

Feb. 18, 1958

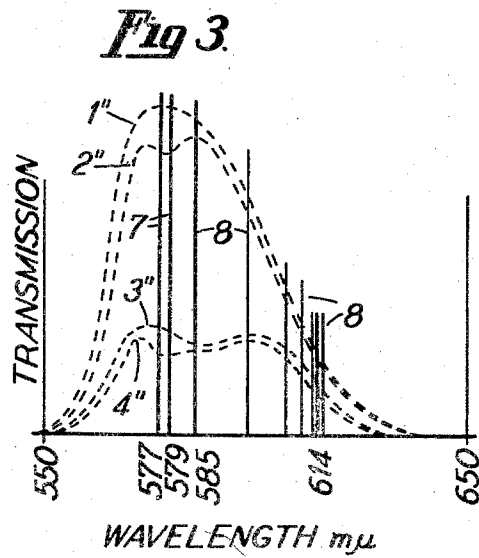
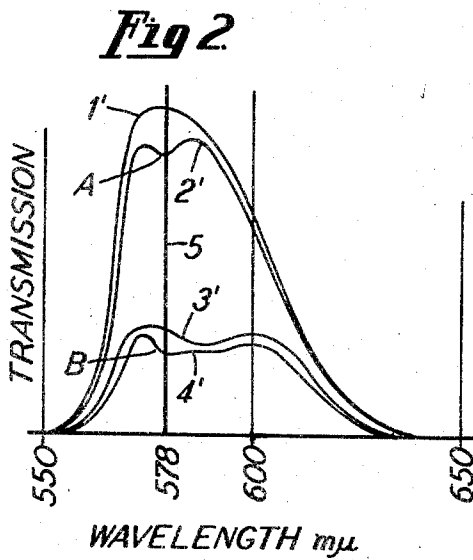
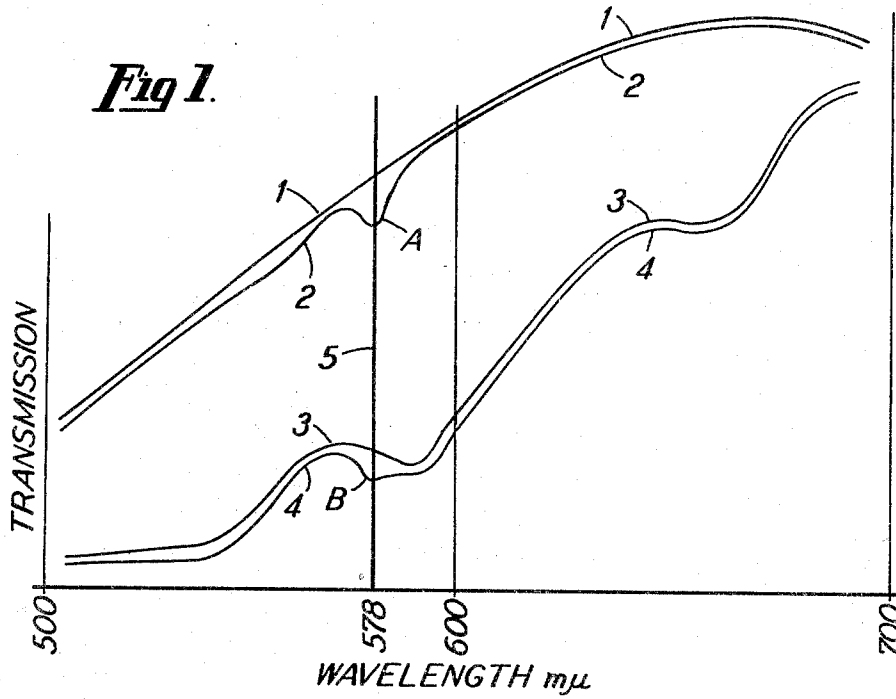
G. N. BLISS

2,823,800

AUTOMATIC CANDLER FOR BROWN OR WHITE EGGS

Filed June 26, 1953

3 Sheets-Sheet 1



INVENTOR.

