Jan. 10, 1956

E. H. BICKLEY

2,730,234

COLOR SORTING MECHANISM

Filed Aug. 2, 1952

2 Sheets-Sheet 1

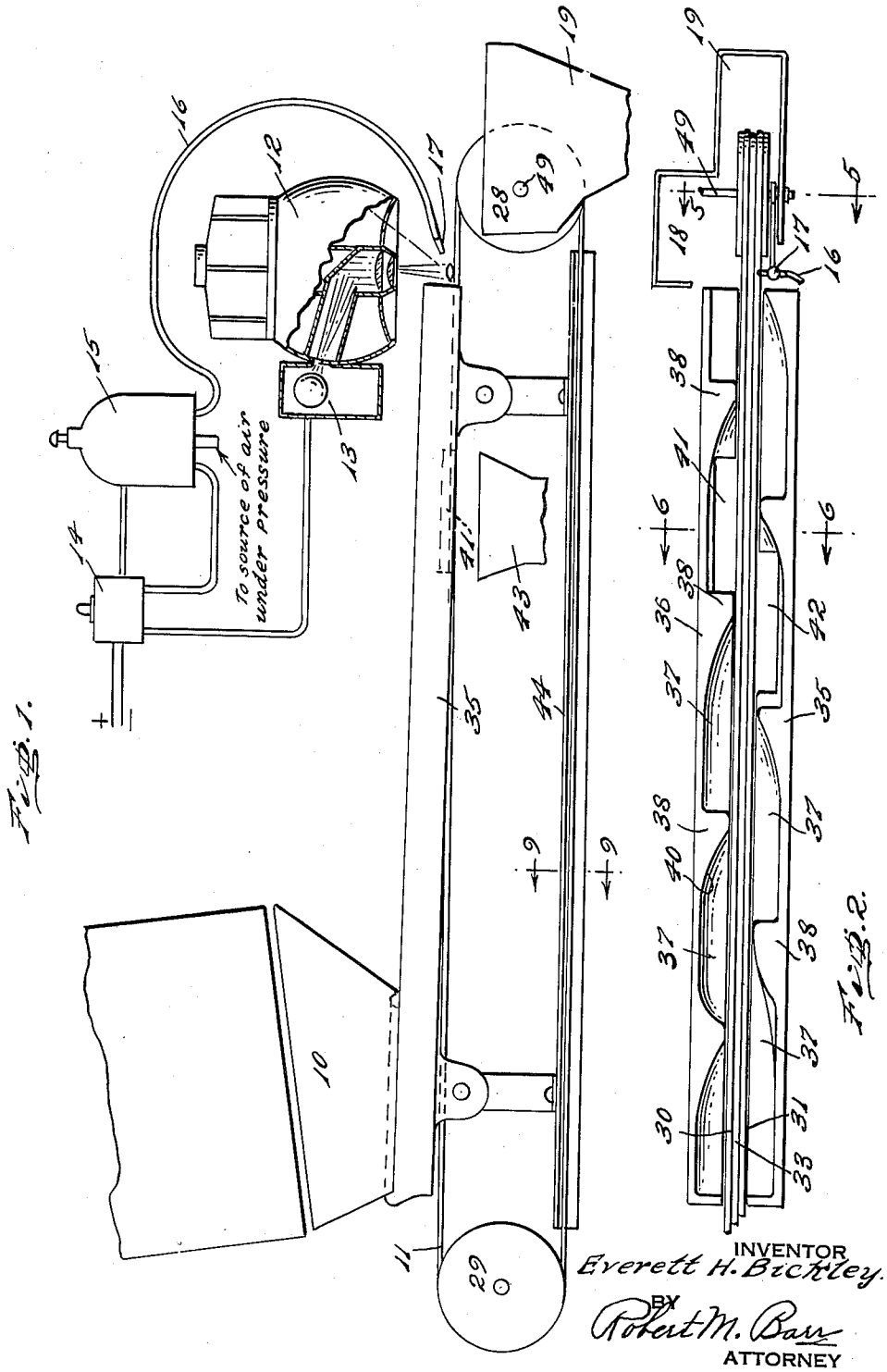


Fig. 1.

Fig. 2.

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Fig. 3.

