

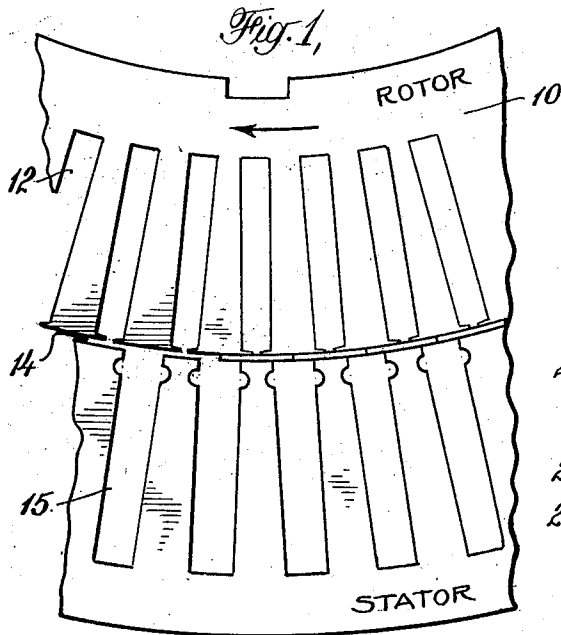
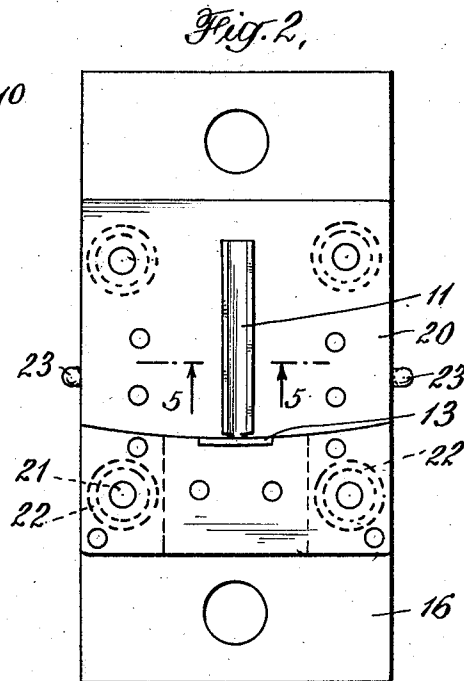
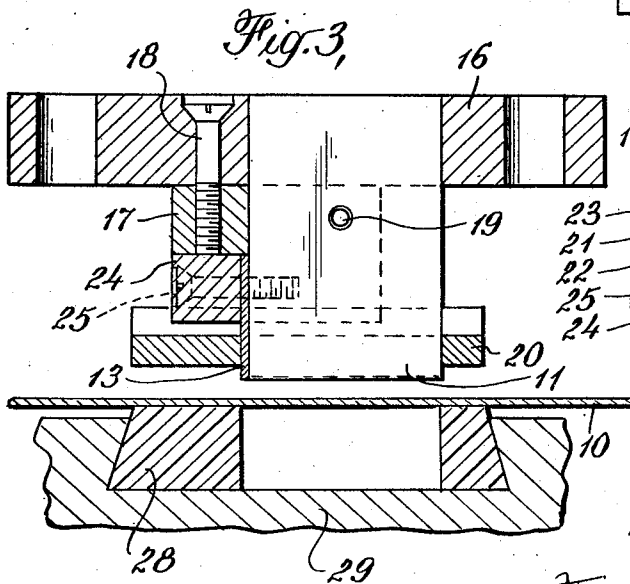
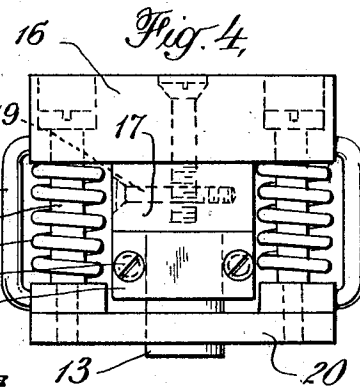
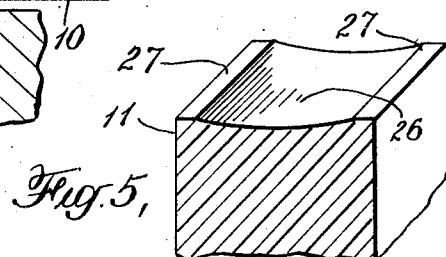
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PUNCHING DEVICE

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PUNCHING DEVICE

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This invention relates to punches for making apertures or openings in materials such as sheet metal, and has particular reference to punches of a complex shape such as those which usually require a great amount of machining and are subject to easy breakage due to thinness of certain portions thereof, or because of the strains set up in the metal during heat treatment.

