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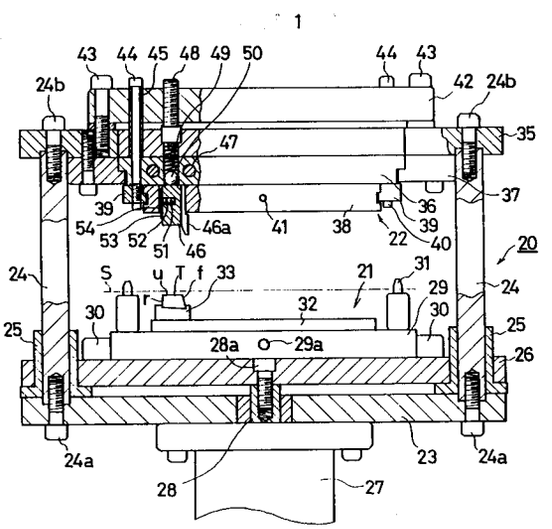
(54) **APPARATUS FOR PRINTING SYNTHETIC RESIN MOLDED PIECE.**

(57) An apparatus for pressing a printing sheet against a multiplicity of molded pieces supported on the top surface of a substructure and heating, wherein a heating member serving as a print head is supported on a superstructure and the pressing force of the heating member can be controlled from the top surface of the superstructure.



EP 0 485 638 A1

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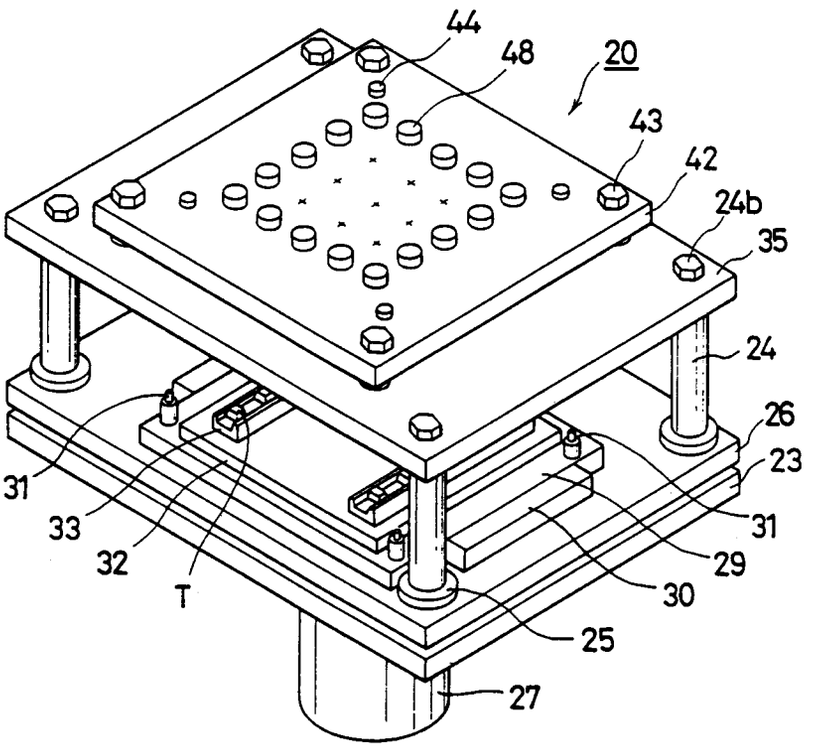


Field of Art

The present invention relates to apparatus for printing a number of moldings of a synthetic resin, and more particularly, apparatus for simultaneously printing a number of molded pieces of a small size, for example keys made of a synthetic resin and mounted on keyboards.

Background Art

Keyboards are used as operating means for such as word processors, computers, electronic musical instruments, electronic control devices for machine tools and so forth. On each keyboard, then, a set of a number of keys such as alphabet entry keys, number entry keys, cursor keys, control keys and so on are mounted according to functions as required of the operating means.

For the material for keys on the top surfaces of which characters and/or patterns are shown by printing, use is made of a synthetic resin such as PBT (polybutylene terephthalate) for example. While keys are produced by molding the synthetic resin, they are diversified in size, shape and in particular in the angle of inclination of their top faces according to their predetermined respective positions on a keyboard.

The keys T have a contour comparable to a truncated tetragonal pyramid and comprise a hollow body. They have a top face to be touched by a finger tip which is concaved, more or less shaping after the configuration of the finger tip, and have side faces each of which expands downwardly from the top face. The top face and a bottom face of a key are not parallel to each other, and a far side face of the key has a height greater than a near side face, namely a side face on the side closer to a key punching operator than the far side face. Depending on the predetermined positions of keys on a keyboard and the assigned functions of the keys, keys are so made as to have varied shapes, particularly in their side faces. Keys are made carrying various characters, patterns or the like on their top faces, showing their assigned functions according to the predetermined key positions on the keyboard. For the showing of such letters, patterns, symbols or the like on key tops, conventionally a multi-color molding method has been used, making use of resins different in color, but this production method has the shortcomings not only that the production steps required are complex and the cost of production is unacceptably high but also that it is difficult to produce fine characters, patterns or the like by molding. Thus, lately it has beome of practice to carry out a transfer printing.

Known transfer printing methods mainly comprise such a printing method according to which a letter, a pattern or the like is printed in a reversed or turned-over form on a transfer printing sheet, using a dispersion dye having a melting temperature lower than a synthetic resin used for the keys; then, the transfer printing sheet is placed in touch with the printing face on the top of the key and a heating is effected to cause the dispersion dye to become melted and to permeate into the key (sublimation printing method).

In the above described transfer printing method, backing faces conforming to the shapes of keys are formed on surfaces of jigs to be set on a printing machine, and with the angle of inclination of the backing faces appropriately altered, a set of keys are supported so that the top faces of the set of keys to form a substantially horizontal plane. Upon completion of such setting of keys, a transfer printing sheet is placed on the keys and a heated printer head is applied under pressure against the upper surface of the transfer printing sheet for the prescribed length of time to carry out the printing.

The transfer printing sheet is preparatively printed with a letter, pattern or the like in a reversed or turned-over form, and as a result of the application of pressure and heat by the printer head, a dispersion dye forming the letter or pattern on the transfer printing sheet becomes sublimated and transferred onto the keys to carry out a printing. The transfer printing sheet comprises a paper, a synthetic resin film or an aluminum foil-paper laminate, and it is in the form of a flat sheet, which may occasionally be imparted with incisions so as to be adapted to the side face shapes of keys.

As before stated, the top face of a key or the key top is concaved to facilitate touching by a finger tip and, in addition, inclined in the forward or the backward direction, so that it is diffcult to support a number of keys with their top faces arranged in the form of a plane. In placing a flat transfer printing sheet on the plane of the key top faces, it is likely that there become considerable gaps produced between the transfer printing sheet and the printing surfaces on the top of keys. In view of the above technical difficulties, the printer head is so structured as to comprise a heater part provided on the underside of a backing plate, and an elastic body comprising for example a silicone rubber, provided on the underside of the heater part in a relatively large thickness (on the order of 30 to 40 mm), whereby the printer head compresses the transfet printing sheet through the elastic body. The elastic body provided in a leading or lower end portion of the printer head functions as a kind of a cushioning member for desirably accurately pressing the transfer printing sheet against the top faces (printing surfaces) of keys having

complex shapes and also as a heat transmission member for transmitting the heat of the heater part to the printing surfaces of keys.

