July 25, 1933. T. A. WRY 1,919,995

METHOD OF FORMING CORES FOR DYNAMO ELECTRIC MACHINES

Filed Oct. 26, 1932

Fig. 1.

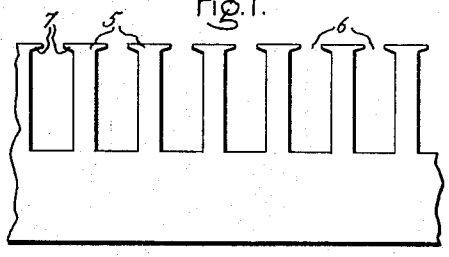


Fig. 2.

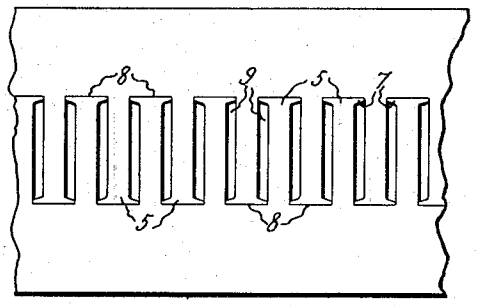


Fig. 3.

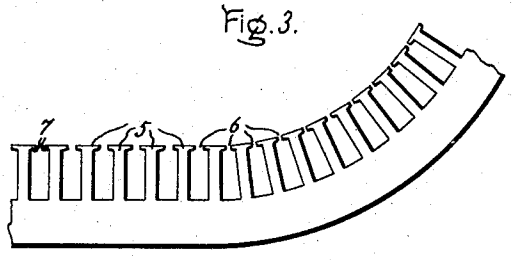
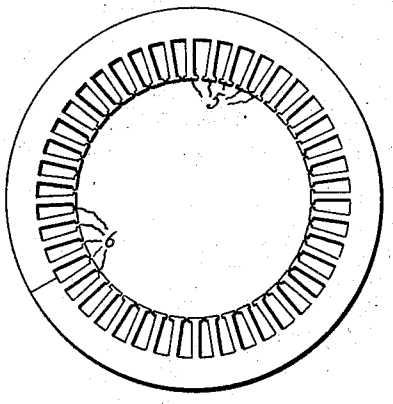


Fig. 4.



Inventor:
Thomas A. Wry.
by Charles E. Fuller
His Attorney.

Patented July 25, 1933 1,919,995

UNITED STATES PATENT OFFICE

THOMAS A. WRY, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

METHOD OF FORMING CORES FOR DYNAMO-ELECTRIC MACHINES

Application filed October 26, 1932. Serial No. 639,626.

In the construction of dynamo electric machines, a large item of expense is the magnetic steel used in the construction of the stator and rotor cores. This is particularly true where silicon steel is used for the purpose. The established practice is to punch rings or round disks from sheet stock for the smaller size machine and to punch segments for the larger sizes. In both cases, each punching is provided with teeth between which are slots to receive the windings. In many cases, the punchings are also provided with external perforated lugs to receive clamping bolts. Punching round or segmental objects from rectangular sheet stock results in a large amount of scrap which substantially increases the cost of manufacture. Furthermore, commercial sheet steel as obtained from the manufacturers is not of exactly the same thickness throughout the sheet. Due to this, it is the custom in assembling a core structure to pile a certain number of disks or pieces forming a set in place, then to pile a second set on top of the first but angularly advanced with respect thereto by a certain amount, then add more disks or pieces angularly advanced from the second and so on, the purpose being to average the inequalities in the total assemblage and avoid small spaces between adjacent laminations. Such a method of procedure increases the cost of assembly, and also results in a structure in which the grain of the steel instead of extending uniformly in one direction throughout the core, as it should to attain the best electrical results, extends in a number of different directions, depending principally upon the number of laminations in each of the aforesaid sets.

My invention has for its object an improved method of making cores whereby the cost of laminated stator and rotor cores is decreased by utilizing the stock in a more economical maner and at the same time providing a core in which the grain of the steel extends uniformly in the same direction.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the accompanying drawing, which is illustrative of my invention, Fig. 1 is a plan view of a piece of strip stock having teeth and coil slots cut along one edge; Fig. 2 illustrates my improved method of cutting two pieces of core stock from a single strip of steel with interlocking teeth and coil slots; Fig. 3 shows one of said strips partially bent in an edgewise manner, and Fig. 4 shows a complete stator core.

In Fig. 1 is shown a piece of strip stock having teeth 5 and coil slots 6, said teeth being parallel to each other and having overhanging ends 7 which serve in part to confine the windings within the coil slots in the final assembly. In such a construction, all of the stock removed from between the teeth to form the coil slots is scrap material. The arrangement is more economical of material than where disks and segments are cut from large sheets of stock.