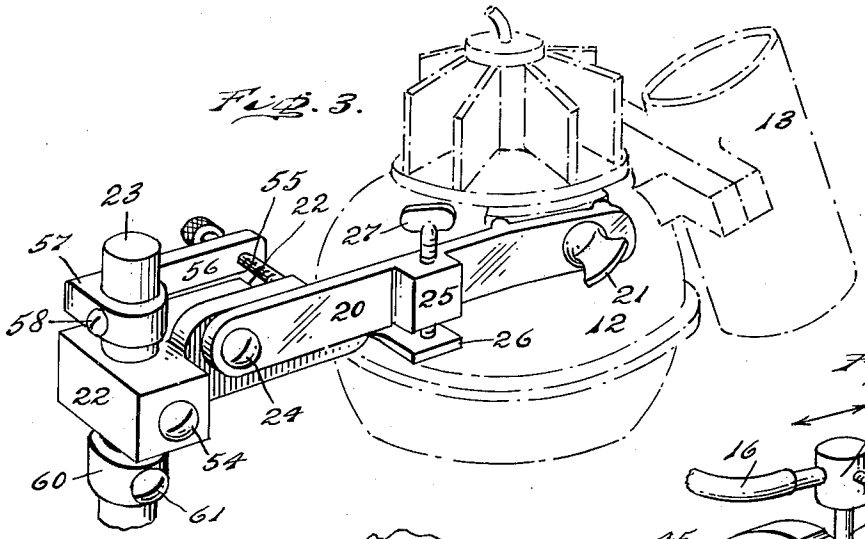


Fig. 8.

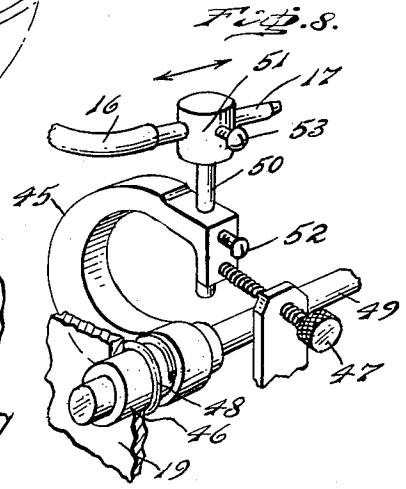


Fig. 4.

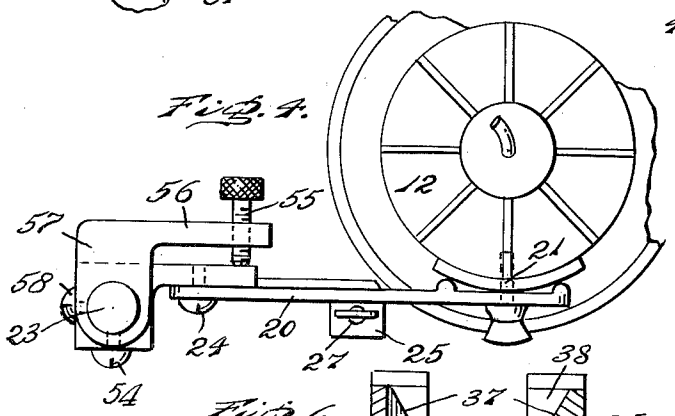


Fig. 6.

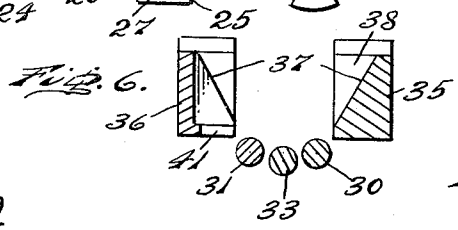


Fig. 5.

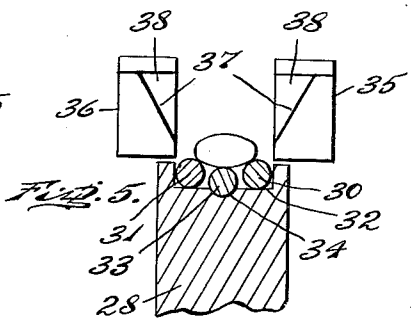


Fig. 9.

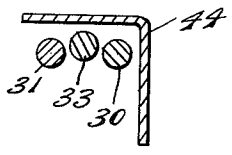
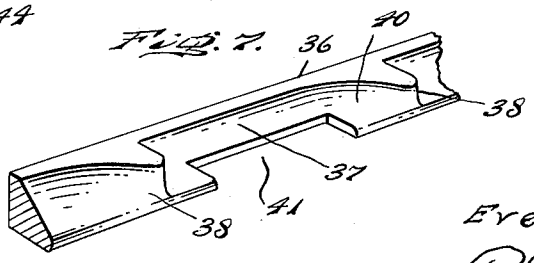


Fig. 7.



