Dec. 16, 1969 A. NIEWYK ET AL 3,484,772

LINT INDICATOR SYSTEM

Filed July 6, 1966

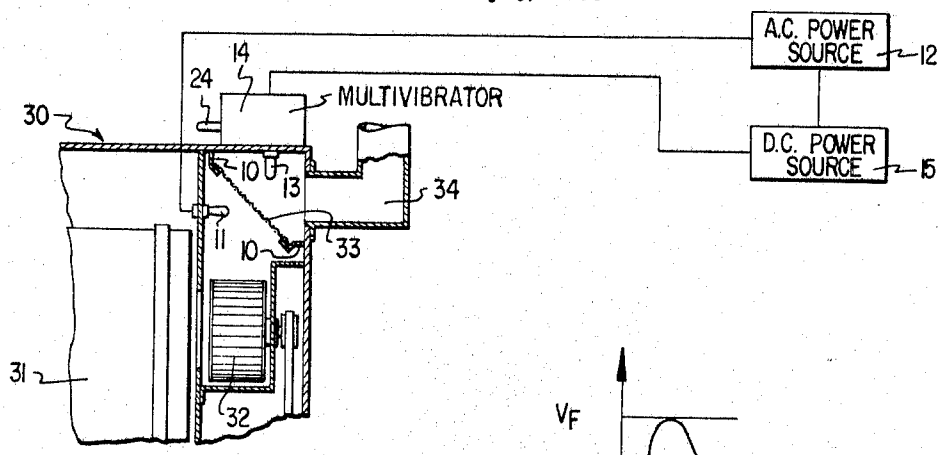


FIG. 1

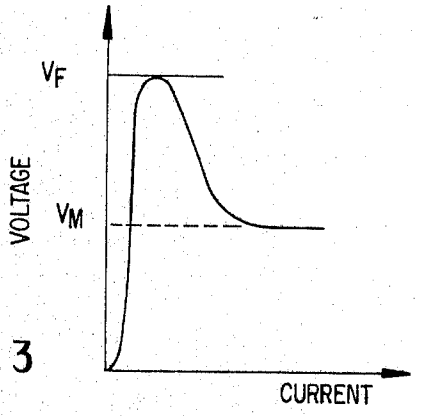
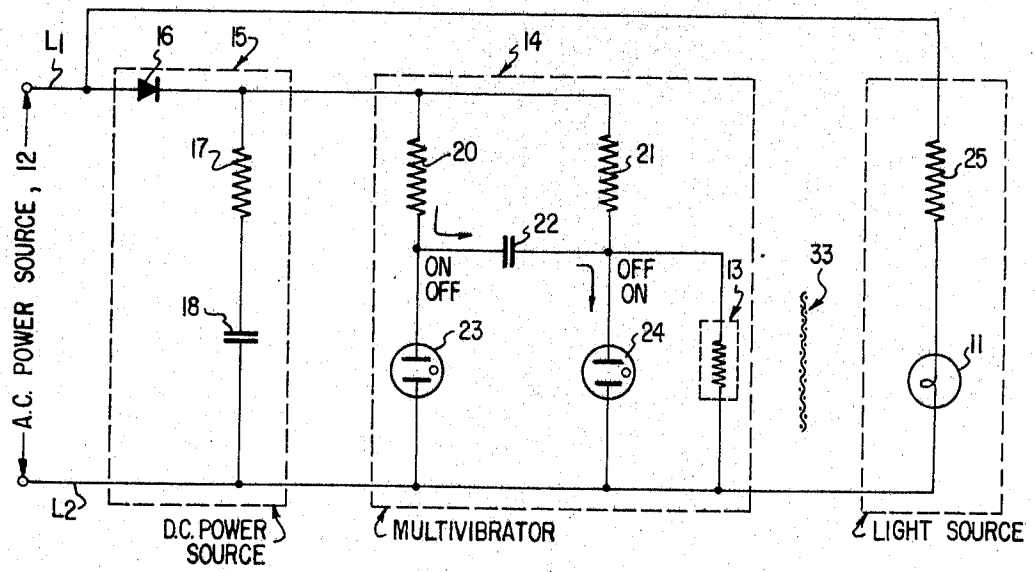


FIG. 3

FIG. 2



INVENTORS.
ANTHONY NIEWYK
JAMES L. McCONNELL
BY
Seyfarth, Cothwell, Mecca, Zinn & Maycock
ATTORNEYS.

