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[21] Appl. No. **850,004**

[22] Filed **Aug. 14, 1969**

[45] Patented **June 29, 1971**

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[32] Priority **Aug. 21, 1968**

[33] **Japan**

[31] **43/60292**

[50] Field of Search..... 98/116, 41;
415/148

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[54] **SHUTTER MEANS OPERATED BY FAN MOTOR**
2 Claims, 10 Drawing Figs.

[52] U.S. Cl..... 98/116,
415/148

[51] Int. Cl..... F04d 25/14

ABSTRACT: A ventilator having a shutter closed when the ventilator is in inoperative position and a mechanism operable by a part of the output of a fan motor to actuate the shutter for the opening and closing operations thereof.

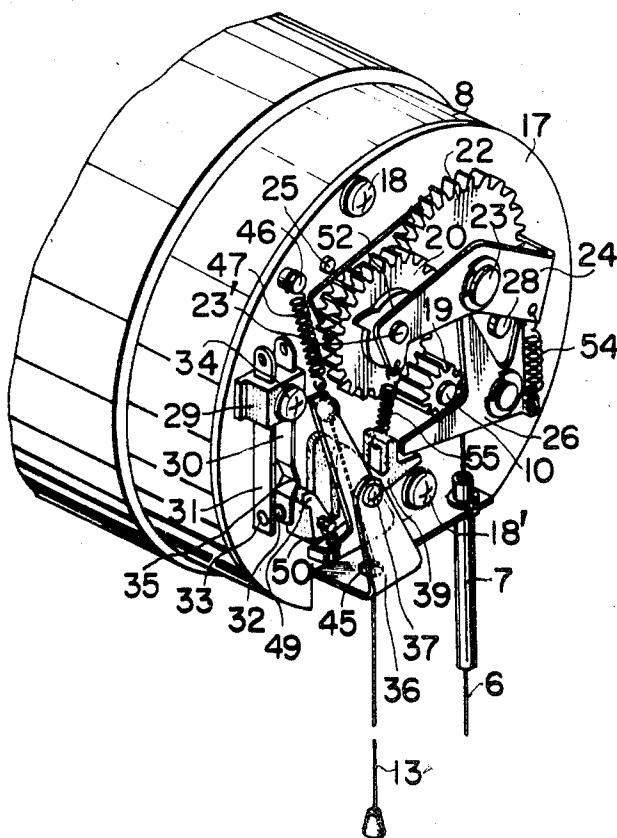


FIG. 1

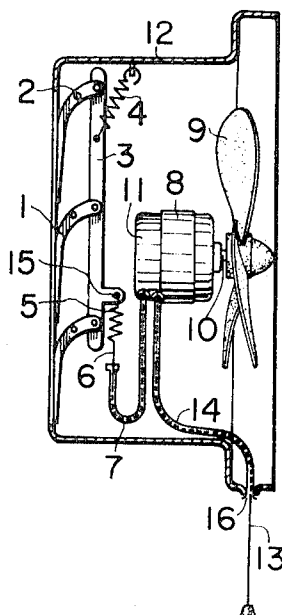
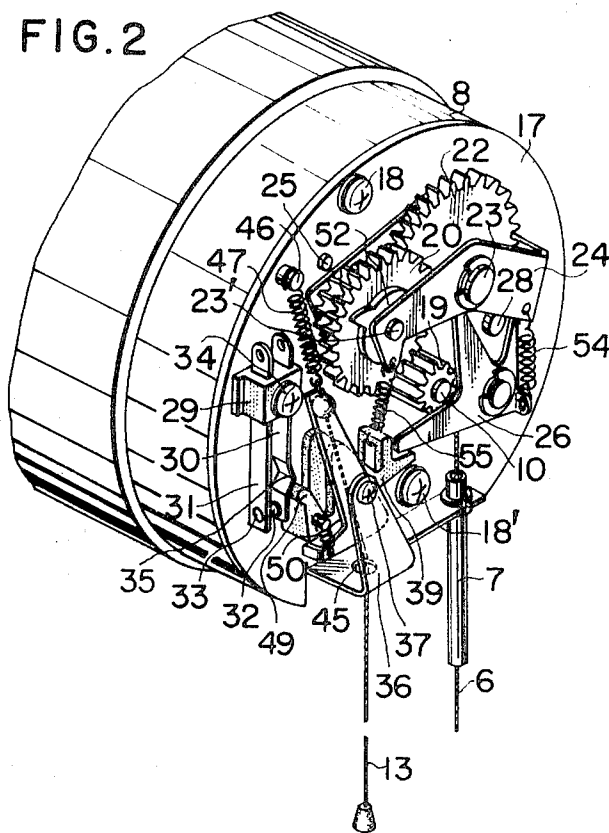


