May 29, 1934. B. COOPER 1,960,231

SHADE INSPECTING MACHINE

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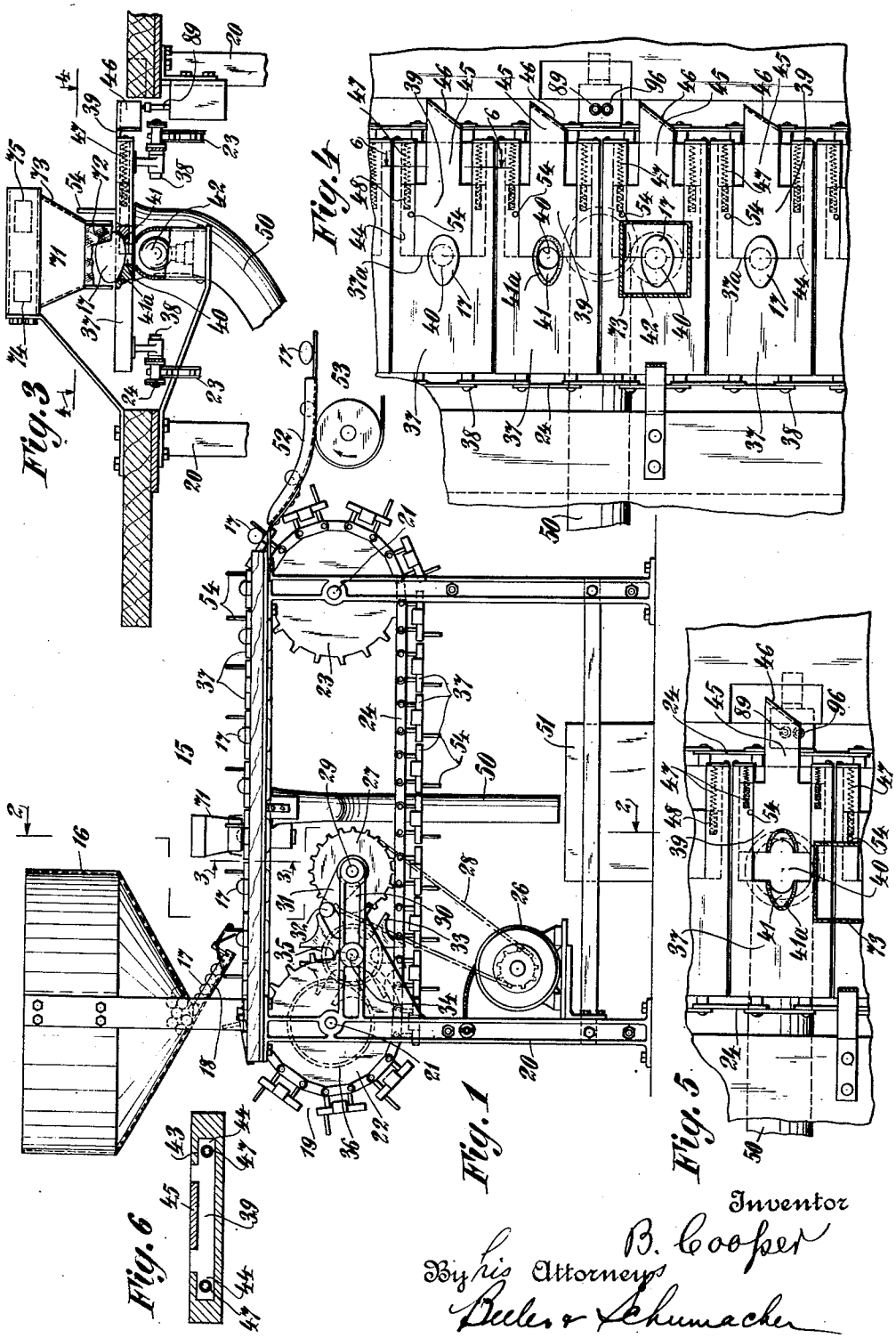

