United States Patent [19]

Rocchitelli

[11] **3,892,933**

[45] **July 1, 1975**

[54] **APPARATUS FOR LOCKING AND RELATED RELEASING OF CLOSURE DEVICES OF DOORS OF MACHINES, MORE PARTICULARLY FOR WASHING MACHINES**

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[22] Filed: **Nov. 24, 1972**

[21] Appl. No.: **309,415**

[30] **Foreign Application Priority Data**

Nov. 26, 1971	Italy	31664/71
Mar. 7, 1972	Italy	21515/72
Apr. 28, 1972	Italy	23725/72

[52] **U.S. Cl.** ..... **337/77;** 68/12 R; 200/61.64; 200/61.67

[51] **Int. Cl.** **H01h 61/02;** H01h 71/16

[58] **Field of Search** ..... 200/61.64, 61.67; 68/12 R; 337/120, 77; 310/4.1

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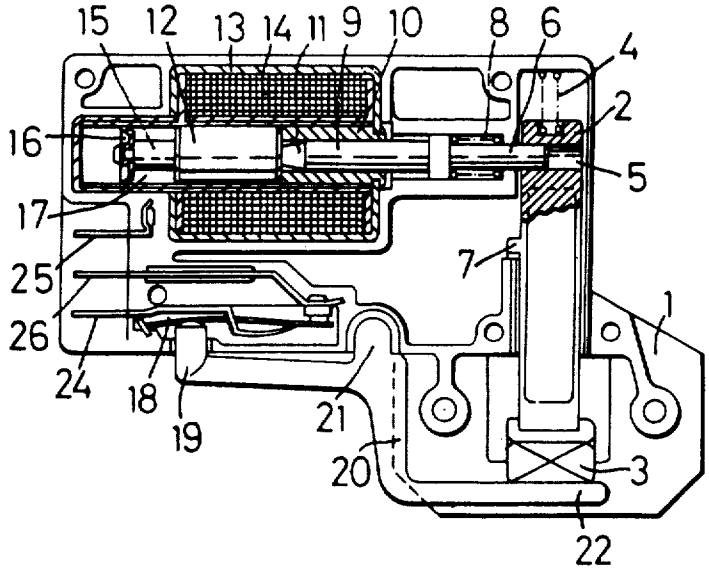
Primary Examiner—David Smith, Jr.

Attorney, Agent, or Firm—Roland T. Bryan

[57] **ABSTRACT**

An apparatus for locking and belated releasing of closure devices of doors of machines, more particularly for washing machines, wherein a latch cooperating with the door closure hook is held in locking position during the operation of the machine by a pin which releases it with a certain time delay after switching off the machine motors, so that the door can be opened only when the members of the machine subject to inertial rotation are at a complete standstill. This time delay is obtained through a fluid pump, thermostat or other suitable device, while the latch is locked during the operation by means of an electromagnet or circuit resistance coiled on the thermostat connected to the machine starting pushbutton.

