July 4, 1961 H. S. LIPPINCOTT 2,990,911

MEANS TO INDICATE SHORTING OF PRECIPITATOR BY COLLECTED MATERIAL

Filed Sept. 12, 1957

FIG. 1.

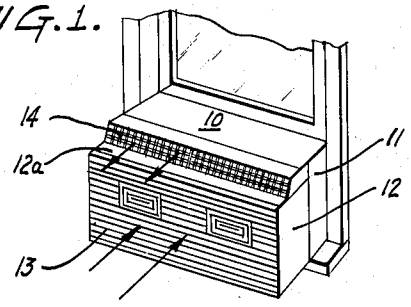
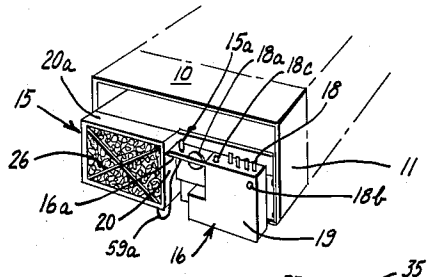


FIG. 2.



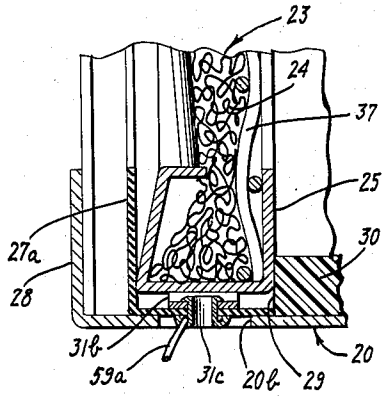


FIG. 4.

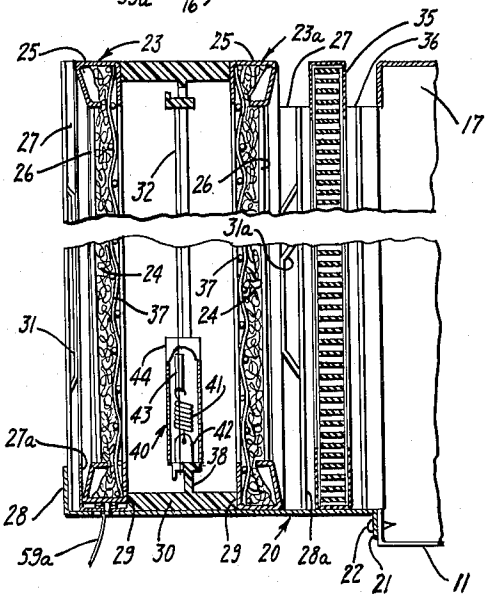


FIG. 3.

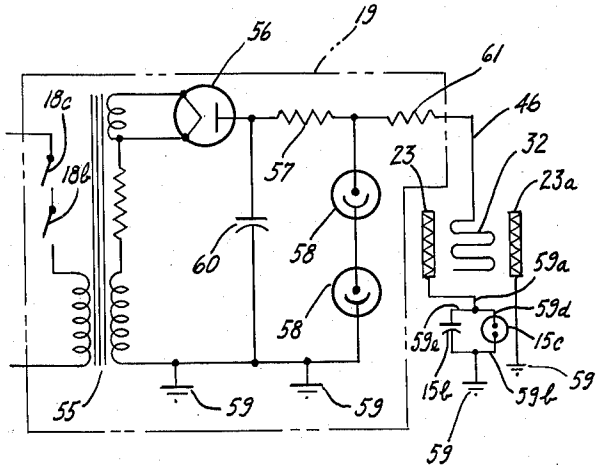


FIG. 6.

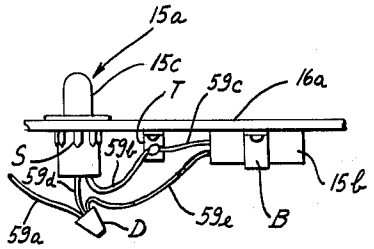


FIG. 5.

INVENTOR.
HOLLAND S. LIPPINCOTT
BY
Carl H. Synnestvedt
AGENT

United States Patent Office 2,990,911 Patented July 4, 1961

2,990,911

MEANS TO INDICATE SHORTING OF PRECIPITATOR BY COLLECTED MATERIAL

Holland S. Lippincott, Riverton, N.J., assignor to Philco Corporation, Philadelphia, Pa., a corporation of Pennsylvania

Filed Sept. 12, 1957, Ser. No. 683,554
2 Claims. (Cl. 183—7)

The present invention has to do with indicating means, and more particularly to means for visibly indicating the performance of electrostatic precipitating apparatus of the type used for cleaning air within a habitable enclosure.