Conditions today required to meet in the manufacture of keys include that a variety of keys can be produced each in a small quantity, that fine characters, symbols, patterns or the like can be clearly printed, that letters or the like printed on the key top have a high durability such that they do not fade away or blur when rubbed by a finger tip bearing a trace of a cosmetic such as a hand cream thereon, and that from a view point to do with the production step, the transfer 10 printing can be carried out in a short period of time at the prescribed high temperature.

As stated above, however, the conventional printing head or printer head comprises an elastic body such as a silicone rubber provided on a surface of a heater part, which has such a large thickness as to be 30 to 40 mm, and by making use of deformation of the elastic body, the transfer printing sheet is pressed against the top faces of keys, namely the printing surfaces, so that the degree of transmission of heat from the heater part tends to be so low that a problem is posed that in order to raise the temperature on the key top to a suitable temperature for the intended printing in a short time, it is necessary to operate a preparative heating.

Also, according to the method in which a support member for jigs to be mounted on a printer, formed with backing faces conforming to the shapes of keys, is fixed on the printer, then a set of keys is supported by the support member, and with a transfer printing sheet placed in contact with the keys, the elastic body heated by a heater is pressed against the transfer printing sheet, the elastic body and the transfer printing sheet undergo deformation according to the concave shapes of key top faces. That is to say, while the elastic body does not undergo a large extent of deformation in its portions in contact with the key top faces, its remaining free portions not in contact with the key top faces undergo a considerable expansion, and in accordance with such deformation of the elastic body, the transfer printing sheet undergoes a large extent of local pulling. Conventionally, to prevent this phenomenon from occurring, it is devised to impart incisions or slits to the transfer printing sheet so as to prevent a large deformation from being generated on the printing surface.

As pointed out above, according to the conventional transfer printing methods, the elastic body comprising a silicone rubber for example that is used to press the transfer printing sheet against the key top surface is so thick that it tends to apply an excessive pressure on the printing portion of the transfer printing sheet and, in addition, it tends to expand to a large extent in its portion lying outside the key top surface to pull the transfer printing sheet in a lateral direction.

According to the conventional transfer printing methods, heating is made while a pressure application is made through a relatively thick layer of silicone rubber or the like, so that there tends to occur a considerable degree of difference between the temperature of the heater and that on the surface of the printer head contacting the transfer printing sheet, whereby a problem is likely that not only it is difficult to effect heating to a suitable temperature but also the required time for heating has to be relatively long.

Depending on a difference in the kind of electronic appliances and implements, the operation keys differ from one another in such as the concave structural feature and the area size of their top faces, the size of characters or letters and/or patterns to be printed, and the printing condition, too, may vary. Thus, if the force of pressing the transfer printing sheet against the key top is delicately adjusted, separately in connection with each of a set of keys, then it is possible to attain an optimal pressure application.

In the conventional printing apparatus, an arrangement is made such that a jig thereon supporting a number of keys can be adjusted in its vertical position relative to a support plate fixed on a frame of the printing apparatus, using bolts for example. Thus, it is possible to adjust the height of keys as a whole relative to the printing head, but it is impossible to effect a separate height adjustment for separate keys.

Depending on positions at which keys are arranged on a keyboard, the keys have to be made differing from one another in the angle of inclination of their top faces, theie shapes, their sizes and so forth, and to add to this, it is necessary to print prescribed letters and/or patterns on the key tops according to the positions on the keyboard at which the keys are to be arranged. For the printing on key top surfaces, conventionally it has been operated to manually implant individual keys of the prescribed set of keys directly in jigs to be mounted on the printer. According to such method, however, an inconvenience is met that it is indispensable to prepare a number of jigs corresponding to the number of different keyboards. To add to this, it is an extremely troublesome operation to fix keys to jigs, each time ascertaining the size and the shape of keys one by one, and with this method, it is hardly possible to cope with the cases where it is required to produce a variety of keys, each in a small quantity, and yet in a limited length of time.

In order to give a solution to the above indicated problem of the complexity for supplying keys to the printing machine, it has already been employed for practice to provide key receiving cases, in each of which a set of keys are preparatively placed according to the prescribed arrangement of keys on a keyboard, and in carrying out the printing, it is operated to mount a fresh key receiving case on a jig mounted on the printing machine in subsitution for an existing key receiving case on the jig.

However, this method, too, involves a serious problem: The operation for arranging the prescribed set of keys on a key receiving case is carried out with the key tops facing above same as their arrangement in a completed keyboard product. However, in fixing the keys to their positioning members on the jig to be set on the printer, it is necessary to manually pick up each key out of the key receiving case, transfer the picked-up key onto the positioning member fixed to the jig set on the printer, and set keys as prescribed by fitting.

As means for eliminating the need of such manual operations, a method is known, according to which a reversing jig is laid on a key receiving case accommodating the prescribed set of keys therein, and by turning the resulting assembly of reversing jig and the key receiving case upside down, the keys are transferred onto the reversing jig. By such reversing operation, the keys become in a reversed or turned-over condition. Then, on the reversed key set, the jig to be mounted on the printer is laid, and the keys and the jig are in an assembled condition turned upside down again, whereby keys are now received in the jig in a normal condition for undergoing printing.

The earlier described method of manually setting keys one by one in the prescribed positions on a jig by fitting is extremely troublesome as pointed out before. The immediately above described method of utilizing a reversing jig can attain an improvement in or relating to the operation efficiency in comparison with the manually operated method, but according to this method, not only reversing operations are required to be done but also the need is involved for a variety of devices such as key receiving cases, reversing jigs and printing jigs and accordingly the need for a fairly broad space for storing the various devices.

It is a today tendency that electronic appliances and implements are increasingly diversified and yet unit quantities for their production are relatively limited. As the electronic appliances and implements are increasingly diversified, so is the arrangement of keys on keyboards. In other words, today it has grown to be a subject for solution in the key manufacturing industry how to efficiently carry out the production of a wide variety of keys, each in a small quantity.

The present invention has been made with a view to obviating the above indicated various problems and difficulties of known printing apparatus, and it contemplates to attain the following objects.

(1) To provide a printing apparatus with which the force of pressing a heating body against objective articles for printing comrising moldings of a synthetic resin or, more particularly, touch keys or simply keys, can be readily adjusted for each of a set of keys or of small groups of the keys in accordance with particular printing conditions involved such as the particular degree of the complexity of letters, symbols and/or patterns to be printed, the shapes of top face of keys, and so on.

(2) To provide a printing apparatus in which, in order to avoid the generation of a mutual displacement likely between an objective article for the printing and a transfer printing sheet, virtually no use is made of an elastic body at a leading or lower end portion of a heating member or, if an use has to be made of an elastic body, it is possible to use an elastic body of a highly limited thickness.

(3) To provide apparatus by which the surfaces of a transfer printing sheet and of an objective article for printing can be heated rapidly to the prescribed printing temperature, whereby a precise transfer printing can be carried out.

(4) To provide a printing apparatus in which the pressing force of a heating member can be readily adjusted and which accordingly can cope with the demand for printing a wide variety of articles for printing, each in a small quantity.

(5) To provide a printing process according to which, in the printing step, keys are readily supplied in the prescribed key arrangement to a printing apparatus, and upon completion of the printing, they can be taken out of the printing apparatus and conveyed to the prescribed position outside the printing apparatus.

