

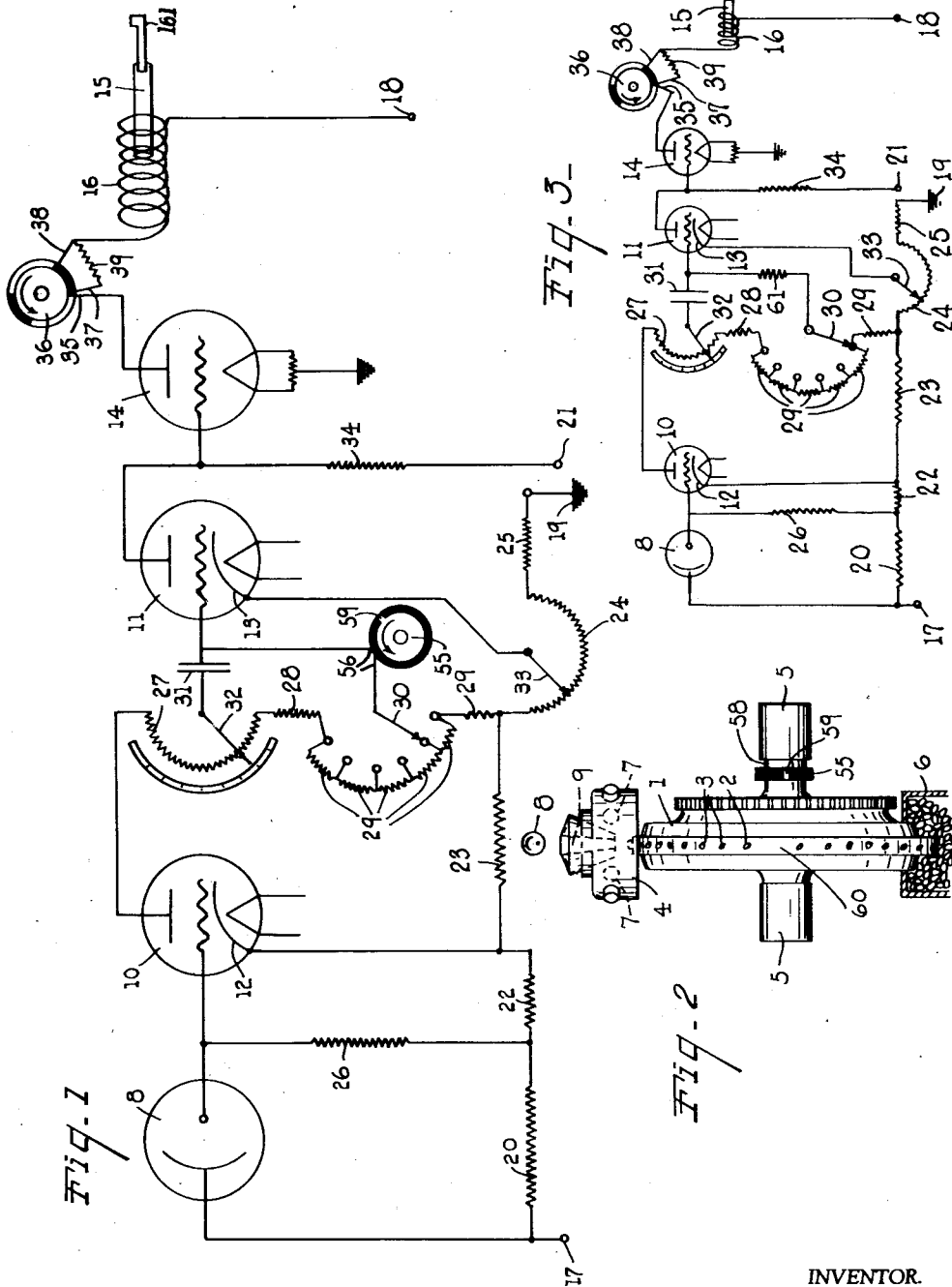
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PHOTOELECTRIC ASSORTING DEVICE

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PHOTOELECTRIC ASSORTING DEVICE

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The main objects of this invention are:

First, to provide a photoelectric assorting apparatus which is especially well adapted for assorting small articles such as beans.

