

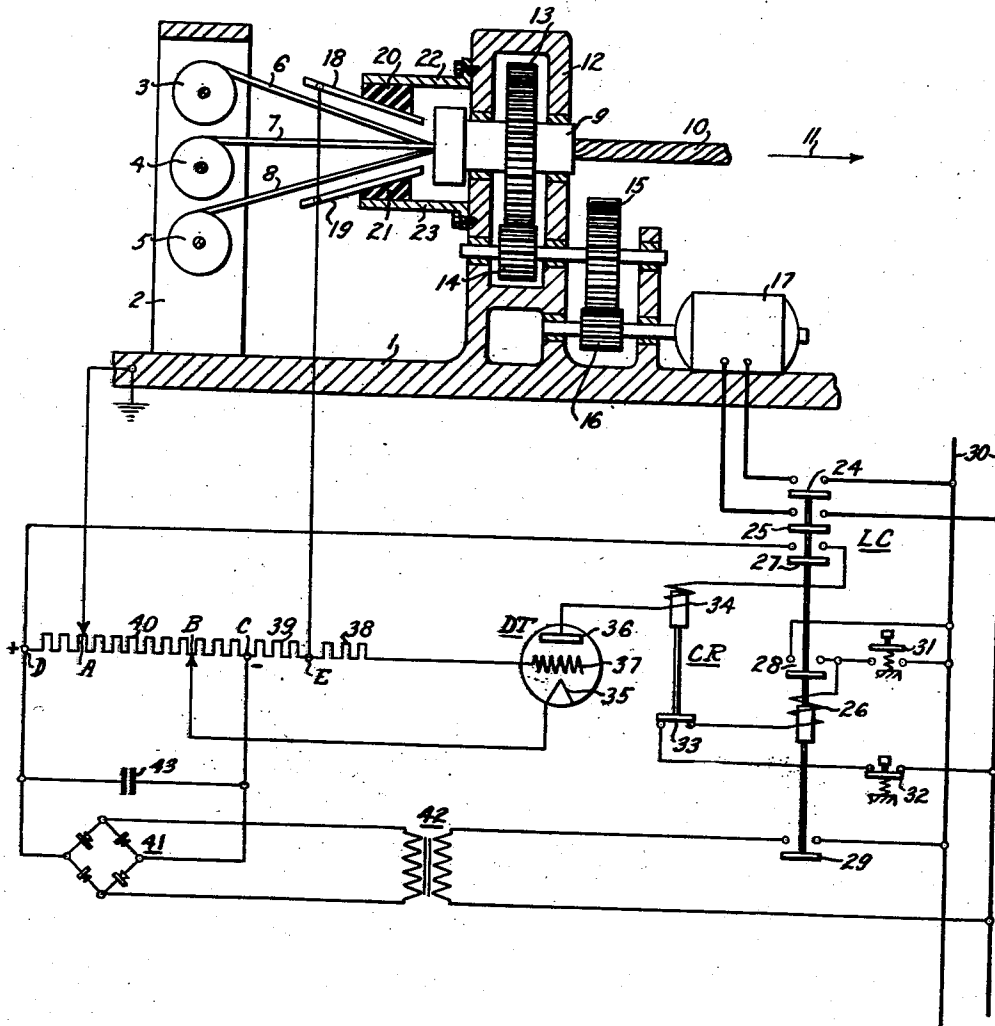
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FAULT-RESPONSIVE CONTROL SYSTEM FOR STRAND WORKING MACHINES

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FAULT-RESPONSIVE CONTROL SYSTEM
FOR STRAND WORKING MACHINES

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Our invention relates to fault-responsive controls for electric drives of strand fabricating machines, such as spooling, warping or stranding machines, and particularly to a control system for stopping the electric drive of wire stranding machines upon the occurrence of a wire break.

In wire stranding machines, a number of wires are taken from supply reels and drawn through a die which twists or strands them together. Occasionally one of the wires may break, and the broken end will be whipped about by the turning of the die head. When this happens, it is necessary to stop the machine immediately.

In order to obtain such an automatic cut-off, a metal rod may be placed along the wires to be stranded so that when a wire breaks its end will strike the rod and complete a temporary circuit connection to a relay serving to disconnect and stop the drive motor.

At the preferred high operating speeds of modern wire stranding machines, the contact engagement between the wire and the rod is of extremely short duration as compared with the time constant of the cut-off relays available for this purpose. As a result, the operation of the relay is apt to be unreliable even if a sensitive and quick-acting relay is employed.

Similar conditions obtain in other strand-fabricating machines, such as spoolers or warpers, for operating simultaneously a plurality of threads or wires.

