

Dec. 29, 1942.

G. H. RENDEL
APPARATUS FOR INDICATING AND CONTROLLING THE
AMOUNT OF STRIP IN LOOPER PITS
Filed May 9, 1940

2,306,750

3 Sheets-Sheet 1

FIG. 1.

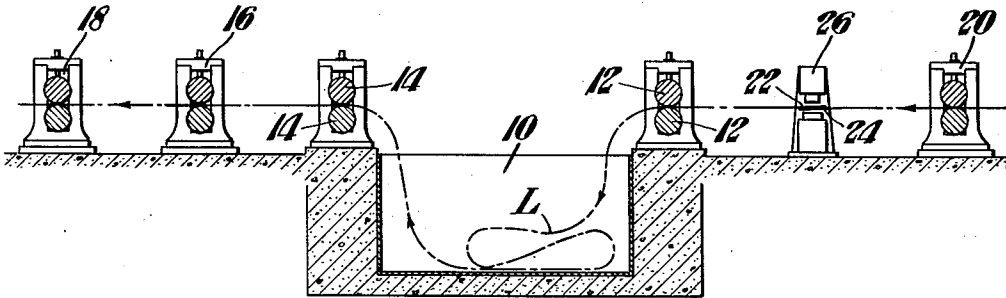
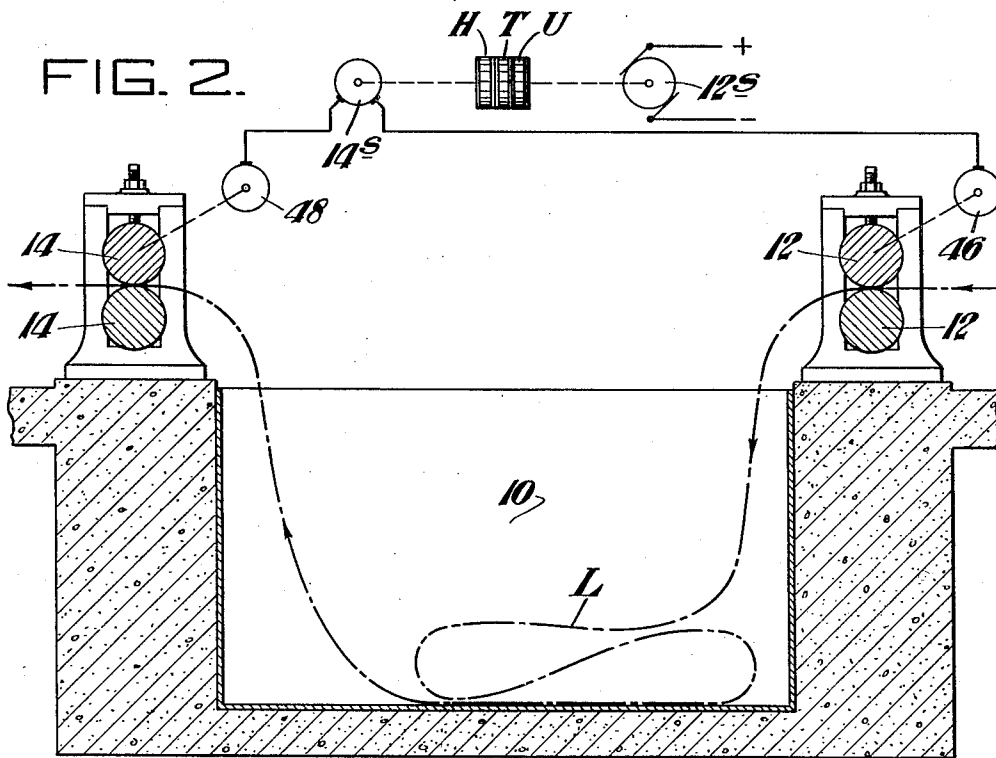


FIG. 2.

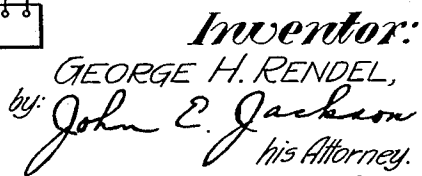


Inventor:
GEORGE H. RENDEL,
by: *John E. Jackson*
his Attorney.