5 Second, to provide means in a system of the foregoing character for automatically maintaining extremely constant functioning even in the presence of gradual variations of power supply voltages, photo-tube sensitivity, ambient temperature, lamp brightness and certain other factors, which variations would otherwise be intolerable or materially reflect in accuracy of the apparatus.

15 Third, to provide an assorting machine with which great speed is attainable without consequent errors.

Fourth, to provide an assorting machine disposed to appraise any given one of the objects being assorted without error due to the nature of a preceding object.

20 Fifth, to provide an assorting machine requiring a minimum of attention due, among other factors, to the use of a control dial bearing significant calibration.

25 Objects relating to details and economies of my invention will appear from the description to follow. The invention is defined and pointed out in the claims.

30 Preferred embodiments of my invention are illustrated in the accompanying drawing, in which:

Fig. 1 is a diagrammatic view of a photoelectric assorting device and circuit therefor embodying features of my invention.

35 Fig. 2 is a fragmentary top plan view of the conveyor and associated parts.

Fig. 3 is similar to Fig. 1 and illustrates a modified form of my invention.

40 Considerable skill and time are required to set an assorting machine for the most desirable separation. If, then, such a machine will not closely maintain this careful setting, the amount of attention required becomes excessive. If direct current amplifiers are used in the ejecting circuit, very minute variations in lamp brightness, photo-tube sensitivity, photo-tube resistor value, voltage supplies, etc., are magnified and largely displace the setting of the machine. Attempts have been made to utilize alternating current amplifiers especially with resistance-capacity couple, so that after, for example, a permanent dimming of the lamps, by bleeding off the abnormal condenser charge through the grid resistor, the grid returns to the normal or original position. Such circuits attempt to judge objects by difference from a

background which usually appears between objects. The grid resistor which bleeds off current to avoid permanent displacement always bleeds off a part of the working impulse, amplifying with poor fidelity the impulses received from the photo-tube. It can also be shown that such circuits always involve errors due to the fact that after viewing a dark object they require a larger impulse to trip than after viewing a light object. Hereinafter, this is referred to as historical error, that is, error due to an improper appraisal of an object resulting from the nature of a preceding object.

15 The permanent displacement of machine setting (as caused by a change in lamp brightness) in direct current amplifiers is exceedingly undesirable. The return to original "setting" of the alternating current amplifier is only a partial correction, because if the lamps are, for example, dimmer, all succeeding impulses will be smaller, and the machine does not need the original setting, but rather a new setting carefully proportioned to the new lamp brilliance.

20 The present invention includes a circuit so designed as to automatically maintain the impulse required to trip the ejector essentially proportional to the intensity of illumination. Inasmuch as change in photo-tube sensitivity and change in photo-tube resistor value have the same effect as change in lamp brightness, they are likewise accurately compensated.

25 In a capacity-coupled amplifier, the grid resistor should be of very high value for faithful amplification of the working impulses. This same resistor should be of very low value while viewing the background, in order to assure the attainment of equilibrium before the succeeding object appears. This disparity results ordinarily in a compromise value, neither high enough to accomplish the first object nor low enough to accomplish the second. Fair results may be attained by wide separation of objects being assorted so that the background is viewed much longer than the object is viewed. This imposes a serious capacity limitation.

30 In the circuit which is the preferred embodiment of the present invention, every one of the aforementioned discrepancies is reduced theoretically to zero, and with readily attainable manufacturing accuracy they are too small to be detectable in operation. The faithfulness of amplification is as high as that of a direct current amplifier, the resetting following a change in lamp brilliance is closely proportional to said change, the background is successfully used as a com-

parison standard, and in addition, the objects being assorted may follow each other very closely and very rapidly. This circuit furthermore makes possible the calibration of the control dial in such figures as the percentage decrease in field brightness required to operate the ejector which immensely simplifies the maintenance of a large bank of machines.

