

Nov. 3, 1959

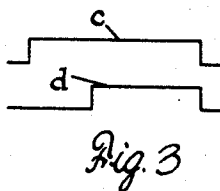
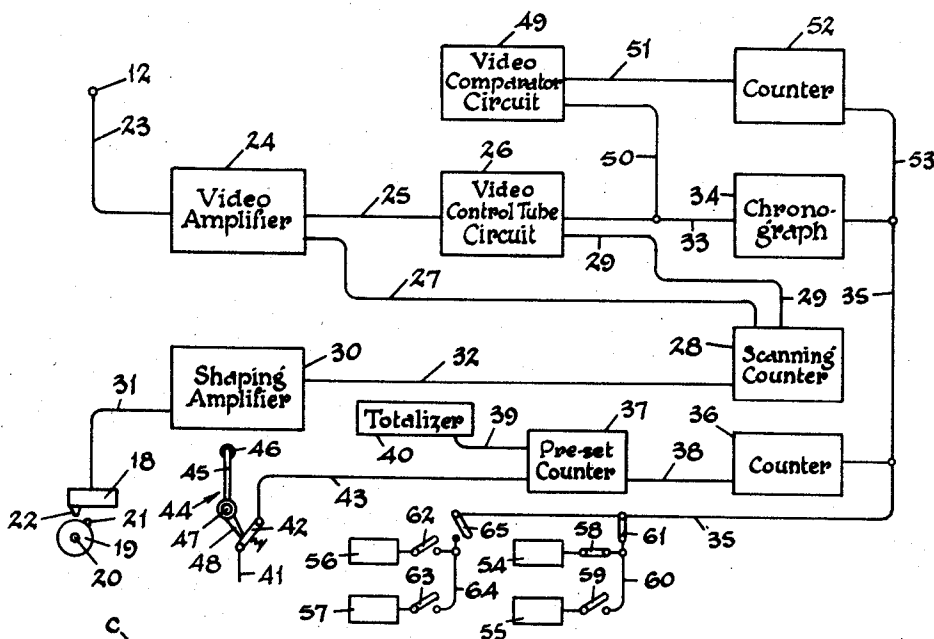
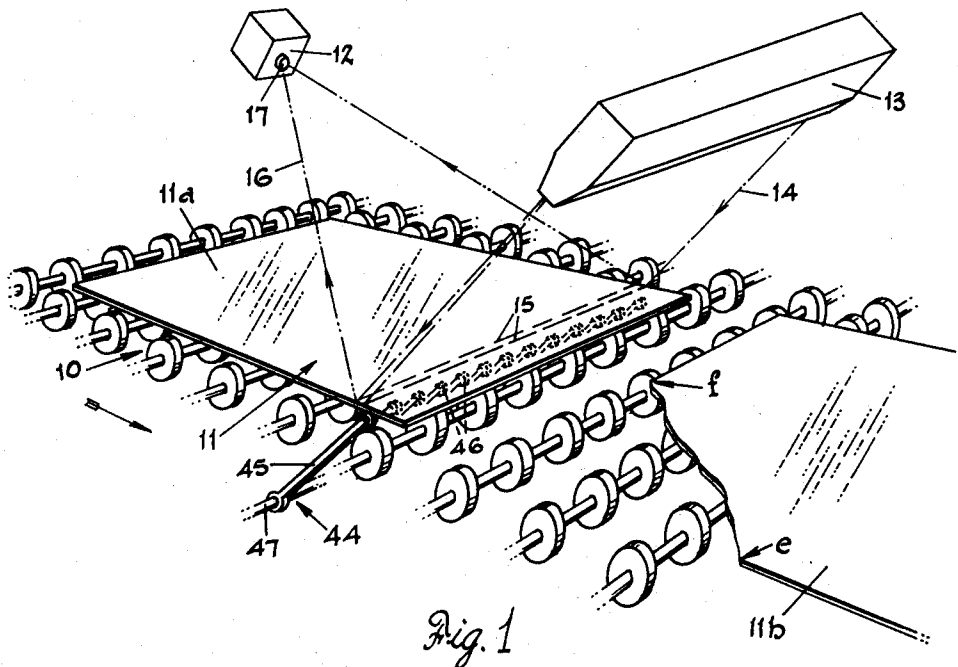
R. W. MEYER, JR

2,910,908

ELECTRO-OPTICAL COMPUTING DEVICE FOR SURFACE AREAS

Filed May 27, 1955

2 Sheets-Sheet 1



INVENTOR.
Richard W. Meyer, Jr.
BY
Nobbe & Europe
ATTORNEYS

Nov. 3, 1959

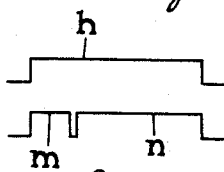
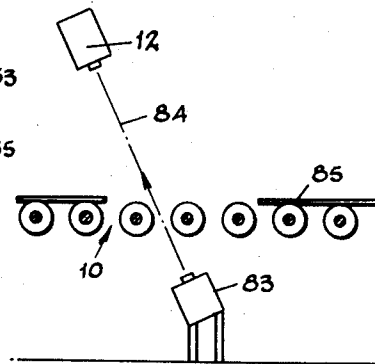
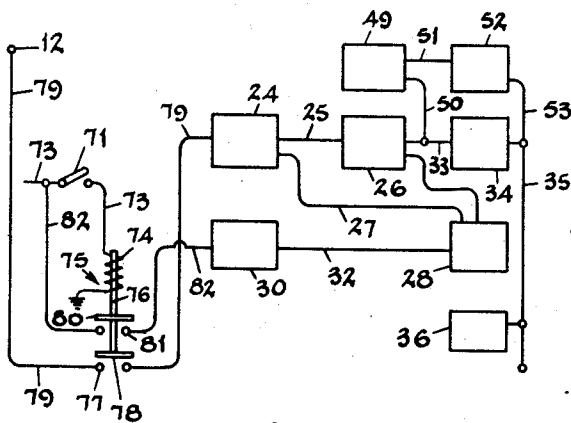
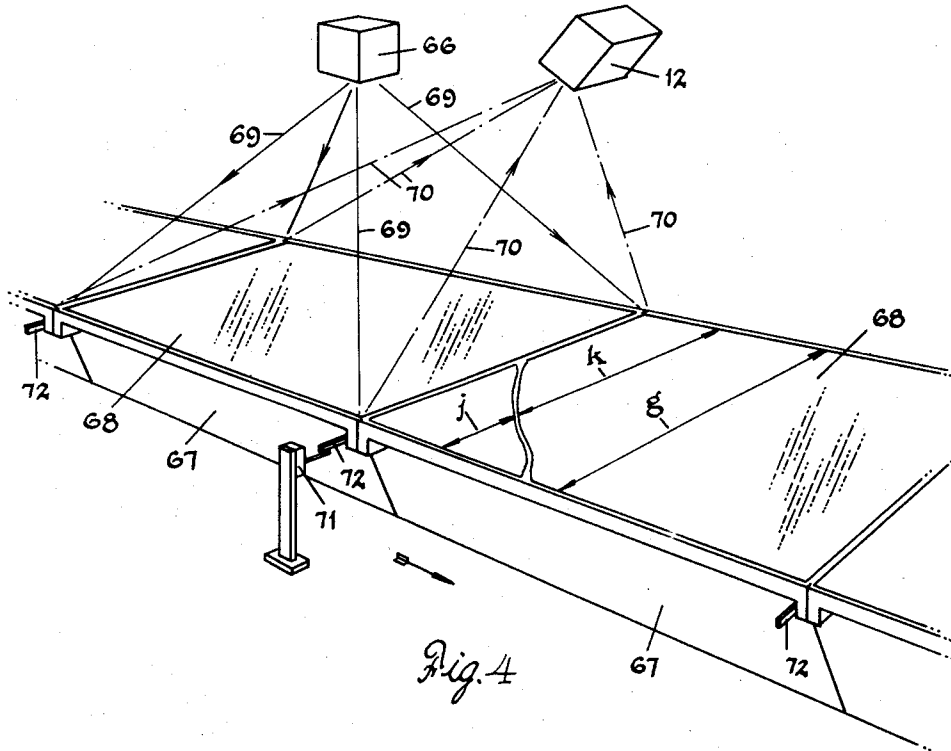
R. W. MEYER, JR