(6) To provide a printing process according to which a series of steps can be carried out with ease, ranging from a molding step of an objective article for printing and a printing step to a step for assembling keyboards for electronic appliances and implements.

Disclosure of the Invention

The apparatus for printing moldings for attaining the above objects according to the present invention has the following characteristics.

A) The apparatus comprises an upper structural part including heating members as a part of a printing head or pinter head, a lower structural part for supporting moldings, objective articles for printing, disposed in opposing relation to the upper structural part, and means for moving the upper and the lower structural parts towards or away from each other, wherein the heating members have pressing faces and are supported on the underside of the upper structural part in a manner of being movable to-and-fro individually or in small groups thereof so that their pressing forces can be adjusted by pressure adjusting means operable on an upper face portion of the upper structural part.

B) The heating members forming a part of the printing head are fitted in bearing holes in the upper structural part in a manner of being movable to-and-fro.

C) The heating members are held by springs provided in the bearing holes, in a manner not to come out of the bearing holes.

D) The pressure adjusting means for adjusting the force of the heating members to press against moldings comprises a bolt operable on an upper face portion of the upper structural part and a spring the pressing length of which is adjusted by the bolt, and the heating members are imparted with elastic pressing force through the spring.

E) The spring of the pressure adjusting means is in the form of a coiled spring, and either the heating member is directly pressed by the coiled spring or an arrangement is made such that through a stress concentrating member such as a steel ball supporting the coiled spring on its one side portion and pressing an end portion of the heating member on its other side portion, pressing forces can be concentrated at a central portion of the heating member.

F) The heating member is provided on its surface with a thin layer of an elastic body, by which the heating member can exert an accurate presssing force application onto surfaces of moldings.

G) The elastic member comprises a silicone rubber sheet or tetrachloro ethylene (Teflon) sheet the thickness of which is so small as to be 0.2 ~ 1.00 mm or, more preferably 0.2 ~ 0.5 mm, as opposed to the large thickness of 30 to 40 mm in the cases of conventional printing apparatus.

H) The heating members are heated by heat from an electric heating device built in the upper structural part, and for the heating device, use is made of a sheathed heater comprising a nichrome wire.

I) The heating member is formed with a lateral bore, into which a coiled spring is inserted to support the heating member movably in the bearing hole in the upper structural part by the action of a spring force.

J) The heating member has a face to press against an upper surface of a molding and a face to press against an inclined side face of the molding.

K) The heating member comprises a main heating part to press against the upper surface of the molding and an auxiliary heating part to press against side faces of the molding.

L) The pressure adjusting means for pressing the heating member from the upper surface of the upper structural part comprises a hydraulic or pneumatic cylinder device.

M) The pressure adjusting means comprises an electric motor.

N) The apparatus is structured so that a molding receiving case having the prescribed set of keys supported therein is supported on a printing jig of the lower structural part of the apparatus, in which the printing operation is carried out while the keys are maintained in a condition of floating above the molding receiving case.

O) The apparatus is incorporated in a conveyor line, which comprises a step of charging molding receiving cases having moldings placed therein, a step of disposing a transfer printing sheet in the prescribed position above a molding receiving case, a step of printing with the heating members applied under pressure against a rear-side surface of the transfer printing sheet, a step of discharging the used transfer printing sheet, and a step of discharging the moldings of which the printing is completed out of the printing jig of the apparatus.

P) For the above step of discharging printed moldings, a device is provided, for discharging the moldings by vacuum attraction.

Q) Means for feeding moldings to the printing apparatus, means for printing the moldings and means for discharging the printed moldings are arranged in a circular layout around a turntable.

R) The molding receiving case supporting moldings therein is fitted in the printing jig and is formed with an opening through which to project a member for supporting the moldings on the underside thereof.

S) The molding receiving case is formed with lateral ridge parts and vertical ridge parts crossing one another to form a lattice structure, and the prescribed positions for supporting moldings are formed at inter-sections of the crossing ridge parts.

T) The molding receiving cases can be stacked to a multi-stage assembly.

Brief Description of the Drawings

Fig. 1 is a partly borken-away front view, showing essential portions of a printing apparatus pertinent to the present invention;
Fig. 2 is a perspective view of essential portions of the printing apparatus;
Fig. 3 is a sectional partial view, schematically showing the heating member and the pressure adjusting means provided in the upper structural part;
Fig. 4 is a sectional view, showing the condition in which a key is supported on the printing jig;
Fig. 5 shows a sectional view of the key receiving case having keys supported therein;
Fig 6 shows a top plan view of the key receiving case;
Fig. 7 shows a sectional view of the upper structural part in the instance in which a cylinder device is used for the pressure adjusting means;
Fig. 8 is a side elevational view, schematically showing an automatic printing system utilizing a belt conveyor therein;
Fig. 9 is a perspective view of the printing apparatus applied to the automatic printing system shown in Fig. 8;
Fig. 10 is a top plan view, schematically showing an automatic printing system utilizing a turntable therein;
Fig. 11 is a sectional view, showing the condition in which key receiving cases supporting keys therein are stacked one on top of the other;
Fig. 12 is partly broken-away sectional view, showing the condition in which keys are supplied onto the printing jig in the codition of the keys of being supported in the key receiving case;
Fig. 13 is a side elevational view, showing the condition in which with the printing jig mounted on the printing apparatus, a printing operation is under way;
Fig. 14 is a side elevational view, showing the structural relationship between the key receiving case and the positioning jig;
Fig. 15 is a perspective view, showing the structural relationship between the key receiving case and the positioning jig in a dismounted condition of these structural members;
Fig. 16 is a front elevational view, showing the structural relationship between the heating member and the positioning jig according to another arrangement;
Fig. 17 shows a bottom plan view of the heating member shown in Fig. 16; and
Fig. 18 is a front elevational view, showing the structural relationship between the heating member and the positioning jig according to a still another arrangement.

Best Mode for the Carrying Out of the Invention

Embodiment 1:

In Fig. 1 and Fig. 2, a printing apparatus 20 comprises a lower structural part 21 and an upper strucructural part 22, of which the lower structural part 21 includes a movable plate 26 which is vertically movably supported through a bearing 25 (although it is not shown, a ball bearing is incorporated) by verticals 24 fixed by bolts 24a at four corner portions of a fixed plate 23 mounted on a frame (not shown) of the apparatus.

The movable plate 26 is fixed by a bolt 28a to a leading end of a piston rod 28 of a cylinder device 27 fixed on the underside of the fixed plate 23, and it is driven upwardly or downwardly along the verticals 24. On the movable plate 26, a support plate 29 is immovably held by mutually opposingly disposed guide members 30, while the positioning of this support plate 29 in the direction towards or away from the plane of the drawings sheet can be adjusted by an adjustment bolt 29a as it is guided between the guide members 30. Also, at four coner portions of the support plate 29, there are implanted pins 31 for supporting a transfer printing sheet S in position. Moreover, on the upper surface of the support plate 29, a printing jig 32 is fixed, on which keys T comprising moldings are supported by fitting through positioning jigs 33.

The upper structural part 22 includes a support plate 36 supported through a fixing jig 37 to the underside of a fixed plate 35 secured by bolts 24b to the verticals 24, and on the underside of this support plate 36, a heating-member support plate 38 is supported movably in a direction toward or away from the plane of the drawings sheet by mutually opposingly disposed guide members 39 fixed by bolts 40 to the support plate 36. The position of the support plate 38 is adjustable by a bolt 41.

