United States Patent [19]

Scaletta

[11] **3,869,910**

[45] **Mar. 11, 1975**

[54] **DIAGNOSTIC TEST DEVICE FOR DEVELOPER MATERIALS**

[75] Inventor: **Joseph Louis Scaletta,** Rochester, N.Y.

[73] Assignee: **Xerox Corporation,** Stamford, Conn.

[22] Filed: **June 18, 1973**

[21] Appl. No.: **371,331**

[52] **U.S. Cl.** ..... **73/150 R,** 118/9, 356/202, 356/244

[51] **Int. Cl.** **G01n 33/32**

[58] **Field of Search** ..... 73/150 R, 432 R; 356/202, 356/209, 244, 36; 96/1 R, 1 SD; 118/9; 324/32

[56] **References Cited**

UNITED STATES PATENTS

2,573,881	11/1951	Walkup et al.	96/1 SD UX
2,972,332	2/1961	Limberger	96/1 SD UX
3,057,324	10/1962	Iwerks	96/1 SD UX
3,436,648	4/1969	Tae Kim	324/32
3,573,906	4/1971	Goffe	96/1 R X
3,719,165	3/1973	Trachienberg et al.	118/9 X
3,756,192	9/1973	Locklar et al.	118/9 X

OTHER PUBLICATIONS

Brickmore, J. T., et al., Configural Studies on Cascade Development, in Photographic Science & Engineering, 14 (1): p. 42–51, Jan.–Feb. 1970.

Primary Examiner—Richard C. Queisser
Assistant Examiner—Joseph W. Roskos

[57] **ABSTRACT**

A method and apparatus is provided to test samples of developer material comprising carrier and toner particles. The apparatus has a hopper into which a sample of developer is placed. A gate is opened to allow the developer to flow from the hopper over at least a conductive surface and two conductive pads located below the conductive surface to develop the same. A development electrode plate is spaced from the conductive pads to enhance solid area development. After development, the electrode plate is removed from the apparatus to expose the conductive pads and the optical density of toner development of the conductive pads is analyzed to determine developer quality. This apparatus is portable and may be used by a service representative to test developer on machine location.

