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(54) Improvements relating to ventilators.

(57) An opening flap ventilator for buildings has pneumatic opening springs (13) and electric motor-gear drive mechanism (14) operable to close the ventilation flap (11). The mechanism has an electrically energised clutch (54) interposed in the gear drive chain (24, 26, 28, 48, 46) (see Fig. 2). On de-energisation of the clutch (54), which may be automatic in response to the detection of a fire condition occurring, the ventilation flap (11) is automatically opened. The flap (11) is subsequently closed by operation of the motor which drives a winch pulley (20) for winding in a single operating cable (76) in opposite directions from a location between its ends. The winch pulley (20) is of split construction and can be dismantled to enable the motor-gear drive unit to be removed whilst leaving the operating cable (76) in place. The gear drive mechanism holds the flap (11) locked in its closed position so long as the clutch (54) remains energised. The motor may be driven in reverse to allow the flap to open under the action of the springs (13) for normal day-to-day ventilation.

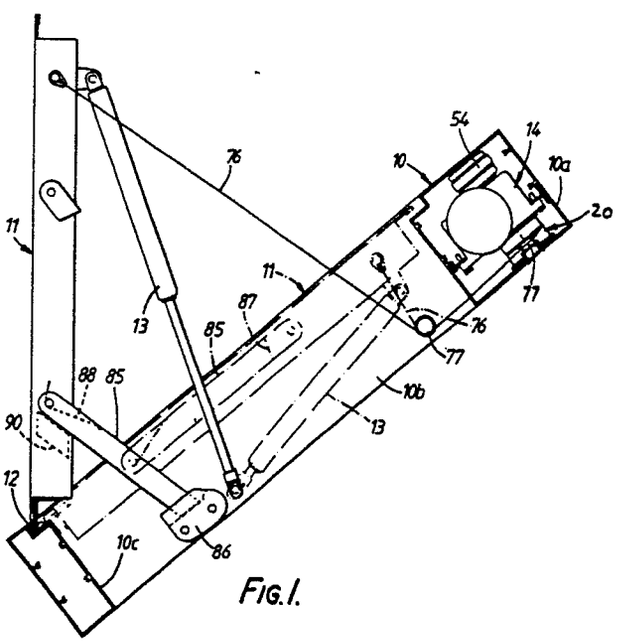

FIG. 1.

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IMPROVEMENTS RELATING TO VENTILATORS

The present invention comprises improvements relating to ventilators and concerns controllable ventilators which are required to open to exhaust heat, smoke and fumes from a building in the event of a fire and to close to conserve heat in the building under normal conditions.

Such ventilators may also serve to provide day-to-day ventilation of the building and may be made to open automatically in response to a fire condition occurring, using a smoke and/or fire detecting system.

According to one aspect of the present invention, such a ventilator comprises an electric motor-gear drive mechanism operable to open and/or to close the ventilator, the mechanism including an electrically operated clutch interposed in the drive train and energisable drivably to engage an output drive shaft of the mechanism with the motor, electrical circuit means being provided for energising the electrically operated clutch, the output drive shaft being freely rotatable when the electrically operated clutch is de-energised.

With this arrangement, the ventilator may be opened by gravitational action or by spring means, especially in the event of a fire, by de-energising the electrically operated clutch, and this may be done automatically in response to the onset of a fire condition using a suitable fire and/or smoke detector. Also, the ventilator is rendered "fail-safe" as a fire ventilator in that the ventilator is free to open or to be opened to serve as a fire ventilator in the event of a power shut off or a power failure to the electromagnetic clutch occurring.

However, the electrical circuit means may be such that the electrically operated clutch remains energised so long as a power supply is available connected to drive the motor, the motor then being driven both to open and to close the ventilator, at least for day-to-day ventilation purposes.

The gear drive mechanism may include a worm gear of sufficient gear ration to prevent it being back driven whereby the ventilator is prevented from being forced open when the electric motor is stationary and the electrically operated clutch is energised, the worm gear being disposed in the drive train between the electric motor and the electrically operated clutch.

According to a further aspect of the present invention, there is provided a ventilator comprising an electric motor operable to open and/or to close the ventilator, and connectible to drive a winch pulley in at least one direction, the winch pulley being adapted to wind out and to wind in in opposite directions a single ventilator operating cable from a location between its ends, depending upon the direction of rotation of the pulley.

The arrangement as defined in the immediately preceding paragraph facilitates the cable installation, since one length of cable only is used, while pulling at two locations, and the arrangement also ensures that the cable is always uniformly tensioned so that smooth operation of the ventilator is assured.

Preferably also, the winch pulley is of split construction to enable the winch pulley to be disengaged from the cable when the cable is fully wound out.

This enables the drive unit of the ventilator, including the winch pulley, to be readily removed for servicing and replacement.