It is known that operation of electrostatic precipitating devices is characterized by the presence of relatively high voltages. Accordingly, and in order to ensure safe operation of air cleaning means comprising electrostatic precipitators of the portable type, as well as, for example, the type utilized in combination with window mounted air conditioners, it is important to include various safety features designed to protect users of such apparatus from the aforementioned relatively high voltages associated therewith. Further, it is to be noted that since operation of an electrostatic precipitator is substantially noise-free, and in the absence of moving parts in such apparatus, a user may be unable readily to determine whether or not the precipitator is operating, or even to distinguish between faulty and normal operation thereof; also in certain electrostatic precipitating apparatus it is necessary that the user periodically clean or replace dust collector elements comprising electrodes of the high voltage electrical circuitry, and it is imperative that means be provided for warning the user of the presence of hazards, in the event of malfunctioning of conventional interlock means provided for deenergizing the apparatus upon disassembly of the same.

Heretofore, no simple, reliable and positive means for indicating the condition of operation of such equipment, in these important respects, has been available. It is, accordingly, the general object of this invention to provide a novel electrical circuit comprising but a single visible indicating means for indicating that the precipitator is operating, that the collecting electrodes, or filters, have become dirty and are in need of replacement, and that the electrical interlock apparatus is operating properly.

It is an additional object of the invention to provide in electrostatic precipitating apparatus visible signaling means for indicating presence of a shock hazard.

A still further object is to provide signaling means of the foregoing type which has a useful life of long duration and requires a minimum of care on the part of the user.

In the achievement of the foregoing and other objects and advantages, a preferred embodiment of the present invention comprises, in combination with an electrostatic precipitator, signaling or indicating means including a glow-discharge lamp disposed in novel and suitable electrical circuitry with an electrode of the precipitator. The invention, in an important aspect thereof, contemplates locating the lamp in series electrical circuitry with the discharge and collecting electrodes of so-called "single stage" precipitator apparatus, the latter being characterized in that the aforesaid electrodes cooperate to provide a combined ionizing and collecting field.

The novel features of the invention, and the manner in which the foregoing and other objects and advantages are best achieved will be apparent from the following description taken in view of the accompanying drawing, in which:

FIGURE 1 is a perspective showing of a window mounted room air conditioner made in accordance with a preferred embodiment of the invention;

FIGURE 2 is a view similar to FIGURE 1, but showing a portion of the housing structure removed;

FIGURE 3 is a somewhat enlarged fragmentary sectional view of the apparatus shown in FIGURE 2;

FIGURE 4 is a further enlarged fragmentary view of apparatus shown in FIGURE 3;

FIGURE 5 is an enlarged fragmentary view, in elevation, of apparatus shown in FIGURE 2; and

FIGURE 6 is a schematic showing of the electrical circuitry of precipitating apparatus embodying the invention.

Prior to a detailed description of the novel apparatus in light of the accompanying drawing, it is pointed out that for purposes of illustration the present invention is embodied in combined filtering and refrigerating apparatus of the type disclosed and claimed in the copending application of Robert G. Kurtz, Serial No. 647,540, filed March 21, 1957, now U.S. Patent 2,933,151, and assigned to the assignee of the present invention.

Now making more detailed reference to the drawing, and particularly to FIGURE 1, there is shown a conventional window mounted air conditioner **10** including a cabinet **11** and a conventional decorative panel **12**. Disposed in the decorative panel are the inlet and outlet air grilles **13** and **14**, respectively, each being in air flow communication with the usual refrigerating and air moving means (not shown) housed within the air conditioner cabinet.

Shown in FIGURE 2 is air conditioner **10** with the decorative panel **12** removed to expose electrostatic filtering and ionizing means **15** in novel combination with indicating means, designated generally by reference numerals **15***a*, with which this invention is concerned. In accordance with the embodiment illustrated, the construction and arrangement of the filter **15** is such that it is disposed intermediate the inlet grille **13** and the inlet air duct **17** of the air conditioner. There is also shown in FIGURE 2 a suitable electrical component structure or "pack" **16**, **16***a*, including cycle controls, indicated at **18** and **18***a* as well as ionizing voltage supply means **19**. Additionally, there is provided suitable interlock switch means **18***b*, which in the embodiment illustrated comprises a push button switch operably engageable with decorative panel **12**, selectively to deenergize or energize voltage supply **19**, in response, respectively, to removal or installation of the latter. Additionally, there is provided a suitable manually operable switch **18***c* for selectively deenergizing and energizing voltage supply **19**. Access to the above mentioned switch **18***c* and controls **18**, **18***a*, as well as indicating means **15***a*, is accommodated by a suitably hinged cover **12***a* provided in the panel **12**.