GEORGE N. BLISS

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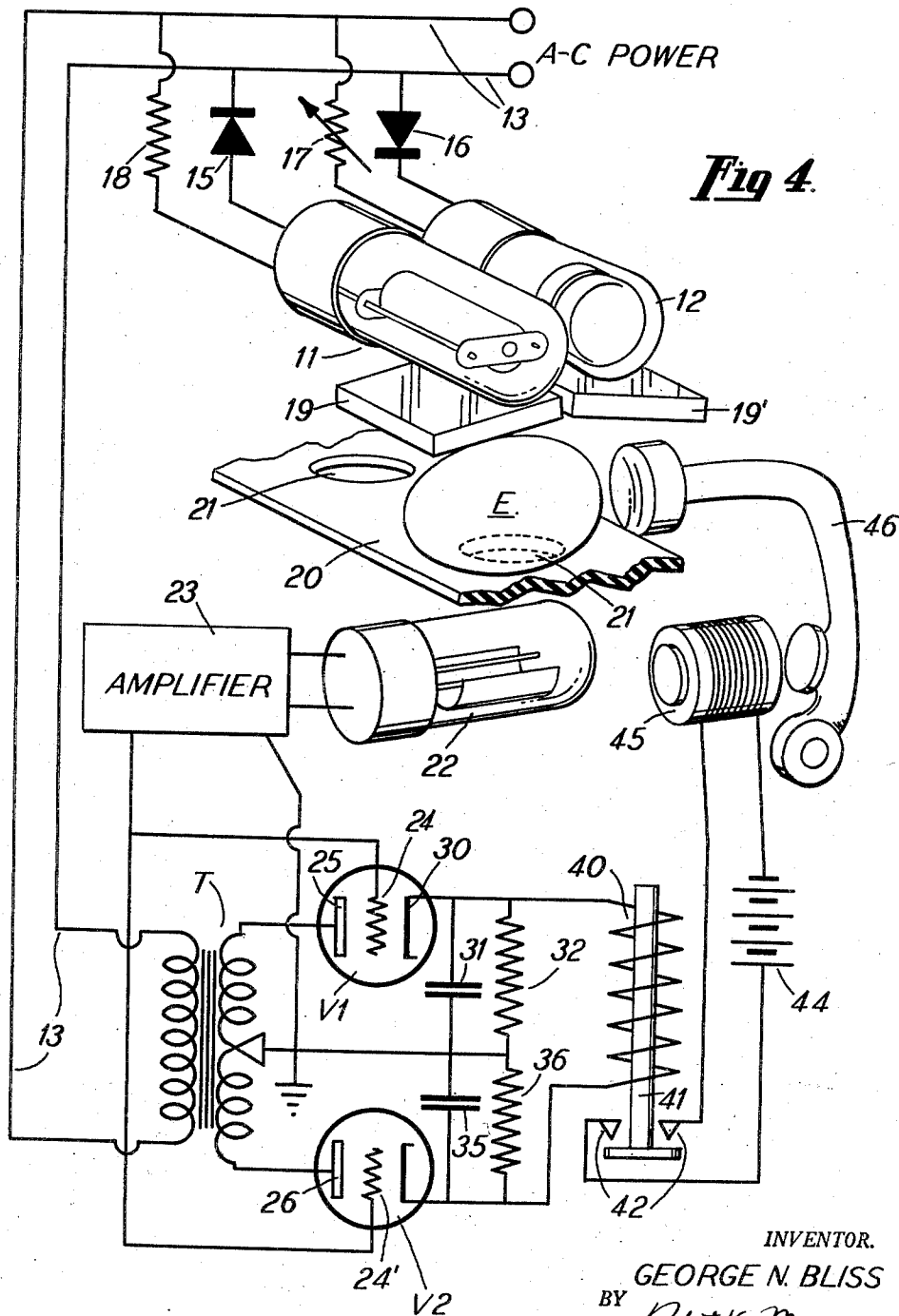
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3 Sheets-Sheet 2



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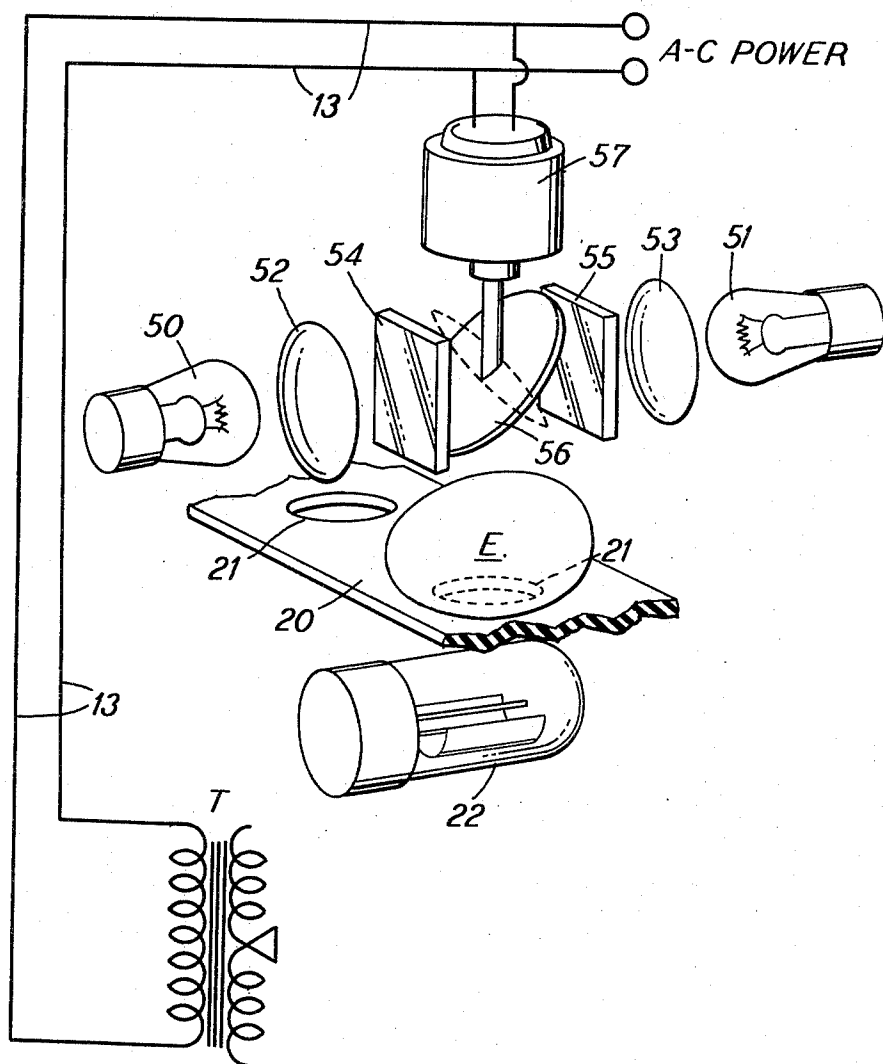
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Fig 5.



