United States Patent [19]

Loschengruber

[11] **3,915,273**

[45] **Oct. 28, 1975**

[54] **ELECTROMECHANICAL SAFETY LOCK**

[75] Inventor: **Bernhard Loschengruber,** Gondsroth, Germany

[73] Assignee: **Condux-Werk Herbert A. Merges K.G.,** Wolfgang, near Hanau, Germany

[22] Filed: **June 10, 1974**

[21] Appl. No.: **477,998**

[30] **Foreign Application Priority Data**

June 13, 1973 Germany 2329964

[52] **U.S. Cl.** **192/135;** 192/136

[51] **Int. Cl.²** **B04B 7/06**

[58] **Field of Search** 192/135, 136; 210/146

[56] **References Cited**

UNITED STATES PATENTS

1,837,244	12/1931	Watson	192/136
2,738,072	3/1956	Knight	192/136 X
3,161,273	12/1964	Simons	192/136
3,734,290	5/1973	Nelson	192/136 X
3,762,552	10/1973	Landwier	192/136 X

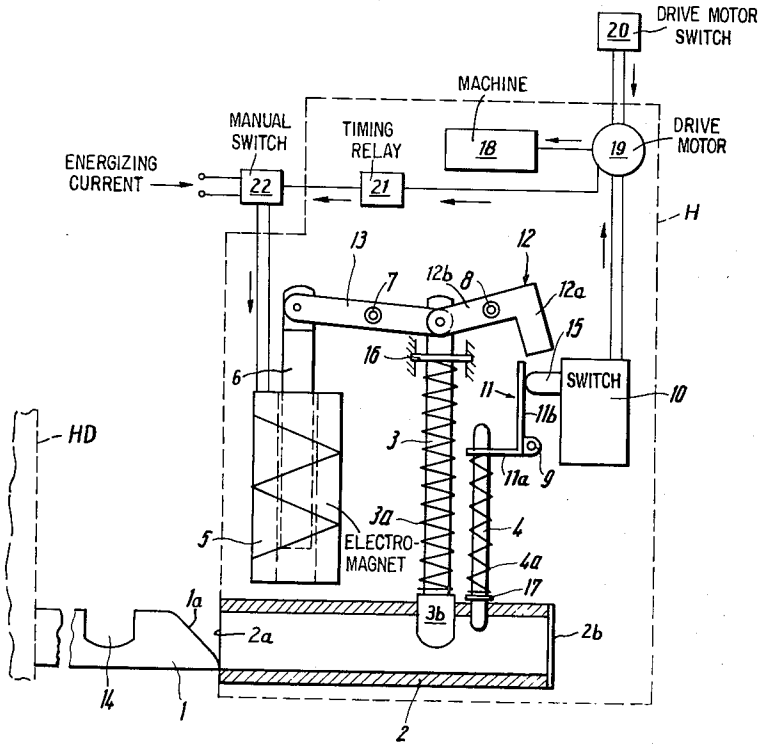
Primary Examiner—Allan D. Herrmann

Attorney, Agent, or Firm—Spencer & Kaye

[57] **ABSTRACT**

An electromechanical safety lock for a housing accommodating a machine. The safety lock has a locking bolt affixed to an openable housing door, a locking rod for blocking the bolt to lock the door and a mechanism which is actuatable by the locking bolt and which permits the machine (or its drive motor) to be energized only when the locking rod blocks the locking bolt. The safety lock further has an electromagnet which, when energized, withdraws the locking rod from the locking bolt. The safety lock further has a device which permits energization of the electromagnet only when the machine is at a standstill.