FIG. 2



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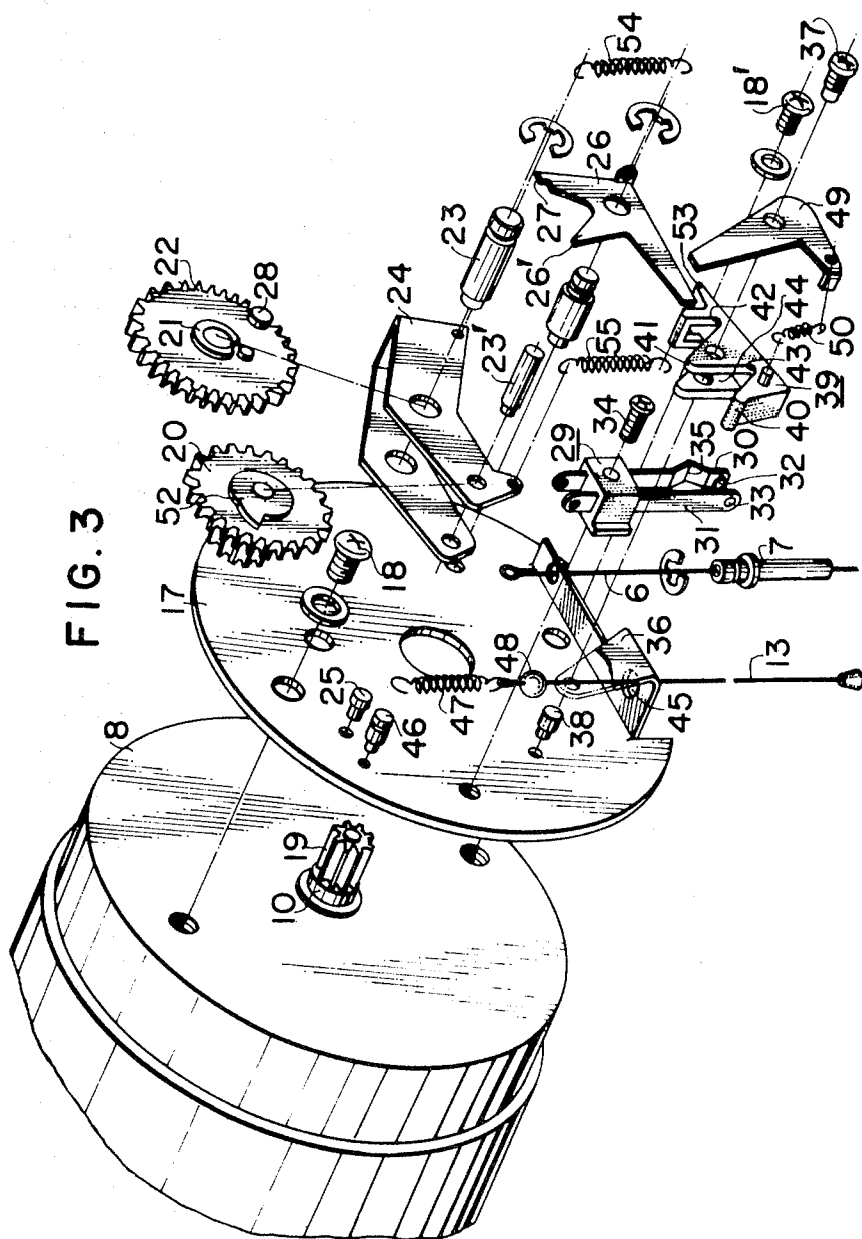