8 Claims, 13 Drawing Figures



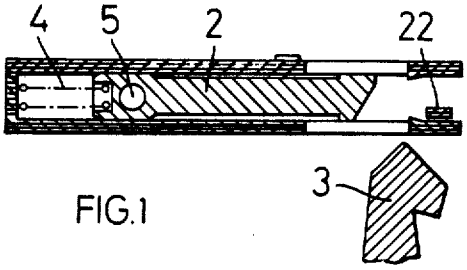


FIG.1

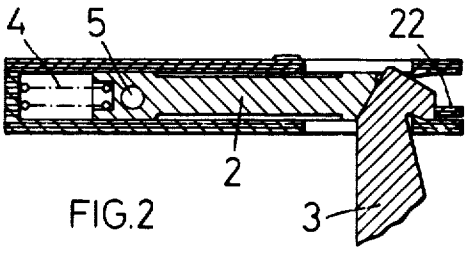


FIG.2

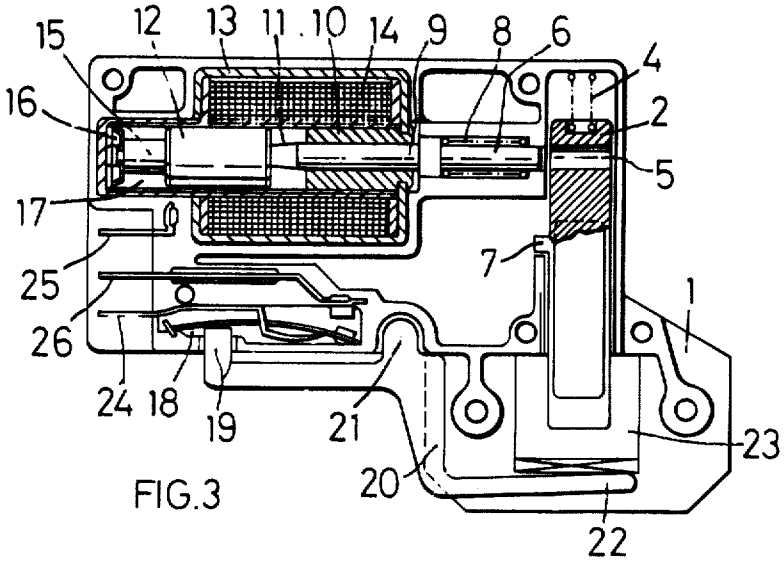


FIG.3

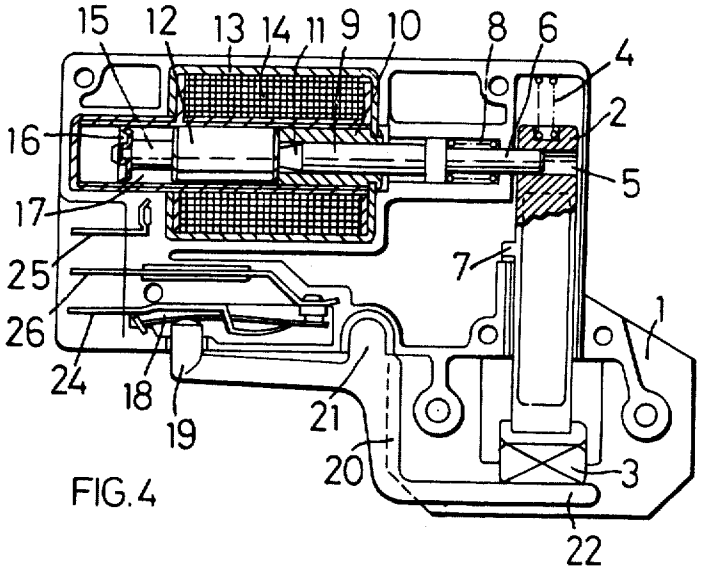


FIG.4

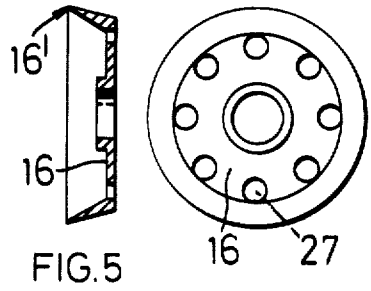


FIG.5

