Nov. 16, 1948. A. B. WILSON 2,454,021

APPARATUS FOR TENSIONING STRIP MATERIAL

Filed Sept. 7, 1944

2 Sheets-Sheet 1

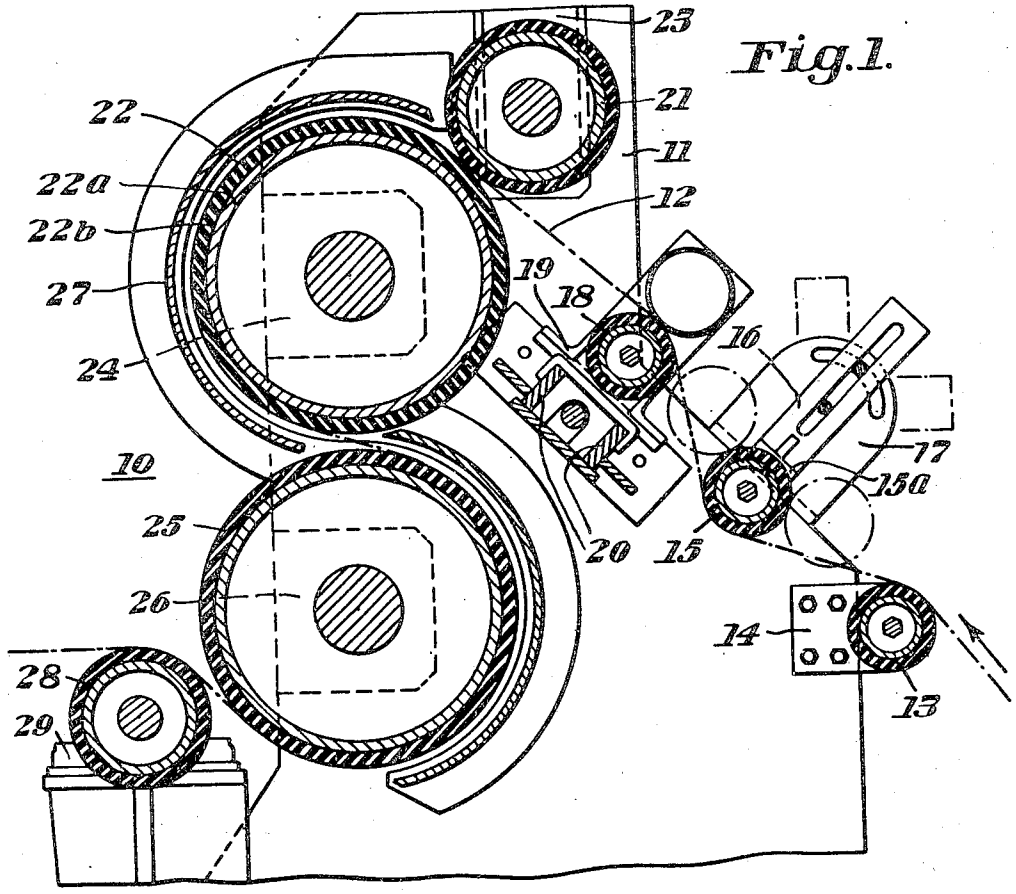
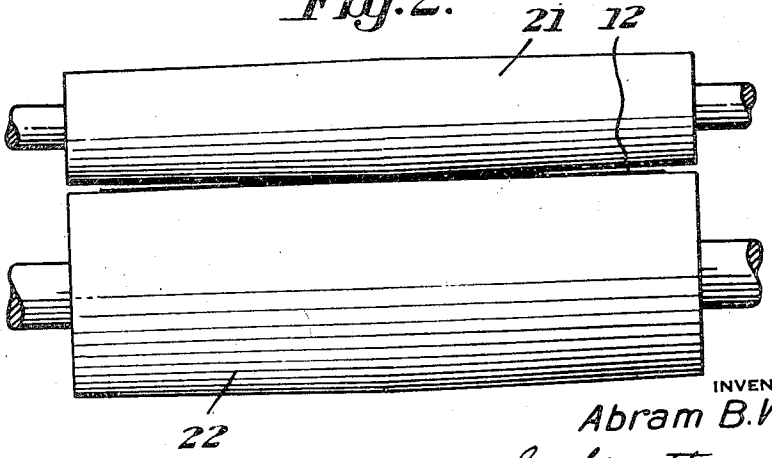


Fig. 1.

Fig. 2.



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Fig. 3.