In the illustrated embodiment of my invention, 1 is a constantly moving continuous conveyor, in this case a drum, having a series of uniformly spaced article seats 2 each adapted to convey an article 3 to be inspected through an inspecting zone 4. The conveyor is in the form of a hollow drum journaled to rotate in the standards 5, one of the standards being hollow and connected to suction means (not shown) for creating a suction at the article seats 2 for holding the articles 3 thereon, the articles being picked up by the conveyor as the latter sweeps through an article supply means 6.

The article inspecting zone 4 comprises a housing containing lamps 7 for illuminating the articles and rim of the conveyor as the latter passes through the zone, the light reflected therefrom being directed to a photo-tube 8 through passage 9.

The photo-tube controls article discharging means comprising a first stage triode amplifier 10 and a second stage triode amplifier 11. These triodes are preferably of the type having indirectly heated cathodes 12 and 13. The amplifiers control an ionizing or power tube 14 preferably of the grid controlled gaseous discharge type, the functioning of the power tube energizing the solenoid 16 to attract the armature 15, thus ejecting undesirable articles from the conveyor by striking them with a properly placed tappet 161 attached to the armature.

Direct current potentials are provided (by means not shown) to give -250 volts, ground potential, +20 volts and +150 volts and are connected respectively to terminals 17, 19, 21 and 18. A voltage divider circuit is provided between the -250 volt terminal and ground, comprising a 2200 ohm resistor 20, a 40 ohm resistor 22, a 1200 ohm resistor 23, a 200 ohm potentiometer 24 and a 2500 ohm resistor 25. The plate of photo-tube 8 is connected to terminal 17, and the anode of photo-tube 8 connects directly to grid of amplifier tube 10 and through 40 megohm resistor 26 to the positive terminal of resistor 20. The cathode of amplifier 10 is connected to the positive end of resistor 22, thus biasing the grid of amplifier tube 10 with potential drop across resistor 22. The plate of tube 10 connects to the positive terminal of resistor 23 through a composite resistor consisting of 20,000 ohm potentiometer 27 (the control dial), 1000 ohm resistor 28 and six 1500 ohm resistors 29 connected in series to consecutive points of a gang switch (range selector) whose movable contact 30 may thus be connected to any terminal.

In Fig. 2, a normalizing space 60 is provided in the rim of conveyor 1 by the omission of an object or article seat. Spaces 60 may be provided alternately of the article seats 2 or may be more widely distributed, say, one space 60 following a series of fifteen or twenty article seats.

A rotary switch 55 of insulating material is provided with a small conducting lug or contact 59. Brushes 56 bearing on this rotary switch make contact with the conducting lug 59 during part of the time when space 60 is traversing the inspecting zone 4 and serve to connect the grid

of amplifier tube 11 with contact 30. The grid of amplifier 11 is permanently connected through condenser 31 to movable contact 32 of potentiometer 27. The cathode of amplifier 11 is connected to movable contact 33 of potentiometer 24. The plate of amplifier 11 is connected to the grid of gaseous discharge tube 14 and through 50,000 ohm resistor 34 to +20 volt terminal 21. The gaseous discharge tube cathode is centrally connected to ground and its plate connects to brush 35 bearing on a commutator 36.

The filaments of tubes 10, 11 and 14 are preferably heated by separate windings of a transformer (not shown).

Commutator 36 is so geared to drum 1 that one revolution of the commutator encompasses the passage of two objects. On this commutator there also bear brushes 37 and 38 connected together with a 6000 ohm resistor 39. Brush 32 also connects through 400 ohm solenoid 16 to positive voltage supply 13. The insulating and conducting segments provided on commutator 36 are so placed and proportioned that as an object enters the inspecting zone brushes 35 and 37 are connected together. Plate potential is applied to gaseous discharge tube 14 so that it may discharge, but solenoid 16 will not drive the armature because of the current limitation by 6000 ohm resistor 39. This condition obtains for approximately one-third of the time interval between consecutive object seats and is hereinafter referred to as the scanning period. At the termination of this period, commutator 36 connects brush 35 directly with brush 38, thus short-circuiting resistor 39 and permitting the solenoid 16 to actuate armature 15 and its attached tappet if tube 14 has lighted during the scanning period. This commutator condition obtains for the second one-third cycle hereinafter referred to as the stroke period. At the termination of the stroke period, brush 35 is disconnected from both brush 37 and brush 38, which condition obtains for the remaining one-third cycle hereinafter referred to as the tappet return period. The assorting cycle is made up of the scanning, stroke, and tappet return periods and constitutes the interval between the time when the scanning of one object starts and the time when the scanning of the next object starts.

