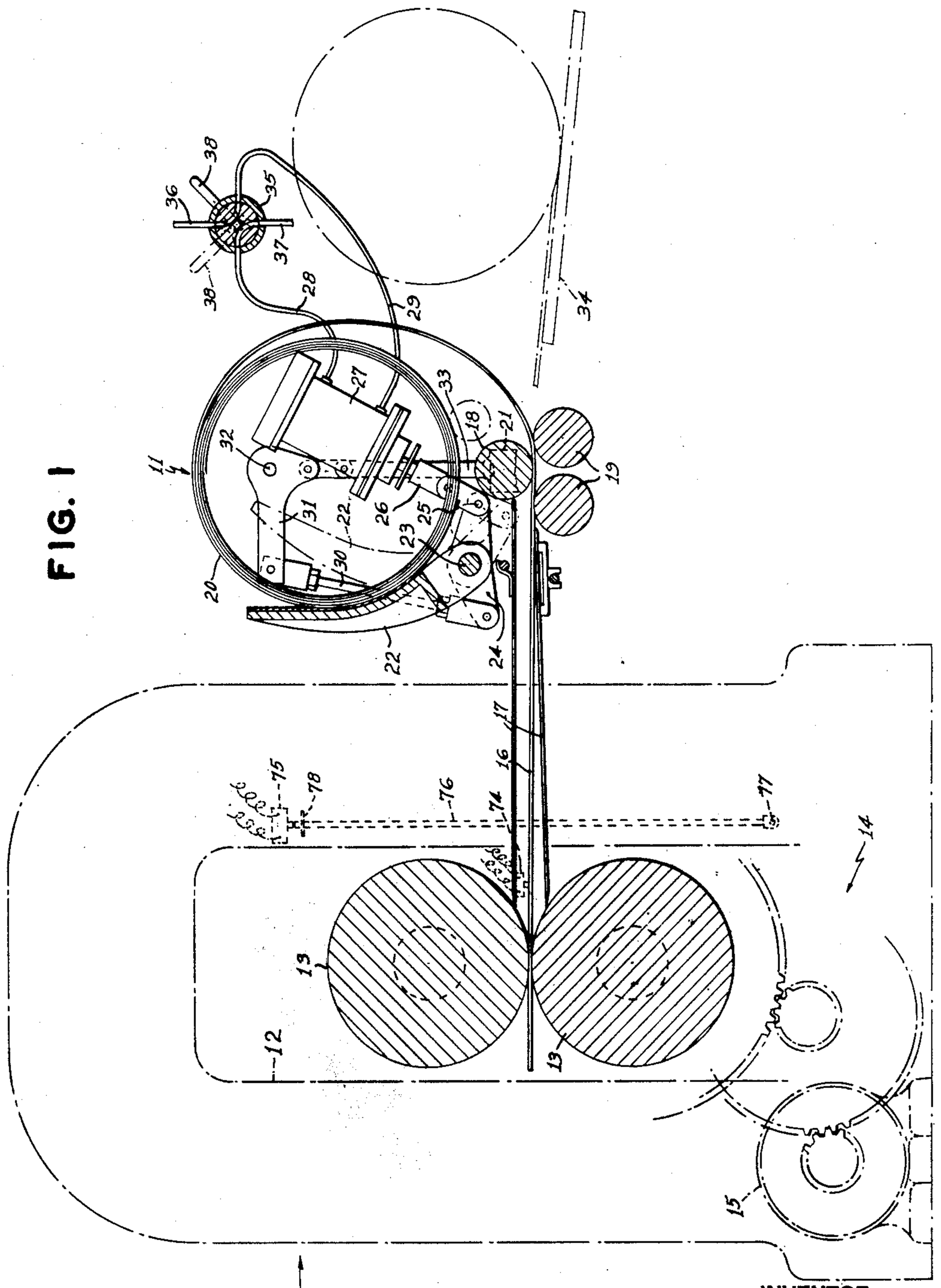
Sept. 29, 1953 H. F. ANDERSON 2,653,496

ROLLING MILL AND COILING APPARATUS

Filed Nov. 25, 1947 2 Sheets-Sheet 1

FIG. 1



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