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AUTOMATIC CANDLER FOR BROWN OR WHITE EGGS

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Application June 26, 1953, Serial No. 364,264

5 Claims. (Cl. 209—111)

This invention relates to egg candling and particularly to automatic candling machines involving the elimination of eggs known to the trade as "bloods." Such eggs are now candled by hand, the egg being held in front of a strong beam of light, and if the inspector sees a blood spot or a reddish color the egg is rejected. This is a tedious and rather uncertain process dependent on the human eye, and smaller blood spots are often missed while many good eggs with heavy shells or dark colored yolks are mistakenly rejected as "bloods."

The great quantity of eggs that must be candled has led to various attempts to produce automatic machines for the purpose. These have not gone into general use so far as "bloods" are concerned because of the complexity of the problem, though specialized lights of various wave lengths both in the visible spectrum and the invisible infra-red spectrum have been tried. In ordinary spectrographic analysis the light absorption of a sample of the material is compared with that of a standard material. This could be done with an egg if the material in the egg could be removed from the shell and put in the usual glass cell used in spectroscopy thru which the light could pass.

But with commercial eggs the shell must not be broken, and any light must pass thru the various materials of the shell before reaching the fluid interior. The shell materials are if anything more dominant than the fluid so far as light is concerned, having greater opacity and broad spectral bands such as calcium for example, while blood or hemoglobin bands are relatively narrow and dispersed in various places. The difficulties are great enough when the eggs are all of the same general type and color, but have appeared insuperable in the past when the eggs to be mechanically processed included various shell colors ranging from white to brown. The problem then was not only to detect the presence of blood instantaneously, but also to instantaneously readjust or re-set the operating characteristics of the blood detector according to the varying types of shell structure. This was further complicated by the fact that shells of the same color may transmit light differently due to different shell thickness.

In the present invention particular light waves selected from certain portions of the hemoglobin spectrum (and which also vary with the shell characteristics) are used alternately with other light waves which vary only with the shell characteristics but which are not appreciably affected by hemoglobin. The latter waves can then in effect be used to subtract the shell characteristics from the former, leaving the net operation of the device solely dependent on the hemoglobin. This subtraction however is not of a simple arithmetical nature, since a correction that would be suitable when both factors were small would need to be multiplied many times when both factors were many times larger. Consequently, instead of a fixed arithmetical subtraction to neutralize the shell factor, it is necessary that the correction be varied proportionately to the level of transmissibility at which the

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device is working, that is, in practice, that the correction factor be readjusted for each egg.

The solution of the problem will become more apparent as the description proceeds; but from the foregoing it will be seen that this invention differs from simple spectrographic analysis in that instead of comparing the sample to be tested with a standard object, there is no fixed standard for comparison, no alternation of beams between two such objects, but each egg is in effect only tested against itself, not against another egg. The apparatus is continually reset automatically.

This makes possible the mechanical automatic candling of bloods from mixed lots of white and brown eggs such as are ordinarily received from the farmer, particularly in the mid-west. The invention has been reduced to actual practice by test runs under volume conditions with satisfactory results.

Referring now to the drawings forming part of this specification,

Fig. 1 illustrates the transmissibility of light at various wave lengths thru typical eggs of different colors, the vertical scale of light transmission being logarithmic to accommodate the great range of variation that occurs.

Fig. 2 is another set of curves for the same eggs showing the transmission of incandescent light in the general region of 570–610 $m\mu$, after the red and infra-red rays on the one side and the green blue and ultra-violet rays on the other side have been filtered out from the curves of Fig. 1 by a suitable filter.

Fig. 3 is a further set of curves for the same eggs showing the light transmission of certain wave lengths of mercury light and neon light, filtered by a suitable filter as in Fig. 2. Here we have a group of narrow bands of light of certain wave lengths instead of the broader area of Fig. 2.

Fig. 4 is a diagrammatic view illustrating the general principles of the invention as applied to a rapidly moving stream of eggs of various colors.

Fig. 5 shows a modified form having a mechanically rotated flicker and the two types of light waves are obtained by filters from incandescent lamps.