To best understand the operation of this circuit, it must be considered as performing alternately two essentially independent functions: (a) normalizing or setting, which may be defined as a specific, automatic process whereby the circuit is given a setting appropriate to certain conditions such as lamp brightness or photo-tube power, and (b) appraising or the actual sorting.

The machine assumes function (a) during the brief interval in which lug 59 of rotary switch 55 is in contact with brushes 56. Condenser 31 then ceases functioning as an electrostatic inductor because of the relatively short circuit between its terminals. The grid of amplifier 11 is resistance-coupled to amplifier 10 through contact 30 of the range selector switch. The plate current of amplifier 10 causes a certain total potential drop across its composite 30,000 ohm plate resistor 27, 28, 29, of which the grid of amplifier 11 may receive 5%, 10%, 15%, 20%, 25% or 30%, depending upon the setting of the range selector. In the drawing, the pointer 30 is shown in the position which applies 10% of this potential as an automatic bias to amplifier 11. An additional manually controlled bias is applied by moving contact 33 of potentiometer 24 until with lamps

7 extinguished tube 14 barely lights, its grid having been brought to the critical ignition point by gradually decreasing the plate current traversing resistor 34. I term this bias the critical bias, i. e., the value of grid bias of the ionizing tube, which is barely sufficient to withhold ionization. If now the lamps 7 be lighted and tube 14 extinguished as by opening its plate circuit, the grid of tube 14 will be found to acquire an additional bias essentially proportional to the effective brightness of the lamps. This bias I term a retaining bias, i. e., any bias of the ionizing tube's grid in excess of the critical bias. The term "effective brightness of the lamps" is used to signify the brightness of lamps 7 as measured by its effect on whatever photo-tube is used, and after traversing any color filter which may be present. It will be understood that the establishment of the excess or retaining bias on the grid of tube 14 takes place every time lug 59 makes contact. This may be a single lug as shown, effecting a setting once per revolution of the drum, or there may be several lugs with corresponding blank normalizing spaces 60 on rim 1. When lug 59 leaves brushes 56, the machine is set and the assorting, or function (b), takes place in the following manner. The grid of amplifier 11 is left floating and is connected only to condenser 31. Impulses originating at the photo-tube and amplified by tube 10 pass through the composite plate resistor. The position of the dial determines what fraction of the impulses is to proceed to amplifier 11. The 20,000 ohm potentiometer 27 covers a range of from one-third to three-thirds of this impulse. For example, let us assume that the slide 32 divides the entire plate resistor in half. The ejector mechanism will then function on any decrease in field brightness greater than 20% as may be seen from the following. A 100% decrease in lamp brightness will operate the ejector when 10% of the first amplifier plate voltage change is applied to the grid of the second amplifier, when normalizing. When assorting, five times 10% of this voltage change is applied so that only one-fifth of the change represented by total extinction is sufficient. The dial may be calibrated "20%" at this point and, this being simply the ratio of two resistors, the machine will maintain this setting indefinitely.

I have described the preferred embodiment of my invention, which has the advantages of giving full accuracy, compensation for lamp illumination, avoiding historical error, and permitting close spacing of articles to allow high speed operation. A modified form of my invention is illustrated in Fig. 3 and is similar to the form illustrated in Fig. 1, with the exception that rotary switch 55 and its attendant brushes 56 are omitted, the wires leading thereto being permanently connected together. A suitable grid resistor 61 is interposed between the grid of tube 11 and contact 30. In other respects, the circuit is identical with that of Fig. 1. In the embodiment just described, it is necessary to provide standards of brightness between each pair of objects; that is to say, the objects must be relatively widely spaced compared to the close spacing possible in the preferred embodiment of Fig. 1. However, the construction of Fig. 3 allows compensation for variation in lamp brightness, permits calibration of the compensator dial, and with liberal spacing of objects or articles on the conveyor will attain considerable accuracy.

