April 27, 1965 W. WANIELISTA ETAL 3,180,973

APPARATUS FOR FUSING MASTER PLATES

Filed Dec. 15. 1961

3 Sheets-Sheet 1

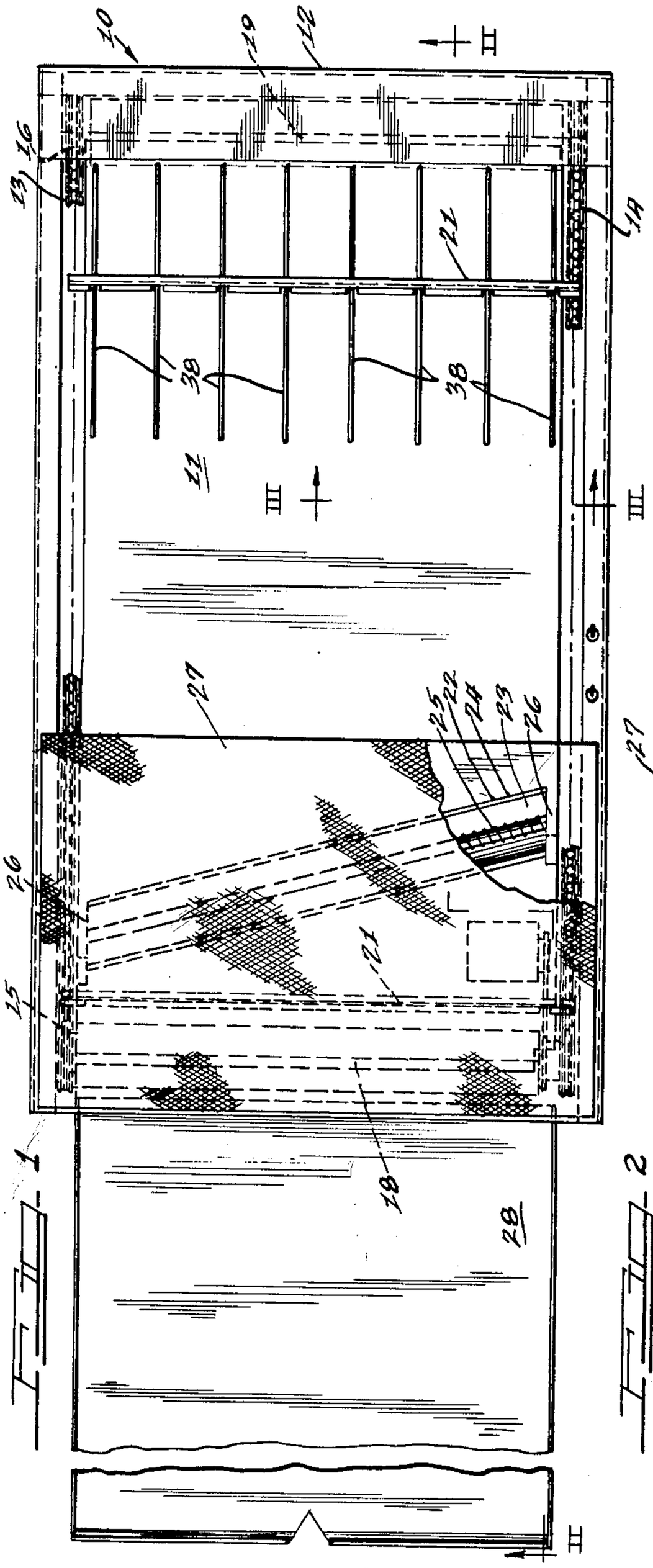

