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Feder

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[54] **PREVENTING AGGLOMERATION OF PARTICLES DURING SCREENING DUE TO ELECTRICAL EFFECTS**

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[52] **U.S. Cl.** ..... **317/2 R,** 209/9, 317/262 R, 317/262 E

[51] **Int. Cl.** **H05f 3/00**

[58] **Field of Search**.... 317/2 R, 3, 4, 262 R, 262 A, 317/262 E; 209/3, 4, 9, 127, 238, 379, 385, 387; 210/243; 134/1

[56] **References Cited**

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[57] **ABSTRACT**

Agglomeration of particles, e.g., plastic particles, during screening due to electrical effects is prevented by impressing a voltage on an insulated conductor resting directly on the screen.

21 Claims, 5 Drawing Figures

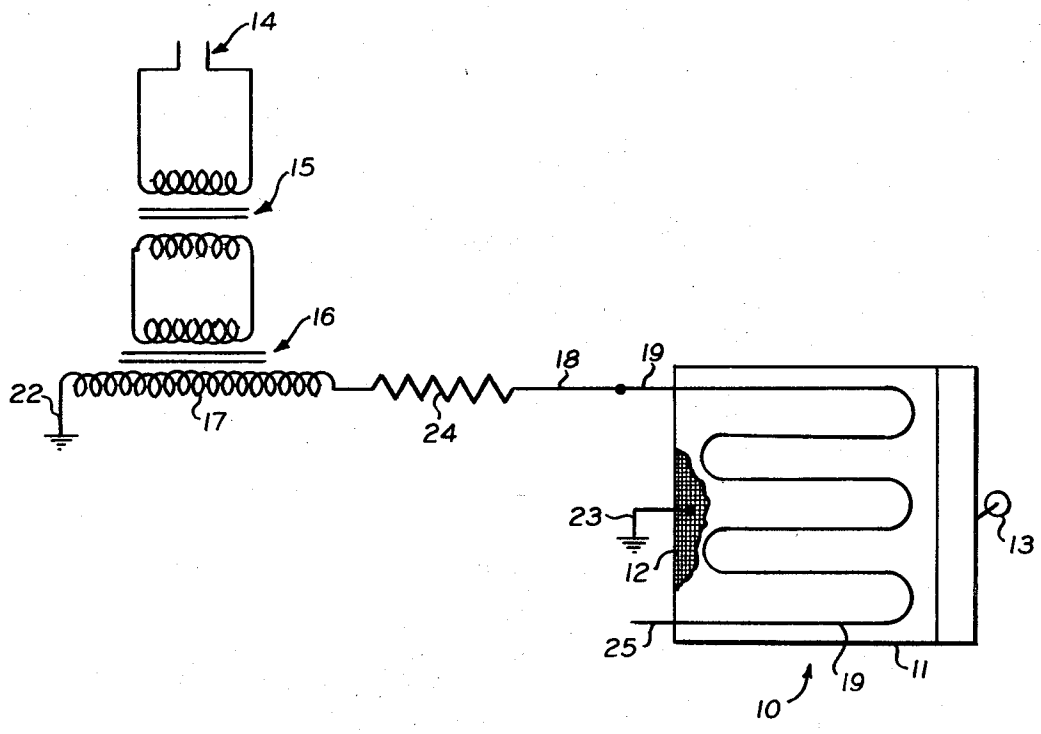


FIG. 1.