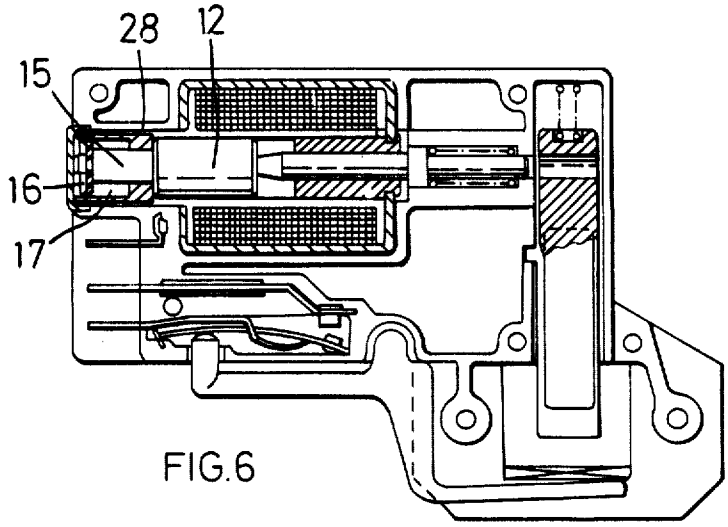


FIG.6

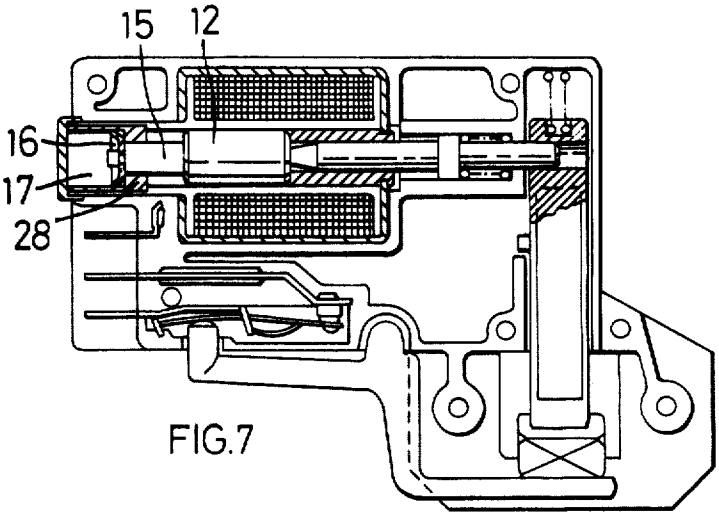


FIG.7

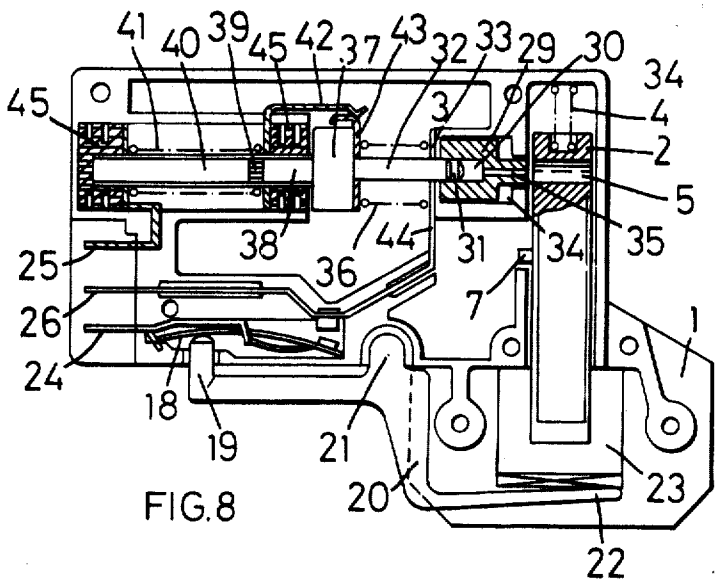

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FIG.8

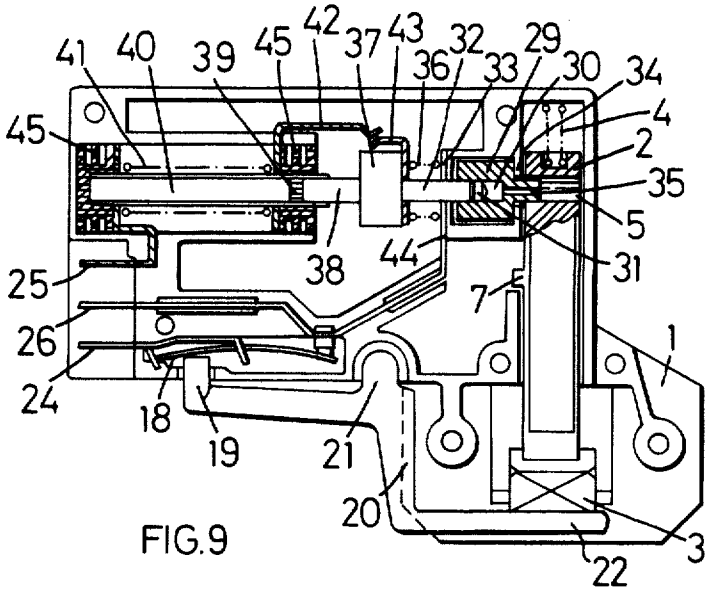
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FIG.9

