

Dec. 13, 1955

S. C. BARTLEY

2,726,587

PHOTOGRAPHIC CONTACT PRINTER

Filed Dec. 3, 1951

6 Sheets-Sheet 1

Fig. 1.

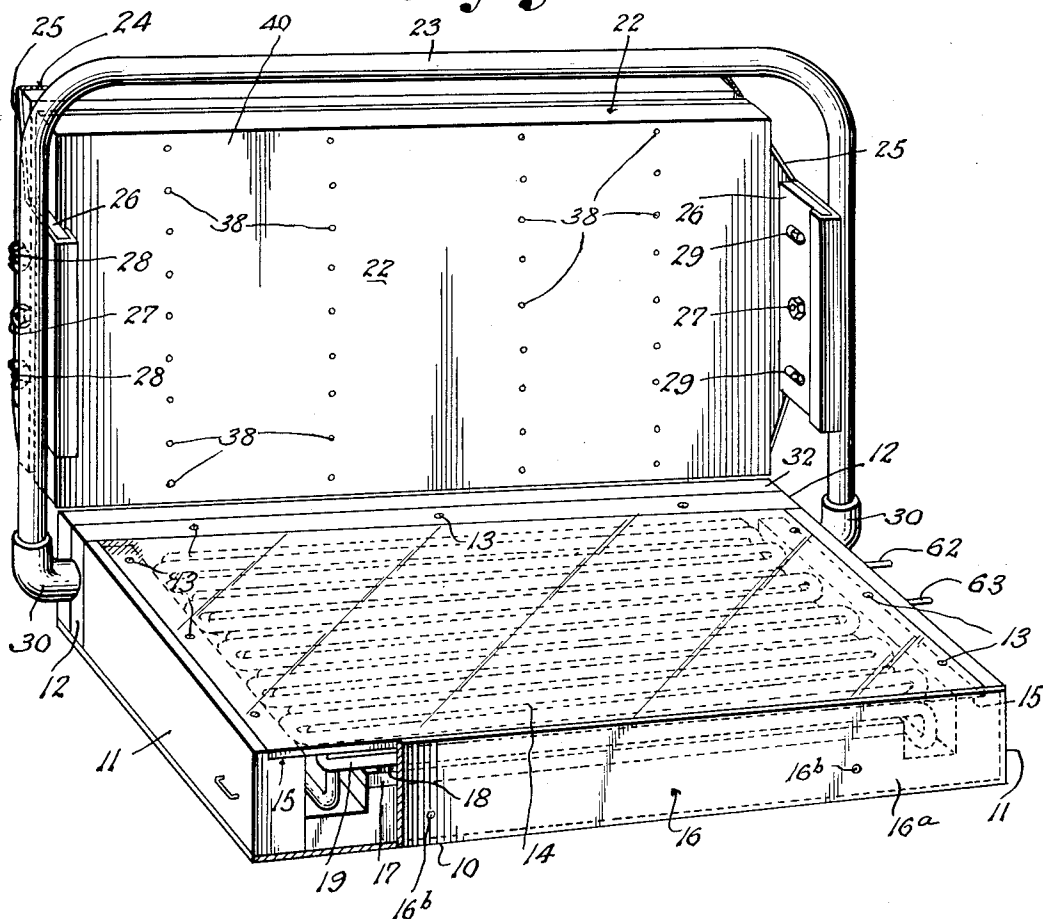
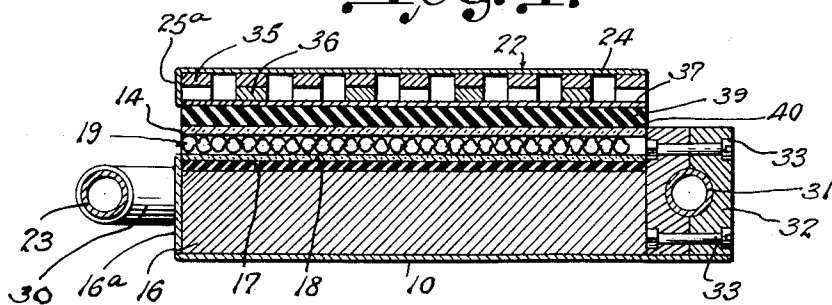


Fig. 2.



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Fig. 2.

