

April 26, 1927.

R. E. RUNDELL

1,626,359

COLOR SORTING MACHINE

Filed July 31, 1926

4 Sheets-Sheet 1

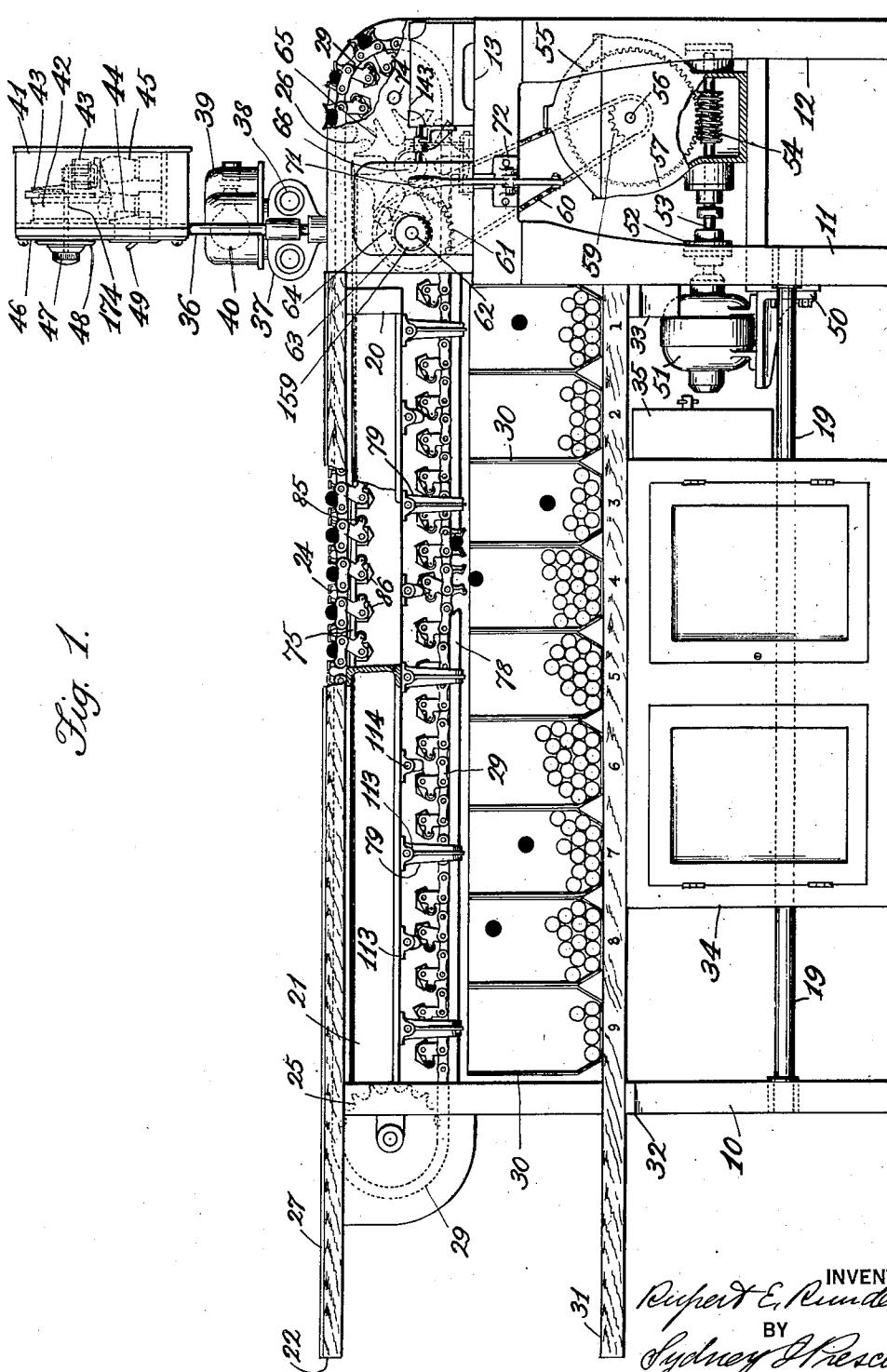


Fig. 1.