FIG. 4

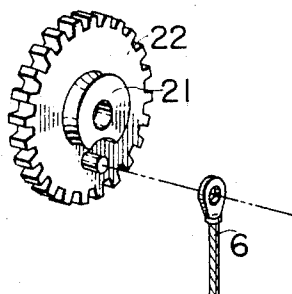


FIG. 10

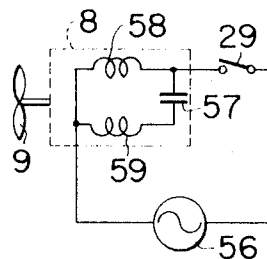
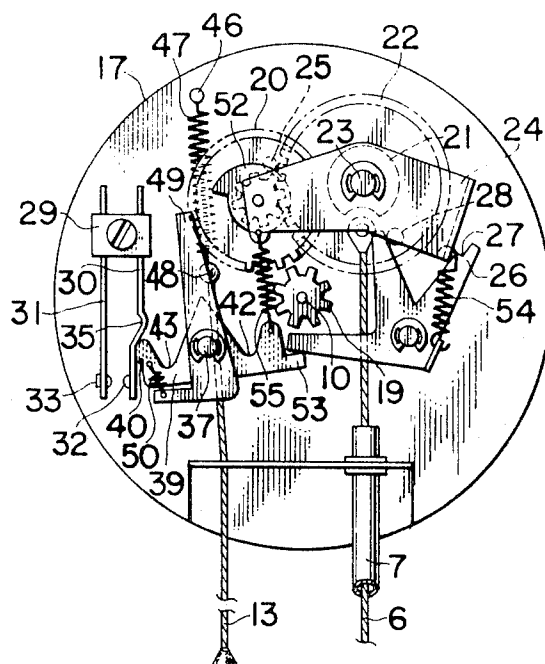
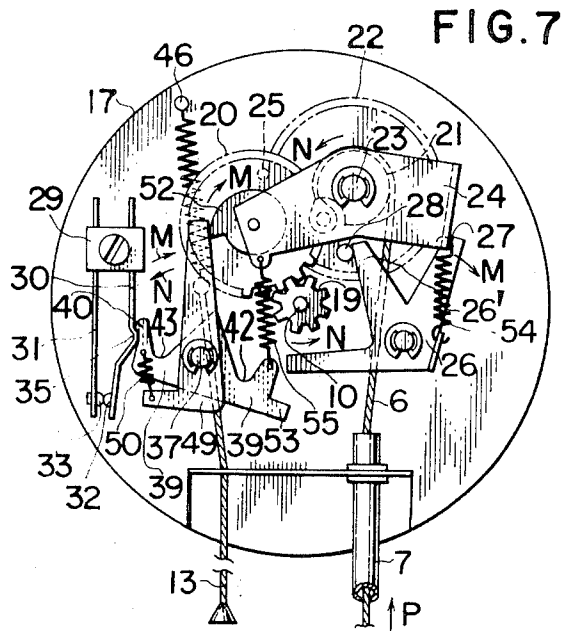
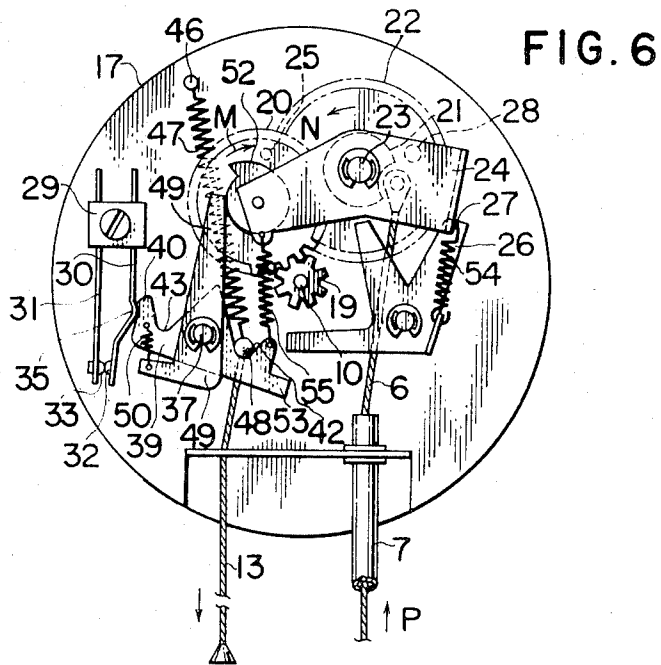
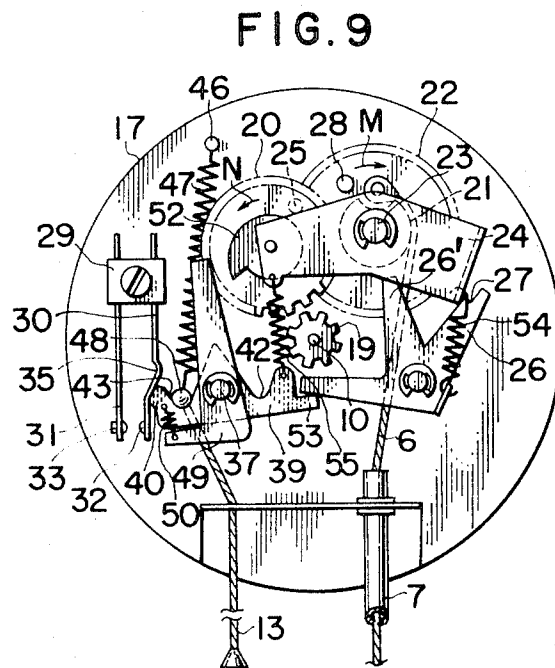
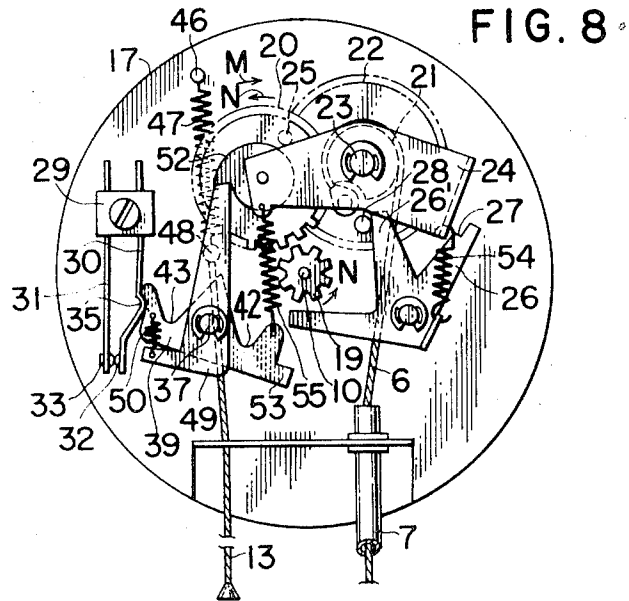