2,910,908

ELECTRO-OPTICAL COMPUTING DEVICE FOR SURFACE AREAS

Filed May 27, 1955

2 Sheets-Sheet 2



INVENTOR.
Richard W. Meyer, Jr.
 BY *Nobbe & Swope*
 ATTORNEYS

1

2,910,908

ELECTRO-OPTICAL COMPUTING DEVICE FOR SURFACE AREAS

Richard W. Meyer, Jr., Toledo, Ohio, assignor to Libbey-Owens-Ford Glass Company, Toledo, Ohio, a corporation of Ohio

Application May 27, 1955, Serial No. 511,734

12 Claims. (Cl. 88—14)

The present invention relates broadly to the computing of surface areas and more particularly to an improved apparatus for determining the surface area of sheet materials.

It will be at once recognized that the totaling in square footage of finished sheet materials is an essential part of most production operations wherein one or both surfaces of such materials have been worked upon. Also where individual pieces of sheet material are of a substantially similar surface area, the recording of information, such as the gross or total square footage, can be readily obtained by the number of sheets processed. This, however, requires the constant attention of one or more operators who "book" the number of sheets passing through an initial and/or final station. In this manner, an original record can be compared with the final record and any interim loss quickly evaluated.

The loss factor, as for example in the case of sheet glass, imposes a slightly different problem since only a portion of a sheet may be damaged, such as a corner that is broken off. This creates an irregularly shaped remaining area at one or sometimes both ends of the sheet and, unless figured out with conventional measuring devices, the surface area remaining in such sheets can only be roughly estimated. This is especially true in the finishing of sheets of plate glass, which before becoming commercially acceptable optically, must be ground and polished.

Thus where the number of plate glass blanks is recorded at the beginning of the grinding and polishing operations, the original surface area of each blank, or the running total of a plurality, in square feet can be obtained. However, during and between production operations such as in the case of grinding, polishing and handling of the glass blanks and due to normally expected occurrence, there usually is a breakage loss that will reduce the square footage of glass sheets having a required width for ultimate use. In other words, the final totalled square footage of glass will be a summation of finished sheets having full areas defined at least by a required width and other or "broken" sheets having in part a required width and other areas of lesser or random and irregular width. Such surface areas of lesser width, are of course, in most cases usable for sheets of smaller dimension but, during the steady flow of a production line, it has been found to be practically impossible to accurately compute the square footage of these areas with the result that the actual output or gross square footage of glass having an acceptable width cannot be readily obtained.

By means of the improved method and apparatus of this invention, as hereinafter described, the square footage of sheets, moving along a production line, is continuously and automatically obtained and computed into permanent records of the total output. And the procurement of such a record is made without physical or mechanical contact of the computing device with the material. Also by simultaneously recording the square

2

footage having a lesser or irregular width, the amount of surface areas of glass sheets having a standard width can be determined from the total square footage.

It is therefore the prime object of this invention to provide an improved apparatus for obtaining the surface area of sheet materials.

Another object of the invention is to provide an improved apparatus for scanning the surface of sheets of material to obtain the area thereof and then recording the square footage to indicate simultaneously the differential between full sized sheets and sheets of lesser size caused by breakage.

Another object of the invention is to provide an improved apparatus for obtaining the square footage area of a sheet of material, recording such footages in an accumulative total and simultaneously making a secondary record of the square footage of a sheet of lesser area than a full sized sheet whereby a differential in the totalled record of square footage can be established to determine the actual amount of sheet area having a nominal width.

Another object of the invention is to provide an improved apparatus for scanning the surface of a sheet of material such as glass, plastic or the like and automatically computing the square footage contained within the area of such a surface.

Another object of the invention is to provide an improved apparatus for scanning the surface areas of sheet materials passing therebeneath, automatically computing such surface areas into units of square feet and then adding the same in an accumulatively recorded total.

Another object of the invention is to provide in apparatus of the above character means for controlling the operation of the apparatus according to the rate of movement of the sheets moving therebeneath.

Another object of the invention is to provide in apparatus of the above character a scanning instrument adapted to transmit a definite signal to a computing device according to a standard width of sheet and in timed relation to a sheet passing therebeneath, said signals being thereby converted to indicate a unit of square footage of surface area.

A further object of the invention is to provide in an apparatus of the above character means for automatically and continuously scanning the surface of a moving sheet having a known width to obtain the square footage area thereof, and means interconnected therewith for separately obtaining the footage areas of sheets or portions of such sheets having a lesser width whereby the differential of actual square footage of sheet materials having a known width can be determined from the automatically recorded total of the entire square footage.

A still further object of the invention is to provide in an apparatus of the above character means for automatically scanning the surface area of a moving sheet having a known width to substantially instantaneously obtain the total square footage thereof, means being provided for transmitting a variable signal from the scanning device to a computing means whereby the said total square footage of each sheet will be added to an accumulative record of such square footages.

Other objects and advantages of the invention will become more apparent during the course of the following description when read in connection with the accompanying drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the same:

Fig. 1 is a perspective view of a production line conveyor for sheet materials and of a computing device, constructed in accordance with this invention;

Fig. 2 is a schematic view of an electrical system by means of which the computing device operates;

3

Fig. 3 is a diagrammatic view illustrating the length of signals for a required width of sheet and also for a sheet having a broken portion;

Fig. 4 is a perspective view of a line of work tables and of sheet materials supported thereon and wherein the computing device is operated according to a second embodiment of the invention;

Fig. 5 is a schematic view of an electrical system by means of which a computing device is operated by the apparatus shown in Fig. 3;

Fig. 6 is a diagrammatic view illustrating a difference of length of signals; and

Fig. 7 is a perspective view of a conveyor and the arrangement of the computing device when operated according to a third embodiment of the invention.

This invention, in its several embodiments, utilizes an electronic scanning device to operate in response to light images received therein. Thus it is contemplated to direct a ray of light into the path of conveyed materials and, where the surface of the materials is adapted to reflect the light image, cause the scanning device, such as a television camera, to become activated when the reflected light ray is received or "picked up." The camera therefore will transmit video signals when the light ray is intercepted, so as to be reflected, but will not transmit like signals when the rays are not reflected thereunto. Thus when the camera is continuously functioning, the repeated transmission of electronic signals or impulses will denote the presence of a sheet of material in the light ray while the absence of these signals will indicate an open spacing between the sheets or the presence of a sheet having portions broken therefrom.

