United States Patent [19]

Voorehes et al.

[11] **3,817,067**

[45] **June 18, 1974**

[54] **STOCK SUPPLY SYSTEM**

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[22] Filed: **Sept. 5, 1972**

[21] Appl. No.: **286,123**

[52] **U.S. Cl.** **72/12**, 226/42, 72/27, 72/24, 72/161

[51] **Int. Cl.** **B21c 19/00**, B65h 23/22

[58] **Field of Search** 72/24, 27, 12, 28; 226/42

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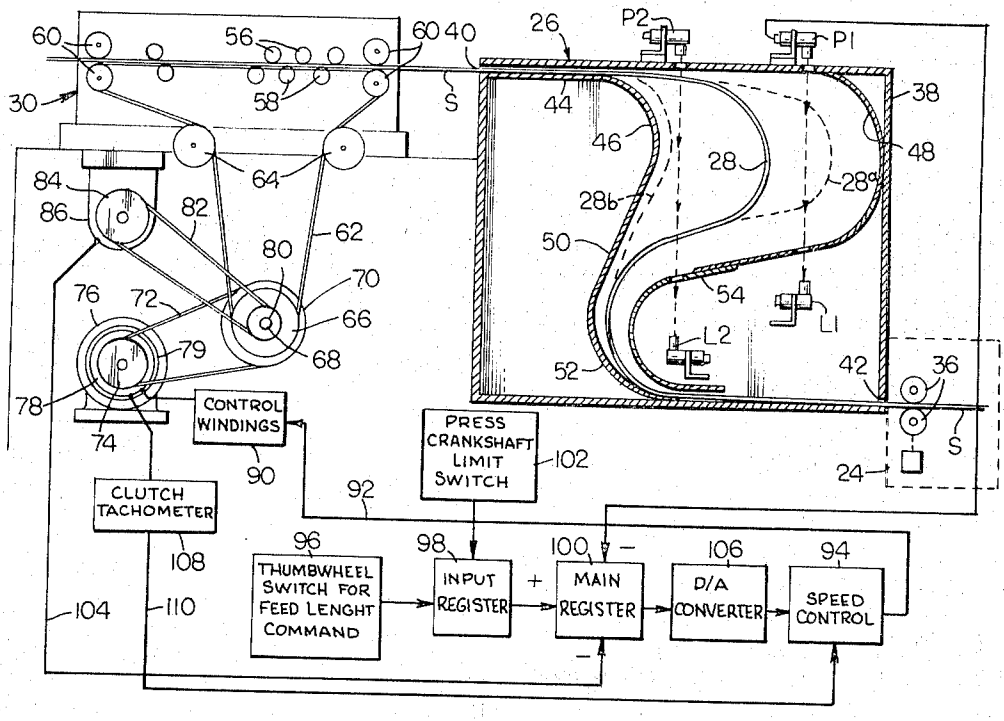
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[57] **ABSTRACT**

A stock supply system, especially for supplying strip stock from a supply thereof to a feed device pertaining to a machine in which the supply system includes a straightening roller stand driven by a variable speed drive and with an arrangement provided for maintaining a loop in the stock being supplied between the straightening roller stand and the feed device. The feed device operates intermittently to supply the stock to a machine and the machine supplies a signal on each cycle that tends to increase the speed of the variable speed drive. A feedback signal tends to reduce the speed of the variable speed drive thereby tending to maintain the aforementioned stock loop at about a fixed size. When the loop exceeds a certain length, the speed of the drive is reduced, and if the loop shortens beyond a predetermined amount, the machine being fed and the feed device and the roller stand come to a halt.

