This invention relates to a control system, and more particularly to an electroresponsive system for automatically regulating the feeding of web material or the like into a flying shear or similar work device.

An object of the invention generally stated is to provide for automatically controlling the feeding of web material, such as metal strips, bars, sheets, and the like, into a continuously operated flying shear or similar work device, and for accurately synchronizing the movement of the material with the movement of the shear blades.

A more particular object is to provide for automatically controlling the entrance of the leading end of a piece of web into a flying shear in timed relation with the movement into cutting opposition of the shear blades, a series of light-responsive devices, such as selenium cells 12, 13, 14 and 15, is arranged below the path of the strip 8. Above these devices, and in vertical alignment with them, a series of lamps 16, 17, 18 and 19 is arranged, being supported in any suitable manner directly over the path of the stock so that the rays of light produced by them will be intercepted by the stock as it passes between them and the cells 12, 13, 14 and 15. For a purpose which will presently appear, these lamps and light-responsive devices are arranged some distance from the shear 1 and uniformly spaced along a length of the roll table which is equivalent to the distance between successive cutting blades of the shear or the distance which the table normally feeds the stock between cuts.

For energizing the system, a source of current supply represented by line conductors L1 and L2 is provided. To these line conductors the lamp 16, which is spaced farthest from the shear 1, is connected by a pair of conductors 21 and 22 for continuous illumination. The light cell 12 associated with this lamp is connected to the supply conductors L1 and L2 by a pair of conductors 23 and 24, and adapted to function as a sort of start and stop control for the rest of the system, being of the type which closes the circuit 25 controlled by it when the light to it from the lamp 16 is shut off by the strip 8 as the strip approaches the shear. This circuit, as shown, is traced through the actuating coils 26a of a normally open double pole contactor 26 and connected to the line conductors L1 and L2. One pole 26b of such contactor is adapted to control a circuit 27 by which the other lamps 17, 18 and 19 of the system are connected to the source of current supply L1 and L2 in series circuit relation with an interrupter switch 28 which is coupled to the shear. The other pole 26c of this contactor is adapted when closed to establish a shunt circuit 29 about one of the operating coils 29a of a time delay relay 29.

This relay 29, while it may take numerous other forms, is, as shown, one of the residual magnetism delaying type, a form of relay which it is believed is sufficiently well known in the art as not to require any specific detailed description. As illustrated, it consists of an armature 29b on which two opposing coils 29a and 29c are mounted and...
connected by independent circuits 31 and 32 to the source of current supply L1 and L2, respectively. The upper of these coils, 32c, is in the presence of 5 greater force upon the armature 29b than the other coil 29c, and to normally maintain the bridging member 29d of the relay in a circuit-closing position. When the contactor 26 is closed, however, the shunt circuit 28 which is contro-10 15 trolled thereby is closed, the magnetic field of the main coil 29c of the relay 29 collapses as fast as its energy can be dissipated. As soon as the force produced by this field falls below the force produced by the field of the lower coil 29c, the relay opens, the operation requiring a period of time determined by the characteristics of the two coils, and their magnetic circuits which, as will be appreciated by those skilled in the art, may be changed by changing the characteristics of such coils and their magnetic circuits.

The bridging member 29d of the relay 29 is employed to complete a series of holding circuits 33a, 33b and 33c for the actuating coils 34a, 35a and 36a of a series of normally closed contactors 54, 35 and 36 which are employed to control a series of circuits 27, 37 and 38 provided with a series of resistors 41, 42 and 43, respectively, that are in turn connected in a circuit 44 by which the field windings 11a of the table motor 11 are connected to the source of current supply L3 and L4 and utilized for varying the field of such motor to thereby vary the speed of the feed table. As illustrated, the actuating coils 34a, 35a and 36a of the contactors 34, 35 and 36 are connected by separate circuits 45, 46 and 47 to the source of current supply L3 and L4 through the light cells 13, 14 and 15 which are themselves connected in parallel relation to the circuit 23 and utilized to control the operation of these contactors, being adapted to close the shunt circuits and cause the contactors 34, 35 and 36, respectively, to open whenever the rays of the lamps 17, 18 and 19 are projected upon them. Consequently, as the lamps 17, 18 and 19 are illuminated by the interrupter switch 20, which is energized as soon as the contactor 26 is closed by the stock passing under the first lamp 16, these cells 13, 14 and 15 are rendered responsive for closing the circuits 44, 45 and 46 which control the actuation of the contactors 34, 35 and 36, and they turn the opening of the shunt circuits 41, 42 and 43.