According to one aspect of the invention, transparent or opaque materials that will reflect light may therefore be automatically and continuously scanned and the originated signals converted into a recordable unit which can be read as the square footage of a sheet of material. These signals may be reproduced at regularly spaced intervals so that groups of units can be taken as representative of a desired area and accumulatively recorded. On the other hand, the distinction of an illuminated area on or over a full surface in contrast to non-reflecting areas bounding such a surface can be taken as a "full" count of a sheet of material and the total square footage thereof instantaneously obtained. Still further, this invention contemplates the use of such scanning devices to obtain the square footage of materials that do not readily reflect light or can be more readily scanned by causing the material to completely obscure a light ray. Since the scanning is carried out by absence of light, the presence of a light ray will denote the lack of sheet materials being moved in the path of the ray or the presence of sheet having a portion broken therefrom. In each event, the single line scan or a full raster count of a camera may be interpreted as a full width or full area of a sheet whereas a lesser raster count will indicate a lesser width or area of a sheet and these differentials can be recorded to indicate a predetermined total of square footage or a diminishment therefrom.

Referring now particularly to Fig. 1 of the drawing wherein the first and preferred embodiment of my invention is illustrated, there is shown a conventional form of roller conveyor 10 on which are carried a series of sheets 11 of glass, plastic or like light-reflecting materials. As herein disclosed, the sheets 11 are of glass and preferably of finished plate glass. That is to say—as viewed in Fig. 1, it may be assumed that the sheets of glass 11 have been ground and polished on both of their surfaces, washed and are presently being conveyed to a storage area.

Now, when the sheets are bedded in plaster on the tables of the grinding and polishing line, they are more or less uniform in size and will have substantially the same surface area as defined by their length and width as shown by the sheet 11a. Naturally for some subse-

4

quent operations or uses, the width of the finished sheets becomes of greater concern than the length since smaller sheets may ultimately be obtained in standard lengths (the original width of sheet) when the said sheet is scored or cut transversely to its blank size length. A sheet may thus be scored transversely to obtain a number of smaller size sheets, each of which will contain a surface area or square footage equal to that of a similar size of sheet. And, in estimating a square footage for production requirements, it should be ordinarily assumed that such estimates could be procured from the square footage of glass initially laid on the tables at the start of the grinding operation.

However, it is also reasonable to assume that, in the grinding, polishing handling and storage and due to normally expected occurrences, some of the glass blanks, originally having a somewhat standard surface area, will become broken and not have a common width throughout their length. Thus as shown by the sheet 11b a corner area has been accidentally broken therefrom and, while the remaining area is usable, there is a loss of glass for some subsequent purposes. Obviously this immediate end portion of the sheet is irregular in area and, during its continuous movement, the actual dimensions thereof are extremely difficult to accurately obtain.

According to this embodiment of the invention, a beam of light is directed angularly downward onto the glass surface to produce a narrow image or light band thereon, and the reflected beam is picked up by means of a scanning device 12 such as a conventional television camera. It is therefore preferable that the apertured end of a lamp box 13 be covered by a translucent glass plate to provide a light beam of uniform intensity and have an opening adapted to direct a very narrow transverse beam of light, as indicated at 14, toward the path of and onto the surface of the sheet 11.

The beam of light 14 is usually longer than the width of a sheet moving therethrough so that the intercepted portion of the beam will illuminate the entire width of the sheet in transverse relation to the sheet's direction of motion. This will produce a narrow light image or band 15 on the sheet surface and the rays therefrom, as indicated at 16, will continuously be reflected from the leading to the following end of the sheet to set up a reflected ray having an expanse equal to the width of the sheet in the area then illuminated.

The reflected rays from the light image or band 15 will be directed angularly upward as indicated at 16 toward the lens 17 of the camera 12. In actual practice, it has been found advantageous to mount the camera at an elevation of substantially nine feet above the surface of the glass sheet or the plane of the conveyor rollers and to angularly position the same in a plane normal to the plane of the glass sheets along the longitudinal center line and so as to fully receive the rays 16 reflected from the light band 15.

The operating circuit of the television camera is regulated to produce or "send out" an output of video signals or impulses in a transmission pattern that is established by a predetermined width of sheet material being worked upon. This transmission pattern, as will be more fully hereinafter described in detail, and through suitably connected circuits, is relayed to a computing or totaling device whereby the conversion of a series of signal patterns periodically spaced from one another can be interpreted as a unit of area of the sheet. When the width of a sheet varies, as from breakage, the transmitted impulses will, by the totaling device, indicate a lesser amount of surface area and consequently a decrease in width from that basically determined.

Stated otherwise, a "single line" scan of the television camera in a substantially horizontal plane and transversely to the direction of movement of the sheet of material causes a series of impulses to be originated. Since the camera functions to line scan the light beam

5

15 of the moving sheet continuously, each series of impulses and/or the number thereof will be dependent on the width of the sheet. Now if the impulse series are recorded at periodic intervals, the spaced interim can be considered a longitudinally spaced area of the sheet. This then, for a predetermined width of sheet and regularly spaced intervals of function can be converted to indicate a unit of surface area or the square feet therein. And any variance of sheet width will be indicated by fewer number of square feet.

In order to produce regularly spaced intervals of video signal transmission, a tachometer 18, as shown in Fig. 2, is provided which is adapted to function at regularly spaced intervals of time. For example, such a device may be regulated to operate thirty times per second of time and thus activate the associated circuits of the television system at such regularly spaced intervals. Simply illustrated, the tachometer 18 may be actuated by means of a cam 19 that is mounted on a shaft 20 suitably geared to a shaft of the conveyor 10 to produce a cooperating ratio of 30:1. The cam 19 as herein shown has a lug 21 adapted to engage the conventionally shown arm 22 of the tachometer. Accordingly, for each complete revolution of a shaft of the conveyor, the cam 19 will cause the tachometer 18 to function thirty times and at intervals that are spaced to agree with substantially 400 thousandths of an inch lineal movement of the material on the conveyor. Thus, at regularly occurring intervals, the pulses or signals originating in the camera 12 will be transmitted to a totaling device.

In the event that the line speed of the conveyor 10 is in the order of fifty feet per minute, the control exerted by the tachometer 18 will become repeatedly effective a like multiple of times to activate the transmission of the electronic pulsations from the camera to the totaling device. Likewise, if the conveyor is operated at a slower or faster rate of speed, the tachometer will be operated either in a slower or more rapid manner. Thus, by way of example, if a standard of six feet is predetermined as a desired width of glass sheet, the series of video signals or pulsations of the television camera 12, which during a single line scan are induced by the reflected image ray 16 of the light band 15 on the glass surface, may be regulated to agree with such a width or to a defined number of pulsations in relation to a light band reflected from a sheet six feet in width. Now, when the tachometer is operated by the cam lug 21 and thirty times for each complete revolution of a conveyor shaft, these pulsations will be transmitted to the totaling device in spaced series that individually occur at substantially regularly spaced distances of 400 thousandths of an inch.