16 Claims, 6 Drawing Figures



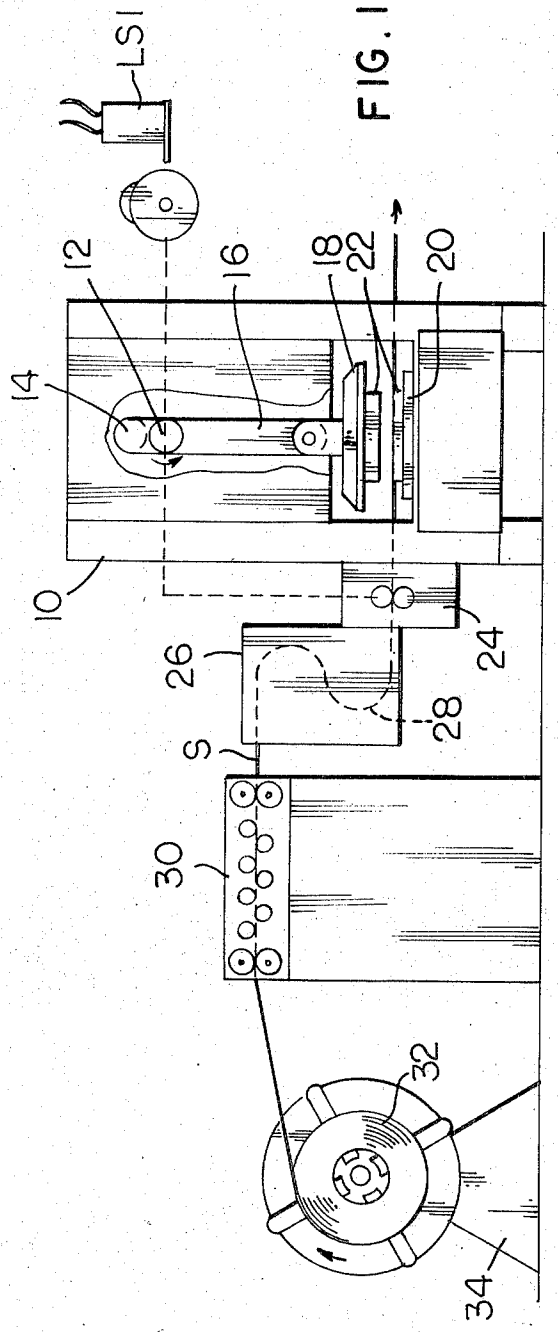

LS1
12
16
18
22
20
14
10
24
26
28
S
30
32
34

FIG. 1

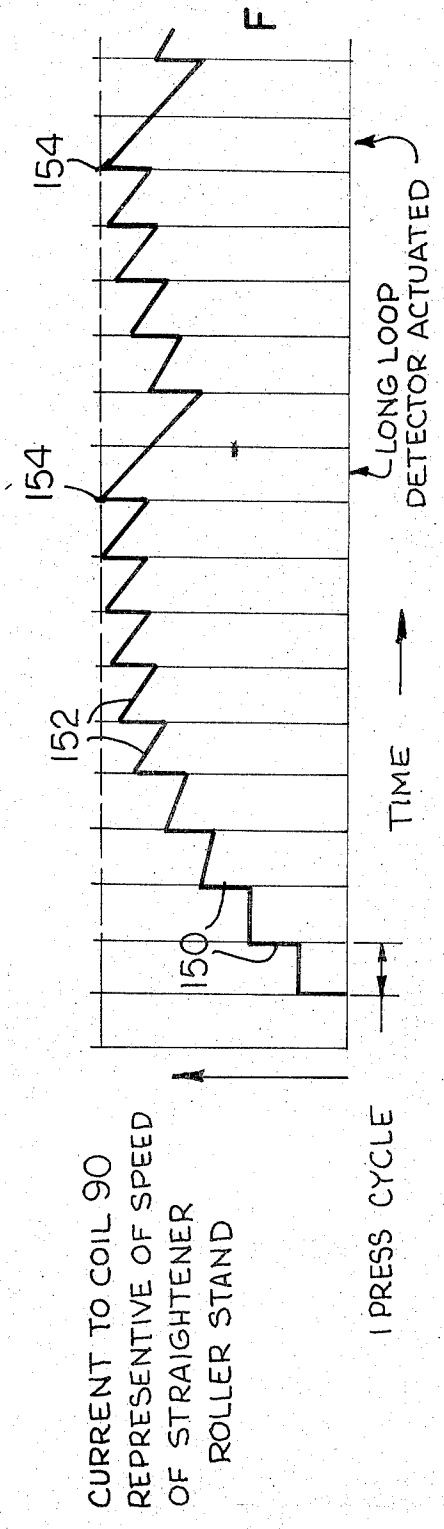

154
154
152
150
LONG LOOP DETECTOR ACTUATED
TIME
CURRENT TO COIL 90 REPRESENTIVE OF SPEED OF STRAIGHTENER ROLLER STAND
1 PRESS CYCLE

FIG. 4

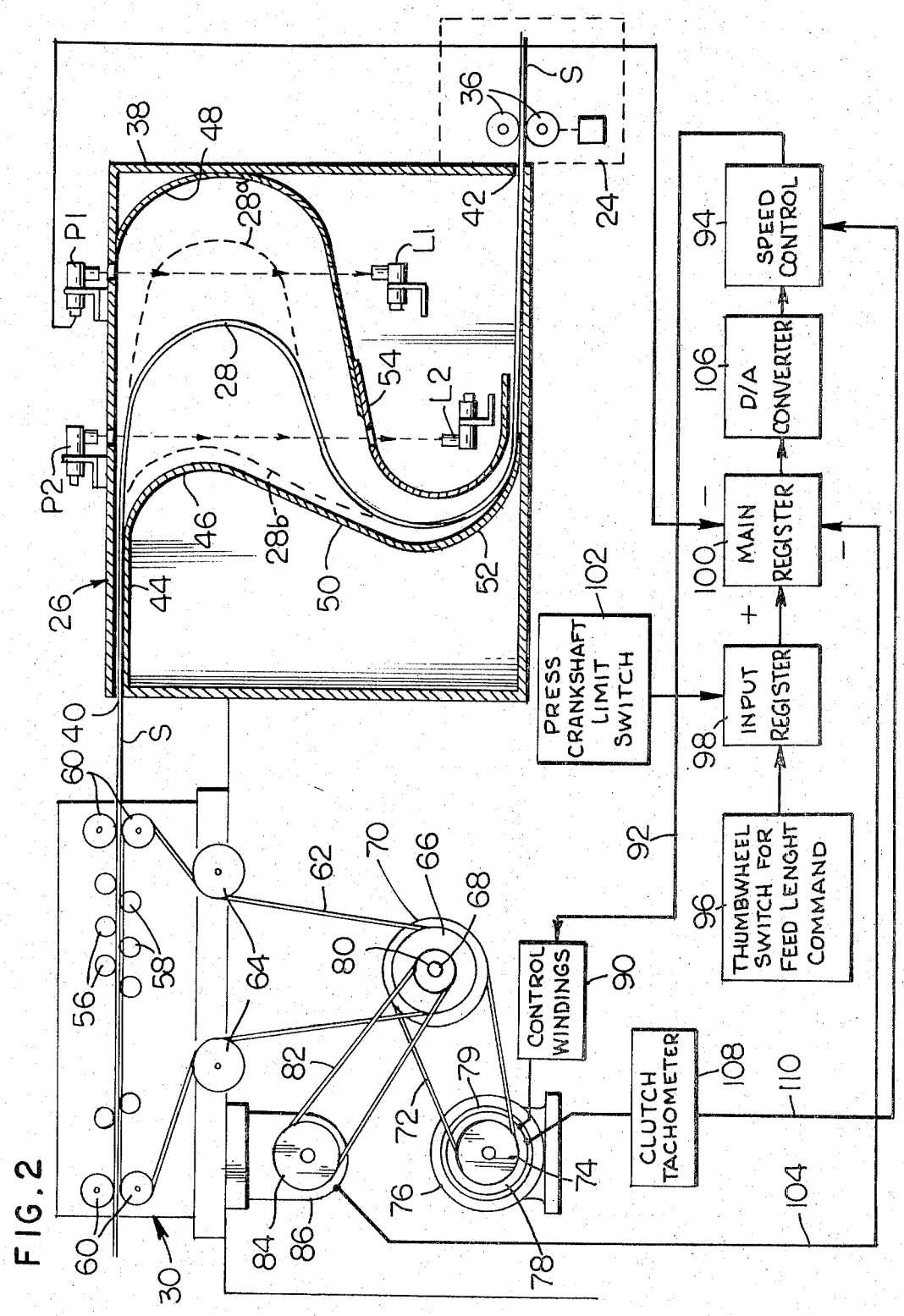

P1
P2
L1
L2
S
24
26
28
28a
28b
30
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
76
78
79
80
82
84
86
90
92
94
96
98
100
102
104
106
108
110
CONTROL WINDINGS
CLUTCH TACHOMETER
PRESS CRANKSHAFT LIMIT SWITCH
INPUT REGISTER
MAIN REGISTER
D/A CONVERTER
SPEED CONTROL
THUMBWHEEL SWITCH FOR FEED LENGHT COMMAND
+
-
-