Similar reference numerals refer to similar parts thru-out the various views.

Referring now to Fig. 1, the curve 1 illustrates the amount of light of various wave lengths transmitted thru a typical white egg free from blood, the wave lengths shown including the region in which the present invention operates. There is of course light transmitted at many other wave lengths thru an egg, both in the green, blue, violet and ultra-violet beyond 500 $m\mu$ and in the infra-red beyond the 700 $m\mu$; and while such regions have been used in other devices in attempts to solve the problem, the present invention is restricted to the particular range here illustrated, so that it is unnecessary to show the whole spectrum.

The number 500 corresponds approximately to green-blue light and 700 corresponds to the threshold of vision at the red end of the spectrum, while the middle part of Fig. 1 with which the present invention is particularly concerned is in the region of yellow light. While prior inventions have claimed success in the infra-red region, I have found the shell characteristics too dominant in that region to make possible the continuous correction by adjacent wave lengths which is the principle of the present invention, and which I have only been able to attain in the yellow light region.

Curve 1 in Fig. 1 shows that the light transmitted thru a good quality white egg without blood increases smoothly from green light (500 $m\mu$) thru yellow to the red (700 $m\mu$). Curve 2 of Fig. 1 shows that a similar white egg but with only a small blood spot shows a dip at A due to the light absorbed around 578 $m\mu$ by the hemo-

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globin present. Curve 3 shows the light transmitted thru an egg free from blood and of as good quality as the egg in curve 1 but differing only in that it has a brown shell. It will be noted that the shell color makes a much greater difference in the amount of light transmitted at 578 $m\mu$ than does the presence or absence of blood; so that unless the eggs being run thru a machine are all of the same general white characteristics the presence of bloods may not be detected.

Curve 4 represents the light transmission at various wave lengths thru a similar brown shell egg except that it has a blood spot indicated by the sharp dip B. It is interesting to note that both curves 3 and 4 have a general dip between 575–600 $m\mu$ but that the sharp dip B in curve 4 is as definite relative to curve 3 as the dip A in curve 2 is relative to curve 1. It follows then that in order to detect bloods in a miscellaneous run of eggs having various shell characteristics, the criterion must be, not comparison with a white egg standard, but comparison with what the transmission of each particular egg would be if it had all its other characteristics except that blood was not present. In short, to compare each egg with what it would or should be in its own more perfect form.

One of the principles employed here, it is believed for the first time, is to also use light in more bands or areas in the same general region but having the characteristic that their total effect is little changed by variations in the 578 $m\mu$ light while at the same time the total varies proportionately (if not equal to) the variation in the 578 $m\mu$ transmissibility. The proportionality can be converted to equality by simple electrical means. If this equality is set on blood free eggs it will be disturbed by the presence of hemoglobin in any egg regardless of the shell color. The application of these principles appears difficult, if not impossible, in the green-blue end of the spectrum due to the rapid diminution of light plus the adverse effect on balance brought about by size and position of the yolk (because of its high green-blue absorption). The red end of the spectrum offers no better solution as there is too little variation in transmission. However, the desired result can be accomplished with suitable filters in the yellow-orange region here described adjacent the 578 $m\mu$ line, provided a narrow band close to 578 $m\mu$ is used as one of the factors and a broader or more extensive range of wave length in that region is used as the other proportionate factor.

The first step in such a solution is to eliminate the wave lengths with which we are not concerned, such as the blue and red ends of the spectrum, so that their energy will not confuse or obliterate the rather delicate effects in the range where we must work. Accordingly, by the use of a suitable light filter we reduce the working area to that illustrated for example in Fig. 2 or Fig. 3. This relatively small part of the whole light spectrum is peaked at about 578 $m\mu$ and falls rapidly down in both directions so as to have little red or green light.

Referring now to Fig. 2, the curves 1', 2', 3' and 4' correspond in general to curves 1, 2, 3 and 4 of Fig. 1, with the effect of the filter superimposed as described to eliminate the wider range of wave lengths. In the more restricted range of Fig. 2 the dips A and B caused by the absorption of light by hemoglobin are visible as in Fig. 1. However, their general effect is still relatively slight in proportion to the total quantity of light that comes thru the filter, that is, the total area under the curve.

The maximum variation of proportionality would come best in a very narrow band if the band could be located where the maximum dips occur, since then the effect would not be averaged in with less active variations at other wave lengths. I have found that mercury light can be effectively used for this purpose if employed in connection with a filter such as described, which also cuts out the mercury lines at 546 $m\mu$ but passes the yellow mercury

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lines at 577 and 579 $m\mu$. These 577–579 $m\mu$ lines are so close together that for practical purposes they will be herein considered as at 578 $m\mu$, indicated by the reference numeral 5.

While such light might be used to detect bloods in eggs having rather uniform shell characteristics, it is evident from the curve 3 or 3' in relation to curve 1 or 1' that the color of the shell can have much greater effect than blood, so that a good brown egg without blood will register lower than a white egg with blood. On the other hand, if the machine were set to handle brown eggs correctly it would then pass blood eggs that happened to have white shells. For a general solution another factor must be introduced.