If desired, the circuit illustrated in Fig. 1 may

be modified so that the brushes 56 connect the grid of tube 11 not to contactor 30, but to the positive end of resistor 23. By such a circuit, full accuracy is obtained, historical error is avoided, and close spacing of articles on the conveyor with resulting full speed operation is made possible. However, obviously the compensation for variations in lamp illumination is lost.

Since the grid side of coupling condenser 31 has, when assorting, no connection whatever to a fixed potential point, this unit does not act as a "capacity," introduces no time delay, and requires no appreciable charging current. Potential changes are transmitted essentially without alteration regardless of frequency, steepness of wave front, or duration. This gives exceedingly high precision and uniformity to the series of appraisals and completely overcomes historical error.

As the stream of articles passes the scanning zone, certain articles will register sufficiently to operate the ejector mechanism earlier or later in the cycle than others. If the trip were permitted to occur at a moment of sufficient darkness, the ejector would strike at times too high or too low to certainly dislodge an article. A sufficiently broad ejector blade would be reliable in removing rejected articles, but with the close spacing which the present invention makes possible, such a broad ejector would frequently strike two objects at once. Furthermore, such an ejector would extend either into the inspecting zone or so close to it that its shadow might interfere with the viewing mechanism.

In the present invention, the sustaining resistor 39 permits the lighting of gaseous discharge tube 14 at any instant during a scanning period, but delays the armature stroke until the object seat is carefully and properly located for meeting the thrust of a narrow, low-placed tappet blade. Once lighted, the tube 14 retains a state of ionization so that an impulse sufficient to light the tube 14 cannot be recalled by a subsequent brightening of the field.

By the structure just described, I have provided what may be termed an isochronous ejector mechanism, viz., an ejector and associated apparatus disposed to start an actual ejecting stroke at an invariable time in the assorting cycle if a sufficient impulse was received at any previous portion of that cycle.

It will be apparent to those skilled in the art that I provide an assorting system which is independent of annoying variations which heretofore have affected the efficiency of photo-electric assorting devices. I have solved a vexing problem of long standing inasmuch as my system is entirely independent of constant illumination at the inspecting zone, which was a necessary and almost unattainable characteristic of assorting machines prior to my invention. My device is especially well adapted to high speed and is very accurate in sorting small articles such as beans and the like.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a photoelectric assorting apparatus, the combination of an illuminated viewing field, a photo-tube optically exposed to said field, a conveyor for introducing into said field alternately objects to be assorted and portions of a reference background, an ejector capable of ejecting certain objects from said conveyor when actuated, and an electrical amplifying system receiving im-

pulses from said photo-tube, capable of actuating said ejector, and containing a first amplifier tube and second amplifier tube, electro-static induction means between said tubes the plate of said first amplifier causing voltage variations in the control-grid of said second amplifier by electrostatic induction while objects are being viewed, the grid of said second amplifier being essentially floating during such times, said grid being connected through a highly conductive path to a suitable established biasing potential while said photo-tube views the reference background.

2. In a photoelectric assorting apparatus, the combination of an illuminated viewing field, a photo-tube optically exposed to said field, a conveyor for introducing into said field alternately objects to be assorted and portions of a reference background, an ejector capable of ejecting certain objects when actuated, and an electrical amplifying system receiving impulses from said photo-tube, capable of actuating said ejector, and containing a first amplifier tube and a second amplifier tube, electro-static induction means between said tubes, the plate of said first amplifier causing voltage variations in the control-grid of said second amplifier by electrostatic induction while objects are being viewed, the grid of said second amplifier being essentially floating during such times, said grid being connected through a highly conductive path to a biasing potential varied by direct current amplification of the photo-tube current while said photo-tube views the reference background.