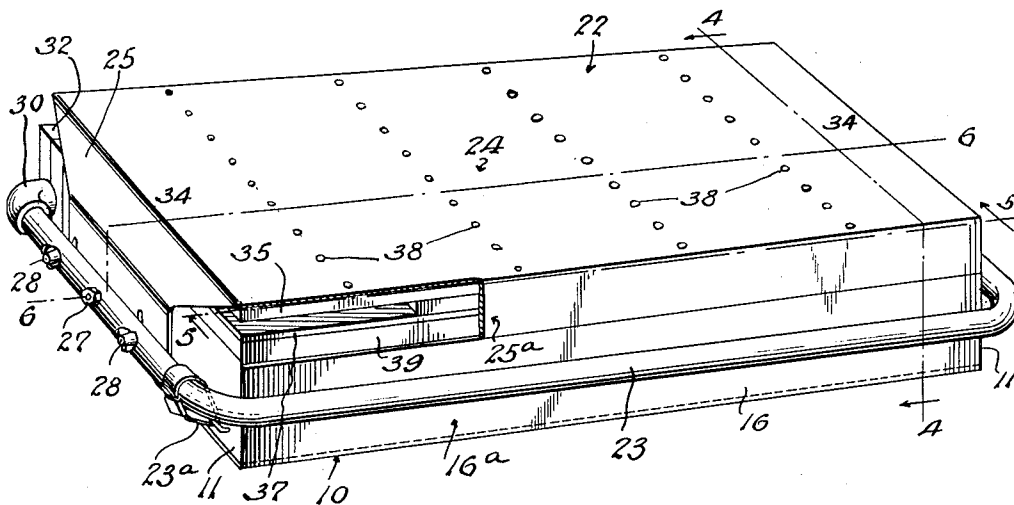


Fig. 6.

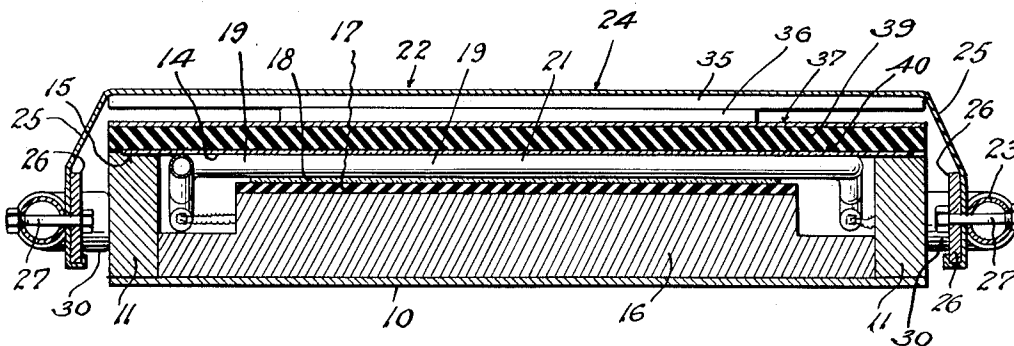
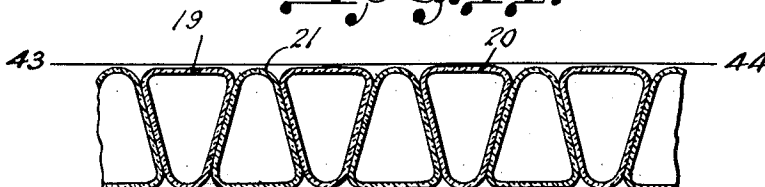


Fig. 14.



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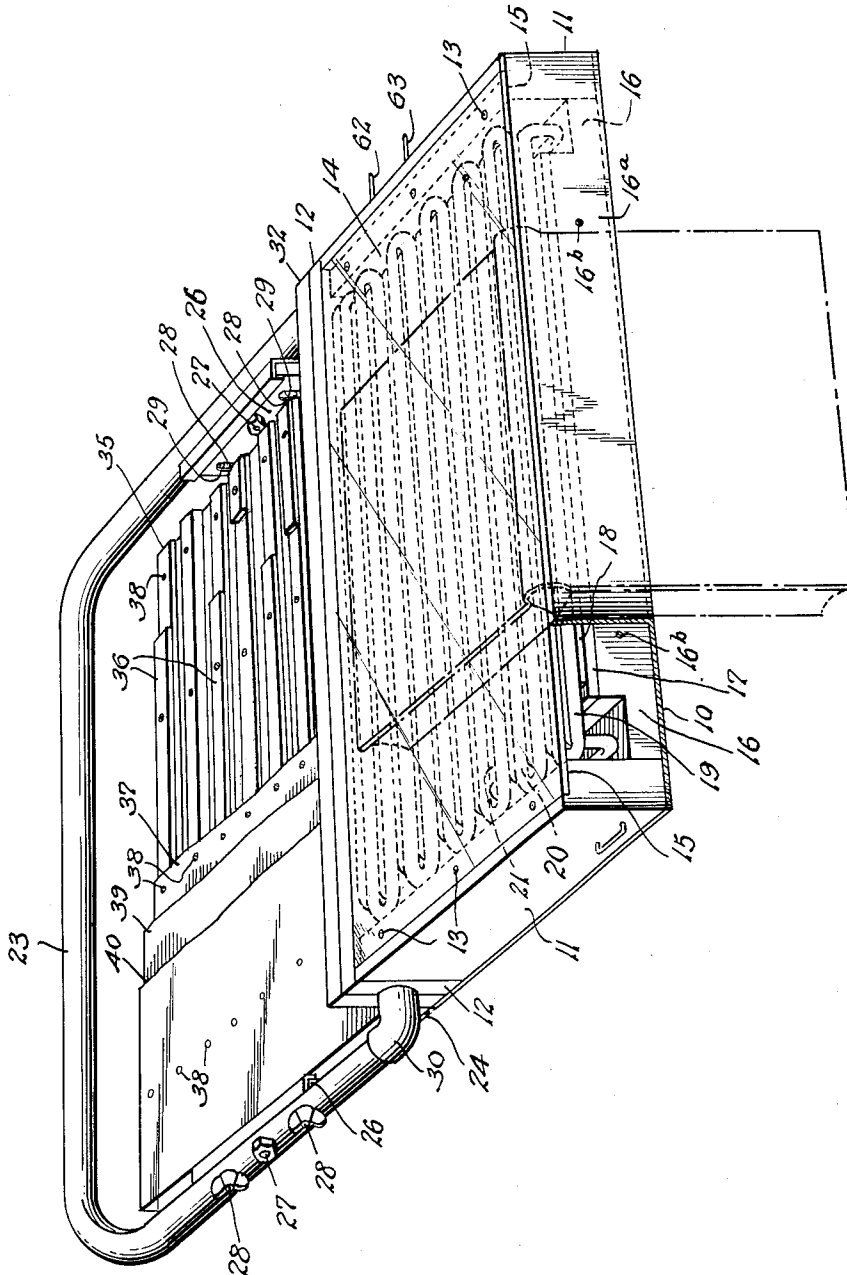
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Fig. 5.