7 Claims, 2 Drawing Figures



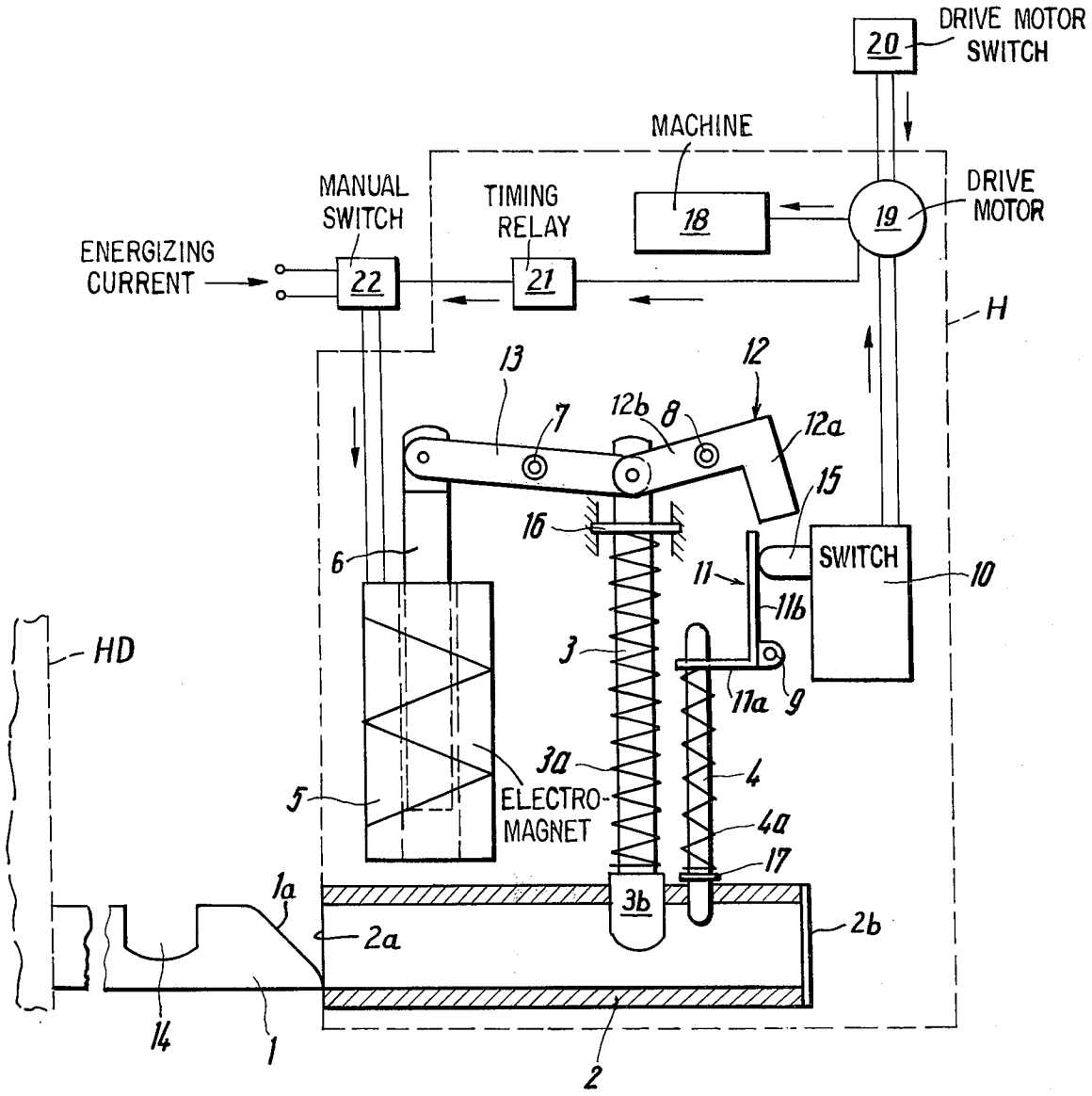

DRIVE MOTOR SWITCH
20
MACHINE
18
DRIVE MOTOR
19
MANUAL SWITCH
22
TIMING RELAY
21
ENERGIZING CURRENT
H
13
12
7
12b
8
12a
15
16
6
SWITCH
10
11
11b
HD
3
11a
9
3a
4
5
ELECTRO-MAGNET
4a
17
1a
3b
2b
2a
14
1
2