It is an object of our invention to provide an automatic cut-out control for electric drives in which means for transmitting transient control impulses are used for controlling a cut-off relay of comparatively large time constant and which affords a reliable pick-up of the control impulses by the relay so as to ensure a satisfactory operation of the cut-out control regardless of the length of energizing time required by the relay.

Another object of the invention is to provide the just-mentioned control operation in a stranding machine in which, as aforementioned, a broken wire or thread is caused to complete a control circuit under conditions or during a period which ordinarily is apt to be unsuitable for the safe operation of a protective cut-out relay.

In another aspect, it is an object of our invention to permit, in cut-out controls of the type above-mentioned, the use of simple and sturdy electromagnetic relays regardless of any misproportion of their time constant or other requirements to the conditions of the primary impulses supplied by the fault-responsive control means of the machine to be controlled.

According to our invention and in order to achieve these objects, we provide a gaseous discharge tube, i. e., a gas or vapor filled electronic device such as known as "thyatron," between the primary impulse transmitter and the cut-out relay so that the transient control impulse serves merely to "fire" the tube, while the anode or main circuit of the tube, which continues to remain conductive after the firing moment, is connected to the relay and maintains it energized until its operation is completed. We also provide electric interlock means between the tube circuit, on one hand, and the relay or the circuit of the electric drive, on the other hand, so that the tube is automatically disconnected from the relay upon completion of the relay or cutout operation. Thus, the control circuit places itself into the initial condition once the control function is fully performed.

According to another feature of the invention, a potentiometric grid circuit is provided which has points of different polarity, relative to the tube cathode, connected with the fault-responsive impulse transmitting means so that the occurrence of an impulse has the effect of changing the grid polarity thereby determining the firing moment of the tube.

These and other features of the invention will be apparent from the following description of the wire stranding machine and its appertaining drive and cut-out control means schematically illustrated in the drawing for exemplifying the invention.

Referring to the drawing, the numeral 1 denotes the iron frame or supporting structure of the machine. This structure includes a standard 2 which accommodates a plurality of reels or spools, of which three are illustrated and denoted by numerals 3, 4 and 5. The wires 6, 7 and 8 taken from these spools are guided through a rotating die-head 9, which when in operation twists the wires together to a stranded wire or cable 10 which leads the stranding unit in the direction indicated by the arrow 11.

The die-head 9 is revolvably mounted in bearings carried by another standard 12 which forms part of the rigid frame structure 1 of the machine. A spur gear 13 is mounted on the revolvable head 9 and meshes with a pinion 14 shafted to another gear 15 which meshes with a pinion 16 mounted on the shaft of an electric drive motor 17. The train of gears and the motor 17 are also mounted on the supporting structure of the stranding machine.

A number of metallic rods or bars, such as

those denoted by 18 and 19, are arranged in proximity to the path of the wires 6, 7 and 8 to be twisted so that they are separated from these strands by an insulating air-gap as long as the wires are in proper condition. The rods 18 and 19 are mounted on insulating supports 20 and 21, respectively, which are secured to the standard 12 by brackets 22 and 23, respectively. Consequently, the rods 18 and 19 are usually insulated from the supporting structure while the wires 6, 7 and 8 and the strand 10 are in conductive connection with the structure due to the engagement of these wires with the die-head 9 and other metallic parts of the machine.

The drive motor 17 is controlled by a line contactor LC which has two contacts 24 and 25 for supplying energizing current from an alternating current line 30 to the motor when closed. The contactor has an electromagnetic control coil 26 and is also provided with an interlocking contact 27, a self-holding contact 28, and a control contact 29. Contacts 27, 28 and 29 are closed and opened together with the main contacts 24 and 25. The contactor coil 26 is connected with the alternating current line 30 through a normally open start button 31 and a normally closed stop button 32. The coil circuit extends through a contact 33 of a control relay CR whose control coil 34 opens the contact 33 when energized.

An electronic tube of the arc-discharge type, known as "thyatron," is provided at DT for controlling the relay CR. The tube has an arc discharge path extending between its cathode 35 and anode 36 and is controlled by a grid 37 so as to remain non-conductive as long as the grid 37 has a positive blocking potential relative to the cathode 35. The anode circuit of the tube extends through the coil 34 of relay CR and the interlocking contact 27 of line contactor LC. The grid 37 is connected with fixed resistors 38 and 39 and also with a potentiometric resistor 40 which extends between the negative point C and the positive point D. These two points are connected to the respective output terminals of a rectifier bridge 41 which is fed by a transformer 42 from the alternating-current line 30 and controlled by the contact 29 of the line contactor LC. A condenser 43 is connected across points C and D of the potentiometer 40.

The point A along the potentiometer is connected to the grounded frame structure 1 of the wire stranding machine, and hence is in conductive connection with the wires 6, 7 and 8 to be stranded. The point marked B and located at the negative side of the potentiometer 39 relative to point A, is connected with the cathode 35 of tube DT. Another point marked E and located intermediate the resistors 38 and 39 is connected with rods 18 and 19, and hence is insulated from the wires 6, 7 and 8 as long as the wires are in satisfactory condition.