Now referring again to FIGURE 2, there is shown filtering and ionizing means **15**, including a sleeve-like housing **20** provided with a suitable detachable cover **20***a*. As seen in FIGURE 3, cover **20***a* has been removed thereby providing access to the filter elements to be hereinafter more fully described. Attachment of filtering means to the air conditioner may be made in any suitable manner, and it is seen in FIGURE 3 that the preferred embodiment contemplates the simple expedient of attaching housing **20** by screws **22** passing through flanges **21** thereof and into the air conditioning cabinet **11**. Additionally seen in FIGURE 3 are upstream and downstream impingement type filters or collector electrodes **23** and **23***a*, preferably of metal construction and including coatings of viscous material (not shown). The filter illustrated comprises a filter medium **24** of several layers of expanded aluminum sheet supported within an aluminum frame **25**. Serving further to rigidify the

frame 25 are diagonal cross members 26 which are attached at the corners of the frame by known suitable means.

Retaining means for filters 23 and 23*a* include guide channels 27 comprising flange portions 28 and 28*a* of housing 20, and edges 29 of an insulating frame 30 (to be hereinafter more fully described), said channel being adapted slidably to receive the filters for removal and insertion thereof. Disposed in one of the aforementioned channels 27, preferably although not necessarily the upstream channel, is an insulating member 27*a* comprising an L-shaped sheet of suitable material which serves electrically to insulate frame 25 of metal filter electrode 23 from the housing 20 for reasons to be hereinafter more fully explained.

Referring further to FIGURE 3 there is seen an electrode 32 supported in a serpentine manner by frame 30—which is electrically non-conductive—in vertically extending parallelly disposed spans lying substantially in a plane extending transverse the direction of air flow.

Immediately downstream of the second metal filter 23*a* is a charcoal filter 35 adapted for slidable insertion into or removal from channels 36, much in the manner of filters 23 and 23*a*. Insertion and removal of the foregoing elements is accomplished through the mentioned top access opening provided in housing 20, as best seen in FIGURE 3, and with the cover 20*a* removed. Additional structure includes wire screens 37 affixed to the inner faces of the filters 23 and 23*a*. These wire screens insure proper spacing of the filter media 24 from the ionizing wire 32, inasmuch as metallic filter media of the type illustrated is sometimes flexible and movement thereof may upset the substantially critical spacing between the ionizing wire and the collector electrode.

A tensioning means 40 comprising spring 41 is affixed at one end to suitably formed portion 42 of the web 38 and at the other end to clamping means 43 affixed to wire 32. Enclosing the tensioning means 40 is a sleeve-like member 44 of electrically insulating material. Tensioning means 40 will advantageously compensate for variations in the length of wire 32 and therefore aid in maintaining proper spacing of the wire from the collector electrodes 23 and 23*a* by preventing undue sagging of the wire.

Suitable electrical terminal means (not shown) is associated with the ionizing wire to accommodate energization of the same by wire lead 46 (FIG. 6) to be hereinafter described.

In the channel member 27 adapted to receive the downstream collecting electrode 23*a* there is disposed a leaf spring 31*a* adapted resiliently to bear against the inserted electrode to retain the same and enhance electrical contact of the latter to grounded housing 20. There is further provided in the channel member 27, adapted to receive upstream filter 23, a leaf spring 31 adapted to bear against insulating member 27*a* which is thereby urged against an inserted filter 23, to retain the same.

In particular accordance with one aspect of the present invention, and as best seen in FIGURE 4, an aperture 20*b* is provided in housing 20, said aperture accommodating passage of wire lead 59*a*. Wire lead 59*a* is electrically connected to leaf spring contact 31*b* by means of eyelet 31*c*, the latter serving also to mount contact 31*b* upon insulating member 27*a*. Thus it is seen that filter electrode 23 is electrically insulated from the grounded housing 20, and the sole electrical contact to the filter 23 is made through the above described contact 31*b*.

Now referring to FIGURE 5 there is seen in detail the indicating means 15*a* shown in FIGURE 2, said means comprising a capacitor 15*b* and a lamp 15*c* of the type commonly known as a glow-discharge lamp. There is of course included known suitable bracket means B associated with structure 16*a* for supporting the capacitor 15*b* as well as known snap-action means S for holding the base portion of lamp 15*c* in a suitable aperture provided in the aforementioned structure 16*a*. There is also provided associated electrical circuitry for incorporating the indicating means into the electrostatic filtering circuit, said circuitry including wire lead 59*a*, terminal means T for grounding leads 59*b* and 59*c*, as well as connector D for joining leads 59*d* and 59*e* to 59*a*.

Now referring to FIGURE 6 of the drawing there is seen a schematic diagram of suitable electrical circuitry for producing the desired combined ionizing and collecting electrostatic field, in novel combination with the indicating circuit with which the present invention is concerned.