Monochromatic light at about 595 $m\mu$ is transmitted by both white and brown blood-free eggs in the same proportions as at 578 $m\mu$, though in somewhat larger quantities, and would make an ideal balancing light provided a source of such light were readily available. However, it is not necessary that the light be monochromatic; it may in fact be a relatively broad filtered band provided the variation is proportional. The areas under the curves in Fig. 2 cover a relatively broad band of that character, and with an appropriate filter the area under curve 3' is to the area under curve 1' as the height of the 578 $m\mu$ line at the point of intersection with curve 3' is to the height of that line to the intersection with the curve 1'. Also, the area under the curve 1' is to the height of the 578 $m\mu$ line to the point A as the area under the curve 4' is to the height of the 578 $m\mu$ line to the point B. While this is not exact, as a practical matter it is sufficiently close to give an adequate correction.

Instead of a relatively broad band as in Fig. 2, bright line sources emitting multiple bands of monochromatic light may be used, as shown in Fig. 3, to obtain a similar effect of proportionality. Fig. 3 shows monochromatic mercury light bands 7 at 577–579 $m\mu$ (substantially 578 $m\mu$), and some monochromatic neon light bands 8 of which the strongest are at 585 $m\mu$ and 614 $m\mu$. By a proper choice of filter the total transmission of the neon lines (that is, the height of neon lines to where they intersect a given curve, added together) can be made proportional to the transmission of the 578 $m\mu$ mercury band—the proportionality holding for all eggs regardless of color. This gives the key to the stabilization factor desired for balancing. The presence of blood has a pronounced effect on mercury light transmission but very little on neon, so that the neon light can supply the stabilizing or correcting factor.

The application of these principles to an automatic sorting mechanism for eggs can now be described. Referring now to Fig. 4, the mercury light 11 and the neon light 12 are supplied by the A. C. power line 13 thru rectifiers 15 and 16 respectively and whatever type of ballasts 17 and 18 or auxiliary equipment are necessary for the particular lamps in use. The element 17 has a variable control or dimmer so that in preparing the instrument for use the effect of the neon light 12 can be adjusted to balance the effect of the mercury light 11, as will be described. Such an equalizer can of course be put in either light circuit so as to balance the other.

The rectifiers 15 and 16 are arranged in opposite polarity so that for example during the positive half of the power cycle the mercury lamp 11 is lighted and during the negative half of the cycle the mercury lamp is extinguished and the neon tube 12 is lighted. These alternate beams of light from the two sources pass thru the filters 19 and 19' respectively and thru the egg E on the moving belt 20 having holes 21 thru which the light passes to the phototube 22. The impulses from this phototube 22 may be amplified at 23 and transmitted simultaneously to the grids 24 and 24' of the tubes V1 and V2. These tubes are powered by the transformer T whose primary is fed by the same A. C. power line 13

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that feeds the lamps 11 and 12, so that the lamps 11 and 12 and the tubes V1 and V2 alternate simultaneously.

The circuits in the lower part of Fig. 4 connected to the A. C. power line 13 and to the amplifier operate in general as an electronic switch to transmit alternately the pulsations due to the mercury light and then due to the neon light with sufficient smoothness so that they can be balanced against each other. The switching is here accomplished without moving mechanical parts. The plates 25 and 26 in the tubes V1 and V2 are wired for opposite polarity so that when plate 25 is positive the plate 26 is negative, and vice versa. Thus when the amplified current from phototube 22 is impressed on the grid 24 and 24' of the tubes V1 and V2, one tube will conduct and the other will not. The other tube will switch in when the alternating power current reverses, and simultaneously the other of the light sources 11 or 12 will come into play to send its beam of light thru the egg to energize the system. The selective action of the tubes V1 and V2 is due to the well known property that such a tube will not conduct when its plate is negative but will conduct when its plate is positive.

For example, during the positive half of the power cycle the rectifier 16 is unable to conduct and neon tube 12 extinguishes, while rectifier 15 passes current lighting mercury tube 11, whose light passes thru the filter 19 and egg E and is received by the phototube 22. The phototube current after being amplified at 23 is impressed simultaneously on both the grids 24 and 24' of the tubes V1 and V2, but at this instant the plate 25 is positive and the plate 26 is negative, rendering the tube V1 conducting and the tube V2 non-conducting. Thus cathode 30 of the tube V1 rises to a voltage equal to the peak grid voltage swing, where it is maintained by the charge on condenser 31. The cathode resistor 32 bleeds the charge in condenser 31 slowly in relation to the recurring positive half cycles so that a steady potential is maintained corresponding to the maximum grid voltage during the positive half of the cycle.

