Aug. 8, 1933. E. H. BICKLEY 1,921,863

SORTING MACHINE

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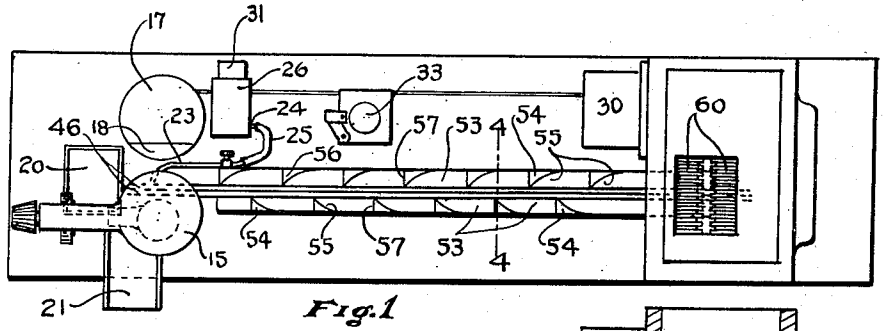


Fig. 1

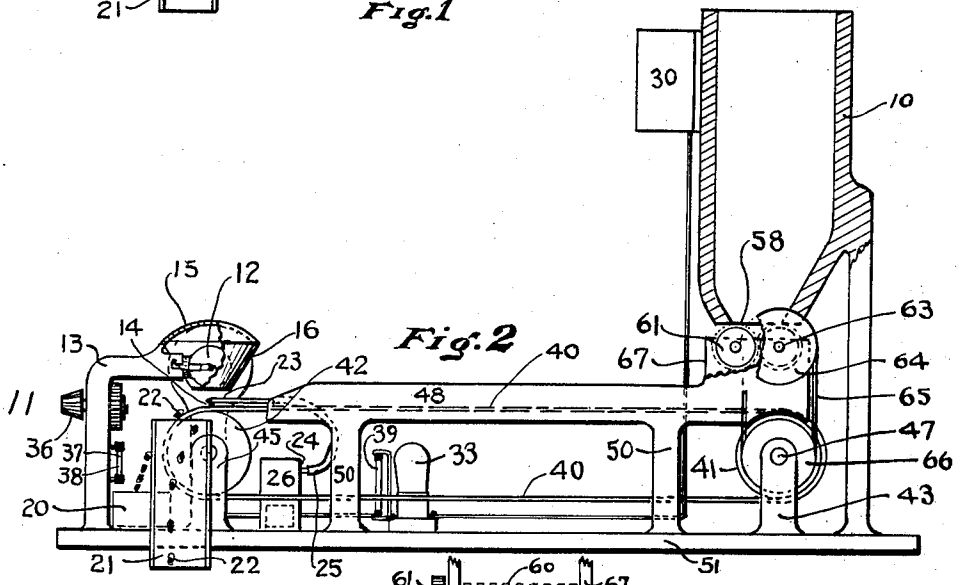


Fig. 2

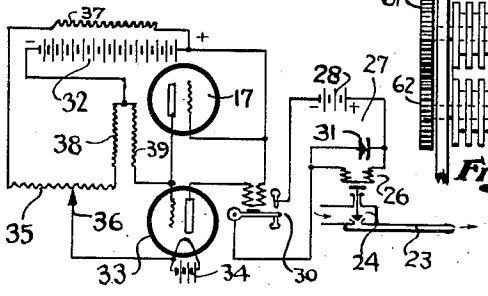


Fig. 3.

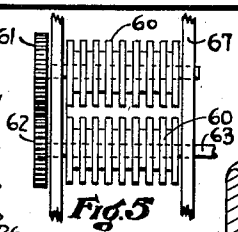


Fig. 5

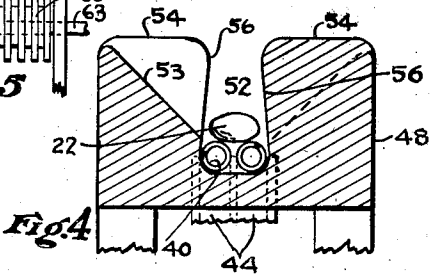


Fig. 4

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SORTING MACHINE

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13 Claims. (Cl. 209—111)

The present invention relates to automatic sorting machines and more particularly to the feed for delivering articles to the sorting mechanism and the electric circuits used therewith.

In the automatic sorting of articles by color and shades where speed is a factor it has been found quite essential that all articles should be presented to the sorting mechanism in the same relative position. This has been found to be particularly true when the sorting takes place by the use of an apparatus having a photo-electric cell as the light sensitive element.