United States Patent Office 3,484,772 Patented Dec. 16, 1969

3,484,772

LINT INDICATOR SYSTEM

Anthony Niewyk, St. Joseph, and James L. McConnell, Stevensville, Mich., assignors to Whirlpool Corporation, Benton Harbor, Mich., a corporation of Delaware

Filed July 6, 1966, Ser. No. 563,167
Int. Cl. G08b 21/00; G01n 21/12; B01d 51/00
U.S. Cl. 340—236 9 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for the detection of lint in a fabric treatment appliance is disclosed. The appliance may be, for example, a clothes dryer and includes a light permeable filter for entrapping lint released by the fabrics. The apparatus includes a light source positioned to pass light through the filter and a light sensitive element positioned to receive the light passed through the filter. An oscillator is controlled by the light sensitive element in such a manner as to be biased to prevent oscillations when the filter is unclogged and allowed to oscillate when the filter is clogged. The oscillator controls a light which is made to flash when the oscillator oscillates and is turned off when the oscillator is prevented from oscillating. Thus, the operator of the appliance is alerted by the flashing light of an undesirable build up of lint.

This invention relates to apparatus for the detection of line in a fabric treating appliance, such as a clothes dryer, and more particularly to apparatus for alerting the operator of the appliance to the presence of an undesirable level of lint built up in the lint trap associated with the appliance.

Conventional clothes dryers available today include a clothes receiving drum provided with an air inlet and an air outlet. A fan positioned cooperatively with the exhaust opening exhausts the air from the drum and discharges it through a discharge passageway. In order to trap the lint carried by the air, a lint trap may be provided and positioned at the discharge side of the fan. This trap may consist of a screen or the like permitting passage of air therethrough while filtering out the lint carried thereby. As the drying process continues, lint build-up on the screen takes place.

Since an accumulation of lint on the screen would materially reduce or cut-off air flow through the dryer and result in overheating or scorching of the fabrics contained therein, it is desirable that the operator be alterted to such a build-up of lint. Previously, the operator was called upon the inspect to screen periodically and decide for himself when this undesirable condiiton existed. To avoid operator misjudgement or negligence, it is proposed by this invention to automatically bring this undesirable condition to the attention of the operator.

Essentially the features of the invention are accomplished in the following general manner:

A source of light is positioned to pass light through the lint screen and a light sensitive element is positioned to detect light passing through the screen. The light sensitive device is part of an electronic circuit. This circuit is one which has two modes of operation. The mode of the circuit is determined by an electrical characteristic of the light sensitive device. For instance, this characteristic may be resistance. As an illustration, if the resistance of the light sensitive device as determined by the amount of light detected thereby, is below a certain predetermined value, then the electronic circuit operates in its first mode. If the resistance of the light sensitive element **13** is above this predetermined value, the electronic circuit operates in its second mode. The resistance of the

light sensitive device may be a function, either direct or inverse, of the amount of light passing through the lint screen. The amount of light is in turn determined by the amount of lint build-up on the screen. For convenience, the first mode may be identified as the undesirable lint level mode and the second as the tolerable lint level mode.

It is, therefore, an object of the present invention to provide in a laundry appliance such as a clothes dryer having a lint screen, control means for providing the operator with an automatic indication of the mode of operation of the dryer, that is, a tolerable lint level mode or an undesirable lint level mode.

It is a further object of the present invention, as will be more fully explained subsequently, to minimize the effects of the supply line voltage fluctuation on the indicating circuitry.

It is a still further object of the invention to provide indicating circuitry in which some of the active elements of the circuitry function as the indicators.

In the drawings:

FIGURE 1 is a schematic illustration partly in section, showing one form of the present invention;

FIGURE 2 is an illustration of one form of electrical circuitry that may be employed in accordance with the present invention, and

FIGURE 3 is a graph plotting voltage against current illustrative of a typical neon bulb that may be employed in the circuitry of the present invention.

Referring to FIGURE 1, there is shown the environment of a dryer including the dryer housing **30**, drum **31**, fan **32**, lint filter **33**, and exhaust passageway **34**. These environmental elements are illustrative only and are not, per se, part of the present invention. The lint filter **33** is shown as a screen positioned at the exhaust side of the fan **32** and mounted by any conventional means such as brackets **10**.

The fan exhausts the air from the drum **31** and discharges it through the lint screen **33** to the exhaust passageway **34**. The lint screen **33** filters the air and produces line build-up thereon.