FIG. 2

FIG. 3

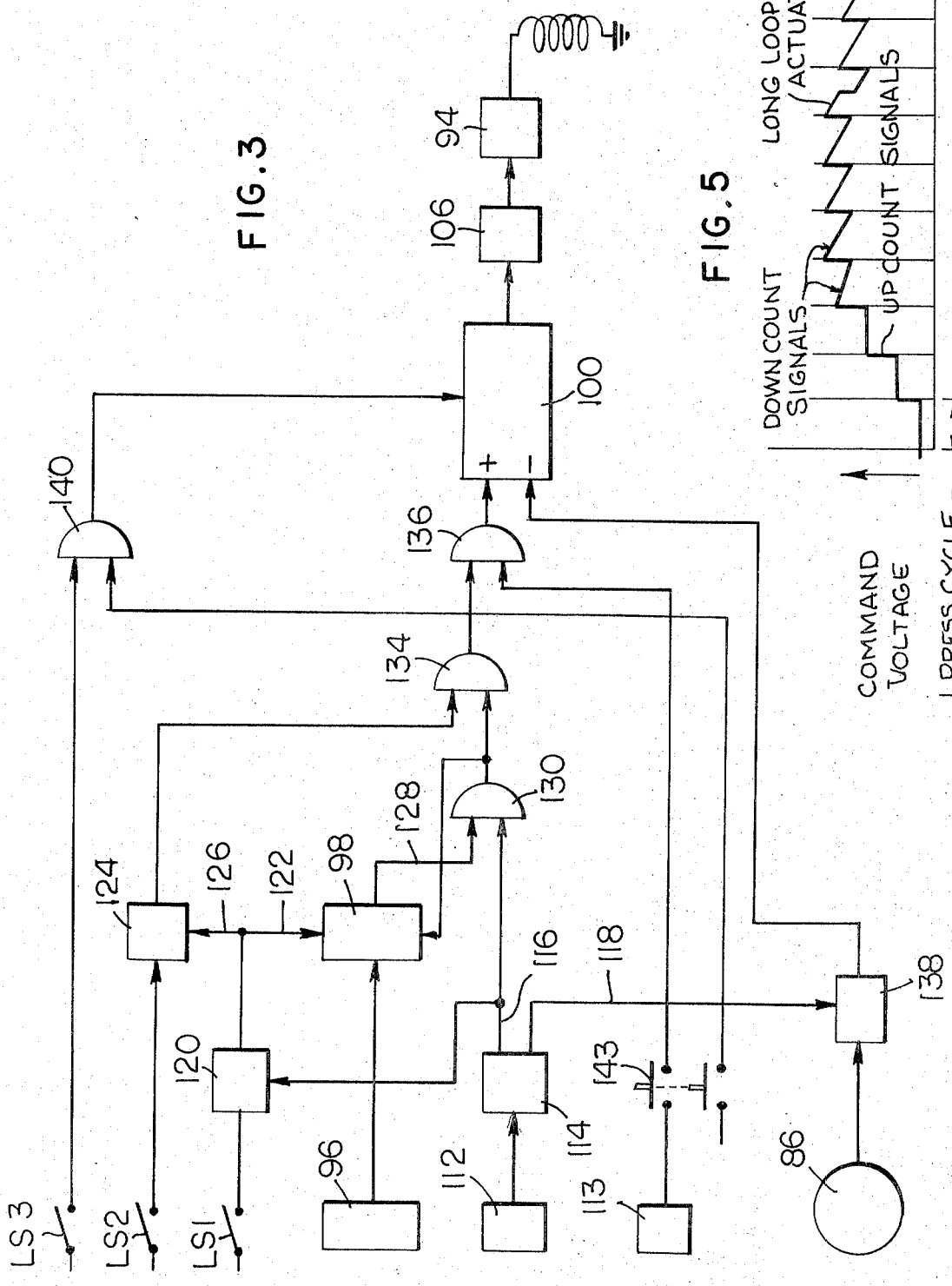

LS3
LS2
LS1
96
112
113
114
143
120
122
124
126
98
128
130
134
136
140
100
+
-
94
106
86
116
118
138

FIG. 5

LONG LOOP DETECTOR ACTUATED
DOWN COUNT SIGNALS
UP COUNT SIGNALS
TIME
COMMAND VOLTAGE
1 PRESS CYCLE

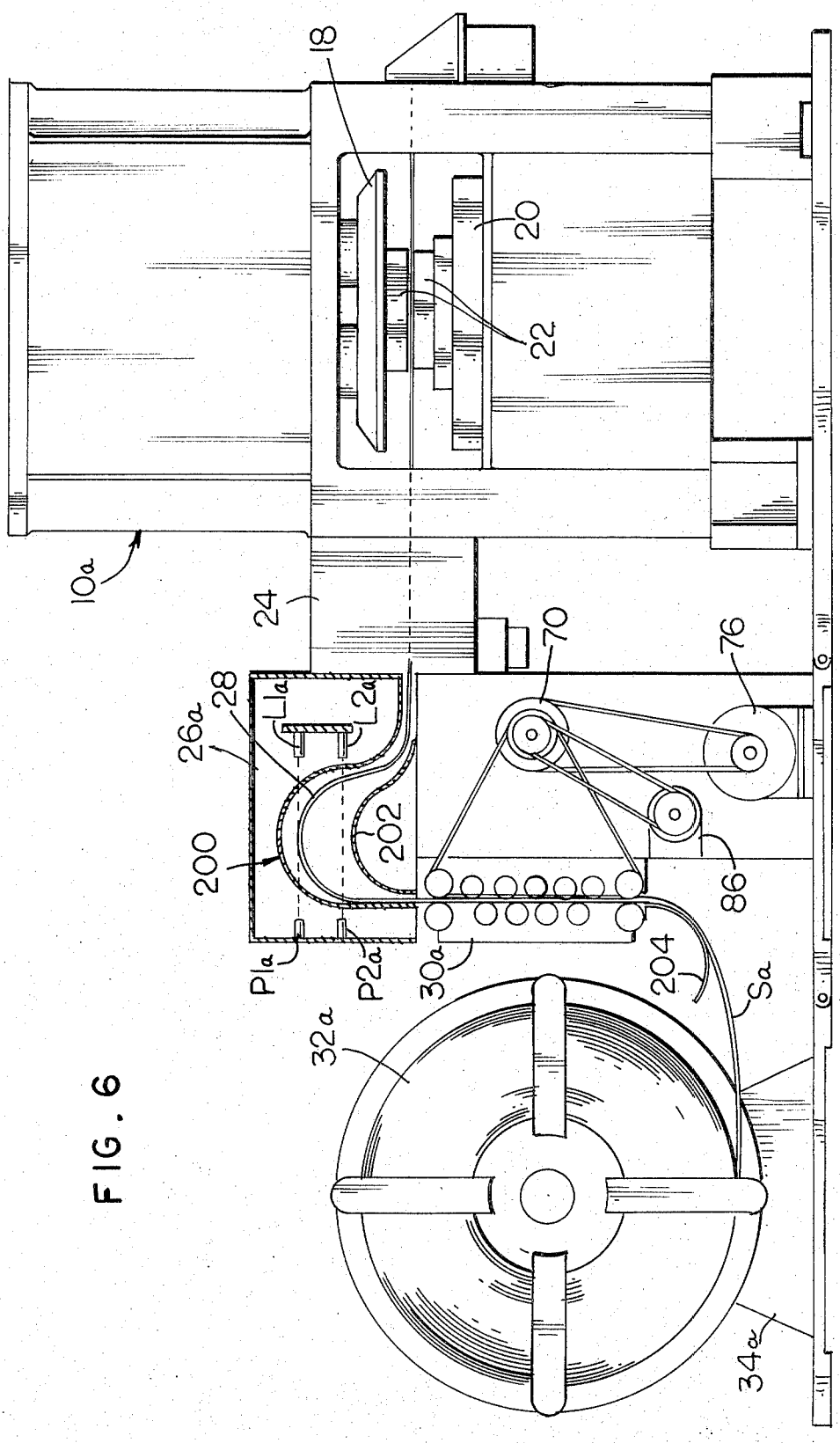

18
20
22
10a
24
70
76
28
26a
L1a
L2a
202
200
86
P1a
P2a
30a
204
Sa
32a
34a

FIG. 6

STOCK SUPPLY SYSTEM

The present invention relates to a system for supplying stock to an intermittently operating feed device for a machine, such as a press or the like.

Stock supply systems are known and quite often take the form of an arrangement for withdrawing strip stock from a reel thereof and supplying it to an intermittent feed device. Such supply systems quite often maintain a supply loop in the stock ahead of the feed device so that substantially continuous movement of the stock from the supply can be maintained while intermittent feeding thereof to the machine being supplied takes place.

The present invention is concerned with a stock supply system of the nature referred to but particularly adapted for use in connection with extremely high speed machines. An example of such a machine, is a press operating at speeds of up to 1,600 strokes per minute or more with a feed device attached thereto that feeds stock into the press on each stroke thereof. With such extremely high speed operation of the press and feed device, it becomes quite important to maintain the supply of stock to the feed device as uniformly as possible and to provide controls to control the speed of delivery of the stock which are sensitive to varying conditions.

With the foregoing in mind, a primary objective of the present invention is the provision of a stock supply system of the nature referred to which will maintain substantially uniform stock supply conditions under high speed operations.

Another object of the present invention is the provision of a stock supply system of the nature referred to operating in conjunction with a straightening roller stand in which the speed of operation of the straightening roller stand is subject to fine speed control.

Another object of the present invention is the provision of a stock supply system in which the stock moves at relatively high speed but wherein the supply loop in the stock disposed ahead of the feed device does not whip or cause problems in any other manner.

A still further object is the provision of a stock supply system of the nature referred to in which adjustments in the speed of delivery of the stock are made substantially continuously and in small increments thereby permitting extremely fine control of the stock delivery.