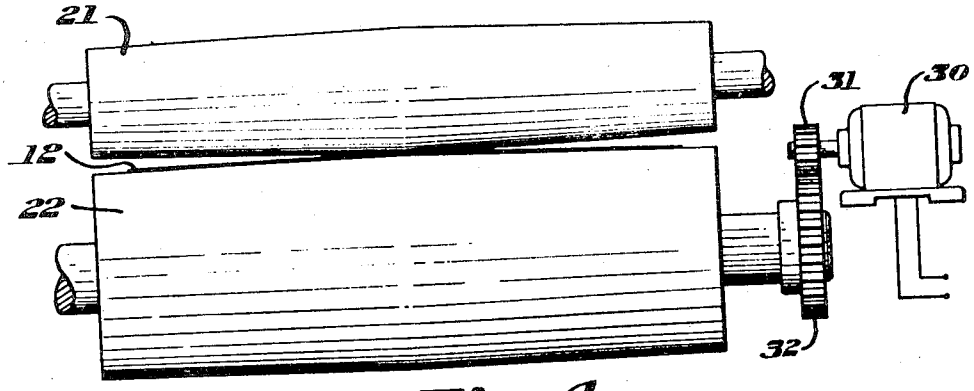
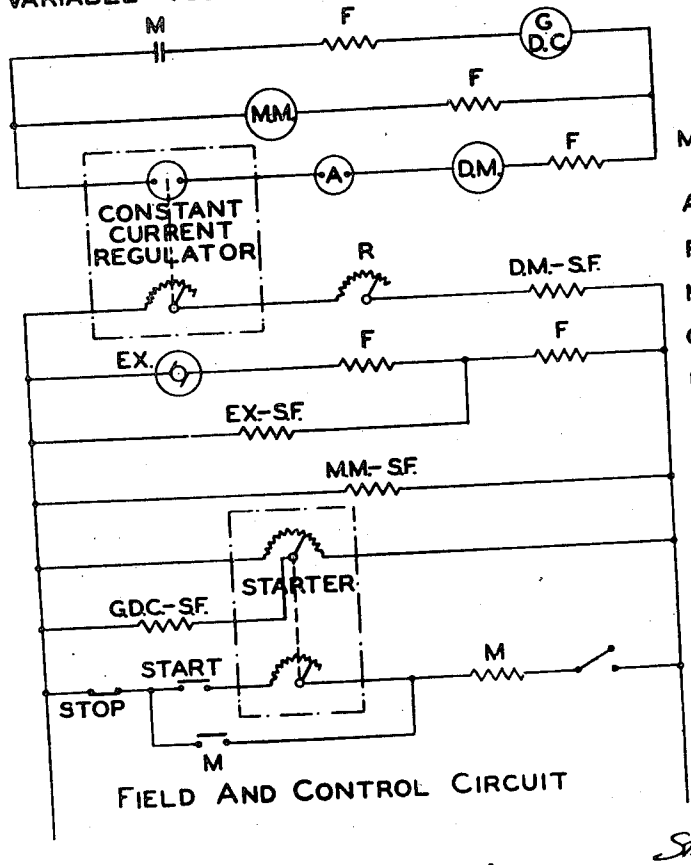


Fig. 4.

VARIABLE VOLTAGE ARMATURE CIRCUIT



FIELD AND CONTROL CIRCUIT

LEGENDS:-

M — MAIN LINE CONTACTOR & COIL

A — AMMETER

F — SERIES FIELD

M.M.-MAIN MOTOR

G.D.C.-D.C. GENERATOR

D.M.-DRAG MOTOR

EX.-EXCITOR

R — VARIABLE RHEOSTAT

S.F.-SHUNT FIELD

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APPARATUS FOR TENSIONING STRIP MATERIAL

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5 Claims. (Cl. 271—2.3)

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This invention relates to the tensioning of strip while being processed in strand form.

In order to achieve high rates of production and the low unit cost thereby made possible, metal strip, e. g., steel strip, is now being processed to a large extent in the form of a continuous strand or ribbon, instead of after being cut into lengths. The apparatus for subjecting strip to various processes frequently has a length of several hundred feet and the strip is fed through the apparatus at a high rate of speed. Tensioning devices appropriately located have been employed for insuring proper travel of the strip through the apparatus. These devices, as constructed heretofore, have been characterized in operation by a marked tendency of the strip to weave from side to side therein. If unchecked, this tendency may cause the fouling of the strip edges on the processing apparatus resulting in damage to the material and possibly jamming the entire apparatus, necessitating a lengthy shut-down for the removal of damaged strip, readjustment of the apparatus and again starting the processing operation. It is evident that the risk of such delays constitutes a serious threat to the high production rate which is the only justification for the expensive installations necessary for processing strip in strand form.