Fig. 1

Fig. 4

Fig. 3

Fig. 5

Fig. 6

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Fig. 9

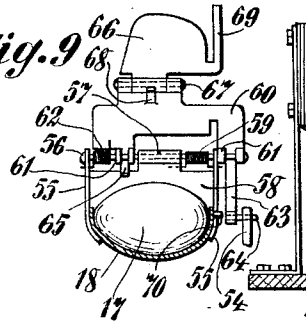


Fig. 2

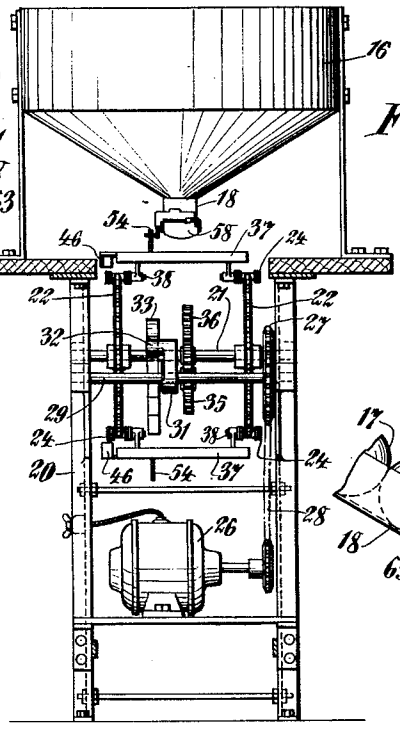


Fig. 7

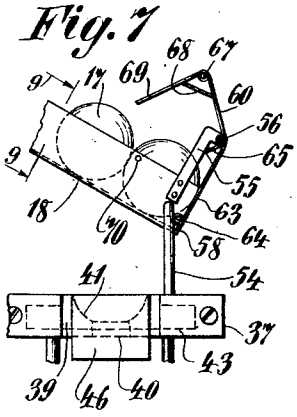
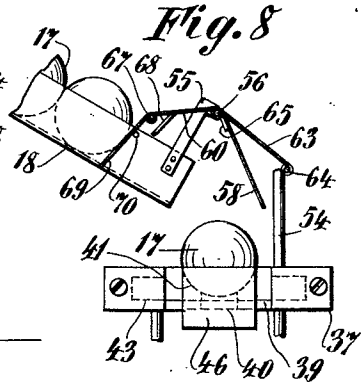