For starting the machine the push button 31 is actuated. This closes the circuit of coil 26 through contact 33 and push button 32. The coil closes all contacts of the line contactor LC and thus connects the motor 17 to the line 30 while closing a self-holding circuit for coil 26 through contact 28. Hence, when releasing the start button 31, coil 26 remains energized and the motor 17 in operation. During this operation, the contact 29 is closed so that the rectifier bridge 41 is energized and impresses a direct-current voltage across the potentiometer 40. As a result, the grid 37 assumes a potential which is

negative with respect to the cathode potential derived from point B. Although now the interlocking contact 27 of line contactor LC is closed, the relay coil 34 in the anode circuit of tube DT is at first not energized because the negative potential at grid 37 prevents the tube from firing. This condition is maintained as long as the machine performs a satisfactory stranding operation.

However, if one of the wires 6, 7 or 8 breaks, the broken end is whipped about by the revolving die-head 9 and hence will strike against one of the rods 18 and 19. This establishes a temporary conductive connection between the rod and the machine body which short-circuits the resistance arrangement in the grid circuit of the tube 33 between points A and E. Since the potential at point A is positive relative to the cathode potential at B, the grid 37 is now placed on a positive firing potential which causes the tube to conduct current. This current is maintained independent of further changes in the grid circuit and causes the relay CR to open its contact 33. As a result, the current supply to the contactor coil 26 is interrupted, so that the line contactor LC opens its contacts. This disconnects the motor 17 and thus stops the stranding machine. The opening of contact 27 interrupts the anode circuit and causes the relay CR to close its contact 33 after the completion of the protective operation. After that the system is in its initial condition, and can again be started after removing the fault.

The machine can also be stopped at will by actuating the push button 32. This opens the self-holding circuit of coil 26 and thus causes the line contactor LC to open its contacts.

It will be understood from the foregoing description that the transient impulse supplied by the striking of a broken wire against one of the insulated rods 18 or 19 serves merely for starting the tube operation, and that the subsequent energization of the control relay CR is independent of the duration or intensity of the primary control impulse, and is terminated only after the machine has been stopped, regardless of the length of time elapsing from the occurrence of the control impulse to the completion of the interruption of the motor circuit. This renders it possible to use various types of electromagnetic relays in the place of relay CR regardless of any misproportion of their time constants or other operating conditions, such as their energy requirements, to the duration or other energy condition of the primary control impulse.

It will also be understood that the invention is similarly applicable to stranding machines in which the twisting die is stationary while the wire reels are carried by a rotating frame. The invention is further applicable to other types of strand fabricating machines, such as warpers or spoolers, where a multiplicity of strand or thread elements are simultaneously subjected to a working operation and require a stoppage of the machine when one of the strands or threads breaks.

In view of these possibilities of modifying the invention without departure from its essential features, we wish this specification to be understood as illustrative and not in a limiting sense.

We claim as our invention:

1. In a wire stranding machine, the combination of a conductive machine structure in electric connection with the wires to be stranded, a conductive element insulated from said structure and arranged to be touched by a broken wire, a

motor for driving the machine, switch means having separate sets of simultaneously operating contacts, one of said sets being connected with said motor for controlling its operation, a cut-off relay for controlling said switch means, a gaseous discharge tube having an anode circuit connected with said relay through said other set of contacts for energizing said relay and a grid circuit containing a source of graduated voltage having different potential points connected with said structure and said element, whereby said grid circuit is provided with firing voltage for rendering said tube conductive when said element is touched by a wire and said anode circuit subsequently opened when said relay causes said switch to open said contact sets.

2. In a wire stranding machine, the combination of a conductive machine structure in electric connection with the wires to be stranded, a conductive element insulated from said structure and arranged to be touched by a broken wire, a motor for driving the machine, switch means having separate sets of simultaneously operating contacts, one of said sets being connected with said motor for supplying it with energizing current, a cut-off relay for controlling said switch means, a gaseous discharge tube having an anode circuit connected with said relay through said other set of contacts for energizing said relay and a grid circuit containing a potentiometer and a voltage source connected to said potentiometer so as to supply said tube normally with a blocking grid voltage, said grid circuit having points of different voltage connected with said structure and element respectively so that said tube obtains firing grid voltage when said element is touched by a wire, whereupon said anode circuit is opened and said motor disconnected when said relay causes said switch to open said contact sets.