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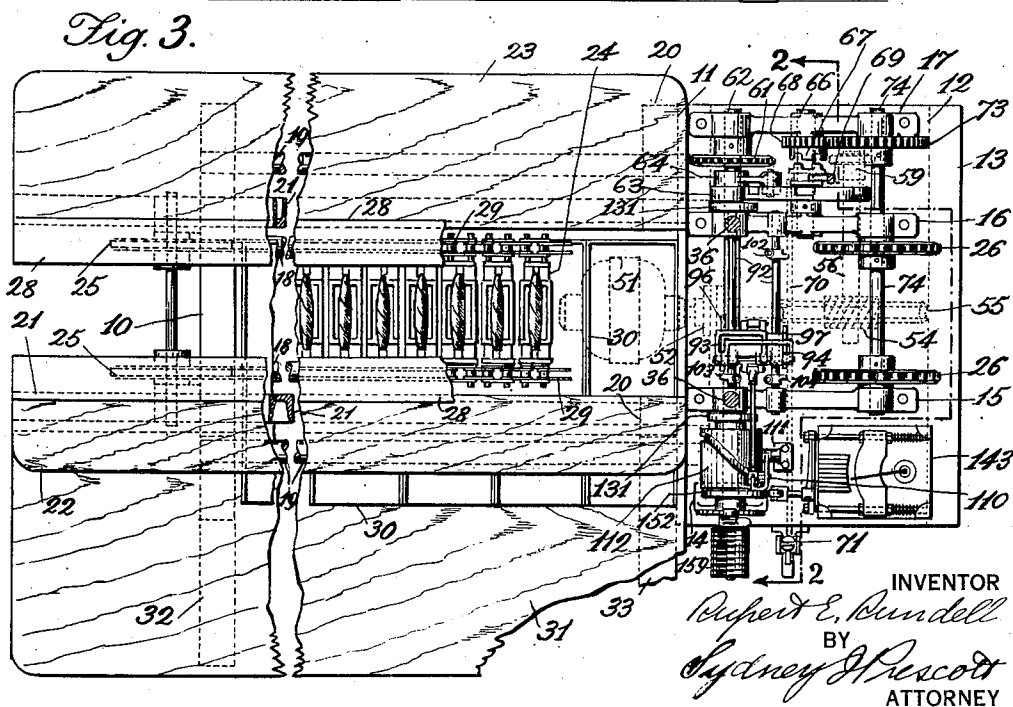
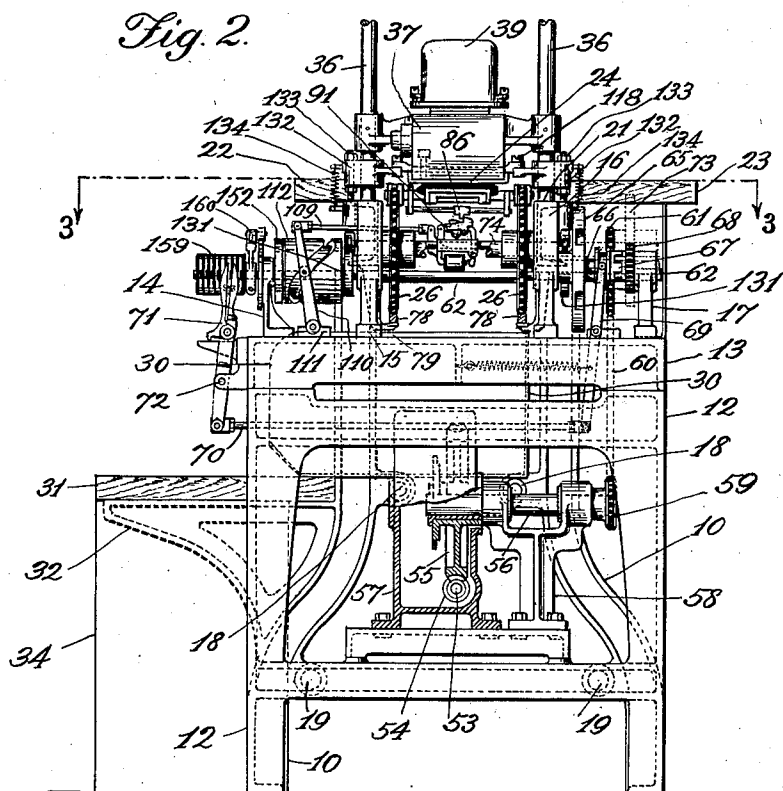
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4 Sheets-Sheet 2



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Fig. 4.

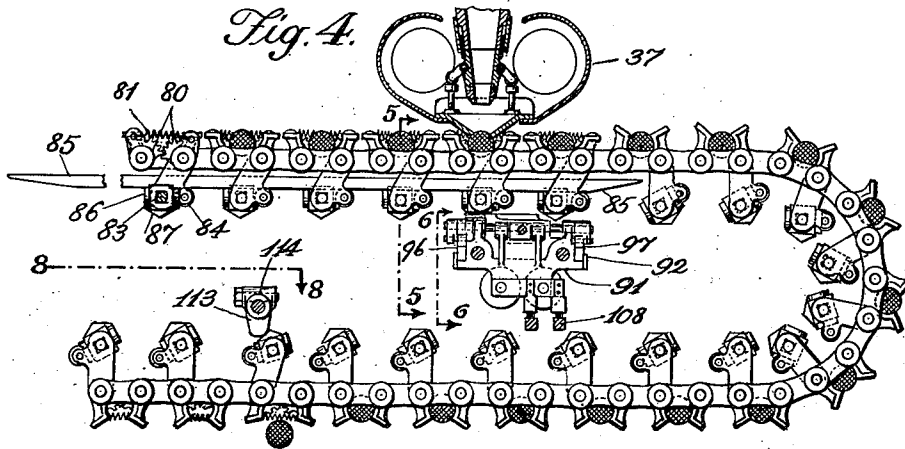


Fig. 5.

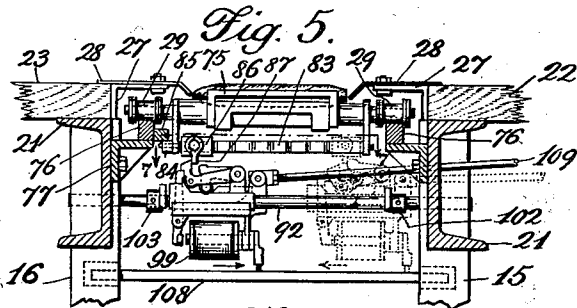


Fig. 6.

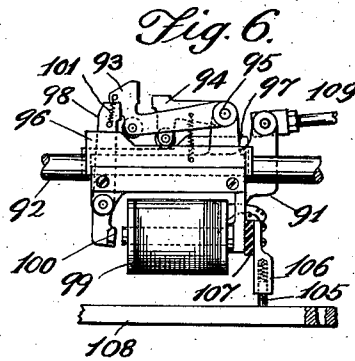


Fig. 7.