In a similar manner the mercury lamp 11 extinguishes during the negative half of the cycle and the neon tube 12 lights up. After passing thru the filter 19' and egg E the neon light is received by the phototube 22 and again the impulse from the phototube is amplified and impressed simultaneously on both grids 24 and 24'. But at this time, due to the alternation of the power cycle, the polarity on plates 25 and 26 is now reversed so that tube V1 is non-conducting and tube V2 is rendered conducting. Thus the condenser 35 receives a charge equal to the maximum grid voltage during the negative half of the cycle, a steady charge being held by the rapidly recurring negative half cycles slowly bled thru the cathode resistor 36.

Thus a charge is maintained on condenser 31 proportional to the filtered mercury light transmitted by the egg, and a charge is maintained on condenser 35 proportional to the filtered neon light transmitted by the egg. Various other forms of electronic switch known in the art may be used.

To initially set the machine an egg known to be free from blood is placed on the belt in the light beam and the voltage on either the neon or mercury lights (or both) is adjusted so that the voltage across the condensers 31 and 35 is equal. Thus no current will flow thru the relay coil 40. This balance is usually checked with a number of eggs in the run to make sure that it is substantially maintained with different shell colors.

If a blood egg passes between the lights and the phototube, however, the flashes of mercury light falling on the phototube will be weaker than the flashes of neon light due to the absorption of mercury light by hemoglobin; and accordingly the voltage across the condenser 31 will not rise to as high a value as the voltage across the condenser 35. Current will then flow thru the relay coil 40, attracting the armature 41 and closing the contacts 42.

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These contacts are in the circuit of the battery 44 which energizes the electro-magnet 45 and attracts the kick-off arm 46 that causes the egg to be rejected.

As the ordinary power line operates at 60 cycles per second, the process is very rapid, and each egg normally receives several impulses as it goes by. The device lends itself to large scale commercial operation, since large quantities of eggs may be run rapidly thru the light beams in a continuous stream at uniform speed, intermittent motion not being necessary. Any form of conveyor belt that will permit the transmission of light may be used, and the eggs can also be conveyed by cradles or arms or rolled along tracks if desired; in other words, it is adaptable to most of the handling and conveying systems now in use.

The fact that the test is not dependent on a single pair of impulses but that the impulses can be repeated several times for each egg tends to increase the reliability of the operation, since any hesitation or stickiness of an operating part tends to be overcome by the repetition of the energizing force.

While a merely diagrammatic form of diverting mechanism 44-45-46 is shown for purposes of illustration, it will be understood that the final impulse may be applied to any rejecting switch mechanism used in conveying machinery that can be electrically controlled, and that usually such diverting switches as used in the conveyor art are relatively light and small elements often including memory devices which easily divert an object from its stream at some later point in its travel.

Various light sources may be substituted for the neon balancing light, provided they fulfill the two essential requirements described, namely (1) that they are in the middle portion of the visible spectrum, i. e., in the yellow region or closely bordering thereon in the yellow orange or yellow green and sufficiently close to the blood variable test light so that their general variations are proportional to that test light's general behavior; and (2) that the total of the balancing light is sufficiently independent of the specific blood test light so as to be but little if any affected by blood conditions. This requires in general a good filter in or close to the yellow region, peaked close to the 570-610 m μ region, as can be obtained by filters commercially available.

With suitable filters it is possible to use other light sources such as an argon tube, or a fluorescent tube, or even an incandescent lamp, provided its filament is fine enough to permit sufficient cooling during half of the power cycle. The preferred form of the invention shown in Fig. 1 to Fig. 4 inclusive is free from all moving mechanical parts in the light detector system by virtue of the inherent properties of the particular light sources employed.

The modification shown in Fig. 5 illustrates another form in which a narrow peaked filter and a balancing filter in a closely adjacent zone may be operated to obtain the result using incandescent or fluorescent lights for the source. Ordinary filters are not sharp enough for the detector beam; but by using at least one filter of the interference type an approximation of the 578 m μ band may be obtained. Where the lights are not sharply intermittent a mechanical shutter must be employed.

In Fig. 5 the continuously illuminated lights 50 and 51 connected to any suitable power line (not necessarily A. C.) give out various wave lengths of light including yellow, yellow-orange and yellow-green; and this light is collimated by the lenses 52 and 53 so as to produce beams of parallel light which then pass thru an interference filter 54 and a filter 55 to fall upon the revolving mirror 56 driven by the synchronous motor 57 connected to the A. C. power line 13.

Interference filters, unlike ordinary colored filters, are essentially fixed separation Fabry & Perot interferometers. They are constructed of alternate layers of semi-reflecting film and transparent dielectric, the thickness of the dielectric being equal to a whole number of wave lengths. While these filters can be constructed to

transmit extremely narrow wave bands, they suffer from several disadvantages, chief among them being that their minimum transmission of undesired wave lengths is at least several percent. Since such a narrow-band filter must necessarily transmit only a small percent of the total light, even a very small amount of undesired light transmitted thru the rest of the spectrum is a quantity to be reckoned with. Supplementary color filters help but do not entirely cure the situation. However, within their limits of accuracy, such filters may be used.

