Feb. 22, 1966 J. BOYCE 3,236,376

DUST REMOVING APPARATUS FOR AN ARTICLE CLASSIFIER

Filed June 19, 1963

FIG_2

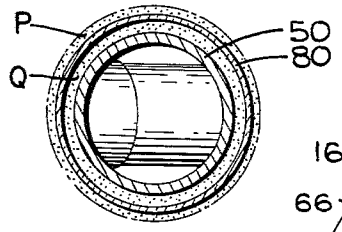

FIG_1

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United States Patent Office 3,236,376 Patented Feb. 22, 1966

3,236,376
DUST REMOVING APPARATUS FOR AN ARTICLE CLASSIFIER

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Filed June 19, 1963, Ser. No. 289,086
10 Claims. (Cl. 209—111.6)

This invention relates to a dust removing apparatus and more particularly a dust removing apparatus for a sorting machine having an optical sorting system.

An object of this invention is to provide a new and improved dust removing apparatus.

Another object of this invention is to provide a new and improved dust removing apparatus particularly adapted for an optical classifying or sorting machine.

Another object of this invention is to provide a new and improved dust removing apparatus for an optical classifying machine which utilizes a stream of gaseous fluid to entrain dust or any other foreign particles which may interfere with the optical classifying system of the machine.

The classifying or sorting apparatus to which this invention pertains is adapted to determine the basic color of objects such as rice, beans, peas and the like and on the basis of such color determination the articles are classified. The machine is so constructed as to allow gravitational downward cascading movement of the articles. During such cascading movement through various parts of the apparatus, the articles generate a certain amount of dust due to the friction therebetween and the friction with the walls of the machine. The dust so generated is in part deposited upon certain of the optical elements of the classifying system, thereby affecting the intensity of light utilized by the optical system for classifying the articles and thus reducing the sensitivity of the system. As a result of this condition, the machine had to be periodically shut down and those elements of the optical system which were coated with dust had to be hand-cleaned to restore the optical system to its clean state.

The manner in which the above and other objects of the invention can be accomplished will be apparent from the following detailed description of the invention.

In the drawings:

FIGURE 1 is a vertical central section of a classifying apparatus incorporating the dust removing apparatus of this invention.

FIGURE 2 is an enlarged section taken along line 2—2 of FIGURE 1.

Referring now to FIGURE 1 there is shown an article sorting or classifying machine incorporating the dust removing apparatus of this invention. For a detailed description of the construction and operation of the optical system and the main structural components, reference should be had to U.S. Patent No. 3,009,571 issued November 21, 1961, and application Serial No. 144,601 filed October 12, 1961 entitled Color Sorting with Polarized Light, now abandoned, assigned to the same assignee as this invention. The classifying apparatus with which this invention is associated includes a generally cylindrical housing 10 supported in an upright position by a base 12. Articles to be classified are deposited in a funnel 14 which defines, with a lamp housing 16, an annular discharge passage 18 through which the articles to be classified pass. As the articles pass through the annular discharge passage 18 they fall upon a conical skirt 20 having a radially extending downwardly directed upper surface terminating at another annular opening 22 that is defined by the conical skirt 20 and a circumferential partition 24. Upon leaving the annular opening 22, the rice is free to fall downwardly toward either of two generally annular chambers 26 and 28. A series of circumferentially adjacent air valves 30 (only two of which are shown) are located in a plane normal to the axis of the tubular housing 10 and between the annular discharge 22 and the annular chambers 26 and 28. As explained in the above mentioned patent and in the above mentioned copending application, the air valves 30 are operative to effect changes in the trajectory of the articles as they fall from the opening 22 toward the annular chambers 26 and 28 by being responsively connected to the optical system of the apparatus so that the air valves are selectively opened to direct a jet of air radially inwardly at the appropriate time to thereby divert the rejected articles into the annular chamber 28. The portion of the housing 10 within which the articles being classified are deflected from their normal trajectory will hereinafter be referred to as the inspection zone. The annular chambers 26 and 28 have a common lower stationary annular wall 32 which includes openings 34 and 36 through which the classified articles pass into associated chutes 38 and 40, which convey the classified articles to suitable containers positioned to receive the articles.

