March 22, 1960 W. H. WARNER 2,929,500

APPARATUS FOR SORTING ARTICLES

Filed April 29, 1957 3 Sheets-Sheet 1

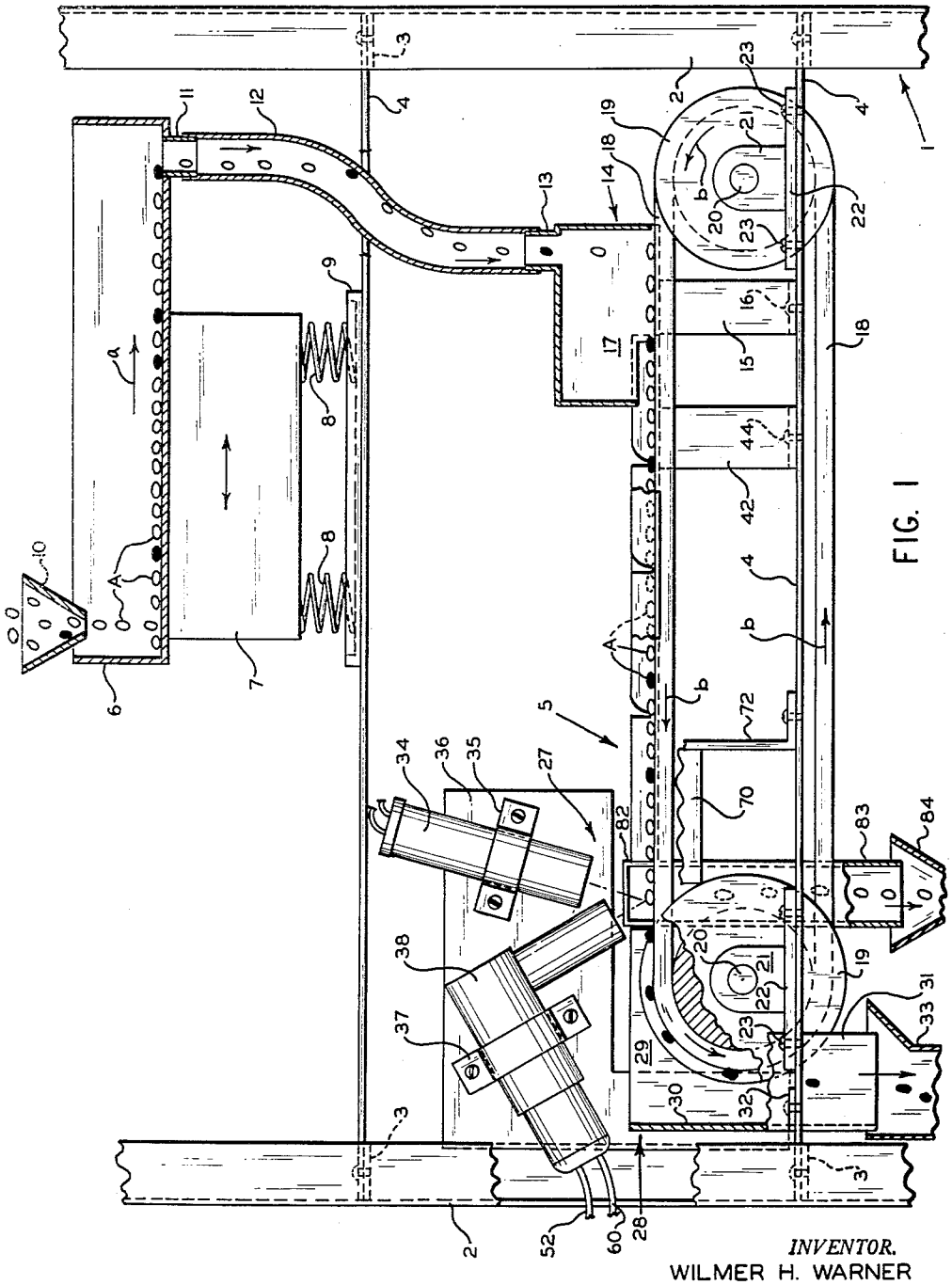


FIG. 1

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APPARATUS FOR SORTING ARTICLES