Specific embodiments of ventilators in accordance with the present invention will now be described by way of example, and not by way of limitation, with reference to the accompanying drawings in which :-

FIG. 1 is a cross-section of a ventilator in accordance with the present invention in an inclined mounted position and shown in its open and closed positions;

FIG. 2 shows an electric motor-gear drive mechanism of the ventilator with its gearbox housing in cross-section;

FIG. 3 is a view from the right hand end in Fig. 2;

FIGS. 4 to 13 show details of a winch pulley of split construction; and

FIGS. 14 to 22 show details of an alternative winch pulley of split construction having a double start thread to wind a cable in opposite directions from one end of the pulley.

With reference now to the accompanying drawings, and first to Figs. 1 to 13, the ventilator has a hollow frame 10 and a single, bottom hung, outwardly hingeing ventilator flap 11 to provide for day-to-day and for fire ventilation hinged to the frame at 12. Gas springs 13, one at each side, are provided for opening the flap 11, the flap then assuming its substantially vertical position as shown in Fig. 1. An electric motor-gear drive mechanism 14 shown in Figs. 2 and 3 is installed inside a hollow, top frame member 10a of the ventilator about midway between the side frame members 10b of the frame 10. The bottom frame member is indicated at 10c. The unit 14 comprises an electric motor 15 and a gear drive mechanism 16 housed in a gear box housing 17 adapted for flange mounting as at 18 inside the ventilator top frame member 10 a. The unit 14 has an output drive in the form of a winch pulley generally indicated at 20 and disposed laterally to one side of

the unit which is generally elongated to fit within the hollow top frame member 10a . The pulley 20 is fixedly carried by an output drive shaft 22 which also carries the final gear 24 of a spur gear set 24, 26, 28 contained within the housing 17. The gears 26 and 28 of the spur gear set are mounted on further drive shafts 30, 32. The drive shafts 22, 30 run in ball races 34 and 36 carried by the housing 17. The drive shaft 32 runs at one end in a ball race 38 carried by the housing 17, the shaft 32 also being rotatably supported concentrically, within a hollow drive shaft 40 which runs in a ball race 42 carried by the housing 17. The motor shaft 44 fixedly carries a worm 46 which drives a worm wheel 48 fixedly carried by the shaft 40. The shafts 32, 40 carry laterally outside the housing 17, on the side opposite the winch pulley 20, the two elements 50 and 52 respectively of an electromagnetic clutch 54. The clutch 54, when energised, drivably engages the drive shaft 40 with the drive shaft 32 and operation of the motor 15 in one direction or the other drives the pulley 20 to open or close the ventilator.

Referring now to Figs. 4 to 13, the pulley 20, in a first embodiment, is of split construction and is formed in two opposite flanged side parts A and B seen in Figs. 7 and 8 and Figs. 9 and 10 respectively. The two parts A and B are splined at 60 to the output drive shaft 22 and are held in place against a shoulder 22' (see Fig. 4) of the shaft 22 by a screw fixing 62. A diametrically disposed recess 64 in the inner side face of the side part A houses a pair of guide rollers 66 mounted on pins 68 received in bores 70 in the side part A one on each side of, and symmetrically disposed with respect to, the shaft 22, the pins 68 and rollers 66 normally being trapped between the pulley side parts A and B, the rollers 66 being, nevertheless, freely rotatably between the side parts. The side parts A and B have respective right hand and left hand threads 72 and 74 for winding in and winding out in opposite directions a single ventilator operating cable 76 from a location between its ends, depending upon the direction of rotation of the pulley 20. Thus, as seen in Fig. 4, the pulley 20 is rotated anticlockwise to wind in the cable 76 in two opposite directions and close the ventilation flap and clockwise to wind out the cable 76 in two opposite direction and open the ventilation flap. To this end, the cable 76 has its respective ends symmetrically connected to the ventilation flap 11 on opposite sides of the flap and towards the top edge of the flap as seen in Fig. 1, the two cable lengths extending between the ventilation flap 11 and the winch pulley 20 being guided through the hollow ventilator frame 10 around symmetrical arrangements of guide pulleys such as 77.

When the ventilation flap is fully open, the cable 76 extends through the recess 64 only partially lapping each roller 66 and the shaft 22, that is to say generally with the configuration shown in Fig. 5 but with the cable extending straight away from the pulley at each side. In this condition, the pulley 20 can be taken apart to release the cable from the pulley and the whole electric motor-gear drive mechanism can be removed from the ventilator for servicing or replacement.

Rotation of the pulley 20 to close the ventilation flap winds in the cable from the dividing plane 78 (split line) of the pulley parts A and B, in opposite directions, the cable turns being guided outwardly of the dividing plane 78 towards the pulley flanges, by the screw threads 72, 74 as best seen from Fig. 4. During the initial quarter turn of the pulley 20, the cable 76 is wrapped further about the rollers 66 as seen in Fig. 5, the cable thereafter wrapping about the circumference of the pulley 20.

In the closed condition of the ventilation flap in which the flap assumes its inclined condition as seen in Fig. 1, the motor is de-energised but the electromagnetic clutch 54 remains energised by means of a separate electrical circuit. The ventilation flap is secured closed when in its closed condition by the worm gear set 46, 48 which is of a gear ratio which is incapable of being back driven. Thus, the gear drive mechanism 16 cannot be overhauled by tensioning the cable whilst the clutch 54 is energised.