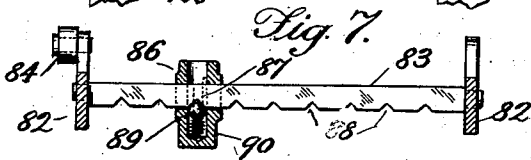
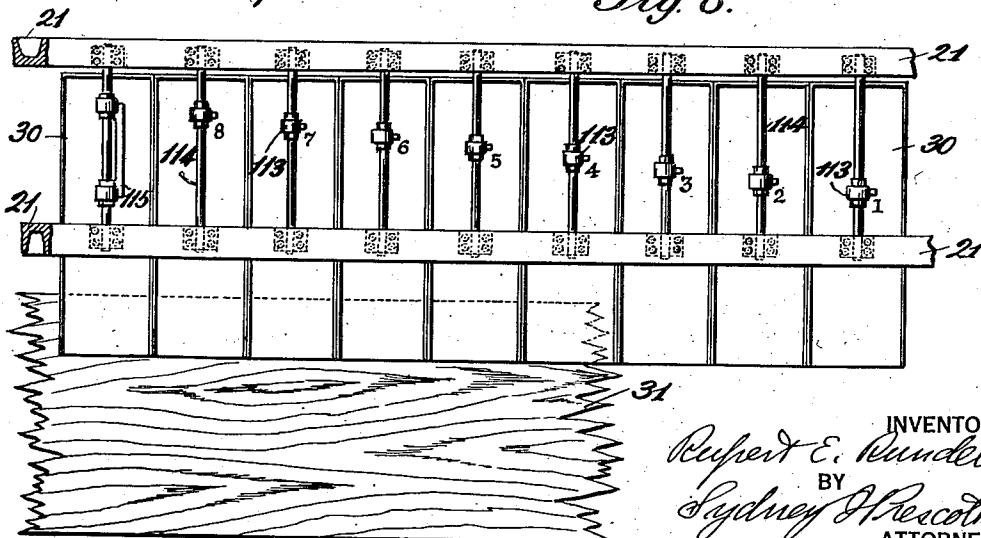


Fig. 8.



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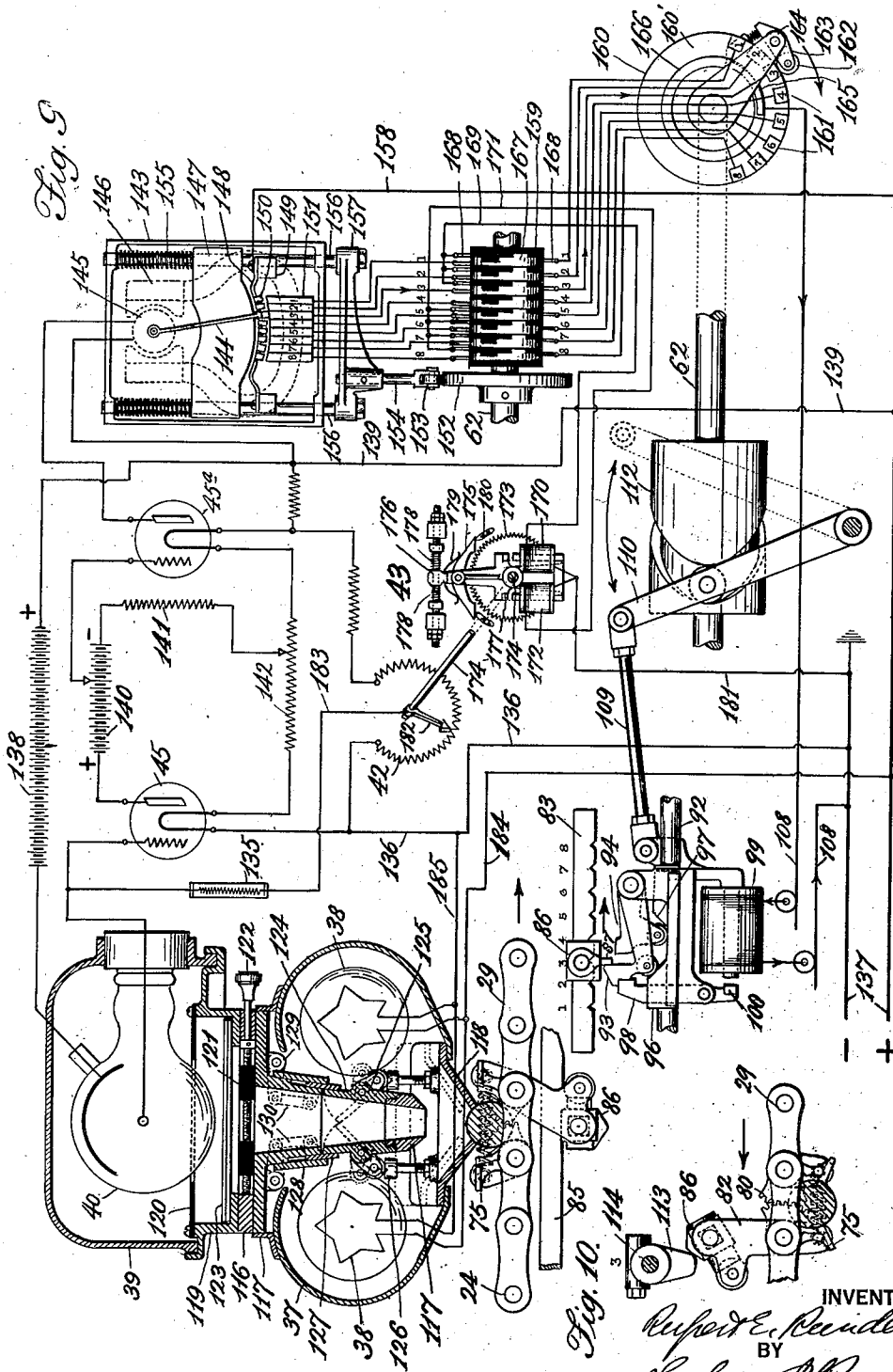
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4 Sheets-Sheet 4

1,626,359



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COLOR-SORTING MACHINE.

Application filed July 31, 1926. Serial No. 126,200.

This invention relates to an improved machine for automatically sorting cigars or other objects according to their color or shade, and its main object is the production of a machine of this type which possesses greater capacity and efficiency than those heretofore known. Another object is the production of such a machine in which the objects are placed on an endless conveyor and automatically distributed into a plurality of receivers or bins, usually eight or more in number, all objects of the darkest color or shade being deposited in the first bin, those of the next lighter color or shade in the next bin, and so on to the bin next to the last which receives the objects of the lightest color or shade, the last bin being reserved for extreme colors or shades not within the range of color or shade for which the machine is particularly designed. With these and other objects not specifically mentioned in view, the invention consists in certain constructions and combinations which will be hereinafter fully described and then specifically set forth in the claims hereunto appended.

