May 13, 1958 J. O. TAYLOR ET AL 2,834,132

ELECTROSTATIC APPLYING AND HOLDING DEVICE

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FIG. 1.

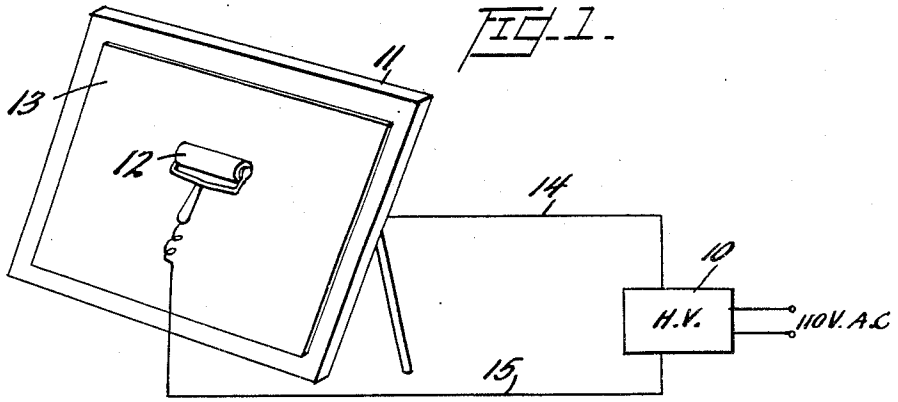
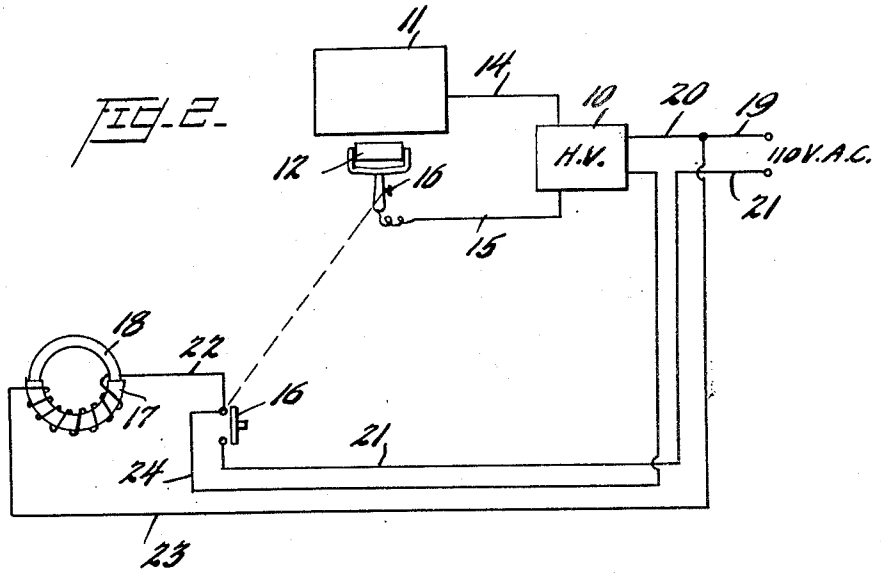


FIG. 2.



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FIG. 3.