FIG. 5







SHUTTER MEANS OPERATED BY FAN MOTOR

There has been a ventilator having a pull cord for actuating a shutter actuation mechanism for the opening and closing of the shutter of the ventilator, the shutter actuation mechanism being arranged in operative association with an electrical switch for the fan motor so as to open or close the shutter in synchronism with start or stop of the rotation of the fan motor.

However, prior art pull cord-operated type ventilator has a difficulty that the shutter load is to be bored by the pull cord, so that larger force is essentially required to manually operate the cord. In addition, the pull cord has been designed to have larger actuation stroke, which render the manual operation of the cord troublesome. Moreover, the fact that larger force is required to operate the pull cord makes it difficult to actuate the cord in a direction other than a predetermined one unless appropriate guide means such as rollers are provided for the pull cord. Still further, said fact makes it inevitable to employ a pull cord of a larger diameter which essentially spoils the appearance of the cord.

The prior art ventilator, furthermore, requires that the fan motor and the electrical switch therefore be mounted separately with resultant complicated electrical circuit arrangement, so that maintenance and cleaning of the ventilator are inevitably rendered troublesome. In addition, since the force to actuate the pull cord is limited by the inherent design of the prior art ventilator, the force to actuate the shutter is especially limited with a resultant difficulty that, in the application where a large quantity of dust and vaporized oil particles are apt to be deposited on the parts of the ventilator, the deposited oil and dust particles adhesively connect the parts of the ventilator so that the limited actuation force is insufficient to separate the adhesively connected parts thereby to open or close the shutter.

It is a primary object of the present invention to provide a novel ventilator which utilizes the output of the fan motor to actuate the shutter for the opening and closing operations thereof.

It is another object of the present invention to provide a ventilator in which the force required to pull a shutter actuation pull cord is as small as a force required to pull a pull cord for operating an electrical switch such as one associated with a fluorescent lamp as on the ceiling so that the shutter actuation pull cord may operated very easily and in any direction and that the pull cord may be of a smaller diameter so as to be inconspicuous.

It is a still another object of the present invention to provide a ventilator in which larger magnitude of force for the actuation of the shutter is generated so as to assure the opening and closing operations of the shutter.

It is a further object of the present invention to provide a ventilator in which the electrical switch for the fan motor and the actuation mechanism for the opening and closing operations of the shutter are gathered into a unit which in turn is united with the fan motor to form a unitary structure for a simplified ventilator arrangement so that the wiring and assembly involved in the manufacture of the ventilator are extremely simplified and the maintenance and cleaning of the ventilator are remarkably easy.

According to the present invention, there is provided a ventilator comprising a switching mechanism operable by actuation of pulling cord to form a closed electrical circuit for the operation of a fan motor, clutch means operable in response to the electroconductive operation of said switching mechanism to bring said fan motor into driving connection with a drive mechanism for the actuation of shutter means, a clutch releasing mechanism operable to render said clutch means inoperative when said shutter means are in fully opened position, locking means operable to hold said shutter means in fully opened position in synchronism with the clutch releasing operation of said clutch releasing mechanism and a mechanism operable by the breaking operation of said switching mechanism to cancel said clutch releasing operation and the locking operation of said locking means.

Other objects and features of the present invention will be apparent from the following description with reference to the accompanying drawings.