Fig. 8



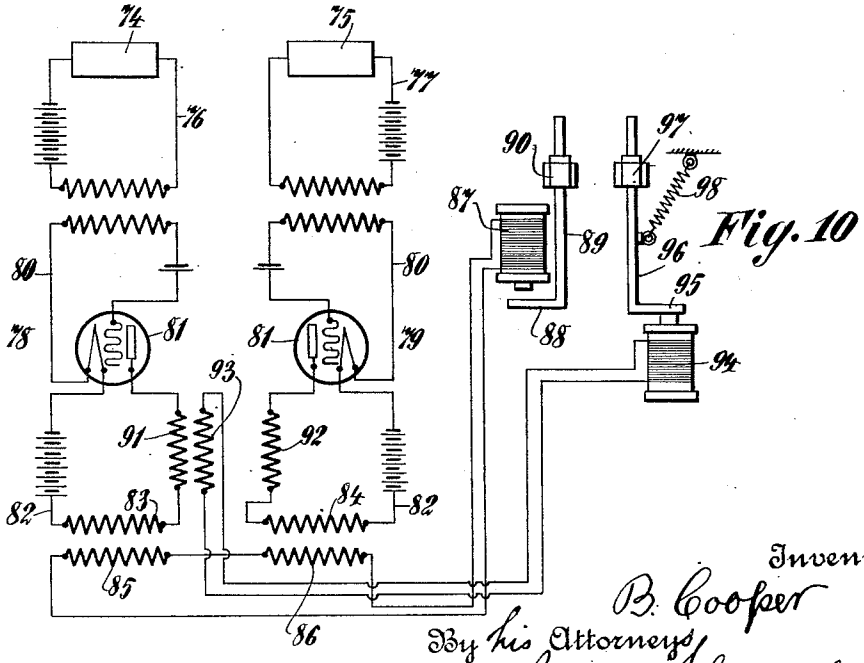


Fig. 10

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SHADE INSPECTING MACHINE

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Fig. 11

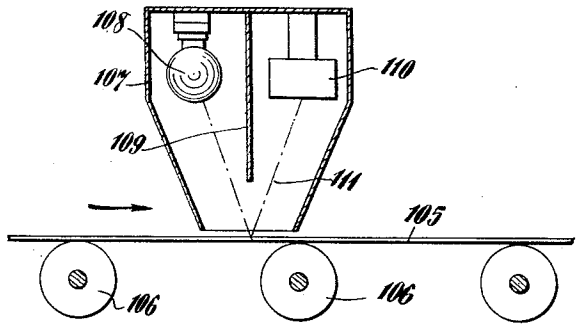
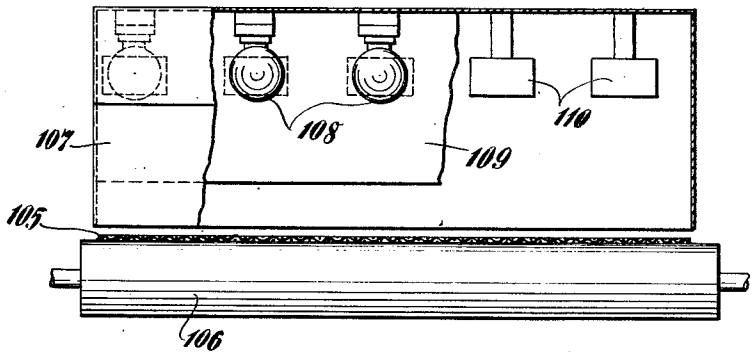


Fig. 12



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Patented May 29, 1934

1,960,231

UNITED STATES PATENT OFFICE

1,960,231

SHADE INSPECTING MACHINE

Benjamin Cooper, New York, N. Y.

Application June 20, 1928, Serial No. 286,836

15 Claims. (Cl. 209—111)

This invention relates to devices for sorting articles according to color or shade thereof, and particularly according to a spotted or unspotted condition of the articles.

One object of the invention is to provide an improved device of the character described for electrically indicating a spotted condition or variation from a desired shade of an article.

Another object of the invention is the provision of a device of the nature set forth having improved means for sorting articles, as for example eggs, which are being candled and separated to eliminate the spotted or defective eggs from the good eggs.

A further object of the invention is to construct a device of the type alluded to having improved means to permit a plurality of articles to be sorted according to a spotted or unspotted condition thereof, which means includes photosensitive devices receiving light from different portions of an article for a comparative indicaton as between a spotted and an unspotted portion thereof.

A further object of the invention is seen to reside in the provision of improved means comprising a plurality of photosensitive means to coact with separate portions of an egg, or the object.

Still another object of the invention is to provide an improved conveyor and coacting parts, and to make the device comparatively simple and inexpensive, and nevertheless reliable and efficient in use.

This invention contemplates the provision of improved means for sorting from a plurality of articles those that lack a prescribed uniformity in shade or color. It may be employed to interiorly examine and sort transparent or translucent objects, of which eggs fall in the latter category. It may, however, be suitably modified to act similarly with opaque objects. As an instance of such use, may be mentioned that in connection with textiles and the like.

One feature of the invention is the employment of counteracting currents that may be originally generated by photo-sensitive cells, a plurality of which are used in the machine. Each cell is activated by separate light from a mass of material, as, from different portions of the same article.

If the amount of light received by each cell is the same, a balance in the currents is obtained. If there is a difference in shade or color, there is an unbalance of the currents, and an electromagnet is energized. This may operate an indicator, which may take any suitable form and may include an armature. The latter may actuate a conveyor of the articles, or other mechanical means, to cause the defective articles to be dropped or otherwise removed from the conveyor. In the event that the article that is being examined is totally black, or of a darker shade than desired, a second indicator may function, and actuate the conveyor to cause such article to be removed. The last mentioned indicator is actuated by an electromagnet that is energized when there is a balanced as well as an unbalanced condition of the aforesaid currents, to attract and move its armature out of operating condition. When there is no current generated, due to the article being black, the said armature is released and may move automatically into operating condition to indicate the defective condition of the article.

