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CONTROL SYSTEM

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Fig. 1.

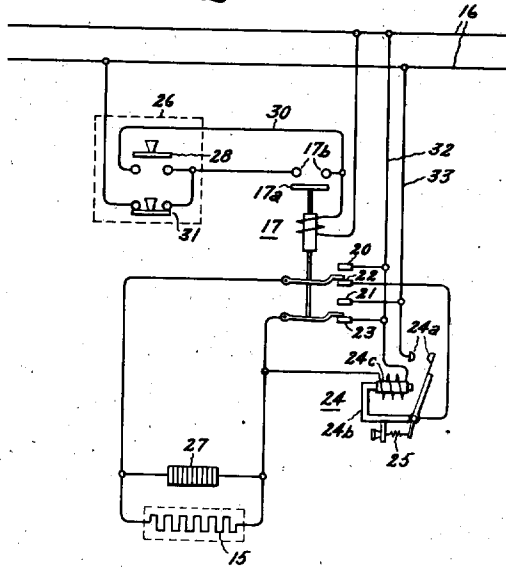
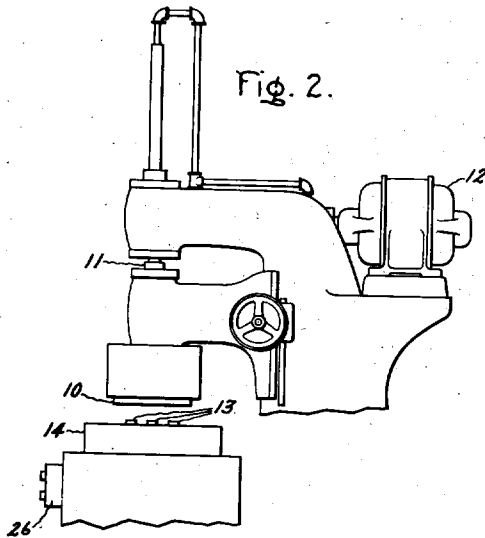


Fig. 2.



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CONTROL SYSTEM

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5 Claims. (Cl. 175—181)

This invention relates to control systems, more particularly to control systems for electromagnets and the like, and it has for an object the provision of a simple, reliable and improved system of this character.

More specifically the invention relates to electromagnets utilized to hold articles in position while certain operations are performed. For example, certain articles are held securely in position by means of a magnetic chuck during grinding or milling operations. After the operation is completed, the chuck must be demagnetized in order to remove the article. Mere deenergization of the electromagnet coil is insufficient because the residual magnetism is sufficiently strong to prevent removal for several hours after deenergization. Heretofore, demagnetization of the electromagnet has been accomplished by reversing the connections of the magnet coil to a source, estimating the amount of time required for demagnetization and then opening the reverse connections. If the estimate was erroneous, repetition of the entire sequence of operation was necessary, thus causing considerable delay and a corresponding decrease in the output. Accordingly, a further object of the invention is the provision of means for eliminating all guess work and judgment and positively effecting demagnetization of the electromagnet in the minimum possible time.

In carrying the invention into effect in one form thereof, means are provided for reversing the connections of the magnet coil to the source, and time element means are provided for interrupting these reverse connections a predetermined interval of time after their establishment.

For a better and more complete understanding of the invention, reference should now be made to the following specification and to the accompanying drawing in which Fig. 1 is a simple diagrammatical illustration of an embodiment of the invention, and Fig. 2 is a simple diagrammatical illustration of a grinding machine and magnetic chuck to which the invention is applicable.

Referring now to the drawing, a stone 10 is secured to and rotated by means of a spindle 11, which in turn is connected to and rotated by means of an electric motor 12. The article to be ground or polished by the stone is held securely in place by means of a magnetic chuck 13, which in turn is mounted in a reciprocating table 14.

Only the core portion of the chuck is shown in Fig. 2. The chuck, however, is provided with a magnet coil 15, by means of which the core is energized. The force required to maintain the work object securely in position during milling or

grinding operation, is often a very considerable amount, and for this reason the magnetizing coil 15 has many turns of fine wire, and the coil is so designed that the ampere turns are sufficient to exert the maximum magnetizing force required.

Due to the large number of ampere turns required a very considerable amount of energy is stored in the magnetic field. Furthermore, the work which is held by the magnet acts as a keeper for the magnetic core structure. Thus, if the magnet coil 15 is merely deenergized when the grinding or milling operation is completed, the residual magnetism of the magnetic structure will persist in sufficient strength to prevent the removal of the work for several hours.

In order to provide rapid demagnetization of the electromagnet and prompt removal of the work from the chuck in order to provide for repetition of the grinding or milling operation on a succeeding piece of work, the control system shown diagrammatically in Fig. 1 is provided.

As illustrated in Fig. 1, the coil 15 of the electromagnet is arranged to be connected to a suitable source of direct current represented by the supply lines 16. Suitable switching means illustrated as an electromagnetically operated contactor 17 are provided for effecting the connection of the coil 15 to the source. The contactor 17 is provided with a pair of movable contacts, which when moved into engagement with the stationary contacts 20, 21, connect the coil 15 of the electromagnet to the source for the purpose of energizing the magnet so as to hold the work piece securely. Also the contactor 17 is provided with a pair of stationary contacts 22 and 23, which, when engaged by the movable contacts, reverse the connections of the coil 15 of the electromagnet to the source to provide for demagnetization of the electromagnet and release of the work piece.

In order to prevent the disconnection of the coil 15 from the source prior to complete demagnetization or subsequent thereto, a time element device 24 is provided having a pair of contacts 24a included in the reverse connections. Although any suitable type of time element device may be used, it is preferred to utilize a device having a magnetic core structure 24b provided with a copper jacket 24c. The time element device 24 is provided with an adjustable tension spring 25 for adjusting the time delay drop-out action of the device 24 to the exact predetermined time interval required to effect disconnection of the coil 15 from the source 16 when the magnetization of the electromagnet is substantially zero.

Control means, illustrated as a push button

switching device 26 are provided for controlling the operation of the contactor 17 in establishing and reversing the connections between the coil 15 of the electromagnet and the source 16. A discharge resistance device 27 is connected across the magnet coil 15. This resistance may be of any suitable type.

With the above understanding of the elements and their organization in the completed control system, the operation of the system itself will readily be understood from the following detailed description. Assuming a piece of work to be placed on the core surfaces 13 of the electromagnetic chuck, the electromagnet is energized by depressing the start button 28 to bridge its cooperating stationary contacts. This completes an energizing circuit for the operating coil of the contactor 17, which circuit is readily traced from the upper supply line 16 through the coil of the contactor, through conductor 30, stationary contacts bridged by the button 28, normally closed contacts of the stop push button 31 to the lower side of the supply source 16. Contactor 17 in responding to energization, moves its movable contacts into engagement with upper stationary contacts 20 and 21, thereby connecting the coil 15 of the electromagnet directly to the supply source 16. Contactor 17 in closing also operates its auxiliary movable contact member 17a into engagement with cooperating stationary contact 17b, thereby to complete a holding circuit for the operating coil of the contactor independent of the start button 28, which may now be released.

The engagement of the lower main movable contact member of the contactor 17 with the upper stationary contact 21 completes an energizing circuit for the operating coil of the time delay device 24 which circuit is readily traced from the upper supply line 16 through conductor 32, coil of time delay device 24, lower main contact of contactor 17, contact 21 and conductor 33 to the lower side of the supply source 16. In response to the energization of its coil, time delay device 24 closes its contact 24a. The closing of this contact, however, has no effect at this time since the movable contact member 24a is connected to the lower stationary contact 22 of the contactor 17, which at this time is not engaged by the movable contact of the contactor.

When the milling or grinding operation of the work is completed and it is desired to demagnetize the chuck and remove the work to make way for a new piece, the stop button 31 is depressed to interrupt the energizing circuit for the operating coil of the contactor 17. As a result of deenergization, contactor 17 allows its movable contacts to descend out of engagement with stationary contacts 20 and 21 and into engagement with stationary contacts 22 and 23. This obviously reverses the connection of the electromagnet coil 15 to the supply source 16, since the left-hand terminal of this coil, which was previously connected to the upper supply line 16 is now connected to the lower supply line through the contacts 24a, (previously closed) of the time element device, and the right-hand terminal of the coil 15, which was previously connected to the lower supply line is now connected to the upper supply line. As a result, the magnetism of the magnetic structure is rapidly decreased. It will be observed that the engagement of the lower movable contact with the stationary contact 23 provides a short circuit for the operating coil of the time element device 24.

After the expiration of an interval of time, the

duration of which is determined by the setting of the adjusting spring 25, and which is just sufficient to allow the magnetism of the electromagnets 13, 15 to decay to zero, the time element device 24 opens its contacts 24a, thereby to interrupt the reverse connection of the magnet coil 15 to the source 16, thus deenergizing the coil when the electromagnet is deenergized, thus allowing the removal of the work piece and replacement by a new piece.

While in accordance with the provisions of the patent statutes, this invention is described as embodied in concrete form, it will be understood that the elements and connections shown and described are merely illustrative and that the invention is not limited thereto, since alterations and modifications will readily suggest themselves to persons skilled in the art without departing from the true spirit of this invention, or from the scope of the annexed claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A control system for an electromagnet comprising a switching device for connecting the coil of said magnet to a supply source and for subsequently establishing reverse connections between said coil and said source to demagnetize said magnet, a separate time element device and contacts in said reverse connections controlled by said time element device, and connections controlled by said switching device for energizing said time element device to close said contacts prior to establishment of said reverse connections and for deenergizing said time element device upon establishment of said reverse connections thereby to open said contacts a predetermined interval of time after establishment of said reverse connections.

2. A control system for electromagnets comprising an electromagnetic contactor for connecting the coil of the magnet to a supply source, and for subsequently establishing reverse connections between said coil and said source to demagnetize said magnet, a time element device having an operating coil, contacts in said reverse connections controlled by said operating coil, connections for said operating coil controlled by said contactor providing energization of said operating coil to close said contacts when said magnet coil is connected to said source and for deenergizing said operating coil upon establishment of said reverse connections thereby to effect opening of said contacts a predetermined interval of time after establishment of said reverse connections.

3. A control system for an electromagnet comprising a contactor for connecting the coil of said magnet to a source of supply and for subsequently establishing reverse connections between said coil and said source to demagnetize said magnet, a time element device having contacts in said reverse connections and an operating coil, connections between said operating coil and said contactor providing energization of said coil to close said contacts when said magnet coil is first connected to said source and short-circuiting said operating coil upon establishment of said reverse connections thereby to effect opening of said contacts a predetermined interval of time after establishment of said reverse connections.

4. A control system for the coil of an electromagnet comprising a time element device having an operating coil and a pair of normally open contacts, and a contactor provided with contacts for connecting the coil of said magnet to a

source independently of said normally open contacts and for connecting said operating coil to said source to close said normally open contacts, said contactor also being provided with contacts for establishing reverse connections for said magnet coil thereby to demagnetize said magnet and for short-circuiting said operating coil thereby to open said normally open contacts and interrupt said reverse connections a predetermined interval of time after establishment.

5. A control system for an electromagnet comprising a contactor for connecting the magnet coil to a source of supply and for subsequently establishing reverse connections between said coil and said source to demagnetize said magnet, a time element device having normally open

contacts in said reverse connections and provided with an operating coil, connections between the operating coil of said time element device and the contacts of said contactor providing energization of said coil to close said normally open contacts when said magnet coil is first connected to said source and short-circuiting said operating coil upon establishment of said reverse connections thereby to effect opening of said reverse connections a predetermined interval of time after establishment, means for varying the duration of said time interval, an energizing circuit for said contactor, and manually operated switching means for controlling said circuit.

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