I have invented a novel method and apparatus for tensioning strip which avoid the tendency toward side-wise weaving exhibited by the tensioning apparatus known previously. In a preferred embodiment of the apparatus, I provide one or more tensioning rolls so positioned that the strip wraps around a substantial portion of the periphery thereof. A pressure roll cooperates with one of the tension rolls to grip the strip frictionally therebetween. The tension roll with which the pressure roll cooperates has a convex contour or a crown. That is to say, the roll is slightly larger at the middle than at the ends and tapers progressively from the middle toward the ends. The pressure roll may be truly cylindrical but the effectiveness of the apparatus in eliminating side-wise weaving is improved if the pressure roll has a crown similar to that of the tension roll. In either case, the pressure roll and the tension roll cooperating therewith exert a frictional grip on the strip principally adjacent the center, leaving the strip edges unstressed, or, in any event, stressed to an extent much less than the central portion.

A clear understanding of the invention may be had from a consideration of the following detailed description referring to the accompanying drawings illustrating a preferred embodiment and practice. In the drawings,

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Figure 1 is a central section through a tensioning apparatus of my invention on a plane normal to the axes of the tension and pressure rolls; and

Figure 2 is diagrammatic view showing the convex contour of the pressure and tension rolls to an exaggerated degree.

Figs. 3 and 4 illustrate conventional means for controlling the tension rolls.

Referring in detail to the drawings, my tensioning apparatus indicated generally at 10 comprises spaced housings 11 between which the strip being processed, designated 12, is adapted to pass. On the entering side of the apparatus, an entry guide roll 13 is journaled in bearings 14 secured to the housings. A deflector roll 15 is journaled in bearings 15a carried on arms 16. The arms are pivoted for angular movement on brackets 17 secured to the housings. A second deflector roll 18 is journaled in bearings 19 adjustable transversely of the apparatus on rails 20 extending between the housings.

The path of the strip 12, as indicated in chain lines, is over the guide roll 13, under the deflector roll 15, over the second deflector roll 18 and thence between a pressure roll 21 and an upper tension roll 22. The pressure roll is journaled in chucks 23 adjustably mounted in the housings. The tension roll 22 is similarly journaled in chucks 24.

After passing between the rolls 21 and 22, the strip wraps around the latter and then around a lower tension roll 25 journaled in chucks 26. The tension rolls have shields or jackets 27 extending around the portions thereof engaged by the strip. From the lower tension roll 25, the strip passes over an exit guide roll 28 journaled in bearings 29.

The upper tension roll 22 with which the pressure roll 21 cooperates has a convex or crowned contour, as shown in Figure 2, to an exaggerated degree. The illustrated embodiment of the invention is intended for use in an electrolytic strip-tinning apparatus, and all the rolls include a metal body 22a and a rubber sheath thereon to protect the coated material from abrasion. The sheath 22b is ground slightly larger, say .030", at the middle than at the ends and with a contour which tapers progressively from the middle to the ends.

The provision of an upper tension roll having a slight crown, such as that indicated, has been found effective to reduce materially the extent of side-wise weaving of the strip as it progresses.

In order to eliminate weaving, for all practical purposes, the pressure roll 21 should also have a crown similar to that of the upper tension roll, viz. about .030".

It will be apparent from a consideration of Figure 2 that when the pressure roll 21 is adjusted relative to the tension roll 22, so as to grip the strip therebetween, the cooperating rolls exert a frictional force principally on the central portion of the strip, leaving the edge portions relatively free and unstressed, or, at any rate, under a tension much less than that exerted on the central portion. The width of the central portion of the strip to which the tension is principally applied by friction, of course, varies with the pressure exerted by the roll 21. This pressure naturally varies with the operating conditions existing in the particular processing apparatus to which the invention is applied. For obvious reasons, the tension on the strip is kept at the lowest value sufficient to effect a desired travel of the strip through the apparatus. It will be understood that the apparatus shown in the drawings is intended to exert back tension on the strip, but the principle of the invention may also be incorporated in the apparatus for pulling the strip through the processing equipment. The operation of the tensioning apparatus is controlled in usual manner by means independent of the strip, e. g., by motor drive or generator drag, which may be applied to one or more of the rolls, preferably the tension rolls. Such means are shown in the Stafford Patent 2,315,459 and the Taylerson Patent 2,338,143.

