May 27, 1952 C. D. TUTTLE ET AL 2,598,466

ELECTROSTATIC SPRAY PAINTING METHOD AND APPARATUS

Filed July 13, 1948 2 SHEETS—SHEET 1

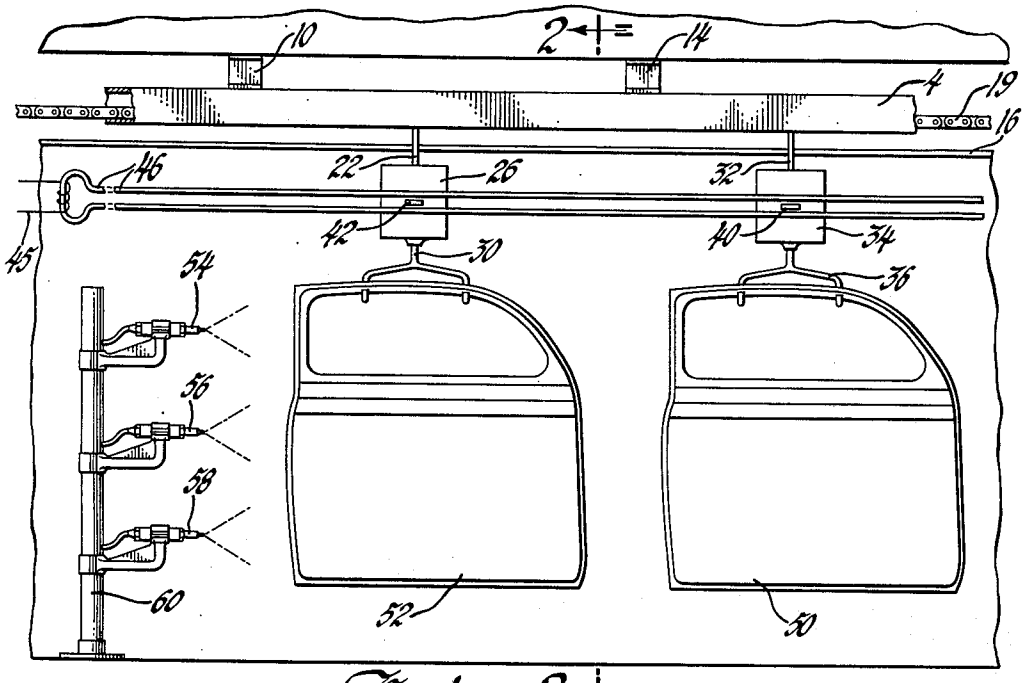


Fig. 1

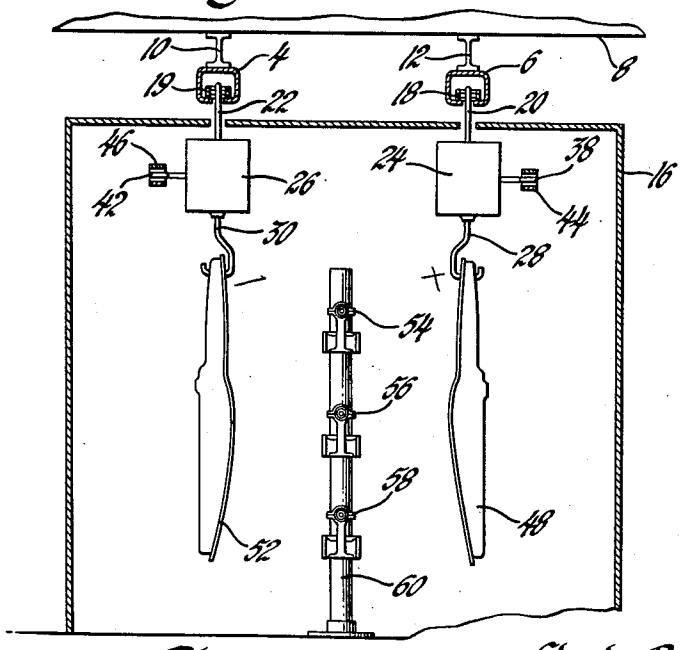


Fig. 2

Inventors
Charles Derwood Tuttle
Grayland T. Larsen &
Lewis J. Lamm
By Spencer, Willis, Helwig & Baillio
Attorneys