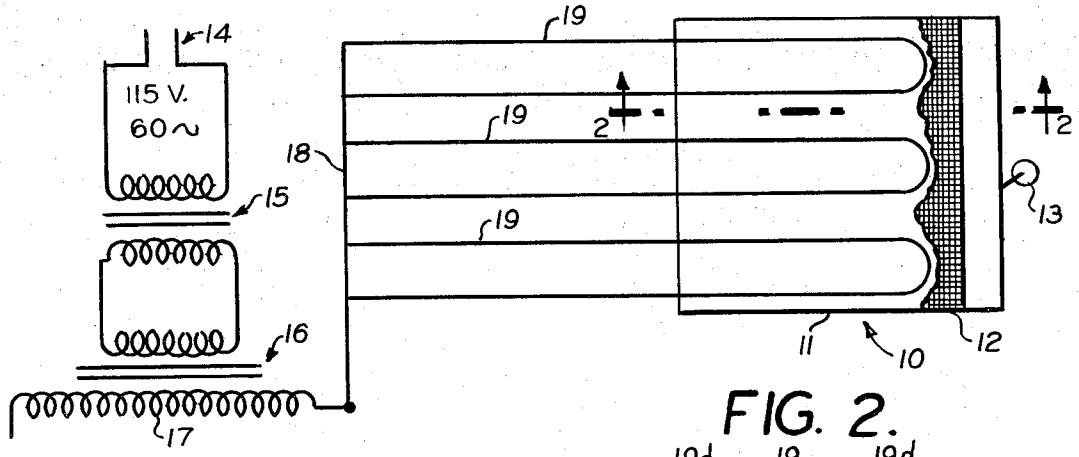


FIG. 2.

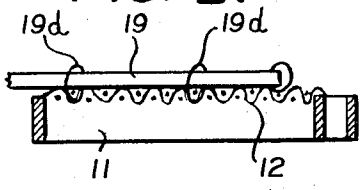
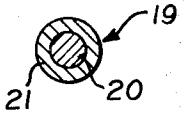


FIG. 3.



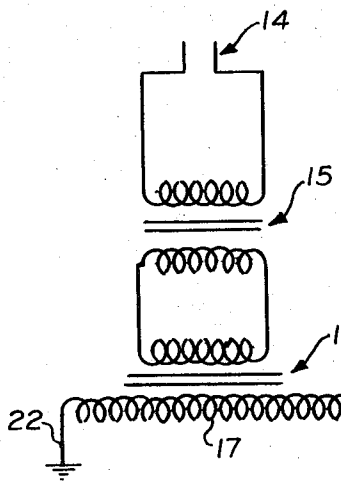
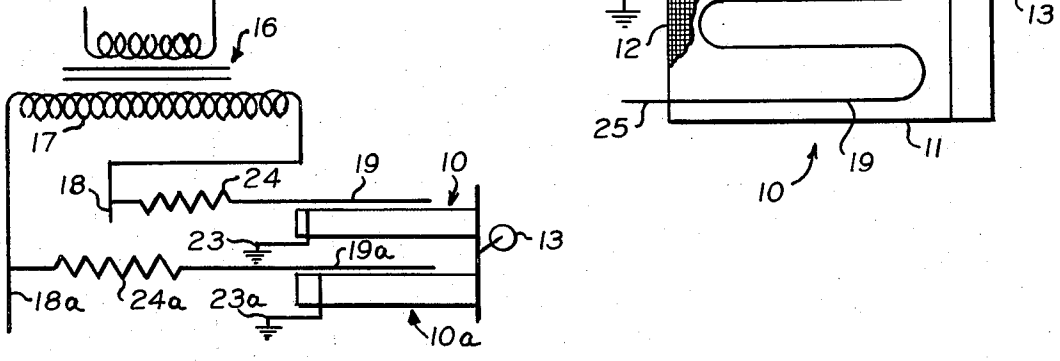


FIG. 4.

FIG. 5.



PREVENTING AGGLOMERATION OF PARTICLES DURING SCREENING DUE TO ELECTRICAL EFFECTS

This invention relates to the screening of particles, for example plastic particles, which tend to agglomerate during screening due to electrical effects.

A problem in the screening of plastics, for example polystyrene, polycarbonate, polypropylene, polyethylene, or polyvinylchloride, is that the particles tend to agglomerate during screening due to electrical effects. Possibly due to interaction between the particles and/or between the particles and the screen, electrical charges occur in the particles, and those charges cause the particles to agglomerate. The usual indications of electrostatic charges, e.g., sparking to the finger, are not usually observed. The electrical properties of the plastic may depend on additives present. In general, if carbon black is present, no difficulty is encountered.

The problem of eliminating electrical charges on materials in the course of production is common, arising with respect to many materials and material handling procedures. The matter has been studied by many, and numerous devices are offered for eliminating the electrical charges.

Levy, STE Journal, Vol. 18, No. 10, Oct. 1962 states, "The method of supplying these particles called ions for purposes of neutralization is splitting air molecules into positive and negative parts. This is called ionization. There are two methods of ionizing: (1) bombard the air molecules with high speed particles emitted by radioactive elements such as polonium or radium and (2) apply a high voltage electrical field across an air gap."