In the accompanying drawings, in which like characters of reference indicate the same or like parts, Fig. 1 is a side elevation of a machine constructed in accordance with the invention; Fig. 2 is a sectional elevation taken on the line 2—2 in Fig. 3; Fig. 3 is a plan view of the major part of the machine as seen from the line 3—3 in Fig. 2; Fig. 4 is a fragmentary side elevation of the conveyor for the objects being sorted and associated mechanism; Fig. 5 is a sectional elevation taken on the line 5—5 in Fig. 4, showing the arrangement of the gripper setting device; Fig. 6 is a side elevation of the gripper setting device as seen from the line 6—6 in Fig. 4, but on an enlarged scale; Fig. 7 is a plan view of one of the rider bars and rider carried by the object grippers and taken on the line 7—7 in Fig. 5; Fig. 8 is a plan view showing the gripper opening devices and taken on the line 8—8 in Fig. 4; Fig. 9 is a diagram of the electrical connections, also showing the electric eye mechanism, the arrangement of the selector switch, the commutator, the timing device for the gripper setting operation, and the automatic circuit regulating device; and Fig. 10 is a

detail elevation of one of the gripper trippers.

In carrying the invention into effect, there is provided an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, and electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith. These elements may be widely varied in construction within the scope of the claims, for the specific structures selected to illustrate the invention is but one of many possible concrete embodiments of the same. The invention, therefore, is not to be restricted to the precise details of the structure shown and described.

Generally speaking, the machine consists of an endless conveyor which first carries the objects step by step past a photo-electric cell or electric eye which receives the light reflected by the object from a source within the eye housing, and then grips and holds them suspended while passing over the various object receivers or bins, until the grip is automatically opened when the object has arrived over the proper bin. To accomplish this end, each gripper of the conveyor carries a slide or rider, which, after the object has been exposed to the electric eye, is set in a position on its bar corresponding to the color or shade of the object by means of a reciprocating selector or setter controlled by electric current from the electric eye, each rider in each of its various positions engaging one of the downwardly placed trippers or stops arranged over the bins, thereby opening its gripper and releasing the object which then drops into the bin thus selected. The electric eye is mounted in a housing with an eyelid having an up and down movement, the down movement closing the exposure aperture by placing it snugly over the object and admitting a constant light to the exposed surface of the same. In accordance with the color or shade of the object, more or less of this light is reflected into the electric eye, thereby causing a corresponding current to flow, which, after having been suitably amplified by means of vacuum tubes in a manner similar to that used in radio reception, is passed through a sensitive

indicating instrument in which it causes a corresponding deflection of the needle of that instrument. The eye current indicated is made to perform the function of an automatic selector switch by providing a row of contacts corresponding to the number of object bins in use and, after each exposure and while the indicator shows the corresponding current, presses the end of the indicator needle against this row of contacts, so that for each object a current from a suitable source will flow through the contact corresponding to the deflection caused by the eye current. Each contact of the selector switch is connected to a corresponding contact of a timing device in which a brush, or roller, is moved in synchronism with the selector that sets the gripper riders on the conveyor. During the forward motion of the selector, when the latter pushes a rider along the rider bar, the timing brush passes over the contacts of the timer, so that when the live contact corresponding to the deflection of the eye indicator is encountered, a current will flow through the electro-magnet of the setter, thereby disengaging said setter from the rider and leaving the latter in a position on the rider bar which corresponds to the magnitude of the eye current produced by the respective object. While the next object enters exposure position, the setter moves back to its starting position, and in so doing, resets the rider of the respective gripper to its zero point on its bar.

In order to avoid faulty sorting due to unavoidable changes in the eye circuit, an eye-current produced by a predetermined amount of light, equal to that reflected by an object of the mean or average color or shade of the particular range selected, is sent into the selector switch between each two exposure periods, the eye housing aperture in its uppermost position being closed by a swingable shutter which at the same time opens an adjustable bypass admitting to the electric eye a controllable portion of the light from the illuminating source. The selector switch, at this period of the cycle, by means of a continuously rotating switch or commutator, is connected with a magnetic regulating device attached to a potentiometer controlling the amplifying circuit. If the circuit conditions have remained unaltered, there will be the mean or normal deflection in the selector switch and no action in the regulating device; if, however, changes have taken place so that the eye current due to the average color or shade has increased or decreased, there will be a deflection either smaller or greater than the normal, thereby causing the regulating device to reset the potentiometer, moving it forward in the former case, and backward in the latter case, and thus readjusting the circuit to the changed conditions prevailing.

Referring to Figs. 1 to 3, the machine is in the form of a long table, supported at one end by the pedestal 10 and at the other by the frames 11 and 12 joined by the top-plate 13, upon which are mounted the bearing brackets 14, 15, 16 and 17. The pedestal 10 is connected to the frame 11 by tie rods 18 and 19. Between the pedestal 10 and side brackets 20, attached to the bearing brackets 15 and 16, are carried the channel beams 21 which support inspection table sections 22 and 23 between which moves an endless object conveyor 24 running over sprockets 25 and 26. To the inner edges of the inspection table sections 22 and 23 are fastened the brackets 27 (Fig. 5) which carry adjustable guides 28 which cover up the conveyor chains 29 and leave just enough space between their sloping inner edges to lay the objects evenly in the pockets of the conveyor.

Upon the upper tie rods 18 are supported object receivers or bins 30, the open front ends of which rest upon the unloading board 31, supported by a bracket 32 of the pedestal 10 and by a bracket 33 fastened to the frame 11. In the space below the board 31 is fitted a cabinet 34 into which are placed the electric batteries required for operating the photo-electric cell, the panel for their connection with the eye circuit being housed in a separate box 35 attached to the side of the battery cabinet.