Fig.1

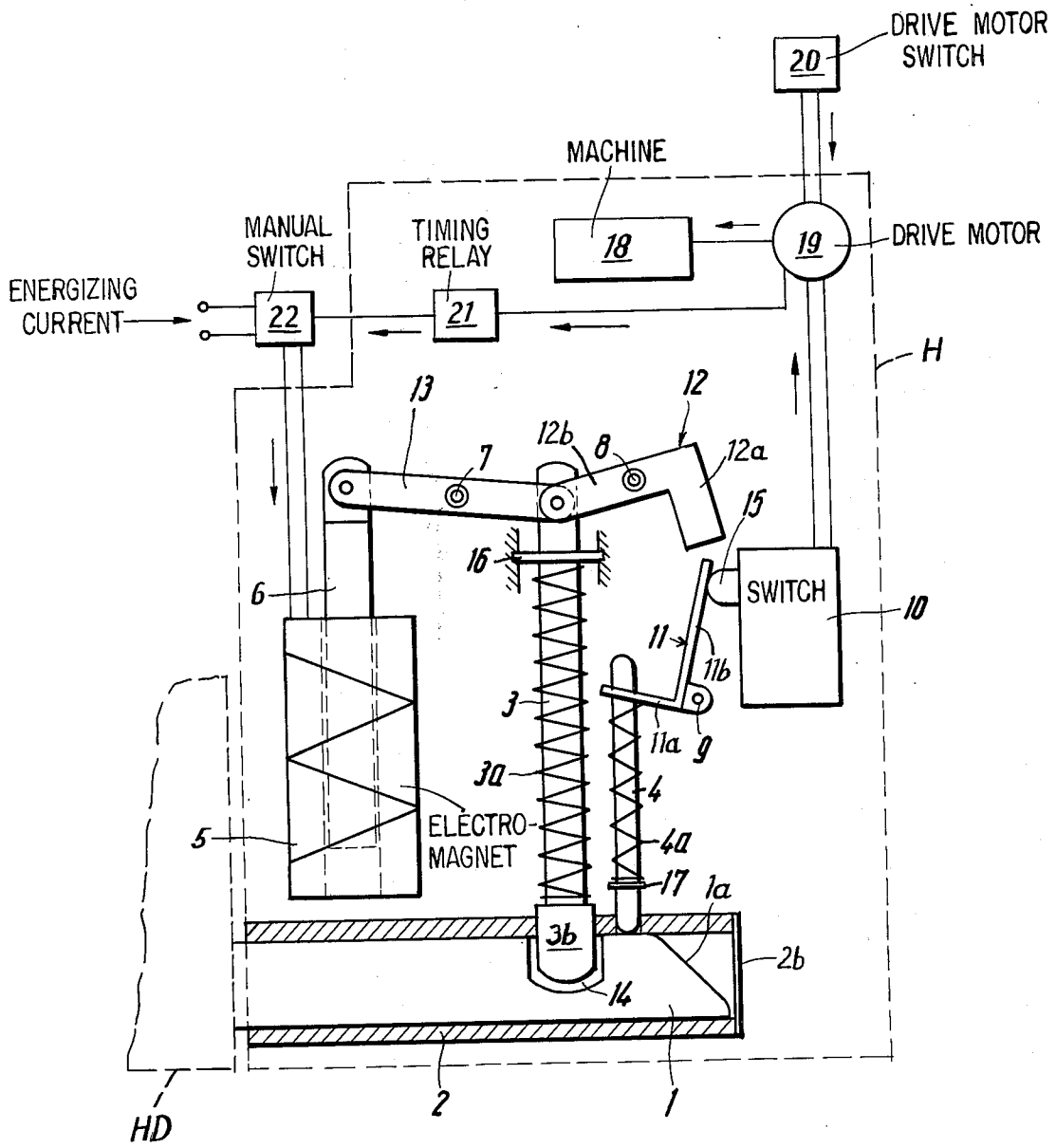

DRIVE MOTOR SWITCH
20
MACHINE
18
19
DRIVE MOTOR
MANUAL SWITCH
TIMING RELAY
ENERGIZING CURRENT
22
21
H
13
12
12b
8
12a
7
15
16
6
SWITCH
10
11
11b
3
11a
9
3a
4
ELECTRO-MAGNET
5
4a
17
1a
3b
2b
14
HD
2
1

Fig. 2

ELECTROMECHANICAL SAFETY LOCK

BACKGROUND OF THE INVENTION

This invention relates to an electromechanical safety lock for a machine housing or a door to gain access to a machine which has moving (for example, rotating) components. The safety lock is of the type which permits an opening of the door or housing component only after the drive motor of the machine has been switched off and the rotating components of the machine have come to a standstill.

Electromechanical safety locks of the above type are generally known and are disclosed, for example, in German Published Patent Applications (Auslegeschrift) Nos. **1,507,489** and **1,590,008.** It is a common characteristic of both types of safety locks that a key is needed for their operation.

