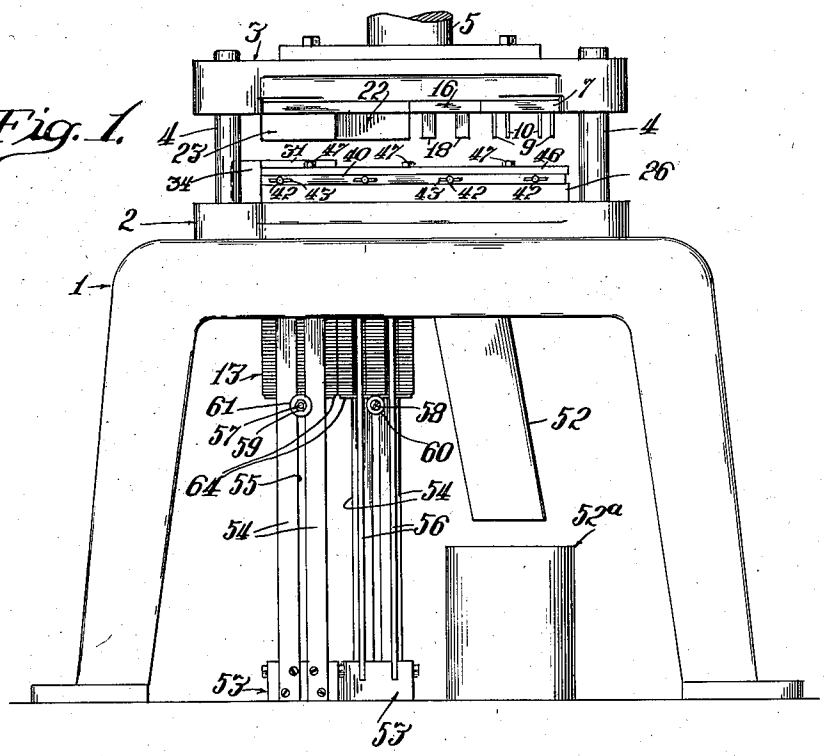
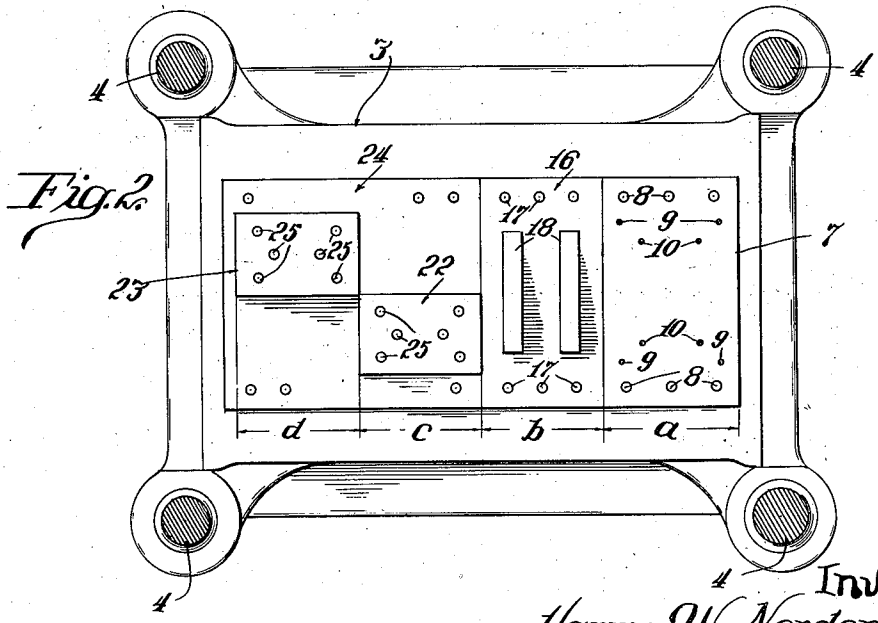


Fig. 2.



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Fig. 3.