FIG. 1

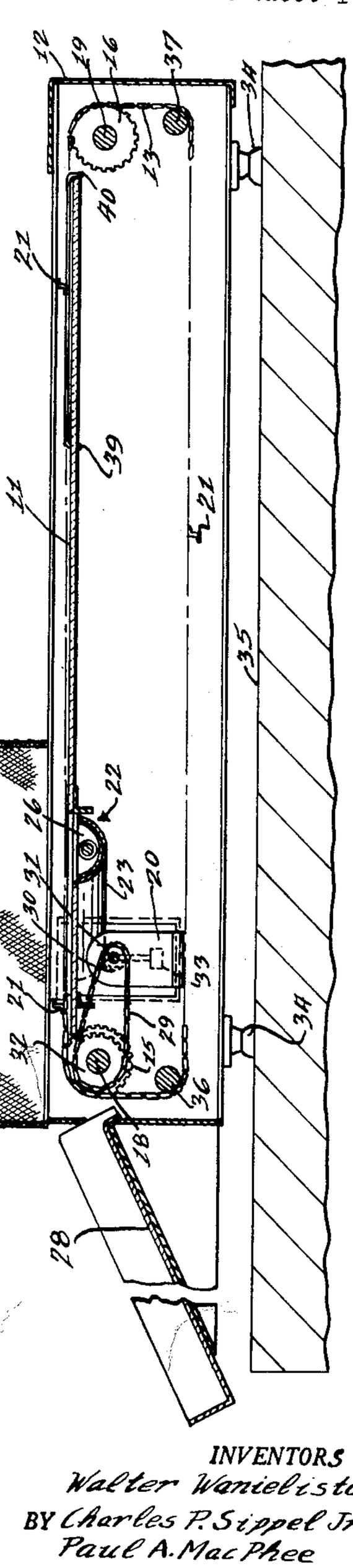

FIG. 2

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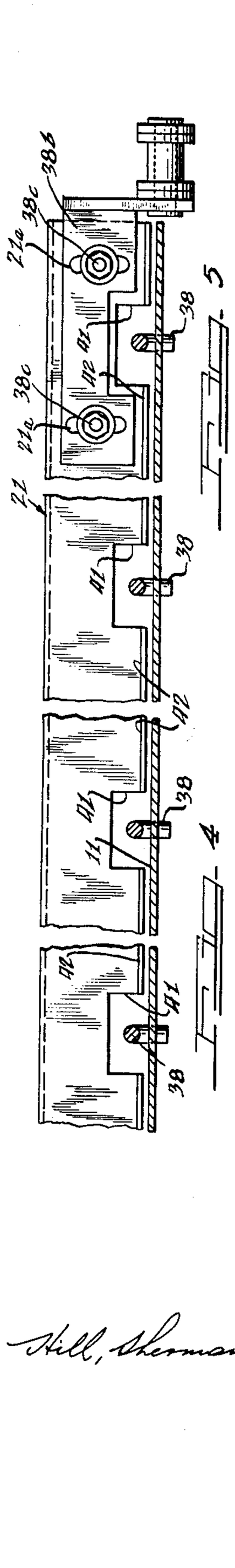

