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(54) Fluff filter monitoring device for laundry driers.

(57) A fluff filter monitoring device for a laundry drier, operable to indicate the presence or absence of the filter (16) in its seat, and the operative state of the filter with regard to its being clogged with fluff.
The device comprises a flexible plastic strip member (27) fixedly mounted in a housing space for the filter (16) and provided with a planar gate portion (26) adapted to intercept the movement of a lug (23) projecting from a door (11) provided for closing an opening giving access to the rotating drum (10) of the machine. When the filter (16) is removed from its housing space (17), the flexible strip member (27) is displaced to a position in which its planar gate portion (26) intercepts the movement of the lug (23) so as to prevent the door (11) from being closed, while when the filter is in place in its housing space, the planar gate portion (26) does not interfere with the lug (23) so as to permit the door (11) to be closed and the machine to be put into operation.

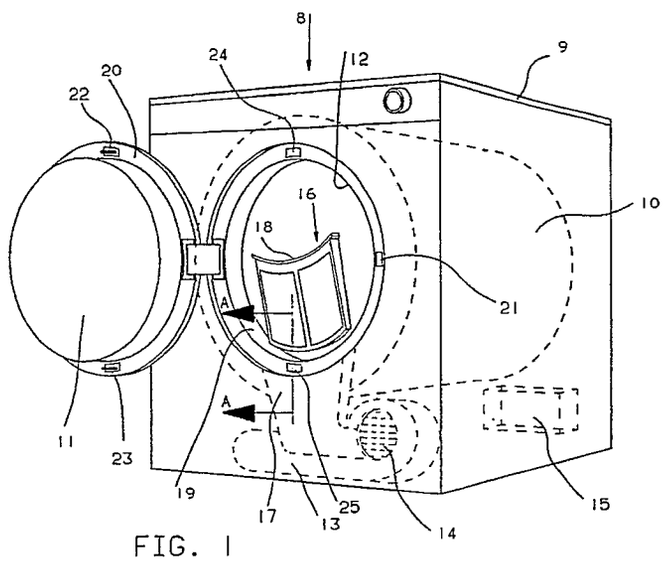

FIG. 1

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The invention relates to a fluff filter monitoring device for laundry driers, of a simple construction permitting the presence or absence of the fluff filter in its seat as well as the condition of the filter with regard to its being clogged with fluff to be indicated.

Modern laundry driers comprise a rotating drum for containing the moist laundry to be dried, a drying air circulation conduit having installed therein at least one blower and an electric heater element operable to produce a hot air flow and to direct it through the laundry to be progressively dried thereby, and a fluff filter acting to retain any fluff released by the laundry for preventing it to enter the conduit. Associated in general to this filter are suitable monitoring means acting to monitor its proper operation and to indicate to the user, by means of suitable optic or acoustic signals, when the filter is completely clogged with fluff and should therefore be cleaned or replaced, to thereby prevent the laundry from becoming overheated or even burnt due to the insufficient circulation of the hot air, so that the satisfactory and reliable operation of the machine is always ensured. On the other hand, however, these machines are not provided with any signalling means for indicating the presence or absence of the filter in its seat, so that, when the filter has been removed from its seat and not been replaced due to lack of attention or for any other reason, it is possible to put the laundry drier into operation, with the resultant impossibility of retaining the fluff and the progressive accumulation thereof in the air circulation circuit, whereby the operation of the machine becomes insatisfactory and unreliable. It is therefore an object of the present invention to eliminate the described shortcomings by the provision of a fluff filter monitoring device for laundry driers designed so as to perform the double function of indicating the presence of absence of the filter in its seat for permitting the machine to function only in the presence of the filter, and of continuously monitoring the degree of clogging of the filter during the performance of each and any selected drying cycle. These and other objects are attained according to the invention by a fluff filter monitoring device for a laundry drier designed with the structural characteristics substantially as described with particular reference to the claims enclosed with this specification. The invention will become more clearly evident from the following description, given by way of example with reference to the accompanying drawings, wherein:

- fig. 1 shows a diagrammatic perspective view of a laundry drier provided with a fluff filter and a monitoring device according to the invention,
- fig. 2 shows a sectional view taken along the line A-A in fig. 1, illustrating a first embodiment of the present monitoring device, with a filter in the fully inserted position,
- fig. 3 shows the device depicted in fig. 2 after removal of the filter,
- fig. 4 shows a sectional view taken along the line A-A in fig. 1, illustrating a second embodiment of the present monitoring device, with the filter in its fully inserted position,
- fig. 5 shows the device depicted in fig. 4 after removal of the filter,
- fig. 6 shows a diagrammatic illustration of the present monitoring device for explaining its function of monitoring the operative condition of the filter and
- fig. 7 shows an electric circuit diagram of the device as depicted in fig. 6.

With reference to fig. 1, there is diagrammatically shown a laundry drier 8 of a conventional type, comprising a metal casing 9 enclosing a rotatable drum 10 for containing the moist laundry to be dried, and accessible through an opening 12 formed in the casing in alignment with the drum and adapted to be closed by a front door 11, and a drying air circulation conduit 13 connected to drum 10 and including at least one blower 14 and an electric heater element 15 operable to produce a hot air flow circulating through drum 10 and conduit 13. The laundry drier further comprises a filter 16 for retaining the fluff entrained from the laundry by the hot air flow, and for thus preventing it from being recirculated through conduit 13, to thereby ensure satisfactory operation of the machine. In particular, filter 16 is advantageously housed in a vertically extending seat 17 located on the front face of casing 9 adjacent front opening 12 in communication with air circulation conduit 13. The upper end face 18 of filter 16 is formed as a circular arc capable of adapting itself to the peripheral rim 19 of opening 12 when filter 16 is fully inserted into seat 17. For permitting access to filter 16, the circular peripheral frame 20 of door 11 is hinged to the casing of the machine adjacent one side, for instance the left side as illustrated in fig. 1, of front opening 12, and is further provided with a hook (not visible in fig.1) adapted to engage a complementary catch in a cutout 21 formed in casing 9 on the diametrally opposite side of front opening 12. Peripheral frame 20 is additionally provided with two projecting lugs 22 and 23 disposed diametrally opposite one another on a line perpendicular to the plane of the hinge and the catch of the door, and adapted to be received in respective cutouts 24 and 25 formed just above and below front opening 12. Disposed adjacent upper cutout 24 in an internal cavity (not shown) of the front wall

of casing 9 is a microswitch (not shown) connected to the electric circuit of the machine and adapted to be closed and opened, respectively, by upper lug 22, as door 11 is being closed and opened, to thereby determine the energization and deenergization, respectively, of the machine. The lower lug 23 on its part is adapted to enter, or prevented from entering, the associated cutout 25 to thereby respectively permitting door 11 to be, or preventing it from being, closed, depending on the actual position of a planar gate member 26 carried by a flexible plastic strip 27 having its other end secured by per se known means (eg. screws 28) to a carrier frame 29 provided in seat 17 for filter 16. In particular, and as shown in fig. 2, flexible plastic strip 27 is mounted in a position causing it to interact with filter 16 as it is inserted into or removed from its seat 17. When filter 16 is being inserted, it slides on planar gate member 26 and along the rearwards bent portion 30 of flexible strip 27, causing it to be forced towards carrier frame 29, as a result of which gate member 26 is displaced to a position away from cutout 25 to thereby permit lower lug 23 to be received therein, and thus door 11 to be closed. In this case upper lug 22 of door 11 enters the corresponding cutout 24 so as to close the above-described microswitch, permitting the laundry drier to be put into operation. When on the other hand filter 16 is removed from its seat for replacement or for being cleaned of fluff retained thereon (cf. fig.3), the rearwards bent portion 30 of flexible strip 27 is resiliently displaced to its rest position, causing planar gate member 26 to assume a position coinciding with lower cutout 25, in which lug 23 of door 11 comes into abutment therewith and can therefore not enter cutout 25, so that the door is prevented from being closed. In this manner the present monitoring device permits the presence or absence of filter 16 in its seat to be readily and reliably detected, at the same time permitting the machine to be, or preventing it from being, put into operation in response to the actuation of the microswitch, which can only be closed when the presence of filter 16 in its seat permits door 11 to be closed.

With reference now to figs. 4 and 5, there is shown a second embodiment of the present monitoring device comprising a pivotable closure member 31 mounted on a pin 32 inside seat 17 of filter 16 so as to interact with the filter in the manner to be described. Closure member 31 includes a planar wall portion 33 having dimensions slightly greater than the cross-sectional area of circulation conduit 13, and a planar gate portion 34 of a shorter length than and disposed perpendicular to wall portion 33 at a position resulting in its being positioned opposite and closely adjacent lower cutout 25, when a torsion spring 35 mounted on pin 32 and having its free ends supported on an inner wall surface 38 of seat 17 and the opposite surface of planar wall portion 33 causes closure member 31, in response to removal of filter 16 from seat 17, to assume a position in which it closes conduit 13 (cf. fig. 5). In this position, lug 23 on door 11 comes into abutment with planar gate portion 34, so that it cannot enter cutout 25 and prevents door 11 from being closed. On the other hand, when filter 16 is fully inserted into its seat 17, closure member 31 is rotated about pin 32 to the position shown in fig. 4, in which planar wall portion 33 extends substantially parallel to interior wall surface 38 of seat 17 and gate portion 34 does no longer obstruct cutout 25, so that lug 23 of door 11 is enabled to enter the cutout, permitting the door to be closed. The resultant closing of the microswitch then permits the laundry drier to be put into operation.

The present monitoring device finally performs the additional function of monitoring the degree of clogging of the filter by the retained fluff. To this purpose, and as illustrated in fig. 6, the device additionally comprises an electronic circuit diagrammatically indicated by a block 39 to be described in detail below, and adapted to detect the presence or absence of the filter in its seat as well as the degree to which the filter is clogged by fluff retained thereon, by applying the principle of generating (at a point B) a light beam directed onto a reflector or mirror C located on the opposite side of filter 16, and receiving (at a point D) the light beam reflected by the mirror. As the light beam has to pass twice through the filter 16 as it is directed onto the mirror at C and reflected back to point D, it is possible to indirectly determine whether the filter is in place and to what degree it is clogged by fluff.

With reference now to fig. 7, there is shown the electric circuit diagram incorporated in block 39 mentioned above. This circuit for monitoring the degree of clogging of the filter substantially comprises a power supply stage 40 connected to the electric mains 41 through the microswitch 42 of the machine when closed by the lug 22 of the door 11 of the machine in the manner described above, and adapted to transform the alternating mains current into a DC voltage to be applied to the electronic circuit components to be described, microswitch 42 being also effective to energize the various electric functional components of the machine (motor, resistance heater etc.) diagrammatically indicated by a block 43, via a pair of main conductors 44 and 45 and an electric switch 46 operable in the manner to be described.

In particular, power subbly stage 40 is operatively connected to a current stabilizing and regulating stage 47 having three output terminals 48,

49, 50 connected respectively to a light-emitting diode 51 or a similar component, a photodiode 52 or a similar component, and a voltage divider preferably composed of three series-connected resistors 53, 54 and 55 the function of which will be explained in the following, all of the named components being connected to power supply stage 40 via a common conductor 56 having a branch connection to ground 57. Diodes 51 and 52 serve the purpose respectively of generating the light beam (at point B) to be directed through the filter and of receiving (at point D) the light beam reflected by the mirror at C on the other side of the filter 16. The present monitoring circuit additionally comprises two electronic comparators 58 and 59 of conventional type, of which comparator 58 is provided with two input terminals 60 and 61 connected respectively to output terminal 49 of current stabilizing and regulating stage 47 and to a connection point 62 between resistors 53 and 54, the output terminal 63 of comparator 58 being connected to an electromechanical actuator 64 (a relay or the like) mechanically coupled to electric switch 46 for the opening and closing actuation thereof, actuator 64 being also electrically connected to common conductor 56. Comparator 58 serves the purpose of comparing the output voltage generated by photodiode 52 in proportion to the intensity of the reflected light beam impinging thereon, to a preselected reference voltage generated by the two resistors 53 and 54, the level of this reference value being adjusted so as to correspond to the completely fluff-clogged state of the filter, the result of this comparison being used to control the opening or closing operation of electric switch 46 by means of the electromechanical actuator 64. As long as the filter is completely unobstructed or only partially obstructed by fluff retained thereon, and thereby permits an efficient circulation of the hot air flow through the conduit 13 of the laundry drier, the light beam reflected by the mirror C and received by photodiode 52 is of sufficient intensity for the generation of an electric voltage at a level above that of the reference voltage, as a result of which the output 63 of comparator 58 is maintained at the logic level "0". Under this condition, actuator 64 maintains switch 46 closed, so that the laundry drier is energized. On the other hand, when filter 16 is completely clogged by the retained fluff and does no longer permit an efficientcirculation of the hot air through conduit 13, with the resultant danger of damage to the laundry or to metal parts of the machine, the light beam reflected by the mirror at C and impinging on photodiode 52 is of an extremely low intensity, or even of no intensity at all, resulting in the generation of an output voltage at a level equal to or lower than that of the reference voltage, causing the output 63 of comparator 58 to assume the logic level "1", as a result of which actuator 64 is operated to actuate, i.e. to open switch 46 to thereby deenergize the laundry drier.

Comparator 59 on its part has a first and a second input terminal 65 and 66 connected respectively to the output terminal 49 of current stabilizing and regulating stage 47, and to a connection point 67 between resistors 54 and 55, and an output terminal 68 connected to common conductor 56 via a light signalling component such as a light-emitting diode 69 or the like. Comparator 59 serves the purpose of comparing the electric voltage generated by photodiode 52 in proportion to the intensity of the light beam reflected by the mirror at C and impinging thereon, to a preselected reference voltage generated by resistors 54 and 55 and adjusted so as to correspond to the completely fluff-clogged state of the filter, and to control through its output 68 the energization of the light signalling component 69 when the filter attains the completely clogged state. Under this condition, and as in the case explained previously, the output 68 of comparator 59 is switched from the initial logic level "0" maintaining light-signalling component 69 in the deenergized state, to the logic level "1" causing the signalling component 69 to light up to indicate the clogged state of the filter. This occurs only when the level of the electric voltage generated by photodiode 52 is equal to or lower than that of the reference voltage, denoting a low intensity or even the total lack of intensity of the light beam reflected by the mirror at C and received by the photodiode. This warning signal is kept alive without variation even in the case of temporary interruptions of the electric power supply or of malfunction of the machine, since the signalling component 69 is always energized through microswitch 42.

The present monitoring device is thus capable in a simple and efficient manner of performing the double function of monitoring the presence or absence of the fluff filter in its seat, and of monitoring the operative state of the filter, so that it can be cleaned or replaced in case of its being clogged, a specific advantage of the present device being that it permits the laundry drying cycles to be executed in a regular manner only when the filter is properly in place.

Claims

1. A fluff filter monitoring device for a laundry drier comprising a casing enclosing a rotatable drum for containing the laundry to be dried and connected to a hot air circulation conduit in which said filter is inserted, said drum being accessible through a front opening of said cas-

ing adapted to be closed by a door operable to actuate switch means connected to electric circuit components of the machine,
characterized in that said filter (16) is associated to inhibitor means (27, 31) cooperating with said door (11) for permitting it to be, or preventing it from being, closed when said filter (16) is in place in its seat or has been removed therefrom, respectively, said filter (16) being further associated to signalling means (51, 52, 58, 59) operable to indicate the operative state of said filter with regard to its being or not being clogged with fluff.

2. A monitoring device according to claim 1, characterized in that said inhibitor means comprise a flexible strip member (27) fixedly mounted in a housing space (17) for said filter (16) and provided with a planar gate portion (26), said flexible strip member (27) being displaceable from a rest position in which said planar gate portion (26) interacts with a corresponding lug (23) of said door (11) to prevent the latter from being closed when said filter (16) is not in place, to an operative position in which said planar gate portion (26) is displaced away from said lug (23) so as to permit said door (11) to be closed when said filter (16) is in place in said housing space (17).

3. A monitoring device according to claim 2, characterized in that said inhibitor means comprises a resiliently biased closure member (31) pivotally mounted in said housing space (17) and provided with two mutually perpendicular planar wall portions (33, 34), said closure member (31) being displaceable from a rest position in which said planar wall portions (33, 34) interact with said lug (23) for preventing said door (11) from being closed when said filter (16) is not in place in said housing space (17), to an operative position in which said planar wall portions (33, 34) are displaced away from said lug (23) to permit said door (11) to be closed when said filter (11) is in place in said housing space (17).

4. A monitoring device according to claim 1, in which said electric circuit components are connected to at least a current supply stage and a current stabilizing and regulating stage adapted to be energized through said switch means, characterized in that said signalling means comprise at least a light-emitting diode (51) connected to a first output terminal (48) of said current stabilizing and regulating stage (47) and adapted to produce a light beam to be directed through said filter (16) onto a mirror (C), at least one photodiode (52) connected to a second output terminal (49) of said current stabilizing and regulating stage (47) ad adapted to receive the light beam produced by said light-emiting diode (51) and reflected by said mirror (C) through said filter (16), for generating an electric voltage in proportion to the intensity of said light beam, and comparator means (58, 59) operable respectively to maintain the machine and at least one filter-clogged warning component (69) energized or in a deenergized state in response to the result of comparing said electric voltage generated by said photodiode (52) to a predetermined reference voltage generated by respective voltage dividers (53,54; 54,55) connected to a third output terminal (50) of said current stabilizing and regulating stage (47).

5. A monitoring device according to claim 4, characterized in that said comparator means comprise a first and a second electronic comparator (58, 59) having their respective first input terminals connected to said second output terminal (49) of said current stabilizing and regulating stage (47), while their respective second input terminals (61, 66) are connected to said voltage dividers (53,54; 54,55), and their respective output terminals (63, 68) are connected to at least one actuator (64) acting on further switch means (46) operable to energize or deenergize the machine, and to said filter-clogged warning component (69) connected on its part to said diodes (51, 52), said voltage dividers (53,54; 54,55) and said power supply stage (40).

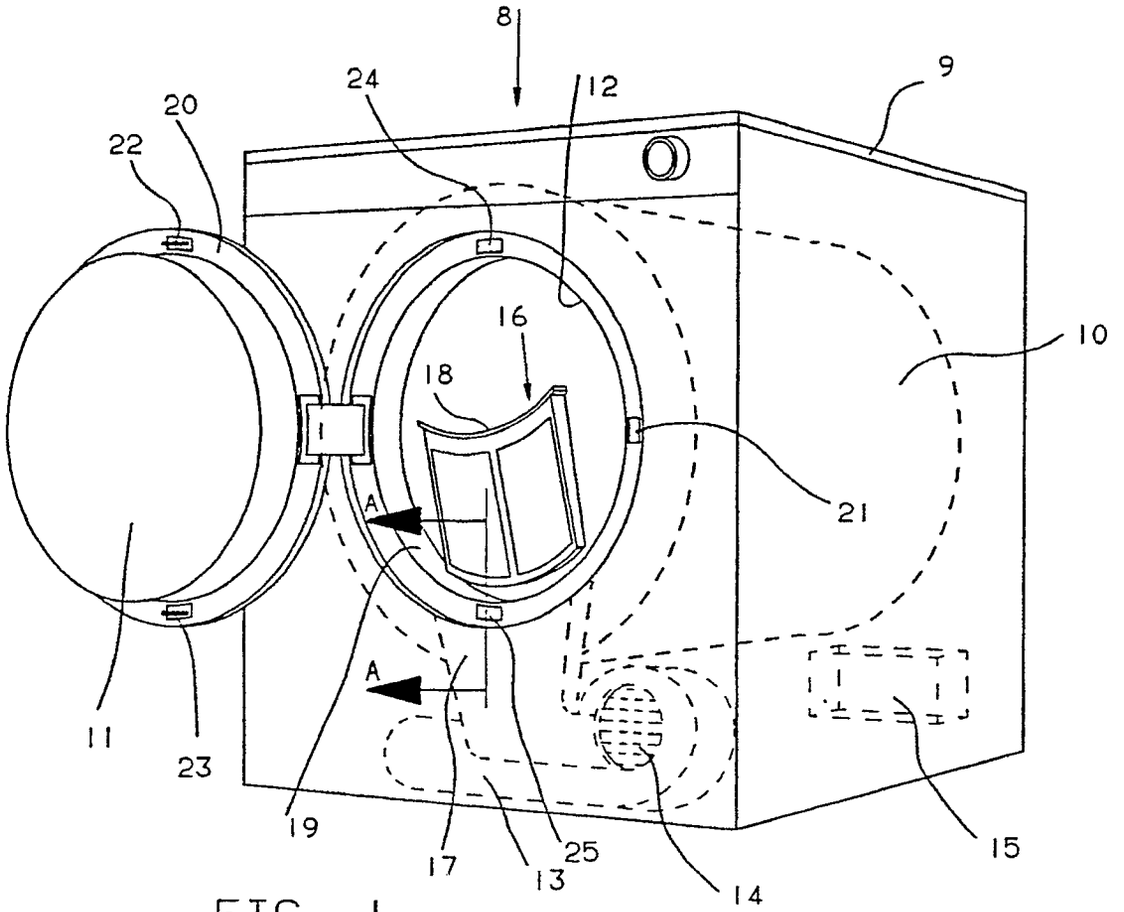

FIG. 1

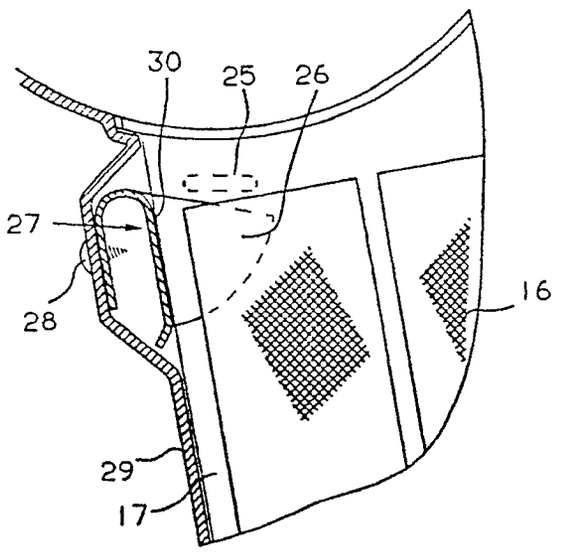

FIG.2

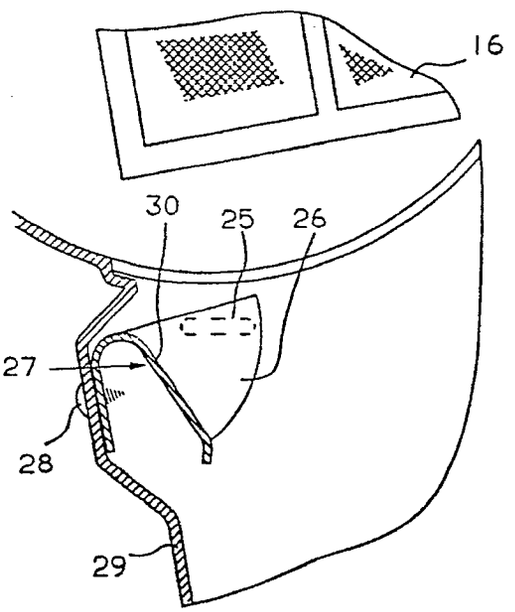

FIG.3

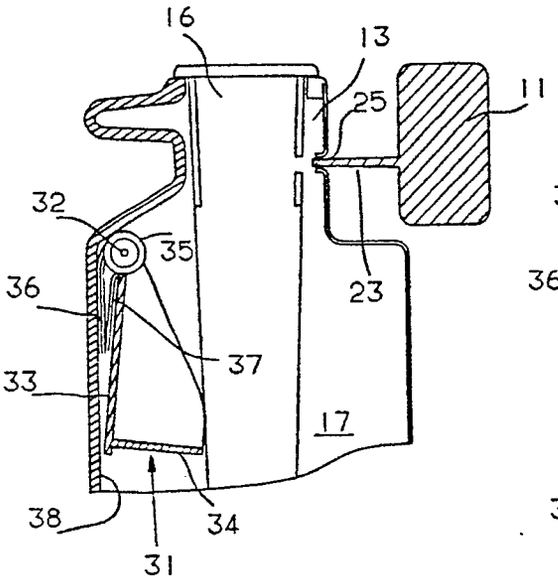

FIG.4

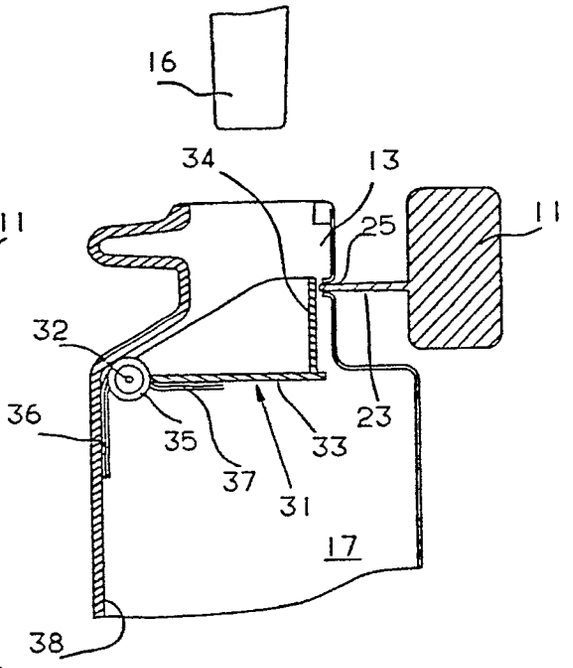

FIG.5

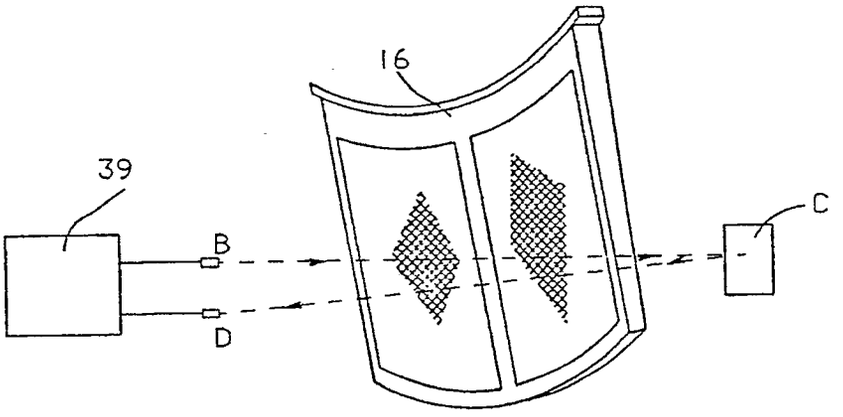

FIG.6

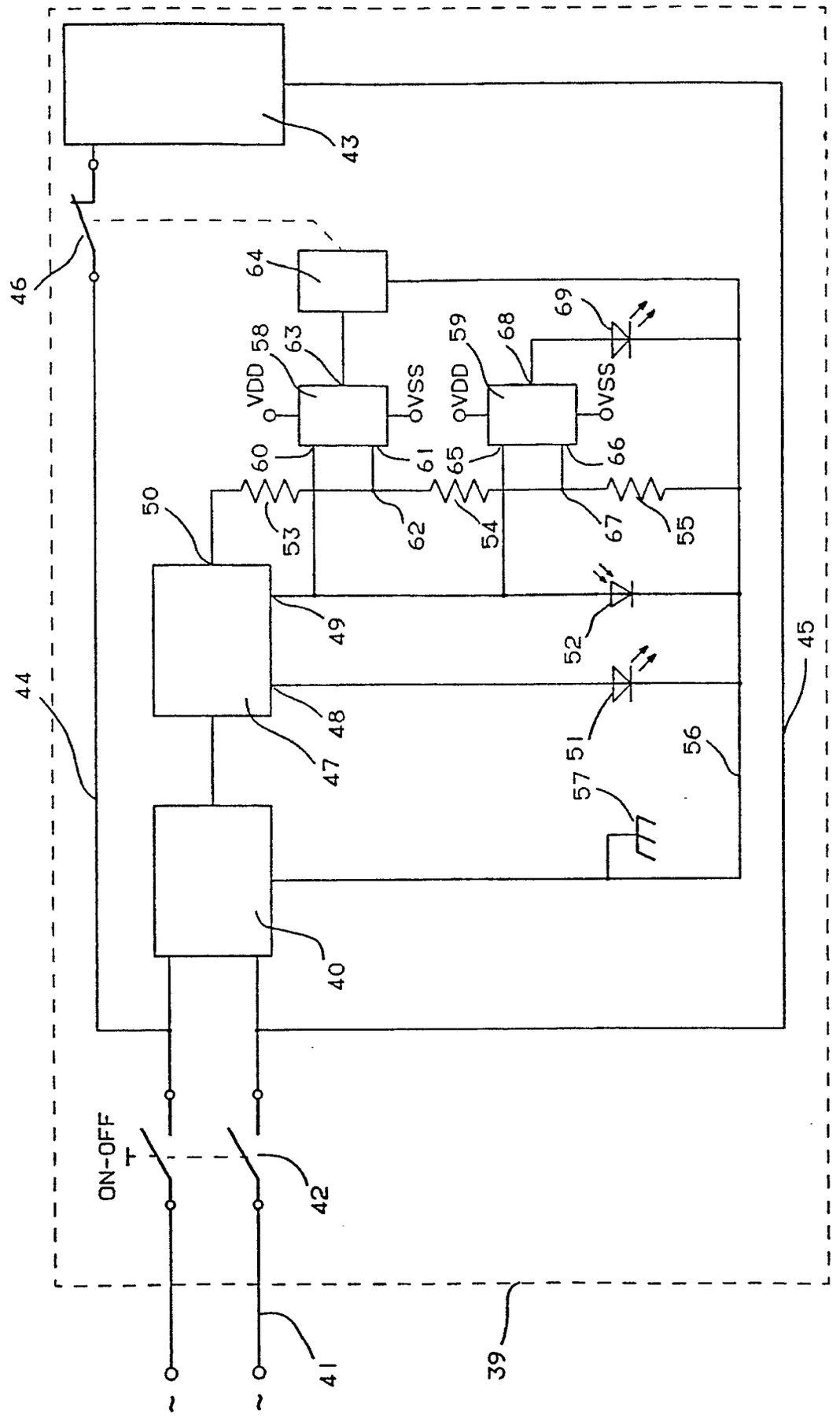
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FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 10 1536

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.5)
A	EP-A-0 250 789 (ZANKER GMBH & CO HG) * claims; figures *	1	D 06 F 58/22
A	US-A-3 579 851 (WESTINGHOUSE ELECTRIC CORPORATION) * column 1 - column 2, line 50; figures *	1	
A	DE-A-2 715 960 (MIELE & CIE.) * claims; figures *	4,5	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D 06 F

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	31 May 91	COURRIER,G.L.A.

CATEGORY OF CITED DOCUMENTS

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