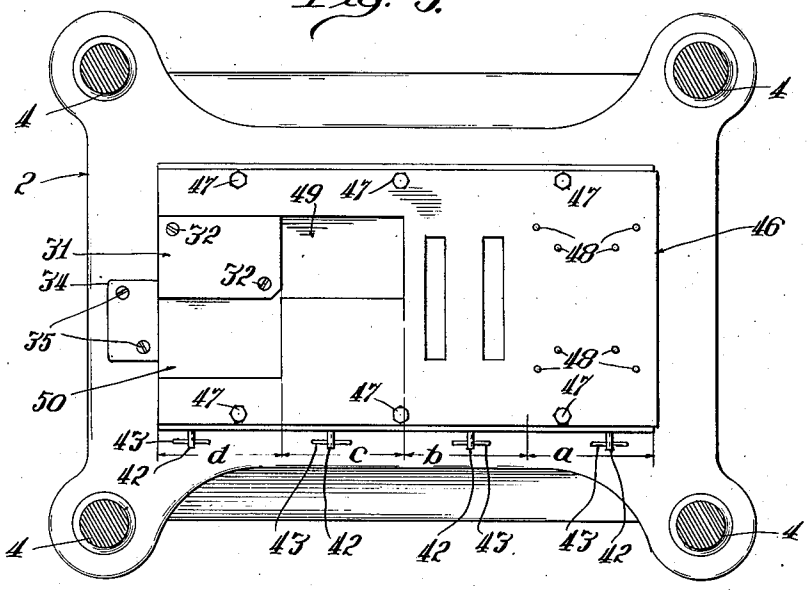


Fig. 4.

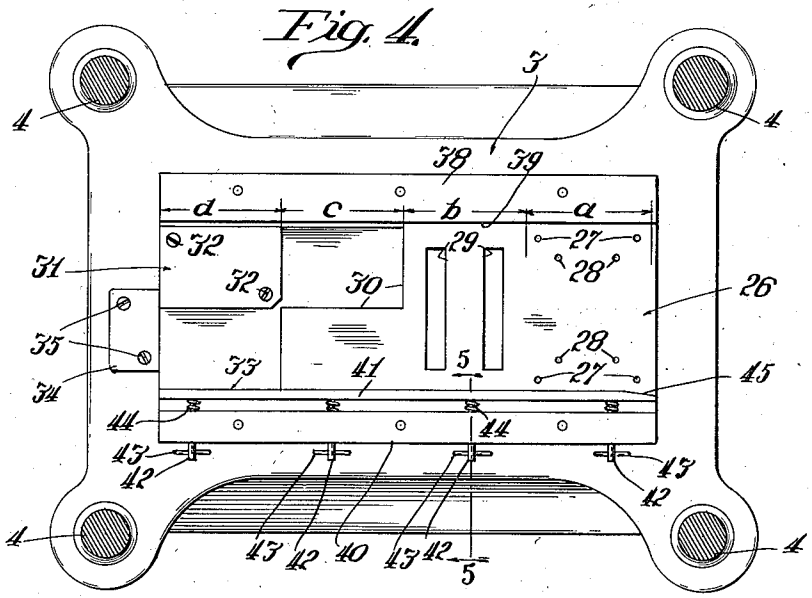


Fig. 11.

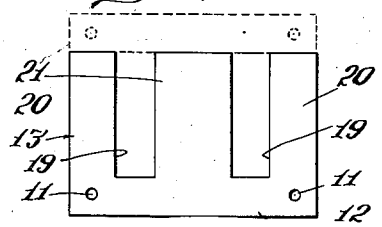
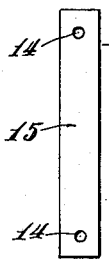


Fig. 12.



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DIE PUNCHING APPARATUS

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Fig. 10.

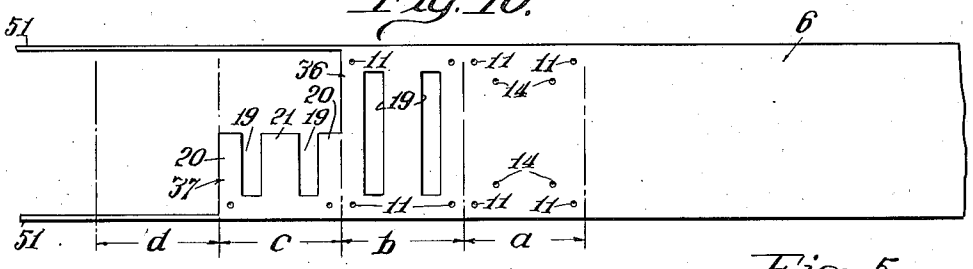


Fig. 6.

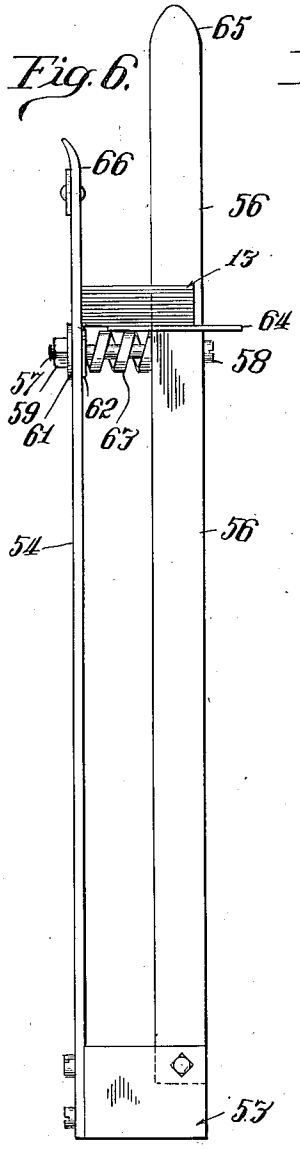


Fig. 7.