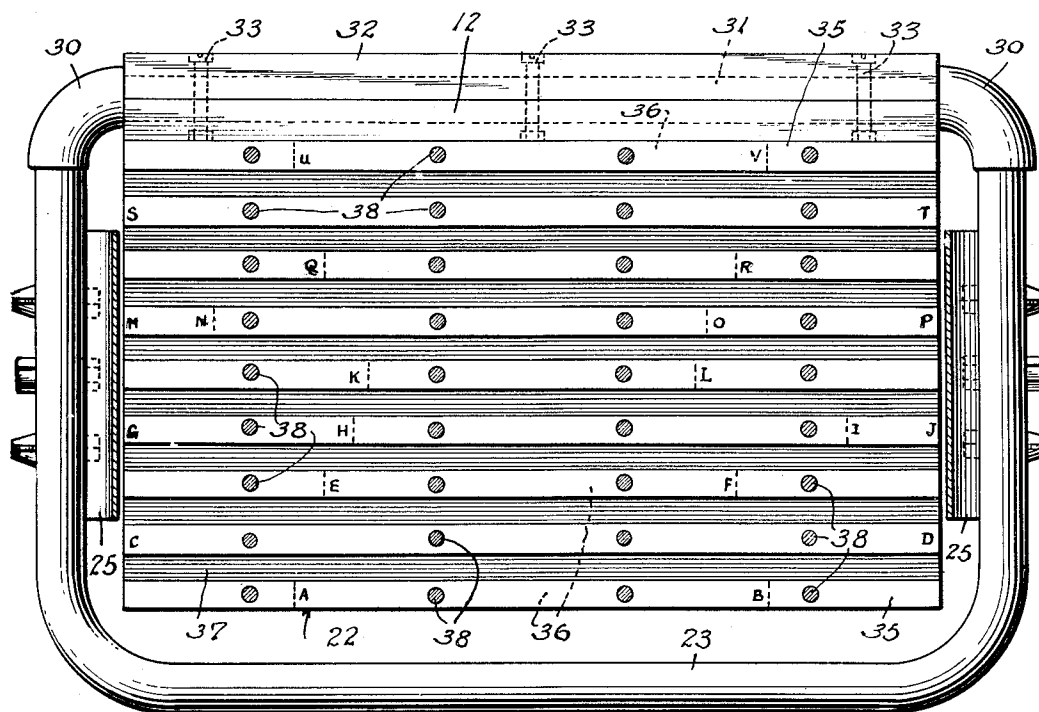
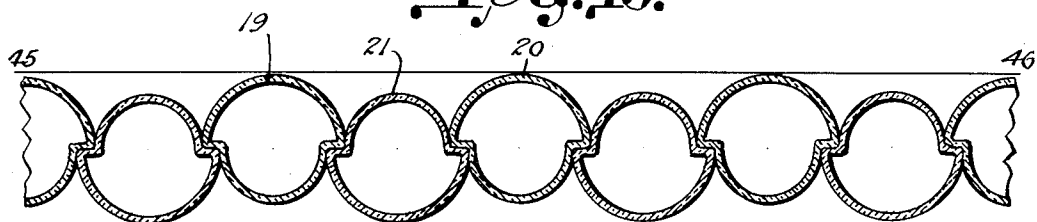


Fig. 13.



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Fig. 7.