Transformer 55, the primary winding of which may be supplied, through interlock switch 18*b* and manual switch 18*c*, with electrical power from a suitable source, supplies a voltage, for example about 6000 volts, to a half wave rectifier tube 56, the same D.-C. voltage being impressed across ionizing electrode 32 and filter electrodes 23 and 23*a*. This voltage is maintained substantially constant by resistor 57 and corona discharge tubes 58, and condenser 60 provides means for maintaining peak voltage supplied by the rectifier tube 56. A resistor 61 is also provided as shown, to control the current through the electrodes 32 and 23, preferably limiting the current to a value of about 10 microamperes.

In particular accordance with the present invention, lead 59*a* extending from the spring terminal 31*b* contacting the electrodes 23 and 23*a* is connected to ground 59 through the glow-discharge lamp 15*c* and the capacitor 15*b*, the latter elements being connected in parallel as shown. Lamp 15*c* comprises a suitably encapsulated neon lamp of the type known commercially as Ne–2, 1/25 watt, and capacitor 15*b* comprises a cylindrically formed .067 μfd. condenser of known type.

Thus, the novel indicating means is disposed in series with a collecting electrode of the air cleaning and filtering apparatus. Disposition of the indicating means in the circuit is such that functioning of the high voltage elements, as well as the apparatus preceding the same will be indicated.

In preferred operation of such a combined filter and ion generator a negative potential is applied to the ionizing wire 32 whereupon electrostatic fields are set up between the ionizing wire and the upstream and downstream filters, or electrodes, at least the former being grounded through the novel indicating apparatus 15*a*. Accordingly, a charge builds up on the upstream filter electrode 23, as well as on the capacitor. When the firing potential of the neon lamp 15*c* is reached, the built-up charge discharges to ground through the lamp, accompanied by glow of the latter. The aforementioned cycle is repetitive in nature, and the frequency of its occurrence will depend, for example, upon the value of the corona current existing at the ionizing wires. Such current may be a function, for example, of the presence of an excessive accumulation of particulate matter upon the electrode 23, this matter tending to bridge the insulating members 27*a*, 30 and housing 20, thereby electrically to ground the said electrode; particulate accumulation is therefore reflected in that a longer period of time is required to build up to the firing potential of the neon lamp 15*c*, to light the same. It is seen therefore that because the lamp is in series with the high voltage elements, excessive particulate accumulation is readily indicated. Thus, progressive fouling of filter 23 will be indicated by a diminishing frequency of light pulsation or "flicker." In the event of component malfunctioning, the nature of the electrical circuitry is such that the lamp will of course cease to fire, thereby indicating a failure in the system, inasmuch as the necessary lamp firing potential will not be attainable. Finally safety of a user of the apparatus is ensured by visual indication of the presence of a shock hazard in the event the interlock feature should fail to deenergize the high voltage

circuit upon removal of the panel 12. Thus, as will now be appreciated, complete operation of the air cleaner is indicated, and failure of any phase of its operation will be indicated by the device hereinbefore described.

Although, in the illustrated embodiment of the present invention, the novel indicating means has been disposed in series circuit with the upstream collector electrode 23, it is to be understood that the downstream collector electrode 23*a* may be disposed in like circuitry with the indicating means, either singly or in tandem with the upstream electrode 23.

While this description and the accompanying drawing are illustrative of a preferred embodiment of the invention, it will be recognized that changes and modifications may be made in the described apparatus, without departing from the scope of the appended claims. For example, there may be provided unitary indicating means 15*a* comprising the essential elements illustrated in FIGURE 5, whereby the means 15*a* serves as a portable test instrument to use with precipitating devices not thus equipped. To this end, element 16*a* may comprise suitable insulating frame structure, and terminal T and lead 59*a* could be modified by affixing thereto leads provided with suitable known clip means for attaching to appropriate electrical components of a precipitator.

I claim:

1. In single stage electrostatic precipitator apparatus, a discharging electrode and a collector electrode consisting of an electrically conductive filter screen, means for applying a high D.-C. potential between said electrodes to create a combined particle ionizing and collecting field therebetween, and visibly pulsating indicator means operative over a range of pulse frequencies and including means for changing said frequencies in response to changes in the amount of particulate collection by said filter screen.

2. Precipitator apparatus in accordance with claim 1, wherein said indicator means comprises a capacitor and a glow discharge lamp arranged in parallel circuit and each disposed in series electrical circuitry with said filter screen and said means for applying a potential.

References Cited in the file of this patent

UNITED STATES PATENTS

2,129,783	Penney	Sept. 13, 1938
2,189,614	Penney	Feb. 6, 1940
2,579,441	Palmer	Dec. 18, 1951
2,738,443	Danziger	Mar. 13, 1956
2,791,725	Williams	May 7, 1957
2,798,572	Fields	July 9, 1957

OTHER REFERENCES

Article titled "Novel Test Meter," in vol. 47, issue 4, page 42 of April 1952 issue of Radio and Television News.