FIG. 5

FIG. 3

FIG. 4

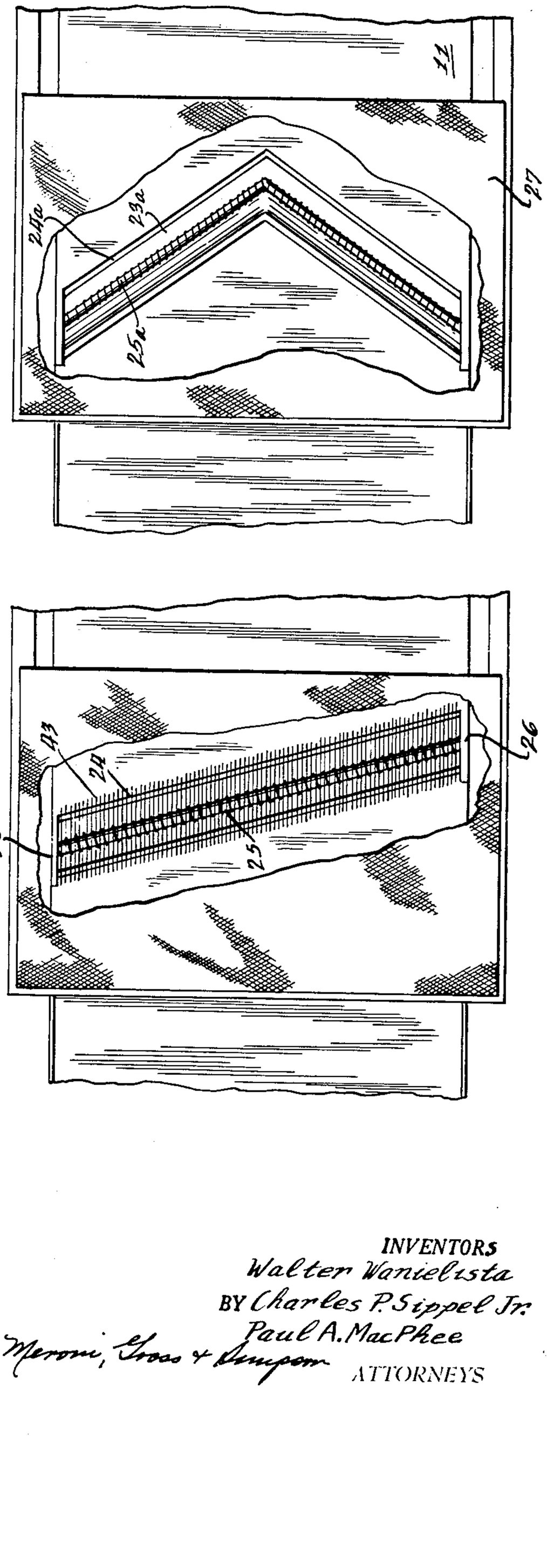

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FIG 6

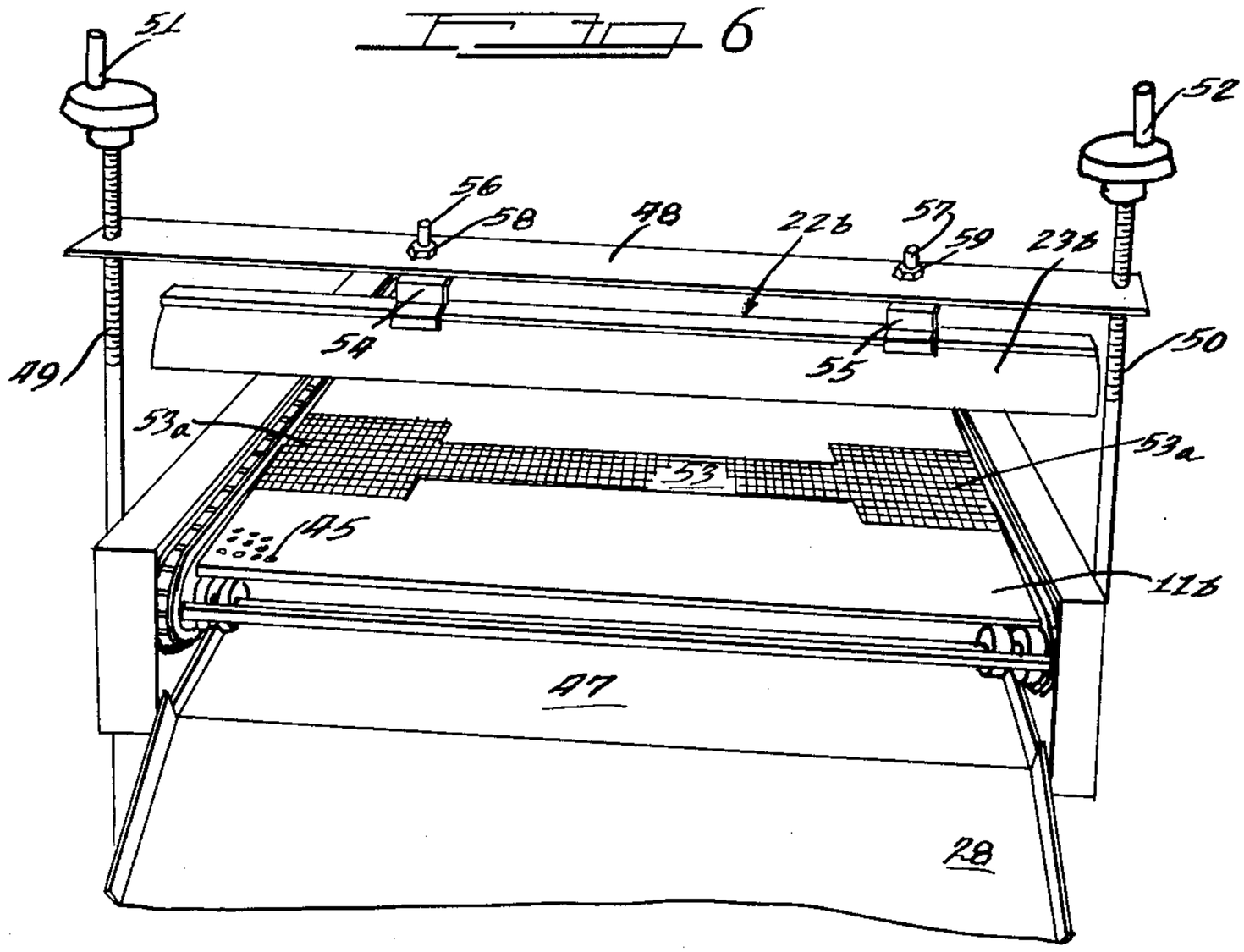
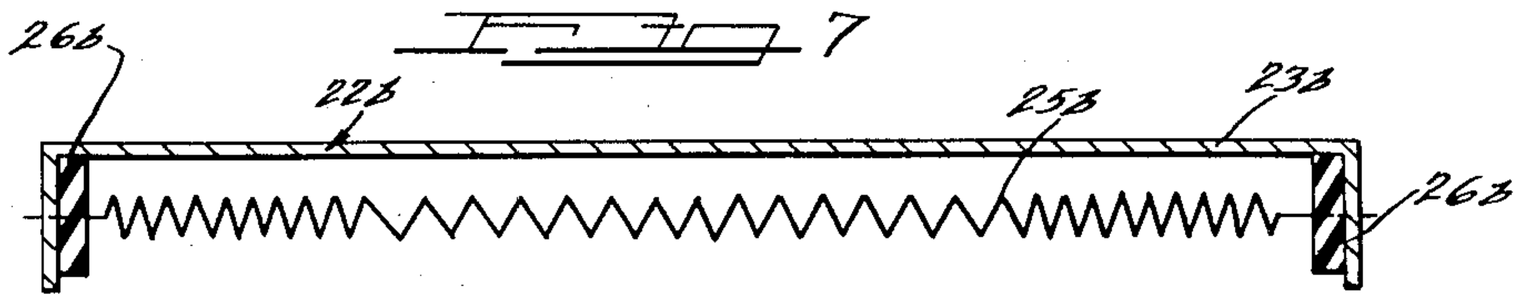


FIG 7



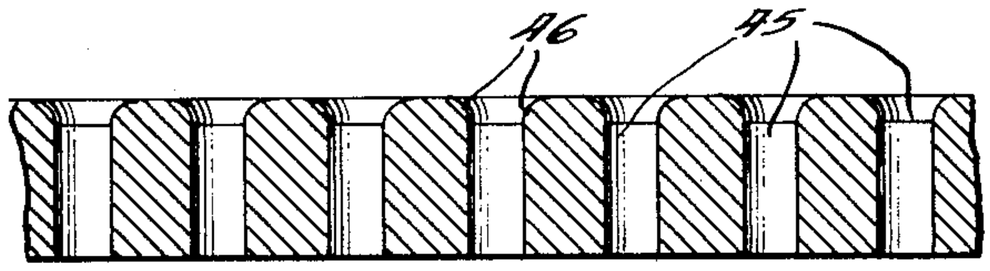


FIG 8

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APPARATUS FOR FUSING MASTER PLATES

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6 Claims. (Cl. 219—388)

This invention relates to apparatus for fusing thermosensitive materials on image bearing members such as master plates for lithographic processes and the like, and more particularly to a fuser for use in electrostatic processing apparatus.