A radioactive instrument for eliminating electrical charges is offered by Minnesota Mining and Manufacturing Co. Air ionizers are offered by The Simco Company, Inc., Lansdale, Pa. Air ionizers are disclosed in the following U.S. Pat. Nos.: Chapman 777,598, Chapman 983,536, Maas 2,752,533, Yonkers 3,221,938, and Heyl 3,309,569.

In an effort to prevent agglomeration in the screening of plastics, e.g., polystyrene, polycarbonate, and polypropylene, I have tried a radioactive static eliminator made by the 3M Company, and a commercially available air ionizer. Both were used as recommended by the supplier. All attempts were unsuccessful. No commercially available device is known to me which is effective in the services mentioned. An alternative to the use of a radioactive device or an air ionizing device, which has been practiced is to add a small amount of soap* to the plastic being screened. That is of substantial effectiveness. It is, however, not a completely satisfactory solution to the problem since in some instances the presence of soap in the product cannot be tolerated. In other cases, that solution is unsatisfactory simply because of customer concern as to possible effects of the presence of soap in the product.

* (Bonds Liquid Static Prevention EPH-26, Bond Chemical Products Co., Chicago, Ill.)

Accordingly, a principal object of the invention is to provide a device which will eliminate or reduce the tendency of particles to agglomerate during screening. Of course, further objects are to provide such a device which is not hazardous to operate, and which is of reasonable cost.

THE INVENTION

I have found that the tendency of particles to agglomerate during screening on a moving screen, which agglomeration interferes with the screening, can be eliminated by impressing a voltage on an insulated conductor resting directly on the screen during the screening. The voltage is sufficiently high to reduce agglomeration of the particles but insufficient to cause a glow discharge along the conductor.

The procedure operates with AC or DC, but operates best using an alternating current. The frequency can be the standard frequency, i.e., 60 cycles in the U.S., 50 cycles in Europe. An oscillator to provide a high frequency is not required.

The voltage can be 800–15,000 volts, and is preferably 3,000–15,000 volts, and still better 10,000–15,000.A transformer can be employed to provide the desired voltage, with the insulated conductor connected to the secondary (high voltage side) of the transformer. In a preferred embodiment, a resistor is operatively connected with the transformer and insulted conductor limiting the current in the conductor to 0.5–15 milliamps, preferably 1 to 5 milliamps.

THE DRAWINGS

Embodiments of the invention are illustrated in the accompanying drawing, wherein:

FIG. **1** is a schematic representation of one embodiment of the invention;

FIG. **2** is a cross-section taken on line **2** — **2** of FIG. **1**;

FIG. **3** is a cross-section of the conductor;

FIG. **4** is a schematic showing of a second embodiment; and

FIG. **5** is a schematic of a third embodiment.

In the various views, like reference characters refer to corresponding parts.

EMBODIMENTS

Referring to FIGS. **1–3**, the invention provides apparatus comprising a conventional moving screen **10** which can be formed by screen **12** mounted on frame **11**. Means such as the eccentric drive **13** are provided for shaking or vibrating the screen. The screen can be metal, for example iron, aluminum, copper, or an alloy, e.g., bronze, brass, etc.

The apparatus includes an isolating transformer **15** provided with means **14** for connection to a standard electrical power source and a high voltage transformer **16**, which can be a neon tube transformer. The high voltage transformer **16** includes the secondary, high voltage winding which is connected to conductor **18**. Conductor loops **19** are disposed as loops directly on the screen **12**, forming a network of conductor lengths on the screen.

The conductors **19** can be secured to the screen by ties **19*d***, as is illustrated in FIG. **2** and so that lengths of the conductor between the ties are free to shake or vibrate so as to aid in the screening. The conductors **19**, as is shown in FIG. **3**, are insulated conductors comprising the metal conductor proper, which is indicated by the reference character **20**, and a sheath of insulating material **21**. The rating of the insulation does not appear to be critical. A system which works well with 600 volt insulation, works equally well with 20,000 volt insulation. The operation apparently does not depend on any leakage of current. As is illustrated in FIG. **2**, the insulated conductor rests directly on the screen **12**, with the insulation of the conductor in contact with the

screen. In the embodiment of FIG. 1, the screen is not grounded. Alternatively, the screen can be grounded. Additionally, the free end of secondary **17** can be grounded, with the screen grounded or ungrounded. Preferably, only the screen is grounded. It is believed that the device is safer when the free end of secondary **17** is not grounded.