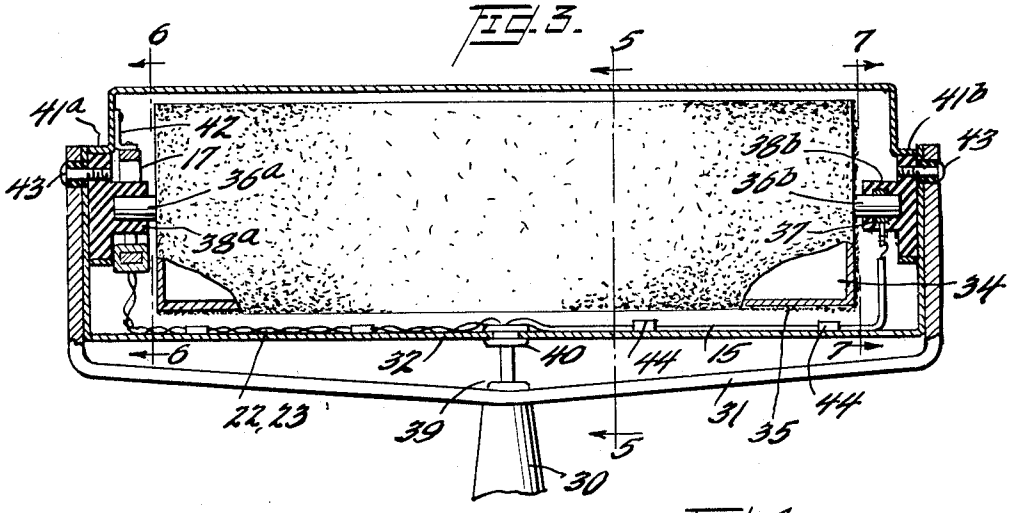


FIG. 4.

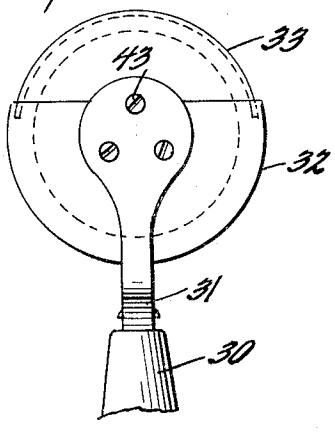


FIG. 5.

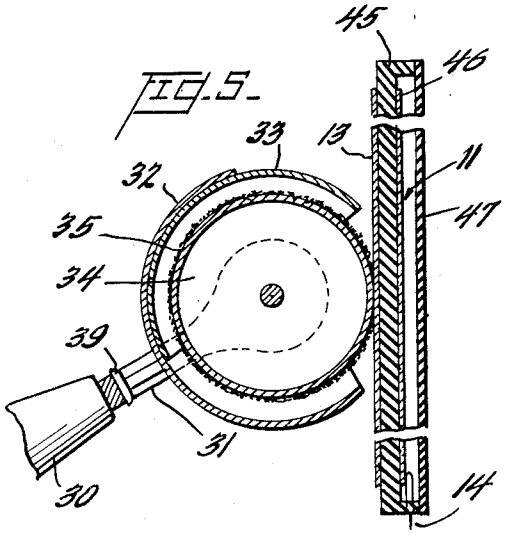


FIG. 6.

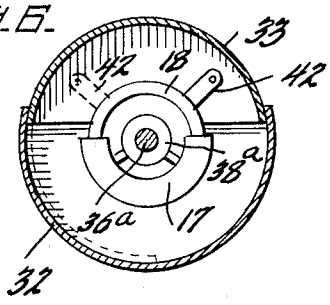
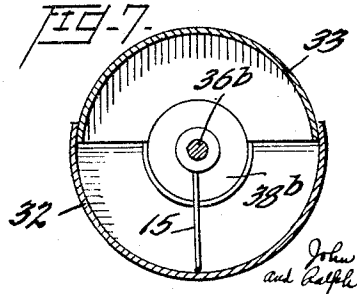


FIG. 7.



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ELECTROSTATIC APPLYING AND HOLDING DEVICE

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Application December 14, 1954, Serial No. 475,195

5 Claims. (Cl. 40—125)

This invention relates to new and improved apparatus for holding sheet material upon a supporting surface.

A principal object of this invention is to improve the smoothness of display of sheet materials.

Another object is to minimize the manual effort usually required in providing for a smooth display of sheet materials having a relatively large area.

Another object is to eliminate the mechanical and physical disfigurement of sheet material incurred during holding.

Another object is to provide a versatile sheeet applying and holding device capable of holding a sheet in any desired position with respect to a backing surface.