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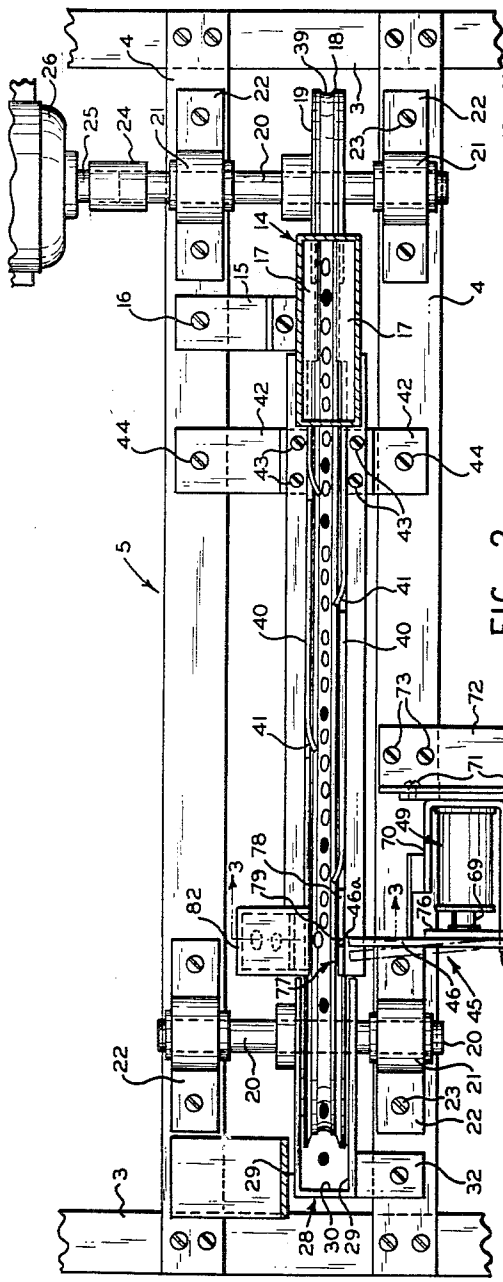


FIG. 2

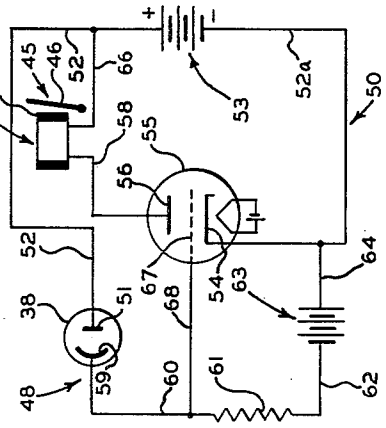


FIG. 9

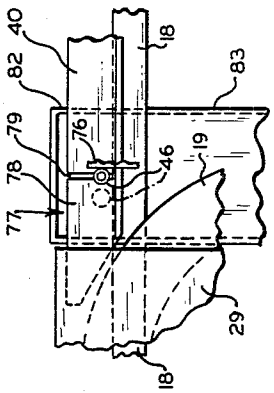


FIG. 4

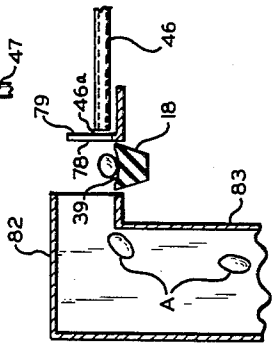


FIG. 3

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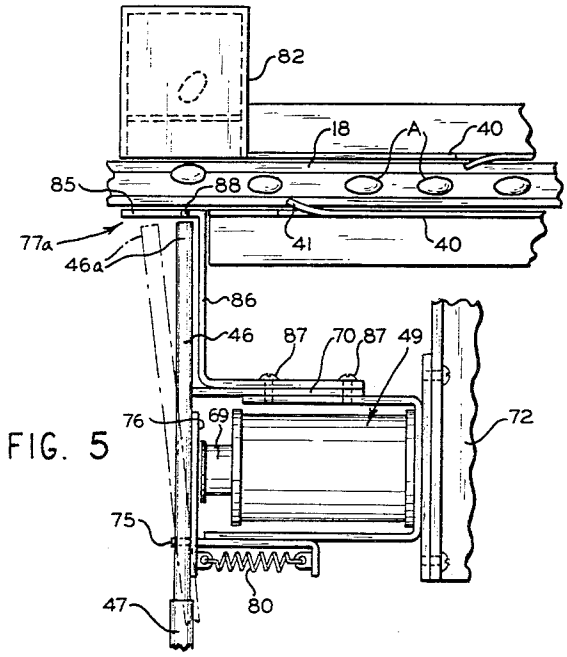