FIG. 1 is a schematic side view of the ventilator according to an embodiment of the present invention;

FIG. 2 illustrates in perspective view an actuation mechanism for the opening and closing operation of the shutter of the ventilator;

FIG. 3 shows in perspective view the parts of the actuation mechanism in disassembled state;

FIG. 4 shows in perspective view a final gear and a wire in the actuation mechanism;

FIGS. 5 through 9 inclusive diagrammatically illustrate in plan views the successive operation of the shutter actuation mechanism; and

FIG. 10 is a diagrammatical illustration of the electrical circuit utilized in the ventilator according to the present invention.

Referring to FIG. 1, the ventilator of the present invention has an outer frame 12 which houses at one end a conventional shutter which is illustrated as being composed of three shutter members 5 pivotally mounted by pins 2 on an appropriate support not shown. The shutter members 1 are connected together by a connecting plate or rod 3 for their simultaneous operations. A shutter return spring 4 is provided between the connecting rod 3 and the outer frame 12. The connecting rod 3 has a lateral projection 15 to which is connected a charge spring 5 at its one end. A wire 6 is connected to the other end of the charge spring 5. Thus, the wire 6 is connected to the shutter member connecting rod 3 through the charge spring 5. In order to assure that the shutter members 1 be fully opened, the wire 6 is designed to have its pulling stroke or displacement somewhat larger than the shutter-opening stroke of the connecting rod 3, the displacement of the wire 6 in excess of the stroke of the rod 3 being taken up by the charge wire 5. The wire 6 extends through and is covered by a guide member 7.

Approximately centrally of the ventilator frame 12 is supported a fan motor 8 from the frame 12 by means of support members, not shown. A fan 9 is fixed onto an output shaft 10 of the fan motor 8. On the end of the fan motor 8 opposite to the fan 9, mounted is a housing 11 containing the actuation mechanism for the opening and closing operations of the shutter members 1. A cord 13 extends from the exterior of the ventilator frame 12 through a guide 14 into the interior of the housing 11 and is connected to the shutter actuation mechanism therein.

In the illustrated embodiment, the guide 14 is shown as being in the form of a tubing. It is, however, to be understood that the guide may be in the form of a guide pulley or guide ring. A neat construction and an improved design may be attained by disposing the guides 7 and 14 in the channel or along the web of a fan motor supporting angle member. In addition, a detachable design may be employed at each of the connections between the outer extremity 16 of the guide 14 and the ventilator frame 12 and between the lateral projection 15 on the shutter member connecting rod 3 and the charge spring 5 so that the guides 7 and 14 may be readily removed together with the fan motor 8 from the frame 12 for easy cleaning of the dismounted elements. Thus, a simplified construction may be achieved with respect to the connection between each adjacent couple of the pull cord 13, the fan motor 8, the wire 6 and the set of shutter members 1, which contributes to the reduction in cost and to the mass production.

Referring to FIG. 2 which illustrates mechanism for opening and closing the shutter members 1. This mechanism is mounted on a baseplate 17 secured by means of screws 18, 18' to the end of the fan motor 8 remote from the fan 9. A pinion 19 is fixed to the output shaft 10 of the fan motor 8. A clutch gear 20 is disposed in meshing engagement with the pinion 19. The gear 20 has fixed thereto a coaxial small diameter gear which is always in meshing engagement with a final gear 22 having a drum 21 (FIGS. 3 and 4) for taking-up the wire 6, these gears forming a reduction gear. As will be best seen in

FIG. 3, the gear 22 is mounted on a shaft 23 on which is pivotally supported a generally U-shaped lever 24 which in turn carries a shaft 23' on which the gear 20 is rotatably mounted.

A stop 25 is secured to the baseplate 17 for limiting the pivotal motion of the lever 24. A first locking plate 26 is mounted by a pin to the baseplate 17. The locking plate 26 operates to prevent at its engaging portion 27 the rotation of the lever 24 thereby for causing the clutch gear 20 and the pinion 19 to be maintained in their meshing position, as shown in FIG. 6. The final gear 22 has thereon an axial projection 28 which, when the drum 21 on the final gear 22 has taken-up a length of the wire corresponding to a predetermined stroke thereof, is brought into engagement with a finger 26' of the first locking plate 26 to disengage the engaging portion 27 thereof from the lever 24 thereby for releasing the latter from the locking plate 26. The clutch gear 20 is disengaged from the pinion 19 when the lever 24 is in a position in which it is in contact with the stop 25.

A switch 29 for the electrical power of the fan motor 8 is disposed within the housing 11. The switch includes a pair of contact plates 30 and 31 having thereon contact points 32 and 33, respectively. The switch 29 is mounted on the baseplate 17 by means of a screw 34. The contact plate 30 is formed thereon with a lateral projection 35.