Heretofore most structures designed for holding sheet material in a desired fixed position with respect to a supporting surface have featured mechanical or adhesive arrangements. Many structures operative in accordance with these techniques have been unsatisfactory for the reason that it has been impossible to display or hold sheets having a relatively large area in a manner free from wrinkles and creases.

Electrostatic principles have also been applied in certain industrial applications for the purpose of holding sheet material in a desired position upon conveyor belts and other movable structure. In these applications, the necessary potentials are usually generated by the friction of moving components with a resulting attraction between a charged sheet and a conveyor belt or the like. Notwithstanding the fact that the application of electrostatic principles to sheet holders results in an advantageous mode of operation wherein large sheets may be displayed in a desired position completely free from creases and wrinkles, no one has heretofore suggested that these principles may be advantageously applied to a display board type sheet holder, and without a movement of components to generate a holding potential by friction.

In a preferred embodiment of this invention, a relatively flat display board is utilized to support sheet material on one surface thereof. From a generic aspect, however, the supporting surface of the board may be formed so as to have a surface of considerable contour. With either construction, the sheet will be held with a minimum of unwanted wrinkles and creases. The purpose for which the sheet is to be supported is not material to this invention, and it may well be that the sheet is to be held for exposure such as may be required in photography, or for visual display, or so that information may be sketched or written thereon. In any event, with the application of the structure of this invention to a display board, it is possible to hold the sheet in any desired position relative to the surface of the board without the use of mechanical holding means such as clamps, thumb tacks, etc., and without the use of adhesives such as glue or paste.

This mode of operation is obtained herein by enclosing within the display board a relatively flat, sheet-like electrode generally parallel to the supporting surface of the board. Inasmuch as a relatively high voltage is to be connected to this electrode sheet during the holding operation, the sheet supporting surface of the display board is formed of an insulating sheet of plastic or the like. The sheet which is to be held is manually placed upon the supporting surface of the board and is subjected to an electrostatic field of exceedingly high intensity by applying a potential to the exposed surface thereof by means of an electroconducting roller or the like. By continually rolling the energized roller over the surface of the sheet so that all areas thereof have been subjected to a relatively high electrostatic intensity, electrostatic attraction causes the sheet to adhere to the display board in a manner free from all wrinkles and creases and without necessity of mechanical or adhesive holding means.

In order that the structural features for attaining the objects of this invention may be readily understood, reference is herein made to the accompanying drawings wherein:

Figure 1 is a simplified diagrammatic representation of the basic structure employed in the electrostatic sheet applying and holding device of this invention;

Figure 2 is a schematic diagram of the electrical circuitry employed in a preferred commercial embodiment of this invention;

Figure 3 is a partially broken-away view of a high-voltage, roller-type applicator for applying an electrostatic charge to a sheet which is to be held;

Figure 4 is an end view of the applicator shown in Figure 3 with the roller guard cover in the safety position;

Figure 5 is a sectional view taken along line 5—5 of Figure 3 and showing the application of the roller type applicator to a sheet mounted on a display board shown in section;

Figure 6 is a sectional view taken along line 6—6 of Figure 3 and showing the roller guard cover in both the safety and operate positions; and

Figure 7 is a sectional view taken along line 7—7 of Figure 3 and showing the roller guard cover in the safety position.

