May 14, 1957 F. KOZIKOWSKI 2,792,468

DELAYED CIRCUIT CLOSER

Filed May 10, 1951

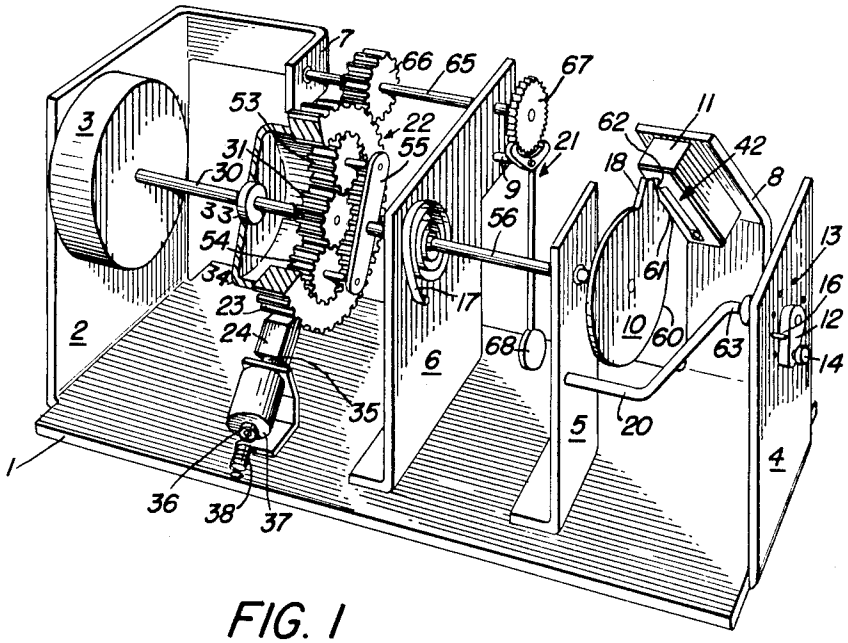


FIG. 1

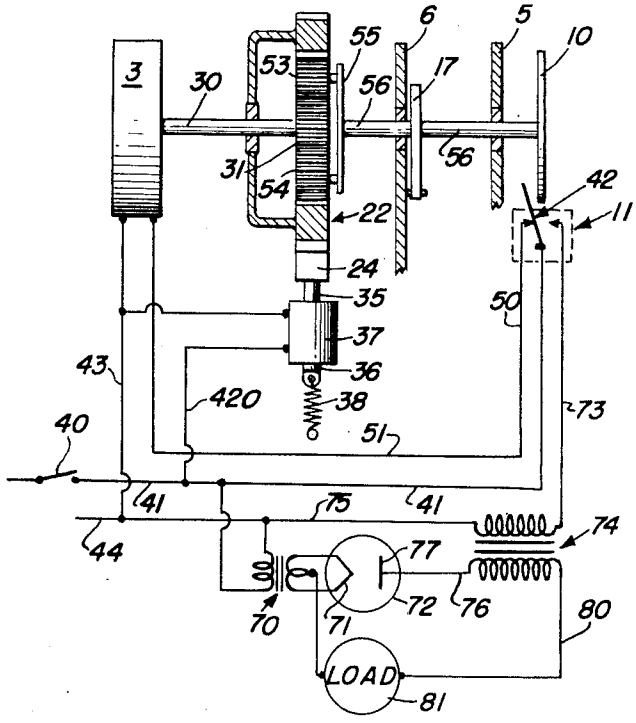


FIG. 2

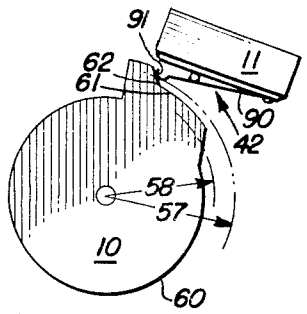


FIG. 3

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United States Patent Office 2,792,468 Patented May 14, 1957

2,792,468

DELAYED CIRCUIT CLOSER

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Application May 10, 1951, Serial No. 225,629

3 Claims. (Cl. 200—92)

The invention relates to an improvement in timers of the type which delay the closing of a circuit to allow some preliminary step to be completed.

Such timers are often used to allow the filament in an electronic tube to be heated before putting current on the plate of the tube. However, such a timer may be used in connection with any apparatus where some part of the apparatus is to be preconditioned or preheated before the load is put on the circuit.

Such timers are necessarily self-resetting, so that if the current fails they will automatically reset to the initial position.

Hitherto, such timers have generally been of the instantaneous reset type—that is, the timer is instantly reset if the current fails.

Where the timer is designed to allow time to preheat part of the apparatus, it is clear that after a current interruption it takes a definite period of time for the apparatus to cool off and if the current comes on before the end of such a period, it is unnecessary to reset the timer to its initial position.

The invention provides for a gradual reset. If the current is put on before the reset is completed, only the time needed to retrace that portion of the reset that has been completed will elapse before the load is thrown on again. This will give time enough to reheat the filament.