Some of the objects of the present invention are to provide an improved feeding mechanism for sorting machines; to provide a feeding means operating in conjunction with a sorting device of the photo-electric cell type wherein articles are accurately segregated as to color and shade and pass through the machine at relatively high speeds; to provide a feeding means for articles of different color and shade wherein provision is made for bringing all articles to be sorted to sorting position one at a time and presenting each article to the sorting mechanism in the same predetermined relative position; to provide an article feeding mechanism in association with a positioning means and operating simultaneously therewith for automatically arranging the articles for delivery in a predetermined position upon said feeding mechanism; to provide means for maintaining and restoring articles on a feeding mechanism in and to a predetermined position; to provide an automatic photo-electric cell sorting means wherein the same corresponding area only of all articles is exposed to the light source reflected to the cell; to provide an automatic means for securing continuous sorting by eliminating sparking and sticking of electrical contacts controlled by a photo-electric cell; to provide an improved and simplified means for adjusting the character of the sorting without affecting the sensitivity of a photo-electric cell by which sorting is accomplished; and to provide other improvements as will hereinafter appear.

In the accompanying drawing Fig. 1 represents a plan of a sorting machine embodying one form of the present invention; Fig. 2 represents a side elevation, partly broken away, of the same; Fig. 3 is a diagram of one form of sorting control circuit; Fig. 4 represents a section on line 4—4 of Fig. 1 but shown on a larger scale; and Fig. 5 represents a detail in side elevation of the agitating discharge rolls.

Referring to the drawing one form of the present invention is shown by way of example as arranged to feed beans from a hopper 10 to and through a sorting unit 11. In the present instance the sorting unit 11 consists of a source of light 12 supported by a standard 13 to maintain a position between a test point 14 and a reflector 15. The point 14 is where the articles are to be viewed for color sorting. The casing of the reflector 15 is provided with converging sides 16 for the purpose of shielding the photo-electric cell 17 from the direct light and this cell 17 is mounted in relatively close proximity to the source of light 12. A window 18 is arranged at one side of the photo-electric cell 17 and so positioned as to receive only the light reflected from the object or article at the test point 14 and thereby sense whether the article is to be delivered into a receptacle 20 or enter a side chute 21 for delivery elsewhere. The machine is here illustrated by way of example as sorting beans 22 to segregate all beans of one shade from the remaining beans of a different shade and from refuse mixed with the beans, and the arrangement is such that the selected beans are automatically diverted to the chute 21 while the rejects are fed into the receptacle 20. This automatic sorting takes place as a result of the light reflected from each bean at the test point 14 and by the use of a puff of compressed air delivered from a nozzle 23 which is located to blow transversely across the path of the beans at or near the test point 14.

For controlling the release of air from the nozzle 23, a valve 24 is provided in the pipe line 25 and is arranged to be opened electrically by a motor 26 included in a normally open circuit 27 having a battery 28 and relay 30. An automatic electric by-pass 31 of suitable design is mounted on the air control motor 26. The winding of the relay 30 is energized by a battery or other source of current 32 included in the plate circuit of a thermionic valve 33 which is operated by current from a battery 34 and may be controlled by a resistance 35 arranged to be varied by a movable tap 36. Resistances 37, 38 and 39 are connected in the circuit and are suitably proportioned to obtain the proper conditions for operation depending upon the sensitivity of the photo-cell 17, the strength of the light source 12, the size of the reflector 15 and the color of the object at the test point 14.

For conveying the beans 22 or any other objects to be sorted to the test point 14 an endless carrier 40 is located to receive objects from the hopper 10 and bring them to the test point

14. In the preferred construction this carrier 40 consisted of two endless spring coils arranged side by side and stretched between two pulleys 41 and 42 to form a suitable receiving and sustaining surface for the objects. The pulley 41 is journalled in suitable posts 43 near the hopper 10 and has its periphery provided with two grooves 44 for respectively seating the carrier coils and maintaining them in the desired close relation. The pulley 42 is journalled in suitable posts 45 near the test point 14 and has its periphery provided with two grooves 46 for respectively seating the carrier coils in the same relation as do the grooves 44. The pulley 41 is fast to a shaft 47 arranged to be driven from any suitable source of power.

For supporting the carrier 40 during its travel from the hopper 10 to the test point 14 a guide member 48 of elongated form is supported upon legs 50 from a base 51 at the proper height to carry the objects past the test point 14. The member 48 has a longitudinal slot 52 to receive the carrier 40 and prevent side play thereof while maintaining the proper inter-relation between the carrier coils.