In the device according to the German Published Pat. application No. **1,507,489,** there is provided a handwheel-shaped housing portion which may be screwed on a threaded stub of the machine housing and, when so mounted, a locking can be effected by means of a cylinder lock which is provided with a key-operated catch. In the locked position, the key may be withdrawn and the handwheel may rotate idly on the housing. For removing the handwheel, a force-transmitting connection must be established with the aid of the key between the cylinder lock and the handwheel to permit the latter to be wound off the threaded stub. The door or housing portion to be opened is freed in this position; the key cannot be removed since the catch of the cylinder lock is in its work position.

The same key is used for operating a switch lock for turning on or off the drive motor of the machine. Since, when the handwheel is removed, the catch is in its operative position, the key cannot be used and thus the drive motor cannot be turned on. The key may be removed from the switch lock only when the latter is brought into its off position. In order to ensure that the handwheel cannot be taken off during the period of idle rotation of the machine components subsequent to deenergizing the machine (for example, by switching off the driving motor of the machine), the thread pitch on the stub is so designed that the time needed for winding off the handwheel is always greater than the idling run of the rotating machine components.

The safety lock described in the German Published Pat. application No. **1,590,008** relates to a safety switch for the starting and stopping of a machine drive motor wherein the key for opening the housing may be removed only after release by a timing (delay) mechanism. The timing mechanism is wound up by turning on the motor switch and starts to run only after the motor switch is brought into its off position.

The above-outlined two known safety locks require a device to be mounted both on the machine housing and on the switch of the associated drive motor. Further, both locks should operate on the same key. Although sufficient safety may be accomplished with these types of locks, their application requires significant work and cost input. A further disadvantage of these known key-operated devices resides in the inherent danger of using duplicate keys or keys which accidentally fit into the lock. Further, in practice, the safekeeping of such keys is often problematical.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an improved electromechanical safety lock of the aforeoutlined type which is more economical and which needs no keys for its operation and wherein the danger of gaining access to the associated machine before its rotating components come to a standstill is reliably eliminated.

This object and others to become apparent as the specification progresses, are accomplished by the invention, according to which, briefly stated, the safety lock has a locking bolt affixed to an openable housing door, a locking rod for blocking the bolt to lock the door and a mechanism which is actuatable by the locking bolt and which permits the machine (or its drive motor) to be energized only when the locking rod blocks the locking bolt. The safety lock further has an electromagnet which, when energized, withdraws the locking rod from the locking bolt. The safety lock further has a device which permits energization of the electromagnet only when the machine is at a standstill.

The particular advantage of the electromagnetic safety lock according to the invention resides in the fact that it may be mounted with simple means on the machine housing; the motor switch needs no modification. Also, since the electromagnetic safety lock according to the invention requires no keys, the problem of lost keys or the use of unauthorized keys does not occur. Furthermore, a circumvention of the electromechanical safety lock is not possible since the latter is disposed in a closed casing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view of a preferred embodiment of the invention in a "machine open" position.

FIG. **2** is a schematic view of the same embodiment in a "machine locked" position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the figures, to a housing door HD of a housing H accommodating a machine **18** (having rotary components) there is affixed a locking bolt **1.** To the machine housing H (to which the housing door HD may be hingedly mounted) there is affixed a bolt sleeve **2** which has an opening **2***a* and which is closed at its rear at **2***b*. The bolt sleeve **2** and the locking bolt **1** have coinciding longitudinal axes so that upon opening and closing of the housing door, the locking bolt **1** can slide into and out of the bolt sleeve **2.** The locking bolt **1** has a particular configuration, namely, it has a tapered free end **1**a and, adjacent thereto, a notch-like detent **14.** There is further provided a locking rod **3** having a terminus **3***b* which projects into the bolt sleeve **2** transversely to the bolt sleeve axis and which is adapted to be lockingly received by the notch **14** of the locking bolt **1.** The locking rod **3** is guided by a stationarily supported plate **16** which also serves as a spring seat for one end of a compression spring **3** *a*. The other end of the spring **3***a* engages a shoulder of the locking rod **3.** Upon introduction of the locking bolt **1** into the bolt sleeve **2** through the opening **2***a* from the left as viewed in the Figures, first the tapered end portion **1***a* lifts the locking rod **3.** As the locking bolt **1** is brought into its terminal position, that is, it abuts against the closed rear end **2***b* of the bolt sleeve **2,** the notch **14** is dis-

posed vertically below the free end 3*b* of the locking rod 3. The latter, biased downwardly by the compressed spring 3a, snaps into the notch 14, so that the locking process occurs in an impactlike manner.