On the upper surface of the fixed plate 35, a top plate 42 is fixed by bolts 43. Also, bolts 44 and collars 45 are provided through the top plate 42 and the fixed plate 35, and by the bolts 44, the guide members 39 are supported. Further, the bolts 44 are so extended as to have their upper ends projected above the upper surface of the top plate 42 in that it is then possible to operate dismounting or mounting and adjustment of the position of the heating-member support plate 38 from the side above the top plate 42.

In the support plate 36, a heater 47 is built in, whereby heating members 46 for heating keys can be heated to the prescribed temperature. Also, through the top plate 42, pressure adjusting means or bolt 48 is threadably provided, and at the bottom of this bolt 48, a spring 49 is disposed, which

presses at its lower end against a ball 50, through which the pressure adjusting bolt 48 presses against the upper end of the heating member 46. Accordingly, by adjusting the bolt 48 on the upper surface of the top plate 42, it is possible to adjust the pressing force of the heating member 46, namely the force of the heating member 46 to press the transfer printing sheet S against the printing surface of the key or the key top surface.

The heating member 46 is formed with a lateral or transverse bore 51, in which a spring 52 is inserted, by which a pressure plate 53 is pressed to in turn press an inner wall surface of a hole 54 formed in the heating-member support plate 38, whereby the heating member 46 is supported in the hole 54 and the vertical position of the heating member 46 can be adjusted. Therefore, the heating member 46 can automatically move vertically upon contact against the correspondingly located key T, against the spring force of the spring 49. Also, by the provision of the pressure plate 53, it is made operable with ease to removably fit the heating member 46 in the hole 54 from the side below the heating-member support plate 38.

Fig. 3 has been taken for illustration of the support structure for the heating member 46 in detail, and as shown, in an underside portion of the heating-member supporting plate 38, the opening 54 is provided, which is diametrally narrowed in its upper portion to a through-hole 54a of a small diameter, through which a pressure member 50a is inserted. This pressure member 50a comprises a head portion 50b having a larger diameter than the through hole 54a and a neck portion 50c downwardly extending from the head portion 50b. On its top surface, the head portion 50b is formed with a recess, in which the ball 50 is fitted, which is a member for concentrating the spring forces of the spring 49 at a central point.

According to the above structuring, while the heating member 46 is vertically movable relative to the heating-member supporting plate 38, it is possible with ease to mount the heating member 46 or replace it with a fresh one.

While the heating member 46 is a member for heating the top face u of the key T, it has an auxiliary heating part 46a, by which a front face f of the key T is heated, so that the top face u and the front face f of the key T can be heated and printed at a same time.

Further, as can be seen from Fig. 3, the heating member 46 is upwardly movably supported in the hole 54, and in the illustrated condition, the head portion 50b of the pressure member 50a is in contact with the upper surfce of the heating-member supporting plate 38. The process for simultaneously heating and printing the top face u and a side face of the key T is an advantageous process for the printing of multi-function keys, and as means for carrying out this process, it may be devised to form the underside of the heating member 46 to be concave so as to integrally provide a peripheral skirt part 46c as shown in Figs. 16 and 17. With the ceiling surface of the concave portion applied against the top face u of the key T and with the skirt part 46c pressed against side faces of the key T, heating may be operated to carry out a transfer printing.

Fig. 18 shows another embodiment of the heating member 46, in which a frame-type auxiliary heating member 46C defining a tetra-pyramidal inner surface is provided to a lower end portion of the heating member 46, and by the skirt portion 46c formed by the auxiliary heating member 46C, heating and pressing of side faces of the key T can be effected.

There are instances in which a clear printing free of an irregularity in the printed density can be efficiently performed by heating the key T from a lower wall and peripheral walls prior to and during the printing.

In practice, where the printing is to be made covering a relatively broad area as in the cases of a so-called flat-type key, a key having a broad printing area for the printing of an ornamental letter such as an embroidered letter or a key of which a whole top surface is to be printed except for a pattern or a figure, it is necessary to carry out a particularly uniform printing.

As means for such printing, it may be devised to use for the printing jig 32 and positioning jigs 33a a material having a high thermal conductivity such as aluminum and steel, dispose a heater 45a in a hollow formed in the printing jig 32, and heat the key T from its rear side or underside prior to and/or during printing as shown in Fig. 4, whereby it is possible to carry out a printing in a desirable manner.

Now, entering a description of the operation of the above described printing apparatus 20, keys T produced through molding step (moldings or articles to be printed) are placed in a key receiving case 60 made of a synthetic resin as shown in Figs. 5 and 6, and in that condition, they are set by fitting to the positioning jigs 33 of the lower structural member 21.

The key receiving case 60 has various functions and it functions as a kind of storing box for supplying the prescribed set of keys as a whole to the printing apparatus, as a discharge box for taking out printed keys at a same time, as a carrying box for conveying printed keys to another processing step and further as a storing box for the printed keys. This key receiving case 60 comprises a frame 61, in which lateral ridge members 62 and vertical ridge members 63 are provided in a lattice-

like arrangement, and a positioning part 64 is provided at each of the intersections of the ridge members 62 and 63, whereby an open space 65 is formed in a region surrounded by four positioning parts 64.

In the open space 65, a portion of the positioning jig 33 of the lower structural member 21 is projected, and on the projected portion of the positioning jig 33, the key T, an objective article for printing, can be fitted (refer to Fig. 15).

As earlier described, the key receiving case 60 having keys T set at prescribed positions by fitting is set by fitting on the positioning jigs 33 of the lower structural member 21 shown in Fig. 1. In the fitted condition of the positioning jigs 33, keys T are supported by fitting by the positioning jigs 33 in a condition of floating appreciably above the key receiving case 60.

Then, with holes in the transfer printing sheet S aligned with pins 31 implanted on the support plate 29, the sheet S is supported at the prescribed position relative to keys T, and the cylinder device 27 is then actuated to stretch the piston rod 28 to thereby lift the lower structural member 21.

On the other hand, the heating member 46 supported by the support plate 38 is preparatively heated to the prescribed temperature by the heater 45 built in the support plate 36. Also, the member 46 is so adjusted by the ball 50, spring 49 and the adjusting bolt 48 as to exert the prescribed pressing force, and as the lower structural member 21 is pushed up by the function of the cylinder device 27 as described above, the keys T having the transfer printing sheet S placed thereon become pressed against the heating member 46.

Further, the ball 50 is a member having a function to concentrate the spring forces of the spring 49 on a central point on the top end surface of the heating member 46, whereby it is possible to prevent the heating member 46 being subjected to a biased force application. The transfer printing sheet S comprises a sheet on which letters, symbols and/or patterns are printed in reversed or turned-over condition with for example a dispersion dye, and when it is heated at the prescribed temperature for the prescribed length of time for the melting of the dispersion dye, the turned-over letters and/or patterns printed with the dispersion dye on the transfer printing sheet S can be transfer-printed in a melted condition on the top surfaces u and the front surfaces f of the keys T.

In order to have the letters and/or patterns printed on the tansfer printing sheet to be clearly transfer-printed, an elastic body 7 forming the pressing surface of the heating member 46 should not be such a one as being deformable at a large extent for reasons as described before. Also, from the standpoint of thermal conduction, this elastic body 7 should preferably be relatively thin, or if it is possible, use of this body 7 should be avoided, advantageously.