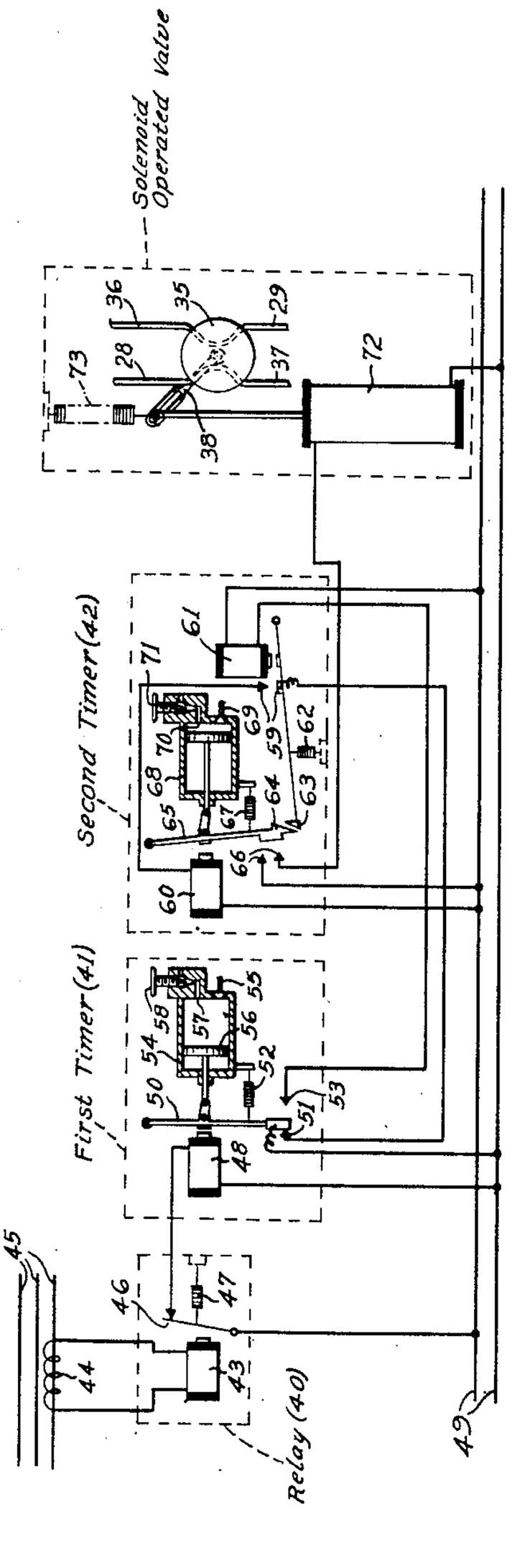

FIG. 2

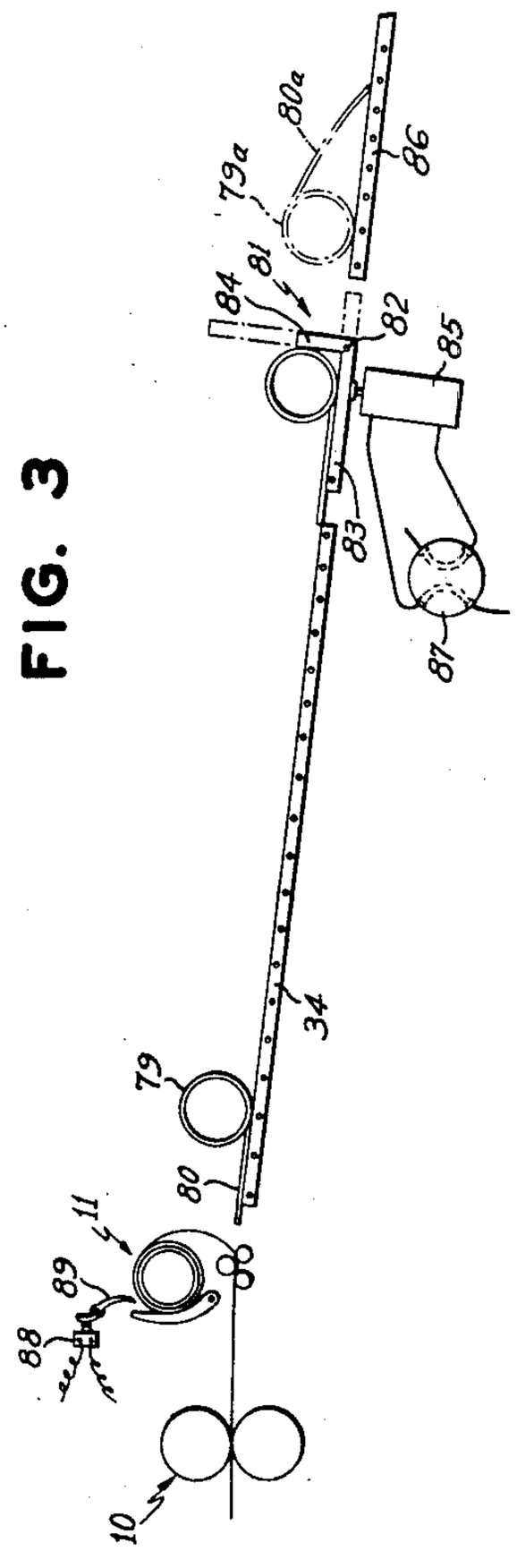

FIG. 3

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ROLLING MILL AND COILING APPARATUS