The vertical rods 36 extending upwards from the bearing brackets 15 and 16 carry the eye housing 37, which contains the object illuminating lamps 38, and, in a separate top compartment 39, carry the photo-electric cell or electric eye 40 and the panel box 41 containing the circuit controlling potentiometer 42, the potentiometer regulator 43, the circuit switch 44, and the amplifying vacuum tubes 45, the turning knob 47 and dial 48 of the potentiometer, the operating handle 49 of the circuit switch being mounted on the panel 46 of the panel-box 41.

Upon the bracket 50, attached to the frame 11, is mounted the motor 51 which, through a coupling 52 on a shaft 53, drives the worm 54 meshing with a worm-wheel 55 on a shaft 56 supported by a gear housing 57 and bearing brackets 58. On the shaft 56 of the worm-wheel 55 is mounted a sprocket 59 which, by a chain 60, drives a sprocket 61 on a cam shaft 62. Upon the latter is mounted a Geneva-stop 63 and arm 64 driving a Geneva-gear 65 on a shaft 66 which carries a clutch 67 and spur gear 68. The shifting lever 69 of the clutch 67, through the rod 70, is controlled by a hand lever 71 fulcrumed in a bracket 72 attached to the frame top-plate 13. The gear 68 meshes with a gear 73 on a shaft 74 on which are mounted the driving sprockets 26 of the endless conveyor 24.

The object conveyor, which is shown in detail in Figs. 4 and 5, consists of the endless

chains 29 which carry between them the object grippers 75. The upper runs of the chains 29 are supported by guides 76 held by brackets 77 attached to the side surfaces of the channel beams 21, and the lower runs are prevented from sagging by the guides 78 supported by brackets 79 suspended from the bottom surfaces of the channel beams 21.

Each pair of grippers is linked together by the gear sectors 80 joined by the springs 81 which tend to close the grippers. One of the members of each gripper carries near its ends the downwardly projecting arms 82 which support between them the square rod 83. One of the arms 82 of each gripper has a lateral extension in which is mounted a roller 84 engaging a cam track 85 extending the entire length of the loading table, thereby holding the grippers open against the pressure of the springs 81 for the reception of objects. At its ends, the cam track 85 is beveled upwards, so that the rollers run free, allowing the springs 81 to close the grippers, thereby locking the objects in place.

Upon each of the rods 83 is slidably mounted a rider 86 having a downward projection 87. The rider bars 83 have a number of notches 88 corresponding with the number of object bins, and a ball 89, within the rider and subjected to the pressure of a spring 90, engages with these notches as the rider is moved along the bar (Fig. 7).

While an object is being exposed to the electric eye, the rider 86 of its gripper is automatically moved into a position on the rider bar 83 corresponding to the shade of the object, by means of the setter 91 which slides back and forth on the rods 92, supported by bearing brackets 15 and 16, during each step of the conveyor 24.

The setter, Fig. 6, has two levers 93 and 94 so mounted on a pivot shaft 95 that their free ends, which rest on slidable cams 96 and 97, respectively, can alternately engage with the two sides of the projections 87 of the riders 86. When the setter moves in the direction of the full line arrow shown in Fig. 5, the long lever 93 is up and the short lever 94 is down, so that the lever 93 engages the rider projection 87, and the rider 86 partakes of its forward motion. The lever 93 is held in its upper position by the lever 98 controlled by the electro-magnet 99 carried by the setter. When the magnet 99 is energized, it attracts the armature 100 carried by the lower arm of the lever 98, thereby tripping the lever 98 and causing the spring 101 to depress the lever 93, disengaging the latter from the rider, which thereupon will remain in the position it then occupies. The setter, however, will complete its stroke, at the end of which it encounters a stop 102 mounted on the rod 92. This stop engages the sliding cam 97 thereby causing it to lift the lever 94, as shown

in dotted lines in Fig. 5. Upon the return stroke of the setter 91, the lever 94 engages the rider 86 and moves it back to its starting position on the bar 83, the stops 103 and 104 at the starting end of the rods 92, by engaging the cams 96 and 97, raising the lever 93 and depressing the lever 94, so that the setter can engage the rider of the next gripper upon its succeeding forward stroke. As the rider setter moves back and forth, the brushes 105, held by the lugs 106, attached to the insulating block 107 on the setter 91, slide upon the contact rails 108 fastened to insulating blocks attached to the bearing brackets 15 and 16, so that the magnet 99 may be energized at any point along the stroke of the setter.

The setter is moved back and forth by the rod 109 controlled by a lever 110 fulcrumed in the bearing 111 and engaging a cam 112 mounted on the shaft 62.

The gripper discharging devices or trippers, one of which is located over each bin, consists of stops 113 mounted on rods 114 supported from the channel beams 21. A rider 86 having been set in proper position on the bar 83 by the action of the magnetic setter, its projection or nose 87, at discharging position, will engage the stop 113 of the corresponding bin 30, the stops 113 being arranged progressively over the widths of the different bins, as shown in Fig. 8. Thus, if the rider has been set in notch 3 in the bar 83, it will engage stop 3, thus causing the lever 82 to turn, thereby opening the jaws of the gripper and releasing the object, which will drop into the third bin.

The stop over the last bin is in the form of a bar 115 extending over the entire width of the rider bar, so that every rider passing over the last bin will be engaged, thus dropping into that bin any object of a shade not within the range selected.

The electric eye, Fig. 9, consists of the photo-electric cell 40, an adjustable range control shutter 116, light sources 38, light directing passage 117, and a movable eyelid 118 forming the bottom of the eye housing 37. The upper compartment 39 of the eye housing is made in two parts, the lower part 119 carrying the permanent light shield 120 with an opening just large enough to receive the bulb of the photo-electric cell 40. Between the upper and main compartments of the eye housing is inserted the adjustable shutter 116 which has opaque members 121 movable towards and away from each other by means of right and left threaded adjusting screw 122. In the space between the shield 120 and the shutter 116 are placed the color filters 123, made of tinted glass, which modify the chromatic distribution of the light. The photo-electric cell does not react to the various colors to the same relative extent as does the human eye, and the

object of the color filters is to partly absorb those colors to which the photo-electric cell is more sensitive than is the human eye, thereby causing the electric eye to "see" the various shades in their true relation.