In making master plates for lithographic work, or the like, a reproduction is utilized which takes the form of a latent electrostatic charge image, forming a magnetic pattern on a suitable plate-like member or matrix. Application of a developer mixture to the image-bearing plate serves to develop this latent image. Typically, developer mixtures include a so-called toner powder or developer powder, with magnetizable particles such as iron filings or the like interspersed therewith. Brushing contact of such powder may be effected in a manner such that the image is substantially localized in accordance with the object being reproduced, and stabilization of the image is accomplished by the fuser of the present invention in a substantially automated manner.

Thus, the invention provides for placing a master plate or the like of paper or other suitable material on the end of a table which may have longitudinally aligned bars to elevate the same slightly for engagement by a pusher bar. The pusher bar or flight bar, may have a Z-shaped cross-sectional configuration so that a lower portion thereof engages beneath an end of the plate or paper, and a central vertical portion pushes the paper over the somewhat elevated longitudinally extending rods and over the table support surface. The movement of the flight bar is accomplished by connection thereof to an endless belt or chain structure operated by suitable motor means which may be adjustable as to speed. The flight bar thus carries the paper into a fusion zone provided by heating means, preferably disposed above the table so that the heat strikes the powdered material to be fused from above. Thereupon, the flight bar carries the image bearing plate with the image fused thereon to a take-off location which may be provided by an angularly inclined dispensing tray or the like.

The amount of heat and extent of application of the heat are critical factors in an effective image forming process according to the invention. Thus, too great an amount of heat will serve to fuse dispersed background particles to the paper. Again, too little heat will result in an insufficient fusing so that the image defining powder may be readily brushed off. Further, it is necessary that the heating effect be substantially uniform over the plate to be treated. Otherwise, differential fusion rates will occur which will result in an uneven image.

Likewise, a problem exists in the presence of moisture in the paper. The heating must be such as to prevent a distortion of the plate from uneven heating on opposite sides thereof. Also, "weeping" of the plate from the heat effect must be compensated for, and the tendency for a plate from which moisture is removed at one side only to bow or bend must be taken into account. The present invention overcomes these problems and provides an effective apparatus for fusing master plates.

Accordingly, it is an object of the present invention to provide a fusion means for fusing master plates for lithographic processing or the like, which master plates are characterized by a latent image formed by electrostatic means or the like, together with an overlay of magnetizable particles adhering thereto with toner powder of thermoplastic characteristic such as can be adhered to the plate upon fusion through heat.

Another object of the invention is to provide a device as described which will move the master plate at a predetermined rate through a heat zone.

Another object of the invention is to provide apparatus as described which will heat the plate uniformly and prevent distortions such as would bend or bow the plate.

Another object of the invention is to provide a device as described which selectively heats the particles which are closely aligned in proximate relationship, while preventing fusion of the more widely dispersed particles.

Other objects and advantages of the invention will become apparent as the description proceeds in accordance with the drawings in which:

FIGURE 1 is a top plan view of an apparatus according to the present invention;

FIGURE 2 is a vertical sectional view, partly broken away, of apparatus according to the view of FIGURE 1, and taken along the lines II—II of FIGURE 1;

FIGURE 3 is a view taken along the lines III—III of FIGURE 1;

FIGURE 4 is a top plan view, partly broken away, of another embodiment of heating means according to the present invention and associated means for affording passage of a master plate thereacross;

FIGURE 5 is a corresponding view of yet another embodiment of the invention;

FIGURE 6 is a perspective view of another form of fusion means according to the present invention;

FIGURE 7 is a vertical sectional view of heating means for the structure of FIGURE 6; and

FIGURE 8 is an enlarged vertical sectional view, partly broken away, of a support plate for the device of FIGURES 6 and 7.

Referring now to the drawings, and to FIGURES 1–3 in particular, a fusing apparatus **10** is shown in accordance with the present invention which includes a support surface **11** which, in the form shown, may be an asbestos material or other insulative material to overcome the heat sink effect of the paper to be treated and absorb moisture therefrom; a box-like housing **12** supporting the support plate **11**; a pair of flight chains **13** and **14** entrained on front and rear pairs of sprockets **15** and **16** joined by bars **18** and **19**; motor means **20** for the sprockets and flight chains; and a flight bar (or plurality of flight bars) **21** secured to opposite chains **13** and **14** transversely of the assembly and the support **11**.