Other objects and advantages of the invention will become apparent as the specification proceeds.

With the aforesaid objects in view, the invention consists in the novel combinations and arrangements of parts hereinafter described in their preferred embodiments, pointed out in the subjoined claims, and illustrated on the annexed drawings, wherein like parts are designated by the same reference characters throughout the several views.

In the drawings:

Figure 1 is a side elevation showing a device embodying the invention.

Fig. 2 is a vertical section taken approximately on line 2—2 of Fig. 1.

Fig. 3 is an enlarged vertical section taken on line 3—3 of Fig. 1, with certain parts removed.

Fig. 4 is a horizontal section taken on line 4—4 of Fig. 3 with certain parts removed.

Fig. 5 is a similar view but showing the conveyor actuated to release a defective egg.

Fig. 6 is a sectional detail view taken on line 6—6 of Fig. 4.

Fig. 7 is a fragmentary view in side elevation showing means for feeding the eggs one at a time onto the conveyor.

Fig. 8 is a similar view showing the means in egg discharging position.

Fig. 9 is an end view of the said means taken on section line 9—9 of Fig. 7, with a detail of the device elevated to show the construction.

Fig. 10 is a schematic view of a circuit embodying the invention.

Fig. 11 is a sectional side view of a further

modification showing an embodiment of the invention.

Fig. 12 is an end view of the same.

The advantages of the invention as here outlined are best realized when all of its features and instrumentalities are combined in one and the same structure, but, useful devices may be produced embodying less than the whole.

It will be obvious to those skilled in the art to which the invention appertains, that the same may be incorporated in several constructions. The accompanying drawings, therefore, are submitted merely as showing the preferred exemplification of the invention.

Referring in detail to the drawings, 15 denotes a device embodying the invention. The same includes a hopper 16 into which are loaded the eggs 17 or other articles to be tested. Extending from the said hopper is a chute 18 for feeding the eggs into an endless conveyor 19. The latter is mounted on a frame 20 in which are journaled at 21 the sprockets 22 and 23 that coact with the endless chains 24. To rotate the sprockets a motor 26 turns a sprocket 27 by means of a chain 28. The sprocket 27 is mounted on a shaft 29 journaled in a bracket 30, and secured to said shaft is an arm 31 having a pin 32. The latter engages a Geneva star 33 which is mounted on a shaft 34 journaled in the said bracket. Affixed to shaft 34 is a gear 35, the teeth of which mesh with those of a gear 36, which, being secured to shaft 21, rotates the sprocket wheels 22. Accordingly, a step by step movement of the conveyor 19 is obtained.

The conveyor 19 comprises a plurality of transversely extending plates 37 mounted on the pivotal cross pins 38 interconnecting the chains 24. Coacting with the plates are the slides 39 mounted thereon, and which form with the said plates the openings 40. About each of said openings is made a recess or groove 41, which may be lined with felt or similar material 41*a*, so that all the light from a lamp 42 beneath the upper run of the conveyor, passing through an opening 40 will be concentrated through an egg placed in a recess 41. One form for mounting the slides 39 may consist in providing each plate 37 with a cut out 37*a* to receive a member 39, the sides of the cut out being grooved at 43 to receive the corresponding guide portions 44 at the edges of the member. The top surface of each plate 37 and its slide 39 is thus coplanar.

The latter preferably terminates in an arm 45 thinner than the main portion thereof and extending beyond its adjacent chain 24. The end of each arm may extend at right angles to form a cam 46 for a purpose hereinafter described. Compression springs 47 located in grooves 43 may extend into bores 48 in the slides 39, and at their other ends abut the plates 49 at the ends of the members 39. By this construction, each slide is movable toward the right as shown in Fig. 5 to provide an enlarged opening 40 to permit an undesirable egg supported thereat to be discharged from the conveyor, after which the springs 47 return the slide back to initial position. The eggs so removed from the conveyor pass downward through a tube 50, and into a receptacle 51. The eggs remaining on the conveyor will pass down an incline 52. and thence onto a belt conveyor 53 to be removed to any desired location.