FIG. 5

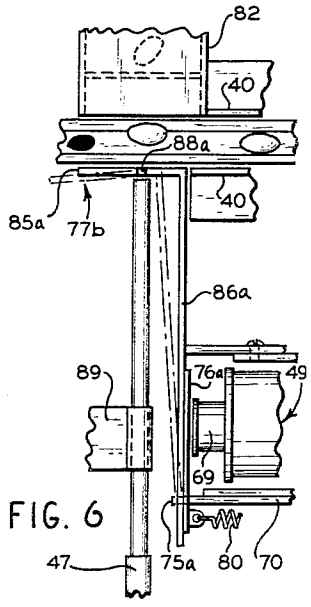


FIG. 6

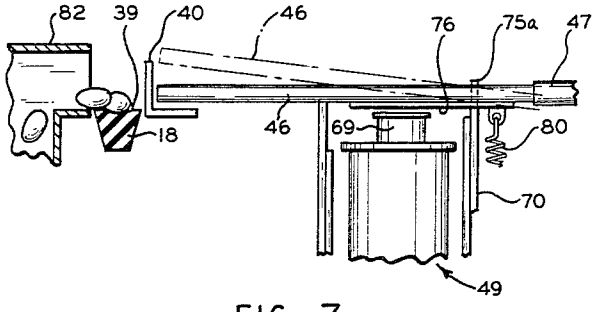


FIG. 7

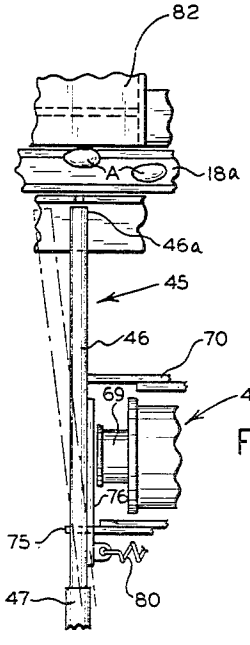


FIG. 8

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2,929,500

APPARATUS FOR SORTING ARTICLES

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Application April 29, 1957, Serial No. 655,607

9 Claims. (Cl. 209—111)

This invention relates to apparatus for sorting articles and more particularly to apparatus for sorting articles in accordance with the color or light reflective properties of the articles.

Apparatus of the general class to which the invention pertains have been proposed heretofore and have been generally well received by industry. Most, if not all, machines for sorting articles according to their color make use of air devices controlled by light sensitive mechanisms to sort culls from acceptable articles. Some of the air devices used heretofore are suction devices, whereas others utilize an air jet in the separation of culls from good quality products. In either event, the overwhelming majority of the air devices in use heretofore in color classification of articles have depended for their proper operation upon valves and valve mechanisms to control the action of the air devices. For mechanical sorting apparatus to be successful, it must operate at extremely high speed which requires the air controlling valves also to operate at extremely high speeds. Since the valves must operate at high speeds, they must be precision formed and light in weight, the latter requirement usually being manifested in a valve of extremely small size. The expense of manufacturing such valves is high and the high cost of manufacture is compounded by the necessity of replacement of such valves which is frequent inasmuch as they necessarily are of relatively delicate nature.

An object of this invention is to provide sorting apparatus for sorting articles in accordance with their light reflective properties and in which air is used to segregate good quality articles from culls, the apparatus being operable without dependence on valves and valve structures for controlling the flow of air.

Another object of the invention is to provide air operated sorting apparatus triggered in accordance with the light reflective properties of the articles to be classified and having control means for the air operated devices formed of inexpensive material.