In accordance with the invention, and in order to supply heat to a plate to be fused as above described, by the fusion of thermosensitive and plastic particles forming a part of a toner powder, a heat application means **22** is mounted adjacent one end of the support **11** which in the form shown, includes a concave elongated reflector **23** set in a diagonal cut **24** in the support **11**; and an elongated heating means **25** secured in end insulating supports **26** so as to direct radiant energy from a focal point relative to the reflector **23** in the manner of a parabolic reflector. The heating means **25** may be a "Calrod" (trademark for a rod-like heating member) or a bar wound with a resistance element, as understood by those skilled in the art. In any event, it will be seen that the cut **24** extends at a diagonal or bias to the axis of the support **11**.

The support **11** in effect defines an approach path for a plate (not shown) moved forwardly by a flight bar **21**. Thereby, the plate will extend one corner thereof to the innermost end of the cut **24** (at the lower portion of FIGURE 1 in the embodiment shown) and this corner will extend across the gap thus formed.

To this end, the portion of the support **11** on the opposite side of this structure is preferably depressed slightly

adjacent the gap so that there will be no inadvertent catching of the plate. However, should such catching occur, only the corner will be engaged and will then be cammed upwardly into the usual flat planar condition. The oncoming plate will have the forward edge thereof guided smoothly over the gap by the corner which first crosses over the gap. Thereby the problem presented with a transverse cut, which would tend to engage the entire front edge of the plate and prevent the plate from moving further, or would otherwise distort the fusing process, has been eliminated.

A guard cage or foraminous expanded metal housing 27 may be mounted above the heating means 22 to prevent inadvertent disturbance of the fusion process and to an extent guard against the effects of air currents.

Heat will be directed against the plate upwardly from the reflector 23 to penetrate the material of the plate and fuse the image from below. Thereafter, the flight bar will move the plate onto the downwardly inclined take-off tray 28, or other suitable means for receiving the completed plate.

In accordance with the invention, one set of the sprockets 15 and 16, such as the front set 15, is energized by the motor 20 through an endless chain 29 or the like trained on a sprocket 30 to the motor shaft 31, and also trained over a sprocket 32 fixed to the front shaft 18 for the sprocket 16. However, the location of the shaft 31 or drive vertically may be varied by suitable bolt means 33 or other means, preferably associated with indicia to indicate tautness. In one form of the invention a belt is used instead of the chain 29, so that a degree of slip is provided by varying the extent of tautness, thereby to control the speed of the chains 13 and 14.

The housing 12 may be supported in any suitable manner as by legs 34 on a support surface 35, and it will be appreciated that variations in this construction are encompassed within the scope of the invention. Set transversely across the housing in subadjacent relation to the bars 18 and 19 for the sprockets 15 and 16, are guide shafts 36 and 37 which assist in guiding the chains in a continuous circuit and similarly provide a directed travel for the flight bars.

It will be appreciated that the flight bars must initially pickup the master plates to be fused and to this end a plurality of parallel, elongated rods 38 of brass or the like are set in the support 11 at the initial position of travel. The rods 38 may have depending ends 39 and 40 to secure them in the said support 11, and the flight bars desirably are cut out in a saw tooth configuration as indicated at 41 to accommodate the said rods 38. Thus, the lower forwardly extending flanges 42 of the flight bars are disposed below the level of the rods 38 and can engage beneath the said plates in a suitable manner to move them forwardly. Also, the flight bars are vertically adjustable by means of end brackets 38*b* and bolt means 38*c* in slots 21*a* at the flight bar ends.

Referring now to FIGURE 4, another arrangement is shown wherein similar parts are designated by similar reference numerals, but a plurality of proximately laterally spaced longitudinally extending and parallel wires 43 are formed across the gap 24. These wires desirably are extremely fine wires and have their opposite ends secured to the adjacent material of the support 11. It will therefore be seen that the master plates will be guided across the gap 24 in a desirable manner without any tendency to become caught or obstructed by the gap or by related parts.