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COLOR SORTING MECHANISM

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Application August 2, 1952, Serial No. 302,343

10 Claims. (Cl. 209—111)

The present invention relates to machines for automatically sorting objects by color and segregating objects of a selected color from other objects of different color or color shade, and more particularly to improvements upon the machine of applicant's patent No. 2,580,275.

Since the machine of the present invention is used primarily for sorting beans, rice, coffee beans, peanuts and the like the following specification uses the term "beans" in a generic sense without limitation to other objects. The sorting separates good beans from bad beans and segregates the sorting into different containers.

With the now extended and almost universal use of automatic sorting in place of hand sorting, the demand for faster and faster sorting has arisen, while at the same time maintaining the highest degree of accuracy. To meet this demand there were many problems to solve, such for example in the case of beans, arranging the beans in single file, presenting each bean in the same position for inspection, eliminating crowding and overflow of beans while feeding, correcting reflected light conditions and other related contingencies.

An object of the present invention is to provide an apparatus for sorting beans which operates accurately at speeds not heretofore attainable in the art.

Another object is to provide a feeding mechanism for beans which delivers the beans to an inspection point in close single file relation while moving at a relatively high speed.

Another object is to provide a novel combination of scanning means and a conveyor having a depressed bean supporting surface operating to maintain the beans positioned for most effective scanning at an inspection point.

Another object is to provide a sorting apparatus wherein novel conveying means for beans prevents overcrowding, overflowing, and displacement of beans while travelling to an inspection point.

A further object is to provide a sorting apparatus wherein a conveyor for beans operates in conjunction with guide members to arrange beans in single file while discharging improperly positioned beans.

A further object is to provide a sorting apparatus wherein means are provided for so adjusting a scanning head that a critical focus of reflected light rays functioned accurately for both small and large beans, and to provide other improvements as will hereinafter appear.

In the accompanying drawings Fig. 1 represents a schematic side elevation of a color sorting apparatus embodying one form of the present invention; Fig. 2 represents a detail in plan of the object feeding and control mechanism; Fig. 3 represents a detail in perspective of a scanning head and the novel adjustable mounting therefor; Fig. 4 represents a plan of the scanning head mounting; Fig. 5 represents a section on line 5—5 of Fig. 2; Fig. 6 represents a section on line 6—6 of Fig. 2; Fig. 7 represents a fragmentary perspective of one of the guides for the conveyor showing the object or bean deflecting face, abutment and discharge slot; Fig. 8 represents a detail in perspective of the three way adjustable mounting for the air puffer nozzle; and Fig. 9 represents a section on line 9—9 of Fig. 1.

Referring to the drawings Fig. 1 illustrates by way of example a general assembly of one unit of a multiple head sorting machine wherein a hopper 10 discharges beans to be sorted upon a conveyor 11 for positioning the beans one at a time for inspection by a scanning head 12. The inspection point is in axial alinement with the head 12 so that the reflected light rays emanating from the head are focussed upon each bean as it reaches the inspection point. Details of the scanning head 12 are shown in applicant's pending application Ser. No. 115,609, now Patent No. 2,665,388, and need not be here repeated, except to note that reflected light from the bean is reflected laterally within the head to enter an offset 13 of the head to operate a photo-electric cell located in the offset. The response of the photo-cell to color changes of the bean traverses an amplifier unit 14 and thus to an electro-magnetic puffer valve 15 supplied with air under pressure to discharge by way of a pipe 16 to a nozzle 17. The nozzle 17 is located at the inspection point and when a good bean passes this point a puff of air ejects the bean into a chute 18 leading to a suitable collector. Off color or bad beans remain in the conveyor to be discharged into a separate chute 19 leading to another collector. Details of the connections for several units and the electro-magnetic valve are respectively described in applicant's Patent No. 2,580,275, and application Ser. No. 743,259, now Patent No. 2,615,470.