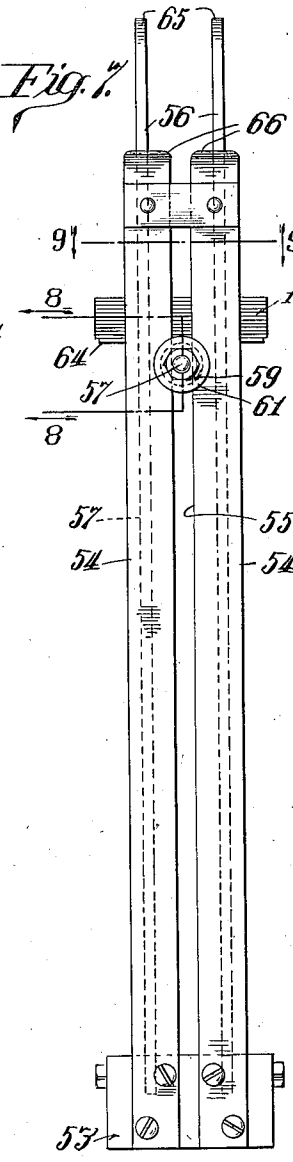


Fig. 5.

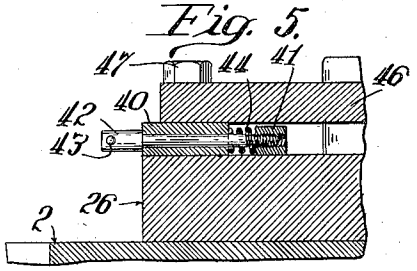


Fig. 8.

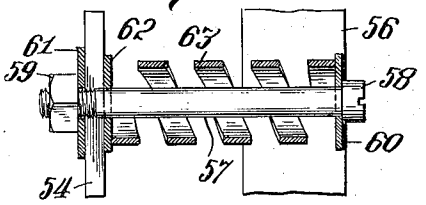
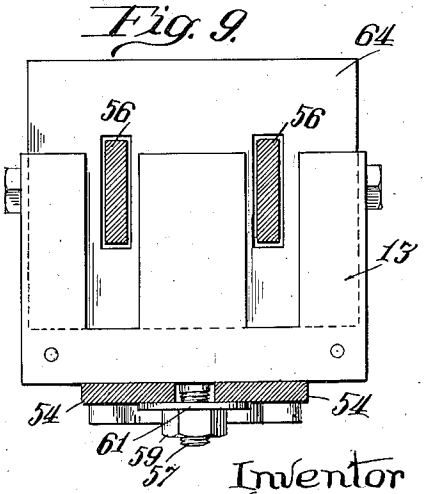


Fig. 9.



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Patented Nov. 19, 1929 1,736,049

UNITED STATES PATENT OFFICE

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DIE-PUNCHING APPARATUS

Original application filed February 2, 1929, Serial No. 337,021, Patent No. 1,718,176. Divided and this application filed May 17, 1929. Serial No. 363,754.

This invention relates to a new and improved apparatus for cutting or stamping from a continuous strip or sheet of metal certain core laminæ used in magnetic circuit apparatus. This application is a division of my copending application Serial No. 337,021, filed February 2, 1929, which has resulted in Patent No. 1,718,176.

In the magnetic circuit of certain electrical apparatus, a core is used that is built up of sheet metal laminations, the core consisting of parallel base members connected by three parallel leg members so as to form two parallel slots extending through the core. Each layer or lamination of this core may be formed of a pair of cooperating laminations, comprising an E-shaped member and a single straight bar lamination similar in form to the base of the E and adapted to be positioned across the open ends of the legs of the E. The present invention relates to an apparatus for stamping out these E-shaped and straight laminations from a single continuous strip of sheet metal so that the laminations will be cut on all sides thereof and be of absolutely uniform shape and size and substantially all of the metal strip will be utilized. The apparatus also provides means for punching holes or perforations in the respective ends of the straight laminations and of the base portions of the E-shaped laminations, through which means may be inserted for holding together the laminations when stacked and assembled to form the core.