The interrupter switch 20, which is connected in series circuit relation with the lamps 17, 18 and 19, as shown, comprises a distributor ring 48 made of insulating material which is mounted in any suitable fashion for rotation with the shear. In the periphery of this ring there are arranged conductor segments 51, 52 and 53, equidistantly spaced and equally spaced. To these segments the one side of the lamp circuit 27 is connected, while the other side is connected by a collector brush 54 disposed to ride on the ring 48 and a conductor 55 to the line conductor L4. Hence, the lamps 17, 18 and 19 are in this way caused to flash each time one of the segments 51, 52 or 53 passes under the brush 54 as long as the circuit 27 is closed, and these segments are arranged to engage the brush at the same time or in timed relation with the movement of the shear blades into cutting opposition.

As will be appreciated, the extent to which the operation of the feed table 9 must be modified to get the end of each piece of stock in step with the shear to produce the length of first cut de-5 sired is determined by the extent to which the stock is out of step when the shear is in operation and is equal to the distance the stock is fed past the first light-responsive device 12 before the lamps 17, 18 and 19 are flashed which, as stated herebefore, is effected by the interrupter switch when the blades of the shear move into cutting opposition. It is for the purpose of measuring this and controlling the modification of the feed table speed that the light-responsive devices 13, 14 and 15 are provided, and while only three are shown here, it will be readily understood that any reasonable number may be employed for such purpose.

As will be also readily appreciated, the feed table may be either slowed up or speeded up to get the stock in step with the shear, although the latter method is practiced in the present embodiment. According to this embodiment the resistors 41, 42 and 43 are so proportioned and the time delay relay 29 so adjusted that they automatically vary the speed of the table sufficiently to make the corrections in the delivery of the stock to the shear required as is determined by the operation of the light-responsive devices 13, 14 and 15. To prevent this irregular operation of the stock feed from interfering with the subsequent cuts made by the shear, these control devices are of course spaced sufficiently far enough away from the shear so that the correction is completely made and the table returned to its normal operating speed before the stock reaches the shear.

By way of describing the operation of the system, assume that the shear is being run at a constant speed which it normally is, although it may be varied as desired by any suitable means, not shown, and that the feed table is being operated at a constant speed as it also normally will be, although, as shown, a variable resistor 56 may be included in its field circuit 44 for manually varying its normal speed. In addition, assume that a piece of stock 8 is loaded at random onto the table. As the front end of such stock passes over the first light-responsive device 12, the light of the lamp 16 above such device is shut off, resulting in its operating to close the circuit 25 which controls the energization of the actuating coil 26a of the contactor 26. With the closing of this contactor the circuit 27 to the shear operated interrupter switch which controls the flashing of lamps 17, 18 and 19 is closed and a set of brushes 28 which shunts the upper coil 39a of the time delay relay 29. The closing of the former circuit to the interrupter switch results in the lamps above the light-responsive devices 13, 14 and 15 being flashed when the first set of blades on the shear moves into cutting opposition, and the closing of the latter sets the time delay relay into operation to open the holding circuits 38a, 39b and 39c for the contactors 34, 35 and 36 which control the resistors 41, 42 and 43.

Should the lamps 17, 18 and 19 flash before the stock 8 reaches the second light-responsive device 13, all of the devices 13, 14 and 15 will operate and cause all of the contactors 34, 35 and 36 to close. These in closing open the circuits 37, 38 and 39 and place all of the contactors 41, 42 and 43 in the field circuit 44 of the table motor. They also close the circuits 33a, 33b and 33c which hold the contactors 34, 35 and 36 closed. Consequently even after the lamps 17, 18 and 19 become dark, which causes the devices 13, 14 and 15 to open, the resistors are maintained in the field circuit until the time delay relay opens. This occurs only after these resistors have been in the field
circuit long enough to cause the stock to be advanced an amount over that which it is when the feed table is at its normal speed, which is equal to the extent it is out of step with the shear.