The light directing passage 117, opposite each of the object illuminating lamps 38, has an opening covered by turnable shutters 124, these shutters being controlled by arms 125 resting upon screws 126 inserted in the movable eyelid 118. When the eyelid 118 is in its lowermost position, in contact with an object on the conveyor, the arms 125 are down and the shutters 124 are open, permitting only light reflected from the object to enter the passage 117. When, however, the eyelid 118 is up, as shown in dotted lines in Fig. 9, the arms 125 are raised and the shutters 124, which then open the sides and close the center of the passage 117, allow direct light from the lamps 38 to reach the photo-electric cell 40, but shut out all light reflected into the mouth of the passage 117. The amount of direct light entering the passage when the shutters 124 are closed, is regulated by slides 127 which can be moved up and down along the guides 128 by means of arms 129 to which they are connected by links 130.

The up and down movement of the eyelid 118 is effected by cams 131, Fig. 2, mounted on the shaft 62, the eyelid being supported by sleeves 132 slidably mounted on the vertical eye housing supporting rods 36, the sleeves having the roller carrying rods 133 resting on cams 131. Springs 134 attached to the bearing brackets 15 and 16 pull down the sleeves 132 and keep the rollers of the rods 133 in contact with the cams 131.

The electrical connections are shown in Fig. 9. One electrode of the photo-electric cell 40 is connected, through the high resistance 135, potentiometer 42, and connection 136, to the negative lead of a direct current supply circuit 137, the other electrode to the negative pole of a high voltage "B" battery 138. The two potential sources thus being in opposition, the voltage impressed on the photo-electric cell is the difference between the two sources. This is done for the purpose (if the voltage of the direct current supply circuit, which also feeds the object illuminating lamps 38, should increase and thus increase the brilliancy of the lamps) of decreasing the impressed voltage of the photo-electric cell, thereby reducing the resulting photo-electric current; and in this manner the two effects will tend to balance each other and thus maintain the equivalent of a practically constant illuminating source. An increase in the voltage of the supply circuit 137 would also increase the voltage drop in the potentiometer 42 and thus increase the grid-bias of the vacuum tube 45 for the first stage of amplification, thus further checking the tendency of the amplified

photo-electric current to rise due to the increase in brilliancy of the lamps.

When light falls on the photo-electric cell, current proportional to the quantity of light flows from the battery 138 through the connection 139 to the positive lead of the supply circuit 137, returning from its negative lead through the connection 136 and passing through the potentiometer 42, resistance 135, and photo-electric cell 40, from which it flows back to the battery 138. The voltage drop across the resistance 135 makes the grid of the tube 45 negative, thereby decreasing the plate current through the battery 140, fixed resistance 141, and variable resistance 142. This, in turn, decreases the voltage drop across the resistance 141, causing an amplified plate current from the vacuum tube 45^a to flow through the selecting instrument 143, thereby deflecting its pointer 144. In the diagram, two stages of amplification are shown, but, according to the magnitude of the impressed voltage, and to the sensitiveness of the deflecting instrument, one stage may be sufficient, or three or more stages may be required.

The selector switch 143, Fig. 9, consists of a sensitive current indicating instrument to which an automatic contact making device is added, the current indicator having a coil 145 suspended between the poles of a permanent magnet 146. The needle 144 of the instrument has its end bent at right angles, the downwardly projecting portion playing in a narrow space between a movable jaw 147 and a contact bridge 148 mounted on stationary supports 149 and having a plurality of flexible fingers 150 which register with an equal number of stationary contacts 151, the number of these contacts corresponding with the number of bins in the machine. The jaw 147 is moved back and forth by a cam 152 mounted on the shaft 62, a roller 153 carried by a rod 154 being caused to bear against the cam by means of springs 155 mounted on slide rods 156 held by a bracket 157 to which the rod 154 is fastened. When the jaw 147 closes, the needle having been deflected by the photo-electric current, it presses the needle-end against one of the fingers 150 of the contact bridge 148, thereby connecting it with the corresponding stationary contact 151 and thus closing an electric circuit from the positive lead of the supply circuit 137 through a connection 158, the contact bridge 148, the contact 151, a rotating switch or commutator 159, and timing device 160, from which it passes at the proper moment into the tripper magnet 99 of the rider setter 91, thence returning to the negative lead of the supply circuit 137. The commutator 159 and timer 160 are mounted on the shaft 62, and are therefore always in synchronism with the cam 112 operating the rider setter.

The timing device, Fig. 9, consists of a number of contacts 161, one for each contact of the selector switch, arranged upon a portion of the circumference of the stationary insulating disc 160', around which a contact brush or roller 162, held in a tensioned lever 163 supported on an arm 164, is revolved in synchronism with the rider setter, the contact portion of the circumference of the disc 160' corresponding to that portion of one cycle of operation during which the rider is moved forward along the rider bar by the cam 112. Each contact 161 of the timer, during the same period, is connected, by means of the commutator 159 with the corresponding contact 151 of the selector switch. The arm 164 has a contact spring 165 bearing upon the continuous contact ring 166 which is connected with one terminal of the tripper magnet 99, the other terminal of which is connected to the negative lead of the supply circuit. The deflection registering current from the selector switch which flows into one of the contacts 151 will therefore pass through the timer into the tripper magnet at the moment when the rider setter 91 arrives at the position corresponding to the timer contact carrying the selector switch current.

