Sept. 29, 1953

W. W. HICKS

2,654,017

BASEBOARD HEATER CONSTRUCTION

Filed Feb. 5, 1951

FIG_1_

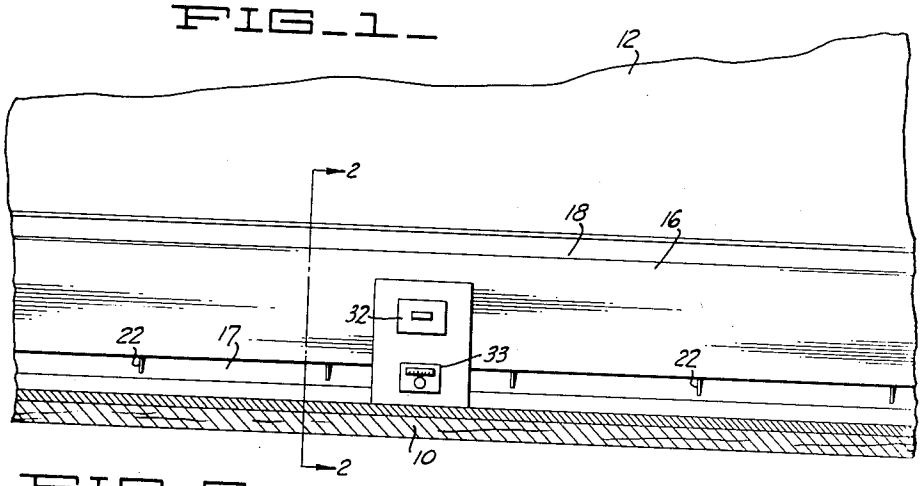


FIG_2_

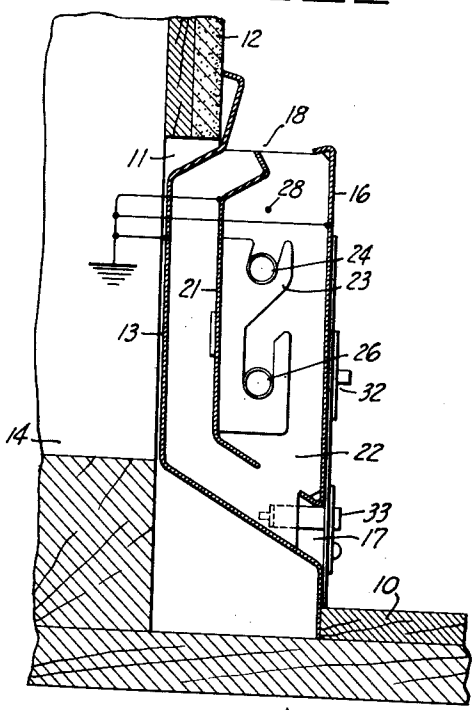
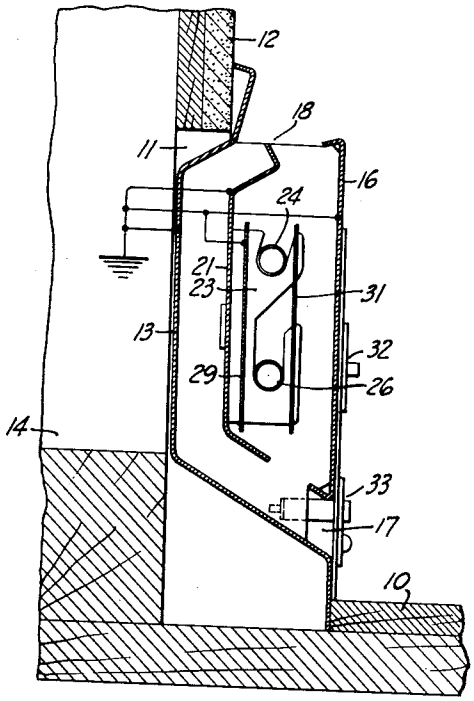


FIG_3_



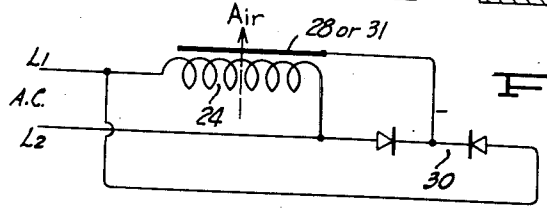


FIG_4_

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UNITED STATES PATENT OFFICE

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BASEBOARD HEATER CONSTRUCTION

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Application February 5, 1951, Serial No. 209,435

2 Claims. (Cl. 219—34)

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This invention relates generally to devices for preventing dust particles from adhering to the walls of a room.