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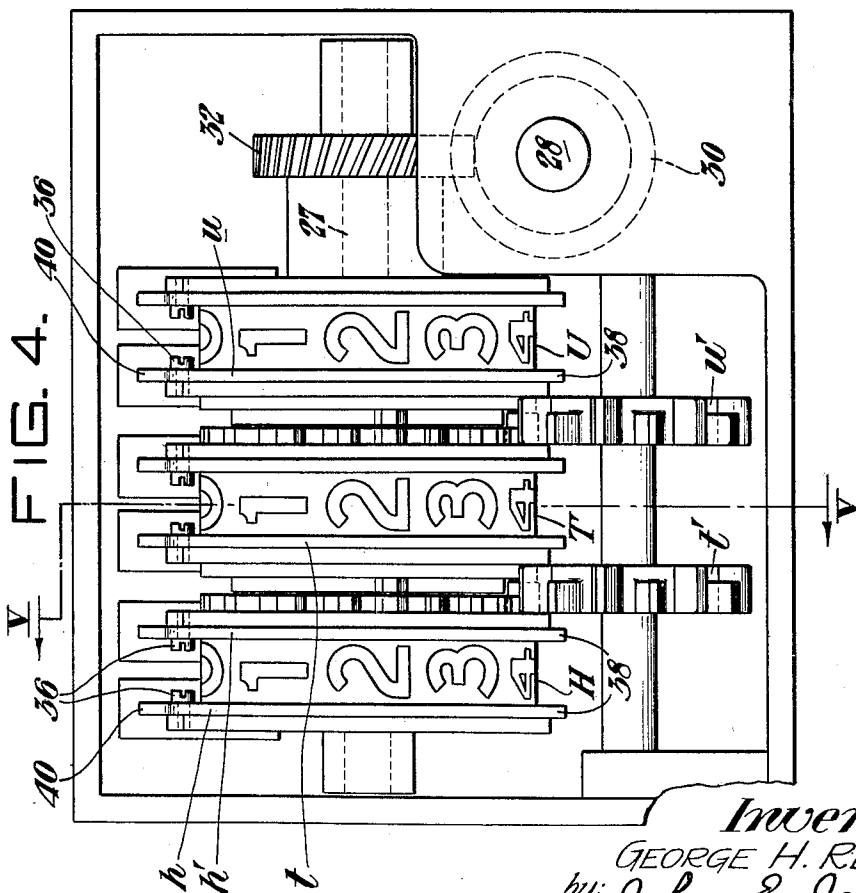
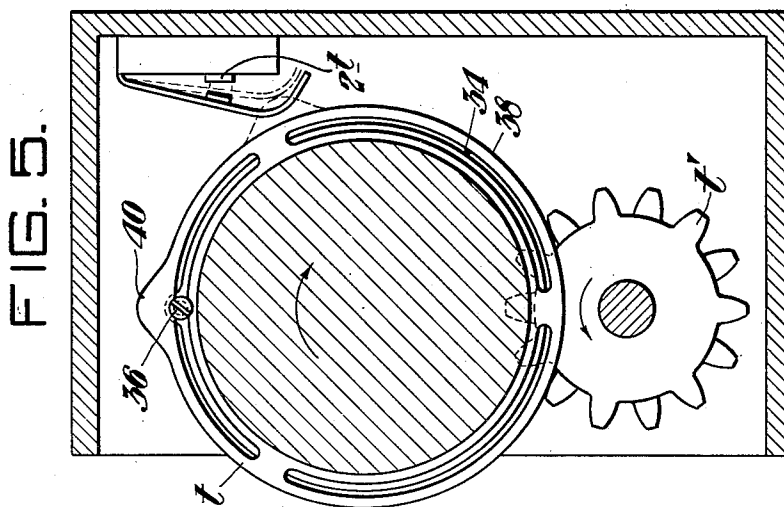


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2. **G. H. RENDEL**
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UNITED STATES PATENT OFFICE

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APPARATUS FOR INDICATING AND CONTROLLING THE AMOUNT OF STRIP IN LOOPER PITS

George H. Rendel, Gary, Ind.

Application May 9, 1940, Serial No. 334,259

4 Claims. (Cl. 80—35)

This invention relates to improvements in means for indicating the amount of slack strip at all times while the strip is traveling between fixed stations. Although not limited thereto, the invention is peculiarly well suited for use in continuous sheet and strip mills which are frequently equipped with a looper pit adapted to accommodate a traveling loop of material so as to provide sufficient slack to permit certain stands of tandem mill to withdraw strip from the pit while the feed-in rolls remain at rest, so as to permit the trailing end of one strip of material to be welded or otherwise united to the leading end of the strip from a supply reel.

