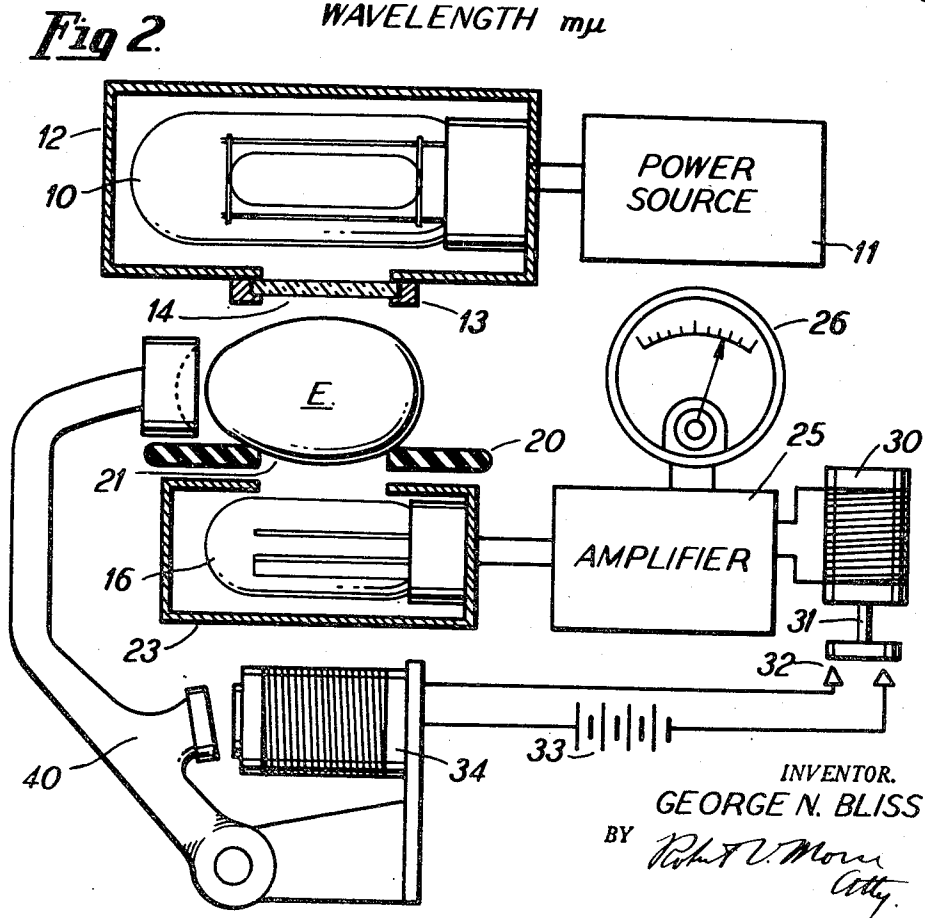
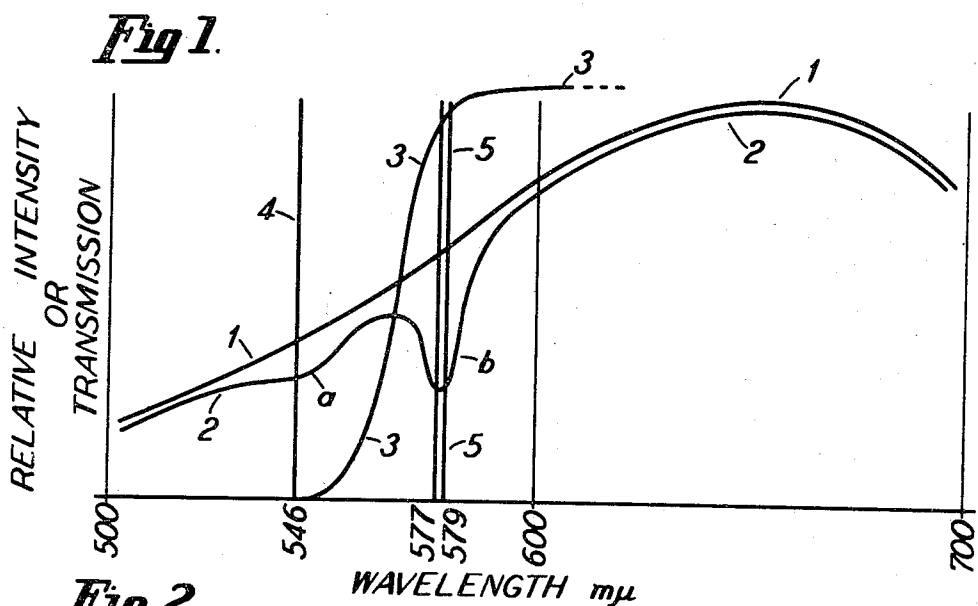


