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ELECTRICAL STEEL

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This invention relates to electrical steels and is particularly directed toward the improvement of the magnetic characteristics of such steels.

Electrical steels so far produced, have been unsatisfactory as to their magnetic characteristics in that the latter have neither been great nor uniform. It is well known that this is a great handicap in the commercial application of these steels as it is impossible to furnish the particular steels desired or to duplicate certain steels with any great degree of success. The difficulties probably are due at least in part to the unequal stresses and strains existing within the metal as furnished and such inequalities are the result of incomplete control. The crystals in the metal are also not in a position favorable to further slip nor are these crystals properly oriented or sized.

An object of the present invention is to treat steel so as to overcome the disadvantages and defects noted above and to provide an improved steel having additional advantages peculiar to its own constitution.

Another object of the invention is to put the steel under tension as it passes through a suitable furnace.

A further object of the invention is to pass the steel into a furnace at a somewhat slower rate than it is removed and then annealing the product.

Other and further objects and advantages will either be apparent hereinafter or will be pointed out as the description proceeds.

According to this invention a set of rolls providing a suitable pass which may or may not be reducing is placed at the charge end and also at the discharge end of a suitable furnace through which the steel is to be passed during its manufacture. The set of rolls at the feed end of the furnace has a variable speed control so that it may be rotated at a rate to feed the steel into the furnace at any desired or required rate. In this disclosure, the set of rolls comprising a given "pass" may be termed "gripping rolls" for they are not necessarily reducing ones.

The set of rolls providing the pass at the discharge end of the furnace likewise has a variable speed control which may be adjusted to withdraw the steel from the furnace at any desired or required rate, but the rate at which a given piece (or pieces) of steel passes through the set of rolls at this discharge end is always kept higher and greater than that at which the same piece (or pieces) of steel passes through the set of rolls at the feed end of the furnace. This can easily be accomplished without any great inconvenience or added expense and enables the production of a more uniform and more highly magnetic electrical steel.

It will be understood that since a given piece (or pieces) of steel is at its one end withdrawn from the furnace faster than its other end is fed into the furnace, the heated steel will be placed under stretching tension, the amount of tension depending upon the difference in the rates at which the steel passes through the sets of rolls. This difference is purposely adjusted so as to produce the desired or required results in the final product and the tension thereby put upon the steel acts so as to make the internal stresses and strains more uniform, to orient the crystals of the metal and to make them all of substantially the same orientation, and to put the crystals in position for proper and/or further slip.

In order to tension the steel sheets, different portions thereof are concurrently or simultaneously in the feed and discharge rolls. More specifically, the tensioning in the furnace of the heated sheets results from the differential pull of the discharge rolls on the steel between them and the feed rolls, which, operating at a slower rate of speed, hold back the steel therein and therebehind to form a drag against which the discharge rolls can pull.

After the steel has passed through the more rapidly rotating set of rolls at the discharge end of the furnace, it passes through roller levelers which perform their usual function and thereafter the steel is annealed at the suitable and proper temperature depending upon the properties desired in the ultimate product. If preferred, the steel which may be formed into sheets, can be

gripped at both ends similar to the manner of gripping in the stretcher leveler process. The grips in the modification now being mentioned, being made of metal, can be used or put within the furnace without difficulty and this would increase the positiveness and the uniformity with which stresses and strains are imparted to the steel.

The roller levelers, of course, remove any irregularities in the surface of the steel and render the same smooth and of uniform thickness. The annealing step, as is known, partially or completely normalizes the stresses and strains in the steel, the amount of normalizing depending upon the temperature of the anneal and the duration of the exposure to such temperature.

In employing the term "electrical steels", I have done such with a descriptive purpose in mind. By such term, I have reference to metals, and particularly to steels that are employed chiefly by reason of their magnetic properties in the design and construction of electrical machinery such as motors, generators, transformers, and the like. The electrical properties of such steels are also very important in view of their employment in developing magnetic, as well as electrical fields; the resistivity, hysteresis and eddy losses, etc., all must be taken into account and suitably balanced in order to attain the desired results.

It will thus be seen that the design and fabrication of such steels involves more than appears at a casual glance. That is, not only must the element, as well as the crystal structure be very completely controlled, but minuteness of detail and sensitive control of all operations are of ultimate importance.

In employing the term "tension" in my description, I mean "a stretching tension". This form of tension must be distinguished from the "ordinary form" as considered in the rolling of sheets, plates, and the like. Such "ordinary tension" is, strictly speaking, a pulling face employed for "taking up" sag of the sheets between sets of rolls or passes; in such a case, the structure of the sheets is not subjected to a stretching force. That is, the pull is enough to overcome the natural tendency of the force of gravity upon a length of sheet material particularly where the distance between roll passes is of a relatively large value. By "stretching tension", I have reference to a tension which is applied for and is of such a value as to stretch heated sheets or the like and effect a moving and/or orientation of the crystalline structure thereof; such "tension" tends to actually elongate the sheet or the like. And, in my invention is must be understood that such elongation occurs while the given portion of a given sheet is within the heating furnace, for after it has left the furnace and begun to cool the force required for further stretching the sheet is greatly magnified and the desired crystalline structure would not be affected.

