Nov. 15, 1949 C. Q. GLASSEY 2,487,865

PHOTOELECTRIC LINE SCANNING

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Fig. 1

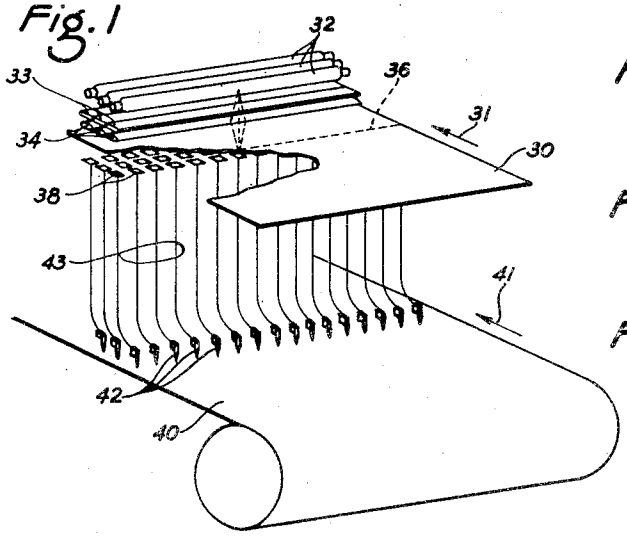


Fig. 4A

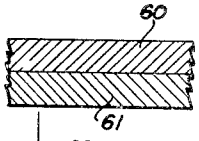


Fig. 4B

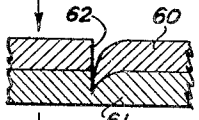


Fig. 4C

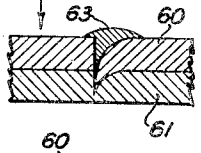


Fig. 5

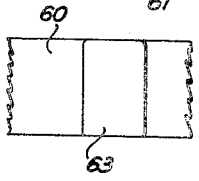


Fig. 2A

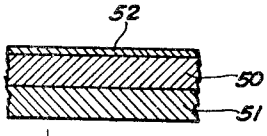


Fig. 2B

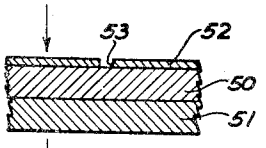


Fig. 2C

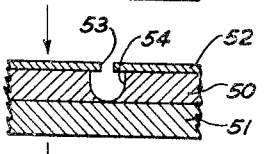


Fig. 2D

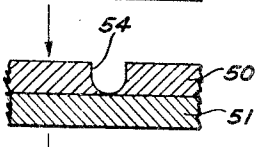


Fig. 2E

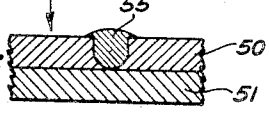


Fig. 3

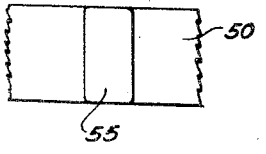


Fig. 6A

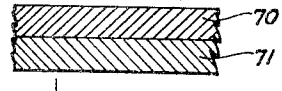


Fig. 6B

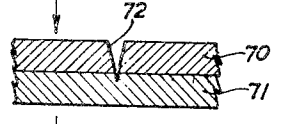


Fig. 6C

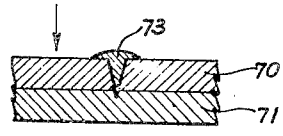
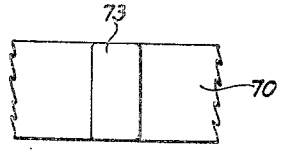