Everyone is aware of the smudge created by dirt deposited upon a wall or ceiling immediately adjacent a baseboard heater or other heater which is mounted on the wall or the smudge which is deposited on a wall immediately above a heater outlet. Various devices have been utilized in an attempt to eliminate these smudges but they have in the main been unsatisfactory. Such prior devices include electrical precipitators which are designed to dispose of the dirt which creates the smudge by precipitating the same within the device. These devices rely upon the use of extensive and expensive equipment which is at best extremely sensitive and requires proper design, proper electric potentials and proper air velocity. The change in the electric potentials or an increase in the air velocity reduces the efficiency of these devices substantially and after a point, for practical purposes, they are unsatisfactory for the purposes intended.

Furthermore, some of the devices require ideal conditions which in actual fact do not exist. These devices rely upon the assumption that the removal of approximately 90% of the dust will be sufficient, ignoring the fact that a space charge will be built up within a room and that there will be a resulting force on charged particles of dust which will propel them toward the wall thereby causing them to be deposited upon the wall with resulting smudge. The residual space charge is objectionable. A more satisfactory solution is perfected in my invention which is to remove the charge on some of the particles rather than to remove the particles themselves. I have found that the circulation of dust particles around a room will be determined by both the currents of the air and the electrostatic field resulting from the space charge that might exist.

It is an object of my present invention to provide a smudge eliminator which is adapted to be incorporated in a conventional electric baseboard heater or panel heater of the type which consists generally of a low panel extending along at least one wall of a room.

It is a further object of this invention to provide a combined air heater and device which will eliminate the accumulation of smudge immediately above the heating panel.

It is a further object of this invention to provide a device of this character which may be utilized generally in connection with baseboard

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or panel heaters which are presently on the market.

Other objects and advantages of the present invention will appear from the following specification taken in conjunction with the accompanying drawings in which:

Figure 1 is a front view of a base board heater construction incorporating my invention;

Figure 2 is a cross-sectional elevation taken along the line 2—2 of Figure 1;

Figure 3 is a cross-sectional detail similar to the view illustrated in Figure 2 and showing one modification of the invention; and

Figure 4 is a circuit diagram showing the method of connecting my baseboard heater and its various components.

As shown in the drawings a baseboard heater is adapted to be mounted along the base of a wall of a room adjacent to the floor 10 within a recess 11 in a wall 12. The heater consists generally of a backing plate 13 which may be secured to studding 14 behind the wall surface 12 in any suitable manner. Plate 13 supports the remainder of the heater.

A face plate 16 is provided which, as shown, is generally spaced from the backing plate 13 to form a longitudinal inlet opening 17, at the lower edge of the device and a longitudinal outlet opening 18 at the upper edge of the device. Within the space between the backing plate 13 and the face plate 16, I have mounted a vertical baffle 21 which may be secured to the device in any conventional manner as by spacers 22. The baffle 21 retains the supports 23 for a pair of heating elements 24 and 26. The heating elements 24 and 26 are preferably electric elements.

Located within the stream of the convection currents of air passing through the heating device there is an electric conductor 28. This conductor is adapted to be maintained at a negative potential by suitable electric means connected to the same.

Figure 4 illustrates a suitable electric circuit for making connection between the various electric elements in which the heating elements 24 and 26 are adapted to be energized by a suitable source of alternating current. The supply lines L-1 and L-2, which represent lines supplying ordinary house current of either 110 or 220 volts, are connected to the heating elements and also to a rectifier 33. The negative side of the rectifier is connected to the conductor 28. The walls 13, 16 and 21 are grounded. As indicated diagrammatically in Figure 4, the conductor 28 is

located in the path of flow of convection currents of heated air from the element **24**.

A particle such as a dust particle, if carrying electrical charge of either positve or negative polarity, will tend to move away from another electric charge of like polarity and toward another electric charge of unlike polarity. Thus, a positively charged dust particle floating freely in air will move away from a region or surface containing positive electrical charge, and toward a region or surface containing negative electrical charge. In other words, there is force on a charged particle that is in an electric field.

An uncharged or electrically neutral particle will have no such tendency. It will not be acted on by the presence of electric charge. Expressed in other words, there will be no force on a neutral particle in a uniform electric field.

In ordinary air, in any ordinary room that does not have devices for either increasing or decreasing the amount of natural ionization, there are electrical charges resulting from natural ionization such as traces of radioactivity and cosmic rays. These charges are called ions; they are particles of various sizes suspended in the air, the largest being particles of dust or moisture and the smallest that can exist for any appreciable length of time being the size of one or more air molecules. There is a tendency for such ions to attach themselves to dust or moisture particles if there are any such particles present in the air. Dust particles may be as small as 1/10,000 millimeter in diameter or less, and they may be as large as 25 to 50 thousandths of a millimeter. Air molecules are of the order of 3×10^{-7} millimeters in diameter. The usual average number of such ions in ordinary air varies from a few hundred to one or two thousand per cubic centimeter of air. The presence of these is not appreciable except by electrical test. However, they can be measured with appropriate apparatus.