In one arrangement, the clutch 54 is incorporated in a separate electrical circuit, controlled by automatic fire response means, which maintains the clutch energised so long as a power supply is available and no fire response is required, so that in the event of a power failure, the ventilator opens automatically and cannot fail to function as a fire ventilator under such conditions. In the present example, the electrical circuit of the clutch 54 includes a smoke or fire detecting device operable to de-energise the clutch to release the ventilation flap for automatic opening by its gas-springs in the event of a fire being detected. However, the clutch may be incorporated in the electrical circuit of the motor so that the clutch remains energised so long as an electric power supply is available to operate the motor and open the ventilator in response to the operation of a smoke or fire detecting device. With this arrangement the clutch operates simply as a fail safe device.

For day-to-day ventilation purposes, the ventilator may be opened by its gas-springs 13, upon de-energisation of the clutch 54, and closed by operation of the motor 15, the clutch 54 then being energised. Alternatively the ventilator may be opened and closed by operation of the motor.

As an additional safety measure, a fused fire

prop 85 (see Fig. 1), pivotally mounted on the frame of the flap 11 swings downwardly to engage an abutment 86 on the frame 10 to prop the flap 11 open in the event of a fire which might otherwise cause the gas-springs 13 to buckle. The prop 85 is formed in two sections normally soldered together as at 87. The prop sections may be joined together with a separate fusible joint mechanically fastened to the sections of the prop. A spring 88 may be provided to swing the prop downwardly and the flat 11 may carry a stop 90 to arrest the prop in its operative position.

The ventilator may be mounted with its bottom hung ventilation flap 11 vertical when in its closed condition, the flap 11 being opened by gravitational action possibly with the aid of kick springs when the clutch 54 is de-energised.

In the example described with reference to the drawings, the electric motor 15 has an operating voltage of 24V DC, an output of 80 watts and a normal operating speed of 3,200 r.p.m. The clutch 54 has an operating voltage of 24 volts DC. The output torque of the gear drive mechanism 16 is 50 Nm at a speed of approximately 7 r.p.m. The worm gear set has a gear ratio of 48 to 1 and the spur gear set a gear ration of 10 to 1. The cable 76 is 2 mm diameter stainless steel wire.

With reference now to Figs. 14 to 22, the output drive shaft 110 of the unit 14 has a keyway 111 and a diametrical slot 112. The shaft 110 is shouldered at 113 to accept an inner end flange 114 for the winch pulley 20 and a separately formed, cylindrical pulley drum 115 of the pulley, flanged as at 116 at its outer end. The inner end of the pulley drum 115 has a diametrical slot 118 shaped as best seen in Fig. 18 and provided with curved slot bounding surface portions 118′ and 118″ leading respectively to adjacent helical end portions 120′ and 121′ of the threads 120, 121 of a double start thread formed round the cylindrical external periphery of the pulley drum. The helical end portions 120′ and 121′ of the threads are of increasing radius so as to blend the ends of the threads 120, 121 with the surface portions 118′ and 118″ in an arc.

To assemble the cable on the winch pulley, the cable is placed in the slot 112 so as to span the flange 114 and the pulley drum 115 is then mounted on the shaft 110 with the cable passing through the slot 118. To disengage the winch pulley from the cable for removal of the electric motor-gear drive mechanism 14 the opposite procedure is adopted.

The shaft 110 accepts a nut (not shown) at its free end 110′ for securing the pulley drum 115 in place on the shaft. The drum 115 is keyed to the shaft with a separate key (not shown). The flange 114 is provided with an integral key 114′.

It will be appreciated that the electric motor-gear drive units 14 which have been described may be incorporated in other kinds of controllable ventilators used for fire ventilation purposes, the cable 76 being connected to close, and to control the opening of, e.g. a pair of hinged, oppositely opening ventilation flaps in a roof mounted ventilator e.g. under the action of gravity, or again to close, and to control the opening of, the louvres of a controllable louvred ventilator by spring action.

Claims

1. A controllable ventilator for buildings having an open and a closed position characterized by an electric motor-gear drive mechanism (14) operable to open and/or to close the ventilator, the mechanism including an electrically operated clutch (54) interposed in the drive train (46, 48, 24, 26, 28) and energisable drivably to engage an output drive shaft (22;110) of the mechanism with the motor (15), electrical circuit means being provided for energising the electrically operated clutch (54), the output drive shaft (22;110) being freely rotatable when the electrically operated clutch (54) is de-energised.

2. A ventilator as claimed in claim 1 in which the electrical circuit means is such that the electrically operated clutch (54) remains energised so long as a power supply is available connected to drive the motor (15).

3. A ventilator as claimed in claim 1 or 2 in which the gear-drive mechanism (14) includes a worm gear (46, 48) of sufficient gear ratio to prevent it being backdriven whereby the ventilator is prevented from being forced open when the electric motor (15) is stationary, the worm gear (46, 48) being disposed in the drive train between the electric motor (15) and the electrically operated clutch (54).