In constructing dynamo electric machinery, such as motors and generators, the rotors and stators are usually made of laminated sheets of iron suitably held together to make a unitary structure. These laminations are blanked from sheet metal stock and are provided with apertures or openings, each of which are adapted to register with corresponding apertures or openings in the next adjacent laminations so as to form slots or grooves for the reception of the dynamo windings.

Formerly, all of these apertures or openings were punched in the rotor and stator blanks simultaneously or in relatively large groups, thus necessitating the use of large punch blocks or plates having the individual punches formed thereon. This form of punch was obviously very expensive and laborious to make, and any defects which developed therein, such as those caused by the breakage or warping of certain portions during heat treatment or use, made it useless, so that the entire punch block or plate had to be replaced at great expense. At the present time, especially in forming the laminations for the larger-sized rotors and stators, one or more individual punches and the corresponding dies are indexed around the sheet metal blank, or the blank is indexed around the stationary punch and die or punches and dies.

In this way fewer punches and dies and less manufacturing expense are possible, but the individual punches are still very expensive to make, and this is especially the case where the punches include relatively thin curved blades such as are provided for the purpose of separating the rotor blank from the stator blank simultaneously with the formation of the winding slot apertures, this

separation also forming the clearance between the finished rotor and stator when they are operated in the dynamo-electric machine. In order to obtain this proper clearance the cutting-off blade portion of the punch must necessarily be thin, frequently not exceeding twenty thousandths of an inch in thickness. This thin blade portion of the punch is not only very susceptible to breakage and distortion in handling and use due to the thinness and brittleness of the hardened metal, but frequently becomes warped and cracked during the heat-treating process because of the unequal internal strains which are set up in the metal, and consequently the entire punch must be scrapped since it is useless for the purpose intended.

Furthermore, inasmuch as a great number of winding slot openings or apertures are required in each rotor and stator lamination, and as a great number of laminations are necessary to make up the completed rotor and stator units each punch should be capable of producing a sufficient number of punching operations without undergoing any appreciable impairment, in order to equalize the cost of making the punch as compared to the value of the finished product. This has not been possible to any extent heretofore unless especially fine steels were used, and most accurate tool work and elaborate heat treatment were resorted to, but these elaborate precautions, although increasing the life of the punch somewhat, also increased the cost thereof so that these precautions were no more warranted than the more frequent change of punches made in the usual manner.

It is the principal object of this invention to obviate these objections by providing a punching apparatus which is more rugged, has a longer life, is less expensive, and which is more efficient than the punching apparatus heretofore employed. Among the other objects of the invention is to provide a punch which is built up in coacting sections, each section being a separate element which contributes to the composite whole punching unit. Accordingly, each section being interchangeable

able, may be replaced when worn or broken, and is heat-treated separately, so that whatever breakage occurs, due to internal strains set up in the metal during heat treatment, does not affect the remainder of the punch. In this way the cost of making and replacing punches is reduced to a minimum and variations in dimensions of the product cut by the punch is avoided, as well as securing the desirable interchangeability of punch parts in a simple manner.

In addition to the solution of the problem of readily handling the thin blade-like parts of a punch in the manner described, the punch of this invention may be so formed that these thin blade-like portions may be formed in the punch block to various shapes, such as curved or angular, without the necessity of cutting these shapes out of a solid block of steel. This facilitates and decreases the cost of making and assembling, as well as procuring a very efficient and durable tool.

Furthermore, the division of the punching unit into several sections may be effected in the most economical way, taking into consideration facility with which the different sections may be made. This is also of especial value from the standpoint of heat treatment, since the more regular in shape that the different sections are, the better the heat treatment, i. e., the heat penetration is more uniform and the internal strains are less, thus resulting in less distortion of the finished punch.

Another object of the invention is to provide a punch which has a longer life than those heretofore employed, which is especially valuable where the nature of the work requires that each punch be capable of a great number of punching operations in order to justify its original cost as compared to the value of the finished product. As pointed out above, this is especially desirable in punching lamination blanks for rotors and stators of dynamo-electric machines where a great number of the same punching operations are required to form a single rotor or stator unit. This object is accomplished in the present invention by shaping the working surface of the punch in such a way that the scrap metal which is punched out of the blank does not drag upon the cutting edges of the punch, but is bent out of the way to afford clearance. Tests have proven in a number of typical instances, that the life of a punch thus formed is increased from 20,000 to 140,000 punching operations, which procures a great saving without exercising extraordinary care in making, employing elaborate heat treatment, or using special tool steel.