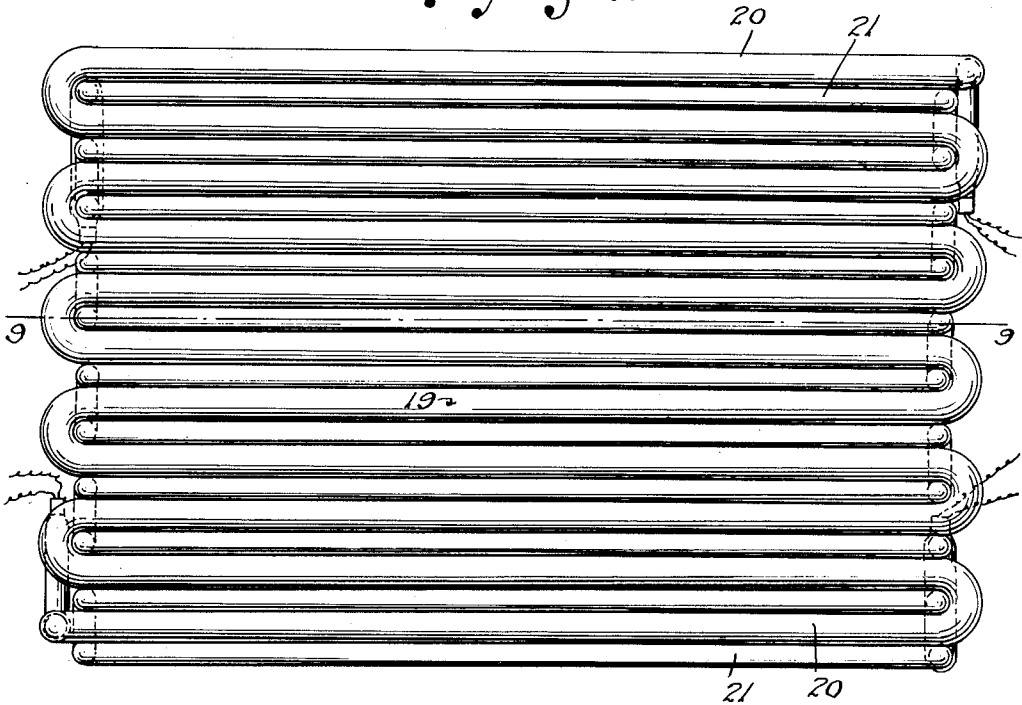


Fig. 8.

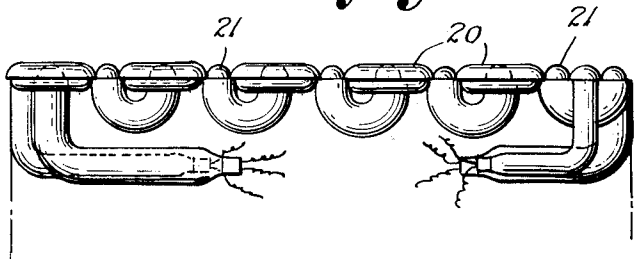
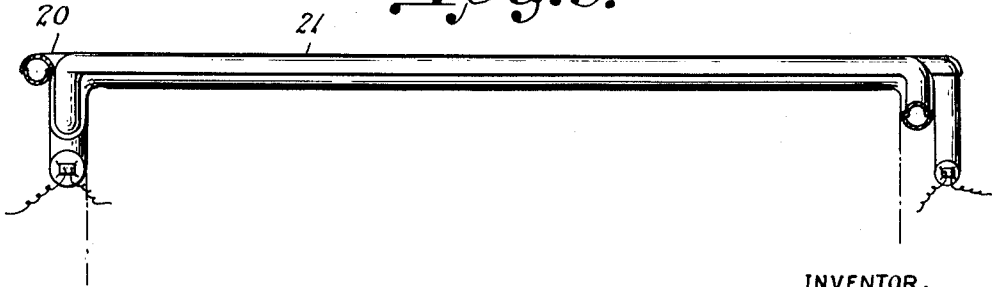


Fig. 9.



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Fig. 10.

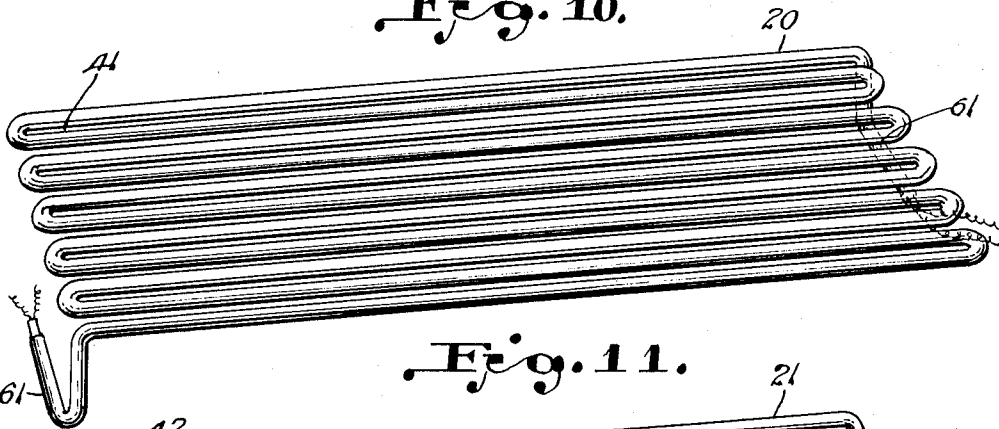


Fig. 11.