Briefly described, the machine comprises four sets of cooperating punch and die members which are adapted to operate substantially simultaneously at each stroke of the press on four adjacent sections of the continuous metal strip, each of these sections corresponding in length to one of the E-shaped laminations. Each stroke of the press turns out two of the E-shaped laminations and two of the straight laminations. At each stroke, one set of punches forms the eight holes, two in the ends of each of the four laminations. At the same time two of the straight laminations are punched out by a second set of the punch and die members. A third set of die members stamps out one of the E-shaped laminations, and a fourth set positioned in staggered relation to the third set punches out the other E-shaped lamination from the portion of the strip from which one E-shaped lamination has been removed by the previous stroke of the press.

The principal object of this invention is to provide an apparatus such as briefly set forth hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide improved means for guiding and drawing the continuous metal strip through the press.

Other objects and advantages of this invention will be more apparent from the following detailed description of one approved form of apparatus operating according to the principles of this invention.

In the accompanying drawings:

Fig. 1 is a side elevation of a portion of one of the presses.

Fig. 2 is a bottom plan view of the upper movable punch member of the press.

Fig. 3 is a plan view of the lower fixed die member of the press.

Fig. 4 is a plan view similar to Fig. 3, with the cover plate of the die removed to illustrate the longitudinal guides for the metal strip.

Fig. 5 is a detail vertical section, taken substantially on the line 5—5 of Fig. 4, through one of the yieldable strip guides.

Fig. 6 is a side elevation of one of the stackers for the E-shaped laminations.

Fig. 7 is a front elevation of this stacker.

Fig. 8 is a detail sectional view, on a larger scale, taken substantially on the line 8—8 of Fig. 7.

Fig. 9 is a horizontal section taken substantially on the line 9—9 of Fig. 7, but on a larger scale.

Fig. 10 is a plan view of the end portion of the continuous metal strip, in the condition in which it appears between any two successive strokes of the press after the first complete laminations have been cut.

Figs. 11 and 12 are detail plan views of the E-shaped and the straight laminations respectively.

In Fig. 11, the position of the straight lami-

nation of Fig. 12, when assembled with one of the E-shaped laminations to form a core, is indicated in dotted lines.

Referring first to Figs. 1 to 4 of the drawings, only so much of a die-press or stamping machine is illustrated as is necessary to explain the present invention. It will be understood that the press itself may take a variety of forms and be operated in any approved manner. As here shown, the press comprises a supporting table or standard 1, carrying a fixed base plate 2 on which the fixed die members are mounted. A vertically reciprocating horizontal carriage or punch-holder 3, which carries the punches, is slidable upon a plurality of spaced parallel vertical guide rods 4 extending upwardly from the base plate 2. Carriage 3 is secured to and moved vertically by the ram 5 which may be operated in any approved and well-known manner. The vertical stroke of the carriage 3 is adapted to move the punches down into the mating die openings and then again elevate these punches to substantially the position shown in Fig. 1, at each stroke of the press.

The carriage 3 and base plate 2 support four cooperating sets of punch and die members which are adapted to operate, substantially simultaneously on each stroke of the machine, on four adjacent sections or areas of the continuous metal strip 6, as shown in Fig. 10. The lengths of these respective areas of the strip have been indicated by dotted lines and designated respectively *a*, *b*, *c*, and *d*, and the same symbols have been used to designate the corresponding areas of the punch and die members in Figs. 2, 3 and 4.

A plate 7, secured to the lower face of carriage 3 by screws or bolts 8 within the section or area *a*, carries a plurality of downwardly projecting cylindrical punches 9 and 10. The punches 9 are so arranged as to form the holes or perforations 11 in the ends of the base 12 of each E-shaped lamination 13 (see Fig. 11) whereas the punches 10 are positioned to form the holes 14 in the ends of each straight lamination 15 (see Fig. 12).

The plate 16, secured to the lower face of carriage 3 by bolts or screws 17, carries two downwardly projecting rectangular punches 18 arranged parallel with one another, and extending transversely of the path of movement of the metal strip 6. These punches 18 are adapted to cut out the two straight laminations 15, at the same time forming the spaces 19 between the end legs 20 and center legs 21 of the two E-shaped laminations. The punches 18 operate on section *b* of the strip 6 while punches 9 and 10 are operating on the section *a* of strip 6.

A pair of rectangular block punches 22 and 23, positioned to operate on sections *c* and *d*, respectively, of strip 6, are secured to the lower face of carriage 3, or to plate 24 thereon, by means of a plurality of screws or similar fastening means 25. Each of these punches 22 and 23 has the same outer rectangular outline as that of one of the E-shaped laminations 13. The punches 22 and 23 are positioned in staggered relation, one in advance of the other and one at each side of the longitudinal center line of the path of travel of metal strip 6.