In order to automatically bring all of the objects to be sorted to the test point 14 in the same position relative to the photo-electric cell 17, the upper face of the guide member 48 is provided with two series of alternately arranged inclines 53 and abutments 54, the inclines 53 leading downward and terminating in close proximity to the top of the carrier 40. The angle of inclination is such as to cause the bean or other object to slide by gravity toward and upon the carrier 40. The abutments 54 are each substantially V-shaped in cross-section with the side 55 which is toward the approaching objects formed as a concave surface leading from the side of the guide member to the vertex edge 56 which is an upward continuation of the side of the slot 52. Thus as viewed from an end of the guide as shown in Fig. 4 the opposite vertex edges preferably converge slightly toward the top of the member 48. The opposite side 57 of each abutment 54 lies in a plane at right angles to the side of the member 48 and hence any bean passing a vertex edge 56 is subject immediately, if necessary, to the returning action of an incline 53. The two series of inclines 53 and abutments 54 are staggered with respect to each other so that the vertices of the abutments 54 at one side of the slot 52 are opposite the middle point of the inclines 53 of the opposite series, and vice versa. The function of this construction is to tap the bean or other object alternately from opposite directions so that it will finally reach the test point 14 in a position with its longitudinal axis parallel to the direction of travel of the carrier and with the same side of every bean turned to the light source.

For feeding the beans or other objects upon the carrier 40 the bottom portion of the hopper 10 is arranged to converge to a discharge outlet 58 across the path of which are two corrugated feed rollers 60 located in slightly spaced relation and driven respectively by pinions 61 and 62 from a shaft 63 which received its motion from a pulley 64 and belt 65 driven from a pulley 66 on the main shaft 47. By this construction the rollers 60 rotate towards each other giving a wringerlike action which agitates and causes the beans to leave the hopper 10 and enter the converging mouth portion of the housing 67 which guides them upon the carrier 40.

In operation the objects to be sorted are placed in the hopper 10 and fall by gravity upon the feed rollers 60 which not only agitate them to prevent clogging of the discharge 58 but also pull them downwardly to drop into the mouth of the housing leading to the carrier. The carrier 40 is now running in the direction to convey the beans or other objects to the test point 14 and consequently a number of beans leaves the housing and starts towards the destination. At first there is no particular orderly arrangement of the beans and those not actually upon the carrier are jostled to the inclines 53 at the sides but are immediately caused to slide back towards the carrier to gradually work into a vacant place in the procession of beans upon the carrier. When the first abutment 54 is reached any beans not in the proper position will project laterally and engage the abutment and be turned towards correct position on the carrier and this action continues throughout the travel of the carrier so that when the last abutment is reached all beans will have been jostled and turned this way and that until they are all in the same position on the carrier clearing the above mentioned abutments. This alternate side tapping by the abutments 54 and side feeding by the inclines 53 together with the vibratory action of the carrier 40 results in the orderly arrangement in single file of the procession of objects and with each presenting the same portion thereof to the source of light and the photo-electric cell. Thus by providing a carrier of spring construction an amount of continued vibration takes place which provides a slippery metallic surface and in addition to causing the objects to assume a central position will also bring the center of gravity of each object to its lowest position and result in a like positioning of all the objects. The beans or objects having all been arranged in predetermined position now pass one at a time and at high speed past the test point 14 where each is registered as to color or shade by the photo-electric cell and all those of like color or shade are ejected by the operation of the electric control of the air nozzle 23 into the chute 21. Beans or other objects such as stones of a different color or shade do not affect the control circuit to the same extent and are therefore all segregated in the receptacle 20.

In order to regulate the extent to which the control circuit responds to variations in the light received by the photo-electric cell and at the same time preserve extreme sensitivity to slight color variations, the circuit shown in Fig. 3 has been devised wherein the variable tap 36 serves to vary the degree at which sorting takes place. By adjusting the tap 36 any predetermined setting for color can be maintained and the sorting quality accurately maintained. The relay 30 for this work must operate with a very small amount of current and with a very weak spring tension while at the same time opening and closing a circuit in which is a current of considerable magnitude. To do this without sticking, pitting or burning of the contacts, the special automatic by-pass 31 is provided which operates when the circuit is opened to provide a low resistance path for the inductive kick of the coil 26 and thereby effectually protects the contacts of the relay from burning, sticking and pitting and ensures continuous efficient op-

eration at high speed over long periods of time under severe loads. This action takes place because the by-pass 31 is connected in shunt with the electromagnetic winding of the motor 26, the source of electricity 28 and the opening and closing relay 30, and the arrangement is such that the cells of the by-pass 31 present a high resistance to block the normal flow of current. Thus upon closing the circuit 27 two paths are provided for the flow of current, one through the motor winding 26 and the other through the by-pass 31, and since the by-pass is connected so that the cells present a high resistance, and of small capacity, the voltage will cause a current to flow through the inductive winding 26 to quickly reach a maximum. If at this point the circuit closing device 30 is opened the collapsing lines of force of the induction will cause a voltage to be generated in the reverse direction with respect to the by-pass which will immediately break down the "blocking" resistance of the unit before the voltage can reach a value sufficient to cause sparking at the contact points, and the energy stored in the induction will expend itself in heat in a momentary current overcoming the resistance of the winding, by-pass and leads, the flow of the current being in the same direction through the winding as the normal current flow from the source of current 28.