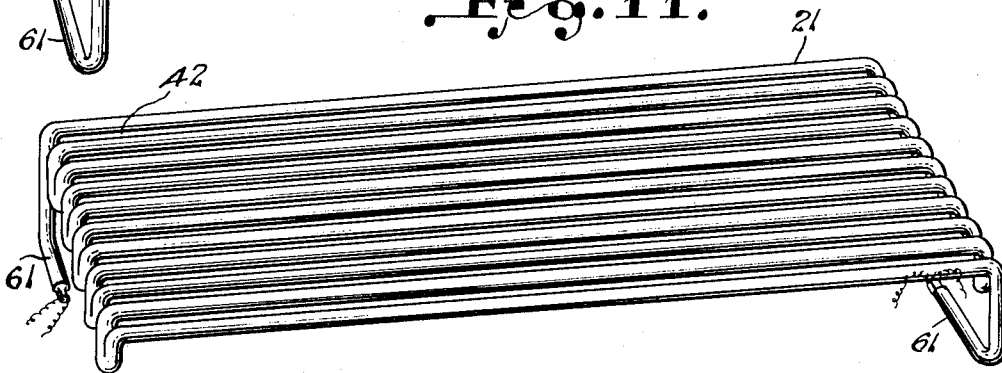
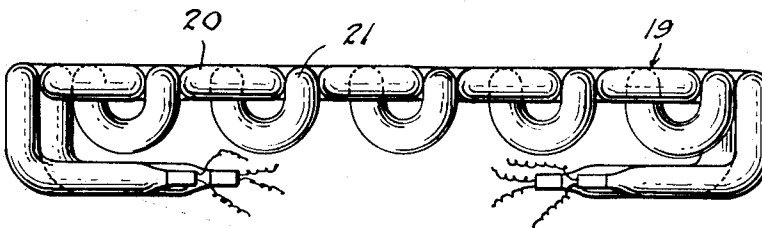


Fig. 12.



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PHOTOGRAPHIC CONTACT PRINTER

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Application December 3, 1951, Serial No. 259,659

2 Claims. (Cl. 95—73)

This invention relates to photography and more particularly to contact printing.

This application is a continuation in part of copending application, Serial No. 234,326, filed June 29, 1951, entitled Illuminating Device, and now abandoned, and is directed to an improved contact copying machine employing improved luminous tube circuits and an improved pressure plate.

The principal object in the improvements of the luminous tube circuits is the creation of a flat light, evenly distributed in its origin, which can be juxtaposed with the copy plate of a contact copying machine and which will pass almost immediately into actinic production through a transparent glass plate and eliminate the loss of light energy usually caused by projecting light upon a copy plate from a distance through a diffusing agent. With this innovation contact copying can be done with safe-handling, slow-acting photographic papers in normal room light and with a normal electrical supply.

In addition to the principal object, other related objects are attained, namely: a plane of overlapping luminous tubes; a source of light conforming in shape, and equal to or greater than, the object upon which it is to be spread; tubes in a lamp structure that will give even illumination and remain free of blackening from electrode sputtering throughout their length; a lamp substantially unaffected by voltage variation in the line of electrical supply; a lamp of unusually long life, not greatly affected by frequent on-and-off operations; a bleeding effect of light around the edges of the copy plate, which makes possible the copying of books and other bound material placed in a 90-degree open position over one edge of the plate; walls of the machine body that will effuse light and not reflect it inward to mar the evenness of light throughout the area of the copy plate; a substantial foundation in a lamp structure that will withstand great pressure and weight when needed in contact copying, a lamp of similar advantages for ultra-violet, infra-red and other forms of radiant energy when like distribution and application are desired; and the distribution of light or other radiant energy in such compactness of space that a portable contact copying machine of unusually shallow structure and of any practical copy-area dimensions can be built.

In accomplishing the principal object, that is, the even distribution of light in its own origin throughout a plane, it was found most practical to conduct electrical energy over the plane by means of continuous tubes filled with gases or other conductors, otherwise the electricity, which in modern usage is made available only at small contact points, would tend to travel in a straight line from point to point across the plane and no distribution of light would result, unless innumerable opposite contact points across the plane could be provided, but such is impracticable. Therefore to produce a rectangular plane of distributed light straight lengths of tubing must be laid parallel, side-by-side, and formed to touch or overlap each other throughout the area. This condition suggests

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several structures employing practical electrical circuits through gases, using round or shaped tubing.

The most obvious of these would appear to be several straight tubes laid side-by-side and overlapping, each evacuated and pumped separately, and having an electrode at each end, all wired in series. The necessarily high voltage for a circuit of this kind would have to pass through a great number of electrodes and likewise great quantities of metal. In addition to the necessary drop in voltage at each electrode, there would be a sputtering of the redundant metal to the inside of the tubes and consequently blackening of tube walls. Excessive heat would also be generated at the tube ends and would travel inward along the tubes, affecting unevenly the ultra-violet radiation from the tubes. Furthermore the separate fabrication and processing of each tube unit would increase the likelihood of uneven light output incident to manufacturing variables.

Another obvious structure would appear to be that of one continuous tube of straight lengths progressively folded back and forth upon each other and overlapping throughout a plane surface. Such a structure would be difficult to form because of the necessity of making complete 360-degree bends for each fold. Granted however that this could be done with molds, jigs, or the like, or that a similar continuous circuit could be made by blowing passages through alternate ends of tubes sealed and joined together in a bank, there would remain the problem of bombarding the circuit with high voltage during evacuation, and such a high voltage current lapping back and forth upon itself so closely would cause the arc to break through at vulnerable points in the circuit and the sharp bending of the arc stream in normal operations would also cause a flaring of light at the bends.

Similar problems would occur in a structure of rectangular convolutions. Light blemishes would also occur at the right-angle bends of the tubing and at all seals in the tubing supply, such tubing being normally obtainable only in short lengths.