Referring now to Fig. 4, the die-plate 26 secured to the upper face of base plate 2 is formed with a plurality of cylindrical vertical openings 27 and 28 adapted to receive the punches 9 and 10, respectively, and cooperate with these punches in cutting the holes 11 and 14 in the laminations. Plate 26 also has a pair of rectangular die openings 29 adapted to receive the punches 18 and assist in cutting out the straight laminations 15. Plate 26 also is formed to surround three sides of a rectangular opening 30 which receives the punch member 22. The fourth side of opening 30 is formed by one end of a block 31 secured by screws 32 to base block 2. Plate 26 also is formed to provide the cutting edges at two sides of opening 33 for punch 23, the other two sides being formed by the block 31 and a second block 34 secured to base 2 by screws 35. The blocks 31 and 34 extend above the lower plane of the path of travel of metal strip 6 so as to form stops against which the end faces 36 and 37 respectively of the strip are caused to abut between each two strokes of the press. The openings 27, 28, 29, 30 and 33 extend completely through the base block 2, so that the pieces of metal cut from strip 6 may fall completely through the machine and be collected or stacked, as hereinafter described.

A fixed bar or side wall 38 is secured at one side of die plate 26, and the inner edge 39 of this member 38 serves as a guide for one edge of the metal strip 6. Parallel with the bar 38 and at the other side of die plate 26 is secured a bar or plate 40, and an inner movable guide member 41 adapted to bear against the other edge of metal strip 6 is carried by a plurality of pins 42 guided through horizontal passages in the bar 40 and screwed at their inner ends into the guide plate 41. The outer ends of pins 42 are provided with handles 43 so that they can be screwed into or out of plate 41 to adjust the position of this guide relative to the fixed guide 39. A coiled compression spring 44 surrounds each pin 42 and is confined between the movable guide 41 and the fixed bar 40 so as to yieldably hold guide 41 in its normal position against the edge of metal strip 6. Guide 41 can, however, yield outwardly against the force of spring 44 to permit the passage of metal strip 6, even though there may be slight inequalities in the width thereof. The inner end of guide bar 41 is beveled, as shown at 45, to facilitate the positioning of metal strip 6 between the two guides.

A cover or stripper plate 46 bridges the die plate and is secured to the side bars 38 and 40 by bolts or screws 47. Cover plate 46 is provided with a plurality of openings 48 which are slightly larger than the die openings 27, 28 and 29 in the plate 26, and adapted to align vertically therewith to permit the free passage of the punch members. Cover plate 46 is also cut away, as indicated at 49 and 50, to permit the passage therethrough of the rectangular punches 22 and 23, and also to permit the die blocks 31 and 34 to project upwardly across the path of travel of the metal strip.

It should now be apparent that the metal strip 6 is guided for longitudinal travel from right to left between the side guides 39 and 41, and between the cover plate 46 and the upper surface of die-plate 26. Between each two strokes of the press, after the punch members have been elevated to the position shown in Fig. 1, strip 6 may be moved to the left between these guide members, until the surfaces 36 and 37 at the left hand end of the strip abut respectively against the blocks 31 and 34. As will be hereinafter apparent, a pair of quite narrow waste strips 51 remain, one at each side of the strip, these waste strips passing at either side of the fixed blocks 31 and 34. These waste strips 51 may conveniently be utilized for pulling the strip 6 through the machine. In the example here shown, this strip-advancing operation is performed by hand, but it will be obvious that mechanical means might be provided for advancing the strip step-by-step between each two strokes of the press.

At each downward movement of the carriage 3, four separate and distinct stamping or cutting operations are performed upon four adjacent sections *a*, *b*, *c* and *d* of the metal strip 6. The punches 9, 10, 18, 22 and 23 are made of slightly varying lengths (see Fig. 1) so that the cutting strain will be distributed through the downward stroke of the press, but all of these punching operations take place during the same downward stroke of the press and may be considered as practically simultaneous.