A further embodiment of the invention is shown in FIG. **4.** The second embodiment differs from that shown in FIG. **1** in that a resistor **24** is disposed in line **18** to limit the current. Additionally, the conductor **19** is a single length winding over the screen forming a network of conductor lengths, and terminating in free end **25.** The secondary **17** of the high voltage transformer **16** is grounded at **22.** The station with respect to grounding is as is the case for FIG. **1.**

Commonly a stack of spaced screens is used with the successive screens being of successively larger screen size going from top to bottom. Such screens are provided by Great Western. Such an arrangement is illustrated in FIG. **5.** Desirably, one end of secondary transformer **17** is connected to a conductor **19** resting on one of the screens, screen **10,** while the other end of the secondary **17** is connected to conductor **19***a* resting on another of the screens, screen **10***a*, with the screens **10** and **10***a* grounded at **23** and **23***a* respectively. For a deck composed of an even number of screens, the insulated conductors resting on half of the decks can be connected to one end of the secondary **17,** while the insulated conductors resting on the other half can be connected to the other end of the secondary. The connection of the conductors **19, 19***a* to the leads **18, 18***a* can be as loops as in FIG. **1** or so that conductors **19, 19***a* terminate in free ends as in FIG. **4.** Resistors **24, 24***a*, which can be 3 megohms are installed in lines **19, 19***a*, respectively. The low voltage side of transformer **16** can be 115 volts 60 cycle and the secondary can be 15,000 volts.

Where resistors are used as in FIG. **4** and FIG. **5,** the system is thereby made safe and an isolation transformer such as **15** in FIG. **1** is not needed for that purpose.

In the embodiments illustrated, the secondary **17** of the high voltage transformer **16** is connected to the conductors **19** (FIG. 1) or the conductor **19** (FIG. **4**) or conductors **19** and **19***a* (FIG. **5**). The transformer rating can be such that a voltage sufficiently high to reduce agglomeration of the particles but insufficient to cause a glow discharge along the conductor, can be impressed thereby on the conductor.

Mounting of the insulated conductors **19** as is described above with reference to FIG. **2,** i.e., with the conductors being secured to the screen at spaced intervals so that lengths of the conductors are free to vibrate or shake and sweep or move over a portion of the screen area has been found to be highly effective. In operation, the screening occurs in the areas swept by the loosely mounted conductors. The areas not swept by the conductors may become clogged during operation. The operation is nonetheless effective, since particles accumulating over clogged areas, due to the vibration of the screen, move to the unclogged areas. The action of the conductors, however, is not merely one of mechanically sweeping of particles over the screen to cause the desired screening, since if the power supply to the conductors is turned off, while the screen is continuously shaken, the entire area of the screen becomes clogged. The ties **19***a* can be at intervals of about 10 – 30 inches. The spacing of the parallel lengths of the conductor **19** on the screen can be about 1 – 6 inches.

I have found the invention to be particularly effective when screening particles of plastic material, especially polystyrene, polycarbonate and polypropylene.

The particles being screened can be sizes within the range of, for example, 18 – 325, usually 35 – 325 mesh (U.S. Standard). The screen size can be as fine as 200 mesh. The system works well for screens as fine as 100 mesh.

The invention is further illustrated in the following examples.

EXAMPLE 1

Polycarbonate powder, ranging in size from 18–230 mesh, was screened on a 50 mesh screen using the apparatus shown in FIG. **1.** The high voltage transformer **16** is a neon tube transformer leaving a nominal secondary output of 15,000 volts at 30 milliamps. Only one leg of the transformer was tapped, as is illustrated. The conductors **19** are **16** gage copper wire having an insulation rated at 600 volts.

The polycarbonate powder was fed to the screen with the charge or static eliminating device turned off. After a few minutes, the screen became completely clogged and hardly any output was noticeable. The charge eliminating device was then turned on. That eliminated the clogged condition, and with such a continuous feeding of the polycarbonate powder, clogging interfering with the screening, did not occur. The only thing more surprising than the simiplicity of the system is indeed its effectiveness.

A bare conductor **19,** under the conditions of this example, sparks to a metal object. In the operation according to the invention, with the conductor insulated and directly resting on the screen, there is no visible spark or visible glow from the wire to the screen or in the vicinity of the wire. Apparently, however, the device provides sufficient ionization of the air in the vicinity of the particles to eliminate the interfering electrical charges, thereby providing very effective screening.