These problems would likewise prevail in a helical structure of continuous tubing flattened longitudinally into two parallel and connected rectangular planes. The light produced by the under side, or un-used side, of the structure, would not be effective on the copying surface, and the extra footage and the electricity required to illuminate the opposite side of the helix would therefore be wasted.

Therefore the interlocking circuits as illustrated and described herein are the satisfactory means with which this invention is concerned. Great lengths of tubing with two or four electrodes are an important advantage, for lamp research has proven that voltage drop at numerous electrodes in multiple units represents mostly wasted energy and that light efficiency increases as the tube length is increased. Blackening of tubes from an excessive amount of electrodes and wiring is practically eliminated. A minimum of material is used in fabricating the lamp and a conservative arc length is maintained; consequently economical use of transformers and electrical power are provided. Smooth passages around bends and throughout the areas are provided for the arc stream, reducing resistance to a minimum and also reducing heat throughout the lamp. The result is a long life expectancy for the tube circuits, which may be compared in their durability to tubes used in ordinary electric signs kept lighted 24 hours a day over a period of several years, with the present use and structure providing additional advantages of a sealed-off condition and brief-interval operations. When the tube circuits are bombarded separately during evacuation the folds are far enough apart to prevent the arc from breaking through at vulnerable points; and in normal operations, when the

circuits are meshed together, two independent currents running in parallel relation provide for smoother operations. Seals in the tubing supply, during fabrication, can be placed at the bends and well away from the working area.

The principal object in the improvement of the pressure plate is the creation of a more evenly distributed pressure upon a plane surface exerted by simple means embodied in a compact portable structure. Additional and related objects are: to provide, in addition to even distribution of pressure over the plane, also approximately the original intensity of the applied pressure made available at any point at which the plane of contact may be disturbed; to provide a structure which performs an additional function in a copying device, the actuating handle of the pressure plate serving also as a carrying handle for the entire machine; to provide a pressure plate that will hinge 180-degrees about an axis to clear a large plane surface to allow the spreading of large, bound books and other large material over the copying surface; to provide a pressure plate that will remain stationary when stopped at any point in its open position; and to provide a pressure plate through which great pressure can be applied.

Vacuum frames have been employed to accomplish the general object of distributing pressure evenly in contact copying, but such require expensive and cumbersome machinery for their operation. Convex rubber mats and curved spring steel have also been used, but they are also cumbersome, and it has been found difficult to effect even distribution of pressure with these instruments. Convex, inflated, plastic bags have been effective in the distribution of pressure, but when pressure is needed to counteract bulges at any or several particular points in the plane of contact the intensity available at these points is only a proportionate amount divided from the entire volume.

When studied by the descriptions appearing below in connection with the drawings, it will be found that the structure of the present invention has been designed not only to distribute pressure evenly throughout the plane of contact but also to produce approximately its original intensity at points where disturbances in the plane of contact are created. This is accomplished by pressure-distributing bars with templates of varying lengths placed in various positions along the under-sides of these bars and arranged in counterbalance according to a mathematical plan, all of which being trussed between the plane of thrust and the plane of transmission. This plan may vary according to modifications in structure and size of copying machine, and it is not intended that the claims herein shall limit this design to the present mathematical arrangement or to the number of bars necessary to accomplish the proper distribution.

Upon this structure the original pressure is applied by the natural movements of the operator in closing the machine and in a normal, leaning position after the machine is closed. The pressure is maintained in this manner during the brief interval of exposure without the necessity of fastening buckles, which would interrupt normal operations. However, buckles may be provided on larger models to exert great pressure upon larger areas. More attentive control of the operation is also maintained and some efficiency results from the hand being already in position to open the machine after the exposure has been made. Other advantages are apparent in a pressure plate compactly designed and activated economically through natural manual operations.

All of the material used in connection with the lamp structure of the machine should be fireproof and of a suitable dielectric quality, because of the hazards of arcing in the high-voltage circuits of the lamp system, and all plate material should be of uniform flatness throughout the structure. From the base plate upward each succeeding plane of weight or pressure should react flatly and evenly with plane of contact in such a way that warp stress is kept at a minimum. Research has proven that

even small points of pressure, very small degrees of stress, and any degree of convexity at any distant point in the structure, either individually or collectively, may affect the ultimate plane of contact during the copying operation.

The attainment of the above-mentioned objects will be more apparent in the following descriptions made in conjunction with the accompanying drawings:

Figure 1 is a perspective view of the contact copying machine with cover and pressure plate in a 90-degree open position with the front panel of the case and the apron of the pressure plate removed.

Figure 2 is a perspective view of the entire machine in a closed and carrying position.

Figure 3 is a perspective view of the machine in a 180-degree open position, showing also a book in copying position, also the plane of clearance for very large books, and a perspective view of pressure plate with parts broken away disclosing pressure-distribution bars and templates.

Figure 4 is a sectional view of the entire machine taken along line 4—4 of Figure 2.

Figure 5 is a horizontal sectional view of Figure 2 taken along line 5—5 looking down upon the whole pressure plate in a closed position and disclosing the distribution of templates along the pressure-distributing bars.

Figure 6 is a sectional view of the entire machine taken along line 6—6 in Figure 2.