To permit each of the eggs or articles 17 to pass from the chute 18 to a recess 41 on the conveyor, an upright member or rod 54 is mounted on each plate 37 to actuate a releasing device on the said chute. The said device includes a pair of brackets 55 on the sides of the chute, in which brackets is journaled a pintle 56. On the pintle is mounted by means of a central bearing 57 a gate 58. The latter is actuated into closing position by a coil spring 59 taking around the pintle at one side of said bearing, one end of said spring engaging the gate and the other a bracket 55. Likewise journaled on the pintle 56 is an arm 60 having bearings 61. A coil spring 62 on the pintle tends to retain said arm in elevated position over an adjacent egg. In this position of the arm, a downward extending portion 63 thereof, having a pin 64 is adapted to coact with a rod 54, thus serving to move said arm as indicated in Fig. 8. Thereupon, an abutment 65 carried by the said arm contacts the gate 58 and opens the same.

To retain the remaining eggs on the chute while the gate is open, a finger 66 is pivotally mounted at 67 on the upper end of the said arm, and is normally supported at a predetermined downward and rearward direction as shown in Fig. 7 by a stop 68 on the arm 60. Said finger has a side extension 69, which, in Fig. 8, coacts with a pin 70 exteriorly mounted on a side of the chute. Therefore, as the gate 58 opens, the finger 66 is coincidentally inserted between the adjacent eggs. The downward pressure of the eggs on the chute is borne by the pin 70. When the device is released by the rod 54, the springs 59 and 60 return the device to initial position.

To permit the eggs or other articles to be electrically tested or candled, the same are caused to successively enter an enclosure 71 having end flaps 72 swingable by the eggs to allow the latter to enter. The said enclosure 71 may comprise a compartment 73 in which are placed a plurality of photosensitive cells 74, 75. These may be of any well known type, and extend in a direction lengthwise of the egg, the direction referred to being transverse to the conveyor preferably. Any number of cells may be employed to correspond to two or more portions of the egg. Each cell is activated by light coming from the lamp 42 and passing through an adjacent or corresponding part of the object that is tested.

Each of the cells 74, 75 is connected in a respective circuit 76, 77 and is activated by the A. C. lamp 42 which supplies the carrier frequency. The current in each circuit is separately impressed upon and amplified by well known amplifying units 78, 79. Each of these units comprises an input circuit 80, an amplifying tube 81, and an output circuit 82. The circuits 82 are provided with inductance coils 83 and 84 through which the respective currents flow in opposite directions, and with which the coils 85, 86 connected in series coact individually. Accordingly, counteracting currents are induced in the latter. The last mentioned coils are connected in series with the winding of an electromagnet 87, which may be caused to operate sufficiently slowly to effect the operation of the cam 46 as stated. When there is an unbalance in counteracting currents, the electromagnet 87 is energized and attracts an armature 88, elevating a follower bar 89, which is slidably mounted in a bracket 90. In its position of elevation, the follower 89 engages the cam 46 of the slide 39 so as to retract the same and cause the defective egg or other article that is being tested to drop through the enlarged opening 40, as aforesaid. When there is a balance of the counteracting currents, the electromagnet is deenergized, and the armature and follower fall

by gravity into inoperative position with respect to the cam.

In the event that the egg or other article, that is being tested is black, or uniformly darker than the desired shade thereof, the same may be detected by the device now to be described. In one of the circuits 82 is a second inductance coil 91, while the other circuit may have a compensating resistance 92. A coil 93 inductively coacts with the winding of an electromagnet 94.

When the latter is energized, it attracts an armature 95, thus depressing a follower bar 96, movable in a guide 97. Tending to elevate the follower 96 is a retractile spring 98, and when elevated, the said follower engages a cam 46, as aforesaid in regard to follower 89, causing the egg or other article that is being tested, to be discharged or otherwise removed from the conveyor. Accordingly, if no light, or less than a predetermined quantity of light is received by the photosensitive cells 74, 75, although the activation of both cells be equal, regardless of the relative quantity of light on the cells the follower 96 will be elevated by the spring 98 into operative position. When the article that is being tested meets the required conditions, so that the counteracting currents referred to are equal, the electromagnet 94 will be energized to depress the follower 96.