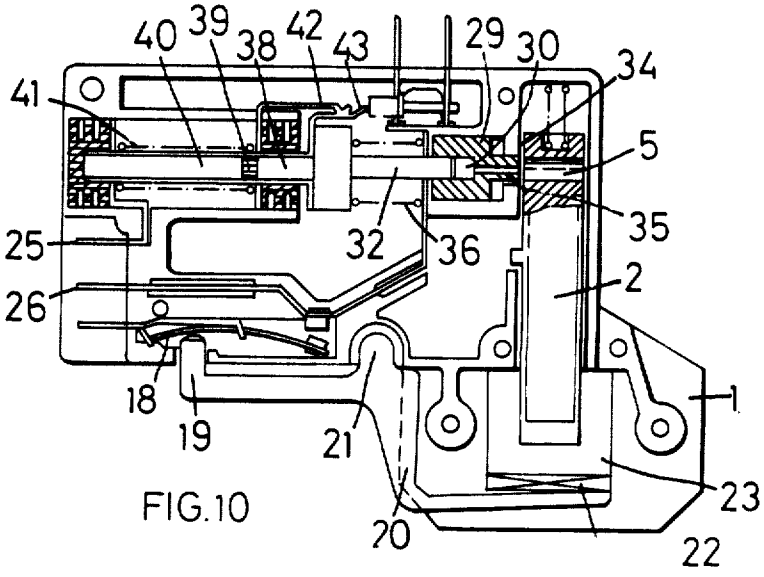

FIG.10

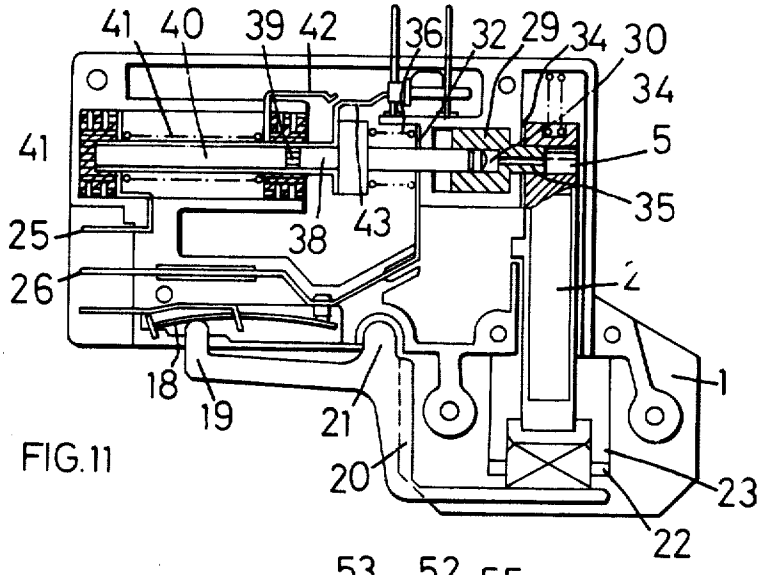

FIG.11

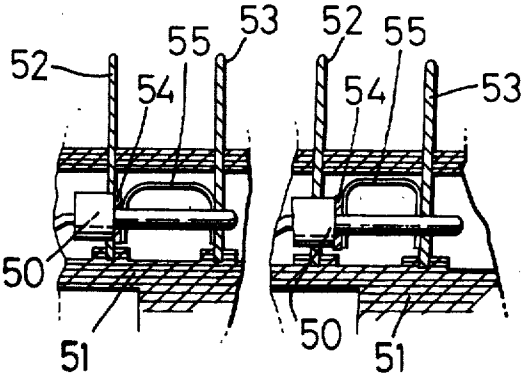

FIG.12

FIG.13

APPARATUS FOR LOCKING AND RELATED RELEASING OF CLOSURE DEVICES OF DOORS OF MACHINES, MORE PARTICULARLY FOR WASHING MACHINES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus for locking and belated releasing of closure devices of doors of machines having internal parts rotating at high speed, more particularly for washing machines.

2. Description of Prior Art

It is known the necessity of providing on the doors of machines having internal parts rotating at high speed, such as washing machines apparatus adapted to lock the closure device of the machine door at start of the machine, and to release it with a certain delay in respect to the current interruption, so as to hinder the opening of the door when some members of the machine may still be subject to an inertial rotation, such as the centrifuge basket. Some apparatus of this kind are already known, in which the releasing delay is obtained through the cooling action of a bimetallic device.

OBJECTS OF THE INVENTION

Primary object of the present invention is to provide a door locking device, giving a wide safety guarantee, as it locks the door before starting the machine, keeping the locking action throughout the entire operation of the machine and after interruption of the current until any rotating member is completely standstill.

Furthermore, the door locking device according to the present invention has also the function of switch series connected to the door, so as to avoid closure of the machine actuating circuits if the door is not perfectly closed, and this device is placed in a position which cannot be reached by the user so that it is absolutely impossible to actuate the machine, even voluntarily, with the door open.

SUMMARY OF THE INVENTION

The apparatus of the present invention substantially consists of a sliding latch cooperating with the hook of the door closure lock, said latch being associated with a pin adapted to lock the latch when some conditions are occurring, said pin being actuated, in a first embodiment of the invention, by an electromagnet connected to the machine actuating controls and its opening being delayed by a fluid pump.

According to another embodiment of the invention the delay is obtained by a device made according to the known wax thermostats (widely used in the automative industry), suitably modified and improved, wherein a pin held in a container partially filled with a particular wax, is expelled by the expansion of wax caused by heating of said container and is withdrawn under an external thrust during the cooling stage of said container.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be better understood with reference to the illustrative and non limiting embodiments which will be described in detail hereinafter with the aid of the accompanying drawings, in which:

FIG. **1** - is a sectional view of the detail of the positions of the latch and door closure hook with the door open, common to all the embodiments of the invention;

FIG. **2** - is a sectional view of the detail of the apparatus latch when the door is closed and the relative position of said latch and of the door closure lock, common to all the embodiments of the invention;

FIG. **3** - is a partly sectioned view of the apparatus with electromagnet and delaying air pump in the rest stage with open door;

FIG. **4** - is a view of the apparatus with electromagnet and delaying air pump in the working stage, locking the closed door;