The invention will be fully apparent from the following detailed disclosure when read in connection with the accompanying drawings.

In the drawings:

Figure 1 is a somewhat diagrammatic view of a continuous mill for rolling metal products such as sheet or strip;

Figure 2 is an enlarged view of the looper pit showing pinch rolls for feeding strip thereto at one side and mills for feeding strip therefrom at the other side;

Figure 3 is a circuit diagram including a schematic illustration of component parts of the approved mechanism;

Figure 4 is a detailed elevation of a counting mechanism equipped with cams and circuit-controlling devices embodying features essential to the combination herein claimed, and

Figure 5 is a sectional view on line V—V of Figure 4.

Referring in detail to the drawings, the numeral 10 represents a looper pit which is adapted to accommodate a traveling loop of slack material such as that indicated at L. The material is fed into the looper pit by feed-in pinch rolls 12—12 located at one end of the looper pit. Similarly the material is fed out of the pit by the mill rolls 14—14 forming part of a tandem mill including roll stands 16 and 18 equipped with rolls of conventional type.

The material fed to the looper pit comes, for example, from a roll stand 20. In the normal operation of continuous sheet or strip mills, it is the practice to weld the trailing end 22 to the leading end 24 from time to time. For this purpose, the conventional type of welder shown at 26 is utilized.

Since the rolls 12 must be stopped during the welding operation and it is normally desired not to stop the operation of rolls 14, it is essential that a generous supply of slack strip be present

in the looper pit 10 at all times. One of the chief features of the present invention is the provision of improved means for visually indicating at all times the amount of slack strip in the looper pit.

It is a further feature of the present invention to provide means whereby a requisite amount of slack strip is automatically maintained in the looper pit, and to provide means for stopping the driving motor of the rolls 14 in the event the amount of slack in the looper pit reaches a predetermined minimum.

The means hereinafter described in detail includes, in combination with the feed-in and feed-out rolls 12 and 14, between which a moving loop of slack strip is adapted to accumulate as the strip is traveling through roll stands, respective actuating means, each driven at a rate proportional to the peripheral speed of a roll of each of said stands, a differential mechanism actuated by the joint operation of said two actuating means, and an indicating device responsive to said differential means for showing at all times the length of traveling loop of slack strip between the said spaced roll stands.

The respective actuating means in the embodiment of the invention illustrated comprises Selsyn transmitters 12s and 14s. The transmitter 12s is driven at a rate of speed proportional to the peripheral speed to which the rolls 12 feed the strip into the looper pit 10, and similarly the transmitter 14s is driven at a speed proportional to the peripheral speed at which the strip is fed out of the looper pit. These two Selsyn transmitters are electrically connected, as shown in the diagram, Figure 3, with a differential Selsyn receiver R. The differential Selsyn transmitter rotates the shaft 27 of a counter, the power being transmitted through a shaft 28 of the transmitter through worm gearing 30 and 32.

The counter illustrated is of a somewhat conventional form except for special cam devices carried thereby for controlling the circuit mechanism referred to in detail hereinafter. The illustrated counter, which is sufficient for the present purpose, includes three numbered dials which will register from 0 to 999. This counter comprises a hundreds dial H, a tens dial T, and a units dial U. As is customary in such decimal counters, one revolution of the unit dial will advance the tens dial one unit. Similarly, one revolution of the tens dial will advance the hundreds dial one unit.

Conventional mutilated gears, such as those shown at u' and t', are effective to transmit movement from the units dial to the tens dial and from the tens dial to the hundreds dial, said

gears meshing with respective cooperating gear-like elements of conventional form carried by the dials, as shown.

The parts are so proportioned and arranged that each lineal foot of strip passing through the pinch rolls 12 will cause the differential Selsyn receiver R and the counter connected therewith to advance one point or unit on the units dial U, while each foot of strip material leaving the pit will be effective to reverse the differential receiver R and has the effect of subtracting one unit from the counter. Therefore it is apparent that if the lineal speed of the strip entering and leaving the pit is equal, the counter will remain stationary. If the entrance speed is greater than the exit speed, the counter will rotate forward and thus at all times register the accumulated amount of slack strip in the pit. Then, when the strip entering the pit is slowed down or stopped, while the strip leaving the pit continues in motion, the counter will be caused to rotate in a reverse manner and will thus indicate the amount of slack strip left in the pit. Thus, the numbers on the counter dials U, T and H visually indicate at all times the amount of strip stored in the looper pit.