If the number of positive ions in a given volume of air is equal to the number of negative ions in that volume, the resulting mixture has no net electrical charge. It is, on the whole, electrically neutral. If such a volume of air were free from outside influences, the positive and negative particles would in course of time come into contact with each other and the individual charges would neutralize each other. This process of neutralization of individual ions takes place slowly, and a region of air may contain a mixture of positive and negative ions for a considerable length of time.

It is usual, in any ordinary room, during ordinary weather, for the number of positive ions per unit volume of air to exceed the number of negative ions per unit volume. Thus, there may be 500 negative ions per cubic centimeter and 800 positive ions per cubic centimeter; these are reasonable numbers, but on another day, with different weather conditions, the number of each polarity of ions may be twice as great.

A piece of metal, such as the wire forming the electric heater elements **24** and **26**, when heated to the temperature of dull red heat, emits positive ions into the surrounding air. At a somewhat higher temperature (the exact temperatures of ion emission depend on the material and on the condition of its surface) the metal also emits electrons which quickly form negative ions in the air. However, my electric heater ordinarily operates at a temperature at which the emission of positive ions greatly exceeds the emission of negative ions.

In a room containing ordinary air with normal ionization, with the number of positive ions per unit volume exceeding the number of negative ions per unit volume, there is a net positive charge in the space of the room equal to the excess of the positive charge over the negative charge. This is called the net positive space charge. This space charge is attached to ions of air or to particles of dust or moisture in the air. It is distributed throughout the space of the room.

The net positive space charge induces an equal and opposite charge, a charge of negative polarity, on the walls or ceiling and floor **10** of the room. The amount of the charge on the walls **12**, ceiling and floor **10** is equal to the amount of the net positive space charge within the room. Between the charge on the walls **12**, ceiling, and floor **10** and the space charge suspended in the air of the room there is an electric field. This field is most intense near the walls **12**, ceiling, and floor **10**, but it exists everywhere except at the exact center of the room.

Dust particles in a room containing ions will be electrically charged, for ions attach themselves to dust particles as soon as there is an opportunity for them to do so.

In a room containing net positive space charge, dust particles with positive charge are driven by electric force toward the walls **12**, ceiling, and floor **10** of the room. This is theoretically evident, as explained above, and it has also been experimentally demonstrated by G. W. Penney and G. W. Hewitt (see "Electrically Charged Dust in Rooms," Trans. Am. Inst. Elect. Engrs., vol. 68, pp. 278–82, 1949).

I have discovered that an electric heater produces an excess of positive ions over negative ions, as a result of emission from the heating element. The amount of ion emission depends on the size and kind of heater element, but if no provision is made to compensate for this natural emission of an excess of positive ions, the net positive space charge within a room containing an electric heater may be greatly increased over the net positive space charge in the same room when there is no electric heater operating. I have measured the ionization in rooms with electric heaters, and have found that the positive ion density may be increased to ten thousand or more ions per cubic centimeter.

It is evident from theory, and is also demonstrated in the work by Penney and Hewitt as described in the article cited above, that when the space charge in a room is increased, as by the space charge owing to an electric heater, charged dust particles are driven more rapidly and more forcefully toward the walls **12**, ceiling, and floor **10** of that room. I have found that the soiling and darkening of the walls that is called "smudging" is thereby increased. It is, in fact, common knowledge that there is a tendency for a wall **12** to smudge above an electric heater that is set in the wall **12** of a room if the air of the room is somewhat contaminated or unclean.

The smudging takes place above the electric heater because the warmth of the heater produces circulation of the contaminated air past this region of wall **12**. The airborne particles of dust, while passing through the heater, have become positively charged by attachment of positive ions emitted by the heater element. As soon as these positively charged particles rise

above the heater, they are exposed to the electric field and are acted upon by the electric force resulting from the space charge in the room, and are driven toward the wall **12**. Some strike the wall **12** forcibly and stick thereto, producing the undesirable smudge. I have found that wall smudging is caused primarily by and consists primarily of various small particles of about one micron in size.

As prevously pointed out herein, it is the purpose of my invention to reduce or eliminate such smudging. I have found that this can be done by placing certain additional elements in the electric heater for the purpose of altering or controlling the amount and polarity of the electric charge on small ions in the air that is circulated through the electric heater and exhausted from the heater into the room. These additional elements act to remove positive electric charge from some or all of the dust particles that are carried by the circulating air through the heater, and to replace the positive electric charge with negative electric charge on some or all of such dust particles.