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This invention relates to rolling sheet metal, and is particularly concerned with the provision of improved automatic apparatus for use in conjunction with rolling mills equipped with apparatus for coiling the sheet metal as it emerges from the rolls. The principal object of the invention is to provide apparatus for automatically performing the operation known in the industry as "pulling a tail" on the coil into which the sheet metal is wound. The so-called "tail" of the coil is a flat uncoiled length at the trailing end of the sheet metal—the last part thereof to emerge from between the rolls. This uncoiled end, or tail, at the outside of the coil, is necessary in order to present the coil to a subsequent rolling or other operation. If no tail is formed, i. e. if the whole length of the metal sheet (or bar, as it is customarily called) is coiled, then the coil must be opened by hand or otherwise in order to present it to the next subsequent operation, and this is often a difficult thing to do, especially with fairly heavy gauge sheet metal.

It has heretofore been customary to pull or form the tail on sheet metal coils being wound on the exit side of a rolling mill by hand manipulation of the coiling apparatus controls. Tail pulling in this fashion requires a very alert operator, because it requires manipulation of the controls at exactly the right time in the very short interval of time following emergence of the trailing end of the sheet metal, or bar, from between the rolls of the rolling mill, and just before it enters the coiling apparatus, in order to discontinue the coiling operation at the proper instant and to leave a flat uncoiled tail of proper length. Even the most experienced operators find it difficult to pull tails of uniform length, that are neither too long to interfere with easy handling of the coil, nor too short for easy presentation to a subsequent operation; and the difficulty of the operation is of course increased at high rolling and coiling speeds.

The invention provides for pulling the tail automatically, and with an accuracy and reliability that even in high speed rolling operations insures the production of coils with uniform tails of optimum length. In accordance with the invention, a rolling mill associated with apparatus for coiling the sheet metal passing through

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the mill, as it emerges therefrom, is equipped with electric control apparatus for automatically discontinuing the coiling action of the coiling apparatus at the precise moment for leaving a tail of desired length for the next subsequent operation such as further rolling, slitting, trimming, etc. The electrical control apparatus comprises first switch means connected with the rolling mill and caused to close promptly upon emergence of the trailing end of the sheet metal from between the rolls. A timer is connected to the first switch means so as to become actuated by closure thereof. A control circuit including second switch means is also connected to the timer, so that said second switch means are closed promptly at the end of the predetermined timing interval for which the timer is set. This control circuit and its second switch means is connected to the coiling apparatus and serves, upon closure of the second switch means, to discontinue the coiling action thereof. Thereby a tail of length determined by the speed of travel of the sheet metal through the rolls, and by the length of the timing interval of the timer, is produced automatically on the coil of metal formed by the coiling apparatus.

It is common practice to eject the coil from the coiling apparatus onto a conveyor, for carrying it to the next subsequent rolling or other operation. Frequently the coiling apparatus ejects the coil with the tail at the bottom, and it is desirable to turn the coil over, to bring the tail to the top, for convenience in presenting the coil to a subsequent operation. The invention contemplates the provision of apparatus for effecting this change in position automatically, directly after ejection of the coil from the coiling apparatus. In accordance with this feature of the invention, a coil positioner is included in the conveyor, and a second electrical control apparatus, which may be identical with that for controlling automatic formation of the tail, is employed for actuating the coil positioner at a predetermined time interval following ejection of the coil from the coiling apparatus.

A preferred embodiment of the invention, in which the foregoing and other features are incorporated, is described below in conjunction with the accompanying drawings. Also described are alternative arrangements of various indi-

vidual components of the new apparatus. In the drawings,

Fig. 1 shows, more or less schematically, a rolling mill and associated coiling apparatus embodying the invention;

Fig. 2 shows, schematically, a form of control circuit in accordance with the invention; and

Fig. 3 shows, schematically, apparatus for changing the position of the coil following its ejection with a tail from the coiling apparatus.