To that end, according to the present invention, the surface of the heating member 46 that is contacted against the transfer, printing sheet S comprises a metal, which may or may not be coated with a thin layer of an elastic body such as a silicone rubber, so that while the transfer printing sheet S is prevented from undergoing a large extent of deformation to undergo a lateral displacement, and through a desirable thermal conduction, a precise sublimation printing can be carried out.

In the step for the molding of keys T, the keys T are produced in prescribed sets according to particular key arrangements on keyboards of electronic appliances and implements. So produced keys T are set at the prescribed positions in the key receiving case 60 by fitting as shown in Figs. 5 and 6. Further, in this described condition, the keys T are arranged with their front faces f and rear faces r oriented in certain respective directions and their top faces u are downwardly inclined toward the side at which a complete keyboard product may be operated. Also, in the described condition in which keys T to be printed are received in the key receving case 60, it is only that the prescribed arrangement of the keys T is met, and the keys T are not in a condition ready for receiving printing.

A plurality of key receiving cases 60 having keys T set by fitting at prescribed positions thereon as described above may be stacked with the peripheral frame 61 of an upper case 60 and that of a lower case 60 engaged by fitting as shown in Fig. 11 and once stored for example on a storing shelf.

Then, complying with a client's demand, keys T may be taken out of the storing shelf in the condition of being set in the key receiving case 60 and conveyed to the printing step.

Fig. 12 illustrates a portion of the printing apparatus, in which the reference numeral 32a denotes a printing jig to be fixed on the movable plate 26 or an operation stand of a printer. To this printing jig 32a, positioning jigs 33a are fixed by bolts 33b. The positioning jigs 33a are formed with positioning portions such as a projection 33c of a shape conforming to the inner side shape of a key T and a portion for holding a skirt portion of the key T in position. In the condition illustrated in Fig. 12, the top face u of the key T is maintained to be as much flat (as much close to horizontal) as possible so that printing on this face u can be carried out, and at the same time, the position of the center of the key T is aligned with the position of a letter or a pattern printed on the transfer printing sheet S.

Fig. 13 shows the printing step, in which keys T supplied together with the key receiving case 60 to the printing jig 32a are positioned by fitting on their respective positioning jigs 33a on the printing jig 32a, and thereafter the printing jig 32a is mounted on the support plate 29 of the printing apparatus. For this mounting of the printing jig 32a on the support plate 29, conceivable are a method of fitting the printing jig 32 on a projection provided on the support plate 29 and a method of fitting the jig 32 in a groove formed in the plate 29.

In the illustrated actual example of the operation in preparation for printing, the key receiving case 60 receiving keys T therein is fitted onto an engagement projection on the printing jig 32a fixed on the support plate 29 of the printing apparatus to complete supplying of keys T into the printing apparatus.

Then, a transfer printing sheet S is fitted at its prescribed points on pins 31 implanted at corners of the support plate to effect positioning of the printing sheet S at the prescribed position relative to the top faces u of keys T. Then, the heating member 46 vertically movably provided on the support plate 38 is pressed against the upper surface of the transfer printing sheet S in the direction shown by an arrow D to carry out heating of the transfer printing sheet S at the prescribed temperature for the prescribed length of time, whereby turned-over letters and/or patterns printed on the transfer printing sheet S are transfer-printed by sublimation on top surfaces of keys T, objective articles or moldings for the printing. Further, as shown in Fig. 1 the printing is effected not only on the top face u of the key T but also on the front face f of the key T and further on side faces of the key T as needs be.

Keys T of which printing is completed as above are removed together with the key receiving case 60 from the printing jig 32a and may be transported to a succeeding process step, which in some instance may be a step for assembling a keyboard or in some other instance may be a step for storing the printed keys T on a shelf, a temporary storing place provided in preparation for the transfer of keys to the keyboard assembling step, or further alternatively, a step for packing a number of key receiving cases 60 in for example cardboard boxes in case where the keys are to be shipped to a distant destination.

Keys T on which the printing is completed and which are taken out of the printing apparatus in manners as described above are subjected to a further treatment according to the particular system adopted in a production line in a particular factory, including the case in which they are manually fitted onto shafts on a keyboard and the case in which a plurality of keys are attracted by suction on a sucking device and all at once fixed to a keyboard, in a keyboard assembling step.

Figs. 14 and 15 show the printing step in detail in the instance in which a particular key receeiving case 60 is utilized. As shown, two rails 32b, parallel to each other, are provided in a manner of projecting above the upper surface of the printing jig 32a, by which the positioning of the positioning jigs 33a in the backward or forward direction is fixed. Through bores provided in the printing jig 32a, bolts 33b are applied to fix the positioning jigs 33a at the prescribed positions. The positioning jig 33a has a top face 33d, which is inclined in the opposite direction to the direction of inclination of the top face of a key T when it is set in a keyboard, corresponding to the degree of the inclination of the key top face, so that when the key T is placed on the top face 33d of the positioning jig 33a, the top face u of the key T can be substantially horizontally maintained.

Also, on the top face 33d of the positioning jig 33a, there are formed protuberances 33e and 33f for the positioning respectively in a longitudinal direction and transverse direction which cross each other at a right angle. These protuberances have slant surfaces inwardly inclined towards the center of the jig 33a. When a key T is fitted inside the protuberances 33e and 33f, the skirt part of the key T is held in position by the skirt portions of the protuberances. Further, in the positioning jig 33a, two slots 33g are formed between two protuberances 33e and 33e, extending along these protuberances.

On the other hand, in an upper portion inside the frame 61 of the key receiving case 60, positioning beam members 64a are provided along the vertical or longitudinal ridge member 63. In fitting the key receiving case 60 on the positioning jig 33a, the positioning beam members 64a can fit into the slots 33g. When the beam members 64a provided to the key receiving case 60 are fitted in the slots 33g as above, the keys T carried on the case 60 can be automatically supported on the positioning jigs 33a and their positioning becomes fixed. Succeeding steps for printing and discharging of printed keys T are carried out in manners as have already been described.

The printing apparatus according to the present invention comprises an upper structural part, a lower structural part disposed in opposing relation to the upper structural part, and means for moving the upper and the lower structural parts towards or away from each other, the upper structural part including heating members having pressing faces and supported on the underside of the upper structural part in a manner of movable to-and-fro individually or in small groups thereof relative to the lower

structural part, the heating members being imparted with pressing force by pressure adjusting means operable from the side of the top surface of the upper structural part, and this apparatus can bring about the following results or effects.

(1) By operating an adjuting bolt constituting the pressure adjusting means from the side of the top surface of the upper structural part, it is possible to accurately adjust the pressing force exerted by the heating members against objective articles for printing.

This means that it is possible to accurately adjust pressing forces exerted by heating members individually or in small groups thereof suitably for particular letters and/or patterns to be printed on top surfaces of keys, objective articles or moldings for printing, whereby a highly desirable printing can be carried out.

In addition, the pressure adjusting bolt can be operated on the top surface of the upper structural part or on the side of such top surface, so that it is possible to effect an adjustment so as to attain an optimum printing condition while a visual observation is performed of the existing printing condition.