These and other objects and advantages of the present invention will become more apparent upon reference to the following detailed specification taken in connection with the accompanying drawings in which:

FIG. 1 is a schematic view of an installation according to the present invention.

FIG. 2 is a view drawn at somewhat enlarged scale showing the device of the present invention and schematically illustrating a control circuit pertaining thereto.

FIG. 3 is a more detailed schematic illustration of a control circuit pertaining to the device.

FIG. 4 schematically illustrates the variation in the supply of control signals to the variable speed drive forming a part of the installation when the control circuit of FIG. 3 is used.

FIG. 5 is a view like FIG. 4 for the control circuit of FIG. 2.

FIG. 6 shows another arrangement of the stock loop control system.

BRIEF SUMMARY OF THE INVENTION

According to the present invention, a machine, such as a press, is provided with an intermittent feed which feeds stock into the machine on each machine cycle. The machine may operate as rapidly as 1,600 cycles per minute or more and on each cycle a certain amount of stock is fed into the machine. The stock is received from a supply thereof which comprises a reel of the stock and a straightening roller stand through which the stock passes and which is driven to withdraw stock from the reel and to advance it toward the feed device.

Interposed between the straightening roller stand and the feed device is a space, preferably confined within a housing, in which the stock forms a captive supply loop of tightly defined size with detectors being provided to determine maximum and minimum lengths of the loop.

The straightening roller stand is driven by a variable speed drive, preferably, in the form of a constant speed motor and an eddy current clutch, and the output speed of the drive is determined by the degree of energization of the eddy current clutch control winding. A source of energy for the eddy current clutch control winding is adjusted in conformity with a signal supplied thereto and this signal is adjusted in speed increasing direction on each cycle of the machine and is adjusted speed decreasing direction by a feedback from the straightening roller stand. The signals from the machine and the straightening roller stand are balanced against each other so that the signal to control the energy to the eddy current clutch control winding tends to maintain the supply loop in the stock at a substantially constant length.