15 Claims, 3 Drawing Figures

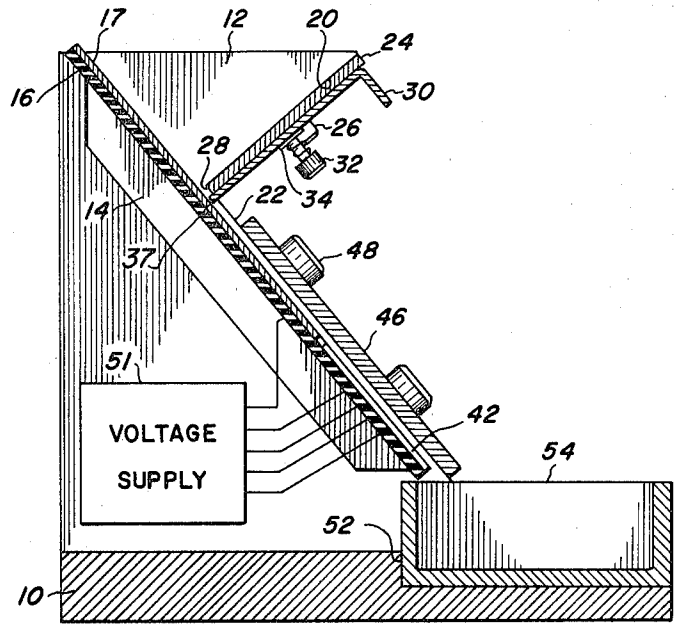


FIG. 1

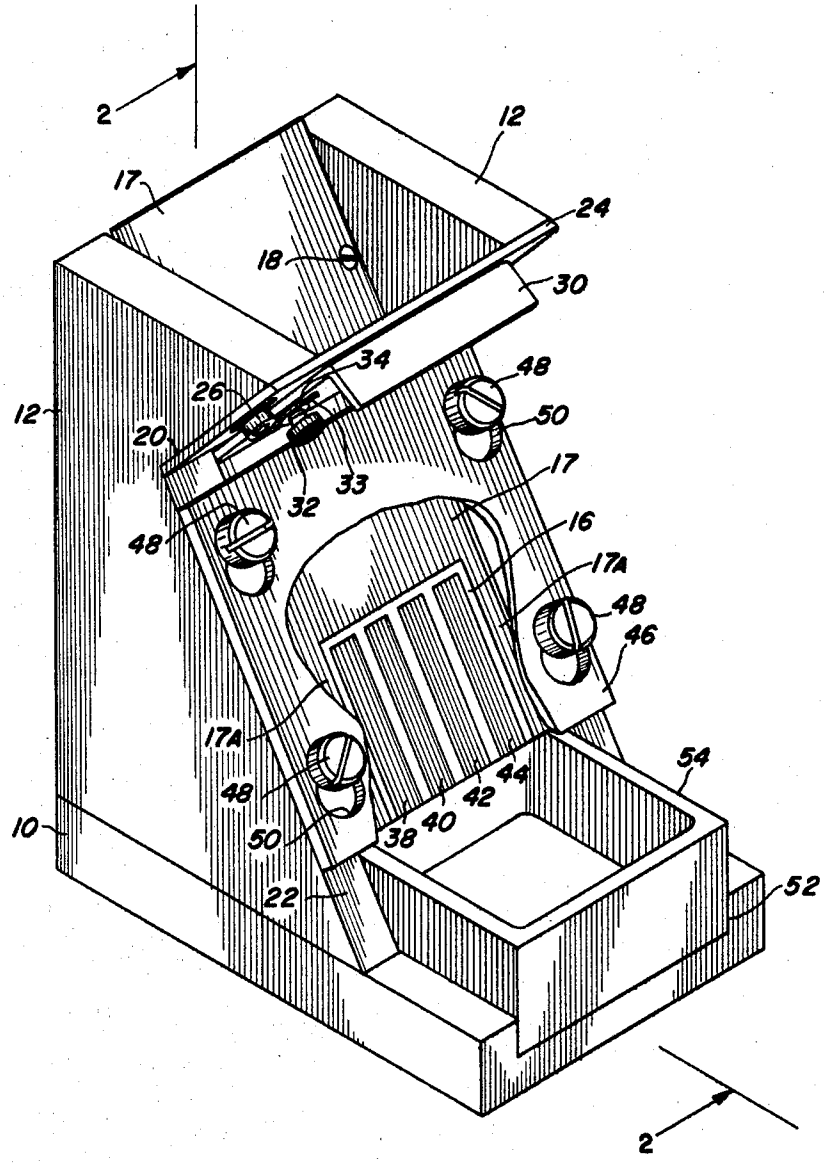

2
12
17
24
18
30
34
48
26
50
12
20
33
32
17
48
16
17A
48
46
17A
54
48
44
42
40
38
50
10
22
52
2

FIG. 3

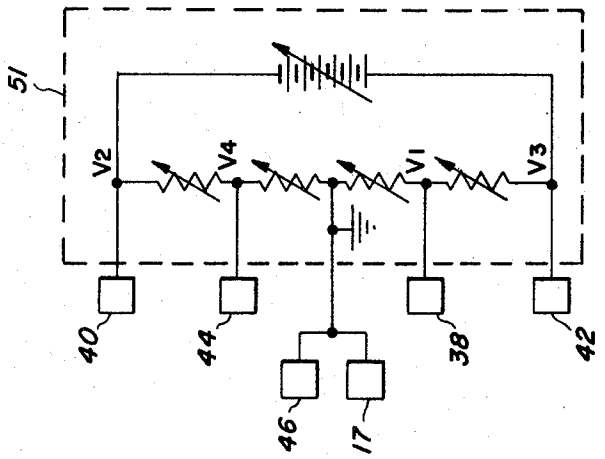
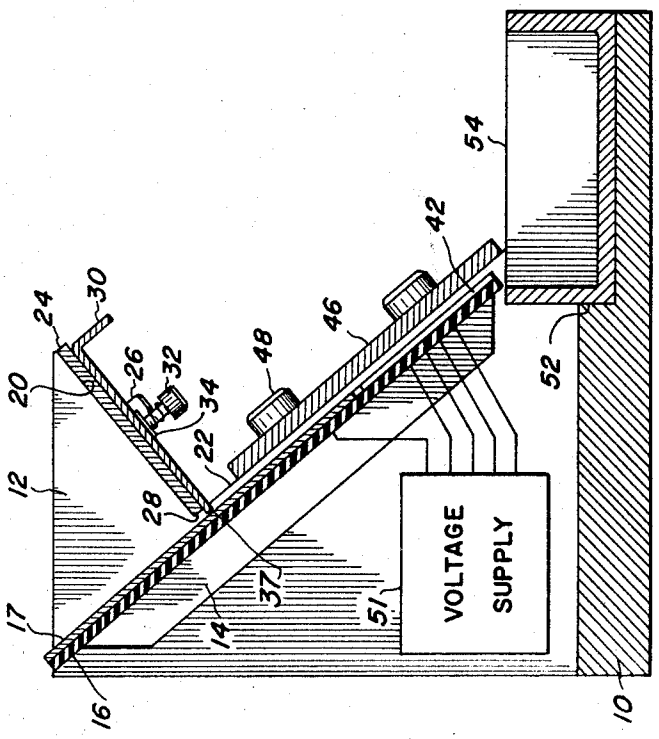