4. A ventilator as claimed in claim 1, 2 or 3 in which the ventilation is opened by gravitational action or springs (13) are provided for opening the ventilator, and the electromagnetic clutch (54) is incorporated in an electrical circuit which is separate to that of the motor (15) and the separate electrical circuit of the clutch (54) includes automatic fire and/or smoke responsive means operable to de-energise the clutch.

5. A controllable ventilator for buildings having an open and a closed position, an electric motor (15) operable to open and/or to close the ventilator and connectible to drive a winch pulley (20) in at least one direction, the winch pulley being adapted to wind out and to wind in, in opposite directions, a

single ventilator operating cable (76) from a location between its ends, depending upon the direction of rotation of the pulley.

6. A ventilator as claimed in claim 4 in which the pulley (20) is of split construction to enable the winch pulley to be disengaged from the cable (76) when the cable is fully wound out.

7. A ventilator as claimed in claim 6 in which the winch pulley is formed in two opposite flanged side parts (A, B) one of which has an open ended recess (64) in its inner side face, there being a pair of guide rollers (66) housed in said recess, one on each side of, and symmetrically disposed with respect to, said output drive shaft (22), and said cable (76) traverses said recess and engages about said rollers, the arrangement being such that, upon rotation of the winch pulley, the cable is wound in opposite directions about the two flanged side parts (A, B) of the pulley respectively.

8. A ventilator as claimed in claim 7 in which the flanged side parts have respective left and right hand threads (72, 74) to receive the windings of the cable on the flanged side parts.

9. A ventilator as claimed in claim 6 in which the winch pulley is formed separate parts (114, 115) one of which comprises the pulley drum (115), the drum having a double start thread (120, 121) to wind in the cable in opposite directions from one end of the drum (115), the drum having a diametrical slot (118) communicating with adjacent ends of the respective threads(120, 121) on opposite sides of the drum.

10. A ventilator as claimed in claim 9 in which the adjacent ends of the respective threads (120, 121) have helical end portions (120', 121') of increasing radius starting at the adjacent ends of the respective threads.

11. A ventilator as claimed in claim 10 in which the slot bounding surfaces (118', 118") leading to the helical end portions (120', 121') of the threads are likewise curved to provide for a smooth lead-in of the cable into the thread grooves.