The rotary switch or commutator 159, Fig. 9, has the object of disconnecting the selector switch 143 from the timer 160 and to connect it to an automatic circuit regulating device for a portion of each revolution. The commutator, which is mounted on the shaft 62, has a number of contact rings 167 corresponding with the number of selector switch contacts 151, each contact ring being of such shape that the first of three contact brushes 168 bearing side by side on its surface will alternately be connected to the second and third brush during part of each revolution. The first lateral portion of each contact ring is continuous all around its circumference; the second portion is continuous only during the part of each revolution corresponding to the object exposure and shade selecting period, insulating material instead of metal comprising the remainder of its surface; and the third portion is continuous only during the remainder of the revolution, which corresponds to the circuit adjusting or testing period, the major portion of the circumference in this case being composed of insulating material. All first brushes, bearing on the continuous portion of the commutator rings, are connected to the corresponding contacts 151 of the selector switch 143; all second brushes, bearing on the nearly continuous portion of the commutator rings and shown at the bottom of the commutator in Fig. 9, are connected with the corresponding contacts 161 of the timing device 160; and all third brushes, bearing on the mostly insulated portion of the

commutator rings, are connected to the circuit regulating device.

The electric circuit of the machine is adjusted for each range of shades by adjustment of the shutter 116 controlling the volume of reflected light from the object, and by a setting of the potentiometer 42, varying the voltage bias on the grid of the amplifying vacuum tube 45. Although the method of voltage supply to the cell, as heretofore explained, produces practically constant light source conditions, a regulating device is provided which will automatically correct the setting of the potentiometer in case there should be temperature variations affecting the values of the resistances or other unforeseen changes in the circuit during a run. For this purpose, the bypass slide 127 of the passage 117 is so adjusted, for each run, that the direct light entering the bypass causes a deflection of the selector switch equal to that produced by the middle shade of the range selected.

The commutator brushes 168 bearing on the third portions of the contact rings 167 are arranged in two groups; those on the contact rings corresponding to the shades lighter than the middle or standard shade, for which the bypass slide has been set, being connected by lead 169 to one magnet 170, and those corresponding to the shades darker than the standard shade being connected by lead 171 to another magnet 172 of the regulating device 43. The contact ring corresponding to the standard shade has no third brush bearing upon it.

The circuit regulating or normalizing device 43, Fig. 9, consists of a ratchet wheel 173, mounted on the potentiometer shaft 174 and having the double-acting pawl 175 attached to the balance arm 176, the latter carrying on either side of its fulcrum the armatures 177 of the electro-magnets 170 and 172. The balance arm 176 is held in its central position by springs 178 pressing against its sides. The pawl 175 is balanced by the spring 179, and its ends engage with the stationary guide pieces 180. When either of the electro-magnets 170 or 172 is energized by testing current from lead 158 of the circuit 137 through the selector contacts 148 and 151 and thence through one of the groups of third brushes of the commutator, to magnets 170 or 172, respectively, and back to the circuit 137 through the common connection 181, the corresponding armature 177 will be attracted, turning the balance arm 176 and thereby engaging one end of the pawl 175 with the ratchet wheel 173. Upon cessation of the current, one of the springs 178 will then force the balance arm 176 back to its central position, thereby turning the ratchet wheel 173 and setting the potentiometer switch arm 182, which, through lead 183 and resistance 135, is con-

nected with the photo-electric cell (to its next position, either raising the grid-bias on the amplifying vacuum tube 45, if the test current was too low, or decreasing it, if it was too high.

The lamps 38 are fed from the circuit 137 by the leads 184 and 185, the latter being joined to the lead 136.

The operation of the machine is as follows (Fig. 9):

The color range having been adjusted in the manner hereinbefore described, the objects placed on the conveyor 24 are exposed, one by one, to the electric eye. As each object dwells in the observation position, the eyelid 118 closes down on it, permitting light rays from the lamps 38 to be reflected from a portion of its surface into the passage 117 and, through the opening of the range control shutter 121 and color filters 123, to reach the photo-electric cell 40. In this, according to the amount of light reflected which varies with the shade of the object, a proportionate current is caused to pass, which, after amplification by means of the battery 140 and vacuum tubes 45, produces a corresponding deflection in the selecting instrument 143. When the pointer 144 has come to rest in its deflected position, say opposite the contact 3, corresponding to the third darkest shade, the jaw 147 of the instrument is closed by the cam 152, thereby pushing the contact finger 3 of the bridge 148 against the stationary contact 3 of the selector, and causing a current to flow from the supply mains 137 through the commutator 159, on which at that time the second brushes (shown at bottom) are in metallic connection with the first brushes through the rings 167, to contact 3 of the timer 160. At the same time, the rider 86 of the gripper 75, holding the object being examined by the electric eye, is moved by the setter 91 along the rider bar 83, by action of the cam 112. When the rider arrives at notch 3 of the rider bar, corresponding to the third shade, the synchronously moving timing roller 162 is passing over contact 3 of the timer 160, thereby closing the circuit through the tripper magnet 99 of the setter 91. The ensuing pull of the armature 100 causes the lever 98 to trip, thus disengaging the lever 93 from the rider which then remains set in position 3 on the rider bar.

After the object has been exposed to the photo-electric cell, the roller 84 on the gripper holding the same leaves the cam track 85, thus permitting the spring 81 to close the jaws of the gripper and locking the object in place. The conveyor then, after passing around the sprockets 26, carries the object suspended in its gripper while passing over the bins 30. The gripper rider, having been set in position 3 on its rider bar, in this position is in line with the stop 113

over the third bin, and when the gripper holding that particular object arrives over the third bin, the stop of the latter engages its rider and opens its jaws, thereby causing the object to drop into the third bin which upon completion of the run will thus contain all objects of the third darkest shade. Similarly, the remaining bins will hold objects of the other shades in the order corresponding with their position, except the last bin which receives all misfits.