Fig. 7



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Fig. 8

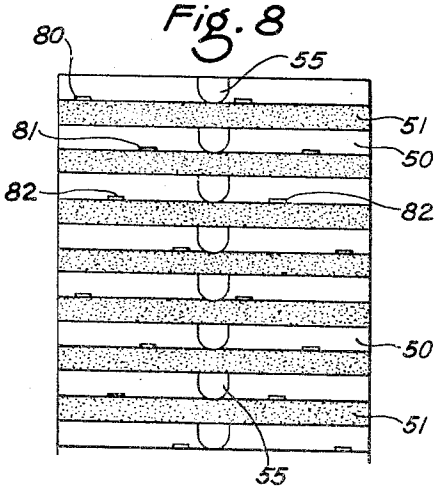


Fig. 9

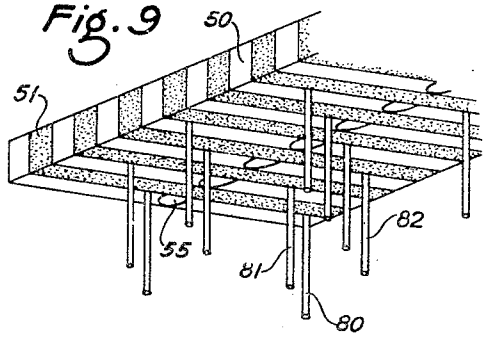


Fig. 10



Fig. 12

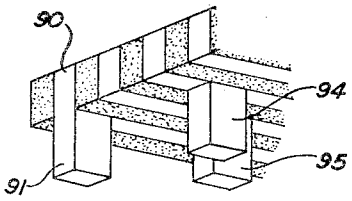


Fig. 11

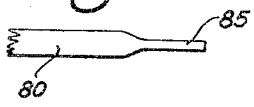


Fig. 13

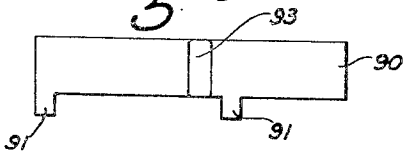


Fig. 14A

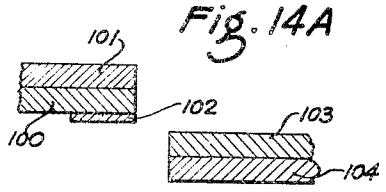


Fig. 14B

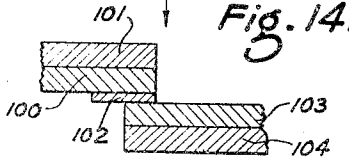


Fig. 16

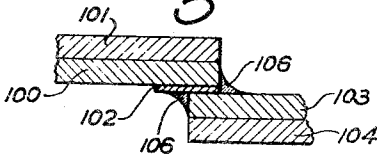


Fig. 15

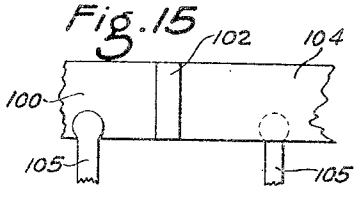
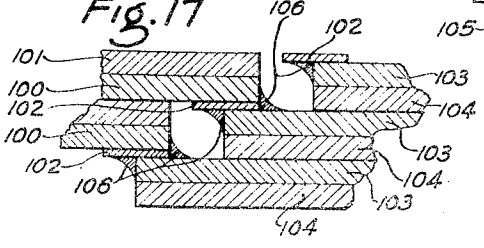