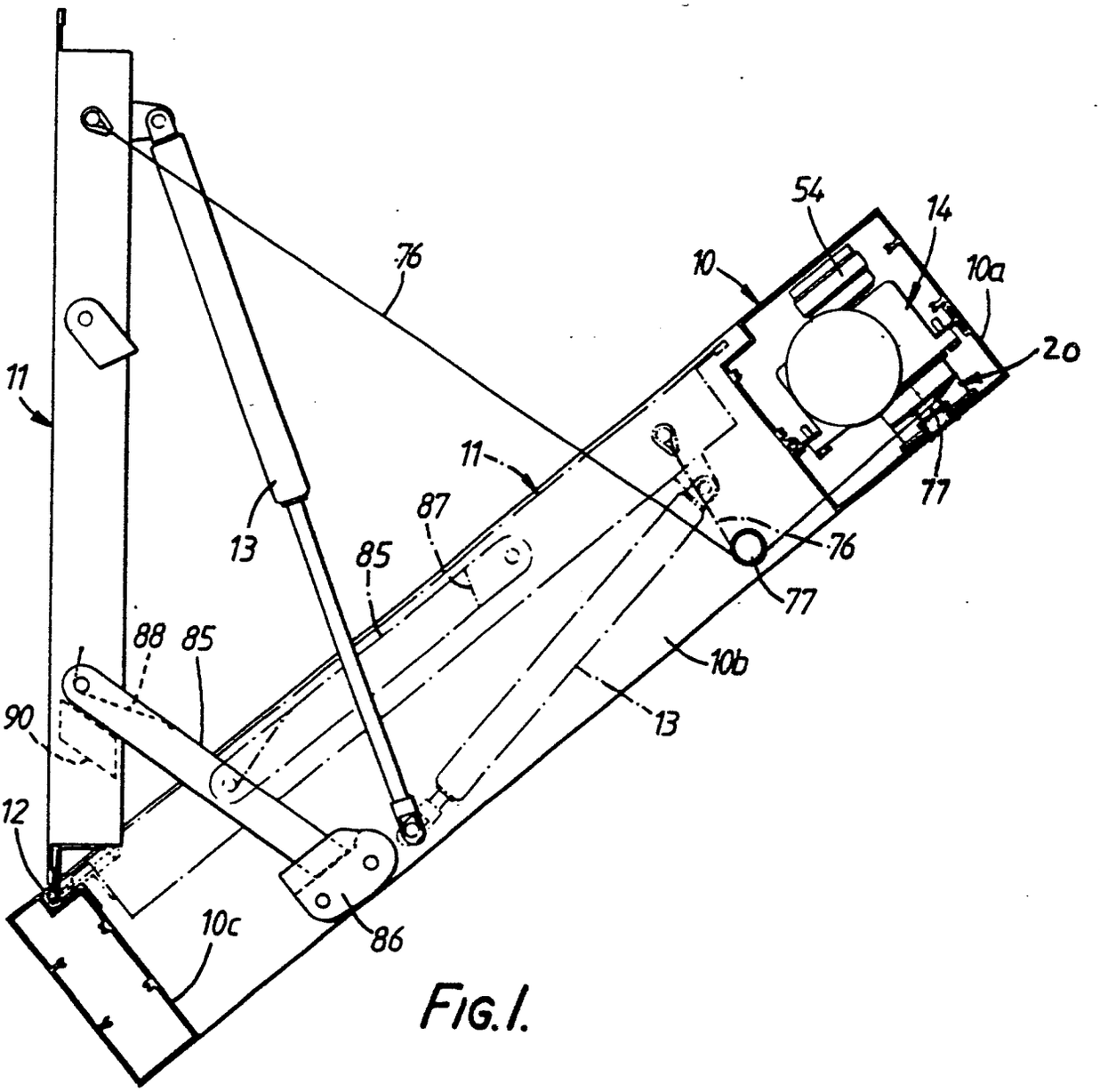
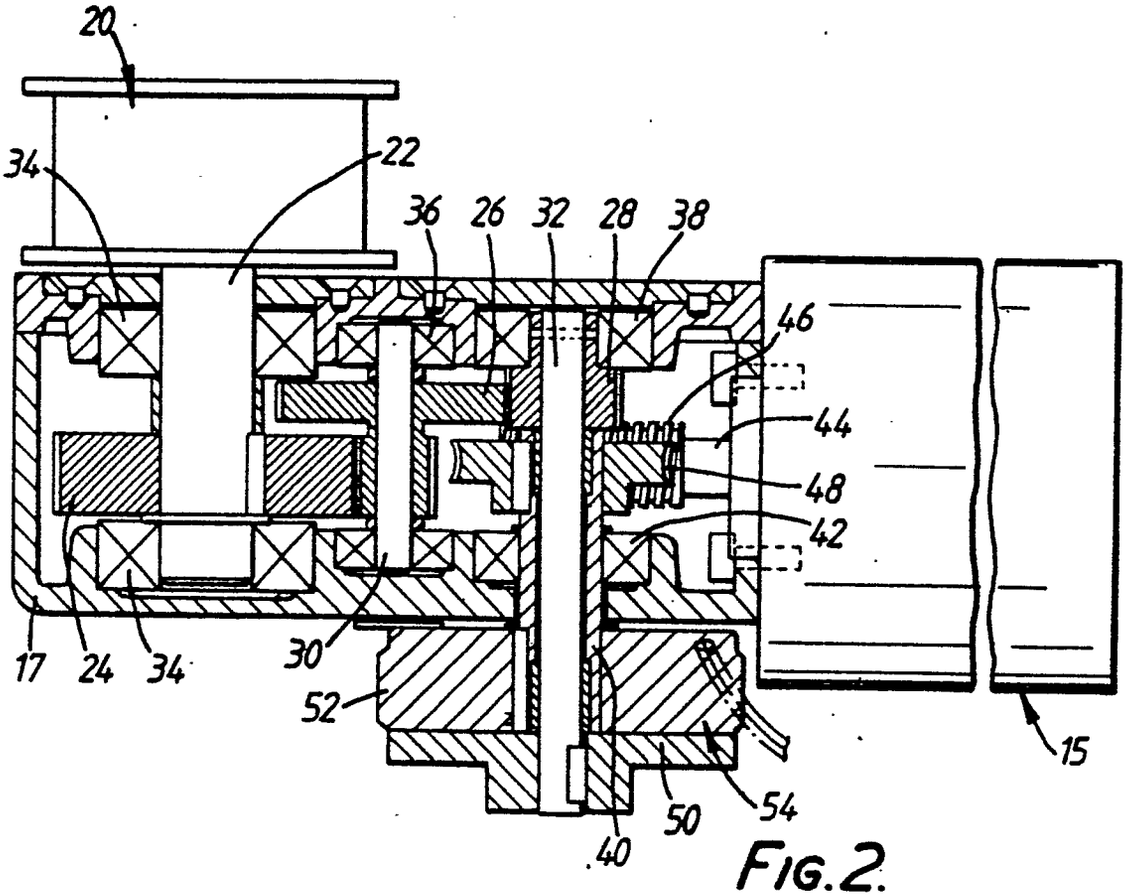


FIG. 1.


20
34
22
36
26
32
28
38
46
44
48
42
17
24
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30
52
40
50
54
15

FIG. 2.