Still another object of the invention is to provide sorting apparatus of the kind referred to wherein the controlling means for the air operated devices are readily accessible for adjustment, replacement, and/or repair without necessitating dismantling of many other parts of the apparatus.

Other objects and advantages of the invention will be pointed out specifically or will become apparent from the following description of the invention when it is considered in conjunction with the appended claims and the accompanying drawings, in which:

Figure 1 is a fragmentary view, partly in side elevation and partly in section, of sorting apparatus constructed in accordance with the invention, certain parts being broken away for purposes of clarification;

Figure 2 is a fragmentary top plan view, partly in section, of a portion of the apparatus shown in Figure 1;

Figure 3 is an enlarged, fragmentary sectional view taken on the line 3—3 of Figure 2;

Figure 4 is a side elevational view of the parts shown in Figure 3;

Figure 5 is an enlarged, fragmentary top plan view of a modified part of the apparatus;

Figure 6 is a view similar to Figure 5, but showing another modified form;

Figure 7 is a view similar to Figure 3, but showing still another modification;

Figure 8 is a view similar to Figure 6, but showing a modified form of the invention; and

Figure 9 is a schematic diagram of certain electrical parts incorporated in the apparatus.

Apparatus constructed in accordance with the invention includes a main frame **1** composed of vertical front and rear members **2** connected one to another by horizontal frame members **3** and having a plurality of generally horizontal stringers **4** on which other parts of the apparatus may be mounted. The frame **1** is so constructed that, in actual practice, it will support a large number of sorting units in side by side and vertical relation, but for purposes of illustration only one unit will be shown and described.

Sorting apparatus embodying the invention is designated generally by the reference character **5** and includes a tray **6** connected to a vibrating body **7** supported on springs **8** which, in turn, are supported on a bracket **9** which is secured to one or more of the stringers **4** in any suitable manner. The tray **6** is located beneath the discharge spout **10** of a hopper (not shown) containing articles A such as beans, rice, peas, seeds, or the like, which are to be sorted by the apparatus **5**. The articles A are discharged into the tray **6** which is oscillated by the vibrating body **7** so as to move the articles in the direction of the arrow *a* in Figure 1 to a discharge opening or tube **11** at one end of the tray **6**. A hose **12** has one of its ends connected to the tube **11** and its other end connected to a tube **13** leading into a receptacle **14** which is mounted on a stringer **4** by means of a bracket **15** and screws **16**, the arrangement being such that articles A discharged from the tray **6** are conducted by gravity to the receptacle **14**.

The receptacle **14** has no bottom, but instead, the side walls **17** converge to a point where their spacing corresponds substantially to the width of an endless belt **18** which is trained around spaced pulleys **19** mounted on shafts **20** journalled in bearing supports **21** having flanges **22** secured to the stringers **4** by suitable means such as screws **23**. One of the shafts **20** is connected by a coupling member **24** (Figure 2) to the armature shaft **25** of an electric motor **26**, the arrangement being such that the pulleys **19** and the belt are driven in the direction of the arrows *b* in Figure 1 so that the upper run of the belt **18** delivers articles A from the receptacle **17** along a generally horizontal path passing through an inspection zone **27** and leading to a collector housing **28**, the latter comprising spaced side walls **29** extending one on either side of the pulley **19** and being connected at corresponding ends by an end wall **30**. The housing **28** is provided with an open discharge chute **31** and is supported on one of the stringers **4** by a bracket **32** in such position that the discharge chute **31** is in alignment with a receiving chute **33** supported in a suitable manner on the frame **1** and serving as means for conducting articles discharged from the end of the upper run of the belt **18** to a suitable conveyor (not shown).

The inspection zone in the illustrative embodiment of the invention is constituted by an exciter lamp **34** adjustably secured by means such as a bracket **35** on a support **36** and located in a position to illuminate each of the articles A presented to the inspection zone. As each ar-

ticle is illuminated, it will reflect light in accordance with its coloring. Adjustably mounted on the support **36** by means such as a bracket **37** is a light sensitive device such as a photo-electric cell **38** which is located in a position to receive light reflected from an illuminated article.