Referring now to FIGURE 5, another form of the invention is shown wherein a chevron shaped gap 24*a* is utilized in conjunction with a reflector 23*a* and heating rod 25*a*. In this form of the invention, the plate will be moved so that the center portion thereof is substantially across the gap by the time the forward corners are in a position to contact the gap. Thus, any catching is eliminated and the plate is guided forwardly without interference.

Referring now to FIGURES 6, 7 and 8, another form of the invention is shown which is characterized by an overhead heating means 22*b* wherein the heat is directed on to the thermoplastic material to be fused without the need for passing it through the body of the paper plate. A considerable amount of energy is absorbed in the passage of heat through the plate from below as in the preceding embodiments, together with a removal of moisture which in some instances might tend to bow the plate. The structure is otherwise similar, but the plate or support 11*b* is made of a metal such as aluminum provided with a plurality of vertical openings 45 which are bevelled outwardly at their upper ends 46 in a countersunk effect.

The apertured construction described is effective to take-off any moisture which might be produced in the heating of a plate by the heating means 22*b*, so that the moisture can pass downwardly through the plate 11*b*. Also, the bottom surface of the housing 12*b* is preferably of a reflective material, as indicated at 47, and so heat is redirected and reflected upwardly to balance the heating on the upper side of the plate and thus maintain a planar condition for the plate during its fusion process. It will be noted that the paper could also be preheated.

The heating means 22*b*, accordingly, preferably includes an elongate support bar 48 threaded on vertical adjustment rods 49 and 50. The adjustment rods 49 and 50 thus extend threadedly through the opposite ends of the said bar 48 and in turn are journalled by suitable means (not shown) at the sides of the frame work or housing of the structure. Handles 51 and 52 are formed at the upper ends of the rods 49 and 50 so that by rotation of the said rods, the elevation of the bar 48, and hence of the heating means 22*b* of the whole, may be adjusted. It will be appreciated that such adjustment will alter the amount of heat directed on to a master plate, as hereinafter further described.

The means 22*b* further includes a shield 23*b* of suitably polished or reflective material, which is concave downwardly. The shield 23*b* has disposed therein a resistance wire 25*b* secured at suitable insulating ends 26*b* and connected to further terminal and conductive means as understood by those skilled in the art. In accordance with the invention, however, and as shown in FIGURE 8, the end portions of the wire 25*b* are preferably wound more tightly than is the central portion of a wire, with the result that a greater amount of heat is produced at the opposite ends of the wire to be reflected downwardly against the outer portions of the master plate. These portions are naturally exposed to environmental cooling influences which are thus compensated for by the denser end windings for the wire.

Further to this end, and also to provide an extent of preheating and heat retention in the support 11*b*, a black coated area 53 is formed in register beneath the shield or reflector 23*b*. This area may be made of any suitable heat-absorptive paint or pigment, which desirably is permanently adhered to the metal surface 11*b*. However, this black material does not occlude the openings 45.

The ends 53*a* of the black band 53 are relatively wide, as shown, so as to preheat the portion of a plate or matrix which may approach thereover. Thus, the heat is transmitted to the plate at the sides thereof to a somewhat greater extent than centrally thereof, further to compensate for environmental cooling influences at the sides of the structure.

The reflector shield 23*b* may be secured to the support bar 48 by any suitable bracket means 54 and 55 combined with bolts or the like 56 and 57 and nuts 58 and 59.

However, it is within the scope of the invention to bow the said shield from a central point downwardly about an axis extending longitudinally of the structure as a whole, and perpendicular to the axis of the shield. Thereby, the ends of the shield are brought closer to the sup-

port surface **11***b*, to further minimize environmental cooling influences at the sides of the structure. Thus, fine adjustment in fusing action is afforded, cooperatively with rougher adjustment by the speed control referred to.