Referring now to Figure 1, the basic elements of the electrostatic sheet applying and holding device of this invention comprise a high voltage energizing source **10**, a display board **11**, and an applicator **12**. The input terminals of source **10** will in most installations be energized from a commercial 110 volt alternating-current distribution line. The high-voltage output of source **10** is a direct-current potential of the order of several thousands of volts. The potential of one of the high-voltage output terminals is applied by conductor **14** to a sheet-like metallic electrode **46** (shown in Figure 5) positioned within or on the backside of display board **11** so as to be in a parallel plane with respect to sheet **13** which is to be held in a fixed position with respect to display board **11**. The other high-voltage output terminal of source **10** is connected to a roller type applicator **12** by means of conductor **15**. A high-voltage circuit path is provided within roller type applicator **12** as will be hereinafter explained in detail so that the surface of the roller assumes the high-voltage potential of conductor **15**. If sheet **13** is manually held in the desired position upon display board **11** and applicator **12** is manually moved over the surface of sheet **13**, the intense electrostatic field generated between applicator **12** and the electrode connected to conductor **14** will cause sheet **13** to adhere to the display surface of board **12** by electrostatic attraction in a manner free from all wrinkles and creases.

The amplitude of the direct-current output potential of source **10** necessary to effectuate optimum holding will vary in different situations. In the main, the magnitude of this potential is dependent upon the thickness and dielectric constant of sheet **13** and also the thickness and

dielectric constant of the insulating surface of display board **11** upon which sheet **13** is held. In any event, the optimum minimum potential for high voltage source **10** may be readily determined by attempting to hold a sheet in place while working through a range of output potentials. In view of the high voltage employed it may be readily appreciated that the lowest voltage satisfactory for proper holding is desirable from a safety aspect.

In Figure 2, push-button type switch **16** and a solenoid **18** have been added to the circuitry to provide a commercial embodiment of the basic structure shown in Figure 1. Push-button switch **16** is advantageously located on the handle of roller type applicator **12** and is electrically connected in the input circuitry of high voltage source **10** so that manual depression of the switch is required to close the energization circuit from the 110 volt A. C. line terminals through conductor **21**, closed push-button switch **16**, conductor **24**, input of high voltage source **10**, conductor **20** and conductor **19** to the line source. In the event high voltage source **10** incorporates a filament type rectifier tube and a filter circuit having a relatively long time constant, some delay will be introduced in the time interval within which output will appear from high voltage source **10** after the depression of push-button switch **16**. Should this delay be objectionable, a high voltage relay may be incorporated in the output circuitry of high voltage source **10**, and push-button switch **16** may be connected to a low voltage energizing coil for this relay. With this arrangement, filament heating and capacitor charging delays will be eliminated. However, the high voltage supply will be energized at all times and an additional switch will be required to de-energize source **10**.

In a preferred construction for roller type applicator **12**, roller **34** is enclosed within a metallic safety housing. This housing comprises a movable cover portion which is withdrawn by energizing toroidal solenoid **17** by current flow in a circuit which includes conductor **21**, closed switch **16**, conductor **22**, the winding of solenoid **17**, conductor **23** and conductor **19**. Armature **18** is rotatably moved in response to the energization of solenoid **17**, and as will be hereinafter described in detail this armature movement is translated into a corresponding movement of the safety cover for applicator **12**. Accordingly, the depression of switch **16** energizes high voltage source **10** and thereby applies high voltage to applicator **12** and the electrode of display board **11**, and also effectuates the withdrawal of the safety cover for applicator **12**.

Referring now to Figures 3 through 7, high voltage applicator **12** comprises a cylindrical roller **34** supported at the terminal ends thereof by trunnions **36***a* and **36***b* which mate with bearings **38***a* and **38***b*, respectively. The bearings are fabricated of any conventional insulating material suitable for withstanding relatively high voltages. Roller **34** is housed within protective metallic covering structure comprising roller guard **32** and roller guard extension **33**. Each bearing **38***a* and **38***b* includes a flat base portion which is screwed to the associated end wall portion of roller guard **32** and the projecting flange portions of bracket **31** by means of screws **43**.