The apparatus shown in Fig. 1 comprises a rolling mill 10, and coiling apparatus 11 for coiling the so-called bar, or sheet, emerging from the rolling mill. The rolling mill and coiling apparatus are both of conventional construction. The rolling mill comprises a heavy frame 12 which provides support for the rolls 13. The rolls are driven through a suitable reducing gear train 14, by an electric motor 15. Sheet metal 16 emerging from the rolls 13 passes between guide plates 17 to top and bottom power driven coiling rolls 18 and 19 of the coiling apparatus. These rolls impart a curvature to the sheet metal, so that it loops upwardly and winds into a compact coil 20.

The upper coiling roll 18 is mounted at each end on a vertically movable supporting member 21. With these members held in their lowermost position, the roll 18 cooperates with the fixed lower rolls 19 to impart a set curvature in the sheet metal and cause it to wind into a coil. By releasing the members 21, causing them to move to their upper position and lift the upper roll 18 away from the lower rolls 19, the coiling action of the apparatus is discontinued.

The release of the members 21 and ejection of the coil from the coiling apparatus is accomplished by a kick-off mechanism comprising a kick-off shoe 22 which normally is in the position shown in full lines in Fig. 1. In this position it forms a backstop for the coiling sheet metal and serves to guide the coil as it is being formed. The kick-off shoe 22 is secured to and supported on a pivot shaft 23, to which the midpoint of a lever 24 is also attached. One end of the lever 24 is pivotally connected by a link 25 to a piston rod 26 connected to a piston within a compressed air cylinder 27. A pair of air pipes 28 and 29 provide, respectively, for admitting compressed air above and below the piston within the cylinder 27. The other end of the lever 24 is pivotally connected to one end of a connecting rod 30, the other end of which is pivotally connected to a bell crank lever 31 mounted on a shaft 32. The bell crank 31 also is linked to a push rod 33 which actuates the vertically movable supporting members 21 for the upper coiling roll 18.

The kick-off shoe 22 is maintained in the position shown in solid lines in Fig. 1 when compressed air is admitted through the lower air pipe 29 to beneath the piston in the cylinder 27 and the upper pipe 28 is opened to the atmosphere. In this position also the bell crank lever 31 is in the position shown, holding the upper coiling roll 18 in its lowered position to cooperate with the fixed coiling rolls 19 and exert a coiling action on the sheet metal or bar coming from the rolls. When, however, compressed air is admitted through the upper air pipe 28 above the piston in the cylinder 27 (the lower air pipe 29 then being opened to the atmosphere), the piston is forced down, moving the kick-off shoe 22 approximately to the position indicated by the dotted lines in Fig. 1. At the same time, the bell crank lever is rotated (in a clockwise direction) by the lever 24 and the connecting rod 30, raising the push rod 33 and releasing the supporting member 21 so that the upper coiling roll is raised sufficiently to discontinue further coiling action on the bar of sheet metal passing beneath it. The forward motion of the kick-off shoe 22 from the position shown in solid lines to that shown in dotted lines ejects the coil of sheet metal from the coiling apparatus onto a conveyor 34 (indicated only schematically in Fig. 1). Thereafter, by reconnecting the lower air pipe 29 to a source of compressed air, and the upper pipe 28 to an exhaust to the atmosphere, the piston within the cylinder 27 is returned to the upper limit of its travel, the kick-off shoe 22 is returned to the position shown in full lines, and the upper coil roll 18 is again brought down into position to exert a coiling action on the next bar passed through the rolling mill.

The supply of compressed air to the air cylinder 27 through the air pipes 28 and 29 is regulated by a four-way control valve 35. With the valve in the position indicated in full lines in Fig. 1, a compressed air supply line 36 is connected through the valve to the lower air pipe 29 leading to beneath the piston in the cylinder 27, and the upper air pipe 28 is connected through the valve to an exhaust pipe 37 open to the atmosphere. With the valve in this position, therefore, the kick-off shoe and the upper coiling roller 18 are held in the position indicated in full lines in the drawing. By turning the valve handle 38 through 90° to the position indicated in dotted lines, the connections through the air pipes 28 and 29 are reversed, as a result of which the upper coiling roll 18 is released to discontinue the coiling action of the coiling apparatus, and the kick-off shoe is moved to eject the coil from the apparatus to the conveyor 34.

The valve 35 is solenoid operated, and, in accordance with the invention, the operation of the valve solenoid is governed by an electrical control circuit including a timer which causes the coiling action of the coiling apparatus to be discontinued and the coil to be ejected by the kick-off shoe 22 at the proper moment after the trailing end of the sheet metal has emerged from between the rolls 13, so as to leave a tail of desired length on the coil. A control circuit for accomplishing this result is shown schematically in Fig. 2. The four major elements of this control circuit are a relay 40 actuated by emergence of the trailing end of the sheet or bar from between the rolls; a first timer 41, the timing cycle of which determines the length of the tail formed on the coil; a second timer 42, the timing cycle of which controls resetting of the coiler kick-off mechanism; and the solenoid-operated valve.