Accordingly, there has been provided a fusion system which is highly effective in fusing thermoplastic image-representing toner powders without a fusion of background materials. The adjustment of the heater means **22***b*, in particular, and the fact that the heating of the fusion material is direct rather than from the bottom of the paper plate or the like, permits a highly selective temperature range to be provided which will largely avoid the fusion of dispersed background portals such as might clutter up the image. The density of the particles is directly proportionate to their sensitivity to heat.

Although we have herein set forth and described our invention with respect to certain specific principles and details thereof, it will be understood by those skilled in the art that these may be varied without departing from the spirit and scope of the invention as set forth in the hereunto appended claims.

We claim as our invention:

1. A fuser for fusing master plates comprising a planar support, a plurality of longitudinally extending spaced rods at one end of said support having surfaces thereon extending above said support to receive a master plate and to hold the plate above the support, a flight bar extending transversely across and spaced above said support and movable forwardly over said support, said flight bar comprising a first portion extending substantially perpendicularly to said support and below said surfaces of said rods to engage only a rear edge of a plate being supported on said surfaces, and a second portion extending substantially parallel to said support and forwardly away from said bar to support the rear edge of the plate above said support during forward movement of said flight bar, means for moving said flight bar forwardly in successive passes over said support, and electric heating means mounted above and extending transversely of the support to heat and to fuse the master plate moved by said flight bar.

2. A fuser for master plates or the like comprising a support plate, electric heating means above the support plate to direct heat downwardly thereon, a plurality of elongated rods in parallel, spaced apart longitudinal alignment at one end of the support plate, a flight bar, means for moving the flight bar in successive passes over the support plate in perpendicular relation to the said rods, and cut-out portions on the flight bar for accommodating the rods, said flight bar having a lower edge disposed by said carrying means beneath the said rods and extending forwardly from said flight bar to pick up a rearward edge of and to move a master plate across the support plate while maintaining the rearward edge of the master plate above said support plate.

3. A fuser for master plates or the like comprising a support plate, a plurality of elongated rods in parallel, spaced apart longitudinal alignment at one end of the support plate, a flight bar, means for moving the flight bar in successive passes over the support plate in perpendicular relation to the said rods, and cut-out portions on the flight bar for accommodating the rods, said flight bar having a lower edge disposed by said carrying means beneath the said rods and extending forwardly from said flight bar to pick up a rearward edge of and to move a master plate across the support plate while maintaining the rearward edge of the master plate above said support plate, and electric heating means extending laterally across the support plate for heating a master plate carried by the flight bar, said heating means being disposed above the support plate.

4. A fuser construction comprising a metal plate having openings therein, a pair of vertical threaded rods journalled on each side of said plate, a support bar threaded onto said rods for adjustment in height by rotation of the rods, and a downwardly concave reflector carried by the support bar, said reflector having an electric heater therein extending thereacross, and means for engaging only at the rearward edge thereof and for moving forwardly a thin member to be fused across said metal plate and beneath said concave shield while maintaining the rearward edge of the thin member above the metal plate.

5. A fuser for fusing master plates comprising a planar support, means defining a plurality of rods at one end of the support and extending in spaced relation to said support for receiving a plate thereon, a flight bar, means for moving the flight bar over the support in a plane parallel to said support, cut-out portions on the flight bar for accommodating the rods, and electric heating means mounted above and extending transversely across the support to heat and fuse a master plate moved by the flight bar, said flight bar having a lower flange adjacent said cut-out portions for engaging a plate at the rearward edge thereof and for moving the plate over the support.

6. A fuser for fusing master plates comprising an elongated planar support, a plurality of rods on one side and at one end of said support having surfaces defining a plane parallel to and spaced from said support for receiving a plate, a flight bar associated with said support and movably mounted away from the support to traverse the length of the support in a plane parallel thereto, cut-out portions in said flight bar to accommodate said rods, a flange on said flight bar and extending forwardly therefrom and located so as to pass between the support and said surfaces of said rod during a traverse of said flight bar for engaging only the rearward edge of a plate received on said rod and for moving said plate across said support while maintaining the rearward edge of the plate away from said support, and electric heating means mounted above and extending transversely of the support to heat and fuse a plate moved by the bar.

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