Nov. 23, 1926. 1,607,675

E. S. JEFFERIES

APPARATUS FOR HEATING COILED STOCK

Filed August 9, 1923 2 Sheets-Sheet 1

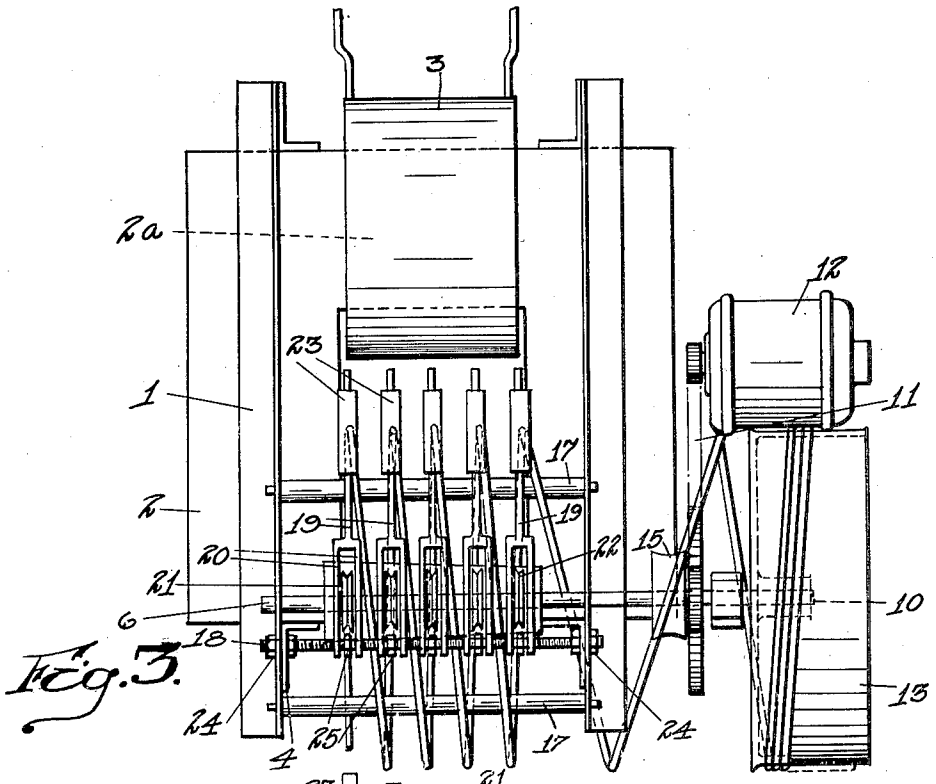


Fig. 3.

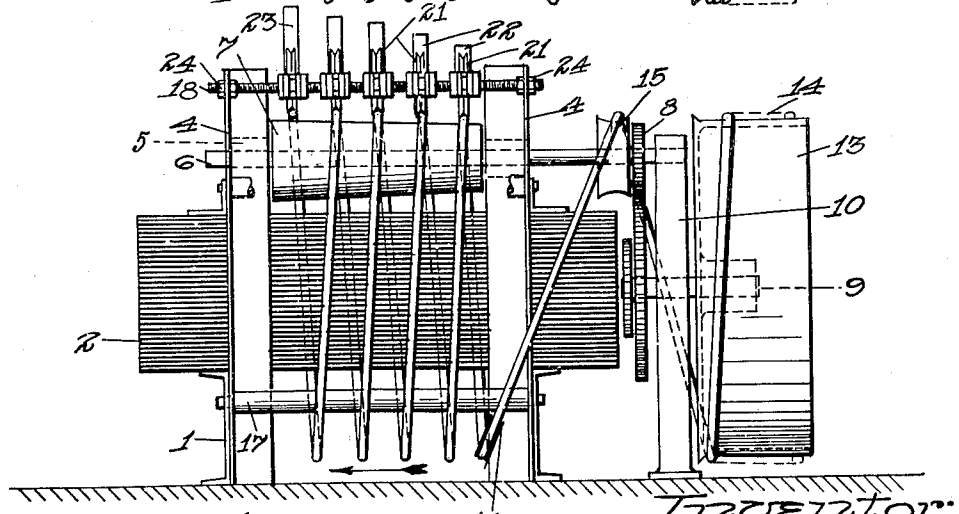


Fig. 1.