(2) Pressing forces applied by the heating members can be adjusted in connection with individual heating members or small groups thereof, separately, so that while it has been necessary in the cases of conventional printing apparatus to provide a relatively thick eleastic body on the pressing face of heating members in order to make up for an error in the pressing forces of individual heating members, it is sufficient according to the present invention only if a thin layer of an elastic body is provided, whereby it can be prevented from occurring that due to a deformation of an elastic body, the transfer printing sheet is laterally pulled at a large extent to generate a shear in printing and/or a difference in the printed density.

(3) Now that it is unnecessary to provide an elastic body of a relatively large thickness, heat of the heating members can be efficiently transmitted onto the surface of the objective article for printing, so that it is possible to carry out a precise printing.

Embodiment 2:

Fig. 7 shows a sectional view, taken for illustration of essential portions of printing apparatus according to another embodiment of the present invention, which apparatus includes a hydraulic or pneumatic cylinder device 48a for the pressure adjusting means provided to the fixed plate at the top of the upper structural part 22 (the ceiling plate 42 shown in Fig. 1 is not shown herein), and also an insulation plate 35a disposed between the fixed plate 35 and the support plate 36.

The present apparatus has the cylinder device 48a in place of the pressure adjusting bolt 48, the spring 49 and the ball 50 in the apparatus shown in Fig. 1. This cylinder device 48a is either provided with means for adjusting the internal pressure and means for measuring the internal pressure 48a or connected to a pressure control device.

In the former case in the above, it is possible to adjust the internal pressure of the cylinder device 48 by operating a suitable adjusting means comprising for example a pressure adjusting screw. In the latter case, then, it is possible to monitor the existing printing condition and, through the pressure control device, perform a controlling so as to attain a pressure condition under which printing takes place according to an optimum printed sample. Further, the insulation plate 35a is provided in order to prevent a preset pressure from undergoing fluctuation likely when a fluid such as air or another hydraulic fluid contained in the cylinder device 48 undergoes expansion when the heat of the heater 47 is transmitted to the cylinder device 48.

Embodiment 3:

Fig. 8 illustrates a third embodiment of the present invention and schematically shows a series of devices for automatically carrying out the printing. Along a conveyor 100, there are provided in series a supply station (A) for supplying objective articles for printing, a transfer printing sheet supply station (B), a transfer printing station (C), a discharge station (D) for discharging used transfer printing sheets, and a product discharge station (E) for taking out printed articles.

In the present apparatus, an assembly of a key receiving case 60 having a number of keys T, the objective articles for printing, mounted on prescribed positions thereon and a printing jig 32 on the support plate 29, on which the jig 32 of the key receiving case 60 is mounted by fitting, may be supplied on the article supply station (A) at the starting end of the conveyor 100 to complete supply of the objective articles for printing.

Then, as the conveyor 100 moves, at the transfer printing sheet supply station (B) a transfer printing sheet S carrying the prescribed letters or patterns on the underside surface thereof is placed above the keys T on which the printing is to be made, by fitting the transfer printing sheet S on pins 31 on the support plate 29. Then, at the position of a printing apparatus P provided in the succeeding transfer printing station (C), the support plate 29 is set on the movable plate 26 in the lower structural part 26 and the support plate 29 is lifted

through a pushing-up operation of the cylinder device 27 to press the keys T against the heating members 46 provided on the upper structural part 22 to carry out a sublimation printing.

In the above, further, the pressure exerted by the heating member 46 is adjusted in the embodiment shown in Fig. 1 by the pressure adjusting means comprising the spring 49 and the adjusting screw 48 and, in the embodiment shown in Fig. 7, by the pressure adjusting means comprising the cylinder device 48.

Upon completion of the printing in manners as described above, the transfer printing sheet S is removed away the printed keys T at the discharge station (D) for the transfer printing sheet. Then, at the product discharge station (E), a product discharging device 101 is brought to locate above the printed keys T and is actuated to attract the keys T thereto by suction out of the printing jig 33 on the support plate 29 and carry the attracted keys T to the prescribed location. The key receiving case 60 left on the printing jig 33 in the above is released and conveyed to the step for the molding of keys T.

Fig. 9 is a perspective view, showing a device for automatically exchanging support plates 29 of the printing apparatus P of the above described third embodiment of the invention. As shown, according to this device, the support plate 29 positioned on the movable plate 26 by guide members 30 is pushed out of the printing apparatus P by a cylinder device 102 in the direction shown by an arrow to carry out exchanging of the existing support plate 29 with a fresh one on which a key receiving case 60 having keys T, objective articles for printing, mounted therein, is set on printing jigs 32 and the positioning jig 33. Further, the printing apparatus P is arranged at a side of the conveyor 100, whereby it is possible to supply keys T to be printed, together with a transfer printing sheet S, from a side position of the printing apparatus P onto the lower structural part 21 of the printing apparatus P by the cylinder 102, and after completion of a sublimation printing, transfer the printed keys T together with the support plate 29 and so on onto the conveyor 100, which conveys the printed keys T to a succeeding process step.

Embodiment 4:

Fig. 10 shows a top plan view, taken for illustration of a printing step pertinent to a fourth embodiment of the invention, in which around the periphery of a turntable 103, there are provided in series the supply station (A) for supplying objective articles for printing, transfer printing sheet supply station (B), transfer printing station (C), discharge station (D) for discharging a used transfer printing sheet, product discharge station (E) for taking out printed articles, and a discharge station (F) for discharging the key receiving case. According to the present embodiment of the invention, the various operation stations in the embodiment shown in Fig. 8 are arranged in a circular or round layout, and the printing operation is carried out in same manners as described above.

Results/Effects of the Invention

With the printing apparatus according to the present invention structured as described above, the pressure adjusting means may be operated at a position above or on the top surface of the upper structural part to adjust the pressure application of the heating member on moldings, namely objective articles for printing, so that, while the existing printing condition is visually observed, a fine or delicate adjustment of the pressure application can be carried out immediately when such is required, whereby it is possible to always maintain an optimum printing condition.

Also, the heating members for pressing the transfer printing sheet against the surfaces of moldings and effecting the necessary heating to carry out a sublimation printing are supported in a manner capable of coming into or out of the upper structural part individually or in small groups thereof, and the degree of their pressure application onto the moldings can be adjusted by the pressure adjusting means, so that the layer of an elastic body such as silicon rubber to be provided on the surfaces of the heating members can be relatively thin when compared with the elastic body layers in the conventional printing apparatus.

Therefore, the heating members can exhibit an exceeding heat transmission effect when compared with conventional printing apparatus with which it was necessary to heat molding, the objective articles for printing, in preparation for the carrying out of sublimation printing. Not only that, but also they can heat the transfer printing sheet accurately to the prescribed temperature. Further, the elastic body used is so extremely thin that the degree of deformation which it may undergo is extremely limited, so that it does not produce a force to laterally pull the transfer printing sheet, whereby the transfer printing sheet and the moldings do not undergo a mutual displacement and a clear printing can be obtained. In conventional printing apparatus, it was likely that when pressed by the heating members, the transfer printing sheet became displaced in a lateral direction, and to obviate this drawback, it was necessary to provide and use a particular transfer printing sheet formed with slits in the vicinity of a pattern for the printing. With the printing apparatus according to the present inven-

tion, a clear printing can take place even without using such a particularly processed transfer printing sheet.

Then, the printing method making use of a particular key receiving cases according to the present invention is characterized in that a same key receiving case can be utilized in all the steps of supplying moldings, the objective articles for printing, into the printing apparatus, carrying out the printing and taking the printed moldings out of the printing apparatus.