Preferably, the stock loop gradually increases in length until a maximum loop length is detected, whereupon the energy supply to the eddy current clutch control winding is reduced, thus, shortening the loop which will, thereupon, gradually build up again to maximum length.

If the stock loop shortens to a predetermined minimum length, the machine and the feed devices and the straightening roller stand come to a halt until proper adjustments have been made.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings somewhat more in detail, FIG. **1** schematically illustrates a machine **10** in the form of a press which has a crankshaft **12** rotatable therein, the throw **14** of which is connected by connecting rod **16** with a slide **18.** Slide **18** is opposed to a bed member **20** and mounted on the slide and bed member are cooperating elements of a die set **22.** Mounted on the frame of the press is a feed device **24** adapted for being driven by crankshaft **12** and operable to feed stock into the press while the parts of the die set are separated while interrupting the feed when the parts of the die set are operating on the stock disposed therebetween.

On the side of feed device **24** opposite the press frame there is a device **26** in which a captive supply loop **28** is thrown into the stock S being fed to machine **10.**

On the side of device **26** opposite feed device **24** is a straightening roller stand **30** which may be of any conventional type and which, as will be seen hereinafter, includes feed rollers which are driven at variable speed. The stock S which passes through straightening roller stand **30** is derived from a reel **32** of the stock rotatably mounted on a support **34** which preferably includes a drag brake to maintain a certain degree of tension in the stock ahead of the straightening roller stand.

The crankshaft **12** of the press, as will be seen in FIG. **1**, is adapted for operating a limit switch LS1 once on each rotation of the crankshaft, and this limit switch forms a control element pertaining to the control system that controls the speed of operation of the feed rollers in the straightening roller stand.

FIG. **2** shows more in detail the straightening roller stand **30** and the drive therefor and the device **26** in which the supply loop **28** of stock S is disposed. FIG. **2** also schematically illustrates at the discharge side of device **26** the feed rollers **36** pertaining to the feed device **24** and which are pressed against opposite sides of the stock S so as to be in frictional engagement therewith.

Device **26** comprises a box-like chamber **38** having an inlet opening at the top at the left side at **40** and a discharge opening **42** at the right on the bottom immediately ahead of feed rollers **36.**

Mounted inside chamber **38** and leading inwardly of the chamber from the bottom of inlet opening **40** is a plate **44** forming a throat or passage through which the stock is fed ad terminating in a curved flexible end portion **46** which can serve to positively guide the stock and to prevent a sharp bend therein if the stock engages portion **46.**

At the opposite side of the chamber from inlet **40** and near the top is another curved sheet **48** and which may also be flexible and which will guide the stock as the stock comes in engagement therewith.

A guide plate **50** is also mounted in the chamber **38** and at the bottom has a curved part **52** which is arranged in spaced relation to another curved flexible plate **54.** Curved portion **52** and curved plate **54** define an outlet channel through which the stock passes in approaching discharge openng **42.**

An important feature of the stock loop control system is that it permits the physical size of the stock loop to be held to a minimum, consistent with the allowable elastic bending stresses in the material being transported. By so proportioning the guiding surfaces of the stock loop control unit to maintain the minimum allowable radius of curvature of the material the minimum possible mass of stock is accelerated on each feeding cycle by the intermittent feed unit on the press. Minimizing the mass of stock to be accelerated permits the feed unit to experience the lowest possible accelerating loads, and thereby to achieve the maximum possible feeding rates within its rated force and torque capacities.

The positive guiding and restraint provided by the stock loop control unit also maintains the size and shape of the stock loop consistent from one press feeding cycle to the next so that nearly identical loads are imposed on the intermittent feed on each cycle of operation, helping to assure consistent feeding accuracy. The provision of flexibility in the stock guiding surfaces within the loop control unit, particularly flexible member **54,** tends to minimize the whipping action of the stock loop as it is intermittently advanced and stopped by the press feed.

Proper contouring of the stock guiding surfaces within the loop control unit can permit the end of the stock to automatically be guided through the loop control unit to provide a self-threading action, minimizing the manual effort required to thread the end of a new coil of stock from the straightener into the press.

The length of the supply loop **28** and the stock in chamber **38** is adapted for being detected by a pair of photocell-lamp combinations with lamp L1 and photocell P1 being disposed so that a certain maximum length of the stock loop will interrupt the light beam passing therebetween, whereas a lamp L2 and photocell P2 are arranged so that the light beam extending therebetween will be interrupted, except when the supply loop shortens beyond a minimum allowable length.

The normal length of supply loop is indicated at **28** while the dotted line **28A** represents a maximum length loop and the dotted line **28B** represents a minimum length loop. It will be understood that proximity switches or switches actuated by engagement with the stock could be provided in lieu of the lamp and photocell combinations illustrated.

It will also be apparent that lateral guiding means could be provided in chamber **38** for confining the stock passing therethrough to a certain lateral range if so desired, whereby the device would thus become adapted to different stock widths.

The straightening roller stand **30,** located to the left of chamber **38** in FIG. **2,** consists of upper and lower rows of straightening rollers **56** and **58,** respectively, and arranged in opposed staggered relation and operable, in a known manner, to straighten stock drawn therethrough. The straightening roller stand includes opposed feed rollers **60** at the opposite ends, at least two of which carry sprockets about which a chain **62** is entrained with the said chain passing about idlers **64** and then about a driven sprocket **66.**

Sprocket **66** is mounted on a shaft **68** on which is mounted a drive member **70** connected by flexible drive element **72** with output member **74** pertaining to a drive motor **76.** Drive motor **76** is connected with output member **74** by way of an eddy current clutch **78** so that the coupling of motor **76** to putput member **74** can be varied by varying the supply of energy to the control winding of the eddy current clutch **78.**

The aforementioned shaft **68** carries a further drive member **80** connected by flexible drive member **82** to input member **84** which drives a pulse generator **86.** At this point, it will be apparent that the pulse generator **86** supplies pulses in conformity with the speed of operation of the straightening roller stand.