In the illustrative embodiment of the invention, the segregation or classification of articles depends on their light reflective characteristics, so it is important that all of the articles on the delivery belt **18** be located as uniformly as possible to the lamp **34** and the cell **38**. This objective is achieved by forming the upper surface of the delivery belt **18** with a concave groove as is indicated best in Figures 3 and 7 at **39** and by the provision of guide rails **40** located one on either side of the belt **18** and having inwardly turned projections at spaced intervals which extend towards the belt and function to center the articles A on the belt with their longitudinal axes parallel to the run of the belt. The guide rails **40** may be supported by a suitable number of brackets **42** secured to the rails **40** by screws **43** and to the stringers **4** by screws **44**.

The invention includes means operable according to the reflectivity of an article for diverting a selected article A from the path it otherwise would follow. In Figures 2 through 4 and 9 the diverting means is indicated by the reference character **45** and includes an air or other suitable fluid medium conduit member **46** having a hose **47** connecting one end of the conduit **46** to a source of pressure fluid such as a conventional air compresser (not shown). The discharge end **46***a* of the member **46** is located adjacent to the path followed by the articles A on the belt **18** so as to be capable of directing fluid in a direction to intersect the path of the articles A, the force of the pressure fluid being sufficiently great to unseat an article from the belt. The conduit member **46** may be simply a tube of conventional construction, preferably formed of light weight material. Neither the member **46** nor the hose **47** need include any valve structure therein, but each preferably permits pressure fluid from the source to flow continuously therethrough. It is not practical to permit a stream of pressure fluid to blow continuously across the path of the articles A inasmuch as this would result in unseating all of the articles. Accordingly, apparatus constructed in accordance with the invention includes control means designated generally by the reference character **48** operated in accordance with the degree of light reflected from an illuminated article to the photocell **38** for selectively enabling and disabling the flow of fluid through the conduit member **46** to divert an article from the path of the belt.

Referring principally to Figure 9, the control means **48** includes an electromagnet **49** connected to the photoelectric cell **38** through an amplifier **50**. The anode **51** of the photoelectric cell is connected by a wire **52** to the positive terminal of a "B" battery **53**, the other terminal of the battery being connected by a wire **52***a* to an independently heated cathode **54** of a triode tube **55**. The plate **56** of the tube is connected by a wire **58** to one terminal of the electromagnet **49**. The cathode **59** of the photo-cell is connected by a wire **60** to one end of a resistor **61**. The other end of the resistor **61** is connected by a wire **62** to the negative pole of a "C" battery **63**, the positive pole of the battery being connected by a wire **64** to the wire **52***a*. From the wire **52** connected to the positive pole of the battery **53** leads a wire **66** which is connected to the other terminal of the electromagnet **49**. The grid **67** of the tube is connected by a wire **68** to a point on the wire **60** intermediate the cathode **59** of the photoelectric cell and the resistor **61**.

The arrangement of the amplifier parts is such that when insufficient light is reflected into the photo-cell **38** to establish a current therethrough, the battery **63** biases the grid **67** so as to prevent current from flowing through the tube **55** and thus deenergizes the electromagnet **49**. When sufficient light is reflected into the photoelectric cell **38** to permit current to flow therethrough, however, the grid bias will be changed so as to permit current to flow through the tube **55** and thereby energize the electromagnet **49** and cause its pole piece **69** to exert an attractive force on the conduit member **46**. The amplifier may include conventional means (not shown) for conditioning the energization of the electromagnet in accordance with any number of variations of the strength of the signal emitted by the photocell **38**.

In the embodiment of the invention shown in Figures 2, 3, 4, and 9, the electromagnet **49** is mounted on a bracket **70** which may be bolted or otherwise secured as at **71** to a mounting plate **72**, the latter being secured to a stringer **4** by means such as screws **73**. The bracket **70** includes a part **74** which projects beyond the pole piece **69** and provides a support on which the conduit member **46** may be pivoted as at **75** for swinging movements of the discharge end **46***a* from side to side in a substantially horizontal plane. To assure good magnetic attractiveness between the armature **69** and the conduit member **46**, the latter may have a magnetic plate **76** soldered or otherwise secured thereto.