Referring now more particularly to Fig. 2, the television camera 12, containing its own deflection circuit, will be seen as connected by a line 23 to the circuit of a conventional video amplifying apparatus 24 for transmission of video signals or electronic pulsations thereto. In turn, the video amplifier 24 is connected by line 25 to a video control tube circuit generally designated 26, and by a line 27 to a second circuit generally described as a scanning counter 28. The counter 28 is connected by line 29 to the monitor control side of the video control tube circuit 26.

Thus the reflected ray 16 of the light image 15 will cause video signals to be put out by the camera 12 and transmitted by line 23 to the video amplifier 24 as video signals. These are further carried through line 25 to the tube circuit 26. Also through line 27, the video amplifier 24 sets up a series of secondary pulsations which are received by the scanning counter 28 and generally termed "scan" signals. The scan signals serve to activate the circuit of the scanning counter, dependent however upon an interlocking control which initiates functioning of this counter at regularly spaced intervals of time. The scanning counter 28 is therefore inactive, while receiving the scan signals by line 27, until it is

6

activated in response to a shaping amplifier 30, the circuit of which is controlled in function by the tachometer 18.

The shaping amplifier 30 is connected by line 31 to tachometer 18 and the activity of its functioning is carried to the scanning counter 28 by line 32. By reason of this circuited arrangement, if the conveyor line 10 is halted while a sheet of glass 11 is located so as to carry the image of light rays 14 as a transversely disposed band 15, the reflected image, indicated by lines 16, will be picked up by the camera 12 and the signals created thereby transmitted to the video amplifier 24 which, by line 25, transmits the video signal side to the video control tube circuit 26 and by line 27, the secondary or scan signal side to the scanning counter 28. However, since the tachometer 18 is not operated by the lug 21, the shaping amplifier 30 will not function to periodically activate the scanning counter 28 and consequently this counter will not influence the monitor side of the tube circuit 26 through line 29. Also, in the event that there is no glass on the conveyor, or during the interval between sheets being carried thereon, the tachometer 18 will be operated in timed relation to the lineal speed of the conveyor but, since the light rays 14 will not be intercepted by a glass surface, there will be no activity of the camera 12. Therefore, the normal functioning of the scanning counter 28, as induced by the shaping amplifier 30 by line 32, will accordingly be rendered ineffectual to activate the monitor side of the tube circuit 26 through line 29 by reason of the fact that there will be no scan signals transmitted from the video amplifier 24 by line 27 to the counter 28.

However, with the conveyor 10 operating at a desired speed and with glass sheets carried thereon sequentially reflecting the light image 15 to the camera 12, the coordinated efforts of the video amplifier 24 and shaping amplifier 30 will activate the scanning counter 28 to close a service line 29 to the monitor side of the tube circuit 26. The output side of this circuit is connected by line 33 to the circuit of a so-called "output counter" chronograph or computer 34. The chronograph, when active, converts the signals from the tube circuit 26 into a regulated number of impulses which are then transmitted by line 35 to the output indicator or counter 36 which registers a unit, such as one hundred, on one scale and then automatically transfers the record of one unit to a gross or totaling scale. Thus, a sheet of glass which, for example, measures six feet in width and twelve feet in length will continuously carry a light image 15 for twelve feet while passing through the beam of light 14 emanating from the lamp box 13. In being so conveyed, the lineal movement of the sheet will be in timed relation to rotation of the cam 19. The lug 21 of the cam by engaging the arm 22 of tachometer 18 will, through the above described circuit, activate the counter 28. This will complete the circuit through line 29 a like number of times so that the responding activity of the video control tube circuit 26 will cause the chronograph 34 to function sequentially and rapidly operate the counter 36 to denote a total of seventy-two. This count of, for example, seventy-two can thus be read as the square footage area of one full glass sheet; however, for the purpose as herein set forth, such individual counts are not segregated but as mentioned above, are accumulated in units as of one hundred and then registered in the gross or total of already recorded units or square feet.

For simplicity of description, the camera 12 may be regulated to transmit a series of forty-five signals or pulsations when the camera receives the reflection of a light image 15 six feet long. This will produce a series of signals, or a wave band having a theoretical length as shown at c in Fig. 3. Obviously when the light image 15 is less than six feet in length, a lesser number of signals will be originated. This will occur when a sheet, such as is indicated at 11b, passes through the band of light

image to cause reflection toward the camera 12. As shown by way of example, a broken area or corner may start at one side, for example, nine feet from the leading edge and end at the following edge three feet from the opposite side of the sheet. In this event, the length of the light image 15 will progressively diminish and the camera 12 will be caused to put out a proportionately lesser number of signals from or up to the arbitrarily mentioned forty-five.

That is to say—if the leading end of a glass sheet has been broken, the length of the light image will be materially shorter than the full width of the sheet and will gradually and irregularly proceed transversely across the sheet until the full width of sheet or full length of the light image is obtained. This will cause the output of a wave band or so-called "gate" as shown at *d* in Fig. 3 upon each operation of tachometer 18. On the other hand, if the broken section occurs in the following or rear area of the sheet, the length of the light image will probably diminish as is determined by the line of the break until it terminates at the end margin of the sheet. Thus, as shown in Fig. 1 for purposes of illustration in connection with sheet 11*b*, the full length of light image 15 as indicated at *e* will thus diminish gradually until the end of the sheet at *f* is reached and consequently the number or length of the series of signals during each line scan will correspondingly be reduced.

The series of pulsations at *e* will therefore be the equivalent of the so-called "gate" shown at *c* in Fig. 3 while the pulsations created between said point *e* and to the end edge *f* will be substantially a variation from or equivalent to the wave band or gate shown at *d* in the same figure. Thus for the leading unbroken area of the sheet fifty-four units or square feet will be counted (9×6) and the square footage of the remaining area bounded by a side length of three feet, an end length of three feet at *f*, a limit line defined by the band 15 at *e* and the irregular edge produced by the break will be counted by the lengths of the image at each interval of camera transmission. The square footage of this area, which cannot be otherwise computed rapidly while the glass sheet is moving at a described rate of fifty feet per minute, is therefore and nevertheless received and carried by the transmitted signals to the counter 36 and therein recorded.

Interconnected with the counter 36, there is an auxiliary counter 37 which counts the loss, if any exists, in any individual blank. This counter which is of the "pre-set" variety is adjusted to read the total units or square footage of the average blank. Thus when the average is established as seventy-two square feet (6×12), the counter 37 will respond with the functioning of counter 36 and then automatically return to a zero count. However, in the event that a lesser count than seventy-two is received in the counter 36, as for example, sixty-five, the counter 37 will subsequently be activated to increase its total of sixty-five to seventy-two. In other words, there will be a difference of seven units. For this purpose, the pre-set counter 37 is connected by line 38 to the totaling counter 36. Connected by line 39 to counter 37 is a totalizer 40.

The counter 37 is actuated by an "enabling" circuit that is connected to a suitable power source line 41 and controlled through a micro-limit switch 42. As shown in Fig. 2, the switch 42 is connected by line 43 to counter 37 and is actuated by a lever arrangement 44. Referring to Fig. 1, the lever 44 may comprise a series of supporting arms 45 that carry rollers 46 and are mounted on a ball-bearing journaled shaft 47. Preferably the arms 45 and rollers 46 are arranged along the shaft 47 at regularly spaced intervals in order that several of the rollers, or the entire number thereof, will be engaged by the leading edge of a glass blank whether it is of full width or of a shorter width as produced by breakage. Also carried on shaft 47 is a switch-actuating arm 48.