FIG. **5** - is a plan and sectional view on enlarged scale of the detail of the piston of the delaying pump;

FIG. **6** - is a view of the apparatus with electromagnet and delaying liquid pump in the rest stage with open door;

FIG. **7** - is a view of the apparatus with electromagnet and delaying liquid pump in the working stage, locking the closed door;

FIG. **8** - is a view of the apparatus with wax thermostat in the rest stage with open door;

FIG. **9** - is a view of the apparatus with wax thermostat in the working stage with lock of the closed door;

FIG. **10** - is a view of an apparatus similar to FIG. **8**, with the application of the control device for washing machines with electronic program;

FIG. **11** - is a view of an apparatus similar to FIG. **9**, with the application of the control device for washing machines with electronic program;

FIG. **12** - is an enlarged detail of FIG. **10**; and

FIG. **13** - is an enlarged detail of FIG. **11**.

In all the figures the parts which are not modified will be indicated with the same reference numerals.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIGS. **1–5** the door locking device according to a first embodiment of the invention consists of a box **1** for containing all the members of the apparatus, said box containing more particularly at latch **2** engaging and locking the head of a hook **3** of the machine door lock.

This latch **2** is constantly held urged downwards by the spring **4** and at its top there is a hole **5** for a locking pin **6.** Latch **2** is held in axial position of hole **5** with pin **6** through the pawl **7.**

The locking pin **6** is constantly held in opening position by the action of spring **8** and with its extension **9** passes through the fixed magnetic core **10** and at its end is provided with a vibration dampening gasket **11** through which it leans the movable core **12.**

Electromagnet is formed by an external core **13** enveloping it completely, so as to keep enclosed the electromagnetic flux, a coil **14,** the movable core **12** and the fixed core **10.** The movable core **12** is forwardly extended with a stem **15** ending with the piston **16** which can slide in a chamber **17.** Said chamber is in communication with the atmosphere at the stem through the gap existing around the movable core **12.**

Piston **16** is formed by a frustum-conical body of plastic material having the cross section shown in FIG. **5** and bearing at its upper flat portion a set of very little holes **27** of a number and sizes varying according to the desired time delay.

Piston **16** in its closure position (from left to right in FIG. **3**) allows passage of air through its outer edges **16,** which on the contrary have a sealing effect when the piston is moving in the contrary direction, so that the

fluid is compelled to pass through said holes **27** delaying the return stroke.

In the apparatus there is also a microswitch unit comprising a blade with contact **18** actuated by the pushbutton **19** and born by a Z-like arm **20** which can be rotated around pin **21**, whose opposite end **22** is arranged at the hole **23** for the introduction of hook **3** of the door, and having its terminal **24** connected to one of the poles of the current supply line. The other end of the current supply line reaches the terminal **25.**

The energization circuit of the coil is ending at the terminals **25** and **26** so that it is energized only when the door lock hook acting on the end **22** of arm **20** lets current to pass to the coil.

The operation of the apparatus is the following: upon closure of the door of the washing machine, its hook **3** is inserted on one side into the recess **23** so as to act with the lower part on the end **22** of arm **20** so as to lower it and to keep it in said position (see FIGS. **1–2**) and with the upper part on the latch **2** so as to become associated thereto (see also FIGS. **1–2**).

Following this action arm **20** is moving downwards, so that lever **20** rotating around the pin **21** causes the pushbutton **19** to act on blade **18** of the microswitch so as to close the circuit of energization of the coil of the electromagnet.

In consideration of the energization of the coil, the fixed core **10** is magnetized, attracting the movable core **12** which in turn urges the pin **6** to be inserted in the hole **5** of the latch **2** and the air contained in the upper part of the chamber passes in the lower part of chamber **17.** The whole remains in this conditions up to the completion of the working cycle of the machine.

The vibration dampening gasket **11** has the function to avoid that the vibrations of the movable core **12** because of the current circulating in the coil, are passing to the latch **2.**

At the end of the working cycle, the current at the terminals **25–25** is interupted by the machine control unit so that the coil is disenergized and under the push of spring **8** the pin **6** may be withdrawn and comes outfrom the hole **4** releasing the latch **2,** allowing lifting and extraction of the hook of the machine door.

However, this does not happen immediately, but after a certain period of time according to calibration of the apparatus, that is according to the greater or lower resistance to the passage of air from one side to the other of the chamber **17,** resistance which is made by the holes **27** of the piston **16.**

Opening of the machine door may therefore take place only when the pin **6** is completely disengaged from hole **5,** that is after those predetermined 10–45 seconds spent by the piston **16** under the action of the spring, to return from position of FIG. **4** to that shown in FIG. **3.**

In the case that for the operation of the delaying pump it is desired to use a liquid such as oil, instead of air, the apparatus is modified as shown in FIGS. **6** and **7.** In other words the chamber **17** instead of being in communication with external air through the outer walls of the movable core **12** at its upper part, is closed by a complementary chamber **28** which acts as a seal on the shaft **15** of the piston, and such a chamber **28** is filled with a liquid which passes from one side to the other of the piston **16** according to its movements.