3. In a photoelectric assorting apparatus, the combination of a viewing field, a photo-tube optically exposed to said field, a conveyor for introducing into said field periodically objects to be assorted and portions of a reference background, an ejector capable of ejecting certain objects when actuated, and an electrical amplifying system receiving impulses from said photo-tube, capable of actuating said ejector, and containing a first amplifier tube and a second amplifier tube, electro-static induction means between said tubes, the plate of said first amplifier causing voltage variations in the control-grid of said second amplifier by electrostatic induction while objects are being viewed, the grid of said second amplifier being essentially floating during such times, said grid being connected through a highly conductive path to a biasing potential varied by direct current amplification of the photo-tube current while said photo-tube views the reference background.

4. In a photoelectric assorting apparatus, the combination of a viewing field, a photo-tube optically exposed to said field, a conveyor for introducing into said field periodically objects to be assorted and portions of a reference background, an ejector capable of ejecting certain objects when actuated, and an electrical amplifying system receiving impulses from said photo-tube, capable of actuating said ejector, and containing a first amplifier tube and a second amplifier tube, electro-static induction means between said tubes, the plate of said first amplifier causing voltage variations in the control-grid of said second amplifier by electrostatic induction while objects are being viewed, said grid being connected through a highly conductive path to a biasing potential while said photo-tube views the reference background.

5. In a photoelectric assorting apparatus, the combination of a continuous conveyor having spaced article seats and portions of a reference

background thereon, photoelectric means arranged to view articles in said seats and said portions, means to illuminate the conveyor and articles, means controlled by said photoelectric means for ejecting articles from said conveyor including a grid-controlled gaseous discharge tube so connected that its plate current causes and determines the ejecting operation, means acting to periodically normalize the apparatus when said photoelectric means views said reference portions, and means further timing and controlling said ejecting means comprising a commutator driven in timed relation with said conveyor, and brushes bearing against said commutator and disposed to apply plate voltage to the grid-controlled gaseous discharge tube during scanning periods through a circuit incapable of operating said ejector and to apply plate voltage to the grid-controlled gaseous discharge tube during ejecting periods, whereby ejection of an article occurs at an invariable point in each assorting cycle.

6. In a photoelectric assorting apparatus, the combination of a continuous conveyor having spaced article seats and portions of a reference background thereon, photoelectric means arranged to view articles in said seats and said portions, means controlled by said photoelectric means for ejecting articles from said conveyor including a grid-controlled gaseous discharge tube so connected that its plate current causes the ejecting operation, means acting to periodically normalize the apparatus, and means further timing and controlling said ejecting means comprising a commutator driven in timed relation with said conveyor, and brushes bearing against said commutator and disposed to apply plate voltage to the grid-controlled gaseous discharge tube during scanning periods through a circuit incapable of operating said ejector and to apply plate voltage to the grid-controlled gaseous discharge tube during ejecting periods through a circuit capable of operating said ejector, whereby ejection of an article occurs at an invariable point in each assorting cycle.

7. In a photoelectric assorting apparatus, the combination of a continuous conveyor having spaced article seats and portions of a reference background thereon, photoelectric means arranged to view articles in said seats and said portions, means controlled by said photoelectric means for ejecting articles from said conveyor including a grid-controlled gaseous discharge tube so connected that its plate current causes the ejecting operation, and means further timing and controlling said ejecting means comprising a commutator driven in timed relation with said conveyor, and brushes bearing against said commutator and disposed to apply plate voltage to the grid-controlled gaseous discharge tube during scanning periods through a circuit incapable of operating said ejector and to apply plate voltage to the grid-controlled gaseous discharge tube during ejecting periods through a circuit capable of operating said ejector, whereby ejection of an article occurs at an invariable point in each assorting cycle.

8. In a photoelectric assorting apparatus, the combination of a continuous conveyor having spaced article seats and portions of a reference background thereon, photoelectric means arranged to view articles in said seats and said portions, solenoid means controlled by said photoelectric means for ejecting articles from said conveyor including a grid-controlled gaseous dis-

charge tube so connected that its plate current causes the ejecting operation, and means further timing and controlling said ejecting means comprising a commutator driven in timed relation with said conveyor, and brushes bearing against said commutator and disposed to connect said ejector solenoid to the plate circuit of said grid-controlled gaseous discharge tube through a resistor during scanning periods and disposed to short-circuit said resistor at a fixed point in the assorting cycle.