Fig. 17



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Fig. 18

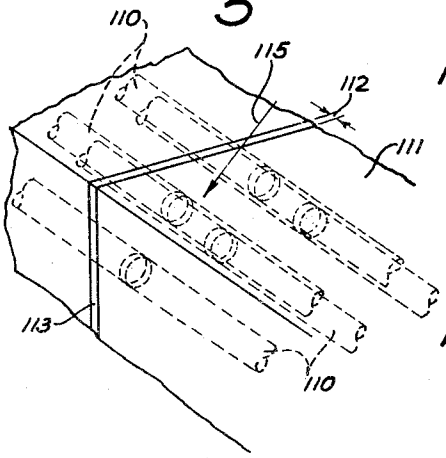


Fig. 19

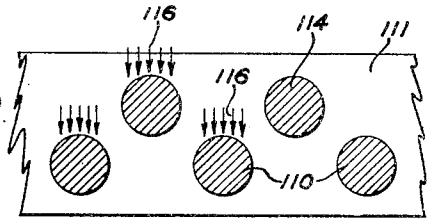


Fig. 20

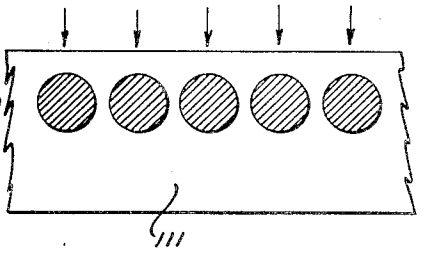


Fig. 22

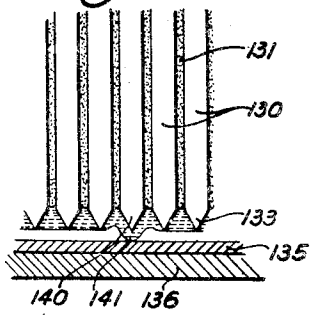


Fig. 21

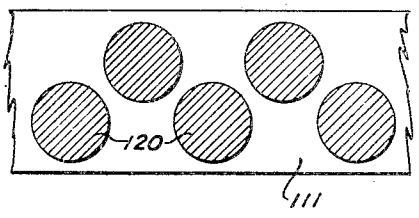


Fig. 23

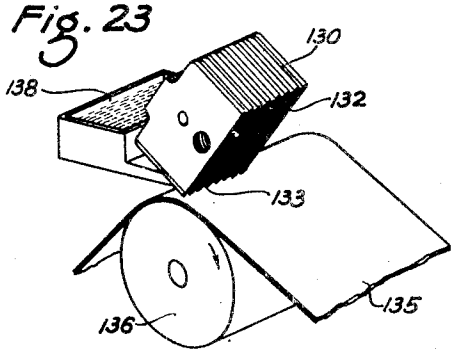


Fig. 24

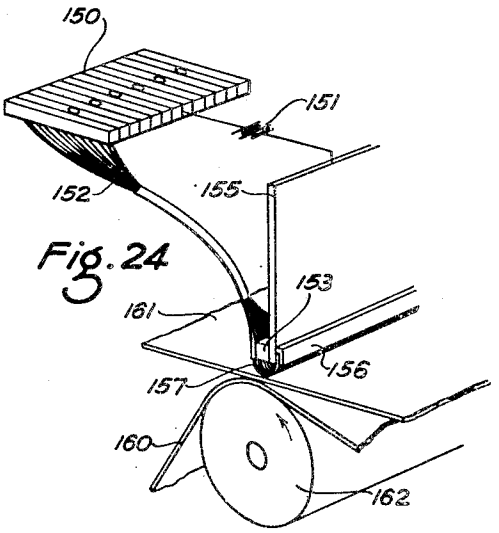
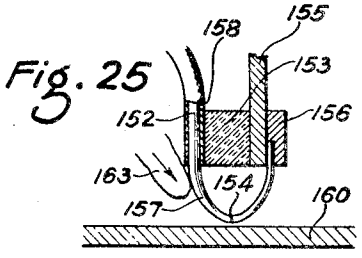


Fig. 25



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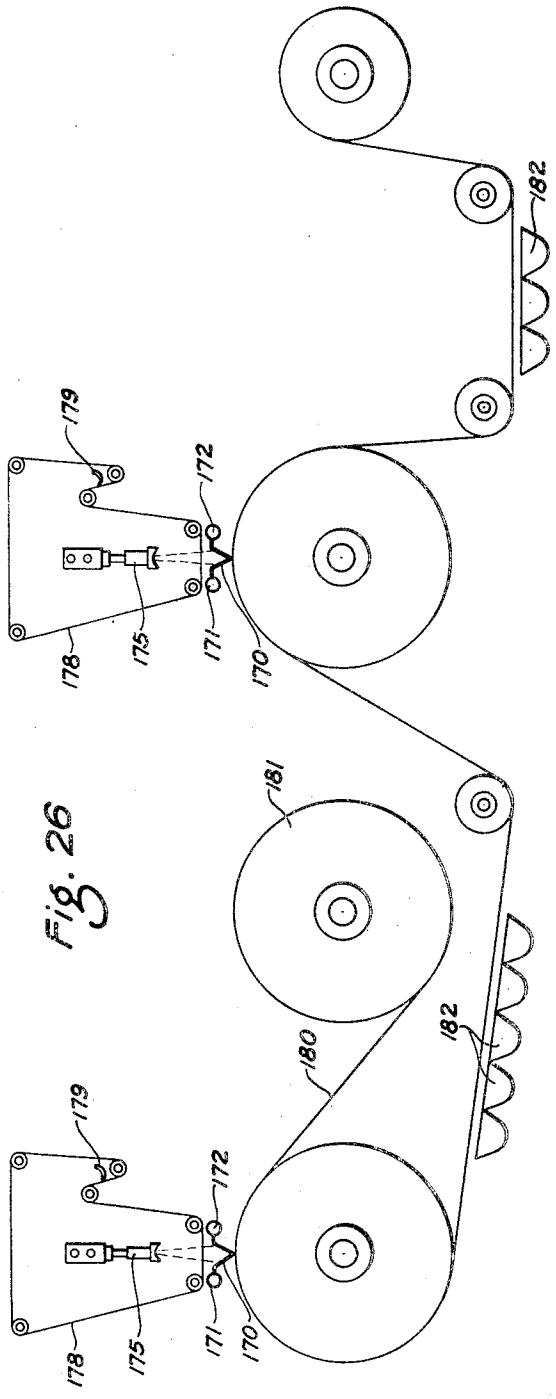


Fig. 26

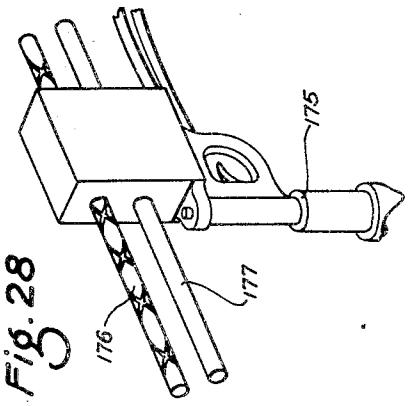


Fig. 28

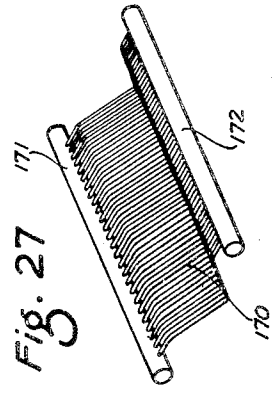


Fig. 27

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Patented Nov. 15, 1949

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UNITED STATES PATENT OFFICE

2,487,865

PHOTOELECTRIC LINE SCANNING

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Application February 27, 1947, Serial No. 731,372

6 Claims. (Cl. 201—63)

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This invention relates to photoelectric cells and particularly to photoelectric cells for line scanning processes such as taught by Serial Number 731,173 Murray, filed concurrently herewith.