The cylindrical surface **35** of roller **34** is processed with an electroconducting film which may be aquadag or silver paint, and the right-hand portion of roller **34** is also processed with a corresponding conducting film whereby trunnion **36***b* is electrically connected to the cylindrical surface **35** of roller **34**. Metallic slip ring **37** is formed within bearing **38***b* and establishes a friction electrical contact with trunnion **36***b*. High voltage conductor **15** is soldered or otherwise connected to the projecting lug of slip ring **37** and is clamped to the bottommost portion of roller guard **32** by means of clamps **44**. Grommet **40** insulates high-voltage conductor **15** from roller guard **32**, and the cable is fed through an axial hole located within handle **30**. Grommet **39** insulates conductor **15** from metallic support bracket **31**.

The terminal ends of roller guard extension **33** are formed with flanges **41***a* and **41***b* which bear against the base portion of bearings **38***a* and **38***b*, respectively. This coupling arrangement enables roller guard extension **33** to be relatively movable with respect to roller guard **32** whereby roller **34** may be partially exposed or fully enclosed by the protective metallic housing as desired. An exposed view of the roller is shown in Figure 5.

Toroidal solenoid **17** is fixedly positioned upon the projecting portion of roller support bearing **38***a* and the motion of the movable armature **18** is transmitted to roller guard extension **33** by means of connector **42**. With such an arrangement, the energization of solenoid **17** causes the withdrawal of roller guard extension **33** at the desired times in response to the manual depression of push-button switch **16**. Biasing springs (not shown) force armature **18** in a position which will cause roller guard extension **33** to envelop roller **34** whenever push-button switch **16** is in the open position. Figures 4, 6 and 7 show the roller applicator **12** in the safety position in which guard extension **33** and guard **32** fully enclose roller **34**. Figure 5 and the broken line positioning of components in Figure 6 show guard extension **33** in the withdrawn position.

The detailed construction of a preferred embodiment of a display board **11** is shown in Figure 5. The display board comprises a front cover **45** constructed of insulating material and a back cover **47** also constructed of insulating material. Metallic sheet **46** is fixedly positioned within the box-like display board structure and conductor **14** provides an electrical path to electrode **46** from the high voltage source. As is shown in Figure 5, with roller guard extension **33** withdrawn in response to the energization of solenoid **17**, the electroconducting coating **35** of roller **34** creates a relatively intense electrostatic field in the shortest straight line distance between film **35** and electrode **46** whereby electrostatic attraction causes sheet **13** to adhere to the front section **45** of display board **11**. By manually moving applicator **12** over all surface portions of sheet **13** electrostatic attraction causes sheet **13** to adhere smoothly and firmly upon the front section of display board **11** without wrinkles and creases.

It is to be understood that the above-described arrangements are illustrative of the applications of the principles of this invention. Numerous other arrangements may be devised by those skilled in the art without departing from the scope of the invention.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. An electrostatic sheet applying and holding device comprising sheet holding means including a relatively smooth sheet supporting surface of electrical insulating material, a flat electrode supported on the back of said sheet supporting surface, an instrument comprising an extended current carrying surface providing a second electrode, and a source at high voltage current connected with said electrode whereby when a sheet is placed upon the sheet supporting surface, the sheet is charged when the instrument is moved thereover and the sheet is sustained upon the supporting surface by the electrostatic charge induced on the sheet.

2. An electrostatic sheet applying and holding device in accordance with claim 1 wherein said instrument has a cylindrical shape.

3. An electrostatic sheet applying and holding device according to claim 2 where said instrument is rotatably mounted.

4. An electrostatic sheet applying and holding device comprising sheet holding means including a relatively smooth sheet supporting surface of electrical insulating material, an electrode conforming to the configuration of and disposed adjacent to said sheet supporting surface, an instrument comprising a current carrying surface providing a second electrode, and a source of high volt-

age connected between said electrodes whereby when a sheet is placed upon the sheet supporting surface, the sheet is charged when the instrument is moved thereover and the sheet is sustained upon the supporting surface by the resulting electrostatic charge.

5. An electrostatic sheet applying and holding device in accordance with claim 4, wherein said instrument comprises a cylindrical roller and adjustable guard means mounted adjacent the periphery of said roller.

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