A part of the optical inspection system associated with the air reject valves 30 is rotatably mounted in a tubular sleeve 42 having lower and upper bearings 44 and 46 respectively which rotatably support a tubular shaft 48. A tubular lens mount 50 is rotatable with and secured to the upper end of the tubular shaft 48 and supports lenses 52, 54, 56, 58 and mirrors 60 and 62. The remaining elements of the optical system are mounted within the lamp housing 16 and include a lamp 64, which is the source of illumination, and lenses 66 supported on the upper end of a fixed optical tube 68.

The structure described thus far is disclosed in the above-mentioned patent and application, and the manner in which the articles to be classified are classified is also explained.

As previously mentioned, due to the sliding friction between the articles themselves and between the walls of the passageways during the classifying operation of previous machines, dust was formed and deposited on the lenses 54 and 56 particularly. The deposited dust reduced the accuracy of the optical system because the amount of light transmitted to the inspection zone was greatly reduced, thus reducing the responsiveness of the associated light-analyzing components. This invention solves this problem by providing streams of flowing fluid, preferably air, directed in a manner to, in part, entrain the dust in the air streams and to effect a wiping action on the optical elements subject to be coated with dust. The streams of fluid have the attendant advantage of dissipating the heat produced by the lamp 64. In achieving such a result this invention includes a fan or blower 70, which may take any conventional form, having the discharge thereof in communication with the upper portion of the lamp housing 16 by a conduit 72. An annular partition 74, supporting and centering the optical tube 68, has a series of circumferentially spaced holes 76 formed therein through which the air discharged by the blower 70 passes downwardly as shown by the illustrated arrows. An annular ring 78, having the inner circumferential wall formed to define a converging passageway, is provided at the lower surface of the lamp housing 16. As will hereinafter be explained, a part of the air in the lamp housing 16 flows through the passageway formed by the annular ring 78. A tubular transparent light shield 80, having the lower end thereof outwardly flared, encloses a portion of the lens mount 50 and has the upper end thereof extending into the lamp housing 16.

The light shield has its outer surface spaced radially inwardly from the adjacent margin of the annular ring **78** and its inner surface spaced radially outwardly from the outer surface of the lens mount **50** to thereby define concentric annular openings through which the air from the blower 70 passes. The air passes through the annular openings and forms fluid streams. As shown, the stream P is adjacent the outer surface of the shield **80** and thes tream Q is between the passageway defined by the inner surface of the shield **80** and the exterior of the lens mount **50**. The lower flared end of the light shield **80** is supported on an annular ring **82** which is in turn supported by a tubular sleeve **84** having the upper end secured to the ring **82** and the lower end secured to the tubular sleeve **42**. Another tubular ring **86**, concentric with and radially spaced from the ring **84**, has the lower end thereof secured to a flange **88** to define an annular opening **90** forming the entrance to the passageway included between the tubular rings **84** and **86**. The chamber **28** has an outwardly and downwardly directed conical wall **92** having the upper circular margin thereof secured to the upper end of the tubular ring **86**, as shown in FIGURE 1. A conical baffle **94** has its lower end secured to the outer surface of the conical wall **92** and the upper end spaced from the adjacent flared portion of the light shield **80** to define an annular passageway **96** through which the air in stream P flows during its downward movement toward the passageway included between by the tubular rings **84** and **86**. The inner diameter of the tubular ring **82** is greater than the diameter of the adjacent portion of a lens mount **50** so that a passageway **98** is formed through which the air from the air stream Q flows into the tubular ring **84** as shown. The tubular ring **84** includes a series of circumferentially spaced holes **100** formed through the wall thereof to permit flow of the fluid into the annular cavity defined by the tubular members **84** and **86**. The upper portion of the tubular sleeve **42** includes a radially enlarged flange **102** having a series of axially extending circumferentially spaced holes **104** through which all of the fluid flows to an annular plenum chamber **106**. A conduit **108** connected to the plenum chamber and to the inlet of a blower **110** is provided for moving the fluid from the plenum chamber **106**.