To the terminal **26** where one of the poles of the coil arrives, is connected also the wire for returning tension to all other movements of the machine, so that the same microswitch, in addition to be used as control for the operation of the locking circuit, has also the function of interrupting the series of control circuits of the machine, because the machine cannot start operation with the door open, as it can not be actuated if the door hook did not push downwards the lever **22.** Moreover this control is arranged in a not accessible position and can be actuated only by the hook of the machine door.

A second embodiment of the present invention is shown in FIGS. **8** and **9** wherein all the other members of the apparatus are unaltered, but the moving and timing element consists of an apparatus made along the known principles of a wax thermostat, substantially comprising an internally hollow metal body which is partially filled with a particular wax having a high thermal expansion coefficient, eventually mixed with additives (copper, aluminum powder etc.) and on which a pin or piston is inserted and held in contact with the wax by means of an external thrust, said piston being expelled when the ambient in which said hollow body of the thermostat is inserted, is brought to a higher temperature because of the expansion of the wax, and always under the thrust of the external element, is withdrawn when the ambient in which the hollow body of the thermostat is inserted is cooled and the wax returns to its original volume.

Such a type of thermostat is widely used in the automotive industry and is generally applied on the engine cooling circuit, to control various members connected to said circuit. Such a thermostat has a reliable and lasting operation allowing tens of thousands of operations.

It is however to be understood that the invention does not only comprise only the application of a known wax thermostat device, as the conventional wax thermostats for the automotive industry cannot be applied in this case because they are too slow in their extraction movement, they fuse and therefore the phenomenon of the wax expansion takes place at a temperature of about 80°–90° and they cool down also very slowly, while for the present application to washing machines it is required an almost immediate extraction and a withdrawal within a period of approximately 15 to 45 seconds.

Some measures were tested for speeding up the operations more particularly of the expansion phase, by making thermostat bodies with very thin outer walls in order to feel at once the effect of a heat source placed outside them, but the maximum effort was above all to choose with advantage for the duration, substances having in addition to a high coefficient of thermal expansion and a high velocity of expansion, a lower melting point, that is between 40° and 50°C.

It has been found that this object is well met by some paraffins with low melting point, as substitution for the already known waxes, and more particularly a phisical mixture comprising 55% of butil behenate:

$CH_3 - (CH_2)_{20} CO - O - CH_2 = (CH_2)_2 - CH_3$

and 45% of stearyl adipate:

$$\begin{array}{l} CO - O - CH_2 - (CH_2)_{16} - CH_3 \\ \diagdown \\ (CH_2)_4 \\ \diagup \\ CO - O - CH_2 - (CH_2)_{16} - CH_3 \end{array}$$

This mixture has a melting point of 49.6°C, allows the manufacture of thermostat bodies with walls having a thickness not greater than 15/100 of millimeter, has a considerable velocity of expansion so that it is possible to obtain thermostats capable of expelling the piston on a time of 1–3 seconds and to withdraw in 15–45 seconds, varying the wall thickness, density of the mixture and heat source.

In order to make possible the variation of the pin withdrawal time and therefore the door releasing time, but keeping unaltered in a certain range the velocity of return of the wax thermostat itself, so that with one thermostat having always the same dimentions and characteristics it is possible to obtain different locking speeds with a simple modification of a little detail of the apparatus in order to meet the different requirements of the variuos manufacturers, to the pin or piston of the wax thermostat and more particularly between it and the hole 5 of the latch 2 it has been inserted a clutch connection formed by a cylinder ending with a pin, the latter being associated to the hole 5 of Latch 2.

With reference now to FIGS. 1, 2, 8 and 9, the door locking device according to this embodiment of the present invention comprises, like the preceding one, a box 1 for enclosing all the members of the apparatus, which more particularly contains a latch 2 which engages and locks the head of the hook 3 of the machine door lock.

This latch 2 is held constantly urged downwards by a spring 4 and at its top has a hole 5 for a locking pin of predetermined length, which is the extreme extension of a cylinder 29 provided with an internal cylindrical cavity 30 wherein it slides under friction exerted by a rubber ring 31 and a rod 32.

In view of this coupling, when the cylinder 29 is free to move in either direction, it is drawn by the eventual movement of the rod 32. If on the contrary the cylinder 29 reached the stop 33 and 34 or for eventual incidental obstacles along its path, for instance lack of axial alignment of hole 5 with the extension 35 of the cylinder 29, it has to stop, the rod 32 slides inside the cavity 30, of the cylinder 29.