The operation of the invention will now be clearly understood, and it may be briefly considered in a general sense in connection with the testing of eggs. An egg is defective if it is spotted, and the spot therein may be at either end of the egg. Occasionally a black egg is encountered, but this invention is adapted to meet all of these conditions. While I have shown a pair of photosensitive cells it will be appreciated that any number of them may be used according to the nature or size of the article that is tested. Thus it may be advantageous to employ a third cell in the embodiment hereinbefore described to receive light from the central portion of the egg, to safeguard against a condition where an egg may be centrally spotted. It is clearly within the skill of the electrical expert to arrange any number of photosensitive cells in circuits having counteracting currents, according to the principle of this invention.

Where one portion of an egg is spotted, this invention detects the egg by making a comparative test between the spotted and unspotted portions of the egg. Differently stated, the test is made between a spotted mass and an unspotted mass.

The operation of the invention is not affected by the color of the yoke of the egg, due to the comparative nature of the test and the use of the principle of counterflowing currents. Nor will the shape of the egg influence the result of the test, since normal egg material possesses considerable translucency.

The functions of the invention permit an article of one uniform shade to be passed and an article of a substantially different or uniformly dark shade to be rejected; in each case different electrical effects are obtained whose value is zero; and the photosensitive cells or elements coact for producing an effect of non-zero value where the article is spotted. Spotted articles will be sorted regardless of the shade of the article according to a range and variability not heretofore obtained. Thus the invention permits the sorting from white articles and articles of any shade, of articles that are spotted. The significance of the invention may be further noted in that the spotted articles can be sorted out even if the shades of the spots are lighter than the shades of uniformly lighter articles that are being sorted; in other words, the invention will respond to a range of shades of the spots substantially equal to the range of mainly uniform shades of the articles that are being sorted. If the article of substantially different shade is black, the invention has an unlimited range in response to different shades.

In Figs. 11 and 12 is shown a modification showing the invention applied to test the uniformity in shade or color of an article having a large surface, as, for example, a textile 105. The latter is movably carried by supporting means 106. In a casing 107 extending transversely over the textile, is a series of spaced bulbs 108, divided by a longitudinal partition 109 from a corresponding series of photosensitive cells 110, that are activated by light reflected from the textile as shown by lines 111.

An unintended unevenness in shade or color may thus be detected, and any suitable device such as a signal, a recorder, or a stop for the mechanism feeding the material, may be actuated by an unbalanced current in a circuit of the type described for the preferred form of the invention.

I claim:

1. A device of the character described, including a plurality of photosensitive cells, circuits coacting with the cells to produce counteracting currents, and an electromagnet coacting with the circuits to be energized in an unbalanced condition of the same, an armature operated by the electromagnet when the same is energized, a second electromagnet coacting with one of the circuits, a second armature operated by the second electromagnet, whereby the second electromagnet is deenergized independently of the relative condition of the photosensitive cells.

2. A device as set forth in claim 1 in which a conveyor is provided for a plurality of articles, said conveyor having separate supporting means for said articles, said cells receiving light from said articles, said armatures actuating said supporting means to cause the same to drop an article when the cells are unevenly activated, or are not activated at all.

3. A sorting device including a conveyor means for carrying a plurality of articles, a plurality of photosensitive cells in counteracting relation to each other and responsive to radiant energy from each of said articles, and actuator means caused to be operated by said cells, said actuator means including means responsive to certain of said cells according to a difference of shade in an article, and other means responsive to one of said cells according to a uniformly dark shade of an article transmitting substantially no radiant energy, and said actuator means causing the conveyor means to sort the articles according to the operation of the different responsive means.

4. A device including means for directing radiant energy from an article, a conveyor for moving a plurality of articles successively into coaction with said means, means including a plurality of photosensitive interacting cells activated by radiant energy from the successive articles, said means being operative according to the difference in activation of cells depending upon whether the articles are spotted or not, said means being unaffected by any uniform shade of the articles, and means coacting with a cell upon lack of activation thereof, said second and third means causing

the conveyor to sort the spotted and the uniformly dark articles.