The roller supporting arms 45 are thus disposed in the path of the blanks 11 on the conveyor 10 and so that

the rollers 46 thereon will be engaged by the leading edge of said blank and so as to maintain rolling contact with the lower surface. The plurality of arms will accordingly be depressed. This action swings the shaft 47 and operates to remove the arm 48 from engagement with the switch 42 so as to open the same. Then, as a blank 11 is carried from contact with the rollers 46, the shaft 47 will be swung so that arm 48 actuates the switch to close a circuit between lines 41 and 43 to the pre-set counter 37.

Thus, when the rays 14 are intercepted by a blank 11, the reflecting rays 16 from the light image 15 will be received by the camera 12. As hereinbefore set forth, the video signals from the camera are received in the totaling counter 36 and pre-set counter 37. In the event of a full-size blank, the reflecting rays 16 will cease at the following edge at which time the counter 36 will record a total of seventy-two units or square feet while the counter 37 will return to a zero setting. However, should the blank have an area broken therefrom, the counter 36 will record the total of, as for example, sixty-five units, which of course is also recorded in the counter 37. Now when the switch 42 is again closed, the counter will be activated to function sufficiently to increase this total to the presetting of seventy-two before returning to zero. During this functioning the difference of seven units is recorded in the totalizer 40 which is connected to the counter 37. Since the differential of seven units indicates a loss from the average of seventy-two units or square feet, the grossed reading on the totalizer 40 may be taken as the actual loss of glass from any gross record previously entered during a continuous line-production operation.

In order to obtain the square footage of salvage glass remaining in a blank that has been damaged by breakage, a video pulse comparator circuit 49 is connected by line 50 to line 33 between the tube circuit 26 and the output counter chronograph 34. The comparator circuit 49 is regulated to respond to any lesser number of pulses or signals than the standard or full count of forty-five originating in the circuit 26 and to impart its activity by line 51 to the output indicator or counter 52. This output indicator or counter is connected by line 53 to line 35 from the output chronograph 34 to receive output signals therefrom. However, functioning of the counter 52 is controlled by the comparator circuit 49 which, as above said, is regulated to function only during the continuous output of fewer signals than forty-five. This auxiliary operation will record in units, denoting square feet, all areas of glass sheets that have a lesser width than any required width, such as six feet. Referring to Fig. 3, the series of pulsations created by the full band as at *c* and the shortened band at *d* will be received by the counter 36 while only those created by the band *d* will be received by the indicator 52.

At the end of any production time period as of an eight hour shift, the accumulative total of counting indicator 52 may be subtracted from the entire gross or total as recorded by the counter 36 and the result remaining will be the square footage of glass having a nominal width of six feet. Consequently, the output of a day's production can be obtained in a continuous and automatic manner without the attendance of operators who ordinarily have been required to record the number of full-sized finished sheets of plate glass and to estimate the remaining areas of sheets that have portions broken therefrom. The counter 36 may include, if desired, a so-called "memory" device in the form of a tape-printing instrument. Such devices are commonly known to record a numeral total as well as the hour and date of such information.

As a further advantage, the invention contemplates the division of the accumulative gross, as recorded by segregated totals which may be obtained to distinguish the types of glass that have been ground and polished. Since modern glass production not only requires the use

of clear or regular soda-lime-silica glass, but many other varieties such as those known to be sun-glare reducing, it is highly desirable to take from any entire total those totals of square footage of glass sheet having a different variety of composition. It may, as well, be of production interest to obtain the total square footage of finished glass from the melt of one or more particular furnace tanks. Such totals need not necessarily be subtracted from the entire or grossed total but merely recorded as individual and selected portions thereof.

For this purpose, a plurality of indicators or counters 54, 55, 56 and 57 are connected in the circuit of line 35. Preferably the indicators 54 and 55 are connected by individual switches 58 and 59 to line 60 which in turn is connected to line 35 through switch 61. Likewise indicators 56 and 57 are connected by individual switches 62 and 63 to line 64 and therethrough by switch 65 to line 35. Thus, as shown in Fig. 2, the circuit to indicators 56 and 57 will be open at switch 65 while the circuit to indicator 54 through switch 58, line 60 and switch 61 will be closed but the line 60 to indicator 55 will be open at switch 59. Obviously either of the indicators 54-55 or 56-57 in pairs may be employed to denote one particular furnace output while individually, they may denote the glass of one special composition from the furnace. An operator can thus establish a controlled condition of the switches 61-65 and the switches 58-59 and 62-63 according to production information and by this means obtain an accurate record of a particular glass while it is simultaneously being entered as a part of the entire total on indicator 34 or the total of areas remaining after breakage or being recorded on the indicator 52.

According to the second embodiment of my invention as shown in Figs. 4, 5 and 6, the system hereinbefore described may be employed to equally good advantage for obtaining the total square footage of a sheet of material, such as glass or the like, in a substantially instantaneous manner. Such a procedure may be carried out either while sheets are carried by a conveyor, or in case of plate glass blanks while they are still bedded on a grinding table as shown in Fig. 4. In fact, by obtaining the square footage of glass upon completion of the first and/or second grinding and polishing operations, it will be possible to gain a more exact estimate of the final gross of glass that can be further processed.

For this purpose, a lamp-box 66, as shown in Fig. 4, is mounted above the line of grinding tables 67 at a point immediately following the last polishing unit. Preferably the lamp-box is equipped to illuminate the entire area of a blank 68 as by a light beam indicated by lines 69. The camera 12 is now regulated to scan the full blank or in other words, upon receiving the reflected rays 70 from the glass surface, take a full raster count of the blank on one table.

By way of example, the camera may be actuated by a micro-limit switch 71 to cause the instantaneous transmission of video signals to the video amplifier 24. One manner in which this may be carried out, although this is not to be understood as restrictive of other and equivalent controls, is illustrated in Figs. 4 and 5 wherein it will be seen that the switch 71 is mounted adjacent the path of the grinding tables 67 and so as to be periodically engaged by a suitable trigger 72 carried by each table and as the same passes thereby. The switch is adapted to momentarily energize a solenoid relay switch which sets up a circuit from the camera 12 for the transmission of video signals to the video amplifier 24 and a secondary or scan signal circuit to activate the scanning counter 28.

Thus, as illustrated in Fig. 5, the switch 71 is located in a supply line 73 to the coil 74 of the relay switch 75. When energized by momentary closure of switch 71, the coil 74 moves armature 76 to engage contacts 77 and 78 thereby completing a line circuit 79 from the

camera 12 to the video amplifier 24 for the transmission of video signals or impulses. By engagement of contacts 80 and 81, a service line 82 is completed to the shaping amplifier 30. Now by line 32, the amplifier 30 will excite the scanning counter 28 simultaneously with the transmission of the secondary signals from amplifier 24 by line 27. As previously set forth, this will cause the control tube circuit 26 to transmit the necessary impulses by line 33 to the chronograph 34.

Of course, where a full count is taken or the entire surface area of a blank is instantaneously scanned, the chronograph 34 responds to the total of pulsations and by line 35 transmits this information to the counter 36 to register the count of the full square footage of the blank. When the blanks have a dimensional size of six by twelve feet, the indicator will then count or register an increase of seventy-two units to the accumulating gross or total therein recorded.