The baseplate 17 is formed thereon with a U-shaped supporting plate 36 which carries a fulcrum axle 37. The baseplate 17 has fixed thereto a second fulcrum axle 38 which cooperates with the first fulcrum axle 37 to pivotally or rotatably support a generally W-shaped turning-over plate 39. The latter has a switch-engaging portion 40 which is in contact with the lateral projection 35 on the contact plate 30 so that the spring force of the same prevents rotation of the turning-over plate 39. The latter is also formed with a central mountain-shaped turning-over guide portion 41, valley-shaped notches 42 and 43 at the opposite sides of the guide portion 41 and a central space or recess 44 through which extends the cord 13 which is passed through a pulling cord guiding aperture 45 in the supporting plate 36. The forward end of the cord 13 is connected to one end of a pulling cord return spring 47 which in turn is connected at the other end to the baseplate 17 by means of a pin 46. Thus, the pulling cord 13 is tensioned by the pulling cord return spring 47 between the pin 46 and the cord guiding aperture 45 and extends linearly. A turning-over plate engaging piece 48 of a diameter larger than the gap or width of the space 44 in the turning-over plate 39 is mounted on the pulling cord 13 at a level somewhat higher than the top of the turning-over guide portion 41 as viewed when the pulling cord return spring 47 is in its contracted position.

As will be appreciated from the above description, the electrical switch 29, the turning-over plate 39 and the pulling cord 13 cooperate to form a pull cord-actuated switching mechanism. This switching mechanism is of the arrangement that when the pulling cord 13 is pulled down, the turning-over plate engaging piece 48 alternately engages in the notches 42 and 43 of the turning-over plate 39 thereby to alternately turning-over the latter. Upon the turning-over motion of the turning-over plate 39, the switch engaging portion 40 of the plate 39 is caused to move past the lateral projection 35 of the contact plate 30 so that the contact point 32 is brought into contact with the other contact point 33. The series of operations are illustrated in FIGS. 5 through 9 inclusive.

A second locking plate 49 is mounted on the same shaft as that of the turning-over plate 39 for the simultaneous turning-over movement therewith. The second locking plate 49 is connected by a spring 50 to the turning-over plate 39 so that a bearing piece 51 of the locking plate 49 is maintained in engagement with the turning-over plate 39. It is, therefore, apparent that the second locking plate 49 is rotatable relative to the turning-over plate 39 only in counterclockwise direction within a range determined by the spring 50. The second locking plate 49 is adapted to be engaged by a unidirectionally

engaging cam or pawl 52 provided on the clutch gear 20. With the turning-over plate 39 rotated or turned over in clockwise direction, the second locking plate 49 is not engaged by the pawl 52 when the clutch gear 20 is driven by the pinion 19 in a direction indicated by an arrow M as shown in FIGS. 6 and 7, but the locking plate 49 is in engagement with the pawl 52 to form a unidirectional locking mechanism as shown in FIG. 8 when the clutch gear 20 is disengaged from the pinion 19 so that the gear 20 and the pawl 52 are rotated in the reversed direction indicated by an arrow N by the load imparted by taking-up of the wire 6. On the other hand, when the second locking plate 49 is turned-over in counterclockwise direction, the second locking plate 49 is moved away off the pawl 52 to release the clutch gear 20 as shown in FIG. 9. The load of taking-up the wire 6 always exerts a clockwise force to the lever 24 so that the latter is actuated to disengage the clutch gear 20 from the pinion 19.

The turning-over plate 39 is also provided with a projection 53 which, when the plate 39 is turned-over in counterclockwise direction, is brought into engagement with the first locking plate 26 to disengage the same from the lever 24. The operation of the projection 53 is required for the purpose to be described hereunder. Assuming that the projection 53 is absent and that the ventilator is operated by the pull cord 13 from the position in which the ventilating operation is started as shown in FIG. 6 up to the position in which the wire 6 is nearly completely taken-up (or in other words, just before the opening of the shutter is completed), the rotation of the fan motor is stopped while the pinion 19 and the clutch gear 20 are maintained in meshing engagement with one another since the lever 24 is locked by the first locking plate 26. Thus, the load of the winding of the wire 6 alone is insufficient to rotate the pinion 19 in the reversed direction, so that the wire 6 is taken-up half way and the shutter is partly opened. Many cases are experienced in which the operation of a ventilator is commenced and immediately stopped as described in the above. In such a case, if the above-mentioned projection 53 is present, the same will serve to disengage the first locking plate 26 from the lever 24 so that the clutch gear 20 is disengaged from the pinion 19 to permit the gear 20 to rotate in the reversed direction as well as to permit the wire 6 to be returned or withdrawn in the direction opposite to the direction indicated by an arrow P for closing the shutter members 1.