Fig. 10 illustrates the condition of the end portion of metal strip 6 just after the fourth stroke or any succeeding stroke of the press has been completed. After the carriage 3 is again elevated to the position shown in Fig. 1, strip 6 is advanced to the left until the end portions 36 and 37 engage the fixed stop blocks 31 and 34. This may be accomplished by pushing in the strip 6 at the right of the machine or by pulling on the edge waste strips 51 at the left of the machine. The operations that take place on the next downward stroke of the press will now be described. The space *a* is now occupied by a blank section of strip 6 that has been advanced from the right. The punches 9 and 10 and the cooperating cutting openings 27 and 28 in die plate 26 will now cut out the holes 11 and 14. Section *b*, before this stroke of the press, is occupied by a portion of strip 6, in which the holes 11 and 14 have been punched by the preceding stroke of the press. The downward movement of punches 18 will cut out the two straight laminations 15, these laminations falling down through a chute 52 and being collected in a receptacle 52ª. Before this stroke, section *c* is occupied by a portion of strip 6, such as indicated in section *b* of Fig. 10. In other words, the corner holes 11 and the laterally extending slots 19 have been cut by the two preceding strokes of the press. The downward stroke of punch 22 will now cut out one of the E-shaped laminations from substantially one-half of the metal strip occupying the area *c*. It will be noted that this punch 22 cuts three sides of the lamination, the other side 36 having been cut by the preceding stroke of the press. Before this stroke, which we are now considering, the section *d* is occupied by the half end portion of the strip indicated in section *c* in Fig. 10. The downward stroke of punch 23 cuts the other E-shaped lamination 13 from this end portion of the strip. This punch 23 cuts two sides of this lamination, the other two sides having been cut during the preceding stroke by the two punches 22 and 23, respectively.

It will be apparent that although the cutting of the laminations progresses through four succeeding strokes of the press, two laminations of each type are completed at each stroke. Each of these laminations is cut completely on all sides thereof, so that the width of metal strip 6 is not relied upon for the accuracy of any of the dimensions and the laminations will be of absolutely uniform size and shape. All of the material of strip 6 is utilized except for the very narrow edge strips 51, these edge waste strips being necessary in order that the laminations may be cut accurately on all sides. As hereinabove pointed out, the waste strips 51 are also utilized for advancing the metal strip through the machine.

It will be noted that all parts of this mechanism are quite simple and easily assembled, and that any or all of the punch and die members may be easily removed for renewal or replacement.

Stackers, illustrated in Figs. 1, 6, 7, 8 and 9, are utilized to collect and stack the E-shaped laminations 13 as they are cut from the metal strip 6. A pair of similar stackers is used to collect the laminations simultaneously cut out by the two punches 22 and 23. Each of these stackers comprises a base plate 53, from one side of which extends upwardly a pair of similar parallel plates or rods 54 so as to provide a vertical slot 55 therebetween. A second pair of vertical bars or

rods 56 extends upwardly in parallel relation from the other side of base block 53. The guide rods 56 are so spaced as to loosely occupy a portion of the spaces 19 between the legs of the E-shaped laminations 13. The bases 12 of these laminations are adapted to bear against the inner faces of the rods 54. A pin or bolt 57, which projects slidably and horizontally through the slot 55, has a fixed head 58 on one end thereof, and a removable head 59, usually in the form of a nut, on the other end thereof. A washer or plate 60 is positioned against the inner face of head 58 and a washer or plate 61 engages the inner face of head 59. A third washer 62 is slidably positioned on bolt 57 and an expansion spring 63 surrounding bolt 57 and confined between the washers 60 and 62 serves to clamp the washers 61 and 62 against the opposite faces of the vertical rods 54 and thus yieldably hold the spring-pressed bolt assembly against these rods and maintain it yieldably at any elevation thereon. A supporting plate 64 is provided with suitable apertures so as to be guided vertically along the other pair of rods 56. Plate 64 is supported upon the horizontally projecting assembly consisting of bolt 57 and the washers and springs supported thereby.

One of these stackers is positioned beneath each of the openings 30 and 33 with the upper ends 65 of the rods 56 projecting upwardly into the slots 19 of those E-shaped laminations which remain in the die-plate 2. The upper ends 66 of the rods 54 are beveled outwardly and placed flush with the bottom of the die-plate 2 to engage the outer edges of the base 12 of the laminations 13 and guide them into the stacker. As the laminations 13 are projected downwardly through the machine, they will be caught upon the supporting plate 64 and stacked, as indicated in Figs. 1, 6 and 7. As additional laminations 13 are punched from strip 6, these stacks will be forced downwardly, the spring-held bolts yielding to permit the washers 61 and 62 to be forced down along the rods 54. At the same time, this frictional engagement will be sufficient to support the stack of laminations carried by platform 64. One of these stackers may be removed at any time with the stacked laminations carried thereby, and replaced by an empty stacker. It will be apparent that the use of these stackers avoids the necessity of assembling and stacking the laminations 13. It will be understood that suitable devices for catching and stacking the straight laminations 15 might be used, but since it is much easier to stack these blanks than it is the E-shaped laminations, it is ordinarily sufficient to collect these laminations in an ordinary receptacle, such as indicated at 52a.