9. In a photoelectric assorting apparatus, the combination of a continuous conveyor having spaced article seats and portions of a reference background thereon, a photoelectric cell arranged to view articles in said seats and said reference background, means controlled by said photoelectric cell for ejecting off-color articles from said conveyor, means acting to periodically normalize the apparatus with respect to the light reflected from said spaced reference portions to said cell and comprising first and second amplifiers in the control circuit of said ejecting means, a condenser in the plate-grid circuit of said amplifiers, means to periodically establish a grid biasing circuit around said condenser when said photoelectric cell views a reference portion, and means to vary the extent of the bias so applied to said second amplifier, and means further timing and controlling said ejecting means, whereby ejection occurs at an invariable point in the assorting cycle.

10. In a photoelectric assorting apparatus, the combination of a continuous conveyor having spaced article seats and portions of a reference background thereon, a photoelectric cell arranged to view articles in said seats and said reference background, means controlled by said photoelectric cell for ejecting off-color articles from said conveyor, means acting to periodically normalize the apparatus comprising first and second amplifiers in the control circuit of said ejecting means, a condenser in the plate-grid circuit of said amplifiers, means to periodically establish a grid biasing circuit around said condenser when said photoelectric cell views a reference portion, and means to vary the extent of the bias so applied to said second amplifier, and means further timing and controlling said ejecting means, whereby ejection occurs at an invariable point in the assorting cycle.

11. In a photoelectric assorting apparatus, the combination of a conveyor having spaced article seats and portions of a reference background thereon, a photoelectric cell arranged to view articles in said seats and said reference background, means controlled by said photoelectric cell for ejecting off-color articles from said conveyor, means acting to normalize the apparatus comprising first and second amplifiers in the control circuit of said ejecting means, a condenser in the plate-grid circuit of said amplifiers, means to periodically establish a grid biasing circuit around said condenser, and means to vary the extent of the bias so applied to said second amplifier, and means further timing and controlling said ejecting means, whereby ejection occurs at an invariable point in the assorting cycle.

12. In a photoelectric assorting apparatus, the combination of a conveyor having spaced article seats and portions of a reference background thereon, a photoelectric cell arranged to view articles in said seats and said reference background, means controlled by said photoelectric

cell for ejecting off-color articles from said conveyor, means acting to normalize the apparatus comprising an amplifier in the control circuit of said ejecting means, a condenser, means to periodically establish a grid biasing circuit around said condenser, and means to vary the extent of the bias so applied to said amplifier, and means further timing and controlling said ejecting means, whereby ejection occurs at an invariable point in the assorting cycle.

13. In a photoelectric assorting apparatus, the combination of a conveyor having spaced article seats and portions of a reference background thereon, a photoelectric cell arranged to view articles in said seats and said reference background, means controlled by said photoelectric cell for ejecting off-color articles from said conveyor, and means acting to normalize the apparatus comprising an amplifier in the control circuit of said ejecting means, a condenser, means to periodically establish a grid biasing circuit around said condenser, and means to vary the extent of the bias so applied to said amplifier.

14. In a photoelectric assorting apparatus, the combination of a conveyor for transporting articles to be assorted, a photoelectric cell arranged to view articles on said conveyor, means controlled by said photoelectric cell for ejecting off-color articles from said conveyor, means for actuating said ejection means including an ionizing power tube and electrostatic induction means between said photoelectric cell and said power tube, means to periodically establish a normalizing grid biasing circuit around said electrostatic inductor means, and means to vary the extent of the bias so applied, whereby to adjust the bias of said tube proportional to the illumination of the viewing field of the photoelectric cell.