5. In the event the stock is past the second light-responsive device 13, as shown in Fig. 1, when the lamps flash, only the devices 14 and 15 will be operated. This will result in only resistors 42 and 43 being placed in the field circuit 44, and if past device 14, only device 15 and resistor 43 will be placed in service. Should the stock be in step with the shear when its passes under the first light-responsive device 12, the speed of the feed table will not be altered as the stock in such event will be beyond or under the last light-responsive device by the time the lamps are flashed, so that none of the light-responsive devices 13, 14 and 15 will be operated.

With the passing of the trailing end of the stock over the first light-responsive device 12, such device is operated to open the circuit 25, and this in opening opens the contactor 26 which deenergizes the 27 and 28. Disconnection of the system in readiness for operation on the next succeeding piece of stock to be fed to the shear.

Among the advantages of this invention, it provides a very simple, inexpensive and easily installed, as well as dependable control for regulating the operation of a flying shear so as to control the first cut which a shear will produce on a piece of stock fed to it at random. As will be readily appreciated by those skilled in the art, the invention is particularly applicable to shears of the type illustrated which are provided with a plurality of cutting blades for shears having similar operating characteristics. This is especially true where such shears are adapted to miss cuts to provide the length of cuts desired as disclosed in the present inventor’s copending application Serial No. 678,315, filed June 17, 1933. When applied to shears of this character, as will be appreciated, the length of the first cut is reduced to a fraction of the distance between the cutting blades, such fraction at a maximum being equal to the distance between the cutting blades divided by the number of light-responsive devices employed for varying the speed of the feeding mechanism used with the shear.

According to the provisions of the patent statutes, I have explained the principle and mode of operation of my invention, and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. In combination with means for feeding an elongate web into a flying shear or like work device, means for driving said feeding means, means responsive to the web and shear for varying the speed of the driving means, and other means responsive to the web for controlling the extent of operation of said speed-varying means.

2. In combination with a flying shear or like work device, means for feeding an elongate web into said work device, means for varying the speed of said web, and other means responsive to said web and said work device for setting said speed-varying means in operation, and other means responsive to the web for controlling the extent of operation of said speed-varying means.
set in motion when a piece of stock moves between
said first-mentioned lamp and light-responsive
device for rendering said other lighting means
operable under the control of said shear operated
light-flashing means and also controlling the
period of time said latter light-responsive device
exercises a control over said speed-varying
means, and means operated by the light-respon-
sive devices spaced from said first light-responsive
device when operated by said shear controlled
lighting means for controlling said speed-varying
means.

8. In combination with a flying shear equipped
with cooperating cutting elements, means for
feeding elongate web into said shear, web-respon-
sive means disposed along the path of said web
between points separated a distance effectively
equal to substantially the distance the web nor-
manly travels between cuts, and means controlled
by said web-responsive means for so varying the
delivery of the web to the shear as to thereby
synchronize the entrance into the shear of the
leading end of the web with the movement of said
cutting elements into cutting opposition.

9. In combination with a flying shear equipped
with cooperating cutting elements, means for
feeding web material into said shear, web-respon-
sive means disposed along the path of said feeding
means between points separated a distance
effectively equal to the peripheral distance be-
tween said cutting elements, and means controlled
by said web-responsive means for so varying the
delivery of the web to the shear as to thereby
synchronize the entrance into the shear of the
leading end of the web with the movement of said
cutting elements into cutting opposition.

10. In combination with a flying shear, means
for feeding web material thereinto, means for
varying the speed of said feeding means, a plu-
rality of stock responsive elements arranged in
the path of the web and operative along the length
thereof, and means responsive to the shear co-
operating with said stock responsive means for
controlling the operation of said speed varying
means to thereby control the length of the first
cut.

11. In combination with a continuously oper-
able flying shear equipped with cooperating cut-
ting elements, means for feeding web material
into said shear, means for modifying the delivery
of the web to the shear, web responsive means
disposed at the entry side of the shear and opera-
tive along the length of the web over a distance
effectively equal to the length of the cuts nor-
manly made by the shear, and means responsive
to the shear cooperating with said web respons-
ive means for controlling the operation of said
delivery modifying means to thereby control the
length of the first cut.

12. In combination with a flying shear, means
for delivering web material into said shear, means
for modifying the delivery of the material
to the shear, a plurality of stock responsive ele-
ments arranged along the delivery path of the
material, and means responsive to the shear co-
operating with said stock responsive elements for
controlling the operation of said delivery modify-
ing means to thereby control the length of the
first cut.

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