The eddy current clutch comprises a control winding schematically illustrated at **90** and which receives a supply of energy via line **92** from a controller **94.** Upon an increase in the supply of energy from controller **94** to winding **90,** the coupling of motor **76** to output member **74** is tightened, whereas upon a decrease in the supply of energy from controller **94** to winding **90,** the degree of coupling of motor **76** with output member **74** is reduced. In addition to the eddy current clutch **78,** coupled to output member **74,** eddy current brake **79** is also coupled to the output member **74** to

provide more rapid stopping of the straightener drive.

FIG. 2 also shows, quite schematically, a control arrangement by means of which the signal from controller 94 to winding 90 can be controlled. This circuit comprises thumb wheel switches schematically illustrated at 96 and by means of which a basic feed command can be set up, conforming with the amount of stock to be fed into the machine on each cycle thereof. The command from switches 96 is supplied to a gate 98 and this command is released from register 98 to the upcounting terminal of a register 100 once each cycle of the machine by a control element 102 which corresponds to limit switch LS1 of FIG. 1.

The downcounting terminal of register 100 is also supplied with signals from pulse generator 84 by wire 104. From register 100, a signal is supplied to the digital to analog convertor 106 and from this convertor the signal is supplied to controller 94.

Signals are released from controller 94 in conformity with signals supplied thereto from tachometer 108 driven in unison with the straightening roller stand and connected by wire 110 with controller 94.

When loop 28 reaches a length such that the beam from L1 to P1 is interrupted, the upcount signal to register 100 is blocked for a predetermined number of counts thereby to reduce the signal to convertor 106 and slow down the rate of stock supply.

The current supply to coil 90, as controlled by the circuit of FIG. 2, is shown in FIG. 5.

A schematic view of a somewhat modified control system is illustrated in FIG. 3, wherein the clutch control winding is again indicated at 90 and the controller which supplies signals thereto is again indicated at 94. The digital to analog convertor of FIG. 2 is indicated in FIG. 3 by the same reference numeral at 106. Furthermore, the register 100 of FIG. 2 is shown at 100 in FIG. 3.

As to the remainder of FIG. 3, the thumb wheel switches shown at 96 supply signals to the register 98 as before mentioned.

The circuit of FIG. 3, however, includes a clock pulse source 112, the output from which is supplied to a phase splitter 114 which supplies pulses to wires 116 and 118 which are 180 degrees out of phase with each other.

Wire 116 is connected to a clock synchronizer 120 which receives signals from the aforementioned limit switch LS1. When a signal passes through clock synchronizer 120, it is delivered to gate 98 by wire 122 and to a normally enables gate 124 via wire 126.

The signals to gate 98 release the preset count therein to a wire 128 leading to one input of an AND gate 130, the other input of which is connected to wire 116. It will be apparent that under normal operating circumstances, each time limit switch LS1 closes, AND gate 130 will supply a signal to wire 132. This signal is fed back to the countdown terminal of component 98 and reduces the count therein to 0. This signal is also supplied to one terminal of a two input AND gate 134, the other terminal of which is connected to the output side of gate 124. As mentioned, gate 124 is normally enabled so that under normal circumstances gate 134 will supply a signal to an input of an OR gate 134 the output terminal of which is connected to the upcounting terminal of register 100.

The pulse generator 86 is connected via another clock synchronizer 138 with the countdown terminal of register 100 so that the output from register 100 is alternately modified in an increasing and decreasing manner.

If the supply loop in the stock becomes too long, a switch LS2 is actuated and it conforms in function to that carried out by lamp L1 and photocell P1 in FIG. 2. When switch LS2 is actuated, gate 124 is disabled and when this occurs, the next time limit switch LS1 closes, there will be no countup signal supplied to register 100 while at the same time the countdown signals from pulse generator 86 continue. The stock loop, under these circumstances, tends to remain of a constant length, or to gradually increase in length, with periodic substantial reductions in length.

The machine or press includes a starting clutch or the like, and when starting the machine, limit switch LS3 is momentarily closed, and supplies a signal through an OR gate 140 which is connected to the reset terminal of register 100 and resets the register at 0.

The closing of jog switch 142 is also operable to supply clocking signals from a clock pulse source 113 through OR gate 140 of register 100 while also supplying a countup signal to the register to cause stock to advance in the system.

FIG. 4 schematically illustrates the course of signals supplied to eddy current clutch 90. When the press first starts up, the limit switch LS1 actuated thereby supplies signals which cause the current to coil 90 to increase in increments as indicated by the steps 150 in FIG. 4. After the straightening roller stand commences to operate, countdown signals will be supplied which, in between increments 150 will cause a reduction in the signal to coil 90 as indicated by the lines 152.

By causing the straightening roller stand to run slightly ahead of the amount fed by feed rollers 36, the stock loop will gradually lengthen until the light beam from L1 to P1 is interrupted and it corresponds to closing of switch LS2 and which occurs at the point marked 154 in FIG. 4.

It will be seen that this interrupts the increment 150 that would normally be fed into the register and, instead, permits the feedback pulses from the pulse generator to continue to reduce the supply of current to clutch coil 90 until the supply loop shortens to the point that the light beam from L1 to P1, corresponding to the opening of LS2, is established and the cycle resumes.

It will be evident that other control systems could be provided for comparing speed up signals supplied by the press to slow down signals supplied by the straightening roller stand to maintain the supply loop and the stock substantially constant.

FIG. 6 illustrates an alternate arrangement of the stock loop control system together with the associated straightener, straightener drive, and stock reel. In FIG. 6, the same reference numerals are employed as in the previous views, where applicable, with the addition of an *a*.

The primary objective of this variation on the system is to reduce the floor space occupied and to provide simpler manual access for threading the end of the stock into the straightener stand from a fresh stock reel.

In the design shown the straightener stand 30*a* is oriented to advance stock S*a* vertically therethrough and

into a vertical loop **28***a* at the outfeeding end of the straightening stand which is confined within fixed, curved members forming guiding surfaces within the loop control unit **26***a*. The loop control device and the straightening roller stand of FIG. **6** will be seen to be turned 90° from the FIG. **2** position thereof, thus resulting in a more compact installation. The drive is the same as already described.

The aforementioned guiding members, and which are made like those shown in FIG. **2**, are identified, generally, at **200** and **202** in FIG. **6**. A further curved guide member at **204** is disposed between the take-off region of supply reel **32***a* and the infeeding feed rolls of straightener stand **30***a*.