The key receiving case is useful as a case for therein receiving moldings, namely keys to be printed, in a molding step and also as a case which can be stacked one on top of the other for storing of keys. Upon decision of a particular pattern for the printing, a case having keys yet to be printed placed therein may be conveyed to a printing step, then a printing may be carried out of the keys received in the case and thereafter the printed keys may be taken out together with the case to thereby complete a series of printing operations.

Alternative to the above, it can also be performed that the keys on which the printing is completed as they are received in a key receiving case are taken out of the case by a key take-out device and arranged in prescribed positions on a layout tray. Then, a plurality of layout trays having printed keys arranged thereon may be either stored in the prescribed site for storage or conveyed to a keyboard assembling step.

In other words, as a result of utilization of the key receiving case according to the present invention, it is possible to highly efficiently fulfil a series of operation steps of from a molding step to a printing step or further to a step of assembling an electronic appliance or implement.

Claims

1. Apparatus for printing moldings, characterized by comprising an upper structural part including heating members as a part of a printing head, a lower structural part for supporing moldings, objective articles for printing, disposed in opposing relation to said upper structural part, and means for moving the upper and the lower structural parts towards or away from each other, wherein said heating members have pressing faces and are supported on the underside of the upper structural part in a manner of being movable to-and-fro individually or in small groups thereof so that their pressing forces can be adjusted by pressure adjusting means operable on an upper face portion of the upper structural part.

2. Apparatus as claimed in claim 1, wherein said heating members forming a part of a printing head are fitted in bearing holes in said upper structural part in a manner of being movable to-and-fro.

3. Apparatus as claimed in claim 1, wherein said heating members are held by springs provided in the bearing holes, in a manner not to come out of the bearing holes.

4. Apparatus as claimed in claim 1, wherein said pressure adjusting means for adjusting the forces of the heating members to press against the moldings comprises a bolt operable on an upper face portion of the upper structural part and a spring the pressing length of which is adjusted by said bolt, and the heating members are imparted with elastic pressing force through said spring.

5. Apparatus as claimed in claim 1, wherein said spring of the pressure adjusting means is in the form of a coiled spring, and either the heating member is directly pressed by the coiled spring or an arrangement is made such that through a stress concentrating member such as a steel ball supporting the coiled spring on its one side portion and pressing against an end portion of the heating member on its other side portion, pressing forces can be concentrated at a central portion of the heating member.

6. Apparatus as claimed in claim 1, wherein the heating member is provided on its surface with a thin layer of an elastic body such as a silicone rubber, by which the heating member can exert an accurate pressure application onto surfaces of the moldings.

7. Apparatus as claimed in claim 1, wherein the heating member is heated by heat from an electric heating device built in the upper structural part, and for the heating device, use is made of a sheathed heater comprising a nichrome wire.

8. Apparatus as claimed in claim 1, wherein the heating member is formed with a lateral bore, into which a coiled spring is inserted to support the heating member movably in the bearing hole in the upper structural part by the action of a spring force.

9. Apparatus as claimed in claim 1, wherein the heating member has a face to press against an upper surface of a molding and a face to press against an inclined side surface of the molding.

10. Apparatus as claimed in claim 1, wherein the heating member comprises a main heating part to press against the upper surface of the molding and an auxiliary heating part to press against side surfaces of the molding.

11. Apparatus as claimed in claim 1, wherein said pressure adjusting means for pressing the heating member from the upper surface of the upper structural part comprises a cylinder device operable by a fluid pressure.

12. Apparatus as claimed in claim 1, wherein said pressure adjusting means for pressing the heating member from the upper surface of the upper structural part comprises an electric motor.

13. Apparatus as claimed in claim 1, which is structured so that a key receiving case having the prescribed set of keys supported thereon is supported on a printing jig of the lower structural part of the apparatus and in which the printing operation is carried out while the keys are maintained in a condition of floating above the key receiving case.

14. Apparatus for printing moldings, incorporated in a conveyor line, which comprises a step of charging molding receiving cases having moldings set therein, a step of placing a transfer printing sheet in the prescribed position above a molding receiving case, a step of pressing a heating member against a rear surface of the transfer printing sheet and carrying out a printing, a step of discharging the transfer printing sheet used for the printing, and a step of taking the moldings on which the printing is completed out of a printing jig of the apparatus.

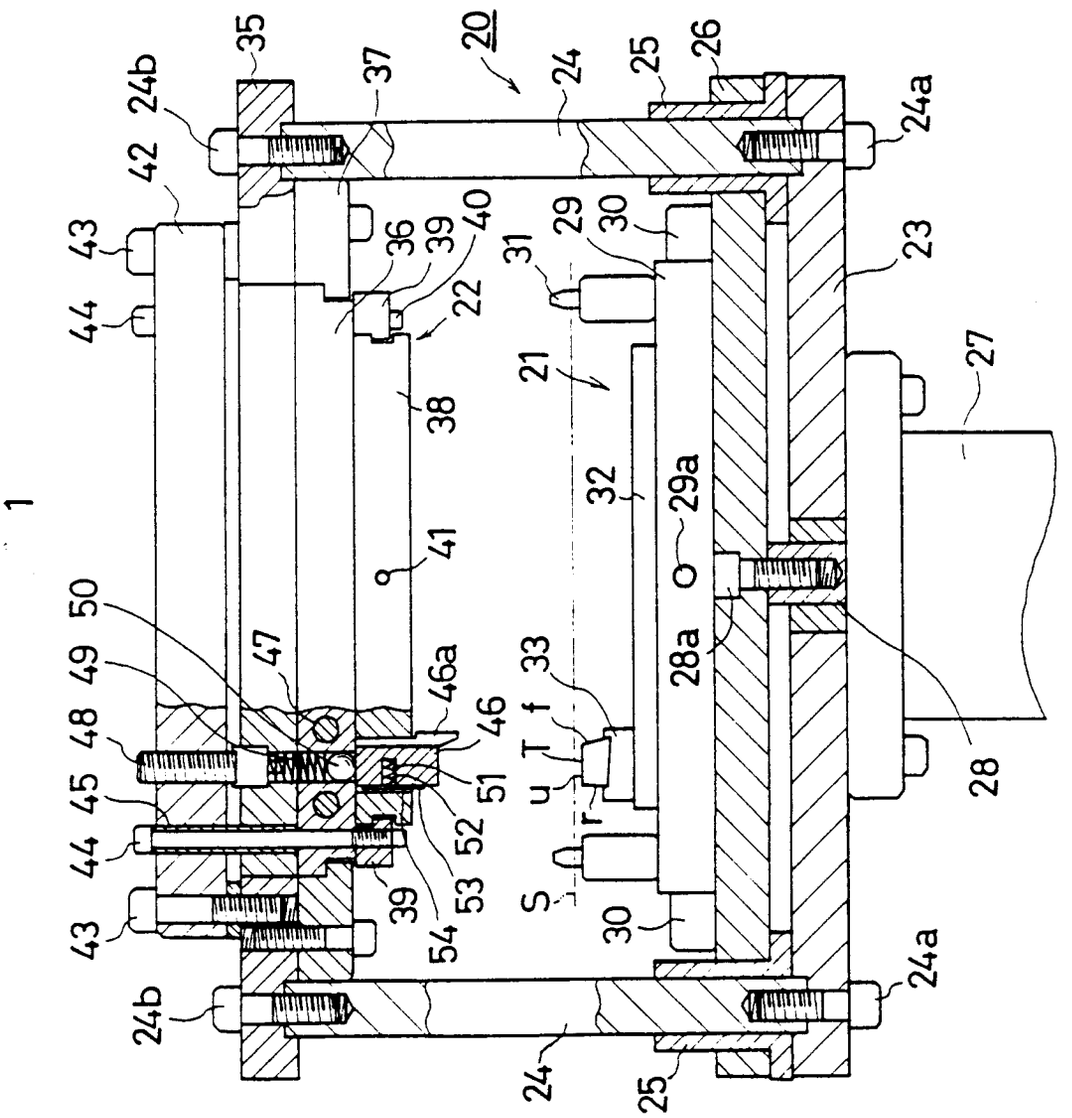
15. Apparatus as claimed in claim 14, wherein in the step of taking the moldings on which the printing is completed out of the printing jig, there is provided a device for taking out the moldings through vacuum attraction.