The latch 2 is held in a position of axial alignment of the hole 5 with the extension 35 by means of the pawl 7. The locking pin 35 is constantly held in the opening position by the spring 36 acting on the rod 32.

The rod 32 is connected to the cylindrical body 37 which in turn is connected to the piston 38 which through the interposition of a pad of elastic material 39 (rubber, neoprene, etc.) partially fills the cavity of a cylinder 40 being the body of a wax thermostat, the remaining portion of which is filled by a particular wax.

The cylinder 40 is sorrounded by an electric resistance 41 having one end connected to the terminal 25 and the other to the contact terminal 42 and through the contact 43, spring 36 and contact 44 to the other terminal 26.

In the apparatus there is a microswitch unit, like in the preceding embodiments, formed by a blade with contact 18 actuated by the push-button 19 born by a Z-like arm 20 capable of rotating around the pin 21 and the other end 22 reaching the hole 23 of introduction of the hook 3 of the machine door, and having the terminal 24 connected to one of the wires of the current supply line.

The second wire coming from the current supply line reaches the terminal 25.

The resistance circuit, as above said, ends at the terminals 25 and 26 so that it is fed only when the machine door closure hook acting on the extreme part 22 of the lever 20 supplies tension to the resistance 41.

The operation of the apparatus is the following; Upon closure of the door of the washing machine, its extreme hook 3 is inserted from one side in the recess 23, acting with its lower part on the end 22 of the lever 20 so as to lower and keep it in such a position (see details in FIGS. 1 and 2) and with the upper part on the latch 2 so as to become associated thereto (see also FIGS. 1 and 2).

Following this action the arm 20 is moved downwardly, so that lever 20 rotating around the pin 21 causes the pushbutton 19 to act on the blade 18 of the microswitch, closing the circuit and supplying tension to the resistance 41.

In consideration of the passage of current through the resistance 41, this is being heated and because of the production of heat the wax contained in the cylinder 40 is expanded pushing forward the gasket 39 and the piston 38 and consequently the rod 32 which in turn pushes forward the cylinder 20 so that the pin 35 made at its end is inserted into the hole 5 and locks the latch 2 (see FIG. 9), until said cylinder 29 stops because its fore surface reaches the wall 34 of the body 1.

In the meantime rod 32 may go on in its forward movement, sliding in the inner cavity 30 of the cylinder 29. In this position the contacts 42 and 43 are being separated so as to break the current feeding the resistance 41 which as a consequence cools down (see FIG. 9).

Subsequently as a consequence of the thrust of the spring 36 the pin 32 slightly goes back at that moment the two contacts 42 and 43 are matched and supply again tension to the resistance which is heated and because of the expansion of wax the pin 32 is again pushed forwards. This phenomenon of very little alternate continuous movements of the pin 32 of the order of hundreths lasts for the whole period of operation of the machine.

When the machine stops at the end of the working cycle, the current to the terminals 25 and 26 is interrupted, resistance 41 and therefore wax contained in the cylinder 40 are cooled and rod 32 because of the effect of the thrust of spring 36 against the body 37 returns to its place, drawing the cylinder 29 and releasing the latch 2.

During its return rod 32 drags cylinder 29 until the latter stops against shoulder 33 of the body 1, while the rod 32 goes on withdrawing coming out from the cavity 30.

Thus, increasing or decreasing the lenght of the pin 35, it is possible to increase or decrease the time of releasing the latch 2 and therefore of opening the door, using the same thermostat 12.

In order to make easier the cooling of the device in this stage, cylinder 40 may be provided at both ends with a plurality of cooling pins 45, whose dimensions are depending from the return speed of the piston 38.

The elastic pad 39 interposed between the wax and the piston 38 has the function of acting as a sealing gasket for avoiding emission of wax in the event of overheating and for warranting this function it is slightly

packed of the action exerted on it by spring **36** on piston **38.**

When a door locking apparatus must be applied on machines having electronic programmers, the apparatus according to the present invention is provided with a further microswitch shown in FIGS. **10** to **13.**

In fact it is known that if the electronic programmer is subjected for a too long time to the main current, more particularly during the take-off period of the motors, the electronic circuit deteriorates.

In such a case of the movable member actuated by the device controlling the latch locking pin (in the instance of the embodiment of FIGS. **10–13** the movable contact **43**) is mounted the insulating pin **50** of a microswitch comprising a base **51** fixed on the box **1** containing the various elements of the device, two fixed contacts **52** and **53** series connected on the circuit of energization of the electronic programmer and the movable contact **54** fixedly joined to the insulating pin **50** electrically connected with the contact **53** through the led **55.**

Therefore, when the movable contact **54** is in contact with the contact **42,** the circuit of the electronic programmer is closed and the current of the electric circuit of the machine passes through it, but when this is detached, the current of the electronic programmer is interrupted.