The relay 40 shown in Fig. 2 is one that is actuated by the difference between the amount of electrical power supplied to the rolling mill motor 15 when the mill is operating under load with a bar of sheet metal passing therethrough, and the amount of power supplied to the mill motor when the mill is idling under nothing more than its friction load, with no bar passing therethrough. Specifically the relay comprises a solenoid 43 energized by a current transformer 44 inductively coupled with one of the conductors 45 of the three-phase power supply line to which the mill motor 15 is connected. When energized, the solenoid 43 opens a switch 46 that normally is held closed by a spring 47. When the rolling

mill is operating under a working load, and in consequence a relatively large amount of current is flowing through the conductors 45, the solenoid 43 is energized sufficiently by the current transformer 44 to open the switch 46. When, however, the rolling mill is idling under no load, the solenoid 43 is insufficiently energized by the current transformer to hold the switch 46 open, and the switch therefore is closed by the spring 47.

The switch 46 is in series with a solenoid 48 in the first timer 41 and a power source 49 for the control circuit. When the switch 46 is closed, the solenoid 48 is energized, throwing the switch arm 50 of a single-pole double-throw switch into position to close with a first switch contact 51. When the solenoid 43 is de-energized by opening the relay switch 46, the switch arm 50 is retracted by a spring 52 away from the first switch contact 51, and into position to close with a second switch contact 53.

Motion of the switch arm 50 is controlled by a dash pot 54, arranged so that retraction of the switch arm by the spring 52 to close with the second switch contact 53 occurs immediately upon de-energization of the solenoid 48; and so that movement of the switch arm 50 in the opposite direction, upon energization of the solenoid 48, occurs only with some time delay. This is accomplished by a poppet valve 55 in the dash pot cylinder which opens to allow ready movement of the dash pot piston 56 in the direction urged by the spring 52, but which closes when the piston is urged to move in the opposite direction upon energization of the solenoid 48. A small air leak passage 57 controlled by a needle valve 58 allows air to leak slowly into the dash pot cylinder when the energized solenoid 48 urges the piston in the direction in which the poppet valve closes, thus permitting the dash pot piston to move relatively slowly in the direction urged by the solenoid and to permit contact to be made between the switch arm 50 and the first switch contact 51 at the end of a time interval that is regulated by the setting of the needle valve 58.

The first switch contact 51 is in a series circuit with a relay 59, a solenoid 60 in the second timer 42, and the control circuit power source 49. Energization of the solenoid 60 occurs only when the switch arm 50 of the first timer is closed with the first switch contact 51, and when the relay 59 also is closed. Closure of the relay 59 is effected by energization of a relay solenoid 61, in series with the power source 49 and the second switch contact 53 of the first timer. It is held closed mechanically, against the force of a relay-opening spring 62, by engagement of the end 63 of the relay-operating arm with a catch 64 mounted on a switch lever arm 65 which the solenoid 60 actuates. When the circuit through the first switch contact 51 of the first timer and the relay 59 is completed, the solenoid 60 is energized, moving the switch lever arm 65 into position to close a pair of switch contacts 66. By this same motion, the latch 64 is disengaged from the end 63 of the relay arm, enabling the spring 62 to retract the relay arm and open the relay contacts, if the relay solenoid 61 is then de-energized. When the circuit through the solenoid 60 is broken, either at the contact 51 or through the relay 59, a spring 67 retracts the switch lever arm 65 to open the contact 66.

Movement of the switch lever arm 65 is regulated by a dash pot 68, arranged so that the lever arm 65 moves to close the contacts 66 immediately upon energization of the solenoid 60, but is retracted but slowly by the spring 67, after the solenoid becomes de-energized, so that opening of the contacts occurs only after some time delay. As in the case of the dash pot in the first timer, this is accomplished by means of a poppet valve 69 and a small air passage 70 controlled by a needle valve 71. The poppet valve 69 is positioned to open and allow rapid movement of the lever arm 65 into position to close the switch contact 66, but to close when the switch arm 65 moves in the opposite direction. Movement of the arm 65 in the direction to open the contacts 66, therefore, occurs relatively slowly through a time interval governed by the setting of the needle valve 71 controlling the rate at which air can escape from the dash pot cylinder.

The switch contacts 66 of the second timer 42 are in series with the power source 49 and a solenoid 72 for operating the four-way air valve 35 controlling operation of the kick-off mechanism of the coiling apparatus 11.