During operation, the tubular shaft **48** and the lens mount **50** are rotated in unison by a conventional electric motor **112** which has a toothed belt **114**, and toothed pulleys **116** and **118** connected to the motor and to the shaft **48** respectively. Another motor **120**, by means of a sprocket chain **122** and sprockets **124** and **126** connected to the motor shaft and to a lower wall **125** of chamber **28** respectively, effects rotation of a partition **128** of the chamber **28**. An annular wall **134** coacts with the outer wall of chamber **26** to form an annular trough **135** at the lower end of chamber **26**, and wall **134** coacts with a second annular wall **136** to define a trough **137** at the lower end of chamber **28**. Brushes **130** and **132** are carried by the partition **128** and have their bristles in frictional sliding engagement with the lower annular plate **32**. The brush **130** moves along trough **135** while brush **132** moves along trough **137** to thereby effect movement of the classified articles to the openings **34** and **36**. It will be noted, therefore that during operation of the machine both the lens mount **50**, and the partition **128**, are being rotated.

In operation, the dust removing apparatus associated with the classifying machine operates as follows. Both of the blowers **70** and **110** move the air in the direction indicated by the arrows. The air discharged into the lamp housing **16** is rapidly decelerated since it abruptly passes into a larger flow area. Such deceleration causes rapid diffusion, and a substantial amount of turbulence is produced which is effective to increase the amount of heat transferred from the source of light to the air. The air then passes through the holes **76** and enters the concentric annular passageways to form streams P and Q. The area provided by the concentric annular passageways is greatly reduced compared to the area of the passage in the lamp housing and therefore rapid acceleration of the air in the passageways is caused and, as a consequence, turbulent flow conditions are again re-established in streams P and Q. This is particularly desirable since turbulent flow effects a very vigorous scrubbing action on the interior and exterior surfaces of the light shield **80** and on the lenses **54** and **56** thereby maintaining these parts substantially free of dust. The air flowing downwardly in the outer stream P encounters the outwardly flared portion of the light shield causing a change in momentum of the fluid and consequently effecting a wiping action on the flared portion. This action of the fluid in the flared portion is particularly significant because the light reflected from the articles being classified through the lens **54** must pass through the flared portion of the transparent light shield **80**. The air in the stream P continues through the passageway **96** where it is effective to entrain a high percentage of the dust particles in the chambers **26** and **28**. The air continues through the opening **96**, through the passageway **90**, and into the space bounded by the tubular rings **84** and **86**, and, by means of the holes **104**, discharges into the annular plenum **106**.

The air in the stream Q continues downwardly through the passageway **98** to the interior of the tubular ring **84**, through the holes **100** and **104** and thence to the annular plenum **106** carrying with it any dust that may be in its flow path. As shown by the arrows, the flow of air in the plenum **106** is introduced by the blower **110** which is connected to the annular plenum **106** by the conduit **108**. In this manner, substantially all of the dust that may interfere with the optical system of the classifying apparatus is swept away as it is being formed.

The invention having been thus described, that which is desired to be protected by Letters Patent is:

1. An apparatus for preventing accumulation of dust on the optical system of an optical classifying apparatus in a machine having wall means defining a dust dispersing chamber comprising optical inspection means located within said chamber including a lens, means passing a stream of gaseous fluid between said wall means and said lens for entraining the dust in the stream, and means for conveying the dust laden stream away from said lens.

2. An apparatus for preventing accumulation of dust on the optical system of an optical classifying apparatus in a machine having wall means defining a dust dispersing chamber comprising optical inspection means located within said chamber including a lens, light transmitting shield means disposed between said chamber and said lens, means passing a stream of gaseous fluid at least around said shield means for entraining the dust in the stream, and means for conveying the dust laden stream away from said lens.