15. In a photoelectric assorting apparatus, the combination of a viewing field, lamps for illuminating said field, a light-sensitive electrical unit optically exposed to said field, means for introducing into said field at certain times objects to be assorted and at certain other times a standard of reflectivity, an ejector capable of ejecting objects when actuated, an electrical amplifying system including a grid-controlled gaseous discharge tube, said system being sensitive to currents from the light-sensitive electrical unit and capable of actuating the ejector at suitable times by the plate current of the grid-controlled gaseous discharge tube, and means for periodically adjusting the retaining bias of said grid-controlled gaseous discharge tube essentially proportional to changes in the effective brightness of said lamps, said periodic adjusting means fully effecting any requisite change of the retaining bias in a single periodic adjusting operation.

16. In a photoelectric amplifier, the combination of a light-sensitive electrical unit, a viewing field therefor, an electrical amplifying system including a grid-controlled gaseous discharge tube, and means for periodically adjusting the retaining bias of said grid-controlled gaseous discharge tube essentially proportional to changes in the illumination of said viewing field, said periodic adjusting means fully effecting any requisite change of the retaining bias in a single periodic adjusting operation.

17. In a photoelectric assorting apparatus, the combination of a viewing field, lamps for illuminating said field, a light-sensitive electrical unit optically exposed to said field, means for introducing into said field at certain times objects to be assorted and at certain other times a stand-

ard of reflectivity, an ejector capable of ejecting objects when actuated, an electrical amplifying system including a grid-controlled gaseous discharge tube, said system being sensitive to
 5 currents from the light-sensitive electrical unit and capable of actuating the ejector at suitable times by the plate current of the grid-controlled gaseous discharge tube, and means for adjusting the retaining bias of said grid-controlled gaseous
 10 discharge tube essentially proportional to the effective brightness of said lamps, said adjusting means fully effecting any requisite adjustment in a single periodic adjusting operation.

18. In a photoelectric assorting apparatus, the
 15 combination of an illuminated viewing field, a photo-tube optically exposed to said field, a conveyor for introducing into said field alternately objects to be assorted and portions of a reference background, an ejector capable of ejecting objects
 20 when actuated, and an electrical amplifying system receiving impulses from said photo-tube capable of actuating said ejector, and containing a first amplifier tube and a second amplifier tube, electro-static induction means between said tubes,
 25 the plate of said first amplifier causing voltage variations in the control grid of said second amplifier by electrostatic induction, said grid being also connected through a highly resistive path to a biasing potential varied by direct current amplification.

19. In a photoelectric assorting apparatus, the
 combination of a viewing field, a reference background, a photo-tube optically exposed to said
 35 field and reference background, means for introducing into said field objects to be assorted, an ejector capable of ejecting certain objects from said means when actuated, and an electrical amplifying system receiving impulses from said
 photo-tube, capable of actuating said ejector, and
 40 containing a first amplifier tube, a second amplifier tube, and electro-static induction means between said tubes, the plate of said first tube

causing voltage variations in the control-grid of said second tube by electro-static induction while objects are being viewed, the grid of said second tube being essentially floating during such times, said grid being connected through a highly con-
 5 ductive path to a suitably established biasing potential while said photo-tube views the reference background.

20. In a photoelectric assorting apparatus, the
 combination of a viewing field, a reference back-
 10 ground, a photo-tube optically exposed to said field and reference background, means for introducing into said field objects to be assorted, an ejector capable of ejecting certain objects from said means when actuated, and an electrical
 15 amplifying system receiving impulses from said photo-tube, capable of actuating said ejector, and containing a first amplifier tube, a second amplifier tube, and electro-static induction means between said tubes, the plate of said first tube caus-
 20 ing voltage variations in the control-grid of said second tube by electro-static induction while objects are being viewed, the grid of said second tube being essentially floating during such times, said grid being connected through a highly con-
 25 ductive path to a biasing potential varied by direct current amplification of the photo-tube current while said photo-tube views the reference background.

21. In a photoelectric assorting apparatus, the
 combination of a conveyor having spaced article
 30 seats, a photoelectric cell arranged to view articles on said seats, means controlled by said photoelectric cell for ejecting off-color articles from said conveyor, and means acting to normalize the
 35 apparatus, comprising an amplifier in the control circuit of said ejecting means, a condenser, means to periodically establish a grid biasing circuit around said condenser, and means to vary the extent of the bias so applied to said amplifier.

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