The operation of the device is the following:
As a consequence of the closure of the door of the machine its extreme hook **3** is inserted in the cavity **23** acting with its lower part on the end **22** of the lever in order to lower it and with its upper part on the latch **2** in order to become associated to it.

Following this action the arm **20** is moved downwardly, so that the lever **20** rotating around the pin **21** causes the push-button **19** to act on tha blade **18** of the microswitch, closing the circuit and supplying tension to the resistance **41.**

In view of the passage of current through the resistance **41,** the latter is being heated and because of the heat produced the wax contained in the cylinder **40** is expanded, pushing forward the gasket **39** and the piston **38** and consequently the rod **32** which pushes forward the cylinder **29** so that the pin **35** made at its opposite end is inserted in the hole **5** and locks the latch **2** (see FIG. **2**), until said cylinder **29** stops because its front surface reaches the wall **34** of the body **1.**

In the meantime the rod **32** goes on moving forward, sliding in the inner cavity **34** of the cylinder **29.** In this position the contacts **42** and **43** are being separated interrupting the current feeding the resistance **41** which consequently is cooled down. The contact **43** in the meantime pushed forward the piece **50** bearing the movable contact **54** (see FIGS. **11** and **13**) which is detached from the fixed contact **52** and the current to the electronic programmer is interrupted.

As a consequence, under the thrust of the spring **36** the pin **32** is slightly withdrawn but at that moment the two contacts **42** and **43** are joined supplying again tension to the resistance which is being heated and under the effect of the expansion of the wax it pushes again forward the pin **32.**

This phenomenon of very little continuous alternate movements of the pin **32** of the order of hundreths lasts for the whole operation time of the machine. During all this time the contacts **52** and **53** are however constantly detached.

When the machine stops at the end of its working cycle, the current to the terminals **25** and **26** is interrupted, the resistance **41** and therefore the wax contained in the cylinder **40** is cooled and the rod **32** because of the thrust of the spring **36** against the body **37** returns to its place drawing the cylinder **29** and releasing the latch **2.** The contact **54** is again associated to the contact **52** closing the circuit to the electronic programmer and the machine is ready for another starting.

I claim:

1. For use in controlling the locking and releasing of latching devices on access closures in machines such as washing machines and the like, internal members of which machines preferably cease movement prior to the time when such closures may be opened for internal access thereto, which latching devices include a moveable latch device for cooperative interengagement with an associated hook member, which latch is to be locked in closed position during operation of the machine by a locking pin and is to be unlocked by actuation of said locking pin at the end of the machine operation with a pre-determined time delay, apparatus comprising a locking pin actuated by a piston moveable in a chamber, means for selectively heating said chamber according to the operative condition of the machine, and a heat expansible, low melting point wax contained in said chamber, expansion of which wax will cause actuation of said locking pin to effect locking of said latch in closed position and contraction of which wax will cause actuation of said pin to effect unlocking of said latch.

2. A device as described in claim **1** wherein said heating means comprises an electrical resistance heater which surrounds said chamber.

3. An apparatus as claimed in claim **2** wherein a pole of the electrical resistance heater is divided into two contacts, one of which is fixed and the other is movable with the piston so that the two maintain contact and complete an electrical circuit except when the piston is actuated by the wax thermostat to position the locking pin in locked position whereby the locking pin is maintained in a locked position without continuous application of electrical energy to the electrical resistance heater and without wax over-heating and excessive pressure generation within the chamber.

4. An apparatus as claimed in claim **2,** wherein a pad of elastic material is interposed between the wax and the piston to act as a gasket for the wax in the melting stages.

5. An apparatus as claimed in claim **2,** wherein the expansible wax comprises a mixture of waxes having a melting point below about 50°C.

6. An apparatus as claimed in claim **5,** wherein the wax mixture comprises a physical mixture of 45 percent butyl behenate and 55 percent stearyl adipate.

7. An apparatus as claimed in claim **2** wherein the piston is operatively connected to the locking pin by means of a piston rod connected to the piston and slidably positioned within a hollow cylinder formed by one end of the locking pin whereby inadvertent energization of the wax thermostat under conditions of misalignment of the locking pin and latch do not result in unsafe operation.

8. A device as described in claim **7** wherein the locking end of the locking pin is selectively replaceable with locking ends of various lengths without modifying the piston rod or hollow cylinder, whereby the velocity of the piston movement may remain the same while the wax thermostat is usable for obtaining different unlocking times.

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