In order to prevent the unseating of articles from the belt **18** except when desired, a shield member **77** may be interposed between the discharge end **46** of the conduit and the belt **18**. In the embodiment of the invention shown in Figures 2, 3, and 4 the shield **77** comprises an integral extension **78** of one of the guard rails **40**, the extension having a slit or opening **79** therein which will be in alignment with the discharge end **46***a* of the conduit when the latter is attracted by the pole piece **69**. The attracted position of the conduit **46** is disclosed in full lines in Figures 2 and 4. To move the discharge end **46***a* of the conduit behind the shield **77** when the pole piece **69** releases the conduit, there is provided a spring **80** having one of its ends anchored to a post **81** on the arm **74** and its other end connected either to the plate **76** or the conduit **46**, the arrangement being such that the spring **80** urges the conduit **46** to the position shown in dotted lines in Figures 2 and 4.

In the operation of the apparatus thus far described, articles to be sorted, e.g. white beans, will be fed from the hopper spout **10** to the belt **18** for presentation in rapid succession to the inspection zone **27**. Beans are classified according to their color; good quality beans being substantially uniformly white, whereas culls are dark. In the drawings, culls are blackened. As each bean reaches the inspection station **27**, it will be illuminated by the exciter lamp **34** and the light reflected by the illuminated bean will be received by the photoelectric cell **38**. If the reflected light is sufficient to cause the cell **38** to generate a signal of predetermined strength, the signal will be transmitted via the amplifier to the electromagnet and the conduit member **46** will be attracted by the pole piece **69** of the electromagnet **49** so as to move the discharge end **46***a* of the conduit into register with the slot **79**, whereby the stream of air flowing through the conduit **46** will impinge against the bean and unseat it from the belt **18**. The unseated bean will be received in a receptacle **82** having a discharge spout **83** opening into a hopper **84** through which good quality beans may pass to a conveyor (not shown). When the bean is removed from the inspection zone, the emission of a signal by the cell will cease and the spring **80** will return the conduit **46** to its ineffective position and hold it there firmly until the conduit again is attracted by the electromagnet.

When a cull bean is presented to the inspection zone **27**, the amount of light reflected by it will be less than the amount reflected by a good quality bean. Hence, there will be little or no flow of current through the photoelectric cell **38** and the signal, if any, emitted thereby will be of insufficient strength for the pole piece **69** to attract the conduit. As a result, the discharge openings **46***a* of the conduit **46** will remain shielded by the

shield 77 so as to divert the air stream from the bean path and enable the cull bean to proceed to the end of the belt run for discharge in the manner previously described.

It is preferred that the good quality articles be removed from the belt by means other than their arriving at the end of the belt run. The advantage of this operation is that it prevents culls being added to previously sorted good quality articles in the event of electrical failure of any of the inspection apparatus. The operation and structure described thus far is only one way in which the preferred result may be obtained; there are several other ways for obtaining the same result.

In the modified embodiment of the apparatus disclosed in Figure 5, the conduit **46** is pivotally mounted as at **75** for swinging movements under the influence of the electromagnet **49** and the spring **80**, all as has been described in connection with Figures 2–4. In the construction shown in Figure 5, however, the guide rail **40** terminates short of the full line position of the conduit **46**. In this embodiment, a shield **77***a* is provided by a plate **85** located in a position to form, in effect, an extension of the guard rail **40** and substantially in the plane of the latter. The plate is supported by an arm **86** which is secured to the electromagnet supporting bracket **70** by suitable means such as screws **87**. The plate **85** has an opening **88** therein which will be in register with the discharge end **46***a* of the conduit **46** when the latter is attracted by the pole piece **69** of the electromagnet. The operation of the construction shown in Figure 5 is similar to that previously described.