3. An apparatus for preventing accumulation of foreign matter on the optical system of an optical classifying apparatus comprising optical inspection means having a rotatable lens mount, a tubular light transmitting shield around said lens mount shielding the lens from such foreign matter, means cooperating with said shield to define concentric passageways, means for passing foreign matter-entraining fluid through said passageways and over said lens and said shield, a plenum communicating with said passageways to receive the fluid therefrom, and means for exhausting the fluid from said plenum.

4. An apparatus for sorting articles that create dust during passage through the apparatus comprising means defining a circular inspection zone across which the articles pass for inspection and wherein the dust is dispersed by the articles, optical inspection means centrally of said zone for directing a beam of light in said zone, tubular transparent dust shield means disposed between said inspection zone and said optical inspection means, and means passing streams of gaseous fluid to the exterior and

the interior of said shield means for entraining and removing the dust created by the articles being sorted.

5. An apparatus for sorting articles that create dust during passage through the apparatus comprising means defining a circumferential inspection zone across which the articles pass for inspection and wherein the dust is dispersed by the articles, a rotatable optical inspection means centrally of said zone for directing a beam of light in said zone, transparent dust shield means disposed between said inspection zone and said optical inspection means, and means pumping air past the exterior and the interior of said shield means for entraining and removing the dust created by the articles being sorted.

6. An apparatus for sorting articles that create dust during passage through the apparatus comprising means defining a circular inspection zone across which the articles pass for inspection and wherein the dust is dispersed by the articles, optical inspection means for directing a beam of light in said zone, transparent dust shield means disposed between said inspection zone and said optical inspection means, said shield and said optical inspection means defining annular passageways through which dust-entraining air flows, and air blowers cooperatively associated on opposite ends of said passageways to move air through said passageways.

7. An apparatus for sorting articles that create dust during passage through the apparatus comprising an air blower, a housing having a lamp therein and having the discharge conduit of said blower in communication therewith, an elongated rotatable lens mount having one end portion thereof extending into said housing, a transparent tubular shield surrounding said lens mount and extending from said one portion longitudinally along said lens mount, said housing, said lens mount, and said shield defining concentric annular fluid passageways through which the air from said blower flows, and another blower having the inducer thereof in communication with the downstream end of said annular passageways to exhaust the air and the dust entrained thereby from the apparatus.

8. An apparatus for sorting articles that create dust during passage through a dust dispersing chamber defined by wall means comprising an air blower, a housing having a lamp therein and having the discharge conduit of said blower in communication therewith, an elongated rotatable lens mount having one end portion thereof extending into said housing, a transparent tubular shield within said chamber, surrounding said lens mount and extending from said one end longitudinally along said lens mount forming annular fluid passageways, and a second blower exhausting the air and the dust entrained thereby from the apparatus.

9. An apparatus for sorting articles that disperse dust during passage through an inspection zone in the apparatus comprising a blower connected to a housing having a lamp therein, said housing having a lower annular end wall circumscribing a circular discharge outlet, an elongated lens mount having one end portion extending into said outlet, a transparent tubular shield surrounding said lens mount between the inspection zone and the lens mount and extending into said outlet, said housing, lens mount and shield defining concentric annular paths along which the gas from said blower flows, the annular end wall, tubular shield, and lens mount providing restrictions in said paths to cause the gas to accelerate so as to assist in the entrainment and removal of foreign matter from said paths.

10. An apparatus for sorting articles that create dust during passage through an inspection zone therein, comprising a first air blower, a housing having a lamp therein and having the discharge conduit of said blower in communication therewith, an elongated rotatable lens mount having one end portion thereof extending into said housing, a transparent tubular shield surrounding said lens mount between said inspection zone and said lens mount and extending into said housing, said lens mount and said shield forming annular air passageways, a second air blower communicating with said air passageways, said first and second air blowers being effective to cause a stream of air to flow through said passageways entraining dust therein, and means to accelerate the flow of air past the lens mount and shield so as to enhance the entrainment of the dust into the air stream.

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