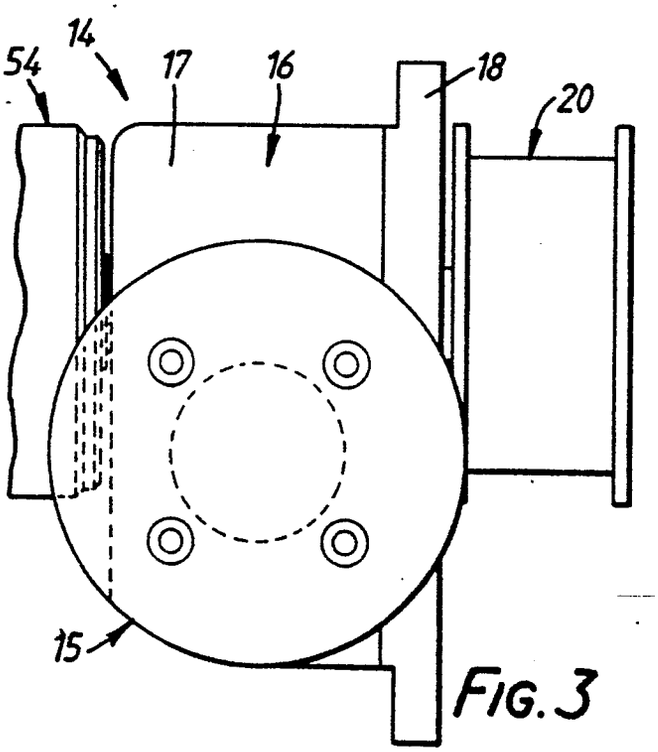
54
14
17
16
18
20
15

FIG. 3

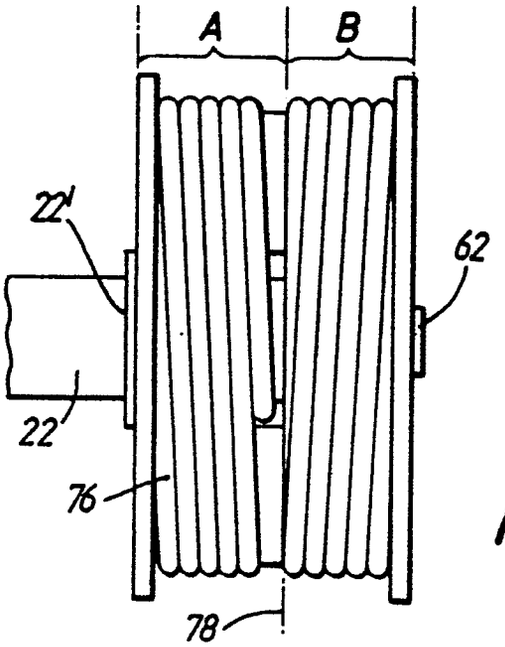

FIG. 4.

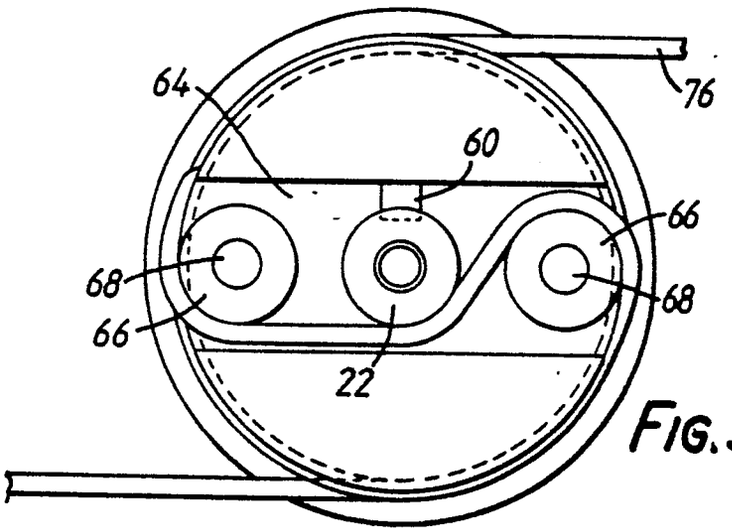

FIG. 5.

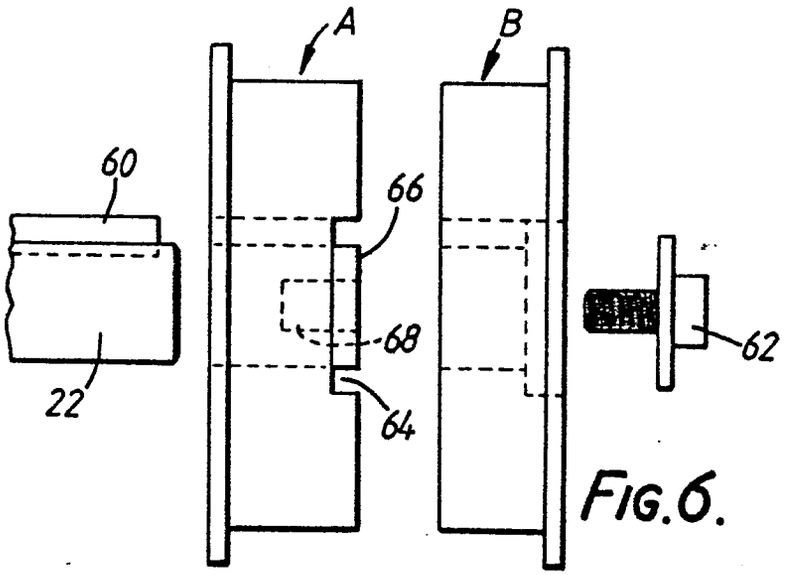

FIG. 6.

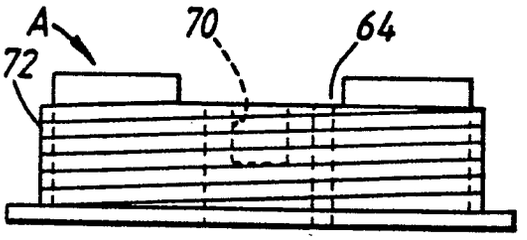

FIG. 7.

FIG. 9.

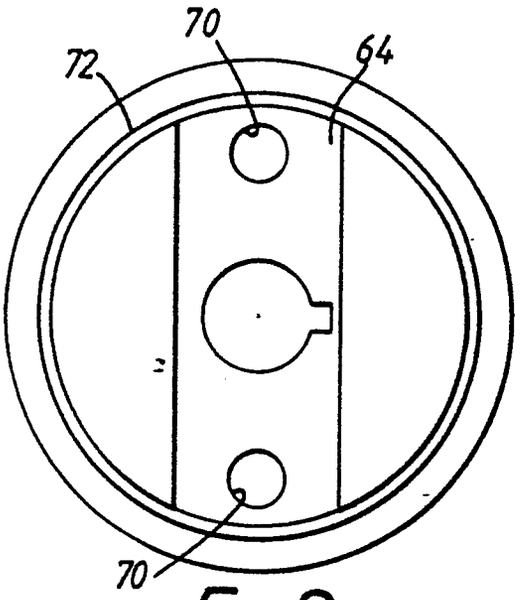

FIG. 8.

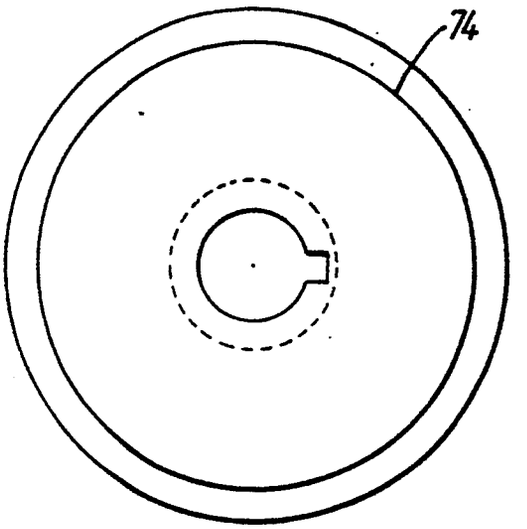

FIG. 10.

FIG. 11.

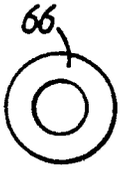

FIG. 12.

FIG. 13.

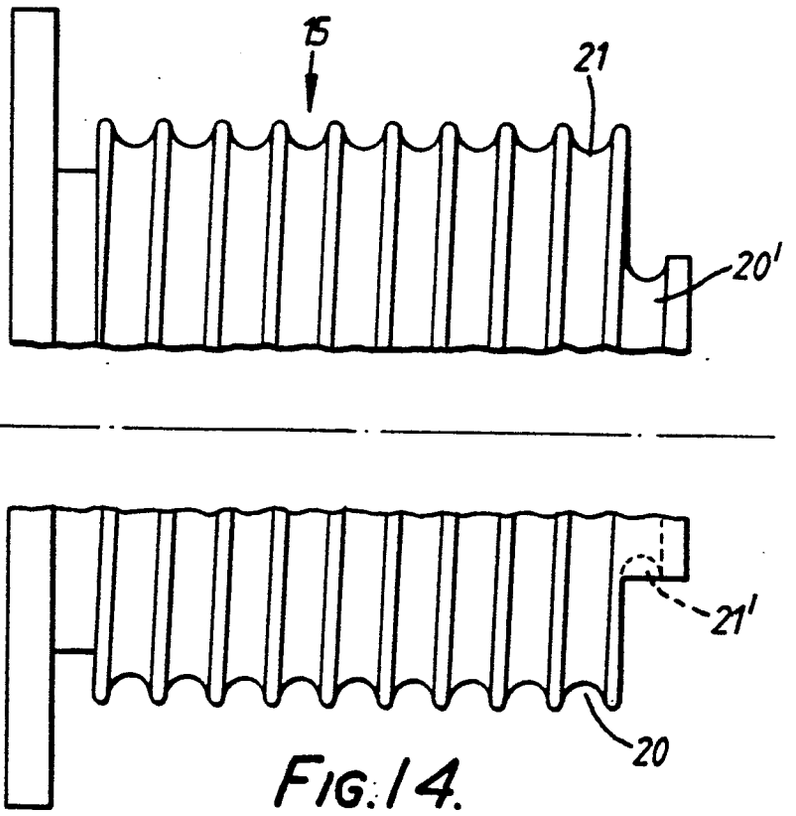

FIG. 14.

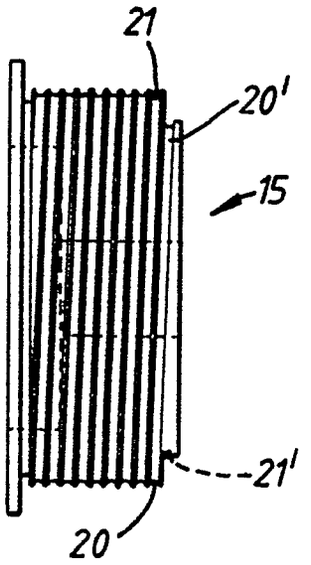

FIG. 15.

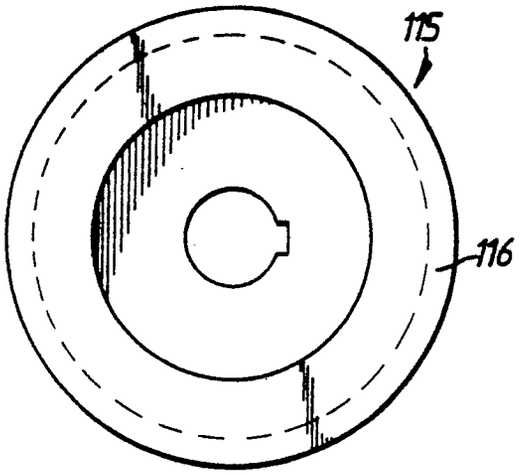

FIG. 16.

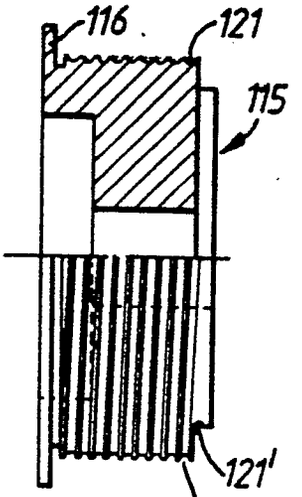

FIG. 17.

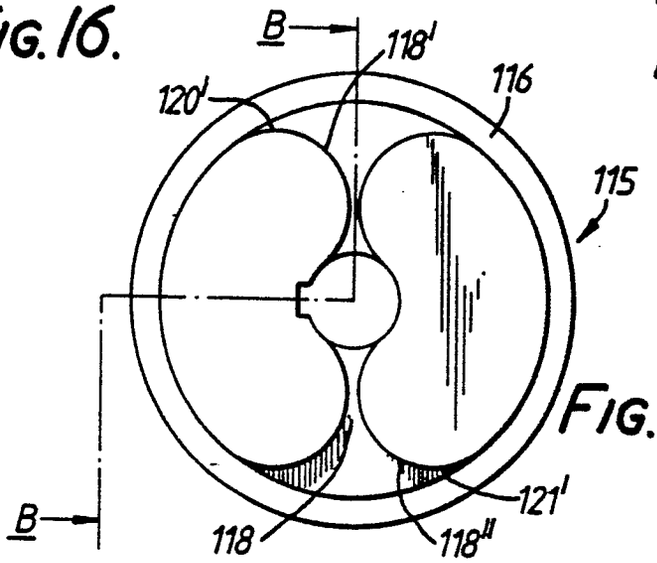

FIG. 18.

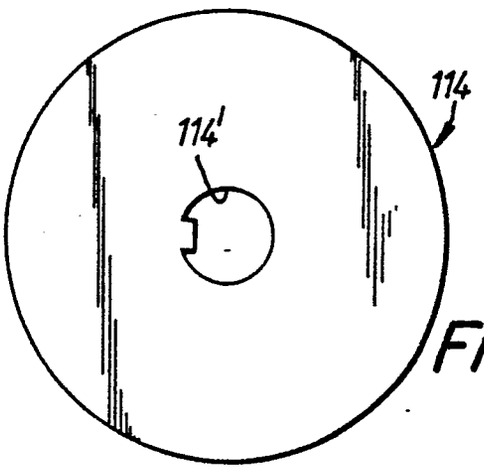

FIG. 19.

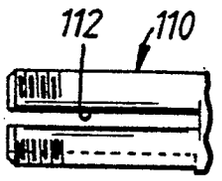

FIG. 20.

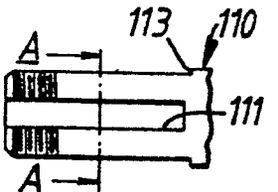

FIG. 21.

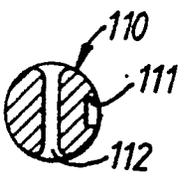

FIG. 22.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 87 31 0382

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A-3 409 359 (L. KUTZNER) * Page 19, lines 3-14; figure 3 *	1-3	A 62 C 3/14
A	FR-A-2 386 677 (G. GODEFROY)		
A	DE-A-2 823 232 (R.A.H. CHASTANIER)		
A	FR-A-2 556 111 (J. GOTLIBOWICZ)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

A 62 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	08-02-1988	WOHLRAPP R.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)