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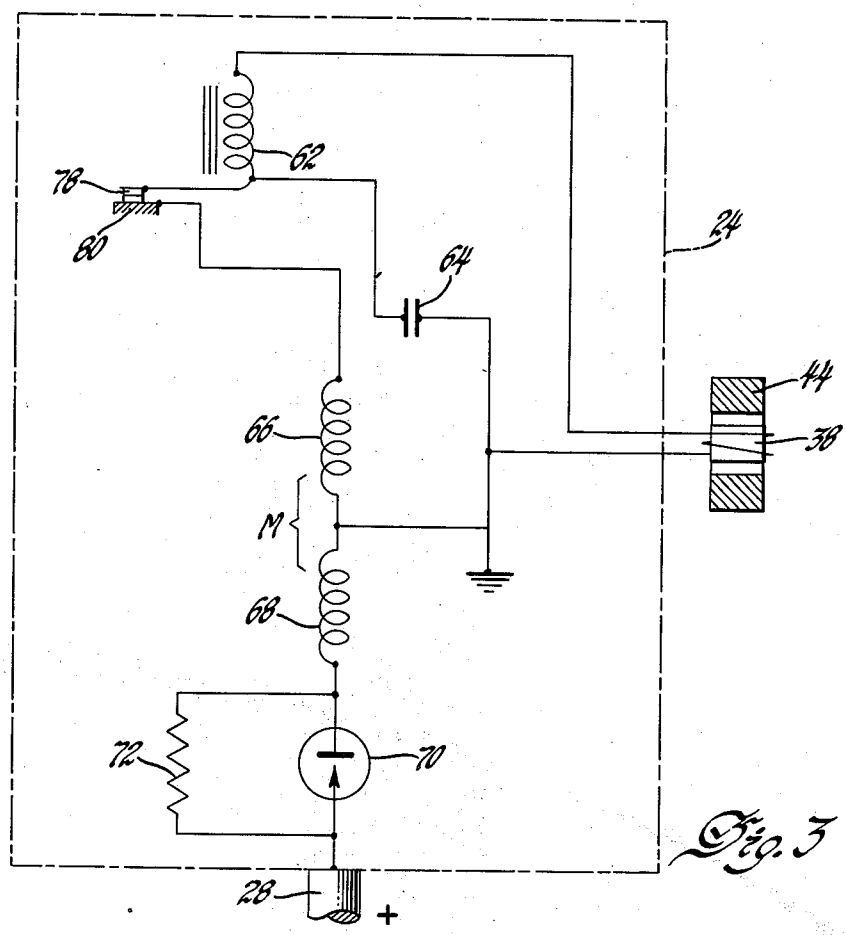


Fig. 3

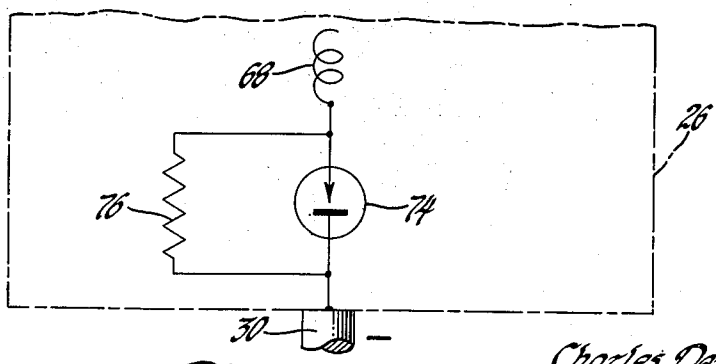


Fig. 4

Inventors
Charles Derwood Tuttle,
Grayland T. Larsen &
Lewis J. Lamm.
By
Spencer, Willett, Hellwig & Baillio
Attorneys

Patented May 27, 1952

2,598,466

UNITED STATES PATENT OFFICE

2,598,466

ELECTROSTATIC SPRAY PAINTING METHOD AND APPARATUS

Charles Derwood Tuttle, Trenton, Grayland T. Larsen, Wyandotte, and Lewis J. Lamm, Detroit, Mich., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application July 13, 1948, Serial No. 38,534

4 Claims. (Cl. 117—93)

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The present invention relates to the coating of articles of manufacture. More particularly it relates to a method of and apparatus for spray painting articles of manufacture using an electrostatic field without the use of ionizing electrodes and utilizing an electrostatic field between two of the articles to be coated.

Previous workers in the electrostatic spray coating art have, for the most part, found it necessary to use ionizing discharge electrodes for the production of corona discharge, and/or ionization, for charging of the particles of coating material. One exception to this generally accepted method of particle charging is shown in a U. S. patent to Pugh 1,855,869. In his proposed apparatus Pugh found it necessary to charge the spray booth to a high potential and the article to be coated to a high potential opposite in polarity. The applicants have discovered a means of electrostatic spraying which makes it unnecessary to use any discharge electrodes or to have the spray booth maintained at a high potential. This new method of electrostatic spray painting discovered by the applicants provides a much more efficient utilization of the paint spray since the applicants spray two articles simultaneously instead of one article and a discharge electrode. Experimental work conducted by the applicants has shown that the attraction between paint droplets and the article to be painted and, hence the efficiency of the painting method, is a direct function of the potential impressed between a pair of articles to be coated. The applicants observed that this direct function between potential gradient and paint attraction continues to a potential of but a few volts and a potential gradient of but a few volts per inch. Thus the applicants' equipment does not depend on any ionization or corona discharge.