A source of light **11** is mounted on one side of the lint filter **33** and connected electrically to an A.C. power source **12**. On the other side of the filter **33** is mounted a light sensitive element **13**. This element **13** is electrically connected to an electronic circuit including a free-running astable multivibrator, shown diagrammatically at **14**. The multivibrator **14** is electrically connected to a D.C. power source **15** which, in turn, is connected to the A.C. power source **12**.

Referring now to FIGURE 2, the A.C. power source **12** is connected across lines L_1 and L_2. Connected in L_1 is the rectifying diode **16**. The rectified output of diode **16** is developed across resistor **17** and capacitor **18** to provide an unregulated D.C. voltage. This D.C. voltage is fed to the astable multivibrator **14**. The multivibrator **14** includes resistors **20** and **21**, capacitor **22**, neon bulbs **23** and **24**, and the light sensitive element **13** which is shown here as a light sensitive resistor. The neon bulb **24** is positioned on the exterior of the clothes dryer in a position where it can be readily observed by the operator (see FIGURE 1). Neon bulb **23** on the other hand is not visible to the operator. A source of light in the form of a lamp **11** is electrically connected across the A.C. power supply **12** and is connected in series with a current limiting resistor **25**. The lint filter or screen **33** is positioned intermediate the light source **11** and the light sensitive resistor **13**.

Assuming that the lint filter is free of lint so that a maximum amount of light reaches the light sensitive resistor **13**, and assuming further that the characteristics of

resistor **13** are such that its resistance is inversely proportional to the amount of light impinging on it, then the resistance of **13** would be at a minimum. This being the case, most of the voltage developed by the D.C. power source will appear across resistor **21** in the leg including resistor **21** and resistor **13**. Therefore, the voltage across resistor **13** and hence across bulb **24** will be insufficient to cause bulb **24** to fire. Under these conditions bulb **24** is in a non-conductive state.

Current from the D.C. power source flows through resistor **20** to charge capacitor **22**. At some point along the charging path of capacitor **22**, the voltage across neon **23** will reach the firing potential. The bulb **23** will fire and will conduct current therethrough. The voltage will then drop from the firing potential to the maintaining potential. It can thus be seen that under the conditions assumed, that is, no lint on the lint filter, bulb **23** will be on and bulb **24** will be off. This is the tolerable lint level mode of operation of the electronic circuit. This mode will continue until the lint level build-up reduces the light detected by resistance **13** whereby its resistance determines a change in the mode of the circuit.

Now assume that the lint build-up on the screen **33** has reached an undesirable level. This means that the light impinging on light sensitive resistor **13** has decreased so that its resistance has substantially increased. This being the case, and resistor **13** and resistor **21** functioning together as a voltage divider, there now will be sufficient voltage across resistor **13** to fire bulb **24**. As seen in FIGURE 3, in which is plotted the *V/I* characteristics of a typical neon bulb are shown, once the neon bulb **24** has fired the voltage across it drops from a firing voltage V_f to a lower maintaining voltage V_m. This sudden decrease in voltage is coupled to the anode of neon bulb **23** by means of the capacitor **22** and causes the voltage across the neon bulb **23**, which up until this time has been conducting, to fall below its maintaining voltage, and, thus, pass into a non-conductive state.

The capacitor **22** now begins to charge through resistor **20**, and in the voltage across neon bulb **23** increases until it reaches its firing voltage. Once the neon bulb **23** has fired, the voltage across it drops from its firing voltage V_f to its lower maintaining voltage V_m. This sudden decrease in voltage is coupled to the anode of neon bulb **24** and causes the voltage across bulb **24** to fall below its maintaining voltage and pass into a non-conductive state. The capacitor **22** now begins to charge in the reverse direction and the voltage across neon bulb **23** will increase until its firing voltage is reached and it fires. The cycle then continues to repeat so long as the resistance of light sensing element **13** continues to remain above a preselected value as a result of sensing a reduced amount of light due to an undesirable level of lint build-up.

It can be seen that when the build-up of lint on the lint screen has reached a predetermined level, the circuit switches modes of operation. In the tolerable lint level mode, the neon bulb **24**, which is visible to the operator, is in its off or nonconductive condition to thereby indicate that the lint level is acceptable. In the undesirable lint level mode neon bulb **24** will be intermittently fired to thereby flash on and off and indicate to the operator that the lint level is not aceptable. It will be readily apparent that although the indication of an undesirable lint level is shown herein as a flashing light, other indication means, either audio or visual could be provided.