I have set forth the above invention in illustrative form only and I do not limit myself precisely thereto as many variations and modifications can be introduced without departing from the spirit or scope of the invention. If I desire, I may use either a single sheet of steel or sheets of steel in pack form and there may be any suitable number of sheets in such a pack. The speed at which the steel is fed through the furnace may be varied and the tension placed upon the steel may be varied by providing a proper differential between the speeds of the sets of rolls. It is also possible that I might desire to feed the steel into the furnace faster than it is withdrawn therefrom, although ordinarily I prefer to withdraw the steel at a faster rate than it is fed into the furnace.

What I claim as new and desire to secure by Letters Patent is:

1. In a method of the character disclosed for improving the characteristics of magnetic steels, passing a steel sheet through a furnace and simultaneously subjecting said sheet to the differential gripping action of feed and discharge rolls operating at different effective speeds, so that said sheet will be subjected to a stretching tension while in the furnace for improving the magnetic quality thereof.

2. In a method of the character disclosed for improving the characteristics of magnetic steels, passing a steel sheet through a furnace and simultaneously subjecting said sheet to the differential gripping action of feed and discharge rolls operating at different effective speeds, said discharge rolls being rotated at a greater speed than said feed rolls, so that said sheet will be subjected to a stretching tension while in the furnace for improving the magnetic quality thereof.

3. A method of the character disclosed for improving the characteristics of magnetic steels, including feeding steel at a suitable rate into a suitable furnace, and discharging the same steel at an increased rate and subjecting it to a stretching tension, while in the furnace by simultaneously subjecting to both the feed and discharge for improving the magnetic quality thereof, and thereafter annealing the steel.

4. A method of the character disclosed for improving the characteristics of magnetic steels, which includes feeding steel at a suitable rate through a roll pass into a suitable furnace, discharging the same steel through a roll pass at an increased rate, said steel being simultaneously subjected to both the feed and discharge passes, so that said steel will be subjected to a stretching tension while in the furnace for improving the magnetic

quality thereof, and thereafter annealing the steel.

5. A method of the character disclosed for improving the characteristics of magnetic steels, which includes feeding steel through a roll pass into a heating furnace and discharging the same steel from the furnace through another roll pass, the effective speed of the latter roll pass being greater than that of the former roll pass, simultaneously subjecting different portions of the same steel to the roll passes and to the heat of said furnace, so that said steel will be subjected to a stretching tension while heated for improving the magnetic quality thereof.

6. A method of the character disclosed for improving the characteristics of magnetic steels, which includes feeding steel through a roll pass into a heating furnace and discharging the same steel from the furnace through another roll pass, the effective speed of the latter roll pass being greater than that of the former roll pass, simultaneously subjecting different portions of the same steel to both roll passes and to the heat of said furnace, so that said steel will be subjected to a stretching tension while heated for improving the magnetic quality thereof, and subsequently leveling and annealing the steel.

7. The method of the character described for improving the characteristics of magnetic steel which includes feeding steel through a variable speed roll pass into another variable speed roll pass, and simultaneously heating the same steel while it is being passed through the roll passes, and maintaining the speed of one of said passes at a higher value than the speed of the other pass for subjecting said heated portions of the steel to a stretching tension, and improving the magnetic quality thereof.

8. The method of the character described for improving the characteristics of magnetic steels which includes feeding steel through a variable speed roll pass into another variable speed roll pass, and simultaneously heating the same steel while it is being passed through the roll passes, and maintaining the speed of one of said passes at a higher value than the speed of the other pass for subjecting said heated portions of the steel to a stretching tension for improving the magnetic quality thereof, and subsequently leveling and annealing the steel.

9. A method of improving the magnetic characteristics of magnetic steel which includes feeding sheets of steel through a pass formed by a set of variable speed rolls into and through a suitable furnace, withdrawing the same sheets from the discharge end of the furnace through another set of rolls forming another pass and rotating at a faster effective speed than the rolls of the first-mentioned pass, the same sheets being simultaneously subjected to both passes and the heat of the furnace, so that said sheets will be stretched at their heated portions and improved in magnetic quality, and subsequently passing said sheets through levelers and annealing them.

10. A method of improving the magnetic characteristics of magnetic steels which includes the steps of simultaneously passing given sheets through a variable speed roll pass into a suitable furnace and through another variable speed roll pass, maintaining the speed of the latter roll pass at a greater effective rate than that of the first-mentioned roll pass, so that said sheets will be subjected to a stretching tension while in the furnace for improving the magnetic quality thereof.

In testimony whereof, I have hereunto subscribed my name this 30th day of September, 1929.

CARL J. STROBLE.