51
V2
V4
V1
V3
40
44
38
42
46
17

FIG. 2


54
42
30
24
46
48
26
32
20
34
22
52
12
28
37
51
VOLTAGE SUPPLY
17
14
16
10

DIAGNOSTIC TEST DEVICE FOR DEVELOPER MATERIALS

DESCRIPTION OF THE INVENTION

A problem with many electrostatic copying machines is that at times, the resultant copy is either light density, overtoned, or has high background. When a machine is serviced, the service representative is presented with a problem of determining whether the above is due to poor developer or to some other malfunction in the copier. It would be very helpful if the service representative had a tool by which he could determine the developer quality at the machine location.

Accordingly, it is an object of this invention to provide an apparatus for testing developer material to determine the quality thereof at the machine location.

A further object of this invention is to provide an apparatus for obtaining certain information on developer materials, which information, when analyzed can be useful in predicting developer performance.

Other objects of this invention will become more apparent from the following description with reference to the drawings wherein:

FIG. 1 is a view of a developer test apparatus;

FIG. 2 is a view taken along section line 2—2 of FIG. 1; and

FIG. 3 is a schematic of an electrical circuit for the test apparatus.

Referring to the drawings, there is illustrated a developer testing apparatus having a main support frame comprising a bottom wall **10** and a pair of spaced sidewalls **12** secured to the bottom wall at the opposite sides thereof. A shoulder **14** extends inwardly from each sidewall. A testboard **16** of insulating material is located between the sidewalls **12** with the rear face thereof bearing against the shoulders **14.** A thin conductive metal film such as copper is secured to the top face of the testboard **16.** Screws **18** fasten the testboard to the shoulders **14.** The upper portion **20** of the front edge of each wall **12** slants inwards and downwards from the upper edge and meets with a lower edge **22** of the front wall which slants forwards and backwards from the line of juncture therebetween. A plate **24** is secured to the upper edge **20** of each wall by screws **26** (only one shown). The plate **24**, the upper portion of the testboard **16** and the upper portion **20** of the walls **12** form a developer hopper at the upper portion of the testing apparatus. The lower edge **28** of the plate **24** is spaced a certain distance from the testboard **16** to form a developer hopper orifice therebetween. A slidable gate member **30** is secured to the plate **24** by a pair of laterally spaced bolts **32** (only one shown) which extend through slots **33** in the gate **30** into the plate **24.** A washer **34** is slidably mounted on the bolt **32** and the washer **34** to bias the washer into engagement with the plate **30** and thereby urge the plate **30** into slidable engagement with the plate **24.** The slots **33** in the plate **30** extend in a longitudinal direction allowing the gate to be moved downwards to bring the bottom edge **37** thereof into engagement with the testboard **16** to close the hopper orifice or to be moved upwards and withdraw the bottom edge **38** of the gate from the testboard to open the orifice.

Located below the conductive film **17** on the testboard **16** are conductive pads **38, 40, 42** and **44,** which may comprise copper, electrically insulated from each other and the film **17.** The pads are located a sufficient

distance below the orifice that a uniform coating of toner particles is deposited on each pad. This distance will vary with the size of the developer, the angle of the testboard and the flow rate. The developable area of each pad is significantly smaller than that of the conductive film **17.** As illustrated in FIG. **1,** the conductive film **17** has laterally spaced extensions **17a** which encompass the conductive pads. These extensions are desirable in some instances but are not necessary to the operation of the apparatus. A development electrode plate **46** bears against and is removably secured to the slanted lower edge **22** of the walls **13** by bolts **48** which extend through a respective slot **50** in the development electrode plate **46** into a respective wall **12.** The slots **50** are enlarged at the lower portion thereof so that the head of the bolts **48** can extend therethrough and the upper portion of the slots **50** are smaller so the plate will be held onto the walls by the enlarged heads of the bolts **48.** The electrode plate **46** may be removed from the wall **12** by sliding the same upwards until the enlarged bottom portion of the slots **50** are aligned with the heads of the bolts **48** and then tilting the bottom of the plate away from the walls **12** to clear the lower bolts and then lifting the plate away from the walls **12.** A voltage supply **51** is located behind the testboard **16** and has terminals electrically connected to each pad, the conductive film and the electrode plate **46** for applying required voltage potentials to each.