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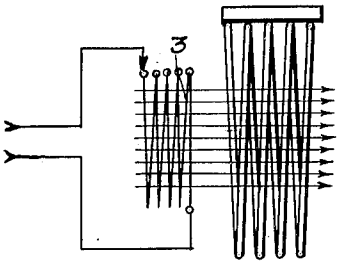


Fig. 4.

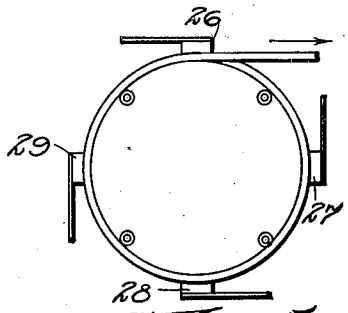


Fig. 5.

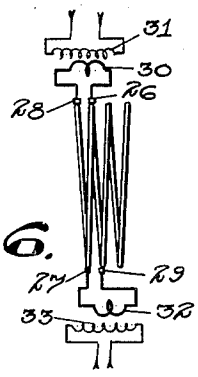


Fig. 6.

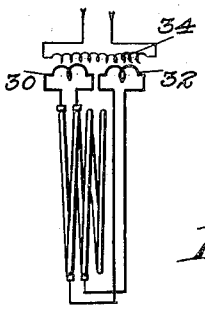


Fig. 7.

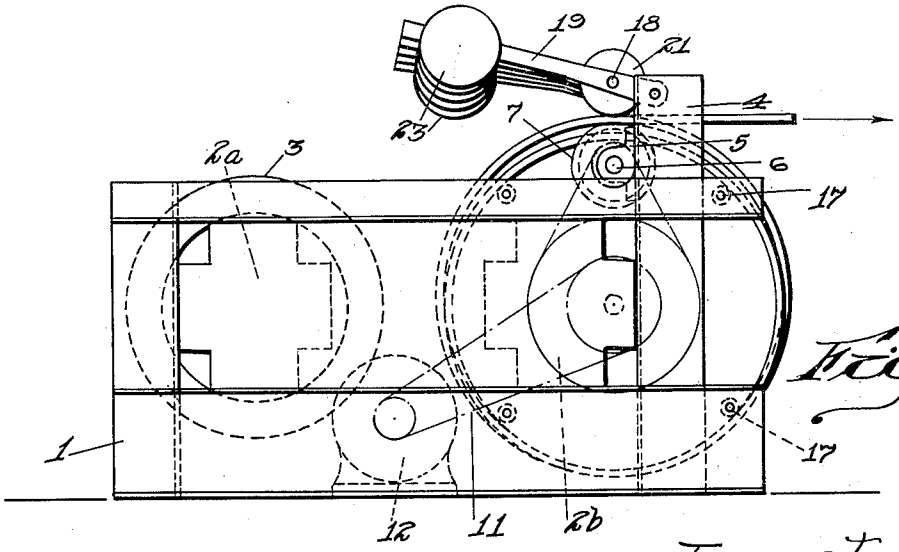


Fig. 2.

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Patented Nov. 23, 1926. 1,607,675

UNITED STATES PATENT OFFICE.

ERNEST S. JEFFERIES, OF HAMILTON, ONTARIO, CANADA, ASSIGNOR OF ONE-THIRD TO EBENEZER A. W. JEFFERIES, OF WORCESTER, MASSACHUSETTS.

APPARATUS FOR HEATING COILED STOCK.

Application filed August 9, 1923. Serial No. 656,604.

My invention relates to apparatus for heating coiled stock by the passage of an electric current therethrough.