While the description and operation of the punch of this invention is presented in connection with the forming of dynamo-electric machine lamination blocks for rotors and stators, it is to be understood that the punch

is not limited to that particular use, but applies equally well to use in punching various shapes for different purposes from blanks of sheet or heavier material.

For a better understanding of the invention reference is made to the accompanying drawings in which

Figure 1 is a diagram indicating the arrangement of the perforations commonly made in rotor and stator lamination blanks and illustrating the manner in which the rotor and stator blanks are separated simultaneously with the punching operation;

Fig. 2 is a face view of a composite punch embodying the invention;

Fig. 3 is a vertical section of the same which also shows its operation in connection with the sheet metal blank and the cooperating die;

Fig. 4 is an end elevation of the punching unit illustrated in Fig. 2; and

Fig. 5 is an enlarged perspective cross section of one of the punching elements taken along line 5—5 of Fig. 2.

In these drawings, the numeral 10 designates the blank of sheet metal from which the rotor and stator laminations are stamped or punched. In forming these laminations, the punch such as that illustrated in Fig. 2, may be used, as well as the cooperating die. The punch illustrated in Fig. 2 comprises two punching elements of which 11 punches the slot 12 as seen in Fig. 1 while punching element 13 punches the clearance groove 14 and simultaneously separates the rotor blank from the stator blank as either the punch or the sheet metal blank are indexed around step by step to perform consecutive punching operations. The winding slots 15 in the stator laminations are punched in a similar manner.

In performing punching operations of the type described, it is evident that in order to obtain laminations of the proper shape with the proper clearance between the rotor and stator units when they are assembled into the finished product, punching element 13 must be curved according to the arc of the clearance between the rotor and stator and also must be of sufficient thinness to maintain the proper clearness between the rotor and stator. In punches made for this purpose heretofore, it has been the practice to shape the entire punching unit out of one piece, thus necessitating a great deal of machine work which is very expensive. However, after the punching unit was properly shaped, the thin blade-like portion was subjected to breakage or distortion due to usage, unequal strains of heat treatment and the like. Consequently when breakage occurred, the whole punching unit had to be scrapped which obviously entailed a considerable loss.

In the present invention these objections are obviated by making the punching unit out of a number of punching elements which when

properly assembled co-act to form a punching unit. In this way, punching elements which are broken or worn may be replaced and are of such shape that they may be readily made from standard stock.

Referring to Fig. 2, the punching element 11 is inserted in a slot provided in base 16 upon which is mounted a U-shaped block 17 by means of screws 18. Thus U-shaped block 17 embraces the sides of punching element 11 and holds it in place by means of screw or pin 19. The stripper plate 20 is slidable on punching element 11 and is mounted on the base 16 by means of pins or studs 21 surrounded by springs 22 in the usual manner. When not in use clips 23 hold the stripper plate 20 in position but these clips 23 are removed when the punching unit is in use so that stripper plate 20 may slide upon punching element 11 against the tension of springs 22.

Block 17 is provided with a recess for the reception of plug 24 which is held in place by means of screws 25. The surface of plug 24 which engages the vertical portion of block 17 is curved to the same extent that the clearance space between the rotor and stator laminations is curved. A slot having a similar curvature is provided in stripper plate 20 for the reception of punching element 13. Punching element 13, however, is initially a straight and flat piece of steel but when it is clamped between the curved surfaces of plug 24 and block 17, it is forced into a curved shape such as illustrated in the drawings. In this way punching element 13 may be shaped as desired without being machine shaped and at the same time forms a rigid punching element which co-acts with punching element 11 to make a composite punch. Accordingly, a minimum amount of machining is required and both punching elements 11 and 13 may be removed and replaced merely by removing screws 19 and 25, respectively. Obviously the thin blade-like portions of a punch may be bent and held in various punching shapes, thereby eliminating the difficult machining operations which are necessary in the forming of punches of odd shapes.

The particular manner of making the punching elements of this invention procures a considerable increase in their length of operation before they become so worn as to be no longer effective. This increase in the life of punches has been found to be as much as seven times, as in a number of typical instances the life of a punch was increased from 20,000 to 140,000 punching operations. This increased operating time is procured by recessing or grooving the operating face of the punch in the manner illustrated by Fig. 5. Fig. 5 is an exaggerated cross section of punching element 11 taken along the line 5-5 of Fig. 2 and shows the longitudinal recess or groove 26 which is ground therein.