One form of line scanning described in the present specification involves some of the principles of fusion photothermography also invented by Alexander Murray and described in copending application, Serial Number 768,979, filed August 16, 1947.

The term "radiation responsive material" is used generically in this specification since the invention is applicable at least to some extent to all forms of photoelectric cells including photo-emissive, photo-voltaic, photo-conductive, and particularly thermocouple forms. The invention relates to the physical structure of the cell and the method of supporting it rather than to its particular composition although for certain purposes, certain forms are preferred over others.

The object of the present invention is to provide a photoelectric cell having a large number of independent units per inch and in a line or row. In what is perhaps an extreme case, 300 elements per inch are provided in order to simulate 300 line per inch resolution in halftone reproduction. Specifically it is the object of the invention to provide such a photoelectric unit with small independent response points, but with sturdy mounting for each point, and with relatively large, at least usuable, electrical leads connected to each point or spot. It is the essential object of the invention to provide methods of manufacturing such a photoelectric unit.

According to the invention, each spot of the unit is made by severing a narrow metal strip and then filling the hiatus with photoelectric sensitive material (such as selenium or a photo-voltaic compound). The conducting metal strip must, of course, have a narrow dimension not appreciably greater and usually less than the thickness of one of the elements (e. g. $1/300$ of an inch). The conducting strip may be a flat strip or a wire. When a flat strip is used, it is preferable to laminate it to an electrical resistance layer, which eventually is to act as the insulator between successive conducting strips. The conducting strip in any case is severed into two parts by etching or simply by separating with a cutting tool or a shearing tool, without severing the insulating support. In the case of wire, it is preferable to embed the wire in plastic by stretching the wires adjacent to one another but slightly separated in a suitable form and then pouring transparent monomeric plastic over the wires

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and then polymerizing. All of the wires are then severed simultaneously and remain embedded in the plastic except where severed. The thermocouple embodiment is a form of this latter system. Iron wires embedded in one plastic block match those of constantan embedded in another block; the severed ends of one or both sets are tinned lightly and a soldered joint provided by placing the blocks together and passing a relatively strong current through the wires. This same method of construction is applied with slight variations to the making of thermocouple pens described in detail near the end of this specification.

In the photo-emissive, photo-voltaic, and photo-conductive embodiments, the hiatus between the two parts of each conducting strip is filled with a photoelectric sensitive compound such as selenium.

In all forms of the invention the resulting unit has a line of sensitive spots with conducting strips extending at right angles from the line in opposite directions. These conducting strips extend an appreciable distance, say ½ of an inch on each side of the spot. For clarity of description let us now assume that this line of spots is held horizontal so that the light may impinge on the spots from above. The metal strips are also horizontal, extending from each side of each spot. Relatively large conductors are connected to each strip and extend downward, i. e. from the back of the unit and preferably the points to which these leads are fastened to the tiny conducting strips, are staggered one relative to another; that is, some of the leads are quite close to the spot and others are at any distance up to ½ inch from the spots.

Other features of the invention and various objects and advantages thereof will be readily apparent from the following description when read in connection with the accompanying drawings, in which:

Fig. 1 is a perspective view of a photoreproduction process employing line scanning.

Figs. 2A to 2E constitute a flow chart of one method of manufacturing a sensitive cell, according to the invention.

Fig. 3 is a side view of the element shown in Fig. 2E.

Figs. 4A to 4C are a similar flow chart of another embodiment of the invention.

Fig. 5 is a side view of the elements shown in Fig. 4C.

Figs. 6A to 6C are a similar flow chart of still another embodiment of the invention.

Fig. 7 is a side view of the element shown in 6C.

Fig. 8 is a greatly enlarged plan view of a photoelectric unit according to the invention.

Fig. 9 is a perspective view showing the lower side of the unit shown in Fig. 8.

Figs. 10 and 11 are greatly enlarged top and side views of a wire to be used as a lead in Fig. 9.

Fig. 12 shows an arrangement alternative to that shown in Fig. 9.

Fig. 13 is a side view of one of the elements used in Fig. 12 and corresponds to Figs. 3, 5 and 7.

Figs. 14A and 14B constitute a flow chart of still another embodiment of the invention.

Figs. 15 and 16 are side and top views of the element shown in Fig. 14B but at later stages of the manufacture thereof.

Fig. 17 is a greatly enlarged detail showing a plurality of such elements after lamination.

Fig. 18 is a perspective view of another embodiment of the invention.

Figs. 19, 20 and 21 are side views of alternative arrangements of the embodiment shown in Fig. 18.

Figs. 22 and 23 are respectively a greatly enlarged vertical section and a perspective view of one method of depositing ink in accordance to the output of a line scanning system made according to the invention.

Figs. 24 and 25 are respectively a perspective view and a greatly enlarged vertical section of a different method of applying ink.

Fig. 26 illustrates the preferred form of printing press corresponding to Fig. 24.

Figs. 27 and 28 are enlarged perspective views of details thereof.