The object of my invention is to provide an improved machine in which wire or rod stock, in the form of a coil, can be effectively heated by the passage of an electric current through one or more turns of the coil, simultaneously with the movement of the coil through the machine. My invention contemplates an arrangement whereby the different turns of the coiled stock successively constitute the closed secondary circuit of a transformer, the heavy short circuit current flowing through the stock serving to heat the same to the desired degree, without any appreciable arcing at the rolling contacts which I employ for completing the secondary circuit of the transformer. The above and other advantageous features of my invention will hereinafter more fully appear, reference being had to the accompanying drawings, in which—

Fig. 1 is a view in front elevation of a coil heating machine embodying my invention.

Fig. 2 is a view in end elevation of the machine shown in Fig. 1.

Fig. 3 is a plan view of the machine shown in Fig. 1.

Fig. 4 is a diagrammatic view illustrating the principle of operation of the machine shown in Fig. 1.

Fig. 5 is a diagrammatic view illustrating a modification of my improved machine.

Fig. 6 is a diagrammatic view illustrating the electrical connections employed in carrying out the arrangement shown in Fig. 5.

Fig. 7 is a diagrammatic view, similar to Fig. 6, illustrating a modification in the arrangement of the electrical connections.

Like reference characters refer to like parts in the different figures.

Referring to the drawings, a suitable frame 1 is adapted to support a transformer core 2 which is generally rectangular in form, although it is to be understood that other forms of transformer cores may be employed. A primary winding 3 surrounds one leg 2^a of the core 2, and as best shown in Fig. 4, the winding 3 is connected to a suitable source of power, not shown, whereby the winding 3 may be energized to cause magnetic lines of force to flow through the core 2.

A pair of uprights 4 extend in front of the leg 2^b of the core 2 and carry bearings 5, between which is rotatably supported a shaft 6. A cylinder 7, preferably composed of a good electrical conducting material, such as copper, is mounted on the shaft 6, the surface of the cylinder 7 being tapered or slightly frusto-conical in form, for a purpose to be hereinafter described. The shaft 6 extends beyond one upright 4, and is connected by gears 8 to a shaft 9, rotatably supported in a bearing 10 parallel to the shaft 6. The shaft 9 is connected in any suitable manner, as by a belt 11, shown in Fig. 2, to an electric motor 12, which is adapted to drive the shafts 6 and 9 in unison.

A cylindrical drum 13 is mounted on the shaft 9, and is adapted to receive the wire rod stock 14 in the form of a coil. The stock 14 is adapted to take one or more turns about the periphery of the drum 13, from which it it passes over guide rolls 15 and 16 to the cylinder 7. The guide roll 16 is carried by one of the uprights 4 and is adapted to direct the stock around guide rods 17 extending between the frame members 1, above and below the core 2. The guide rods 17 are symmetrically arranged about the axis of rotation of the drum 13, and serve to support the stock 14 in substantially the same form in which it is coiled, as it is caused to travel along the cylinder 7 by means which will now be described.

A shaft 18 extends between the uprights 4 above and parallel to the cylinder shaft 6. As best shown in Fig. 3, a plurality of brackets 19 are pivotally mounted on the shaft 18, each bracket 19 comprising spaced arms 20, between which is rotatably mounted a pressure wheel 21. Each wheel 21 is provided with a groove 22 of substantially the same curvature as the stock 14, and weights 23 are provided at the ends of the arms 20 to cause the wheels 21 to press adjacent turns of the coiled stock 14 into frictional engagement with the periphery of the cylinder 7.

Referring now to Fig. 4, it is obvious that when the primary winding 3 is connected to a source of electrical energy, the portion of the coiled stock 14 which is in engagement

with the periphery of the cylinder 7 will constitute the secondary winding of a transformer, inasmuch as the leg 2^b of the magnetic core 2 is surrounded by the coiled stock. The secondary winding thus provided will consist of a number of short circuited turns, through each of which a heavy current will flow, as the cross sectional area of the stock 14, as well as the cylinder 7, is relatively large. Therefore, that portion of the stock 14 through which the secondary current flows will be quickly heated to such a degree that it may be readily worked. It is obvious that rotation of the cylinder 7 will cause the coiled stock to be gradually moved in the direction of the arrow in Fig. 1, the wheels 21 serving to hold the various turns of the stock in frictional engagement with the surface of the cylinder 7. The heated stock is adapted to pass from the machine in the direction indicated by the arrow in Fig. 2.