It is therefore an object of the present invention to provide an efficient method of and apparatus for spray coating articles of manufacture using an electrostatic field.

It is a further object of the present invention to provide a method of and apparatus for spray coating of articles of manufacture using an electrostatic field between two of these articles to be coated.

It is a further object of the present invention to provide a method of and apparatus for electrostatic spray painting in which the need for ionizing discharge electrodes is entirely eliminated.

Other objects of this invention will become apparent upon reading the specification and inspection of the drawings and will be specifically claimed in the claims.

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Referring to the drawings, Figure 1 is a partial sectional view of one form of apparatus used in practicing the present invention.

Figure 2 is a sectional view taken along the line 2—2 of Figure 1.

Figure 3 is a circuit for producing high voltage D. C.

Figure 4 shows the modification of Figure 3 necessary to obtain high voltage D. C. of opposite polarity to that of Fig. 3.

Referring more particularly to Figures 1 and 2, 4 and 6 are monorail conveyors of conventional design attached to an overhead supporting structure 8 by means of supporting members 10, 12 and 14. 16 is a spray booth which may be open at both ends to permit the introduction and removal of the articles to be spray painted. The conveyor chains 18 and 19 have attached thereto at predetermined intervals supporting members 20, 22 and 32. These supporting members are attached to the housing members 24, 26 and 34 containing small high voltage D. C. power supplies. These power supplies will be more specifically described and discussed in connection with the Figures 3 and 4. The supporting hooks 28, 30 and 36 are mechanically connected to the housing members 24, 26 and 34 respectively but electrically insulated therefrom. These supporting hooks are electrically connected to the output terminals of the power supplies contained in these housings as will be more specifically described in connection with Figures 3 and 4. The above mentioned power supplies receive their energization through pickup coils 38, 40 and 42. The coils 42 and 40 are energized by magnetic induction from the electromagnet 46 which is in turn energized from a 60 cycle power source 45. The coil 38 and other inputs to power supplies carried by the conveyor 6 are energized by a similar electromagnetic source 44 which is similarly energized electrically from a 60 cycle power source. The articles to be coated, here shown as automobile doors 48, 50 and 52, are suspended from the hooks 28, 36 and 30 respectively. These articles to be coated are thereby maintained at a high D. C. potential so that the articles suspended from the conveyor 4 are of one polarity, and the articles suspended from the conveyor 6 are of the opposite polarity. This results in a high potential electrostatic field being set up between the articles to be coated. The spray coating material is introduced into this electrostatic field by means of spray guns 54, 56 and 58 of conventional design which are supported in spaced relationship by means of stand 60. These guns may be pointed in a direction generally parallel to the direction

of movement of the articles 48 and 52 on the conveyors 6 and 4. The guns may be so inclined in the horizontal plane as to direct the paint particles toward the articles to be coated without departing from the scope of this invention.

Referring more particularly to Figure 3, a conventional circuit capable of developing a suitable high D. C. potential is illustrated. In this figure, 24 is the casing or housing member shown in Figure 2. 44 is the electromagnetic member and 38 is the coil pickup, both of which are shown in Figure 2. The voltage induced in the coil 38 is applied to the coil 62 of the vibrator having a movable contact 78 and a stationary contact 80. During the time coil 62 is de-energized following opening of the contacts, condenser 64 charges up to the potential induced in coil 38. When the contacts close, condenser 64 discharges through coil 66. These contacts are closed when the coil 62 is de-energized. The interrupted current thus produced by the vibrator appears across the coil 66 and energy is induced into the coil 68 by the mutual inductance M between the coils 66 and 68. The voltage thus produced across the secondary coil 68 is in the order of magnitude of 50 kilovolts. This alternating current is rectified by the rectifier 70 and appears at the terminal 28 as a high positive D. C. voltage to charge the article to be coated. In order to drain the charge from the articles 48 and 52 after they have passed through the paint spray and the coils 38 are no longer magnetically coupled to the magnet 44, a high resistance 72 is provided. This high resistance does not interfere seriously with the charging of the article but allows the charge to drain off to ground after the article has left the spray atmosphere.

Referring to Figure 4, a partial section of the casing 26 and the circuit contained therein is shown. With the exception of the fact that the rectifier 74 is reversed to that shown as 70 in Figure 3, these two figures are identical. The high resistance 76 is similar to and for the same purpose as the resistance 72 in Figure 3. By reversal of the rectifier, a high negative potential is produced on the hanger 30. It may thus be seen that if a power supply such as shown in Figure 3 is used on one conveyor and a power supply such as modified by Figure 4 is used on the opposite conveyor, the articles suspended from these two conveyors will be charged to potentials of opposite polarity, and a strong electric field will be set up between these articles 48 and 52.