The edges of this recess are spaced as indicated at 27 from the edges of the punching element. This spacing of the edges of the groove from the edges of the punching element is important inasmuch as the recess 26 is not intended to cooperate with the cutting edges of the punch in the way of increasing the cutting angle or sharpening the cutting edges but is adapted to impart a curve or bend to the piece of scrap when it is cut from the blank 10. This bending of the scrap causes the edges thereof to be drawn away from the cutting edges of the punch, the edges of the aperture formed in the blank 10 and the sides of the die 28 shown in Fig. 3. In this way, the usual drag of the scrap is eliminated and since this drag has a harmful effect upon the cutting edges of the punch and the die, their effectiveness is prolonged to a considerable degree. While punches such as rivet hole punches have been formed with recesses heretofore, these recesses extend to the cutting edges of the punch and were formed for the primary purpose of increasing the cutting angle of the cutting edge and sharpening the cutting edge. This expedient, while increasing the cutting efficiency and cutting rapidity of the punch decreased instead of increased the life thereof. This was due to the fact that sharper edges and thinner blades of the same kind of material have a shorter life than heavier and thicker blades. The new manner of forming punches, as illustrated particularly in Fig. 5 of the drawings, is accordingly of considerable advantage in the way of increasing the efficiency and the length of life of the punch thus formed.

In Fig. 3 is illustrated the customary manner of operating the punch in which the blank 10 is inserted between the punching apparatus mounted on base 16 and the die 28 mounted in plate 29. The punch is reciprocated so that the punching unit comprising punching elements 11 and 13 perforates blank 10 as indicated at 12 in Fig. 1. After the punching unit has penetrated through blank 10, stripper plate 20 engages blank 10 and is retracted against the pressure of springs 22. Accordingly, when the punch is withdrawn, stripper plate 20 tends to return to its original position and thus forces the blank 10 from the punching elements 11 and 13. As illustrated in Fig. 1, when either the punching apparatus or the blank 10 are indexed around, punching element 13 in its successive positions operates to form clearance groove or space 14 and at the same time to separate the rotor and stator laminations from blank 10. Apertures 15 in the stator may be made in a similar manner either simultaneously with or subsequently to the punching of apertures 12 and groove 14.

The new punching apparatus accordingly procures increased efficiency at decreased

expense, especially in punching blanks which involve a great number of the same operations such as the formation of laminations for rotors and stators of dynamo-electric machines. The accuracy and interchangeability of the separate punching elements which make up the composite punching unit permit replacement of parts broken or damaged and avoid losses which otherwise occur through the necessity of duplicating parts which are not worn because other parts have been injured in use. By dividing the whole punching unit into numerous punching elements which are so formed as to make their original machining as simple as possible, very complicated punching shapes may be formed without requiring the expensive and difficult machining operations usually attending the manufacture of such punches. Furthermore, by providing means whereby the thin portions of punching units may be separately made and shaped into the required punching shape, a further saving in machining is procured, as well as the elimination of the losses caused by cracking and distortion of these thin parts during the heat treating process. All of these various features contribute to the increased efficiency and life of the punch of this invention.

I claim:

1. In a punching device, the combination of a rigid punching element, a frame having a slot for receiving the element, a flexible punching element adapted to form a complete punching unit with the first element, a second slot in the frame formed to a predetermined shape for bending the flexible element to the predetermined shape, and independent means for removably holding the elements in position.

2. In a punching device, the combination of a rigid punching element, a flexible punching element adapted to be bent against a portion of the rigid element and cooperate therewith to form a composite punching unit, a frame having slots for bending the flexible element into the predetermined shape and for holding the elements in rigid cooperating relationship and means forming part of the frame for permitting the removal and replacement of each element without disturbing the other element.

3. In a punching device, the combination of a rigid punching element, a flexible punching element adapted to be bent over a portion of the rigid element and cooperate to form a composite punching unit, a frame having slots shaped to receive the elements in their final arrangement, means cooperating with the frame for holding the flexible element in bent relation to the first element, and securing means passing through each element.

4. In a punching device, the combination of a rigid punching element, said element

having a cutting face formed with a shallow depression spaced from the cutting edges thereof, a flexible punching element adapted to be bent into cooperating relationship with the rigid element to form a composite punching unit, and a frame for holding the flexible element in bent relationship, with the rigid element.

5. In a punching device, the combination of an elongated rigid punching element, a blade-like flexible punching element adapted to be bent into predetermined shape against one end of the rigid element, a frame for holding the elements in said shape to form a composite punching unit, and means forming part of the frame for permitting independent removal and replacement of each element.

In testimony whereof I affix my signature.

HANS HOCHREINER.