As previously stated, the cylinder 7 is tapered or frusto-conical in form, the object of making the cylinder in this form being to take care of the progressive expansion in the coiled stock 14, as the temperature thereof increases in passing from one end of the cylinder 7 to the other. The effect of the tapered form of the cylinder 7 is to increase the speed at which the stock 14 is moved as it traverses the cylinder from right to left, for obviously, there is a greater length of metal to handle at the delivery end of the machine than at the end where the cold stock passes onto the cylinder 7. In order to provide for necessary adjustment of the speed at which the coiled stock is moved through the machine, the shaft 18 is in threaded engagement with the uprights 4, so that turning of the shaft 18 will cause it to be shifted longitudinally in either direction. Such longitudinal movement of the shaft 18 will obviously cause the wheels 21 to be shifted therewith and hold the coiled stock 14 in engagement with the cylinder 7 in different positions. Nuts 24 are provided on the shaft 18 to lock the same in position between the uprights after an adjustment thereof.

In order to provide for individual speed adjustment between the various turns of the stock 14, nuts 25 are provided on the shaft 18 between each pair of arms 20 of the individual brackets 19. By turning the nuts 25 on the shaft 18, it is obvious that any of the brackets 19 can be shifted to the right or to the left, with respect to the other brackets 19, so that the rate of movement of the coiled stock 14 can be adjusted at any particular point on the cylinder 7. With the adjustment afforded by either shifting the shaft 18 bodily, or by individual movement of the brackets 19, it is obvious that the rate of movement of the coiled stock 14 can be very closely adjusted, so that there will be no tendency for the stock to be unduly elongated, or compressed, as it passes through the machine.

The temperature to which the stock 14 is heated in its passage through the machine can be readily regulated by varying the power input to the primary winding 3, or by varying the number of turns in the primary winding by suitable taps, as indicated in Fig. 4.

From the foregoing, it is apparent that by my invention I have provided an improved apparatus for heating coiled stock by the passage of an electric current therethrough, simultaneously with the movement of the coiled stock through the machine. It is obvious that the passage of the heavy current through the short circuited turns of the stock will be accomplished without any appreciable arcing, due to the movement of the stock, owing to the fact that the stock itself is always in rolling contact with the surface of the cylinder 7, by means of which the secondary circuit of the transformer is completed. Furthermore, it is obvious that the stock will pass smoothly through the machine without being unduly stretched, owing to the fact that the speed at which the heated stock emerges from the machine is greater than the speed at which the cold stock enters the machine, thereby taking care of the expansion of the stock, due to heating.

Referring now to Figs. 5 to 7 inclusive, there is shown a modification in the arrangement for causing an electric current to flow through the coiled stock. A plurality of contacts 26, 27, 28 and 29 are adapted to engage the coiled stock 14 at different points on the periphery thereof, the contacts 26 and 28 being connected to the terminals of a secondary winding 30 of a transformer, the primary winding of which is indicated at 31. The contacts 27 and 29 are connected to the terminals of the secondary winding 32 of another transformer, in which the primary winding is indicated at 33. With the primary windings 31 and 33 energized, it is obvious that the secondary windings 30 and 32 will each be short circuited by the portions of the coiled stock 14 between the respective pairs of contacts 26 and 28, and 27 and 29.

A modification of the electrical connections shown in Fig. 6 is illustrated in Fig. 7, in which the secondary windings 30 and 32 are adapted to be energized from a single primary winding 34.

I claim:

1. The improvement in the art of heating metal rod stock, which consists in supporting the stock in the form of a coil, with convolutions of said coil positively spaced apart, and causing an electric current to flow through a portion of the coil.

2. The improvement in the art of heating metal rod stock, which consists in supporting the stock in the form of a coil, with convolutions of said coil positively spaced apart, and causing an electric current to flow through a portion of the coil by magnetic induction.

3. The improvement in the art of heating metal rod stock, which consists in supporting the stock in the form of a coil, with convolutions of said coil positively spaced apart, and causing an electric current to flow through a portion of the coil while the stock is being moved.