Figures 3 and 4 illustrate conventional means for controlling the tension rolls. An electric motor 30 is connected to the roll 22 by gears 31 and 32. This motor may be driven by a source of electricity so as to supply tension to the strip or it may be driven by the strip in which case it acts as a generator and imposes a drag on the strip. Figure 3 shows the motor 30 connected to a source of current and operated to pull the strip through the tensioning apparatus. Figure 4 is an electrical diagram showing electrical connections whereby the motor 30 can be driven by the strip and operated as a generator to impose a drag on the strip. The motor 30 designated DM on the wiring diagram of Figure 4 is a constant speed electric motor which is overdriven by the strip at a higher rate than its normal speed so that it is forced to act as an electric generator and thus resist the forward movement of the strip. Various types of electric motor and wiring arrangements may be employed as will be readily understood by one skilled in the electrical art. This electric motor is preferably adapted to run at a constant speed with a constant load and to vary in torque directly with variations in the current input. The motor 30 may be constructed and connected so that it tends to drive the strip at a rate of, say, 75% of that at which another motor used to pull the strip through the strip processing apparatus (this second motor is designated MM in Figure 4), draws the strip forward. The motor initially aids in moving the strip while the strip processing apparatus is being started up; but when the strip is moving at full speed, the motor is overdriven and becomes a generator of electricity and so applies a counterforce which resists the forward movement of the strip. The faster the strip moves, the greater is this countertorque applied by the motor generator to increase the tension on the strip. The motor 30 has the same general characteristics as the motor MM with which it

is connected in parallel in a constant voltage D. C. circuit. The direct current generator G. D. C. in the variable voltage armature circuit is driven by a suitable constant speed motor. This serves to drive the direct current motor MM and the direct current motor DM at constant speeds when the current is held constant. An exciter EX develops a direct current of constant amperage for the shunt fields which control the speeds of the two motors and the direct current generator. A constant current regulator of standard construction which mechanically interconnects the armature circuit and the shunt field circuit serves to maintain a constant current in the shunt field circuit, and this may be further regulated as desired by the variable rheostat R. Suitable mechanism may be employed to start and stop the motors as illustrated in the diagram, and this may be of any standard construction and need not be here described. By adjusting the rheostat R, the shunt field of the tension motor may be varied to change the speed of that motor and thereby vary the back pressure or the longitudinal tension on the strip. After this adjustment has been made, then that tension will remain uniform because of the constant current developed in the circuit. That is, if the speed of the main motor MM remains uniform, then the current in the shunt field remains uniform and the tension on the strip does not change.

The outstanding advantage of the invention, as already stated, is the reduction or elimination of the tendency of the strip to weave side-wise in its travel through the tensioning device. This obviates the possibility of fouling of the strip on the sides of the processing apparatus and the resulting damage to the strip or the stoppage of the processing apparatus. A further advantage resides in the fact that existing tensioning devices may be easily modified to operate on the principle of my invention. Little or no additional cost is involved in grinding the rubber sheaths of the pressure and upper tension rolls to a convex or crowned contour instead of to a truly cylindrical surface.

Although I have illustrated and described but a preferred embodiment of the invention, it will be recognized that changes in the details of construction may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. Apparatus for exerting a tension on strip comprising a tension roll, means for guiding the strip around the roll in frictional contact with a substantial portion of the periphery thereof, and a pressure roll cooperating with the tension roll to grip the strip therebetween, said rolls having a convex contour.

2. Apparatus for exerting a tension on strip comprising a tension roll, means for guiding the strip around the roll in frictional contact with a substantial portion of the periphery thereof, and a pressure roll cooperating with the tension roll to grip the strip therebetween, said rolls tapering progressively from the middle toward both ends.

3. In metal strip processing apparatus in which metal strip is drawn lengthwise through substantial distances and tends to weave from side to side, means for controlling the movement of the strip through the apparatus and counteracting said tendency and insuring proper tracking of the strip, said means comprising a roll, means for guiding the strip as it moves through the apparatus so that it passes about and in contact with

a substantial portion of the periphery of said roll, a pressure roll cooperating with said first mentioned roll to grip the strip, said rolls being cooperatively contoured so that the strip is gripped therebetween with greater pressure adjacent the center of the strip than adjacent the edges of the strip, and means independent of the strip for controlling rotation of at least one of said rolls.

4. In metal strip processing apparatus in which metal strip is drawn lengthwise through substantial distances and tends to weave from side to side, means for controlling the movement of the strip through the apparatus and counteracting said tendency and insuring proper tracking of the strip, said means comprising a roll, means for guiding the strip as it moves through the apparatus so that it passes about and in contact with a substantial portion of the periphery of said roll, a pressure roll cooperating with said first mentioned roll to grip the strip, at least one of said rolls having greater diameter adjacent its center than adjacent its edges so that the strip is gripped between said rolls with greater pressure adjacent the center of the strip than adjacent the edges of the strip, and means independent of the strip for controlling rotation of said first mentioned roll.

5. In metal strip processing apparatus in which metal strip is drawn lengthwise through substantial distances and tends to weave from side to side, means for controlling the movement of the strip through the apparatus and counteracting said tendency and insuring proper tracking of the strip, said means comprising roll means engaging the strip as it moves through the apparatus so that the strip is in substantial surface contact with said roll means and means independent of the strip for controlling rotation of said roll means, said roll means being contoured to grippingly engage the strip more tightly adjacent the center of the strip than adjacent the edges of the strip.

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