The filter 54 eliminates substantially all wave lengths except close to 578 $m\mu$ and this light strikes the revolving 45° mirror 56 which reflects it downward thru the egg E to the phototube 22. A half cycle later the synchronous motor 57 has rotated the mirror 56 a half turn to the position shown in broken lines in Fig. 5 where it catches light at an adjacent wave length say 595 $m\mu$ or some other equivalent range substantially unaffected by hemoglobin and reflects it in turn thru the egg E to the phototube 22. The remaining operation is substantially the same as described in connection with Fig. 4. The filter 55 need not necessarily be of the interference type, since for its function such a sharp peak is not required, and may be a simple colored filter or combination fulfilling the conditions set forth in Fig. 2.

While two separate lights 50 and 51 have been shown, it will be evident that the same result can be obtained from a single source of light that includes all types of wave lengths required, split into two paths or beams by suitable mirrors or prisms. Such split paths are well known, and most incandescent lights give out a wide variety of wave lengths. The principle of the present invention differs however from ordinary spectroscopic two-beam testing in that one beam does not go thru a separate standard substance, but both beams go thru the same article to balance.

While various arrangements of lights and filters may be used, the combination essential to attain the result herein must involve a very precise narrow band in the 575-580 $m\mu$ region, such as 577-579 $m\mu$ for example, in conjunction with more extensive bands close to that region that are not materially affected by hemoglobin absorption, the latter quantity of light being approximately proportional to, if not equal to, the quantity of light in the 577-579 $m\mu$ region when passed thru a blood free egg.

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 set forth in the following claims.

I claim:

1. In an automatic egg candler for bloods, the combination of a source of yellow light having wave lengths between 575-585 $m\mu$ and including a filter cutting out the green-blue light waves on the one side of the spectrum and the red-orange light waves on the other side of the spectrum, said source providing a beam of light of a narrow band of wave lengths sharply peaked at substantially 577-579 $m\mu$ so as to be strongly affected by hemoglobin, a second beam of light having wave lengths in between 550 $m\mu$ and 630 $m\mu$ and dispersed so that their range is sufficiently extended in relation to wave lengths 577-579 $m\mu$ so as to be relatively little affected by hemoglobin, a filter in said second beam proportioned to transmit a pattern of light wave lengths whose total intensity is approximately proportional, though not necessarily equal, to that of the narrow band of peaked light for various degrees of transmission thru various blood-free eggs, a phototube alternately receiving light from the two said beams after they pass thru the same egg, a variable

dimmer for equalizing the effect of said beams on the phototube when they have passed thru an egg that is free from blood, a two sided alternating switch having one side operatively connected to the phototube when one of said beams falls upon it and having the other side operatively connected to the phototube when the other of said beams falls upon it so that the alternate voltages created by the energization of the phototube by the alternate light beams thru a blood-free egg are balanced out and no effective voltage difference is delivered beyond said balanced circuit, a relay connected to said balanced circuit operative when said circuit is in a state of unbalance, a conveyor for receiving an egg and from which the egg is capable of being rejected, and a rejector operated by said relay to distinguish an egg containing blood from a blood-free egg, said relay and rejector mechanism being energized by a lack of balance in said balancing circuit produced by the absorption of light in the narrow first mentioned beam by hemoglobin in the egg.

2. In an automatic egg candler for bloods, the combination of a source of mercury light having wave lengths at 577-579 $m\mu$ and including a filter cutting out the mercury wave lengths at 546 $m\mu$ and the green-blue light waves on the one side of the spectrum and the red-orange light waves on the other side of the spectrum, said source providing a beam of light of a narrow band of wave lengths sharply peaked at substantially 577-579 $m\mu$ so as to be strongly affected by hemoglobin, a second beam of light having wave lengths in between 550 $m\mu$ and 630 $m\mu$ and dispersed so that their range is sufficiently extended in relation to wave lengths 577-579 $m\mu$ so as to be relatively little affected by hemoglobin, a filter in said second beam proportioned to transmit a pattern of light wave lengths whose total intensity is approximately proportional, though not necessarily equal, to that of the narrow band of peaked light for various degrees of transmission thru various blood-free eggs, a phototube alternately receiving light from the two said beams after they pass thru the same egg, a variable dimmer for equalizing the effect of said beams on the phototube when they have passed thru an egg that is free from blood, a two sided alternating switch having one side operatively connected to the phototube when one of said beams falls upon it and having the other side operatively connected to the phototube when the other of said beams falls upon it so that the alternate voltages created by the energization of the phototube by the alternate light beams thru a blood-free egg are balanced out and no effective voltage difference is delivered beyond said balanced circuit, a relay connected to said balanced circuit operative when said circuit is in a state of unbalance, a conveyor for receiving an egg and from which the egg is capable of being rejected, and a rejector operated by said relay to distinguish an egg containing blood from a blood-free egg, said relay and rejector mechanism being energized by a lack of balance in said balancing circuit produced by the absorption of light in the narrow first mentioned beam by hemoglobin in the egg.