4. The improvement in the art of heating metal rod stock, which consists in causing a length of stock to be moved in the form of a coil, and in causing an electric current to pass through a portion of the coil by magnetic induction, simultaneously with the movement of the stock.

5. The improvement in the art of heating metal rod stock, which consists in short circuiting the stock and causing it to move in a curvilinear path, all parts of which are within the influence of an oscillatory magnetic field, whereby an electric current is caused to flow through a portion of the said coil by magnetic induction.

6. In apparatus of the class described, the combination with a source of electrical energy and a transformer comprising a magnetic core provided with a primary winding connected to said source, of means for causing a length of metal rod, in the form of a coil, to act as the short circuited secondary winding of said transformer.

7. In apparatus of the class described, the combination with a source of electrical energy and a transformer comprising a magnetic core provided with a primary winding connected to said source, of means for causing metal rod to pass in the form of a coil around said core, and further means for completing the electric circuit between certain of the turns of the coil.

8. In apparatus of the class described, the combination with a source of electrical energy and a transformer comprising a magnetic core provided with a primary winding connected to said source, of means for causing metal rod to pass, in the form of a coil, around a portion of said core and thereby serve as the secondary winding of the transformer.

9. In apparatus of the class described, the combination with a source of electrical energy and a transformer comprising a magnetic core provided with a primary winding connected to said source, of means for causing metal rod to pass, in the form of a coil, around the core of said transformer, and further means for short circuiting certain of the turns of said coil, whereby the induced secondary current is adapted to heat the rod.

10. In apparatus of the class described, the combination with a source of electrical energy and a transformer comprising a magnetic core provided with a primary winding connected to said source, of means for causing metal rod stock to pass in the form of a coil around the core of said transformer, means for short circuiting certain of the turns of said coil, and further means for compensating for the expansion of the stock as it is heated by the passage of the induced current therethrough.

11. In apparatus of the class described, the combination with a source of electrical energy and a transformer comprising a magnetic core provided with a primary winding connected to said source, of means for causing metal rod to move, in the form of a coil, around a portion of said core, certain portions of said coil being moved at a greater speed than other portions thereof.

12. In apparatus of the class described, a magnetic core, means for causing metal rod to pass in the form of a coil around a portion of said core, and a rotating cylinder of conducting material in engagement with the turns of said coil.

13. In apparatus of the class described, a magnetic core, means for causing metal rod to pass in the form of a coil around a portion of said core, a rotatably driven cylinder of conducting material having its axis of rotation substantially parallel to the axis of said coil, and means for holding portions of the turns of said coil in frictional engagement with the surface of said cylinder, whereby the coiled rod is adapted to move along said core.

14. In apparatus of the class described, a magnetic core, means for causing metal rod to pass in the form of a coil around said core, a rotatably driven cylinder having a frusto conical surface, and means for maintaining portions of the turns of said coil in frictional engagament with the surface of said cylinder, whereby different portions of said coil are driven at different speeds.

15. Apparatus of the class described including means for supporting coiled stock, means for feeding the coiled stock through the apparatus, and means for passing a current through portions of the stock successively to gradually increase the temperature of the stock as it passes through the apparatus.

16. Apparatus of the class described including separate heating units each including a stock portion, means for feeding looped stock to bring every portion thereof successively to the heating portions of the respective units, and means for maintaining without variation the length of stock supported between said units, irrespective of the expansion of the stock by the heat of the units.

17. Apparatus of the class described, including separate heating units, each includ-

ing a stock portion, means for feeding looped stock to bring every portion thereof successively to the heating portions of the respective units, and means for variably operating said feeding means, whereby to maintain without variation the length of stock supported between units as said stock expands under heat.

18. Apparatus of the class described, including separate heating units, each including a stock portion, means for feeding looped stock to bring every portion thereof successively to the heating portions of the respective units, and means for gradually increasing the rate at which the stock is fed to compensate for expansion of the stock as it is heated.

19. Apparatus of the class described, comprising a rotatably driven member having a frusto conical surface, means for causing metal rod to pass in the form of a coil around said member, and means for variably maintaining portions of said coil in frictional engagement with different portions of said surface, whereby different portions of said coil are driven at different speeds.

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