For clarity, unessential details have been omitted from Fig. 1. A color transparency 30 is moved, as indicated by the arrow 31, by means not shown, under a triple scanning line, provided by three lamps 32, each forming part of an optical system including filters 33 and cylindrical lenses 34 for forming a line of light transversely across the transparency 30. The filters 33 are the primary colors, red, green, and blue, and the red scanning line is indicated by the broken line 36. Light shields are included in each system for confining the scanning beams to their respective paths but are not shown since they would confuse the drawings. The light passing through the transparency 30 impinges on a row of photosensitive elements 38 which are shown as photoelectric sensitive or selenium cells described in detail below.

The output of the sensitive cells, as indicated by leads 43, is used to control the deposition of ink from individual pens 42. This ink is deposited on a strip of paper 40, which is moved, as indicated by the arrow 41, synchronously with the movement of the transparency 30.

Various forms of the photoelectric unit and methods of manufacturing them are illustrated in Figs. 2A to 21. In Fig. 2A, an electrical conducting strip 50 of copper, aluminum or copper alloy is laminated to an electrical insulating strip 51, and the upper surface of the conducting metal strip 50 is provided with a photosensitive resist 52. The total thickness of the strips or foils 50 and 51 is the controlling factor as far as resolution by the scanning system is concerned. If 150 lines per inch resolution is required, the total thickness of the conducting and insulating layers is $1/150$ of an inch. As shown in Fig. 2B, the resist 52 is removed at one point 53 by any of the standard methods used by photo-engravers and then a chemical etching solution or blast of sand is applied to the surface, which etches through the metal strip 50 to form a hiatus 54 extending to the insulating strip 51 as shown in Fig. 2C.

The photo resist 52 may then be removed, if desired, as shown in Fig. 2D, and the hiatus 54 filled with photoelectric sensitive compound to form a spot 55, as shown in Fig. 2E. The compound, of course, should be treated in known manner so that it has a maximum photosensitive response. The conducting strip at this stage is, as shown in Fig. 3, about one inch long, ¼ inch wide, and .002 or .003 inch thick. The selenium spot 55 is to be used end on so that its useful area has a width approximately equal to the thickness of the metal foil, i. e. .002 or .003 of an inch, and a width the other way equal to the width of the hiatus in the foil, which is also made to be about .002 or .003 of an inch.

In Fig. 4A a metal foil 60 is laminated to an insulating plastic foil 61, the foil is severed by marking with a suitable tool to form a hiatus 62 as shown in Fig. 4B. The hiatus 62 extends through the foil 60, but the insulating and supporting layer 61 is not broken. In Fig. 4C, the hiatus 62 has been filled with a sensitive compound spot 63 so that the resulting unit, as shown in Fig. 5, is similar to that shown in Fig. 3.

In Fig. 6A, a metal foil 70 is laminated to an insulating support 71. By means of a razor blade, a small cut mark 72 is put in the metal foil 70, extending through the foil, but not cutting appreciably into the supporting layer 71. The hiatus thus formed is filled with sensitive compound 73 as shown in Fig. 6C, and the resulting unit, as shown in Fig. 7, is also equivalent to the unit shown in Fig. 3.

As shown in Figs. 8 and 9, a plurality of the small units are laminated together. Specifically the unit shown in Fig. 2E is laminated to a number of similar units. For example, if 150 lines per inch resolution is desired, and the total length of the unit is to be 7 inches, 1,050 of such units are laminated together. The complete unit is now about one inch wide, about 7 inches long, and about ¼ inch thick. The spots 55 form a line down the center of the unit. If the unit is held with this line horizontal, each spot 55 is seen to have two conducting strips extending horizontally therefrom and made up of the two parts of each of the foils. Conducting leads 80, 81 and 82 are fastened to the metal foils. Preferably, as shown in Fig. 10, these leads 80 are made of enameled copper wire of suitable weight, say 32 gauge, which have been cut to the desired length. The ends are dipped in varnish remover or heated to remove insulation and then flattened as shown at 85 in Figs. 10 and 11 to give a good contact surface and to provide a thickness in keeping with the dimensions of the assembly.

These leads are inserted as the prepared strips are laminated. The leads from adjacent strips are in staggered positions so that the lead wires 80, 81 and 82 are relatively thick compared to the foil 50. Actually they are much thicker than shown in Fig. 9, in which they are purposely shown quite narrow to indicate the relative position and orientation of the leads rather than the size.

Figs. 12 and 13 show an alternative arrangement in which the individual foils are first die-cut so that each strip 90 is provided with tabs 91 for electrical connections. Fig. 13 is intended to correspond with Figs. 3, 5 and 7, showing the spot of selenium or other material 93 from the side. In Fig. 12 the staggered relation of the tabs 91, 94, and 95 and their relative size are

both apparent. Suitable gauge wire, not shown, is soldered or otherwise connected to each of the tabs.