Figure 7 is a top view of the interlocking tube circuits, angularly-indented tubes being used.

Figure 8 is an end view of the interlocked tube circuits of Figure 7.

Figure 9 is a sectional view taken along line 9—9 of Figure 7.

Figure 10 is a view of one of the tube circuits in which the U-bends are made within the plane of the straight tubing.

Figure 11 is a view of the other tube circuit in which the U-bends are made perpendicular to the plane of the straight tubing.

Figure 12 is an end view of the interlocked tube circuits, cylindrical tubing being used.

Figure 13 is a cross-sectional view of the interlocked tube circuits, angularly-indented tubing being used.

Figure 14 is a cross-sectional view of the interlocked tube circuits, triangular-shaped tubing being used.

The entire laminate structure of the contact copying machine, when in operating position, rests on a base plate of uniformly flat material, preferably sheet aluminum, which in the drawings is designated as 10. Two side walls 11 and a rear wall 12 are attached to the base plate by saw-type bolts 13. These walls are preferably formed or constructed of translucent material which will effuse the light around the edges of the lamp and will not serve to reflect it inward over the plane and cause unevenness of light on the copy plate, as opaque walls would.

Upon shoulders 15 of the side walls is seated a rectangular, transparent glass copy plate 14. All of the structure beneath the copy plate is laminate with, and in supporting relation to, the lamp and copy plate. Lamp base 16, which is slidable and removable, supports mat 17 of a resilient but firm substance, which in turn supports lamp plate 18 of uniformly flat and rigid substance, preferably plate glass. As seen in Figures 1 and 2, to lamp base 16 is attached by screws 16b a thin translucent panel 16a serving as a false front wall and as a flush side for making copies from books placed in a 90-degree open position adjacent to tubes and copy plate.

Upon lamp plate 18 rests the lamp 19 consisting of the two tube circuits 20 and 21, which when interlocked and illuminated form a continuously uniform plane of light. All of the underlying structures are so gauged that they will support the lamp in a contiguous relation with copy plate 14 and cause the lamp itself to support considerable weight and pressure. In gauging these structures a tolerance may be provided and the solidness of the entire lamp

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base may be completed by inserting sheets of suitable dielectric material between mat 17 and lamp plate 18. When resting upon such a structure the lamp itself can support several thousand pounds of pressure, inasmuch as each tube length in the lamp can itself support several hundred pounds when laid upon a uniformly flat surface.

The duty of bringing evenly distributed pressure upon the photocopy material laid upon the above-described structure falls to the main pressure plate designated generally as 22 and the frame for manually or mechanically applying the original pressure designated as 23.

The first plate in the general structure 22 to receive the force from frame 23 is cover plate 24. This plate consists of a thin, rigid, rectangular sheet, preferably of aluminum, extended on two sides to form clipped triangular flaps 25 bent downward, wrapped partially around, and clinched to end-plates 26. Cover plate 24 is also extended along one edge to form flap 25a which is bent downward to shield the front edge of the general structure of pressure plate. Cover plate 24 now holding within its framework the entire pressure plate structure is permanently and pivotably fixed to frame 23 by bolts and nuts indicated by 27 and adjusted to the plane of contact by thumb-screws and bolts 28 in slots 29.

Actuating frame 23 is made of rigid tubular material first bent into a U-form, accommodated with elbow fittings 30 at each end, and is then made into a complete rectangle by axle piece 31, as indicated in Figure 4 and best observed in Figure 5. Axle piece 31 threaded on each end is first screwed into one of the elbow fittings when the other fitting is turned out of the way, then it is screwed back into the other fitting returned into the proper position. Axle piece 31 is enclosed in a cylindrical boxing formed by semicircular grooving extending longitudinally along rear wall 12 and by similar grooving in cap piece 32. A brake for axle piece 31 and actuating frame 23 is conveniently created in this cylindrical boxing by tightening and adjusting cap piece 32 with bolts and nuts 33. Then frame 23 will remain stationary at any angle at which it is stopped. When the machine is closed, straps 23a, with buckles, are fastened around frame 23 and thence to side walls 11, as shown in Fig. 2, to hold machine closed for carrying purposes.

When frame 23 is rotated to a position parallel to the plane of contact it girdles the entire copying machine and when pressure is exerted downward along its handle side cover plate 24 receives this pressure first along edges 34, as seen in Fig. 2, and some of this pressure is distributed normally over the cover plate, but it is obvious that ordinarily this cover plate would tend to bulge up diminishingly from its middle portion outward. But in the present invention this potential bulge is counteracted or flattened out by pressure-distributing bars, the first of which is designated as 35 in Figs. 3 and 5. These bars should be rigid, compact and light in weight, preferably of aluminum. While serving to reinforce cover plate 24 they also transmit pressure to templates disposed in various lengths and in various positions along their under-sides. These templates, one of which is designated as 36 in Figs. 3 and 5, may be of the same cross-section, size and material as the pressure-distributing bars themselves.