Between the locking rod 3 and the rear terminus 2*b* of the bolt sleeve 2, there is positioned a follower pin 4 which projects into the bolt sleeve 2 transversely to the bolt sleeve axis. Viewed from the bolt sleeve opening 2*a*, the follower pin is thus located behind the locking rod 3. The follower pin 4 carries a compression spring 4*a*, one end of which is supported by a collar 17 of the follower pin 4. As the locking bolt 1 approaches its above-noted terminal position, the tapered portion 1a of the bolt 1 causes the follower pin 4 to be lifted. Subsequently, the follower pin 4 rides on the upper edge of the locking bolt 1 as shown in FIG. 2. With the follower pin 4 the coil spring 4*a* is also lifted. The force of this movement is transmitted by the spring 4*a* to one leg 11*a* of a rectangular switch lever 11 pivotally held at 9. It is noted that the follower pin 4 proper does not engage operatively the leg 11*a* of the switching lever 11, but, for example, passes through a forked portion thereof.

A blocking member, such as a locking lever 12 is pivotally held at 8 and if formed of legs 12*a* and 12*b*. The leg 12*a* may be swung into and out of a blocking position with respect to the leg 11*b* of the switch lever 11. The leg 12*b* of the locking lever 12 is articulated to the locking rod 3, so that the movement of the latter causes a pivotal motion of the locking lever 12.

As the follower pin 4 travels upwardly on the tapered portion 1*a* of the locking bolt 1 and the locking rod 3 has not yet dropped into the notch 14, but approaches it while riding on the top horizontal edge of the locking bolt 1, (this operational phase is not illustrated in the figures), the leg 12*a* blocks the leg 11*b*. As a result, the switch lever 11 is prevented from pivoting clockwise in response to the pressure of the spring 4*a*.

As the free end 3*b* of the locking rod 3 drops into the notch 14, the locking rod 3 causes a counterclockwise movement of the locking lever 12 and thus its leg 12*a* clears the leg 11*b* of the switching lever 11. As a result, the switching lever 11, urged by the spring 4*a*, moves rapidly clockwise and actuates a pin 15 of an electric switch 10.

By actuating the electrical switch 10, a circuit (not shown) is closed or opened for rendering the drive motor 19 energizable or non-energizable.

The switch pin 15 of the switch 10 is spring-biased into the off position and is maintained there in the absence of a counter force exerted through the switch lever 11 by the stronger force of the spring 4a.

In the closed position of the switch 10, the drive motor 19 of the machine 18 can thus be turned on (energized) by actuating — for example, manually — a drive motor switch 20. As the drive motor 19 is turned off (de-energized) by the drive motor switch 20, the drive motor 19 emits a signal which is applied to a timing relay 21. Upon termination of the delay period of the relay 21, the latter closes its contacts, which occurrence sets an electromagnet 5 into an energizable state. When the electromagnet 5 is in such an energizable state, it may be energized (that is, connected to a current source) or deenergized by a switch 22 which may be manually operated.

If, while the safety lock is in its position shown in FIG. 2, the electromagnet 5 is energized by actuating the switch 22, it attracts an armature 6. As a result, an armature lever 13, connecting the armature 6 with the locking rod 3, executes a counterclockwise pivotal motion about its pivot 7 and thus the force exerted by the electromagnet 5 is transmitted by the armature lever 13 to the locking rod 3. As a result, the latter, overcoming the force of the spring 3*a*, is lifted to such an extent that its lower terminus 3*b* clears the notch 14 so that the locking bolt 1 may now be withdrawn from the locking sleeve 2 for the purpose of opening the machine housing.

The delay period of the relay 21 is adjustable and is expediently selected such that it is longer than the period of idling machine rotation as the drive motor of the machine is de-energized. It is thus apparent that the timing relay may be set for different idling periods and thus is adapted for use in different types of machines.

The entire electromagnetic safety lock has small spatial requirements and is disposed in a casing (not shown) which has a relatively rigid rear wall (also not shown) for receiving, fixedly or pivotally, the above-described components of the lock. The bolt sleeve 2, too, is affixed to this casing wall.