The radii of curvature of the aforementioned stock guding surfaces are made as small as possible, consistent with bending stresses permissible in the stock to be fed without producing yielding of the material.

The loop control unit thus maintains the advantage of minimum mass of stock in the loop to minimize loads imposed upon the intermittent press feed device which draws from the stock supply loop on each press feed cycle. Stock loop detectors L1*a*, P1*a*, L2*a*, P2*a*, similar to those illustrated in FIG. **2** are employed for controlling operation of the straightener drive in the same manner as described earlier. Provision of the positive stock supply loop guiding system within the loop control unit conveys the same advantages of limiting the whipping action of the stock loop at high operating speeds and imposing a consistent and low accelerating load on the press feed device.

The several components of the FIG. **6** arrangement may be tied together in aligned relation as by a connector device **206**.

It has been mentioned that the stock supply loop gradually lengthens under normal operating conditions and this is achieved by selecting the pulse generator driven by the straightening stand so that it is not precisely matched to the rate at which the feed device is operated. In short, the number of pulses supplied by the pulse generator operated by the straightening roller stand are fewer than the number of pulses added on each cycle of the press. Thus, the straightening roller stand feeds a slightly greater length of stock during each press cycle thant the feed device advances into the press.

The adjustable thumb wheel switches in FIG. **2** determine the number of pulses that are supplied for each feed length on a cycle of the press.

Modifications may be made within the scope of the appended claims.

What is claimed is:

1. In a stock supply system, especially for the high speed advancing of strip stock from a supply thereof toward a feed device for a machine having a work cycle, the feed device having a feed period and a dwell period for each machine cycle for intermittent movement of the stock into the machine; first means adapted for engaging the stock to effect continuous movement of the stock from the supply thereof toward the feed device, a continuously adjustable speed drive drivingly connected to said first means, signal operated means connected in speed controlling relation to said drive, first control means operable when actuated to supply speed increasing signals to said signal operated means and actuated once for each feed period of the feed device, second control means operable when actuated to supply speed decreasing signals to said signal operated means and actuated by said drive in conformity with the speed thereof, receiving means disposed between said first means and the feed device having inlet and outlet means through which said strip stock passes and including wall means for confining a captive supply loop in the strip stock being supplied between said feed means and said feed device, and detector means in said receiving means connected in controlling relation to said drive and operable when actuated to reduce the speed of said drive, said detector means being disposed for actuation by the captive supply loop in the stock in said receiving means when the loop exceeds a predetermined length in said receiving means.

2. A stock supply system according to claim **1** in which said first means comprises a straightening roller stand having stock feed rolls and said drive is connected to said feed rolls.

3. A stock supply system according to claim **1** in which said drive comprises a motor and variable clutch driven thereby, said control means being operable to vary said clutch.

4. A stock supply system according to claim **1** in which said first means comprises feed rolls adapted to receive the stock therebetween, said drive comprising a motor and an eddy current clutch connecting the motor to the feed rolls, said signal operated means comprising a variable source of energy connected to said clutch and supplying energy to the clutch control winding in conformity with control signals supplied to said source.

5. A stock supply system according to claim **4** which includes a register connected to said variable source to supply control signals thereto, said register having an upcounting terminal connected to said first control means and a downcounting terminal connected to said second control means.

6. A stock supply system according to claim **5** which includes means for predetermining the signal supplied by said first control means to said register.

7. A stock supply system according to claim **5** in which the stock has a supply loop therein between said feed rolls and said feed device, detector means adapted to be actuated by the stock loop when the loop exceeds a predetermined length, and means operable during actuation of said detector means for interrupting the signal from said first control means to said register whereby the signals from said second control means causes reduction in the speed of said feed rolls and shortening of the loop.

8. A stock supply system according to claim **1** in which said first means comprises feed rolls adapted to receive the stock therebetween, said drive comprising a motor and an eddy current clutch connecting the motor to the feed rolls, said signal operated means comprising a variable source of energy connected to te control winding of said clutch and supplying energy to the clutch in conformity with control signals supplied to said source, a register connected to said variable source to supply control signals thereto, said register having an upcounting terminal connected to said first control means and a downcounting terminal connected to said second control means, said first control means comprising a switch arranged to be actuated once for each feed period of said feed device, an adjustable counter having an output terminal connected to the upcounting terminal of said register and also having a

control terminal, said switch when actuated supplying a signal to said control terminal to cause the count set in said counter to be released to said output terminal, said second control means comprising a pulse generator driven by said drive and connected to said downcounting terminal of said register, a supply loop in the stock between said feed rolls and the feed device and detector means positioned to be actuated in response to the loop exceeding a predetermined length, and means responsive to actuation of said detector means for preventing the supply of signals to said upcounting terminal of said register.

9. A stock supply system according to claim **1** in which said receiving means comprises a chamber having a first opening on one side to receive the stock from said straightening roller stand and a second opening on the other side to discharge the stock to said feed device, and guide means in said chamber guiding the stock passing therethrough in a curvilinear path which includes at least one loop.

10. A stock supply system according to claim **9** which includes detector means adapted for actuation upon the loop reaching a predetermined minimum length.

11. A stock supply system according to claim **9** in which said guide means includes plate elements disposed on opposite sides of the path taken by said stock in said chamber.

12. A stock supply system according to claim **11** in which at least portions of at least some of said plate elements are flexible.

13. A stock supply system according to claim **9** in which said detector means comprises a lamp-photocell combination.

14. In combination; a press, a feed device for feeding stock intermittently into the press and driven by the press, a straightening roller stand adapted to withdraw stock from a supply thereof and advance the stock continuously toward the feed device, the stock having a confined captive supply loop therein between said straightening roller stand and said feed device, an infinitely variable speed drive connected to said straightening roller stand, a signal operated controller connected to said drive to vary the speed thereof, means operated by the press on each cycle thereof for supplying sped increasing signals to said controller, means operated in synchronism with said straightening roller stand for supplying speed reducing signals to said controller, a first detector adjacent said captive supply loop actuated in response to the said loop exceeding a predetermined maximum length for interrupting the signals from said press operated means to said controller, and a second detector adjacent said captive supply loop actuated in response to the said loop reducing to below a predetermined minimum length and adapted for interrupting operation of said press and straightening roller stand.