Figs. 14A to 17 illustrate the method of making a unit in which at least one dimension of the photoelectrically sensitive spot may be selected at will, but this advantage is gained at the expense of complexity of assembly. In Fig. 14A an electrical conducting foil 100 is laminated to an insulating layer 101 and is provided with a spot 102 of sensitive compound at one end of the foil. Another metal foil 103 on an insulating layer 104 is brought into contact with the sensitive spot 102 as shown in Fig. 14B so that the two foils 100 and 103 overlap any pre-determined amount. As shown in Fig. 15 suitable leads 105 are attached to the foils 100 and 103. In Fig. 16 an insulating lacquer 106 is applied along both edges of the sensitive strip 102. Actually only one edge need be insulated with lacquer 106, but both edges are usually lacquered as a safety measure. A plurality of such strips are then laminated as shown in Fig. 17 with just sufficient off-set to accommodate successive spots 102. The line of spots is now diagonal with respect to the direction of the foils and the resolution is proportionally reduced by the arrangement, but the sensitivity of the individual spots is proportionally increased.

To provide the arrangement shown in Figs. 18 and 19, wires 110 are wound back and forth through a suitable mold in such a way that the wires are parallel, correctly placed and taut. Enameled wire appears to be the most satisfactory for this purpose. The mold is then filled with an insulating plastic 111, which solidifies or polymerizes and the whole unit is removed from the mold. Preferably, a transparent, colorless plastic 111 such as methacrylate is used. The block is then sawed in two parts, leaving a hiatus 112, each wire 110 being cut at right angles. Preferably the cut faces are then milled or ground, and polished. Photoelectrically sensitive compound 113 is then applied to the polished surface of one of the blocks so that the hiatus 112 is filled with compound. Either the whole hiatus 112 is thus filled with compound 113, or alternatively, when the vehicle is repelled by the plastic 111, the vehicle adheres only to the ends of the metal wire to form spots of selenium 114. It is usually desirable to chemically or electrolytically remove the ends of the wires to form depressions into which the sensitive compounds may be placed flush with the surface of one or both the faces.

Since the blocks are transparent, and since the conductivity of the sensitive compound between any pair of wires 110 is affected mainly by the light striking near the wire, resolution is not appreciably reduced by having the whole hiatus 112 filled with compound. That is, the controlling light, as indicated by arrow 115, reaches the compound adjacent to the gap between the wires. Of course, if the compound is located only on the ends of the wire the light, as indicated by arrows 116 in Fig. 19, may come straight through the hiatus 112. In all of this it should be remembered that the total thickness of the block is within the depth of focus of the optical system projecting an image on to a line of cells.

In Fig. 20 the adjacent wires are all in the same horizontal plane so that no depth of focus is required, but this reduces the amount of insulation between adjacent wires, and hence is often

less preferable. Since the arrangements shown in Fig. 19 has more insulation between adjacent wires than is necessary, it is permissible to use thicker wires 120 as shown in Fig. 21, and thus to provide both greater rigidity and greater sensitivity.

In each of the arrangements shown in Figs. 18 to 21, the blocks are cemented merely by heating the sensitive compound to its melting point and then pressing the blocks together so that a thin film of compound joins the ends of each pair of wires. Any interstices in the hiatus 112 may be filled with additional plastic for the sake of sturdiness. In Figs. 19 and 20, 40 gauge wire may be used for 300 line per inch resolution and somewhat heavier gauge may be used in the arrangement shown in Fig. 21. Obviously wire twice as thick may be used where only 150 line per inch resolution is desired.

A row of thermocouples may also be made in the manner illustrated in Figs. 18 to 21. In this connection I wind iron wire tautly on a frame (jig) to form a "cage" and then allow plastic to harden so that the wires are imbedded. The block is then cut, severing the wires and leaving the ends exposed in one half of the block. The same jig is then used for winding a constantan wire "cage" which is similarly imbedded in plastic and sliced. It is a relatively simple matter to tin the ends of the iron wires very lightly. The two blocks are then placed together with the iron wires registering in each case with the corresponding constantan wires. Electric current is passed through the wires thus in contact with sufficient intensity to heat the solder and form a permanent, although not particularly strong, bond. Since there are a large number of these bonds holding the two blocks together, the resulting row of thermocouples has considerable strength and is practical for reasonably careful use.

This same method of making a row of thermocouples is useful when making the printing pens of the type illustrated in Fig. 27 to be discussed below. In this case, after the thermocouples are made, part of the plastic immediately adjacent to the row of couples is removed and then all of the connected wires are bent down to form a trough, the bottom of which is at or close to the junction in each wire. For this arrangement, the wires are all wound at exactly the same level as illustrated in Fig. 20 rather than offset as shown in Figs. 19 or 21.

Although this particular application relates mainly to the making of the photoelectrically sensitive cell, various methods of depositing the ink in accordance with the output of the cells is described in Figs. 22 to 25. One direct method of doing this would be to employ valves operated by the electrical current, but this is not too practical because of the minute size of the valves. A still more direct method described below employs electrostatic attraction and repulsion. The third and most preferred method reconverts the electrical energy into heat energy either by the Joule heating at a thin point in the conductor wire or by the Peltier heating at the cold junction of a thermocouple. This heat is then applied to change the viscosity and hence the rate of flow of ink.