Since the locking rod 3 projects with its free end 3*b* into the bolt sleeve 2 to a greater extent than the follower pin 4 when the machine housing H is open (see FIG. 1) and since the follower pin 4 is disposed closely behind the locking rod 3 as viewed from the opening 2*a*, it is impossible to exert, by means of a screw driver or similar tool, a pressure on the follower pin 4 for the purpose of actuating the switch 10 without first lifting the locking rod 3. Should this occur, however, the locking lever 12 would rotate clockwise and thus, with its leg 12*a*, would block the leg 11*b* of the switching lever 11.

By virtue of the penetration of a different extent of the locking rod 3 and the follower pin 4 into the bolt sleeve 2 and the particular shape of those parts of components 3 and 4 which project into the bolt sleeve 2, the electromechanical safety lock can be operated only by means of the locking bolt 1. The latter, however, is affixed to an openable part (the door HD) of the machine housing H so that a manipulation of the electromechanical safety lock which would lead to an energization of the drive motor in an open position of the machine housing is not possible.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

I claim:

1. An electromechanical safety lock for a housing door of a housing accommodating a machine that includes a drive motor, comprising in combination:

a. a bolt sleeve affixed to said housing and having means defining a sleeve opening at one end of the bolt sleeve;

b. a locking rod having a free terminus projecting transversely into said sleeve, said locking rod having a first position in which said free terminus has an advanced position in said bolt sleeve, said locking rod having a second position in which said free terminus has a withdrawn position in said bolt sleeve;

c. a follower pin projecting into said sleeve, said follower pin having a first position and a second position;

d. first switch means for setting said drive motor into an energizable state and into a non-energizable state;

e. first coupling means for connecting said follower pin to said first switch means for setting said drive motor into said non-energizable state when said follower pin is moved into its said first position and for setting said drive motor into said energizable state when said follower pin is moved into its said second position;

f. a locking bolt affixed to said housing door for movement therewith, said locking bolt being oriented for introduction into and withdrawal from said bolt sleeve through said sleeve opening, said locking bolt including means for moving said locking rod and said follower pin from their respective first position into their respective second position as said locking bolt moves inwardly within said bolt sleeve, said locking bolt further including detent means for receiving said free terminus of said locking rod when said locking bolt is in a fully introduced position in said bolt sleeve for blocking said locking bolt in said bolt sleeve; said locking rod moving into its said first position when said free terminus is received by said detent means;

g. an electromagnet having energized, de-energized, energizable and non-energizable states;

h. second coupling means for connecting said electromagnet to said locking rod for moving said locking rod into its said second position when said electromagnet is in said energized state;

i. second switch means for setting said electromagnet into said energized state and said de-energized state; and

j. means responsive to the operational condition of said machine for setting said electromagnet into the energizable state only when said machine is at a standstill.

2. An electromechanical safety lock as defined in claim **1,** further including a blocking member connected to said locking rod for causing movement of said blocking member by said locking rod; said blocking member having a blocking position for preventing movement of said first coupling means when said locking rod is in its said second position, said blocking member having a withdrawn position for allowing movement of said first coupling means when said locking rod is in its said first position.

3. An electromechanical safety lock as defined in claim **1,** wherein said means responsive to the operational condition of said machine includes an adjustable timing relay connected to the drive motor for receiving a signal from the drive motor upon deenergization of the latter; said timing relay being connected at least indirectly to said electromagnet for setting the electromagnet into said energizable state after a dealy period running from the moment of de-energization of the drive motor.

4. An electromechanical safety lock as defined in claim **1,** wherein said first coupling means includes a lever operatively connected to said first switch means for opening or closing said first switch means and a spring constituting the sole connection between said follower pin and said lever.

5. An electromechanical safety lock as defined in claim **1,** wherein said means for moving said locking rod and said follower pin includes a tapered end portion of said locking bolt; said detent means includes a notch formed in said locking bolt.

6. An electromechanical safety lock as defined in claim **1,** wherein said follower pin is situated immediately behind said locking rod as viewed from said opening in said bolt sleeve; in their respective first position said locking rod extends farther into said bolt sleeve than said follower pin.

7. An electromechanical safety lock as defined in claim **6,** wherein said bolt sleeve has a closed end remote from said sleeve opening.

* * * * *