The positions of templates 36 are best examined in Figure 5, in which their running lengths are designated respectively by letters A to V. For example, template 36 runs from A to B. Others run in succession beneath their respective pressure bars as follows: C to D, E to F, G to H, I to J, K to L, M to N, O to P, Q to R, S to T, and U to V. Other areas not indicated as being supported by templates are bridged over by the pressure-distributing bars. The interspersed pressure areas of the templates and the bridged-over areas therefore distribute the pressure from cover plate 24 to transmission plate 37, the transmission plate being a pressed-wood board of the same areal dimensions as the copy plate. Transmission plate 37, templates 36 and cover plate 24 are all fastened

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together by saw-type bolts 38 whose heads are sunken both on the top side of cover plate 24 as well as on the bottom side of transmission plate 37, the circlets in Figure 1 are only shown to indicate the positions of these bolts.

Sponge-rubber mat 39 is fastened to transmission plate 37 with Plastikon or other suitable adhesive; and to sponge-rubber mat 39 is fastened with rubber cement a thin, white, rubber sheet 40, which serves as a background for material being copied.

Components of lamp 19 may be studied by references to Figures 7-12. The tubular glass stock used in lamp is commercially obtainable in several lengths, sizes, and shapes, and is preferably of the fluorescent, coated type. The tube circuits may be formed by heating, bending, and joining tube lengths as in the regular glass tube bending trade. Modifications of this procedure may be noted however in my application filed June 29, 1951, Serial No. 234,326, entitled Illuminating Device, and now abandoned, wherein pre-formed, molded connectors are illustrated for the continuation of the tube circuits around the bends as a substitute for bending, possibly for mass production, and in Patent No. 2,286,239 to I. Sors, June 16, 1942, in which individual pre-formed fittings are illustrated.

Referring particularly to Figures 10 and 11, the U-bends in tube circuit 20 are made in coplanar relation to the straight lengths of tubing, and in tube circuit 21 the U-bends are made perpendicular or at an angle to the straight lengths. Intervals 41 and 42 of the respective circuits are determined by the outside diameter measure and shape of the tubing used. When round tubing is used these intervals should be almost exactly equal to the outside diameter of the tubing used, allowing a tolerance only for manufacturing variations in the tubing walls, so that circuits 20 and 21 will mesh almost solidly as shown in Figure 12. When angularly indented tubing is used these intervals should allow circuits 20 and 21 to mesh as in Figures 7 and 8. When triangular-like tubing is used the circuits should mesh as in Figure 14.

With the accomplishment shown in Figure 14, it will be readily seen that an area of solid and evenly-distributed light will appear on surface represented by line 43-44 in Figure 14, or line 45-46 in Figure 13, which is the major objective in this invention.

Turning finally to the electrical supply for energizing and illuminating lamp 19, electrodes as indicated by 61, or a more compact design, may be obtained commercially. Tube circuits 20 and 21 may be connected together in series and thence to connections 62 and 63 when only one secondary current and one transformer are used, or they may be connected individually in series to connections 62 and 63, with two additions connections provided, when two secondary currents and two transformers are used. In either case connecting wires may run through lamp base 16 to the distant terminals, unless the formations of tube circuits 20 and 21 result in all of the electrodes being on one end of the machine, which is the simpler arrangement. Suitable transformers and exposure-timing devices for attachment to connections 62 and 63, and for completing the electrical system, may all be obtained commercially.

The following claims are therefore made:

1. A photographic contact printer comprising a rectangular body of three walls supporting on their shoulders a translucent copy plate and, slidable into the body through its open side, a lamp producing light evenly distributed in its origin throughout a plane held flatwise and immediately adjacent to the copy plate, one edge of the lamp being translucent and even with the free edge of the copy plate to permit light to overflow that edge; a rigid frame holding encompassed a pressure plate and hinged to the rear wall of the said body by means incorporating braking friction for holding the frame and pressure plate stationary when not in operation, the frame being means for

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applying pressure upon the pressure plate and for revolving the pressure plate into a plane of contact with the copy plate and into other positions, a portion of the frame opposite its hinge side being a handle for these operations and for hand-carrying the entire photographic contact printer; pivoted to two parallel sides of said frame a pressure plate rotatable on its pivoted axis to a position in which its pressure-forwarding surface, in the orbit of the revolving frame, will subside into a plane of contact with the copy plate and fixed in that position at at least two points on the frame which are removed from the pressure plate axis; the said pressure plate consisting of a cover plate receiving at two of its opposite edges the pressure applied to the frame, a plurality of primary pressure-distributing bars running continuously across the cover plate parallel to its axis and parallel to each other and fastened to the pressure-forwarding side of the cover plate, and a plurality of secondary pressure-distributing bars of variously determined lengths respectively attached longitudinally at planned intervals along the pressure-forwarding surfaces of the primary pressure-distributing bars; and a contact plate of flat and resilient material fastened to the pressure-forwarding surfaces of the secondary pressure-distributing bars.

2. A pressure plate for a photographic contact printer

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comprising a cover plate to which pressure is applied at two of its straight edges; fastened to the pressure-forwarding sides of the cover plate a plurality of primary pressure-distributing bars extending parallel to each other across the cover plate at right angles to its pressure-receiving edges; a plurality of secondary pressure-distributing bars of variously determined lengths respectively attached longitudinally at planned intervals along the pressure-forwarding surfaces of the primary pressure-distributing bars; and a contact plate of resilient material fastened to the pressure-forwarding surfaces of the secondary pressure-distributing bars.

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