3. In a wire stranding machine, the combination of a conductive machine structure in electric connection with the wires to be stranded, a conductive element insulated from said structure and arranged to be touched by a broken wire, a motor for driving the machine, a cut-off relay for disconnecting said motor, a gaseous discharge tube having an anode circuit connected with said relay for energizing the latter and a grid circuit containing a source of graduated voltage having different voltage points connected with said structure and said element, whereby said grid circuit is provided with firing voltage for rendering said tube conductive when said element is touched by a wire.

4. In a wire stranding machine, the combination of a conductive machine structure in electric connection with the wires to be stranded, a conductive element insulated from said structure and arranged to be touched by a broken wire, an electric drive for operating the machine, a cut-off relay connected with said drive, a gaseous electronic control tube having a main circuit connected with said relay for energizing the latter and a control circuit connected to said element and said structure so as to obtain firing voltage when said element is touched by a wire in order to start firing for causing said relay to stop said drive.

5. In a wire stranding machine, the combination of a conductive machine structure in electric connection with the wires to be stranded, a conductive element insulated from said structure and arranged to be touched by a broken wire, a motor for driving the machine, switch means having separate sets of simultaneously closing and

opening contacts, one of said sets being connected with said motor for supplying it with energizing current when closed, a cut-off relay for controlling said switch means, a gaseous discharge tube having a cathode, an anode, and a grid, and a potentiometric tube circuit connected to said cathode and grid and having two points of different polarity relative to that of said cathode connected to said structure and element respectively so that the voltage of said grid is normally negative relative to said cathode and becomes sufficiently positive for firing said tube when said element is touched by a wire, said anode and cathode being connected with said relay through another one of said sets of contacts for causing said relay to control said switch means so as to open said sets of contacts upon firing of said tube whereby said motor is disconnected and said tube and tube circuit restored to initial condition.

6. In combination an electric drive motor, a cut-off relay connected with said motor for rendering it inoperative, a fault-responsive control means for producing a transient impulse of short duration as compared with the time constant of said relay, and a gaseous discharge tube having a grid circuit connected to said means so as to establish firing conditions upon occurrence of said impulse and an anode circuit connected with said relay for energizing the latter, and contact means controlled by said relay and arranged in said anode circuit for interrupting said anode circuit upon operation of said relay.

7. With an electric drive in combination, a relay for controlling said drive, impulse transmitting means for producing a transient control impulse of short duration as compared with the energizing time required for operating said relay, and a gaseous discharge tube having a grid circuit connected to said means so as to establish firing conditions upon occurrence of said impulse and an anode circuit connected with said relay for energizing the latter, and contact means controlled by said relay and arranged in said anode circuit for interrupting said anode circuit upon operation of said relay.

8. With a wire stranding machine in combination, an electric drive, a relay for stopping said drive, transmitting means responsive to the occurrence of a wire break in said machine for producing a transient impulse of short duration as compared with the energizing time required for operating said relay, and a gaseous discharge tube having a grid circuit connected to said means so as to establish firing conditions upon occurrence of said impulse and an anode circuit connected with said relay for energizing the latter, and contact means controlled by said relay and arranged in said anode circuit for interrupting said anode circuit upon operation of said relay.

9. With a wire stranding machine in combination, an electric drive, a cut-off switch for stopping said drive, a relay for controlling said switch, transmitting means responsive to the occurrence of a wire break in said machine for producing a transient impulse of short duration as compared with the energizing time required for operating said relay, and a gaseous discharge tube having a grid circuit connected to said means so as to establish firing conditions upon occurrence of said impulse and an anode circuit connected through said switch with said relay for energizing the latter, whereby said drive is stopped and said anode circuit disconnected subsequent to the occurrence of said impulse.

10. In a strand working machine, the combination of means for accommodating a plurality of strands, fabricating means for simultaneously operating said strands, an electric drive for actuating said fabricating means, a relay contactor for controlling said drive, impulse transmitting means responsive to the occurrence of a strand break producing a transient impulse of short duration as compared with the energizing time required for operating said relay, and a gaseous discharge tube having a grid circuit connected to said means so as to establish firing conditions upon occurrence of said impulse and an anode circuit connected with said relay for energizing the latter, and contact means controlled by said relay and arranged in said anode circuit for interrupting said anode circuit upon operation of said relay.

11. In a strand working machine, the combination of means for accommodating a plurality of strands, fabricating means for simultaneously op-

erating said strands, an electric drive for actuating said fabricating means, a relay contactor for controlling said drive motor, impulse transmitting means responsive to the occurrence of a strand break, switch means having separate sets of simultaneously operating contacts, one of said sets being connected with said motor for controlling its operation, a cut-off relay for controlling said switch means, a gaseous discharge tube having an anode circuit connected with said relay through said other set of contacts for energizing said relay and a grid circuit connected to said input transmitting means so as to be provided with firing voltage for rendering said tube conductive when said transmitting means respond to a break and said anode circuit subsequently opened when said relay causes said switch to open said contact sets.

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