The scanning head 12 is removably mounted for repair or replacement on one end of a laterally disposed bar 20 by means of a thumb-screw clamp 21. The opposite end of the bar 20 is connected to a bracket 22 which is vertically apertured to receive a fixed post 23, whereby the head 12 can be adjusted to bring focussed reflected light rays into substantial coincidence with a bean at an inspection point, after which the bracket is anchored in place by a suitable fastening means. While this is a relatively true setting giving generally satisfactory results it has been found that a very critical setting is necessary to ensure a sensitive operating signal from both small and large beans. For that purpose, the bar 20 is pivoted to the bracket 22 on a horizontal pivot 24, and has a side lug 25 at one side radially spaced from the pivot 24 and vertically alined with an offset 26 projecting from the bracket 22. An adjusting screw 27 is threaded through the lug 25 into bearing contact with the offset 26 to thus form a vernier setting for critical adjustment of the focus by readjustment of the head. The setting is advantageously made upon a small bean first to obtain a sharp focus on a selected small area of the bean to produce an operating signal. Then a large bean is substituted so that the focussed rays strike the bean over a larger area to produce the signal. The two signals can thus be compared and a fine setting made by which a common signal is obtained of substantially equal intensity from both beans. The creation of such a signal by this critical vernier adjustment has not only materially increased the rate of sorting but lowered the loss of good beans by reason of size.

In the present instance the conveyor 11, which carries the beans from the hopper discharges to the inspection point, is formed by three endless belts, preferably of spring wire, which encircle front and rear pulleys 28 and 29 driven from a suitable source of power. Two of the belts 30 and 31 are of the same length and ride in spaced relation upon a depressed track 32, formed in each of the aforesaid pulleys. The third belt 33 is shorter than the other two and rides in a peripheral groove 34, formed in each of the pulleys and substantially medially thereof to locate the belt 33 in vertical alinement with the space between the belts 30 and 31. Furthermore the depth of

the groove 34 is such that the belt 33 travels between and partly below the belts 30 and 31 to form a continuous depressed seat serving as a three point support for each bean to counteract any tendency of the bean to fall off of the conveyor. Also this depressed seat construction coacts with the bean contour to more effectively maintain a constant bean position for accurate inspection results.

In order to prevent overcrowding of the beans on the conveyor and reposition the beans for single file inspection position arrangement, the conveyor is arranged to travel between two elongated fixed guides 35 and 36, each having the face juxtaposed to the conveyor cut-away at intervals to form deflecting faces 37 endwise defined by abutments 38. The faces 37 are each upwardly and outwardly inclined from the plane of the conveyor and merge into an arcuate wall 40 of an abutment 38. The walls 40 are all at the respective discharge ends of the faces 37, so that any beans thrown off of the conveyor, or projecting to the side thereof, will ride along the face to strike the wall 40 and be deflected back towards the conveyor. This construction is particularly effective in breaking up masses or pockets of beans and bringing the beans into line for inspection. Preferably the faces 37 of one guide are staggered with respect to the like faces upon the other guide to keep both sides of the conveyor free of projecting beans while eliminating pockets into which deflected beans might collect. Also, it should be noted that the guides 35 and 36 are supported at an angle, for example, of ten and one-half degrees, to incline downwardly from the hopper 10 to discharge adjacent the bean inspection point. This sloping of the guides aids materially in avoiding clogs and allows more beans to be fed on the belts than has heretofore been possible.

In case an occasional bean or beans fails to enter the line of beans and approaches the inspection end of the conveyor riding upon the moving bean line, a means is provided for removing such beans before the inspection point is reached. As shown, this means comprises two slots 41 and 42 in the respective guides through which such deflected beans can drop by gravity and fall into a suitable receptacle 43.

For the purpose of preventing any beans which fall off the conveyor during the travel from collecting on the conveyor return, thereby throwing the belts off the pulleys, it is preferable to provide a fixed shield 44 which runs substantially the length of the return to overlie it as a guard to keep the conveyor chain clear of beans or dirt. This shield 44 also serves as a support for the guides 37 and 38 as shown in Fig. 1.

Referring to Fig. 8, a novel three-way adjustment for the puffer nozzle 17 is shown, comprising an arcuate bracket 45 pivoted upon a bushing 46 for swinging into contact with an adjustable knurled screw 47 against which it is normally biased by means of a coiled spring 48 interconnected between the bracket 45 and the bushing 46, which latter is fixed to an adjacent part to also serve as a bearing for the shaft 49 of the pulley 28. The set screw 47 is threaded through a located fixed part. The free end of the bracket 45 is vertically apertured to receive the shank 50 of a head 51 for setting in a selected position by means of set screw 52. The head 51 is transversely bored to slidingly receive the nozzle 17, which latter can be fixed in position by a set screw 53. Thus, by releasing the set screw 53 the nozzle 17 can be adjusted towards or away from the inspection point by movement transversely of the head 51. Up or down setting of the nozzle 17 can take place by loosening the set screw 52 to move the shank 50 relative to the bracket 45. Also an arcuate adjustment is possible by adjusting the set screw 47 and rocking the bracket 45 in the required direction to reposition the nozzle 17 with respect to the inspection point.