The embodiment of the invention shown in Figure 6 is generally similar to that disclosed in Figure 5, but differs from the latter in that the conduit member **46** is held in fixed relation by a supporting arm **89** which may be secured to the frame **1** in any suitable manner, whereas the supporting arm **86***a* for the shield **77***b* is pivoted on the pivot **75***a* on the bracket **70** so as to be swingable under the influence of the pole piece **69** and the spring **80** from a position in which the opening **88***a* in the shield plate **85***a* is out of register with the discharge end **46***a* of the conduit to permit a cull to pass the inspection zone, to the position shown in full lines in Figure 6 in which the opening **88***a* is in register with the stream of air issuing from the conduit **46**. In the Figure 6 construction the spring **80** is connected to the shield supporting arm **86***a* which may be provided with a magnetic plate **76***a* similar to the plate **76**. Although in this instance it is the shield **77***b* which is the member movable in accordance with the strength of the signal emitted by the photoelectric cell **38**, the operation of the apparatus is substantially the same as that which previously has been described in connection with Figures 2–5. In the Figure 6 construction, however, it is possible to make the shield **77***b* somewhat lighter in weight than the conduit **46**, thereby promoting more rapid operation of the apparatus.

In Figure 7 there is disclosed an embodiment of the invention in which the electromagnet **49** is supported with its pole piece **69** upright and in which the fluid conduit member **46** is pivoted on the bracket **70** as at **75***a* for swinging movements in a vertical plane. In the full line showing, the pole piece **69** holds the member **46** attracted so that the stream of air issuing from the conduit **46** intersects the path of articles A on the belt **18** to unseat them. However, when a cull passes the inspection zone, the electromagnet **49** will not be energized and the conduit **46** will remain in the position shown in chain lines, in which position the air stream will diverge with respect to the path of the articles. In this embodiment of the invention, the guard rail **40** may terminate short of the position of the member **46**, as shown, and if desired, any of the shields referred to heretofore may be used.

The embodiment shown in Figure 8 of the drawing is similar to that shown in Figures 2–4, the principal difference being that the conduit **46** normally is held attracted by the pole piece **69** so that the stream of pressure fluid issuing from the discharge end **46***a* of the conduit is directed continuously across the path of the articles on the belt **18** except when the degree of light reflected from an object is insufficient to cause a sufficiently strong signal to be emitted by the photoelectric cell **38** to maintain the electromagnet energized. The apparatus may be caused to function in this manner in a number of ways, one of which is to utilize a belt **18***a* having its upper surface made of a material which is of about the same reflectivity as good quality objects to be inspected. In this construction the conduit **46** will be held in the full line position shown in Figure 8 until such time as a discolored object arrives at the inspection zone and interrupts or decreases the strength of the signal emitted by photoelectric cell **38**. In this event, the pole piece **69** will release the conduit **46** and the latter will be moved to its shielded position by the spring **80**. Any of the shields disclosed heretofore may be used in the Figure 8 embodiment. The use of a white or light colored belt is made feasible with apparatus constructed in accordance with the invention inasmuch as the constant flow of air or pressure fluid across the surface of the belt **18** will keep the latter clean.

In each of the disclosed embodiments of the invention no obstruction to the passage of pressure fluid from the source through the discharge end of the conduit is offered. Even so, the amount of fluid required for operation of the apparatus is substantially no more than that required in devices utilizing valves to control the flow of fluid inasmuch as the latter devices usually include safety valves operable to permit pressure fluid in the system to exhaust to atmosphere, thereby preventing excessive pressures from building up in the system.

The disclosed embodiments are representative of the presently preferred forms of the invention, but are intended to be illustrative rather than definitive thereof. The invention is defined in the claims.

I claim:

1. Apparatus for scanning articles according to their color comprising means for delivering articles to an inspection zone along a path leading from a supply of articles to collector means for inspected articles; means at said zone for scanning each article and operable to emit a signal of a strength according to the color of a scanned article; a fluid conduit member having a discharge opening adjacent to said path and through which a stream of pressure fluid flows continuously with sufficient force to divert a selected article from said path; means connecting said conduit member to a source of pressure fluid; means mounting said conduit member for movements to and from a position in which said stream of fluid intersects said path; means operated by a signal of predetermined strength emitted by said scanning means for moving said conduit member to said position; and means connected to said conduit member for moving the latter from said position and holding it out of said position when the strength of said signal is less than said predetermined strength.