Normally, where glass breakage occurs in the grinding and polishing line, an endeavor is rapidly made to fill any and all cracks with additional plaster of Paris in order that the subsequently employed felt covered polishing runners will not be damaged by the ragged edges of the irregularly extending crack or break lines. These filled cracks and even some larger areas exhibit a surface having very low reflectivity in contrast to the glass surface. Across the area of the broken section, the continuity of the component scan lines in the full raster count will be interrupted by such low reflecting areas and consequently each scan line will be of several materially shorter series of pulses. These, however, are for each scan line grouped according to the length of the images of light reflecting from the glass. Thus, the operation of the camera 12 is normal while transmitting the reception of a continuous scan line as indicated at *g* and the consequent wave band or gate will be representative of that shown at *h* in Fig. 6. Where a break or crack occurs, the camera will send forth a number of pulses that will agree in continuity with scan lines having variable component lengths as indicated at *j* and *k* in the broken area and as indicated by the wave bands *m* and *n* having a break therebetween as in Fig. 6. Thus while a full scan will be carried out, the interruption of any scan line into a shorter series of pulsations from the camera 12 will produce concurrent operation of the output chronograph 34 and comparator circuit 49 in the manner previously set forth above. The differential between the gross square footage and the total square footage of broken areas will thus be counted on the respective counting and recording indicators 36 and 52 so that a balance can be established and the amount of glass having a required width readily obtained.

Obviously by the substitution of other suitable controls for the switch 71, the full scanning of the blanks or finished sheets of glass can be carried out at any point of their manufacture.

With reference now to Fig. 7, a further embodiment of my invention contemplates the employment of a scanning system as shown in Fig. 2 to compute or count the square footage of materials which characteristically do not readily reflect light from their surfaces although they are adapted to be otherwise classified as either clear or opaque. According to this use, the television camera 12 is regulated to distinguish between dark and light areas and to respond generally to the absence of light as produced by the interception of a light ray. The continuously reproduced series of signals or pulsations sent forth after each single line scan are adjusted to the length of the obstructed portion of a light ray. And where this length is determined by the width of the sheet material conveyed through the light, the signals will eventually effect a record in the counter 36.

More particularly, the lamp-box 83 and camera 12 are arranged so that the full ray 84 of the light beam from the lamp-box is directed to the scanning tube of the camera. As herein shown, the camera 12 is mounted

11

above a conveyor line 10 while the lamp-box 83 is arranged beneath the shafts and rollers thereof so as to direct the rays 84 upwardly in a narrowly defined beam to the camera lens. Accordingly, if a sheet 85 of glass or other material passes through the light rays 84, the intensity and/or length thereof will be reduced and the camera will function to transmit these video signals in a suitable series or groups thereof to the amplifier 24. These video signals are transmitted from the tube circuit 26 to the output chronograph 34 at regularly spaced intervals that are determined by revolutions of the cam 19 and the sequential engagement of the lug 21 thereon with the tachometer 18.

In the event that a sheet having a broken area enters the beam of the light rays 84, the interrupted portion of the rays will produce the desired response by the camera but the uninterrupted portion of the rays will effect a reduction of the transmitted video signals to indicate a loss in surface area of the sheet. This will again be reflected in the operation of the chronograph 34 as in the case of a full sized sheet and the coordinated operation of the comparator circuit 49 to count the area of the broken portion and record the same in the indicator 52.

The fact that the camera 12 is regulated to scan or "count" by the reduction or complete obstruction of a light beam also permits the use of such an apparatus in the computing of surface areas in square feet of opaque materials such as colored glasses, plastics and even metals. By modified control of the deflection circuit of the camera, it can thus be operated according to the method described in connection with Fig. 7 wherein the transmission of video signals is controlled by the activity of a switch tachometer or when this transmission is controlled by suitable switch devices in the event that a full sheet count is instantaneously made.

In brief summation of the preferred embodiment of my invention, a plurality of sheets 11, as of finished plate glass, are carried forwardly toward a point of removal by the conveyor 10. During their movement therealong, each sheet intercepts the rays 14 of a narrow light beam emanating from an overhead lamp-box 13 to cause a band or light image 15 to be transversely cast on the surface thereof. As the sheet moves continuously along the conveyor, the light image 15 is progressively reflected from the glass surface from one end to the other of the sheet. This reflection or the reflected rays 16 are picked up by the camera 12 which is regulated to transmit, for example, forty-five video signals or electronic pulsations for each single line scan and in response to the transverse light image 15 across a scanned sheet width of six feet. These pulsations are continuously transmitted through a conventional type of video amplifier 24 to a control tube circuit 26. The video amplifier also regularly imparts a secondary control or scanning pulsations to a conventional type of scanning counter 28.

Associated with this scanning counter 28 is a shaping amplifier 30 of conventional type of circuit that is caused to function in accordance with the lineal movement of the glass sheet on the conveyor by means of a suitable tachometer 18. Thus, the shaping amplifier is influential in activating the scanning counter 28 at regularly timed intervals such as thirty times a second of time. In other words, the conveyor, through the tachometer 18 or other conventionally similar device, periodically causes the scanning counter 28 to energize the monitor side of the control tube circuit 26 and thereby cause the transmission of the electronic pulses therefrom to a conventional type of output counter 36. Since these impulses occur at regularly timed intervals, each actuation of the counter 36 will register the width of the glass sheet at spaced intervals of substantially 400 thousandths of an inch. Now if a sheet 11 of six by twelve feet is scanned by the camera

12

12 while moving at a constant rate of fifty feet per minute, the chronograph 34 will be caused to operate the counting indicator 36 to register or record seventy-two units or square feet. Simultaneously, therewith, the counter 37 will indicate the same unitary record and then return to a zero indication.

In the event that the conveyor is temporarily stopped while a sheet 11 in position to reflect the light rays 14 to the camera 12, the fact that the tachometer 18 is not caused to function by the lug 21 will render the scanning counter 28 inoperable so that no line communication can be had from the tube circuit 26 to the chronograph 34. This will prevent continuous operation of the video side of the system through the circuit 26 while the conveyor is idle but with the camera 12 still being influenced by the reflected rays 16. On the other hand, during intervals when no glass is on the operating conveyor, the fact that the rays 14 are not intercepted to produce the band or light image 15 will render the scanning counter 28 inoperable even though the cam lug 21 is continuously rotated to engage the arm 22 of the tachometer to activate said scanning counter 28 through the shaping amplifier 30. The functioning system by which the counter 36 is operated may thus be placed in continuous service and will automatically adjust its operation to agree with the speed of movement of a glass sheet, said operation being also automatically monitored to become effective only upon the existence of a glass sheet in the scanning area.

Now if a sheet having a portion broken or removed therefrom moves into the range of and intercepts the light rays 14, the maximum count of pulsations is transmitted through to the counter 36 and pre-set counter 37 until said broken portion intercepts the light rays 14 and, by the shortening of the transverse image 15, progressively diminishes the width of reflected beam 16. The number of pulsations from camera 12 proportionately and gradually decreases from the maximum of forty-five and the output from chronograph 34 will be equally proportionate so that the indicator 36 will count a lesser number of units or square feet than the maximum of six. Simultaneously, however, the pre-set counter 37 will also count this lesser number of units while the comparator circuit 49 is activated to cause the indicator 52 to count the lesser number of units or square feet. Thus while the indicator 36 continuously will record, when operated, the gross or entire total of square footage of the glass sheets passing through the range of the camera 12, the indicator 52 will automatically count and record the footage of the surface area or salvage areas remaining in a broken sheet. When the following end of the blank is carried from engagement with rollers 46, the switch 42 will again close to complete the "enabling" circuit of the pre-set counter 37. This will cause said counter to complete the recorded count to the established unit of seventy-two before returning to zero. Whatever difference exists by reason of the broken section of the blank is then indicated in the totalizer 40. These recorded totals when taken from the entire total will determine the actual square footage of glass sheets having a required width and also the actual glass loss.