The conductive film **17** on the testboard is spaced a given distance from the front edge **22** of the wall **12** that when the rear face of the development electrode plate **46** rests on the front edge **22** there will be a given space therebetween. The wall **12** may be of conductive material and electrically connected to the electrode plate **46** if the voltage potential of both is desired to be at the same level or the electrode plate **46** can be electrically insulated from the walls **12** if different voltage potentials are desired. A recess **52** is provided in the bottom wall **10** for slidably receiving a developer receptacle **54** therein.

In this apparatus, it is contemplated that there will be at least two conductive pads **38** and **40.** The two pads, the conductive film **17** and the electrode plate **46** are each connected to voltage potentials with the potentials on the pads being different from each other and from the potential applied to the conductive film **17** which is usually ground. The potential applied to the electrode plate **46** will normally be the same as the potential applied to the conductive film but may be a potential which is different than any of the potentials for the pads or the conductive film. As developer passes over the conductive film and pads, toner particles will develop thereonto in accordance with the voltage potentials applied. The voltage potentials are selected in increments relative to each other to set up electric fields so the density of toner developed on each pad and conductive film will be optically different as measured by any standard densitometer in reflectance or transmittance optical density units. The testboard **16** is located at an angle with the horizontal base or bottom wall **10** which optimizes the relative optical developed densities. Depending upon the relative voltage potentials of the various pads, the conductive film and the electrode plate, and the condition of the developer, toner particles may develop onto the electrode plate in accordance with the fields set up between the conductive film and the electrode plate and between the pads

and the electrode plate. The applied voltage potentials may be either negative or positive depending upon the information desired and the charge polarity of the toner particles.

In operation, a given quantity of developer, for instance 10 cc., having carrier particles of an average diameter of 100 microns and negatively charged toner particles having an average diameter of 10 microns is placed into the hopper with the hopper gate in closed position. For this size developer, the spacing between the bottom edge **28** of the orifice plate **20** and the testboard **16** is 0.030 inch in gate open position and the spacing between the rear surface of the development electrode plate **46** and the film **17** of the testboard **16** is 0.060 inch. The testboard is at an angle of 50° to the base wall **10.** The distance between the orifice and the upper edge of the pads **38, 40, 42** and **44** is 2 inches. Referring to the schematic electrical circuit shown in FIG. **3,** the power supply **51** is designed so that a voltage potential V1 applied to pad **38** is −25 volts, the voltage potential V2 applied to pad **40** is +100 volts, the voltage potential V3 applied to pad **42** is −120 volts, and the voltage potential V4 applied to pad **44** is +50 volts. The conductive film **17** and the development electrode plate **46** are connected to the ground or reference potential thereby creating a field between the development electrode and each conductive pad **38,** 40, 42 and **44** to enhance solid area development. The same field potentials between the pads **38, 40, 42** and **44** and the electrode plate **46** may be achieved by placing the conductive film **17** at reference or ground potential, electrode plate **46** at +200 volts, pad **38** at +175 volts, pad **40** at +300 volts, pad **42** at +80 volts and pad **44** at +250 volts. Any suitable or conventional voltage supply may be utilized.

The gate **30** is opened and developer from the hopper flows through the hopper orifice by gravity over the testboard and over the conductive sections thereon to develop the conductive sections with toner particles. The residual developer flows into the receptacle **54.** When all of the developer has passed from the hopper, the power supply is cut off and the electrode plate **46** is removed from the testing apparatus thereby exposing the testboard **16** with the developed conductive portions. The operator takes a generally transparent tape and places it against the conductive portions to remove the toner particles therefrom and places it on a white sheet of paper in order to see the density of the developed portions. After the test is completed, the receptacle **54** may be removed from the apparatus and the developer discharged therefrom.