2. Apparatus for scanning articles according to their color comprising means for delivering articles to an inspection zone along a path leading from a supply of articles to collector means for inspected articles; means at said zone for scanning each article and operable to emit a signal of a strength according to the color of a scanned article; a fluid conduit member having a discharge opening adjacent to said path and through which a stream of pressure fluid flows continuously with sufficient force to divert a selected article from said path; means connecting said conduit member to a source of pressure fluid; a shield member interposed between said path and the discharge opening of said conduit member, said shield member having an opening therein through

which the stream of fluid may pass; means mounting one of said members for movement relative to the other; means operated by a signal of predetermined strength emitted by said scanning means for moving the movable one of said members to a position in which the discharge opening of said conduit member is aligned with the opening in said shield member; and means connected to said movable one of said members for moving the latter to another position in which said discharge opening and said opening in said shield member are out of alignment when the strength of said signal is less than said predetermined strength, thereby disabling the stream of fluid from diverting an article from said path, the means connected to said movable one of said members being capable of holding the latter in said another position and preventing its rebounding.

3. Apparatus as set forth in claim 2 wherein said conduit member is the movable one of said members.

4. Apparatus as set forth in claim 2 wherein said shield member is the movable one of said members.

5. Apparatus for scanning articles according to their color comprising means for delivering articles to an inspection zone along a path leading from a supply of articles to collector means for inspected articles; means at said zone for scanning each article and operable to emit a signal of a strength according to the color of a scanned article; a hollow fluid conduit member providing an unobstructed fluid passageway having a discharge opening adjacent to said path and through which a stream of pressure fluid flows continuously with sufficient force to divert a selected article from said path; means connecting said conduit member to a source of pressure fluid; guide means for guiding articles along said path, said guide means including a wall interposed between the discharge end of said conduit member and said path for shielding articles on said delivering means from said stream of pressure fluid, said wall having an opening therein through which said stream may flow; means mounting said conduit member for movement relative to said wall to and away from a position permitting said stream of pressure fluid to flow through said opening and impinge against articles on said delivering means; and means operated by a signal of predetermined strength emitted by said scanning means for moving said conduit member to said position.

6. Apparatus as set forth in claim 5 including means connected to said conduit member for moving the latter away from said position when the strength of said signal is less than said predetermined strength and yieldably holding the latter away from said position.

7. Apparatus for scanning articles according to their color comprising means for delivering articles to an inspection zone along a path leading from a supply of articles to collector means for inspected articles; means at said zone for scanning each article and operable to emit a signal of a strength according to the color of a scanned article; a hollow fluid conduit member providing an unobstructed fluid passageway having a discharge opening adjacent to said path and through which a stream of pressure fluid flows continuously with sufficient force to divert a selected article from said path; means connecting said conduit member to a source of pressure fluid; means mounting said conduit member in a location to direct pressure fluid issuing therefrom towards said path; a shield member; means mounting said shield member for movement from a first position in which pressure fluid issuing from said conduit member impinges on said shield member and is diverted from said path, to a second position in which pressure fluid issuing from said conduit member passes said shield member and intersects said path; means operated by a signal of predetermined strength emitted by said scanning means for moving said shield member from said first position to said second position and means connected to said shield member for moving the latter from said second position to said first position and holding it there when the strength of said signal is less than said predetermined strength.

8. Apparatus as set forth in claim 7 wherein said means connected to said shield member for moving the latter from said second position to said first position comprises a spring.

9. Apparatus for scanning articles according to their color comprising means for delivering articles to an inspection zone along a path leading from a supply of articles to collector means for inspected articles; means at said zone for scanning each article and operable to emit a signal of a strength according to the color of a scanned article; a hollow fluid conduit member providing an unobstructed fluid passageway having a discharge opening adjacent to said path and through which a stream of pressure fluid flows continuously with sufficient force to divert a selected article from said path; means connecting said conduit member to a source of pressure fluid; a shield member adjacent to the discharge opening of said conduit member and being capable of blocking said stream from said path; means mounting one of said members in a stationary position; means mounting the other of said members for movements from said position in which said shield member blocks the stream from said path, to another position in which said stream intersects said path, and return; means operated by a signal of predetermined strength emitted by said scanning means for moving the movable one of said members from one of its positions to the other; and means connected to the movable one of said members for returning the latter to its original position and holding it there when the strength of said signal is less than said predetermined strength.

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