5. An egg handling machine including means to direct light through an egg, and a plurality of separate photosensitive means individually receiving light from different portions of the egg and coacting each with the other to indicate a defective condition of the egg independently of the color thereof, said means being unaffected by any uniform shade of the eggs and indicating means responsive to one of the photosensitive means upon a lack of activation thereof.

6. A device of the character described, including means to direct light through an egg, means to indicate whether the egg is spotted, said means including spaced photosensitive members receiving light from separate portions of the egg, said photosensitive means producing currents affecting each other to obtain a comparative test of said egg portions, and means responsive to one of said currents, whereby a black egg is indicated.

7. A sorting device having photosensitive means including a plurality of photosensitive cells for inspecting different parts of an article, means responsive thereto for generating counteracting currents, a second means responsive to the photosensitive means for generating a different current, and means coacting with the first and second means and thereby to indicate the existence of said counteracting currents and the lack of any current.

8. A device including a plurality of photosensitive cells for inspecting different parts of an article, circuit means coacting with said cells to produce counteracting currents, a responsive means coacting with the circuit means so as to be energized in an unbalanced condition of the same, a second responsive means coacting with the circuit means so as to be energized and deenergized upon the presence and absence of one of said currents, and elements individually controlled by the first and second responsive means.

9. A device including a plurality of photosensitive cells for inspecting different parts of an article, circuit means coacting with said cells to produce counteracting currents, a responsive means coacting with the circuit means so as to be energized in an unbalanced condition of the same, a second responsive means coacting with the circuit means so as to be energized and deenergized upon the presence and absence of one of said currents, and elements individually controlled by the first and second responsive means, so that one of said elements is projectible and the other retractible by the respective responsive means.

10. A device including a plurality of photosensitive cells for inspecting different parts of an article, circuit means coacting with said cells to produce counteracting currents, a responsive means coacting with the circuit means so as to be energized in an unbalanced condition of the same, a second responsive means coacting with the circuit means so as to be energized and deenergized upon the presence and absence of one of said currents, and elements individually controlled by the first and second responsive means, a conveyor being provided for a plurality of the articles, said conveyor having means controlled by said elements for dropping an article.

11. A sorting device including a conveyor for a plurality of articles, and electrically controlled means including means for examining each article for a difference in shade therein, said first mentioned means being unaffected by any uniform shade of the articles and causing the conveyor to discharge said articles in accordance with the variation in shade in parts thereof, said electrically controlled means including other means for causing the conveyor to sort out articles of a darker shade.

12. A sorting device including a conveyor for a plurality of articles, photosensitive means responsive to radiant energy from said articles for examining each article for a difference in shade therein, said means being unaffected by any uniform shade of the article, and associated means coacting with the photosensitive means so as to be responsive to a substantial lack of radiant energy from an article of a darker shade, said photosensitive and associated means coacting with the conveyor means to cause the same to sort articles having a difference in shade and articles of a darker shade.

13. A device including means for directing radiant energy on an article, means to indicate whether said article is spotted, said means including spaced photosensitive members activated by said energy from different portions of the article, said photosensitive members producing counteracting currents to obtain a comparative test of said article portions, and means responsive to one of said currents whereby a dark article is indicated.

14. A device for sorting articles, having means including photosensitive elements simultaneously activated by light from different parts of the same article for producing counteracting currents, means responsive to the difference between said currents according to the difference in activation of said elements to indicate an article having parts of different shades, and a conveyor for the articles controlled by said means.

15. Apparatus for sorting eggs comprising a source of light, a plurality of light sensitive elements, means for conveying the eggs one by one so as to bring different portions of each egg between the light source and the respective light sensitive elements to vary the relative illumination of the latter in accordance with the relative translucency of the different portions of the egg, an electric circuit controlled by said light sensitive elements in accordance with the difference of degree of illumination of said elements, and sorting means controlled by said circuit to sort out spotted eggs irrespective of the general shade thereof.

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