In the thermocouple printing system, the controlling current may be received either from a row of photosensitive cells of the photo-emissive, photo-voltaic, and photo-conductive types or directly from a row of thermocouples. In the

latter case the thermocouples on which the light is incident form the hot junction and the pens form the cold junction heated by the Peltier effect. In the former case, there is a separate hot junction maintained at constant temperature and again the pens are the cold junction. Alternatively in a so-called positive to positive system, a four junction thermocouple series is used in which the two cold junctions are kept at constant temperature, the image is picked up at one hot junction and the ink deposited at the other hot junction which tends to be cooled by the electric signal.

In Figs. 22 and 23 a plurality of strips 130 similar to razor blades are lacquered with a thin lacquer insulating layer 131, and then laminated and clamped tightly by a clamp not shown, but which remains in position and which is electrically insulated from the metal strips. In this arrangement, the ink is fed down the sloping edges of the strips, but alternatively by the use of thin spacers the pile of strips is made to include interstices for capillary feeding of the ink from the top. The ink is a nonconducting one, as are most inks. When razor blades are used, the pack or pile is first assembled then cut transversely to provide a surface 132 which is polished so that sharp points 133 are provided forming a closely controlled line. A strip of paper 135 passes over an electrical conducting roller 136 so that the paper is spaced an accurately controlled small distance from the points 133; this space is preferably on the order of one or a few thousands of an inch. Ink is provided from a reservoir 138 so that it runs down or between the strips to the points 133 at just the right speed to replace the ink printed as the paper moves along. Each strip is insulated from those adjacent and is connected to the corresponding sensitive cell which scans the original picture. The current is fed through the sensitive cells in pulses so that each strip picks up a pulsating current. The ink, having a high electrical resistance, becomes charged and is repelled, predominantly from the point 140 of the strip which happens to be so charged that a drop 141 of ink is deposited on the paper 135. The roller 136 is conducting in order to increase the attraction for the drop 141. Although the whole blade, or at least half of it, is shown in Fig. 23 for simplicity of description, it is preferable to cut away most of the blade and to use only enough to support the operating points and give the correct capillary feed when ink feeds between the blades, in order to reduce capacity effects to a minimum. Large capacity effects, of course, would cause adjacent strips to pick up any large charge intended for one of the blades so that undesired ink would be deposited from the adjacent points. To prevent the accumulation of large charges on the blades it is often necessary to ground the blade assembly between ink discharges, especially when a high contrast effect is desired, as in halftone.

Figs. 24 to 28 illustrate two similar but slightly different methods of printing in accordance with the output of a line of photoelectric cells of the type described above. In Fig. 24 a row of selenium cells 150 controls the flow of current from a battery 151 through leads 152 and a metal plate 155 to which all the leads are attached. This current differentially heats the narrowest portion of each of the wires 152 and this narrow portion 157 constitutes the writing stylus, the temperature of which controls the deposition of ink on a sheet of paper 160. The ink itself is supplied in solid sheet form 161 which is pressed into contact with the paper 160 as both pass over a roller 162. The amount of ink transferred from the sheet 161 to the paper 160 depends on the temperature of each individual stylus 157. To enhance the heating effect in the stylus, a cold junction 154 as shown in Fig. 25 may be included. The polarity of the battery 151, of course, determines whether the junction is a cold junction or a hot junction.

In Fig. 24, if the row of photoelectric cells 150, is a row of photo-voltaic cells or a row of thermocouples, the system is self energizing and the battery 151 is unnecessary. Thus the battery 151 merely constitutes an auxiliary source of potential and is not fundamental to the invention. The printing is accomplished by the conversion of the electrical energy signals into heat energy by employing either the Joule heating of a fine wire or the Peltier effect at a thermocouple, or both.

Fig. 25 primarily represents a detail of the arrangement shown in Fig. 24. The wires 152 have the insulation 158 thereof removed near one end which is stretched to form the narrow portion 157. The wires are all carried by an insulating block 153 and the end of the narrow portion is clamped by a metal block 156 to the large metal support 155. This arrangement is the same whether or not the thermal junction 154 is included. The contact between the end of the wire and the plate 155 may also constitute a thermal junction, but the effects of it are negligible because of the large heat capacity of the metal plate 155. In addition to illustrating the pen detail, Fig. 25 also shows an alternative method of inking the pens. Instead of a solid sheet 161, ink is fed as indicated by the arrow 163 as a relatively viscous droplet or more exactly an elongated bead across the pens. The viscosity of the ink is considerably lowered by the temperature of the individual pens which causes the ink to flow in accordance with the signal through each pen. The heating is not sufficient to cause the wire to overheat or to decompose the ink, but merely sufficient to control the deposition of a viscous ink. This particular embodiment depending on the change of viscosity of ink with temperature was developed subsequent to the work of Alexander Murray on fusion photothermography. The heat capacity of the ink has been found to be sufficient to carry off the excess heat with the ink and thus to maintain the printing operation in thermal equilibrium. After the ink is transferred, the local heating of the print does not cause any objectionable rise in temperature. The heat transferred with the ink is small but just sufficient to maintain adequate uniformity of the printing operation.