The toner particles which are attracted to positive biased pads **40** and **44** are negative charged toner particles a majority of which would be attracted to a positive charged latent image area on a photoconductor. The toner particles which are attracted to negative biased pads **38** and **42** are positive charged toner particles which do not develop a positive charged latent image and which may deposit on background areas. The relative development of these pads change as the carrier particles age and therefore this type of information can be useful in determining developer characteristics at various stages during the life thereof. Toner particles will also develop on areas on the electrode plate opposite the pads in the opposite manner with negative charged particles developing on areas opposite pads **38** and **42** and positive charged particles developing on areas opposite pads **40** and **44.** Toner particles will also be deposited on the conductive film **17** and the area on the electrode plate **46** opposite the film **17.** The development pattern of toner on the conductive film **17** and the electrode plate may also be useful at times.

The information gathered can then be used as a standard to guide a service representative when using the test apparatus at a copying machine location when he goes into an office to service a machine which exhibits characteristics that may be attributable to developer problems. He takes the developer from the machine developer sump and puts it through the test apparatus by employing the same procedure hereinbefore described. The service representative compares the density of the developed portions to standard samples to determine developer quality. If the quality does not meet specifications, he can change or modify the developer. If the quality is acceptable, he knows the problem resides elsewhere in the copying system.

This test apparatus may be utilized for obtaining information which is also useful for many purposes. Of course, the number of pads used and the voltage potentials selected will be determined by the purpose for which the information is desired. The size of this apparatus is such that it is easily portable. For instance, it is contemplated that the size be not larger than about 6 inches high by 6 inches long by 3 inches wide.

What is claimed is:

1. An apparatus for testing developer quality comprising: a support structure; a generally flat testboard carried by said support structure at an angle to horizontal; said testboard comprising a conductive surface and at least two conductive pads each electrically insulated from the other and from said conductive surface, an electrode plate carried by said support means spaced from said testboard and located opposite at least a portion of said conductive surface and said conductive pads; means for simultaneously applying different electrical field potentials between said electrode plate and each of said conductive pads and said conductive surface whereby developer may flow through the space between said electrode plate and said testboard to develop said conductive surface and said conductive pads in accordance with said field potentials.

2. The apparatus as recited in claim **1** wherein the field potential between said electrode plate and said conductive surface is substantially zero.

3. The apparatus as recited in claim **1** wherein there is a substantial field between said electrode plate and said conductive surface.

4. The apparatus as recited in claim **1** wherein the field potential between said electrode plate and one of said conductive pads is negative in the direction of said one pad and the field potential between said electrode plate and the other of said conductive pads is positive in the direction of said other pad.

5. The apparatus as recited in claim **4** wherein said conductive surface is electrically connected to ground potential.

6. The apparatus as recited in claim **5** wherein said electrode plate is electrically connected to ground potential.

7. The apparatus as recited in claim **1** wherein said field potentials are such as to develop developer on the conductive pads and conductive surface at relative densities which are optically different from each other

as determined by densitometer measurement in optical density units.

8. The apparatus as recited in claim **1** further comprising: a developer hopper located at the upper portion of said support structure, an orifice communicating said hopper with the space between said testboard and said electrode plate, said testboard sloping downwards from said orifice.

9. The apparatus as recited in claim **8** further comprising: movable gate means for closing said orifice, means to retain developer in said hopper and for opening said orifice means to allow developer to flow through said orifice means into the space between said electrode plate and said testboard.

10. The apparatus as recited in claim **8** wherein said conductive surface is located above said conductive pads and has a larger developable area than either of said pads.

11. The apparatus as recited in claim **8** wherein said conductive pads are located below said orifice at a distance to provide generally uniform development thereon.

12. The apparatus as recited in claim **11** wherein the field potential between said electrode plate and one of said conductive pads is negative in the direction of said one pad and the field potential between said electrode plate and the other of said conductive pads is positive in the direction of said other pad.

13. The apparatus as recited in claim **12** wherein said conductive surface is electrically connected to ground potential.

14. The apparatus as recited in claim **13** wherein said electrode plate is electrically connected to ground potential.

15. A method for testing developer comprising: measuring a given amount of developer comprising toner particles and carrier particles into a developer hopper, maintaining a different electrical field potential between an electrode plate and at least two conductive pads and a conductive surface each of which are electrically insulated from each other, passing the developer by gravity at a controlled rate between the electrode plate and the conductive pads and conductive surface to develop the conductive pads and conductive surface with toner particles, and subjecting said pads to toner density analysis.

* * * * *