No claim is made herein to the method of cutting teeth and slots along one edge of a strip of magnetic material as indicated in Fig. 1, and subsequently winding said strip edgewise to form a core as it is the invention of Louis E. Underwood and forms the subject matter of his application for patent Serial No. 639,622 filed October 26, 1932.

I have discovered that further and substantial savings may be effected by choosing proper tooth and coil slot dimensions or sizes and utilizing what is waste material in the type shown as Fig. 1 to form teeth in another or companion strip. The strip stock shown in Fig. 2 is only 43% wider than the stock shown in Fig. 1 yet by this increase, I am able to form two toothed strips, and with practically no waste. From Fig. 2, it will be seen that the outer end 8 of each tooth is aligned with the bottom of the coil slot in the companion strip, and that only a single cutting of the stock at this point is required to sever the parts. The only waste in this construction is the very small pieces 9 located between the sides of each tooth on one strip and the side walls of the teeth forming the coil slots of the companion strip. By suitable dies, the stock is divided into two strips and the teeth and coil slots formed

by a single operation. For this purpose, I may use a die adapted to cut each tooth separately or I may use a multiple die and cut several teeth and slots simultaneously. It will be noted that the ends of teeth are formed by short cuts in two parallel planes and that the distance between them is equal to the length of the teeth. Also that the sides of the teeth are formed by two parallel cuts, one on each side of the waste stock 9. Also that each of said parallel cuts extends to the bottom of the coil slot at one end and terminates just short of the bottom of a slot at the other end and defines the overhanging portion of the tooth. The size and shape of the teeth and slots may be varied from that shown to suit the electrical characteristics of the machine useing the core but the method of cutting the stock will be the same. As the divided stock passes through a suitable punch press containing the dies, it is necessary to separate the strips by raising or lowering one strip with respect to the other to free the teeth of one set from those of the other.

After the strip is so formed with its teeth and coil slots, it is wound edgewise to form a helix of fine pitch. In other words, to form a finished core in which all of the teeth and slots of the numerous turns are in exact axial register. In Fig. 3 is shown a straight strip, one end of which is bent edgewise and also illustrating how the teeth which were initially parallel are moved to radial positions with respect to a common center, the latter being the axis of the shaft carrying the rotor of the completed machine.

In Fig. 4 is shown a helically wound core ready for assembly in a suitable frame. The core may be secured or clamped in the frame in any well known manner.

The invention is illustrated in connection with a stator in which the coil slots open toward the center or bore but it is also applicable to the formation of rotors having peripheral windings by merely bending the strip edgewise in the opposite direction with the teeth projecting outwardly.

Bending steel stock edgewise and at the same time confining each turn to a substantially uniform cross section from the inner to the outer edge, as must be done to obtain the best results, causes strains in the stock and for that reason I anneal the core after being formed and prior to being put into use. For this purpose, any suitable annealing furnace may be used.

A machine suitable for winding steel edgewise is described and claimed in the application for patent of Helge E. Carlson, Serial No. 639,623 filed October 26, 1932.

My improved method as herein set forth results in a large saving in steel for as previously set forth, a strip of stock to form two toothed strips need only be 43% wider than a single strip cut in the manner shown in Fig. 1. Stated another way, if the steel requirements for a given production are of the order of 10 tons, they may be reduced to the order of 3 tons by the use of my invention. For stock, I may use steel sheets and cut them into strips and unite the short strips at their ends by welding or other means to form a long strip, or stock in the form of long strips or ribbons made by steel manufacturers may be used and welded when necessary to utilize the short ends left after the formation of one or more helices.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of making toothed cores for electrical machines which comprises cutting a long narrow piece of magnetic material longitudinally into two narrow strips and simultaneously therewith forming parallel teeth and slots with the teeth in one strip occupying the slots between teeth on the other strip, separating the strips, and finally bending each of the strips edgewise to form a helix with the slots in axial register.

2. The method of making cores for electrical machines having overhanging teeth and coil slots between teeth which comprises taking a single strip of stock, making short cuts in two parallel longitudinal planes, each of said cuts forming the outer end of a tooth and the bottom of a coil slot, cutting the strip in planes perpendicular to the first mentioned cuts to form the sides of the teeth, separating the strips so formed and finally winding the strips with their teeth edgewise to form helices.

3. The method of making cores for electrical machines having overhanging teeth and coil slots between teeth which comprises taking a single strip of stock, making short cuts in two parallel longitudinal planes, each of said cuts forming the outer end of a tooth and the bottom of a coil slot, cutting the strip in parallel planes perpendicular to the first mentioned cuts to form the sides of the teeth, removing the stock between said parallel cuts, bending each strip edgewise to form a fine pitch helix, and finally annealing the helices.

THOMAS A. WRY.