At a transformer secondary of 6,000 volts, performance is passable; 3,000 volts appears to be too low for satisfactory screening.

EXAMPLE 2

A device according to FIG. **4** is utilized to screen polycarbonate powder ranging in size from 18–230 mesh. The screen was 50 mesh. The high voltage transformer **16** has a secondary rating of 6,000 volts. The resistor **24** is a 10 megohm resistor, and limits the current to approximately 0.6 MA. The wire **19** is 16 gage copper wire having an insulation rated at 600 volts.

The grounding of the secondary **17** of the high voltage transformer **16,** at **22,** increases the strength of the field significantly. The resistor **24,** while it does not noticeable influence the operation of the device, as indicated, limits the current.

The system works well at 3,000 volts; 800 volts appear to be too low for an acceptable screening rate.

What is claimed is:

1. In the process of screening a mass of particles comprising feeding the particles to a moving screen for the screening thereof, the particles having a tendency to agglomerate during the screening operation due to electrical phenomena so that the screening is interfered

with, the improvement for counteracting said tendency which comprises impressing a voltage on an insulated conductor resting directly on the screen during the screening, the voltage being sufficiently high to reduce agglomeration of the particles, but insufficient to cause a glow discharge along the conductor.

2. Process according to claim **1**, the screen being a metal screen.

3. Process according to claim **1**, the voltage being an alternating voltage.

4. Process according to claim **1**, the voltage being an alternating voltage of 60 cycles.

5. Process according to claim **3**, the voltage being 800–15,000 volts.

6. Process according to claim **2**, the voltage being an alternating voltage of 60 cycles and 800–15,000 volts.

7. Process according to claim **6**, the particles being plastic.

8. Process according to claim **3**, the particles being polystyrene, polycarbonate, polypropylene, polyethylene, or polyvinylchloride.

9. Process according to claim **3**, the screen being grounded.

10. Process according to claim **3**, and a resistor operatively connected with the transformer and insulated conductor limiting the current in the conductor to about 0.1–15 milliamps.

11. Process according to claim **9**, and a resistor operatively connected with the transformer and insulated conductor limiting the current in the conductor to about 0.5–15 milliamps.

12. Process according to claim **2**, the voltage being an alternating voltage.

13. Process according to claim **3**, the particles being polycarbonate.

14. Apparatus for screening of a mass of particles having a tendency to agglomerate during the screening due to electrical phenomena so that the screening is interfered with, comprising

a. a screen,

b. means for moving the screen to cause screening of particles fed to the screen,

c. an insulated electrical conductor resting directly on the screen,

d. a transformer having the output side thereof connected to said conductor for impressing a voltage on the conductor,

e. the voltage rating of the transformer being insufficient to cause a glow discharge along the conductor.

15. Apparatus according to claim **14** the screen being a metal screen.

16. Apparatus according to claim **14** the transformer rating being 800–15,000 volts.

17. Apparatus according to claim **14**, and a resistor operatively connected with the transformer and insulated conductor limiting the current in the conductor to about 0.5–15 milliamps.

18. Apparatus according to claim **16**, and a resistor operatively connected with the transformer and insulated conductor limiting the current in the conductor to about 0.5–15 milliamps.

19. Apparatus according to claim **14**, the conductor being secured to the screen so that lengths thereof are free to shake in response to shaking of the screen.

20. Apparatus for screening of a mass of particles having a tendency to agglomerate during the screening due to electrical phenomena so that the screening is interfered with, comprising

a. two screens,

b. means for moving the screens to cause screening of particles fed to the screens,

c. an insulated electrical conductor resting directly on each screen,

d. a transformer having the output side thereof connected to said conductors for impressing a voltage on the conductors,

e. the voltage rating of the transformer being insufficient to cause a glow discharge along the conductor.

21. In the process of screening a mass of particles comprising feeding the particles to a moving screen for the screening thereof, the particles having a tendency to agglomerate during the screening operation due to electrical phenomena so that the screening is interfered with, the improvement which comprises impressing a voltage on an insulated conductor resting directly on the screen during the screening, the voltage being an alternative voltage of standard frequency, and being sufficiently high to reduce agglomeration of the particles.

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