A spring 54 interconnects the first locking plate 26 and the lever 24 at their one ends and is tensioned therebetween to bias the locking plate 26 in counterclockwise direction. A spring 55 is also provided between the other end of the lever 24 and a right finger of the turning-over plate 39 to actuate the lever 24 and the locking plate 26 in counterclockwise direction. The spring 54 and 55 in terms of their forces are such that, when the turning-over plate 39 is in its counterclockwise rotated position and the ventilator is out of operation, the spring 54 rotates the lever 24 in the clockwise direction against the biasing force of the spring 55 to bring the lever 24 into engagement with the lever stop 25 on the baseplate 17 (this position is illustrated in FIG. 5). When the turning-over plate 39 has been rotated in clockwise direction, the flexibility of the spring 55 rotates the lever 24 in counterclockwise direction against the force of the spring 54 until the clutch gear 20 is brought into engagement with the pinion 19 and the lever 24 is brought into engagement with the engaging portion 27 of the first locking plate 26. The characteristics of the springs 54 and 55 are predetermined to afford the above operation. In addition, it is required that the spring 55 be of such a resiliency that the counterclockwise torque exerted to the lever 24 by the spring 55 is less than the clockwise torque imparted to the lever by the load of taking-up of the wire 6. This is required in order to move the lever 24 from the position shown in FIG. 7 to the position shown in FIG. 8.

A description will next be made with respect to the condition or requirement involved in the operation in which the clutch gear 20 is brought into meshing engagement with the

pinion 19. It is necessary that the clutch gear 20 and the pinion 19 be instantaneously engaged with one another. This is because, while the clutch gear 20 is not required to be instantaneously shifted in the case where the operation is commenced with the standstill position of the ventilator (that is, the position in which the fan motor output shaft 10 and thus the pinion 19 are stationary) since the fan motor output shaft 10 and the pinion 19 are almost stationary or rotating at a lower speed in this case, the clutch gear 20 must be engaged with the pinion 19 while the latter is rotated at a higher speed by the inertia on the rotor of the fan motor in the instance wherein the pulling cord is actuated to intermit the operation and thereafter is again actuated immediately to resume the operation. If the clutch gear 20 is slowly shifted toward the pinion 19, the gear 20 may hardly be brought into meshing engagement with the pinion 19 resulting in a shortened operative life of the gears. In the present invention, in order to assure that the clutch gear 20 is instantaneously brought into meshing engagement with the pinion 19, the switch engaging portion 40 of the turning-over plate 39 is so shaped as to be quickly moved past the lateral projection 35 on the contact plate 30 when the turning-over plate 39 is switched in either direction, so that the switching movement of the plate 39 is taken-up to a limited extent by the spring 55 which in turn quickly rotates the lever 24.

FIG. 10 is a diagrammatical representation of the electrical circuit employed in the ventilator of the present invention. The circuit includes an electrical power source 56, a capacitor 57, a primary coil 58 of the fan motor, an auxiliary coil 59 of the fan motor and the electrical switch 29 above described.

In general, a ventilator may be selectively controlled in one of the following three ways to any of which the ventilator of the present invention is applicable:

(I) In normal operation:

If the pulling cord is actuated when the ventilator is in its stationary position shown in FIG. 5, the turning-over plate 39 is instantaneously turned over in clockwise direction so that the contacts 32 and 33 of the electrical switch 29 are closed as shown in FIG. 6 to commence rotation of the fan motor 8 and thus the pinion 19 and, at the same time, bring the clutch gear 20 quickly into meshing engagement with the pinion 19, with the result that the drum 21 on the final gear 22 begins to take up the wire 6. At this moment, the lever 24 is given a force in clockwise direction (that is, in the direction in which the clutch gear 20 is disengaged from the pinion 19). However, since the engaging portion 27 of the first locking plate 26 prevents rotation of the lever 24, the drum 21 continues taking-up of the wire 6. The pawl 52 of the clutch gear 20 is rotated in clockwise direction and, in a part of this rotation, is brought into sliding contact with the second locking plate 49 to oscillate the latter in counterclockwise direction. If the traction force having been imparted to the pulling cord 13 is removed, the turning-over plate engaging piece 48 is returned from the position shown in FIG. 6 to the position shown in FIG. 7 and, if the pulling cord 13 is pulled again, the engaging piece 48 is received in the notch 43 in the turning-over plate 39. When the wire 6 has been taken up a length substantially equal to a predetermined stroke necessary to fully open the shutter of the ventilator, the projection 28 on the final gear 22 is brought into pressure contact with the finger 26' of the first locking plate 26 as shown in FIG. 7 until the engaging portion 27 of the locking plate 26 is disengaged from the lever 24, so that the latter is rotated in clockwise direction by the load of taking-up of the wire 6 to permit the clutch gear 20 to be disengaged from the pinion 19. Thus, the clutch gear 20 has a tendency toward being rotated in the reversed direction by the load of taking-up of the wire 6, but the pawl 52 on the clutch gear 20 is locked by the second locking plate 49 so that the reverse rotation of the clutch gear 20 is prevented and the wire 6 is held in completely wound position, with the result that the shutter members 1 are maintained in their fully opened positions and the operation of the ventilator is continued, as shown in FIG. 8. When it is desired to discontinue