The hundreds dial carries a cam *h* which is adapted to control a switch contact 1*h*. The tens dial carries a cam *t* which is adapted to control a switch contact 2*t*. The hundreds dial also carries a cam *h'* which is arranged to control a switch contact 3*h*. The units dial carries a cam *u* which is arranged to control a switch contact 4*u*. The several cams on the units, tens, and hundreds dials are adjustably mounted thereon in the manner illustrated in Figure 5. As there shown, each cam is slotted as indicated at 34 so as to be adjustably secured by means of a suitable screw 36. Each cam contains a dwell portion 38 substantially concentric with the axis of rotation of the dials, and each includes an active rise portion 40 which is designed to be positioned opposite a selected digit on the dial. As thus arranged, the several cams can be set in a predetermined manner so as to effect an automatic control hereinafter described, whereby a determined amount of slack strip can be automatically maintained in the looper pit. These cams are also effective to control the operation of respective controllers 42 and 44, which in turn govern the operation of respective motors 46 and 48, driving the feed-in rolls 12 and feed-out rolls 14 through suitable gear reduction transmission mechanism of conventional form.

There is also provided an alarm 50 whose operation is controlled by the counter cams so as to warn the operator when the supply of slack material in the looper pit has been depleted to an unsafe amount.

When initially starting the apparatus, after threading a new strip through the looper pit 10, the counter can be set to zero by operating a push button 52 which controls the circuit of a relay coil 54 which closes the circuit across contacts 56, including a counter-resetting motor 58. By so resetting the counter to zero after initially threading the strip through the pit, compensation is made for the distance between the ends of the looper pit.

The mode of operation of the apparatus will be readily understood by the following description of a specific example. In practice, it has been determined that under certain operating conditions it is advisable to maintain 570 feet of slack

strip in the looper pit. This will give adequate time to weld the trailing end of an outgoing strip to the entering end of an incoming strip without the necessity of stopping the rolls 14 or other rolls of the stands 16 and 18 of a continuous mill. When the amount of slack strip is so depleted as to contain, for example, only 80 feet, the danger zone is being reached. Accordingly, in the example of operation herein described, the cams *u*, *t*, *h* and *h'* are so set that their active rise portions are located in radial alignment with the appropriate numerals on the dials, as will more specifically appear as the description proceeds.

The rise on cam *h* of the hundreds dial is aligned with the numeral 5 of the dial. As so arranged, switch 1*h* is closed when the numeral 5 comes to a predetermined operative position, and is open at all other times.

The rise portion on cam *t* is arranged to be aligned with the numerals 7 and 8 of the tens dial. As thus arranged, the switch 2*t* is closed when the numerals 7 and 8 come to an operative position, and is open at all other positions.

The rise on hundreds cam *h'* is aligned with numeral 0 on the hundreds dial. Thus the switch 3*h* is closed when the numeral 0 on the hundreds dial comes to operative position, and is open at all other points.

The rise on cam *u* is located in line with numeral 0 on the units dial. Thus the switch 4*u* will be open when the units dial reaches the 0 position, and will be closed at all other points.

The cam settings referred to in detail correspond to the number 570, representing the illustrative desirable number of feet of slack to be maintained in the looper pit, and 80, representing the illustrative minimum safe amount of slack.

In a typical operation, assume that the new strip has been threaded through the looper pit and the dial counter will have been reset, thus compensating for the distance between the ends of the looper pit when the push button 52 is pressed. The operation of the push button is effective to energize the coil 54 of relay D. This relay is held in closed circuit condition through its auxiliary, normally open contacts 56 in series with the switch 4*u*. This switch 4*u* is in parallel with the normally closed contacts 60 of a relay C. Switch 1*h* is also in parallel with switch 4*u*, and contacts 60 on relay C. Relay D is effective to start the reset motor 58 which continues to run until the cams on all the dials register zero, at which time the holding circuit is broken by reason of the switch 4*u* being opened by the cam U, 1*h* being opened by contacts on cam T, and the contacts 60 on relay C opened due to contact 3*h* closing, thus energizing coil 68. After such resetting of the counter to zero position, the apparatus is in readiness for operation, and as the moving strip is accumulated in the pit the dial counter advances. When the numeral 5 on the hundreds dial H reaches a determined reading position, switch 1*h* closes, thus energizing the coil 62 of relay A. As the strip continues to advance, the numeral 7 on tens dial T comes to operative reading position, whereupon switch 2*t* closes, thus energizing the coil 64 of relay B. The energization of the coil 62 of relay A was effective to close the circuit across contacts 66 of said relay through the controller 42 which in turn controls the circuit to the pinch roll drive motor 46, and thus causes the pinch roll motor to operate at a speed which will deliver strip to

the looper pit so as to maintain a slack supply of 570 feet of such strip therein.