Operation

In order to paint or otherwise coat articles of manufacture utilizing the present invention, it is necessary to introduce a potential on two of the articles of opposite polarity and spray the coating material into the electrostatic field thus created between these two articles. As specifically indicated in Figures 1 and 2, the articles to be painted, 48 and 52, are suspended from the terminals 28 and 30 of the power supplies 24 and 26 respectively. Thus there is introduced a potential of one polarity on the article 48 and a potential of the opposite polarity on the article 52. The power supplies 26 and 24 are mechanically attached to conveyors 4 and 6 respectively of conventional design. As these conveyors traveling at approximately the same speed approach the spray booth, the pickup coils 42 and 38 respectively enter the electromagnetic field produced between the arms of each of the electromagnets 46 and 44. These pickup coils thereby have 60 cycle alternating current inductively produced therein. This low potential 60 cycle current is transformed by the power packs 26 and 24 into high voltage D. C., the voltage produced on the hanger 28 being of opposite polarity to that produced on the hanger 30. The desired potential for this voltage depends on several factors and not the least being the distance between the articles 48 and 52. We have found that the attraction of the paint particles and hence the efficiency of the process is a direct function of the potential gradient between the articles 48 and 52 up to a potential gradient of several kilovolts per inch. It is important to obtain a high potential gradient without the production of corona discharge. For this reason one of the objects of the present invention is to charge the articles to be coated at opposite polarities so that the potential of each article may be maintained as low as possible. Thus a high potential gradient is obtained with low maximum potential. As the articles of manufacture, 48 and 52, proceed into the spray booth, a spray mist of paint or other coating material is interposed between them by spray guns 54, 56 and 58. These guns are maintained at ground potential. The paint particles as they proceed into the field produced between the two articles to be coated, are attracted to these articles by the electrostatic field produced therebetween. The paint particles are thereby caused by the field to follow a curvilinear path after they leave the gun and be deposited on an article to be coated. As several of these articles to be coated are in the spray booth at the same time, the particles of paint which are most strongly attracted deposit on the article closest to the spray gun and other paint particles are deposited on other articles depending upon the radius of curvature of the path of paint particle. Thus as the articles to be painted progress through the spray booth, they are completely and efficiently coated with paint.

As the articles pass out of the spray mist, the pickup coils 38 and 42 leave the electromagnets 44 and 46 so that a potential is no longer produced on the articles 48 and 52. In order to remove the charge previously produced on these articles, a high resistance is used to bypass the rectifier in the power pact. This high resistance is shown as 72 and 76 in Figures 3 and 4 respectively. Thus as the articles leave the spray mist, the electrostatic charge is drained from the article so that the article may proceed to the drying oven and/or be handled by operators without danger of electrical discharge with its resulting consequences.

It is to be understood also that although the invention has been described with specific reference to a particular embodiment thereof, it is not to be so limited, since changes and alterations therein may be made which are within the full intended scope of this invention as defined by the appended claims.

We claim:

1. An apparatus for coating two articles of manufacture simultaneously including: conveyor means capable of transporting said articles in a generally parallel direction, and spaced transversely with respect to the path of travel of the articles, means for attaching said articles to said conveyor means, means for introducing a negative potential on one of said articles and means for introducing a positive potential on the other of said articles, and means for introducing a

spray of coating material between said articles the potential difference between said two articles being of sufficient magnitude to cause migration of the coating material particles toward said articles and thereafter allowing said coating material to be subjected to the electrostatic field for a sufficient period of time to permit coating of said articles by electrostatic attraction.

2. An apparatus for coating two articles of manufacture as claimed in claim 1 in which the means for introducing a spray of coating material is a spray gun capable of projecting coating material in a direction generally parallel to the direction of travel of said two conveyors.

3. An apparatus for coating two articles of manufacture as claimed in claim 1 in which the means for introducing the negative and positive potentials on said articles are direct current voltage supplies interposed between said conveyors and said articles of manufacture.

4. A method of electrostatically depositing particles of coating material on the extended surface of two articles of manufacture simultaneously consisting of producing a gaseous suspension of the particles of coating material, placing a negative electric potential on one of said articles and a positive potential on the other of said articles, spacing said articles apart from each other with at least a part of said extended surfaces in opposing relationship and moving said articles simultaneously through said suspension of coating material in a direction generally parallel to said part of the extended surfaces opposing each other to thereby permit the said particles to be attracted to the surface of said articles by electrostatic attraction.

CHARLES DERWOOD TUTTLE.
GRAYLAND T. LARSEN.
LEWIS J. LAMM.

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