In one form the invention further provides that if the current failure is very short—a matter of only a few seconds—the load is picked up immediately if the current comes on again.

Thus, if a filament takes sixty seconds to heat up and ninety seconds to cool off, these things would happen:

Sixty seconds would elapse before the load goes on the plate when first closing the circuit.

If the current thereafter fails for two seconds, then comes on, it will immediately go on the plate.

If the current fails for thirty seconds, the resetting will only be one third completed and when the current comes on it will take only twenty seconds, that is one third the initial time, for the current load to be put on.

Fig. 1 is a perspective view, partly in section, showing diagrammatically one embodiment of the invention.

Fig. 2 is a diagrammatic view of the same embodiment of the invention.

Fig. 3 is a plan view of the cam and the micro switch controlled by it.

Examining the invention first on its broader aspects, the reset timer may be mounted on a base **1** which has an upstanding flange **2** that supports a synchronous motor assembly **3**. The base **1** may also have ribs or partitions **4**, **5**, **6**, **7**, **8** attached to it. These serve to support the various shafts and moving parts in their relative position.

The timer includes a cam **10** which actuates a switch **11** at the end of a selected period of time. This period is selected by moving the arm **12** to indicate the desired time on a scale **13**. The arm **12** may carry a pin **14** which enters holes **15** in the scale to hold the arm in the selected position.

A fixed stop **16** may be provided to limit the range through which arm **12** may be moved.

The timer also includes means to drive the cam back to its initial position if the current fails. These means may be a spring **17** which is wound up while the cam **10** is moved forward to the position where the switch **11** is closed. When the current fails, this wound spring provides the energy to turn the cam **10** backward until a projection **18** engages a stop **20** which is adjustable by the arm **12**.

When the cam **10** is turned backward by the spring **17** an escapement generally indicated at **21** delays the rate of the return of the cam. This escapement is shown of the pendulum type but the invention is not limited to the use of that type; for example the escapement shown in the patent granted Jeanneret on Oct. 24, 1950 bearing number 2,526,620 may be used.

One of the distinctive features of the invention is a planetary gear assembly generally indicated at **22** whose ring gear **23** is locked against rotation by a pawl **24** while the synchronous motor **3** is turning the cam forward but which is free to turn when the pawl **24** is withdrawn to drive the escapement under the power of spring **17**.

Describing the parts entering into these assemblies in more detail, all the parts are supported on the plate **1**. The upturned flange **2** supports the synchronous motor assembly which has a shaft **30** which carries the pinion **31**.

Sleeve **33** which carries arms **34** that support ring gear **23** is supported on shaft **30**. This ring gear has teeth both on its inner surface and on its outer surface. The pawl **24** engages the outer teeth. This pawl is mounted on a stem **35** that passes through the core of a solenoid **37** and carries armature **36**. A spring **38** tends to draw the pawl **24** away from the ring gear **23**.

As will be noted from Fig. 2, when switch **40** is closed current flows through lines **41**, **420**, **43**, **44** through solenoid **37** forcing pawl **24** against the ring gear overcoming the spring **38**. Current also flows through line **41**, switch **42** in micro switch assembly **11**, line **51**, syncro motor **3**, line **52** and lines **43**, **44**.

Thus, when the switch **40** is closed, the ring gear is locked and the synchronous motor started.

With ring gear **23** stationary and pinion **31** revolving, planetary gears **53**, **54** are caused to travel around the inside of the ring gear and as these gears are supported on studs set into arms **55** attached to shaft **56**, that shaft is turned.

Shaft **56** is supported in partitions **5** and **6**. The inner end of coil spring **17** is attached to this shaft, the outer end anchored to partition **6**. The shaft also carries cam **10**. This cam has a circular section **60**, a raised portion **61** and an inclined surface **62** rising further.

When the current fails, the synchro motor stops, the spring **38** withdraws pawl **24**, the pinion **31** is now at rest and the wound up spring **17** turns shaft **56** and attached cam **10** backwards until surface **18** engages the stop **20**. This stop may be attached to a shaft **63** passing through support **4** and attached to arm **12** already described. The length of time required to reset the device depends on the angular position for stop **20** selected.

The supports **6** and **7** support a shaft **65** carrying a pinion **66** driven by the ring gear **23**. This shaft carries the escapement wheel **67** whose rate of escapement is controlled by pendulum **68** supported on stud **9** carried by partition **6**.

In Fig. 2, **70** represents a transformer whose primary is connected to leads **41** and **44**. The secondary of this transformer supplies a current to the filament **71** of the tube **72**. This transformer becomes active and the current begins to flow through the filament as soon as the switch **40** is closed.

When the timer cam actuates the micro switch 11, the switch blade 42 breaks the circuit through lines 50 and 51 to the motor stopping the motor, and closing the circuits through the line 73 and the primary of the transformer generally indicated at 74 and line 75. The transformer 74 now creates a current in the secondary of the transformer and this is led to line 76 to the plate 77 of the tube. The load to be controlled 31 is shown in the circuit 80 leading from the transformer to the load and thence to the mid-point of the secondary of transformer 70.