With further reference to the mounting for the head 12, it should be noted that the bracket 22 is frictionally held against horizontal swinging motion by a friction-holding

screw 54, which when slightly released allows the head 12 to be swung horizontally to permit access to the belts for cleaning or change of the belts, after which it can be swung back to its scanning position. This return to scanning position is accurately centered by providing an adjustable stop 55 threaded through an arm 56 projecting radially from the post 23, to which latter it is adjustably attached by an apertured boss 57. A set screw 58 serves to anchor the arm 56 in such a position that the stop 55 is in the return path of movement of the bracket 22 and determines the limit of such movement as well as ensuring proper centering of the head. Thus, with the scanning head 12 initially accurately set in scanning position, the stop 55 is swung into contact with the bracket 22 and set to thereby define accurate limit repositioning of the head 12 after any swinging aside for repairs or the like to the conveyor or other parts. To prevent the bracket 22 from dropping when the head 12 is swung back and forth, a stop 60 is adjustably carried by the post 23 and is anchored in set position by a screw 61.

Having thus described my invention I claim:

1. In a sorting apparatus, the combination of a scanning head for focussing light rays towards an inspection point, means locating a bean at said inspection point, a fixed post, a bracket adjustably attached to said post, and means connecting said head to said bracket for movement to adjust the focal point of said rays upon a bean, said means including means carried by said bracket for adjusting said connecting means to readjust said focal point.

2. In a sorting apparatus, the combination of a scanning head for focussing light rays towards an inspection point, means locating a bean at said inspection point, a fixed post, a bracket adjustably attached to said post, an arm pivoted to said bracket and attached to said scanning head, means coacting with said bracket to support said arm with said head positioned to focus said light rays upon a bean, and vernier means associated with said supporting means for adjusting said arm relative to said bracket for critical readjustment of said focus.

3. In a sorting apparatus, the combination of a scanning head for focussing light rays at an inspection point, a conveyor for delivering means from a receiving location to said inspection point, said conveyor being formed of three belts, one of said belts being shorter than the others, driven pulleys for said conveyor, each pulley having peripheral grooves to seat said belts with said short belt between and partly below the other belts to provide a seat for received beans, and means associated with said head and responsive to light reflected from beans at said inspection point for separating beans of a selected color from beans of a different color.

4. In a sorting apparatus, the combination of a scanning mechanism positioned to receive light rays reflected from a bean at an inspection point, a conveyor for delivering beans from a receiving location to said inspection point, said conveyor being formed of three belts, one of said belts being shorter than the other two, driven pulleys for said conveyor, each pulley having peripheral grooves to seat said belts with said short belt between and partly below the other belts to provide a seat for received beans, fixed guides adjacent opposite sides respectively of said conveyor, and means associated with said scanning mechanism including a photo-cell responsive to light reflected from a bean at said inspection point to separate beans of a selected color from beans of a different color.

5. In a sorting apparatus, the combination of a scanning head responsive to light rays reflected from a bean at an inspection point, a conveyor for delivering beans from a receiving location to said inspection point, means for driving said conveyor, means forming a guide at each side of said conveyor for maintaining beans in single file, each guide having a slot to discharge laterally displaced beans, and means operated in response to light reflected from beans at said inspection point for separating beans of a selected color from beans of a different color.

6. A sorting apparatus in accordance with claim 5, wherein at least one of said slots is adjacent said inspection point.

7. A sorting apparatus in accordance with claim 5, wherein both of said slots are adjacent said inspection point.

8. In a color sorting apparatus the combination of a scanning head for viewing a bean at an inspection point, means for feeding beans across said point, an air puffer nozzle, and means mounting said nozzle for three way adjustment relative to said inspection point.

9. A color sorting apparatus in accordance with claim 8, wherein the mounting means includes a rockable adjustment, a vertical adjustment and a horizontal adjustment.

10. In a sorting apparatus, the combination of a scanning head for focussing light rays towards an inspection point, means locating a bean at said inspection point, means mounting said head for movement towards and away from said inspection point to adjust the focus of

said rays upon a bean, and a vernier means for adjusting said head for critical focussing adjustment.

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