Also as above mentioned, the entire total may, by the use of individual indicators 54 to 57 inclusive, be broken down into a count of the square footage of special types of glass. This last feature, of course, may be controlled by an operator at the point at which the sheets 11 are removed from the conveyor 10 but when any of such indicators are effective they will operate automatically within the system without further attention on the part of the operator.

According to a further embodiment of the invention, the surface areas of sheets, particularly in the form of plate glass blanks either partially (one side) or completely (two sides) ground and polished may be obtained while the blanks are still embedded in plaster on a grinding table which is one of many moving in an intercon-

nected train from the beginning of the grinding operation to the completion of the polishing operation. Obviously during the working of the first surface of the glass blank or the subsequent working of the second surface, such breakage may occur as to render further handling of the blank useless from a production standpoint. However, the estimated square footage of the blank is recorded or "booked" when it is initially laid or bedded on a table and therefore is a potential amount of glass on which the production estimates are based. If a record of the remaining usable glass is automatically made at two, three or more stations during the finishing of its surfaces, a gross or accumulative total of the square footage may of course be much more accurately computed.

As illustrated in Fig. 4, the camera 12 is regulated to function on a full raster count or to fully scan the entire surface of a glass blank instantaneously. For this purpose, the lamp-box 66 is arranged to completely illuminate the blank 68 by light rays 69 and when the blank is so illuminated as to reflect the light as rays 70, the switch 71 is operated to momentarily establish the necessary circuits to the chronograph 34 and/or comparator circuit 49. After passing the scanning area, the sheet of course is removed from the supporting table to be further surfaced on its second side or to be washed before the final inspection thereof.

By minor adjustment of the switch controls for the camera 12, it is also considered highly possible to employ the apparatus as shown in Fig. 4 in a similar manner to that shown in Figs. 1 or 7, or in other words, when the finished plate glass blanks are being carried to the storage area.

Now if the third embodiment of the invention, as shown in Fig. 7, is to be employed, the camera 12 and the system therefore can be regulated to take a periodic count as monitored by a tachometer. This will produce the transmission of video signals at predetermined intervals to a counting device or indicator. According to this third embodiment of the invention, however, the directed light rays 84 from the lamp-box 83 are not reflected from the surface of the sheet material but the camera and lamp-box are arranged so that the light rays are "aimed" directly toward the camera. The camera will therefore receive the full intensity of the rays while there is no glass on the conveyor. As a sheet moves into the range of and through the light rays, their intensity will be either completely or partially reduced and this will activate the camera to transmit video signals.

While the embodiments of this invention have been described in connection with the conveyance of glass sheets or blanks in spaced relation on a conveyor line, or spaced relation of glass blanks when carried by conventional grinding tables, it is believed to be within the scope of the invention to employ a counting and/or scanning system, as disclosed either in Figs. 1 or 7, where a material is worked simultaneously on both surfaces. Thus in the case of the so-called "twin-grind" process, glass is simultaneously ground on both sides and with various grades of abrasive while in continuous ribbon form. Since there are occurrences when the ribbon is unavoidably fractured, a count of the ground glass ribbon or of other materials as well, if taken before being removed for cutting will automatically establish a record of available stock for further working.

It is to be understood that the forms of the invention disclosed herein are to be taken as the preferred embodiments thereof, and at various changes may be resorted to without departing from the spirit of the invention as defined by the scope of the following claims.

I claim:

1. Apparatus for determining the surface area of sheet material, comprising conveyor means for moving the sheet material along a predetermined path, a light source adapted to direct a light beam toward the path of the material to be modified by the material, scanning means

responsive to the light modified by the material adapted to originate a number of electronic pulses corresponding to the length of the modified light beam, pulse converting and transmitting means to receive said electronic pulses adapted to convert said pulse into a pulse train of regulated impulses, the number of regulated impulses indicating the length of a preselected dimension of the said sheet, counting means for recording said regulated impulses to determine the area of the sheet, and means for causing said regulated impulses to be recorded at periodic time intervals corresponding to a given distance of movement of the sheet.

2. Apparatus for determining the surface area of sheet material, comprising means for moving a sheet of material along a predetermined path, a light source adapted to direct a beam of light toward the path of the sheet, scanning means responsive to light modified by the material adapted to scan the entire surface area of the moving sheet by causing successive single line scanning across the sheet surface transversely of the direction of movement of the sheet, said scanning means including electronic pulse transmitting means actuated in response to the modified light adapted to release a number of electronic pulses corresponding to the transverse dimension of the sheet covered by each successive single line scan, means for recording the number of electronic pulses to determine the area of the sheet, and means for transmitting pulses to said recording means only at periodic time intervals equivalent to a time interval between successive single line scans.

3. Apparatus for determining the surface area of sheet material, comprising conveyor means for moving the sheet material along a predetermined path, a light source adapted to direct a light beam toward the path of the material to be modified by the material, scanning means responsive to the light modified by the sheet material adapted to originate a number of electronic pulses indicative of the value of a dimension of the sheet, first recording means to record the number of electronic pulses to determine the area of the sheet, means associated with said conveyor means adapted to connect said first recording means to said scanning means at periodic time intervals equivalent to a given distance of movement of the sheet, second recording means, and means for actuating said second recording means only when the number of electronic pulses originated by said scanning means are of a lesser number than a predetermined number that would be emitted by said scanning means when responding to light modified by said material of a predetermined standard dimension.

4. Apparatus for determining the surface area of sheet material, comprising conveyor means for moving the sheet material along a predetermined path, a light source adapted to direct a light beam toward the path of the material to be modified by the material, scanning means responsive to the light modified by the sheet material adapted to originate a number of electronic pulses indicative of the value of a dimension of the sheet, first recording means to record the number of electronic pulses to determine the area of the sheet, means associated with said conveyor means adapted to connect said first recording means to said scanning means at periodic time intervals equivalent to a given distance of movement of the sheet, and second recording means responding to a number of electronic pulses lesser than a predetermined number to simultaneously record the same and determine the area of a sheet having a lesser dimension than a preselected standard dimension.

5. In an apparatus as defined in claim 3, wherein third recording means are provided associated with the said first and said second recording means for determining the differential between the actual area of a sheet and a predetermined standard area for a sheet.

6. An apparatus for determining the surface area of sheet material, comprising conveyor means for moving

15

a sheet sheet of material endwise along a substantially horizontally disposed predetermined path, a light source adapted to direct a beam of light toward the path of the sheet to be intercepted thereby, a camera adapted to scan the intercepted light beam and originate a predetermined number of electronic pulses corresponding to a given dimensional width of the sheet, means responsive to said camera for transmitting the electronic pulses, counting means for recording the electronic pulses to determine the area of the sheet and means associated with the conveyor means for connecting the said transmitting means to the said recording means at periodic time intervals equivalent to a given distance of movement of the sheet.