In order to enable the circuit to remain closed during a very short interruption, the cam may be designed as shown in Fig. 3. The portion 60 of the circumference of the cam is of such a radius that the arm 90 carrying the follower 91 attached to the switch box 11 swings out far enough to allow the micro switch arm 42 to move to the position shown in Fig. 2 toward which the micro switch is biased. This cuts the circuit through the transformer 74 which provides current to the load and closes the circuit to 50 which leads to the synchro motor, so that when the current comes on again, the timer will be ready to start.

The switch 11 is of the snap actuated type. Such a switch, when the cam 10 is moving clockwise will not snap to close circuit 73 until the follower 91 of the switch has been moved by the cam outward to a distance 57 which is beyond the raised portion 61 which is a portion of a circular cam whose center is the axis of the cam. However, when the cam 10 is moving counterclockwise the snap switch will not open circuit 73 until the follower 91 of the switch has been moved to a distance 58 from the cam center which is between the cam portion 60 and the raised cam portion 61. When the cam is moving counterclockwise and the arm 90 and the follower 91 again move into contact with the surface 61, the switch arm 52 will remain in contact with line 73 thus maintaining the load, until the cam has moved counterclockwise far enough to allow the follower 91 to cross the arc at radius 58. Thus, it will be noted that when the timer is moving the cam forward the cam will have to move from the position where the surface 18 is in contact with the stop 20 to the position shown in the figure where the load has been applied. If, however, there is a short interruption the switch 42 will remain in contact with 73, but because of the failure of current, the solenoid 37 will cease to function allowing the spring 38 to draw the pawl 24 away from the ring gear and thus start the gradual counterclockwise movement of the cam in Fig. 3, under control of the escapement. However, while the follower 91 in contact with 61, switch 42 is still in contact with 73, and if the current is reapplied during this period, the pawl 24 will again engage the ring gear and current will continue to flow through the transformer 74. Thus, the load is not cut off during the time the synchronous motor is restoring the cam to its on position for instantaneous interruption in the circuit.

I claim:

1. A timing device adapted to delay the actuation of a switch, comprising, a uni-directional motor, a first shaft driven by said motor, a pinion on said shaft, a planetary gear assembly, a ring gear in said planetary gear assembly having internal and external teeth and mounted concentric with the first shaft, a second shaft and pinion mounted concentric with the first shaft, a plate carried by said second shaft, a gear carried by said plate meshed between said pinion and the internal teeth of said ring gear, an electrically operated latch operatable to lock said ring gear in position, an escapement, gearing to connect said escapement to the external teeth of the ring gear, a cam driven by said second shaft and movable from an initial to a final timing position, a spring for returning said cam to its initial position, a switch actuated by said cam in its final timing position, energizing means to operate said motor and latch to lock said ring gear whereby said motor and first shaft drive the second cam through the differential toward the final timing position, said means when deenergized to allow said spring to return said cam toward its initial position by rotation of said ring gear, the escapement controlling the rotation of said ring gear at a regulated speed.

2. A timing device adapted to delay the closing of a circuit after it is started, comprising, a cam movable from its normal position, an adjustable stop to select a normal position that will give the desired delay, a motor having a shaft, a planetary gear assembly whose pinion is on said motor shaft, a ring gear in said planetary assembly that is free to revolve about said motor shaft, teeth on the outside of said ring gear, a pawl adapted to engage said teeth on said ring gear, a solenoid adapted to move said pawl against said ring gear, planetary gears meshing with said pinion and ring gear, a shaft carrying said cam moved forward by said planetary gears at a preset rate after said motor is energized with said ring gear locked against rotation, a load switch located in the path of said cam and adapted to be engaged by it when it approaches the end of its travel, a spring wound up during the movement of the cam from its normal position adapted to move said cam in a reverse direction, an escapement controlling the rate of reverse movement driven from the teeth on the outside of the ring gear, a spring withdrawing said pawl on interruption of the current to free said spring and escapement for moving said cam in a reverse direction.

3. A timing device adapted to delay the closing of a load switch after a switch in the main circuit is closed, comprising, a cam movable from its normal position, an adjustable stop to select a normal position that will give the desired delay, a motor having a shaft, a planetary gear assembly whose pinion is on said motor shaft, a ring gear in said planetary assembly that is free to revolve about said motor shaft, teeth on the outside of said ring gear, a pawl adapted to engage said teeth on said ring gear, a solenoid adapted to move said pawl against said ring gear when the main circuit is closed, planetary gears meshing with said pinion and ring gear, a shaft carrying said cam moved forward by said planetary gears at a preset rate after said motor is energized with said ring gear locked against rotation by said pawl, a load switch in the circuit to be controlled located in the path of said cam and adapted to be engaged by it when it approaches the end of its travel thus applying current to the load after a time delay, a spring wound up during the movement of the cam from its normal position and adapted to move said cam in a reverse direction, an escapement controlling the rate of reverse movement driven from the gear on the outside of the ring gear, a spring withdrawing said pawl on interruption of the current to free said spring and escapement for moving said cam in a reverse direction.

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