3. In an automatic egg candler for bloods, the combination of a source of mercury light having wave lengths at 577-579 $m\mu$ and including a filter cutting out the mercury wave lengths at 546 $m\mu$ and the green-blue light waves on the one side of the spectrum and the red-orange light waves on the other side of the spectrum, said source providing a beam of light of a narrow band of wave lengths sharply peaked at substantially 577-579 $m\mu$ so as to be strongly affected by hemoglobin, a second beam of neon light having wave lengths in between 550 $m\mu$ and 630 $m\mu$ and dispersed so that their range is sufficiently extended in relation to the wave lengths 577-579 $m\mu$ so as to be relatively little affected by hemoglobin, a filter in said second beam proportioned to transmit a pattern of light wave lengths whose total intensity is approximately proportional, though not necessarily equal, to that

of the narrow band of peaked light for various degrees of transmission thru various blood-free eggs, a phototube alternately receiving light from the two said beams after they pass thru the same egg, a variable dimmer for equalizing the effect of said beams on the phototube when they have passed an egg that is free from blood, a two sided alternating switch having one side operatively connected to the phototube when one of said beams falls upon it and having the other side operatively connected to the phototube when the other of said beams falls upon it so that the alternate voltages created by the energization of the phototube by the alternate light beams thru a blood-free egg are balanced out and no effective voltage difference is delivered beyond said balanced circuit, a relay connected to said balanced circuit operative when said circuit is in a state of unbalance, a conveyor for receiving an egg and from which the egg is capable of being rejected, and a rejector operated by said relay to distinguish an egg containing blood from a blood-free egg, said relay and rejector mechanism being energized by a lack of balance in said balancing circuit produced by the absorption of light in the narrow first mentioned beam by hemoglobin in the egg.

4. In an automatic egg candler for bloods, the combination of a source of yellow light having wave lengths between 575-585 $m\mu$ and including a filter cutting out the green-blue light waves on the one side of the spectrum and the red-orange light waves on the other side of the spectrum, said source providing a beam of light of a narrow band of wave lengths sharply peaked at substantially 577-579 $m\mu$ so as to be strongly affected by hemoglobin, a second beam of light having wave lengths in between 550 $m\mu$ and 630 $m\mu$ and dispersed so that their range is sufficiently extended in relation to wave lengths 577-579 $m\mu$ so as to be relatively little affected by hemoglobin, a filter in said second beam proportioned to transmit a pattern of light wave lengths whose total intensity is approximately proportional, though not necessarily equal, to that of the narrow band to peaked light for various degrees of transmission thru various blood-free eggs, a phototube alternately receiving light from the two said beams after they pass thru the same egg, a variable dimmer for equalizing the effect of said beams on the phototube when they have passed thru an egg that is free from blood, a two sided alternating switch having one side operatively connected to the phototube when one of said beams falls upon it and having the other side operatively connected to the phototube when the other of said beams falls upon it so that the alternate voltages created by the energization of the phototube by the alternate light beams thru a blood-free egg are balanced out and no effective voltage difference is delivered beyond said balanced circuit, a continuously moving conveyor for eggs exposing each egg to repeated successive alternations of the beams, a relay connected to said balanced circuit operative when said circuit is in a state of unbalance, and a rejector operated by said relay to distinguish an

egg containing blood from a blood-free egg, said relay and rejector mechanism being energized by a lack of balance in said balancing circuit produced by the absorption of light in the narrow first mentioned beam by hemoglobin in the egg.

5. In an automatic egg candler for bloods, the combination of a source of mercury light having wave lengths at 577-579 $m\mu$ and including a filter cutting out the mercury wave lengths at 546 $m\mu$ and the green-blue light waves on the one side of the spectrum and the red-orange light waves on the other side of the spectrum, said source providing a beam of light of a narrow band of wave lengths sharply peaked at substantially 577-579 $m\mu$ so as to be strongly affected by hemoglobin, a second beam of light having wave lengths in between 550 $m\mu$ and 630 $m\mu$ and dispersed so that their range is sufficiently extended in relation to wave lengths 577-579 $m\mu$ so as to be relatively little affected by hemoglobin, a filter in said second beam proportioned to transmit a pattern of light wave lengths whose total intensity is approximately proportional, though not necessarily equal, to that of the narrow band of peaked light for various degrees of transmission thru various blood-free eggs, a phototube alternately receiving light from the two said beams after they pass thru the same egg, a variable dimmer for equalizing the effect of said beams on the phototube when they have passed thru an egg that is free from blood, a two sided alternating switch having one side operatively connected to the phototube when one of said beams falls upon it and having the other side operatively connected to the phototube when the other of said beams falls upon it so that the alternate voltages created by the energization of the phototube by the alternate light beams thru a blood-free egg are balanced out and no effective voltage difference is delivered beyond said balanced circuit, a continuously moving conveyor for eggs exposing each egg to repeated successive alternations of the beams, a relay connected to said balanced circuit operative when said circuit is in a state of unbalance, and a rejector operated by said relay to distinguish an egg containing blood from a blood-free egg, said relay and rejector mechanism being energized by a lack of balance in said balancing circuit produced by the absorption of light in the narrow first mentioned beam by hemoglobin in the egg.

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