7. An apparatus for determining the surface area of light-reflecting sheet material, comprising conveyor means for moving a sheet of material along a predetermined path, a light source adapted to direct a beam of light toward the path of the sheet to be interrupted thereby, a camera adapted to receive reflections from the intercepted light beam and originate a number of electronic pulses corresponding to a reflected transverse length of said light beam, means responsive to said camera for transmitting the electronic pulses, computing means for receiving the transmitted number of electronic pulses adapted to convert the electronic pulses originated by said camera into a regulated number of impulses defining a measurable unit of a dimension of the sheet, means associated with the conveyor means adapted to connect the transmitting means to said computing means at periodic time intervals equivalent to a given distance of movement of the sheet, and counting means associated with said computing means for recording the number of regulated impulses received from said computing means to indicate the area of the said sheet.

8. An apparatus for determining the surface area of light-reflecting sheet material, comprising conveyor means for moving a sheet of material along a predetermined path, a light source adapted to direct a beam of light toward the path of the sheet to be interrupted thereby, a camera adapted to receive reflections from the intercepted light beam and originate a number of electronic pulses corresponding to a reflected transverse length of said light beam, means responsive to said camera for transmitting the electronic pulses, computing means for receiving the transmitted number of electronic pulses adapted to convert the electronic pulses originated by said camera into a regulated number of impulses defining a measurable unit of a dimension of the sheet, means associated with the conveyor means adapted to connect the transmitting means to said computing means at periodic time intervals equivalent to a given distance of movement of the sheet, counting means associated with said computing means for recording the number of regulated impulses received from said computing means to indicate the area of the said sheet, a comparator associated with the said transmitting means actuated by said transmitting means when the number of electronic pulses originated by said camera is less than a predetermined number, and a second counting means associated with the comparator and adapted to record the number of regulated impulses emitted by said computing means to indicate the area of the surface of the sheet material that has a dimension less than a predetermined standard dimension.

9. An apparatus for determining the surface area of light-reflecting sheet material, comprising conveyor means for moving a sheet of material along a predetermined path, a light source adapted to direct a beam of light toward the path of the sheet to be interrupted thereby, a camera adapted to receive reflections from the intercepted light beam and originate a number of electronic pulses corresponding to a reflected transverse length of said light beam, means responsive to said camera for transmitting the electronic pulses, computing means for receiving the transmitted number of electronic pulses

16

adapted to convert the electronic pulses originated by said camera into a regulated number of impulses defining a measurable unit of a dimension of the sheet, counting means associated with said computing means for recording the number of regulated impulses received from said computing means to indicate the area of the said sheet, means associated with the conveyor means adapted to connect the transmitting means to said computing means at periodic time intervals equivalent to a given distance of movement of the sheet, a pre-set counter associated with the said counting means and adapted to compare the number of regulated impulses received from the computing means recorded by said counting means with the pulse count of a full sized sheet having a predetermined standard area, and means adapted to actuate the pre-set counter when a lesser area count is received thereby to obtain the difference of a sheet of lesser area from a full-sized sheet.

10. An apparatus for determining the surface area of light-reflecting sheet material, comprising a support means for moving a sheet of material along a predetermined path, a light source adapted to direct a beam of light toward the path of the sheet to be intercepted thereby, a camera adapted to receive a full raster reflection from the intercepted light beam on the sheet surface and originate a number of electronic pulses during each scan line which correspond to a reflected transverse length of said light beam, means responsive to said camera for transmitting the electronic pulses, a computing means for receiving the transmitted electronic pulses adapted to convert the electronic pulses originated by said camera into a regulated number of impulses defining a measurable unit of a dimension of the sheet, means associated with the sheet supporting means to connect the transmitting means to said computing means at such times as the full surface of a sheet has intercepted the light beam, counting means associated with said computing means for recording the number of regulated impulses received from said computing means to indicate the area of the said sheet, a comparator associated with the said transmitting means actuated when the number of electronic pulses are less than a predetermined number when so originated in the camera for a standard width sheet, and a second counting means associated with the comparator actuated by said comparator to record the regulated impulses received from the computing means indicating the area of a sheet having a lesser dimension than the area of the sheet having a standard dimension.

11. An apparatus for determining the surface area of sheet material, comprising conveyor means for moving a sheet of material along a predetermined path, a light source adapted to direct a beam of light toward the path of the sheet to be interrupted by a sheet passing there-through, a camera adapted to respond to the interrupted portion of the light beam and originate a number of electronic pulses corresponding to a given dimensional width for the sheet, means responsive to said camera for transmitting the electronic pulses, computing means for receiving the transmitted number of electronic pulses adapted to convert the electronic pulses originated by said camera into a regulated number of impulses defining a measurable unit of dimension of the sheet, means associated with the conveyor means adapted to connect the transmitting means to said computing means at periodic time intervals equivalent to a given distance of movement of the sheet, counting means associated with said computing means for recording the number of regulated impulses received from said computing means to indicate the area of the said sheet, a comparator associated with the said transmitting means actuated when the number of electronic pulses are less than a predetermined number, and a second counting means associated with the comparator actuated by said comparator to record the regulated impulses received from the computing means indicating the area of a sheet having, a lesser dimension

17

than the area of the sheet having a standard dimension.

12. An apparatus for determining the surface area of sheet material, comprising means for moving a sheet of material endwise along a predetermined path, a light source adapted to direct a beam of light toward the path of the sheet to be intercepted thereby, light receiving means responsive to the intercepted portion of the light beam and adapted to originate a predetermined number of electronic pulses corresponding to a given dimensional width of the sheet and spaced from one another along the path of said sheet, a chronograph for recording the number of electronic pulses emitted by said light receiving means, means for transmitting the number of pulses from the light receiving means to the chronograph at periodic time intervals equivalent to a given distance between pulse lines across said sheet, first counting means associated with the chronograph for accumulating the recordings of the said electronic pulses to determine the area of the sheet material, and a second counting means

18

which responds to a lesser number of electronic pulses than the predetermined number, the first and second counting means simultaneously recording such lesser number of electronic pulses to determine the area of the sheet having a lesser dimensional width than the given dimensional width.

References Cited in the file of this patent

UNITED STATES PATENTS

2,356,761	Jones et al. -----	Aug. 29, 1944
2,359,934	Nokes et al. -----	Oct. 10, 1944
2,360,883	Metcalf -----	Oct. 24, 1944
2,494,441	Hillier -----	Jan. 10, 1950
2,756,627	Boycks -----	July 31, 1956

FOREIGN PATENTS

715,631	Great Britain -----	Sept. 15, 1954
---------	---------------------	----------------

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,910,908

November 3, 1959

Richard W. Meyer, Jr.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 15, after "polishing" insert a comma; column 9, line 32, for "or being" read -- are being --; column 13, line 67, for "and at" read -- and that --; column 16, line 29, strike out "a".

Signed and sealed this 26th day of April 1960.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,910,908

November 3, 1959

Richard W. Meyer, Jr.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 15, after "polishing" insert a comma; column 9, line 32, for "or being" read -- are being --; column 13, line 67, for "and at" read -- and that --; column 16, line 29, strike out "a".

Signed and sealed this 26th day of April 1960.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents