

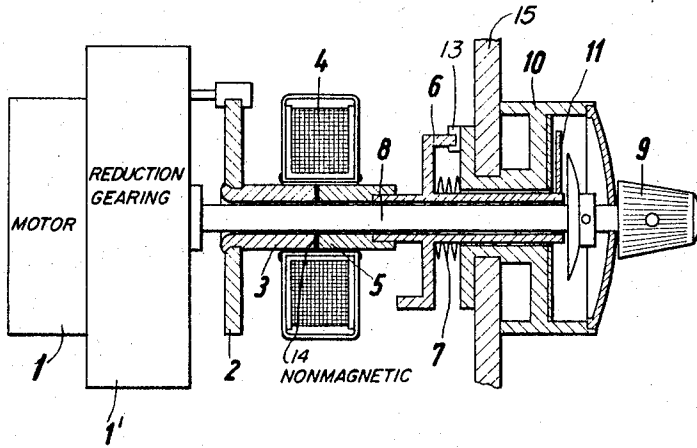
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H. SCHLEICHER

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TIME-DELAY RELAY WITH AXIALLY ALIGNED POLES

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Inventor:
Helmut Schleicher

By

Mestern, Ross & Mester

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**TIME-DELAY RELAY WITH AXIALLY
ALIGNED POLES**

Helmut Schleicher, Hochwaldsteig 19, Berlin, Germany
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4 Claims. (Cl. 335—68)

This invention relates to a mechanical time-delay relay comprising electromagnetic clutch means. In such time-delay relays the time switch is driven by the timing member through the clutch.

Time-delay relays of the specified kind generally comprise a timing member, usually in the form of a synchronous motor, a delay member which can be activated and inactivated through clutch means, and a time switch. Excitation causes the delay member to be coupled to the timing member by the clutch. At the end of the preset delay time the time switch is operated. When the relay is de-energized the delay member is restored to its preset position, usually by spring means stressed during the period of delay. Mechanical clutch means including gear wheels, bevel wheels or discs require movable components which are subject to wear.

The increasing rapidity of the time schedules of machine tools which call for the performance of switching operations at a correspondingly high repetition frequency has an adverse effect upon the life of such time-delay relays because of the wear they experience. If the time sequences vary considerably, time-delay relays are frequently used which include devices for changing the time range. For effecting this adjustment of their operating range, special means are usually provided and these are accommodated outside the timing dial. If several such time-delay relays are used in the same plant, for instance in cascade, then the space occupied by such an assembly is often objectionably large.

The time-delay relay proposed by the invention eliminates these disadvantages by providing an arrangement in which a positively driven timing member ends in one pole of an electromagnet, whereas an entrainable delay member rigid with a timing switch forms the other pole of the electromagnet, the two poles coaxially adjoining each other in such manner that energization or de-energization of the exciting coil couples or uncouples the two poles for joint rotation without causing relative axial movement therebetween. Another advantage of the invention is that error introduced by the delay in the response of mechanical clutches is eliminated, since the magnetic flux becomes effective instantaneously. The magnitude of the flux should be sufficient to insure a coupling action which is free from any time lag yet should permit relative rotation, at the end of the delay time, between the driven pole member and the entrained pole member, thus upon continuing operation of the motor following closure of the contacts of the time switch while the relay coil is still energized. The magnetic coupling action continues, with a relative slipping of the two pole members, until the coil is de-energized, whereupon the entrained member returns to normal under the action of its restoring means. When this is the case the delay member and its contact arm are restored to their preset position by a restoring spring.

The mechanical wear to which the two cooperating surfaces of the pole members are thus subjected may be eliminated in various ways. For instance, a small air gap could be provided between the two coaxial members. However, this would offer a serious obstacle to the generation of sufficient entraining power because the magnetic energy decreases in proportion to the square of the

distance across such a gap. Moreover, the maintenance of an air gap of precise width would involve considerable difficulties in production. The invention therefore proposes to coat the surface of at least one of the poles with a non-abrasive, magnetically neutral material. The existence of this coating has the effect of keeping the two magnetic faces at a precisely defined axial distance whilst at the same time reducing wear to a minimum. The pole face or faces may be thus treated mechanically or electrolytically. A mechanical treatment would consist for instance in interposing a solid lubricant such as graphite, molybdenum disulphide or like substances between the faces, whereas an electrolytic treatment might consist in the electrodeposition of a hard metal coating, for instance a coating of chromium, tantalum or titanium.

Another feature of the invention consists in providing the relay with a central shaft for changing the time range of the relay, said shaft passing through the poles of the electromagnet and through all the axially aligned components. By virtue of this arrangement the entire relay, including all its components, such as the time setting mechanism, the time delay member and time switch, the poles, the exciting coil, the driving motor constituting the timing member, gearing, if any, and so forth, are disposed around this central common shaft. This disposition of all the components about a common shaft facilitates assembly of the relay as well as the subsequent provision of additional components such as gear means and the like. On the other hand, the described construction reduces the space required in the radial direction for mounting the device by utilizing a greater axial depth in the direction of the center shaft. In the majority of applications this is a convenience because in this direction more space is usually available.

An embodiment of a time-delay relay according to the invention will be described in detail and has been shown in the sole figure of the accompanying drawing in schematic form.

A geared driving motor 1 rotates a gear wheel 2 affixed to a tubular pole member 3 which has the form of a sleeve partially surrounded by an electromagnetic coupling coil 4. An adjoining end of a similar pole-forming sleeve 5 is also surrounded by the coil 4. The motor therefore imparts rotation to sleeve 3 through its reduction gearing 11 which includes a pinion 12. When coil 4 is energized, the ensuing electromagnetic flux couples the two poles 3 and 5 for common rotation. Pole 5 constitutes the time-delay member and is formed rigid with an actuating arm 6 adapted to cooperate with a contact not shown in the drawing, to close an external circuit in an off-normal position. Upon de-energization of the coil 4 a restoring spring 7 returns pole member 5 to its normal angular position in which the control arm 6 rests against a stop 13. A control shaft 8 extends outwardly from the speed changer 1' and passes centrally through all the components of the relay including the two poles 3 and 5. This shaft serves for selecting the time range by rotation of a selector button 9. A second rotatable knob 10, journaled in a support 15, serves for setting the delay time within the selected range by displacing the stop 13 to vary the range of rotary entrainment of sleeve 5, a pointer 11 being rigidly connected to this sleeve for indicating the position of the latter. A nonmagnetic and abrasion-resistant coating 14 is shown interposed between the confronting extremities of pole members 3, 5 by being carried on one of them, e.g. the sleeve 3.

What I claim is:

1. A time-delay relay comprising drive means, a first pole member positively coupled with said drive means for rotary entrainment thereby, a second pole member coaxial with said first pole member axially adjoining same,

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electromagnetic coil means surrounding confronting extremities of said members whereby said members are magnetically coupled for joint rotation upon energization of said coil means, an actuating element positively connected with said second member for displacement thereby from the normal position into an off-normal position for the closure of an external circuit upon energization of said coil means, restoring means effective upon de-energization of said coil means for returning said second member to said normal position, and an abrasion-resistant nonmagnetic coating on one of said confronting extremities and in constant contact with the other of said extremities for maintaining the extremities at a precisely defined axial distance.

2. A time-delay relay comprising drive means, a first pole member positively coupled with said drive means for rotary entrainment thereby, a second pole member coaxial with said pole member axially joining same, electromagnetic coil means surrounding confronting extremities of said members whereby said members are magnetically coupled for joint rotation upon energization of said coil means, an actuating element positively connected with said second member for displacement thereby from the normal position into an off-normal position for the closure

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of an external circuit upon energization of said coil means, and restoring means effective upon de-energization of said coil means for returning said second member to said normal position, said driving means comprising a motor provided with a reduction-gear means and with a control shaft extending from said reduction-gear means, said pole members being sleeves supported on said control shaft.

3. A relay as defined in claim 2 wherein said actuating element is an arm engaging stationary stop means in said normal position, further comprising resetting means for varying the range of rotary entrainment of said second member by displacing said stop means.

4. A relay as defined in claim 2 wherein at least one of said confronting extremities is provided with a non-magnetic and abrasion-resistant coating interposed between said extremities.

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BERNARD A. GILHEANY, *Primary Examiner.*

R. N. ENVALL, JR., *Assistant Examiner.*