The operation of the control circuit shown in Fig. 2 is substantially as follows: The contacts are all shown in the position they occupy just before introducing a bar (or sheet) between the rolls 13 of the rolling mill 10. In this position the relay switch 46 is closed, and the solenoid 48 of the first timer is thereby energized. Thus contact is made with the first switch contact 51 of the first timer, but the relay 59 is open, so that the solenoid 60 of the second timer is not energized. Accordingly, the solenoid 72 controlling operation of the valve 35 is not energized, and the valve is held by a spring 73 in position so that the compressed air supply line 36 is connected with the lower pipe 29 leading to beneath the piston in the air cylinder 27, while the upper pipe 28 is connected to the exhaust pipe 37. The coiling apparatus, then, is in position to receive and coil sheet metal issuing from between the rolls 13.

As soon as the bar or sheet enters the rolls 13, the increased power required by the mill motor results in a substantially increased current flowing through the mill motor supply lines 45. In consequence, the solenoid 43 of the relay 40 is energized, opening the relay switch 46. Thereupon the solenoid 48 of the first timer is de-energized, the circuit through the first switch contact 51 of the first timer is broken, and contact is made with the second switch contact 53. This operation occurs without significant time delay. Thereby the circuit through the relay solenoid 61 in the second timer is completed, closing the relay 59, and this relay is held closed by engagement of the end 63 of the relay operating lever with the catch 64. The circuit through the second timer switch solenoid 60, however, is still incomplete, notwithstanding closure of the relay 60, because now it is broken at the contact 51 of the first timer. Consequently nothing further happens as the bar continues through the rolling mill, until its trailing edge emerges from between the rolls. At this moment the power demand of the mill motor 15 drops substantially, reducing the amount of current flowing through the mill motor supply line 45, and resulting in de-energization of the relay solenoid 43. Thereupon the relay switch 46 again closes, energizing the first solenoid 48, and moving the switch arm 50 into position again to close with the first switch contact 51. As pointed out above, this movement occurs slowly, so that the closure with the first switch contact 51 occurs only after a

time delay predetermined by the setting of the needle valve 58. At the end of this timing interval, a circuit is made through the contact 51 and the now closed relay 59, energizing the solenoid 60. Immediately the switch arm 65 of the second timer closes the contacts 66 and completes a circuit through the valve solenoid 72. Thereupon the four-way valve 35 is rotated 90°, causing the coiling apparatus to discontinue its coiling action and resulting in ejection of the coil by the kick-off mechanism.

Movement of the switch arm 65 of the second timer to close the contacts 66 results also in releasing the end 63 of the relay lever arm, so that the relay is opened by the spring 62. In consequence, the circuit through the second timer solenoid 60 is broken again almost as soon as it is made. However, as pointed out above, the switch arm 65 is retracted but slowly by the spring 67, so that there is a time delay determined by the setting of the needle valve 71 before the contacts 66 are again opened and the valve solenoid 72 is again de-energized. At the end of this time interval, the four-way valve is returned to its original position by the spring 73, thereby resetting the coiling apparatus for receiving and coiling a new bar. When this has occurred the control circuit is again in the position shown in Fig. 2, and is again ready to begin the above-described cycle of operations.

It is evident from the foregoing that the timing interval of the first timer (regulated by the setting of the needle valve 58) controls the length of the tail on the coil formed in the coiling apparatus. This it does, of course, by regulating the time interval that passes, following emergence of the trailing end of the bar from between the rolls of the rolling mill, before the coiling action of the coiling apparatus is discontinued and the coil ejected. For any given speed of travel of the bar through the rolling mill, an increase in this timing interval results in decreasing the length of the tail on the coil, and vice versa the tail length is increased by a decrease of this timing interval.

The timing interval of the second timer determines the period between actuation of the coiling apparatus kick-off mechanism and return of the kick-off mechanism to position for receiving a new coil. The timing interval of this timer therefore is not so critical as that of the first timer 41; but it should be amply long enough to allow for complete ejection of the coil.

The particular type of relay 40 shown in Fig. 2, which operates in response to the change in mill motor power demand that occurs between working-load and no-load operation of the rolling mill, is not the only type of switch means that may be employed. Still other forms are shown in dotted lines in Fig. 1. One alternative, for example, is a normally closed switch 74 mounted on the side of the rolling mill from which the rolled metal emerges, and in position to be held open by the bar passing through the rolls. Such a switch will be opened directly after a bar is fed into the rolls 13, and will again close directly upon emergence of the trailing end of the bar from between the rolls, just as does the switch 46 of the relay 40.

Still another switch means that may be substituted for the relay 40 is a normally opened switch 75 mounted on the rolling mill frame 12, and held closed by a rod 76 fastened at one end 77 to the rolling mill frame at a point remote from the switch itself. Whenever a bar to be rolled is introduced between the rolls 13, the strain imposed on the rolling mill frame causes it

to expand slightly, and this expansion is generally sufficient to produce enough relative movement between the switch 75 and the actuating rod 76 to allow the switch to open. Of course, the switch in such case should be of the type designed for operation by very small mechanical movements of the order of a few thousandths of an inch. Such switches, however, are well known and readily available. The operating rod 76 shown in the drawings may be guided in its movement relative to the switch by a bearing eye 78. If the expansion of the rolling mill frame is not by itself sufficient to produce the degree of motion of the rod 76 relative to the switch 75 required to operate the latter, a motion-multiplying lever system may be substituted for the rod 76.

As shown in Fig. 3, when a coil 79 is ejected from the coiling apparatus 11, its tail 80 is at the bottom of the coil, and it is in this position that it is carried from the coiling apparatus on the conveyor 34. Frequently it is desirable to turn the coil over to bring its tail to the top, for convenience in presenting it to a subsequent rolling or other operation. For this purpose, a coil positioner 81 is included in the conveyor. The coil positioner consists simply of an angular cradle pivotally mounted on a shaft 82. The cradle is normally in the position shown in solid lines in Fig. 3, with one side thereof 83 forming an extension of the conveyor 34, and the other side 84 extending upwardly as a stop. An air cylinder 85 is provided for moving the cradle through 90° about its pivot shaft 82, to the position indicated by broken lines in Fig. 3. When so moved, the side 83 of the cradle that was previously in line with the conveyor 34 is brought to an upright position, and the other side 84 is brought into alignment with an extension 86 of the conveyor. Thereby the coil 79*a* is turned over, its tail 80*a* being brought to the top, and in this new position it continues along the conveyor extension 86. The air cylinder 85, by which the cradle is moved, is controlled by a four-way solenoid operated valve 87, in substantially the same manner as the air cylinder 27 of the coiling apparatus is controlled by its four-way valve 35.

In accordance with the invention, a duplicate of the control circuit shown in Fig. 2 is employed to operate the cradle cylinder control valve 87, just as it is used to control operation of the coiling apparatus kick-off mechanism. In this case, a normally closed switch 88 is mounted in position to be opened by a lever 89 promptly upon actuation of the coiling apparatus kick-off mechanism. The switch 88 here takes the place of the relay 40 shown in Fig. 2, and it is connected to the solenoid 48 of the first timer shown in Fig. 2. Otherwise the control circuit of Fig. 2 is just as described above, and its operation is of course the same, the only difference being that the valve controlled thereby is the cradle valve 87 rather than the coiling apparatus valve 35. With this arrangement, actuation of the coiling apparatus kick-off mechanism opens the switch 88, de-energizing the relay 48 of the first timer so that its switch arm 50 is thrown into position to close the circuit through the relay solenoid 61 of the second timer 42. Then when the coiler kick-off mechanism returns to its original position, again permitting the switch 88 to close, the switch arm 50 of the first timer, after a time delay, returns to the position in which a circuit is completed through the first switch contact 51, the relay 59, and the second timer solenoid 60. This results in closing the contacts 66, actuating

the solenoid control valve 87 to move the coil positioner cradle 81 through 90°. After a time delay determined by the second timer 42, the cradle is returned to its original position, ready to receive the next coil ejected from the coiling apparatus. At this point the timing circuit is again in position to resume the above-described cycle of operations. The timing interval of the first timer 41 is, for this purpose, made sufficient to allow the coil ejected from the coiling apparatus to travel down the conveyor to the coil positioner. The timing interval of the second timer 42 is made sufficient to allow the coil 79*a* to move off the coil positioner, before the latter is returned to its normal position.

Thus, in accordance with the complete invention, using automatic timer circuits for both forming a tail on the coil and reversing the position of the coil, this sequence of operations may be performed entirely automatically, resulting in a coil with a tail of suitable length and in position for introduction into the next operation to which it is to be subjected.