Removing electric charge from dust particles is effective because dust particles that are electrically neutral will not be acted on by the electric field of the space charge when they are discharged into the air of the room, and, therefore, they will not be driven against the wall by electrical force. Placing negative charge on dust particles is even more effective because when negatively charged dust particles are discharged into the room they are acted on by an electrical force that is directed not toward the wall **12** but toward the center of the room, and when such negatively charged particles are driven toward the center of the room they are not only prevented from smudging the wall but also they mix with the other charged ions in the air of the room, and since they are negatively charged whereas the net space charge in the air of the room is normally positive, they reduce the net space charge and thereby reduce the electric field that exists between the space charge and the walls **12** of the room. By thus reducing the electric field within the room, the electric force that tends to drive other positively charged dust particles against the wall **12** is diminished, and in this way the effect of placing negative charge on a dust particle is not only to prevent that particle from being driven against the wall **12**, but also to lessen the number of other particles driven against the wall **12**, and the force with which such other particles may be driven against the wall **12**.

To this end, I propose to place a negatively charged electrode **28** in the path of the air leaving the heater. The electric circuit, with rectifier, shown in Figure 4, is one possible way of maintaining the desired negative charge on electrode **28**. When dust particles with positive charge are carried through the heater by the circulation of air, some of them will be attracted by the negative charge on electrode **28**. Those dust particles that come into contact with electrode **28** will lose their positive charge. The positive charge may be, and in many cases will be, replaced by negative charge, and the dust particle will then pass out into the air of the room either electrically neutral, or carrying a negative charge. This is the purpose of the invention, as explained above.

As shown in Figure 2, electrode **28** takes the form of a wire or other suitable electrical conductor in the air stream, electrically insulated from all other parts of the heater and negatively charged. Another and even more effective arrangement of elements is shown in Figure 3, wherein the plates **29** and **31** are placed in the air stream. One of these plates is electrically insulated from the other parts of the heater and is negatively charged, as may be done by connecting it to the negative terminal of the rectifier of the circuit shown in Figure 4. The other of the two plates is electrically connected to other parts of the heater and so to ground. It is not important which of the plates **29** is negatively charged, and which is grounded. A dust particle entering the space between plates **29** and **31**, being carried by the circulating air, may have positive charge from some natural and external source, or it may acquire positive charge by attachment of one of the positive ions emitted by the heater elements **24** and **26**. In either case, every positively charged dust particle passing between plates **29** and **31** will be attracted toward the negative plate. Those positively charged particles that come into contact with the negative plate will lose their positive charge and will then pass on into the room carrying either a negative charge or no charge of either sign. The dimensions of the plates are so related to the speed of circulation of the air that dust particles thus receiving a negative charge will be transported out of the space between plates **29** and **31** before they can be drawn by electrical forces against the opposing or grounded plate. Thus it is provided that many dust particles will carry a negative charge when they are transported by the circulating air into the room.

Tests have shown that either the means of Figure 2 or those of Figure 3 act to diminish smudging, the latter being the more effective.

This application is a continuation-in-part of my copending application Serial No. 106,604, filed July 25, 1949, now abandoned.

I claim:

1. In an electric heater construction for discharging into a room air having substantially equal numbers of positively and negatively charged dust particles, the electric heater having a heating chamber containing a resistance heating element and into which chamber air to be heated is drawn through narrow passageways and from which chamber warm air is expelled through narrow passageways, means for shifting the balance of ion concentration of the air expelled from the heater to substantially equal positive and negative polarity comprising an electrode adjacent the heating element of said electric heater and positioned adjacent the opening from which warm air is expelled, and means for applying a constant negative charge to said electrode.

2. An electric heater for discharging into a room air having substantially equal numbers of positively and negatively charged dust particles, said heater comprising an elongated structure adapted to be positioned along the bottom of a wall and defining an elongated heating chamber, an elongated resistance heating element in said chamber extending longitudinally thereof, said chamber being relatively narrow whereby to define a plurality of narrow air passageways from the bottom to the top thereof, air inlet openings adjacent the bottom of said chamber and an elongated air outlet opening extending along the top of said chamber, said resistance heating element causing convection currents of

heated air to establish upward flow of air through said narrow passageways, means for shifting the balance of ion concentration of the air discharged from said heater to substantially equal positive and negative polarity comprising an elongated electrode adjacent the heating element and extending lengthwise of said chamber throughout substantially the length thereof and positioned adjacent the air discharge opening, and means for applying a constant negative charge to said electrode.

WILLIAM WESLEY HICKS.

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