To protect the equipment from damage such as would be likely to occur if the requisite amount of slack was not maintained in a looper pit, the apparatus in the example assumed is arranged to sound an alarm and slow down the mill when the amount of strip is reduced to 80 feet. This is accomplished as follows: As the stored strip in the looper pit becomes depleted and the hundreds dial reaches 0, the cam *h'* thereof closes switch *3h*, thus energizing the coil 68 of the relay C. As the stored strip in the looper pit becomes further depleted, so as to turn to numeral 8 on the tens dial T to operative position, the cam *t* will close the switch *2t* and thus energize the coil 64 of the relay B. Upon energization of relay B, the circuit will be closed across contacts 70 thereof so as to complete a circuit through the alarm 50, and the controller 44 which governs the operation of the motor 48. Thus when the amount of slack strip becomes so depleted that there is only 80 feet thereof in the looper pit, a warning signal will be given and the mill will be slowed down by operation of the controller 44. If desired, this controller can be so arranged as to stop the operation of the mill drive motor 48.

From the foregoing, it is apparent that the combination of cooperating devices provides a safeguard which will automatically maintain a predetermined amount of slack strip in the looper pit sufficient to give ample time to effect the joining of portions of the strip without shutting down the mill operating on other portions of the strip. Also, in the event that an insufficient amount of slack strip is present, ample warning will be given and the feeding-out of the strip from the looper pit will be automatically interrupted.

While I have described quite specifically the embodiment of the invention herein illustrated, it is to be understood that various changes in arrangement and modifications of details may be made without departure from the scope of my invention as defined in the appended claims.

I claim:

1. The combination with two spaced roll stands between which a moving loop of slack rolled strip is adapted to accumulate, of respective actuating means, each driven at a rate proportional to the peripheral speed of a roll of each of said stands; differential means actuated by the joint operation of said two actuating means; a counter mechanism actuated by said differential means indicating the length of said loop of slack strip; respective controllers governing the lineal speed at which the strip enters and leaves the looped

portion thereof, and switches actuated by said counter mechanism located in circuits of electrical devices which control the operation of said controllers.

2. The combination with two spaced roll stands between which a moving loop of slack rolled strip is adapted to accumulate, of respective actuating means, each driven at a rate proportional to the peripheral speed of a roll of each of said stands; differential means actuated by the joint operation of said two actuating means; mechanism actuated by said differential means indicating the length of said loop of slack strip, said mechanism including cams and switches actuated by said

cams; electrical devices in circuits with said switches; and respective controllers responsive to said electrical devices, said controllers governing the respective lineal speeds at which the strip enters and leaves the looped portion thereof.

3. The combination with two spaced roll stands between which a moving loop of slack rolled strip is adapted to accumulate, of respective actuating means, each driven at a rate proportional to the peripheral speed of a roll of each of said stands; differential means actuated by the joint operation of said two actuating means; counter mechanism actuated by said differential means indicating the length of said loop of slack strip, said counter mechanism including cams, switches actuated by said cams, respective electrical circuits controlled by said switches, electromagnetic means in each of said circuits, respective supplemental circuits under control of said electromagnetic means, and respective controllers in the supplemental circuits effective to govern the lineal speed at which the strip enters and leaves the looped portion thereof.

4. The combination with two spaced roll stands between which a loop of slack rolled strip is adapted to accumulate, of a respective Selsyn transmitter driven by a respective roll of each of said stands; a single differential Selsyn receiver actuated by the joint operation of both said transmitters; a counter mechanism having respective dials corresponding to units, tens, hundreds, etc., driven by said receiver for indicating the length of said loop of slack strip; respective switch contacts controlling circuits of respective electrical devices effective to give an alarm and slow down or stop the mill to prevent damage to the rolling equipment in the event that the amount of stored strip material becomes exhausted, and respective means moving with said dials for actuating said switch contacts.

GEORGE H. RENDEL.