In Fig. 26, the scanning arrangement is omitted but the printing operation starting with the thermocouples is illustrated in its most preferable form. The thermocouples 170 are arranged as a trough. The actual junction need not be exactly at the bottom of the trough but is preferably quite near this point in order to gain the maximum heating effect at the printing point. The row of junctions is formed as above described in connection with the invention, the trough being provided by simple uniform pressure by a knife edge. If at any time, for example when cleaning the pens, the spacing of the thermocouples becomes uneven or the wires overlap,

it is a relatively simple matter to stretch the wires and then to reform the trough by the knife edge method. The leads to the thermocouples are in practice all carried in cables 171 and 172. As pointed out in connection with Fig. 24, one side of the thermocouple may be connected to a common wire or bar. Ink is supplied to the row of thermocouple junctions by a spray gun 175. A line spray might be made up, but in order to insure uniformity of distribution of the ink in the thermocouple trough, I prefer to mount the spray gun 175 on the right and left hand ratchet type reciprocating drive 176. The gun thus moves rapidly back and forth across the thermocouple junction, and its motion is guided by a guide bar 177 as shown in detail in Fig. 28.

In general there is sufficient ink printed from each point of the thermocouple trough to prevent any accumulation of ink in the trough. It is a relatively simple matter to control the rate at which ink is used up by controlling the speed with which the paper supply moves under the pens 170. The rate at which ink is sprayed from the gun 175 is also a direct control in this connection and thus by maintaining a suitable inspection of the prints, their quality can be maintained. However, the white border of each print should receive no ink and the borders between successive prints should also receive no ink. To overcome any tendency to print in these areas and to prevent all undue accumulations of ink, a mask 178 synchronized with the pictures to be printed is passed in front of the spray gun. This mask contains an aperture for each picture and merely picks up any ink sprayed from the gun which would fall on the pens in areas such as borders where no ink is to be printed. That is, the mask 178 is solid except for the picture apertures. The ink is scraped from the mask by a scrapper 179 and preferably is returned directly to the ink supply for the spray gun, but it is quite adequate to collect the ink in a container and to dump it back into the ink supply by hand whenever the container gets too full. The paper 180 from a supply roll 181 passes under the pens 171 and receives an ink impression on one surface of the paper 180 which is then dried by dryers 182. The paper then passes over a second impression cylinder 183 where the other side is printed. The dryers may be on either side of the paper since the effect passes through the paper quite easily. I prefer to use radiant energy dryers such as illustrated but dielectric heating would be satisfactory. Although the printing from the thermocouple pens may be either continuous or intermittent, I prefer an intermittent arrangement and thus the thermocouple trough or applicator is reciprocated vertically, by means not shown, so that the pens make contact with the paper at a speed corresponding to the screen ruling per inch of paper travel. For example, in 300 line quality, the pens touch the paper 300 times per inch.

Having thus described various preferred embodiments of my invention I wish to point out that it is not limited to these structures but is of the scope of the appended claims.

I claim:

1. The method of making a photoelectric unit having a large number of small juxtaposed photoresponsive elements effectively in line, which comprises mounting at least one electrical conducting strip whose narrowest dimension is not appreciably greater than the width of one of said elements integral with an insulating material, laminating the conducting strip to an electrical insulating strip, severing the conducting strip to leave a hiatus also not appreciably greater than the width of one of said elements, filling said hiatus with a photoelectric sensitive material, and then placing a plurality of such electrical conducting strips in close juxtaposition separated by the insulating material.

2. The method of making a photoelectric unit having a large number of small juxtaposed photoresponsive elements effectively in line, which comprises laminating a strip of electrical conducting material whose narrowest dimension is not appreciably greater than the width of one of said elements to an electrical insulating strip, severing said conductor but not said insulating strip to leave a hiatus between the two parts of the conductor also not appreciably greater than the width of one of said elements, filling said space with a photoelectric sensitive material, repeating the above steps to provide a plurality of severed conducting strips with photoelectric sensitive material in each hiatus and laminating the plurality of strips together with interleaving strips of electrical insulating material.

3. A method according to claim 2 in which each electrical conducting strip is laminated to an electrical insulating strip, the exposed surface of the electrical conducting strip is covered with an etching resist except at the point to be severed and the severing step consists of chemically etching through the metal to the electrical insulating strip.

4. The method according to claim 2 in which each electrical conducting strip is laminated to an electrical insulating strip and the severing of the metal is provided by a tool which separates the metal strip into two parts but does not cut through the electrical insulating strip.

5. A photoelectric unit comprising a plurality of juxtaposed tiny spots of radiation responsive material, two electrical conducting strips joined to each spot, insulating material insulating each of the spots from one another and electrical conductors attached to each conducting strip.

6. A unit according to claim 5 in which the electrical conducting strips are all closely parallel to one another with interleaves of insulating material, and in which the electrical conductors are at right angles to the strips and are in staggered relation with respect to the electrical conductors of adjacent strips.

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