It will be noted that no means has been provided to regulate the D.C. power supply output. The proper selection of the tolerances of the various components in the electronic circuit coupled with the fact that the system is to a certain extent self-compensating for line voltage fluctuations obviates the need for regulating the output of the D.C. power supply. The self-compensating feature of the system will be best understood by considering the condition where the line voltage increases above a normal level, whereupon the intensity of light given off by the light source **11** will increase. This would normally mean that more lint would collect on the screen before the resistor **13** would cause the flashing light indication to operate. However, increasing the line voltage will likewise increase the D.C. voltage source output, meaning a greater voltage across the voltage divider **21–13**. The net effect is that the value of resistor **13** will have to increase less in order for the voltage across neon **24** to reach the firing voltage. These two items, that is, increased intensity of the lamp **11** and a decrease in the value of resistor **13** necessary to fire neon **24**, compensate for each other to a certain extent and the amout of lint build-up necessary to cause the flashing indication will tend to remain substantially constant even though the line voltage may fluctuate.

What is claimed is:

1. In a fabric treatment apparatus having a chamber for receiving fabrics to be treated, a light permeable filter for entrapping lint released by said fabrics, means for transporting lint from said chamber to said filter, a light source positioned to pass light through said filter wherein the amount of light permeating said filter is a function of the lint build-up thereon, and control means for providing an indication of lint build-up on said filter, said control means comprising: a light sensitive element positioned to detect light passing through said filter from said light source, said light sensitive element having an electrical characterstic that varies in proportion to the amount of light detected thereby through a range of values on opposite sides of a preselected value; an oscillator circuit connected to said light sensitive element and controlled thereby, said oscillator circuit operating in an oscillatory mode indicative of an undesirable level of lint built-up on the filter when the electrical characteristic of said light sensitive element is within a range of values on one side of said preselected value, and operating in a nonoscillatory mode indicative of a tolerable level of lint build-up on said filter when the electrical characteristic of said light sensitive element is within a range of values on the opposite side of said preselected value; and visual indicator means connected to said oscillator circuit, said visual indicator means producing a flashing output when said oscillator circuit operates in said oscillatory mode and a steady-state output when said oscillator circuit operates in said nonoscillatory mode.

2. The apparatus of claim **1** wherein the electrical characteristic of said light sensitive element is inversely proportional to the amount of light detected thereby.

3. The apparatus of claim **1** wherein said oscillator circuit operates in said oscillatory mode when the electrical characteristic of said light sensitive element is within a range of values above said predetermined value, and wherein said oscillator circuit operates in said nonoscillatory mode when the electrical characteristic of said light sensitive element is within a range of values below said predetermined value.

4. The apparatus of claim **1** wherein the electrical characteristic of said light sensitive element is electrical resistance which is inversely proportional to the amount of light detected thereby, wherein said oscillator circuit operates in said oscillatory mode when said electrical resistance is within a range of values above a predetermined level, and wherein said oscillator circuit operates in said nonoscillatory mode when said electrical resistance is within a range of values below said predetermined level.

5. The apparatus of claim **1** wherein said visual indicator means is a neon bulb for providing an indication of the mode of operation of said oscillator circuit.

6. The apparatus of claim **1** wherein said oscillator circuit is a free running astable multivibrator.

7. The apparatus of claim **6** wherein said visual indicator means is a neon bulb, said astable multivibrator operable to intermittently fire said neon bulb during said oscillatory mode, and to render said neon bulb non-conductive during the nonoscillatory mode.

8. The apparatus of claim 6 wherein said astable multivibrator includes first and second legs connected across a D.C. power supply, said first leg including a series connected first resistor and a first neon bulb, said second leg including a series connected second resistor and a second neon bulb, a capacitor connected between the junction of said first resistor and said first neon bulb and the junction of said second resistor and said second bulb, said light sensitive resistor being connected to said second resistor and across said second neon bulb whereby said second neon bulb is continuously non-conductive when said multivibrator is in said nonoscillatory mode and said second neon bulb is intermittently conductive when said multivibrator is in said oscillatory mode, and wherein said visual indicator means includes said second neon bulb.

9. The apparatus of claim 6 wherein said light sensitive element is a light sensitive resistance having a value inversely proportional to the amount of light detected thereby.

References Cited

UNITED STATES PATENTS

2,554,800	5/1951	Steiner	317—124 XR
3,286,508	11/1966	Spiegel.	
3,324,633	6/1967	Revell	55—274

JOHN W. CALDWELL, Primary Examiner

D. MYER, Assistant Examiner

U.S. Cl. X.R.

55—267, 274, 467; 250—218; 331—130; 340—228; 356—207