May 17, 1955

G. N. BLISS  
AUTOMATIC EGG CANDLER

2,708,515

Filed May 26, 1953



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2,708,515

## AUTOMATIC EGG CANDLER

George N. Bliss, Ithaca, N. Y.

Application May 26, 1953, Serial No. 357,400

2 Claims. (Cl. 209—111)

This invention relates to automatic egg candling machines, and particularly to the detection and elimination of unmarketable eggs known to the trade as "bloods." While such eggs are not dangerous to health, they are not acceptable to customers and many States have laws forbidding their sale for human consumption. Eggs today are inspected by the candling method by which the inspector holds the egg in front of a candling lamp which sends a beam of ordinary light thru the egg, illuminating the contents which is more or less translucent. The inspector turns the egg around in various positions in the beam and works in a darkened room. Blood clots show up as dark or reddish spots, or if there is much blood the whole egg may appear red. However, smaller blood spots are often missed, while many good eggs with heavy shells or dark colored yolks are mistakenly rejected as "bloods."

It is difficult to find a sufficient number of qualified persons to candle all the eggs, since the work involves manual dexterity, considerable judgement and skill, and requires work in the dark against lights, which is hard on the eyes. Enormous numbers of eggs must be handled each year; and since the law requires that most of them be candled, that process constitutes a bottleneck that adds considerably to the cost to the consumer. While elaborate machines have been developed to facilitate the movement of eggs thru packing plants, the eliminating of the "bloods" is still done by the human eye.

Various attempts have been made to solve this problem in the past by transmitting various types of light thru the egg to operate photocells or other light responsive devices to control electric circuits actuating sorting mechanisms. While many combinations of particular lights and filters have been tried, they have heretofore failed to produce a satisfactory solution capable of commercial application.

The present invention uses a mercury lamp as the source of light, filters out its green line at about 546  $m\mu$  along with other blue and violet lines beyond that point, and uses solely the wave lengths at 577  $m\mu$  and 579  $m\mu$  which, being closely adjacent, form a narrow band in the yellow light range. This 577-579  $m\mu$  band, while very much narrower than any filter could produce, nevertheless has a finite width and area which sufficiently coincides with a hemoglobin absorption band so as to be capable of variation according to the presence of blood, and in sufficient extent to operatively modify the overall quantity of light falling on the light sensitive cell. It appears to overcome the difficulties associated with the wave lengths and filters previously used, and to make possible the practical elimination of bloods by automatic mechanical means.

Referring now to the drawings forming part of this specification,

Fig. 1 is a diagram of the relative intensity or transmission of light of various wave lengths thru a normal egg, and thru a blood egg, together with the location of the principal lines of mercury light. It also shows the

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effect of the filter here used in eliminating the light at 546  $m\mu$  and transmitting the light at 577-579  $m\mu$  to operate the device.

Fig. 2 is a diagrammatic view of the mechanism, partly in section, showing the mercury light, the filter, egg, conveyor belt, light responsive cell, amplifier and relay, and a kick-out mechanism for removing the egg when blood is indicated.

Referring first to Fig. 1, the wave lengths of light are indicated from 500  $m\mu$ , which is the green blue range, to 700  $m\mu$  which is the red-orange range. One  $m\mu$  is a millimicron, that is, equal to .000001 millimeter, the  $m\mu$  being a unit that is commonly used in measuring the wave length of light. The light transmissibility of an egg extends to both higher and lower values than shown in the diagram, but since only a very narrow part of that range is used in the present invention there is no need here to extend the diagram further.

The curve marked 1 illustrates the relative light transmission at various wave lengths for a normal egg, showing that the maximum transmissibility to light is between 600  $m\mu$  and 700  $m\mu$ , that is, in the red-orange range. This area has been used in some prior devices, because it was known to be an area of maximum transmissibility, but is not used in the present invention.