It should now be apparent that the improved apparatus here disclosed enables a plurality of laminations of the two types hereinabove specified to be accurately and continuously cut from a single metal strip, even though this strip is not of absolutely accurate width. There is practically no metal waste, except for the narrow edge strips which allow for possible inaccuracies in the width of the original stock strip, or in the positioning of the strip within the machine.

I claim:

1. A machine for cutting core laminations from a strip of material comprising cooperating and relatively movable punch and die elements, the die being formed with openings adapted to receive the punch elements, guide and stop members on the die element whereby the strip may be advanced longitudinally therethrough by steps of predetermined length, the punch comprising a pair of spaced parallel members extending transversely of the strip for punching straight laminations therefrom, and a pair of rectangular block punches positioned in staggered relation one at each side of and abutting the longitudinal center line of the path of the strip.

2. A machine for cutting core laminations from a strip of material comprising cooperating and relatively movable punch and die elements, the die being formed with openings adapted to receive the punch elements, guide and stop members on the die element whereby the strip may be advanced longitudinally therethrough by steps of predetermined length, the punch comprising a pair of spaced parallel members extending transversely of the strip for punching straight laminations therefrom, and a pair of rectangular block punches positioned in staggered relation one at each side of and abutting the longitudinal center line of the path of the strip, the guides and dies being so relatively positioned that all of the strip is utilized except a narrow waste strip at each edge thereof which engages the guide members and is used to advance the strip through the machine.

3. A machine for cutting core laminations from a strip of material comprising cooperating and relatively movable punch and die elements, the die being formed with openings adapted to receive the punch elements, guide and stop members on the die element whereby the strip may be advanced longitudinally therethrough by steps of predetermined length, the punch comprising eight cylindrical punch members positioned to perforate the strip so as to form holes in the corners of the subsequently formed laminæ, a pair of spaced parallel members extending transversely of the strip for punching straight laminations therefrom, and a pair of rectangular block punches positioned in staggered relation one at each side of and abutting the longitudinal center line of the path of the strip.

4. A machine for cutting core laminations from a strip of material comprising cooperating and relatively movable punch and die elements, the die being formed with openings adapted to receive the punch elements, guide and stop members on the die element whereby the strip may be advanced longitudinally therethrough by steps of predetermined length, the punch comprising eight cylindrical punch members positioned to perforate the strip so as to form holes in the corners of the subsequently formed laminæ, a pair of spaced parallel members extending transversely of the strip for punching straight laminations therefrom, and a pair of rectangular block punches positioned in staggered relation one at each side of and abutting the longitudinal center line of the path of the strip, the guides and dies being so relatively positioned that all of the strip is utilized except a narrow waste strip at each edge of the strip which engages the guide members and which is used to advance the strip through the machine.

5. A machine for cutting core laminations from a strip of material comprising cooperating and relatively movable punch and die elements, the die being formed with openings adapted to receive the punch elements, guide and stop members on the die element whereby the strip may be advanced longitudinally therethrough by steps of predetermined length, the punch comprising eight cylindrical punch members positioned to perforate the strip so as to form holes in the corners of the subsequently formed laminæ, a pair of spaced parallel members extending transversely of the strip for punching straight laminations therefrom, and a pair of rectangular block punches positioned in staggered relation one at each side of and abutting the longitudinal center line of the path of the strip, the several punch members being of slightly different lengths so as to engage the strip at different times and distribute the cutting work through the stroke of the press.

6. A machine for cutting core laminations from a strip of material comprising cooperating and relatively movable punch and die members, guides on the die member between which the strip is advanced step by step, the punch member being formed with a plurality of punch elements adapted to enter and substantially fit the openings in the die so as to cut material from the strip, the die comprising three successive equal areas in the space between the guides, the first of these areas in the direction of travel of the strip having two parallel rectangular openings extending transversely of the center line of the path of travel of the strip through which openings a pair of similar straight laminations are punched, the sceond area having a rectangular opening of substantially half the size of the area and positioned entirely at one side of the center line of the path of travel of the strip, the third area having a similar rectangular opening at the other side of the center line, two similar E-shaped laminæ being simultaneously punched through these latter two openings.