15. In a stock supply system, especially for the high speed continuous advancing of strip stock from a supply thereof toward a feed device for a machine having a work cycle, the feed device having a feed period and a dwell period for each machine cycle; first means adapted for engaging said stock to move the stock from the supply thereof toward the feed device, an infinitely variable speed drive drivingly connected to said first means, signal operated means connected in speed controlling relation to said drive, receiving means disposed between said first means and the feed device and including means for receiving and confining a captive supply loop in the stock being supplied, and detector means in said receiving means connected in controlling relation to said drive operable when actuated to control the speed of said drive, said detector means being located for actuation by the captive supply loop in the stock and controlling said drive so as to maintain the length of said captive loop between predetermined limits.

16. A stock supply system according to claim **1** in which said signal operated means includes a register having an upcounting terminal connected to said first control means and a downcounting terminal connected to said second control means.

* * * * *

provide more rapid stopping of the straightener drive.

FIG. 2 also shows, quite schematically, a control arrangement by means of which the signal from controller 94 to winding 90 can be controlled. This circuit comprises thumb wheel switches schematically illustrated at 96 and by means of which a basic feed command can be set up, conforming with the amount of stock to be fed into the machine on each cycle thereof. The command from switches 96 is supplied to a gate 98 and this command is released from register 98 to the upcounting terminal of a register 100 once each cycle of the machine by a control element 102 which corresponds to limit switch LS1 of FIG. 1.

The downcounting terminal of register 100 is also supplied with signals from pulse generator 84 by wire 104. From register 100, a signal is supplied to the digital to analog convertor 106 and from this convertor the signal is supplied to controller 94.

Signals are released from controller 94 in conformity with signals supplied thereto from tachometer 108 driven in unison with the straightening roller stand and connected by wire 110 with controller 94.

When loop 28 reaches a length such that the beam from L1 to P1 is interrupted, the upcount signal to register 100 is blocked for a predetermined number of counts thereby to reduce the signal to convertor 106 and slow down the rate of stock supply.

The current supply to coil 90, as controlled by the circuit of FIG. 2, is shown in FIG. 5.

A schematic view of a somewhat modified control system is illustrated in FIG. 3, wherein the clutch control winding is again indicated at 90 and the controller which supplies signals thereto is again indicated at 94. The digital to analog convertor of FIG. 2 is indicated in FIG. 3 by the same reference numeral at 106. Furthermore, the register 100 of FIG. 2 is shown at 100 in FIG. 3.

As to the remainder of FIG. 3, the thumb wheel switches shown at 96 supply signals to the register 98 as before mentioned.

The circuit of FIG. 3, however, includes a clock pulse source 112, the output from which is supplied to a phase splitter 114 which supplies pulses to wires 116 and 118 which are 180 degrees out of phase with each other.

Wire 116 is connected to a clock synchronizer 120 which receives signals from the aforementioned limit switch LS1. When a signal passes through clock synchronizer 120, it is delivered to gate 98 by wire 122 and to a normally enables gate 124 via wire 126.

The signals to gate 98 release the preset count therein to a wire 128 leading to one input of an AND gate 130, the other input of which is connected to wire 116. It will be apparent that under normal operating circumstances, each time limit switch LS1 closes, AND gate 130 will supply a signal to wire 132. This signal is fed back to the countdown terminal of component 98 and reduces the count therein to 0. This signal is also supplied to one terminal of a two input AND gate 134, the other terminal of which is connected to the output side of gate 124. As mentioned, gate 124 is normally enabled so that under normal circumstances gate 134 will supply a signal to an input of an OR gate 134 the output terminal of which is connected to the upcounting terminal of register 100.

The pulse generator 86 is connected via another clock synchronizer 138 with the countdown terminal of register 100 so that the output from register 100 is alternately modified in an increasing and decreasing manner.

If the supply loop in the stock becomes too long, a switch LS2 is actuated and it conforms in function to that carried out by lamp L1 and photocell P1 in FIG. 2. When switch LS2 is actuated, gate 124 is disabled and when this occurs, the next time limit switch LS1 closes, there will be no countup signal supplied to register 100 while at the same time the countdown signals from pulse generator 86 continue. The stock loop, under these circumstances, tends to remain of a constant length, or to gradually increase in length, with periodic substantial reductions in length.

The machine or press includes a starting clutch or the like, and when starting the machine, limit switch LS3 is momentarily closed, and supplies a signal through an OR gate 140 which is connected to the reset terminal of register 100 and resets the register at 0.

The closing of jog switch 142 is also operable to supply clocking signals from a clock pulse source 113 through OR gate 140 of register 100 while also supplying a countup signal to the register to cause stock to advance in the system.

FIG. 4 schematically illustrates the course of signals supplied to eddy current clutch 90. When the press first starts up, the limit switch LS1 actuated thereby supplies signals which cause the current to coil 90 to increase in increments as indicated by the steps 150 in FIG. 4. After the straightening roller stand commences to operate, countdown signals will be supplied which, in between increments 150 will cause a reduction in the signal to coil 90 as indicated by the lines 152.

By causing the straightening roller stand to run slightly ahead of the amount fed by feed rollers 36, the stock loop will gradually lengthen until the light beam from L1 to P1 is interrupted and it corresponds to closing of switch LS2 and which occurs at the point marked 154 in FIG. 4.

It will be seen that this interrupts the increment 150 that would normally be fed into the register and, instead, permits the feedback pulses from the pulse generator to continue to reduce the supply of current to clutch coil 90 until the supply loop shortens to the point that the light beam from L1 to P1, corresponding to the opening of LS2, is established and the cycle resumes.

It will be evident that other control systems could be provided for comparing speed up signals supplied by the press to slow down signals supplied by the straightening roller stand to maintain the supply loop and the stock substantially constant.

FIG. 6 illustrates an alternate arrangement of the stock loop control system together with the associated straightener, straightener drive, and stock reel. In FIG. 6, the same reference numerals are employed as in the previous views, where applicable, with the addition of an *a*.

The primary objective of this variation on the system is to reduce the floor space occupied and to provide simpler manual access for threading the end of the stock into the straightener stand from a fresh stock reel.

In the design shown the straightener stand 30*a* is oriented to advance stock S*a* vertically therethrough and