The control circuit has been described above in connection with Fig. 2 as involving the use of dash pots to achieve the desired timing intervals, and with needle valves to control the length of these time intervals. This has been done for the sake of clarity and ease of understanding the invention, but it is not necessary that dash-pot timers be used. As a matter of fact, commercially available electronic timer equipment is for many purposes superior to and more suitable than mechanical dash-pot timers. The invention, for example, has been employed successfully using the Model 52C electronic timer made by the United Cinephone Corporation, of Torrington, Connecticut, which timer has a timing interval adjustable in the range from 0.05 to 0.5 second, as the first timer 41; and using a Model 54B electronic timer, made by the same concern, having a timing interval adjustable in the range from 0.1 to 10 seconds, as the second timer 42.

It is equally possible to employ a vacuum-tube electronic relay in lieu of the solenoid actuated relay 40 described above; and in fact in the installation using the electronic timers of the United Cinephone Corporation, such a vacuum-tube relay was employed rather than a solenoid-operated relay.

The invention has been described above with reference to a particular form of coiling apparatus 11 known in the art as a "coiler." Another form of coiling apparatus also used extensively in rolling sheet metal is known as a "blocker." In their mechanical structures, these two types of devices are quite different, and they are used in somewhat different types of rolling operations. They have in common, however, that they are both designed to wind metal emerging from the rolling mill in the form of a coil, and they include kick-off mechanism for ejecting the coil after the bar has passed through the rolls. Accordingly, the invention contemplates, in lieu of the coiler shown in Fig. 1, apparatus in which a blocker is substituted as the coiling apparatus; and as used herein the term "coiling apparatus" is generic to both coilers and blockers.

I claim:

1. The combination with a rolling mill, with coiling apparatus for coiling sheet metal passing through said mill as it emerges therefrom, and with electrical means for deactuating said coiling apparatus, of means for automatically pulling a tail on the sheet metal coil including a source of electric power, a normally closed switch, means holding said switch open only when metal is passing through the mill, whereby said switch closes upon emergence of the trailing end of the metal from between the rolls, a time delay relay connected through said switch to said power source, whereby said relay is set in operation to begin its timing cycle upon closure of said switch, said time delay relay having contacts which close upon expiration of its timing cycle, said contacts being connected in circuit with said power source and with the deactuating means for said coiling apparatus, whereby upon closure of said relay contacts the coiling action of said coiling apparatus is discontinued and a tail of length determined by the speed of travel of the sheet metal through the rolls and the length of the timing cycle of said time delay relay is produced automatically on the coil of metal formed by the coiling apparatus.

2. Apparatus according to claim 1, in which the rolling mill is driven by an electric motor, and in which the normally closed switch by which the time delay relay is actuated comprises a relay having contacts spring biased to a closed position and having an actuating coil connected to the mill motor power supply, said spring bias being sufficiently strong to hold the contacts closed when the mill motor is operating under merely a friction load but being insufficiently strong to hold the contacts closed when the motor is operating under a working load.

3. Apparatus according to claim 1, including means for varying the timing cycle of said time delay relay, whereby the length of tail formed on the coil of sheet metal may be varied independently of the speed with which the sheet metal passes through the rolling mill.

4. In apparatus comprising a rolling mill, coiling apparatus for coiling sheet metal as it emerges from said mill, a pneumatic kick-off mechanism for discontinuing the coiling action of said coiling apparatus, and a solenoid-operated valve for actuating said kick-off mechanism, the improvement comprising a switch, means for closing said switch promptly upon emergence of the trailing edge of the sheet metal from the rolling mill, a power source, a first time delay relay connected in circuit with said switch and said power source, whereby said relay is energized upon closure of said switch, said first time delay relay having contacts which close after said relay has been energized for the period of its timing cycle and which open promptly upon de-energization thereof, a second time delay relay connected through the contacts of said first time delay relay to said power source, whereby said second time delay relay becomes energized upon closure of said first relay contacts, said second time delay relay having contacts which close promptly upon energization thereof and which open upon completion of its timing cycle following de-energization thereof, the contacts of said second time delay relay being connected in circuit with said valve solenoid and with the power source, whereby said kick-off mechanism is actuated at the conclusion of the timing cycle of said first time delay relay and then is reactuated at a later time determined by the timing cycle of said second relay.

5. Apparatus according to claim 1 in which the normally closed switch is mounted on the rolling mill frame and which includes a switch operating rod, one end of said rod being mounted in posi-

tion to operate the switch and the other end being connected to the rolling mill frame at a point sufficiently remote from the switch so that movement of the rod relative to the switch sufficient to throw the switch occurs upon expansion and contraction of the rolling mill frame incident to entrance into and emergence from the rolls, respectively, of the sheet being rolled.

6. Apparatus according to claim 1 in which the normally closed switch is positioned in the path of the metal sheet as it leaves the rolling mill and is there arranged to be held open by sheet metal passing through the mill.

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