While only a single form is shown in which this invention may be embodied, it is to be understood that the invention is not limited to any specific construction, but might be applied to various forms without departing from the spirit of the invention or the scope of the appended claims.

Having thus described my invention, I claim:

1. In a feeding mechanism, a conveyor, means for moving said conveyor, fixed abutments at one side of said conveyor arranged to be struck by any object projecting laterally from said conveyor, and inclined surfaces respectively between pairs of said abutments for directing objects to said conveyor.

2. In a feeding mechanism, a conveyor formed of coiled springs to have a vibratory action when moving, means for moving said conveyor, and a plurality of fixed abutments at one side of said conveyor arranged to be struck by any object projecting laterally from said conveyor.

3. In a feeding mechanism, a conveyor formed of coiled springs to have a vibratory action when moving, means for moving said conveyor, a plurality of fixed abutments at one side of said conveyor arranged to be struck by any object projecting laterally from said conveyor, and inclined surfaces respectively between pairs of said abutments for directing objects to said conveyor.

4. In a feeding mechanism, a conveyor formed of stretched coil springs, means for moving said conveyor, and two series of fixed abutments spaced by said conveyor and arranged to be struck by any object projecting laterally from said conveyor, one of said series being staggered with respect to the other series.

5. In a feeding mechanism, a conveyor formed of stretched coil springs, means for moving said conveyor, two series of fixed abutments spaced by said conveyor and arranged to be struck by any object projecting laterally from said conveyor, one of said series being staggered with respect to the other series, and inclined surfaces respectively between pairs of abutments of both series for directing objects to said conveyor.

6. In a feeding mechanism, a conveyor formed of coiled springs to have a vibratory action when moving, means for moving said conveyor, and two series of fixed abutments spaced by said conveyor and arranged to be struck by any object projecting laterally from said conveyor, one of said series being staggered with respect to the other series.

7. In a feeding mechanism, a conveyor formed of coiled springs to have a vibratory action when moving, means for moving said conveyor, two series of fixed abutments spaced by said conveyor and arranged to be struck by any object projecting laterally from said conveyor, one of said series being staggered with respect to the other series, and inclined surfaces respectively between pairs of abutments of both series for directing objects to said conveyor.

8. In a feeding mechanism, a guide member having a longitudinal slot and surfaces at opposite sides of said slot inclined toward said slot, a conveyor arranged to move through said slot with its top substantially at the level of the lower end of said surfaces, means for moving said conveyor, and fixed abutments projecting from said surfaces and arranged to be struck by any object projecting laterally from said conveyor.

9. In a feeding mechanism, a guide member having a longitudinal slot and surfaces at opposite sides of said slot inclined toward said slot, a conveyor arranged to move through said slot with its top substantially at the level of the lower end of said surfaces, means for moving said conveyor, and a plurality of fixed abutments projecting from both of said surfaces and arranged to be struck by any object projecting laterally from said conveyor.

10. In combination a sorting mechanism comprising a light sensitive cell, means actuated by said cell for segregating objects according to light reflecting characteristics, a positioning device for bringing said objects into operative association with said cell, and means for vibrating said objects during the operation of said positioning device.

11. In a sorting device, a vibratory carrier adapted to receive articles to be sorted, means adapted to illuminate objects at a point on said carrier, a transverse air jet adapted to impinge on objects located at or near said point on said carrier, and photoelectric means adapted to control the action of said air jet for the purpose described.

12. In a feeding mechanism, the combination of a vibratory conveyor, double alined supporting members on said conveyor adapted to axially position objects on said conveyor, and means for automatically distributing objects lineally along said conveyor, to have the same relative position on said conveyor at a given point.

13. The method of sorting objects consisting of feeding said objects one by one on a movable support, contacting and vibrating the objects during the process so as to aline the same with all major axes in one direction and the center of gravity in the lowest position, analyzing the color characteristics of the objects in this position and discharging the object by an air jet controlled by said analysis.

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