Curve 2 illustrates the relative light transmission at various wave lengths for a typical blood egg, and it will be noted that the curve has a slight dip (a) at about 546  $m\mu$  and a more pronounced dip (b) at about 575-580  $m\mu$ . These dips are due to absorption of green light at about 540-550  $m\mu$  and to absorption to a greater extent of yellow light at about 575-580  $m\mu$  when attempting to pass thru hemoglobin.

Curve 3 illustrates the transmissibility of the filter used in this invention to practically eliminate the light in the 540-550  $m\mu$  (green) region but pass the light in the 575-580  $m\mu$  region and beyond.

The green line of the mercury spectrum at 546  $m\mu$  is indicated by the reference numeral 4, and the yellow lines from the mercury light at 577 and 579  $m\mu$  are indicated by the reference numeral 5.

It is difficult to make a filter which will sharply limit the precise wave lengths of light to a sufficiently narrow color band for this problem. While it is possible to use a filter to produce the operative light, it is preferable under the present invention to make use of mercury light and use a filter only to black out one of the mercury lines at 546  $m\mu$  (a green line) while not interfering with the 577 and 579  $m\mu$  (yellow) lines of the mercury light, which being close together and favorably placed in relation to the major dip (b) of the blood egg curve 2 make possible an interaction capable of solving the problem. This action is as follows.

Considering only the 577-579  $m\mu$  lines of the yellow light—which is here the only region permitted to operate—this region, while very sharp and narrow, has nevertheless a finite width so that some quantity of light is passed, this quantity varying directly with the height of the general egg transmission curve in that region. If the egg is normal, without blood spots or hemoglobin, the amount of light passed is directly proportional to the height of the 577-579  $m\mu$  band up to the point where it meets the curve 1. On the other hand, if blood is present, the amount of light transmitted is proportional to where that light band meets the curve 2, a considerably lesser amount. While this difference in amount will vary with different eggs and may not be very great, the fact that in the present invention it is concentrated on a narrow precise band, instead of a broader area such as previous inventions have defined by filters, prevents the small variations from being lost or obscured in the larger mass, so that the full effect of relatively small variations can

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be utilized successfully to operate the light sensitive rejector mechanism.

This mechanism is illustrated in Fig. 2 and consists of a mercury light 10 connected with a suitable electric power source 11, the lamp 10 being preferably enclosed in a box 12 having a window 13 thru which the beam of mercury light may shine on the egg E. To eliminate the 546  $m\mu$  light and pass 577-579  $m\mu$  light a suitable filter 14 may be placed in the window 13. Such filters are available commercially, as for example Corning #3480 or Wratten E2#22. When a high pressure mercury arc is used as the light source in conjunction with a red sensitive cell at the receiving end, an additional red absorbing filter such as Corning #4784 may be required.

The filter may be located anywhere in the beam of light between the light source 10 and the receiving cell 16, since it is immaterial whether the 546  $m\mu$  light is filtered out before or after it passes thru the egg E, so long as it is eliminated before it can reach the responsive cell 16 so as not to actuate it. For example, the filter might be placed between the egg E and the receiving cell 16. However, it is generally more convenient to locate the filters at 14 in the window 13 as shown instead of under the conveyor belt 20.

The conveyor belt 20 is conventionally shown in cross-section in Fig. 2 and may have various forms, as such belts are commonly used in the handling of eggs in packing and processing plants. It is only necessary that it have an opening 21 or other path to allow the beam of light to pass thru the egg and fall upon the receiving cell 16. Since the action of the light and electricity is practically instantaneous the belt 20 can be run continuously, without stopping for each egg, and consequently the machine can work very rapidly, as compared with hand candling.

The receiving cell 16 is preferably enclosed in a box 23 which is opaque except where the beam of light enters it, and the cell 16 may be of any of the well known types which vary an electric current in response to the impact of light. Various types are commercially available; some generate an electric voltage within themselves when light falls upon them, others use an external current supply but vary their resistance according to the light that falls upon them so as to vary the current accordingly. Examples of light sensitive elements include selenium cells, copper oxide cells, photoemissive tubes, and photoconductive tubes such as the lead sulphide tubes. New photosensitive materials are being continually discovered such as germanium crystals and the like. Cells such as selenium and copper oxide cells generate a current when acted upon by light, while most other devices in use pass a current generated by an auxiliary source. In any event, a variable voltage or current is produced which changes according to the amount of 577-579  $m\mu$  light which strikes the cell 16 and accordingly registers the presence or absence of hemoglobin in the egg.