7. A machine for cutting core laminations from a strip of material comprising cooperating and relatively movable punch and die members, guides on the die member between which the strip is advanced step by step, the punch member being formed with a plurality of punch elements adapted to enter and substantially fit the openings in the die so as to cut material from the strip, the die comprising three successive equal areas in the space between the guides, the first of these areas in the direction of travel of the strip having two parallel rectangular openings extending transversely of the center line of the path of travel of the strip through which openings a pair of similar straight laminations are punched, the second area having a rectangular opening of substantially half the size of the area and positioned entirely at one side of the center line of the path of travel of the strip, the third area having a similar rectangular opening at the other side of the center line, two similar E-shaped laminæ being simultaneously punched through these latter two openings, the guides being spaced slightly from the outer sides of the last mentioned rectangular openings, whereby a narrow strip of material will remain at each side of the strip after the punching operations have been completed.

8. A machine for cutting core laminations from a strip of material comprising cooperating and relatively movable punch and die members, guides on the die member between which the strip is advanced step by step, the punch member being formed with a plurality of punch elements adapted to enter and substantially fit the openings in the die so as to cut material from the strip, the die comprising four successive equal areas in the space between the guides, the first of these areas in the direction of travel of the strip being formed with eight openings over which are formed the holes in the ends of the four laminations subsequently formed from the corresponding area of the strip, the second area of the die having two parallel rectangular openings extending transversely of the center line of the path of travel of the strip through which openings a pair of similar straight laminations are punched, the third area having a rectangular opening of substantially half the size of the area and positioned entirely at one side of the longitudinal center line of the path of travel of the strip, the fourth area having a similar rectangular opening at the other side of the center line, two similar E-shaped laminæ being simultaneously punched through these latter

two openings, the guides being spaced slightly from the outer sides of the two last mentioned rectangular openings, whereby a narrow strip of material will remain at each side of the stock strip after the punching operations have been completed.

9. A machine for cutting core laminations from a strip of material comprising cooperating and relatively movable punch and die members, guides on the die member between which the strip is advanced step by step, the punch member being formed with a plurality of punch elements adapted to enter and substantially fit the openings in the die so as to cut material from the strip, the die comprising four successive equal areas in the space between the guides, the first of these areas in the direction of travel of the strip being formed with eight openings over which are formed the holes in the ends of the four laminations subsequently formed from the corresponding area of the strip, the second area of the die having two parallel rectangular openings extending transversely of the center line of the path of travel of the strip through which openings a pair of similar straight laminations are punched, the third area having a rectangular opening of substantially half the size of the area and positioned entirely at one side of the longitudinal center line of the path of travel of the strip, the fourth area having a similar rectangular opening at the other side of the center line, two similar E-shaped laminæ being simultaneously punched through these latter two openings.

10. A die-press for cutting E-shaped laminations from the end portion of a long, relatively narrow strip of material, the laminæ being cut in pairs from opposite halves of the strip with the legs of the E's opposed to one another, comprising cooperating punch and die members, guides on the die members between which the strip is advanced step by step, there being one set of punch and die members for removing the material from between the legs of both subsequently formed E members of the pair on one stroke of the press, and other sets of punch and die members for cutting an E-shaped laminæ from each half of the end portion of the strip on successive strokes of the press.

11. A die-press for cutting E-shaped laminations from the end portion of a long, relatively narrow strip of material, the laminæ being cut in pairs from opposite halves of the strip with the legs of the E's opposed to one another, comprising cooperating punch and die members, guides on the die members between which the strip is advanced step by step, there being one set of punch and die members for removing the material from between the legs of both subsequently formed E members of the pair on one stroke of the press, and other sets of punch and die members for cutting an E-shaped laminæ from each half of the end portion of the strip on successive strokes of the press, and stops formed on the die member against which the strip is advanced after each stroke of the press.

12. A die-press for cutting E-shaped laminations from the end portion of a long, relatively narrow strip of material, the laminæ being cut in pairs from opposite halves of the strip with the legs of the E's opposed to one another, comprising cooperating punch and die members, guides on the die members between which the strip is advanced step by step, there being one set of punch and die members for removing the material from between the legs of both subsequently formed E members of the pair on one stroke of the press, and other sets of rectangular punch and die members positioned in staggered relation, one set at either side of the center line of the path of travel of the strip for cutting the E-shaped laminæ from each half of the end portion of the strip on successive strokes of the press.

13. A die-press for cutting E-shaped laminations from the end portion of a long, relatively narrow strip of material, the laminæ being cut in pairs from opposite halves of the strip with the legs of the E's opposed to one another, comprising cooperating punch and die members, guides on the die members between which the strip is advanced step by step, there being one set of punch and die members for removing the material from between the legs of both subsequently formed E members of the pair on one stroke of the press, and other sets of rectangular punch and die members positioned in staggered relation, one set at either side of the center line of the path of travel of the strip for cutting the E-shaped laminæ from each half of the end portion of the strip on successive strokes of the press, and stops on the die member against which the strip is advanced after each stroke of the press.

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