While the examined object advances and the next one moves into position under the electric eye, the eyelid 118 is raised to its upper position by cams 131, thereby turning the shutters 124 and opening the bypass for the entrance of direct light from lamps 38. The bypass slides 127 having previously been adjusted to the medium shade for this particular run, the light entering the bypass causes the proper test current to flow into the selecting instrument 143, thereby readjusting the potentiometer 42 for the next object in case any changes have taken place in the circuit since the preceding exposure.

In making the connections from the commutator 159 to the potentiometer adjusting device 43, in the present case shade 4 has been taken as the standard, this being one of the two middle shades for the arrangement shown, the machine illustrated having 9 bins for the sorting of 8 shades. Accordingly, the third brush on the fourth commutator ring 167 has been omitted, and the third brushes of rings 1, 2, and 3 are connected to the magnet 170 of the regulator, while those of rings 5, 6, 7 and 8 are connected to the magnet 172.

What is claimed is:

1. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith.

2. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said conveyor having an upper loading run and a lower unloading run in horizontal planes to facilitate loading and unloading.

3. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing

said grippers to sort and deliver them in accordance therewith, said conveyor having a step by step movement to enable said mechanism to successively examine the color of objects carried by said conveyor.

4. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, each of said grippers consisting of a pair of intergeared, spring-closed, and cam-opened jaws for holding one of said objects.

5. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, each of said grippers carrying a part of said mechanism assisting in controlling the delivery of the object it carries.

6. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, and a series of bins along said conveyor and into which said grippers deliver objects carried thereby.

7. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, and a series of open-top bins along said conveyor into which said grippers drop objects carried thereby, each bin being also open at one end to facilitate removal of objects therefrom.

8. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, and a series of bins along said conveyor into which said grippers drop objects carried thereby, there being one bin for all objects of each color within the range of action of the machine and one extra bin for objects outside said range of action.

9. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their

color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said conveyor having a loading run, and said mechanism having operative connections and an electric eye coactive with said loading run.

10. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, and a series of object receiving bins along said conveyor, said conveyor having an unloading run, and said bins being coactive with said unloading run.

11. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said conveyor having a loading run and an unloading run, and said mechanism having operative connections, a gripper setter coactive with said loading run, and a gripper tripper coactive with said unloading run.

12. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism having operative connections, and a cam-actuated and magnetically-controlled gripper setter coactive with said conveyor.

13. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, means for setting each gripper to enable it to unload the object it carries at a predetermined point which is dependent upon the color of said object, and means for tripping said gripper at said point.

14. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism in-

cluding operative connections, cam-actuated and magnetically-controlled means for setting each gripper to enable it to unload the object it carries at a predetermined point which is dependent upon the color of said object, and means for tripping said gripper at said point.

15. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, means for setting each gripper to enable it to unload the object it carries at a predetermined point which is dependent upon the color of said object, comprising a rider bar carried by said gripper, a rider on said bar, and a setter moving said rider on said bar to its proper position and there releasing it.

16. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, means for tripping each gripper at a predetermined point which is dependent upon the color of the object it carries, comprising a rider bar carried by said gripper, a rider set on said bar, and a stop in the path of said rider at said point.

17. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, gripper setting means comprising a rider bar carried by each gripper, a rider on each bar, a cam-reciprocated setter having means for moving each rider on its bar, and an electromagnet and operative connections for releasing said riders when set in proper position.

18. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, gripper setting means comprising a rider bar carried by each gripper, a rider on each bar, a cam-reciprocated setter having cam-actuated levers for mov-

ing said riders on said bars, and an electromagnet and coacting trip device for releasing said riders when set in proper position.

19. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, gripper tripping means comprising a rider bar carried by each gripper, a rider set on each bar, and tripping stops in the path of said riders for opening said grippers.

20. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, an electric eye, a source of light, and means for causing light from said source to be reflected by an object to said eye.

21. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, an electric eye, a source of light, means for causing light from said source to be reflected by an object to said eye, and an adjustable range-control shutter between said object and said eye.

22. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, an electric eye, a source of light, means for causing light from said source to be reflected by an object to said eye, and color filters between said object and said eye.

23. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, an electric eye, a source of light, and means for causing light

from said source to be reflected by an object to said eye including a movable eyelid between said object and said eye.

24. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, an electric eye, a source of light, and means for causing light from said source to be reflected by an object to said eye including a movable eyelid and connected swinging shutters between said object and said eye.

25. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, a housing, an electric eye in the upper part of said housing, a shield engaging the bulb of said eye, color filters below said shield, an adjustable range-control shutter below said filters, a source of light in the lower part of said housing, and a movable eyelid engaging said objects as they pass below said housing and connected swinging shutters causing light from said source to be reflected by said objects to said eye.

26. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, an electric eye, and a circuit-controlling potentiometer.

27. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, an electric eye, a circuit-controlling potentiometer, and a potentiometer regulator.

28. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in ac-

cordance therewith, said mechanism including operative connections, an electric eye, and amplifying vacuum-tubes.

29. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, an electric eye, one electrode of said eye being connected through a high-resistance and potentiometer to the negative lead of a direct-current supply circuit, and the other electrode being connected to the negative pole of a high-voltage "B" battery, to cause the voltage impressed on said eye to be the difference between these two sources.

30. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, a selector switch consisting of a sensitive current-indicating instrument, and an automatic contact-making device associated therewith.

31. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, a selector switch consisting of a sensitive current-indicating instrument, an automatic contact-making device associated therewith, and a timing device.

32. The combination with an endless conveyor having a series of grippers into which objects to be sorted in accordance with their color are indiscriminately loaded, of electrically controlled mechanism for examining the color of said objects and for causing said grippers to sort and deliver them in accordance therewith, said mechanism including operative connections, a selector switch consisting of a sensitive current-indicating instrument, an automatic contact-making device associated therewith, a timing device, an automatic circuit-regulating device, and a commutator alternately connecting the selector switch with the timing device and with the circuit-regulating device.

In testimony whereof, I have signed my name to this specification.

RUPERT E. RUNDELL.