This current or voltage is transmitted to the amplifier 25 where it is amplified to whatever extent desired. For visual operation and calibration a dial indicator 26 is connected to the amplifier 25, and for mechanical operation the amplifier 25 operates a relay 30. This relay 30 is of the hold open type, consisting for example of an electro-magnetic coil having a solenoid plunger 31 operating a contact switch 32 in the circuit of the battery 33 which in turn can energize an electro-magnet 34.

So long as enough light falls on the receiving cell 16 to maintain sufficient current thru the amplifier to hold the relay 30 open, the circuit of the electro-magnet 34 is broken at the switch points 32 and there is no tendency to reject the eggs moving along the belt 20. But if the amount of transmitted 577-579  $m\mu$  light is appreciably diminished by the hemoglobin of a blood egg, the current in the amplifier circuit may be reduced sufficiently so that the plunger 31 is no longer held

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up by the relay 30 and will fall, closing the circuit of the electro-magnet 34, which attracts the movable arm 40 and forces the egg E off the belt. In other words, the rejecting mechanism only operates when a blood egg is present. If the egg is good, or there is no egg present, sufficient light from the lamp 10 falls on the receiving cell 16 to continuously maintain sufficient amplified current to hold the relay switch 32 open.

It will be understood that the rejecting mechanism need not necessarily operate directly under the light, but its action may occur anywhere later along the conveyor thru the use of so-called memory devices which are now frequently used in automatic sorting machines. Whether the rejection is immediate or postponed is immaterial to the present invention, which is particularly concerned with obtaining a primary initiating device capable of instantly distinguishing blood eggs from normal eggs within the range required in commercial practice, so as to equal or excel the precision of the human eye as now used in ordinary candling.

While I have in the foregoing described certain specific forms by way of example, it will be understood that they are merely for purposes of illustration to make clear the principles of the invention, which is not limited to the particular forms shown but is susceptible to various modifications and adaptations in different installations as will be apparent to those skilled in the art without departing from the scope of the invention as stated in the following claims.

I claim:

1. In an automatic egg candler, the combination of a light source having a strong narrow yellow band at about the region 577-579  $m\mu$ , a light sensitive receiving cell responsive to light in said region, a light filter located between the light source and the light sensitive receiving cell, the filter being adapted to pass light waves in said 577-579  $m\mu$  region and block the transmission of light waves of other colors, an egg conveyor for carrying eggs in rapid succession thru the beam of light between said light source and the light sensitive receiving cell so that light of said wave lengths 577-579  $m\mu$  will pass thru each egg to the receiving cell, an electric amplifier connected to said receiving cell, a relay connected to and operated by said amplifier, a switch connected to and operated by said relay, a rejecting circuit connected to and operated by said switch when the current in the amplifier and relay circuit falls below that determined by the beam of said light thru a normal egg to that determined by absorption of light in said region by hemoglobin in an egg, and a rejector mechanism connected to and operated by said rejecting circuit to shift a blood egg to a different path from that of the normal eggs on said conveyor.

2. In an automatic egg candler, the combination of a mercury light source having a strong narrow yellow band at about the region 577-579  $m\mu$ , a light sensitive receiving cell responsive to light in said region, a light filter located between the light source and the light sensitive receiving cell, the filter being adapted to pass light waves in said 577-579  $m\mu$  region and block the transmission of light waves of other colors, an egg conveyor for carrying eggs in rapid succession thru the beam of light between said light source and the light sensitive receiving cell so that light of said wave lengths 577-579  $m\mu$  will pass thru each egg to the receiving cell, an electric amplifier connected to said receiving cell, a relay connected to and operated by said amplifier, a switch connected to and operated by said relay, a rejecting circuit connected to and operated by said switch when the current in the amplifier and relay circuit falls below that determined by a beam of said light thru a normal egg to that determined by absorption of light in said region by hemoglobin in an egg, and a rejector mechanism connected to and operated by said rejecting

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circuit to shift a blood egg to a different path from that of the normal eggs on said conveyor.

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