the operation of the ventilator, the pulling cord 13 is further pulled down to rotate the turning-over plate 39 in counterclockwise direction so that the second locking plate 49 is disengaged from the pawl 52 to allow the clutch gear 20 and the final gear 22 to be rotated in reversed direction, with the result that the wire 6 is unwound to permit the shutter members 1 to be closed and, at the same time, the contacts 32 and 33 of the electrical switch are opened to deenergize the fan motor 8.

(II) In the case wherein the pulling cord 13 is actuated to start the operation and immediately thereafter is again actuated to discontinue the operation:

At a halfway in the course of operation from the position in FIG. 5 through the FIG. 6 position to the position in FIG. 7, if the pulling cord 13 is actuated to discontinue the operation before the projection 28 on the final gear 22 releases the first locking plate 26 from the engagement with the lever 24, the projection 53 on the turning-over plate 39 is brought into engagement with the left finger of the first locking plate 26 to cause the latter to be disengaged from the lever 24 so that the operation of the actuation mechanism is advanced through the position shown in FIG. 9 to the initial position shown in FIG. 5 in which the operation is discontinued.

(III) In the case in which the pulling cord 13 is repeatedly actuated for the repeated interrupted operation in a short time:

In this case, the clutch gear 20 is also quickly brought into meshing engagement with the pinion 19 as described in the above and operates stably.

The ventilator of the present invention has been described in the above in conjunction with an embodiment which is of a type that is adapted to control start and stop of unidirectional rotation. It is, however, to be noted that the invention is readily applicable to a ventilator of two step switch-over type, such as an air intake and discharge type or a strong-weak adjustable type, by an appropriate modification in design of the pulling cord-actuated electrical switch.

As will be appreciated from the above-described embodiment of the present invention, the ventilator of the invention is controlled by manual actuation of a pulling cord to start and stop the rotation of the fan motor but utilizes the output of the fan motor to actuate the shutter members for their opening and closing operations. Thus, only a small force is required to actuate the pulling cord so that the pulling cord may be actuated easily and in any direction. Moreover, even if the pulling cord is actuated at any time during any of operating and stationary positions of the ventilator, it is assured that a starting or stopping operation be carried out without any wrong operation.

What we claim is:

1. A ventilator comprising a motor driven fan, a switching mechanism operable by actuation of pulling cord to form a closed electrical circuit for the operation of said fan motor, clutch means operable in response to the electroconductive operation of said switching mechanism to bring said fan motor into driving connection with a drive mechanism for the actuation of shutter means, a clutch releasing mechanism operable to render said clutch means inoperative when said shutter means are in fully opened position, locking means operable to hold said shutter means in fully opened position in synchronism with the clutch releasing operation of said clutch releasing mechanism and a mechanism operable by the breaking operation of said switching mechanism to cancel said clutch releasing operation and the locking operation of said locking means.

2. A ventilator comprising a motor driven fan having a pinion fixed to the rotational axle thereof, shutter means biased by a spring toward a closed position and connected with a length of wire for the opening-closing operation of said shutter means, an electrical switch for said fan motor, said switch being adapted to be actuated by a pulling cord, a reduction gear mechanism including a clutch gear adapted to be brought into meshing engagement with said pinion when said electrical switch is closed, a drum member mounted on said

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reduction gear mechanism for taking-up said wire, the load of taking-up of said wire being effective to disengage said clutch gear from said pinion, a first locking plate for preventing the disengagement of said clutch gear from said pinion for a moment and, after said wire is taken up a length corresponding to a predetermined stroke thereof, permitting said clutch gear to

be disengaged from said pinion, a second locking plate for preventing said reduction gear mechanism from being rotated in the reversed direction by said load of taking-up of said wire, said first and second locking plates being ineffective to lock when said electrical switch is opened.

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