16. Apparatus as claimed in claim 14, wherein means for feeding objective articles for printing into the apparatus, means for printing the articles, and means for discharging printed articles are arranged in a circular layout around a turntable.

17. Apparatus as claimed in claim 14, wherein the molding receiving case supporting moldings therein is fitted in the printing jig and is formed with an opening for projecting a member for supporting the molding on the underside thereof.

18. Apparatus as claimed in claim 14, wherein the molding receiving case supporting moldings therein is formed with lateral ridge parts and vertical ridge parts crossing one another to form a lattice structure, and the prescribed positions for supporting the moldings are formed at intersctions of the crossing ridge parts.

19. Apparatus as claimed in claim 14, wherein the molding receiving cases supporting moldings therein can be stacked to a multi-stage assembly.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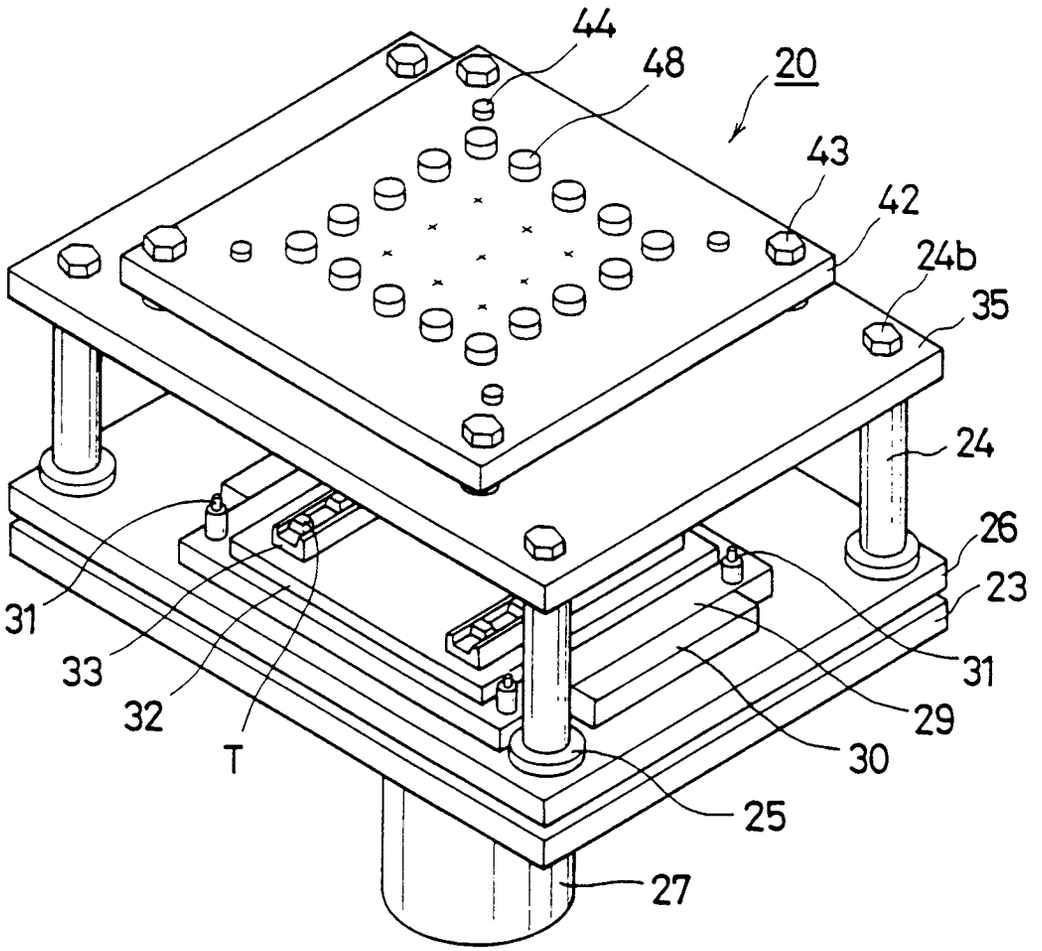

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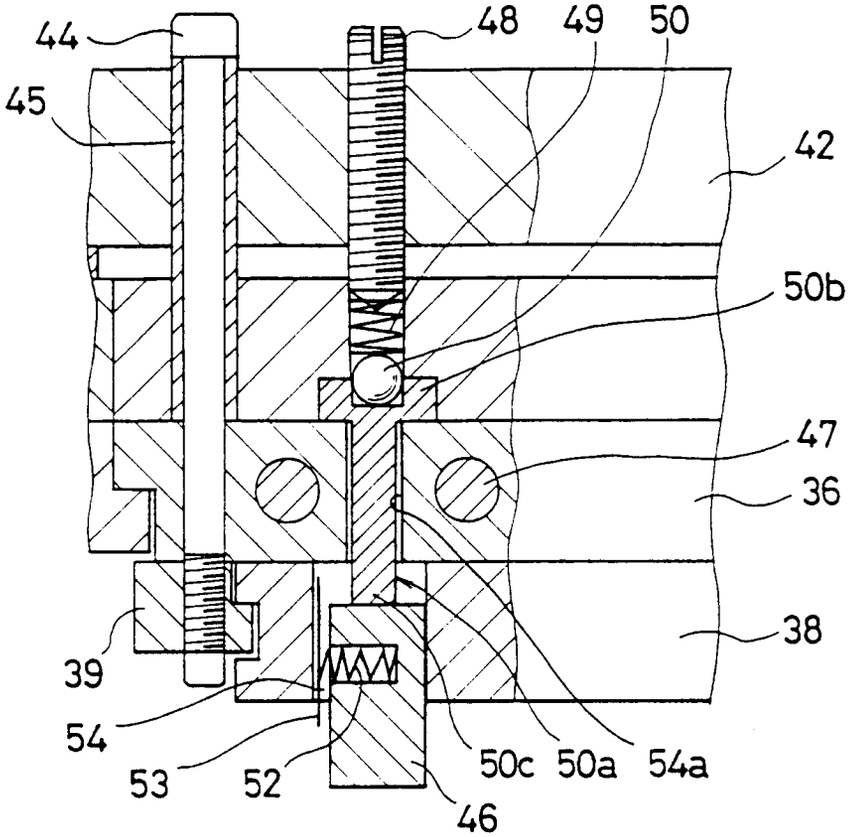

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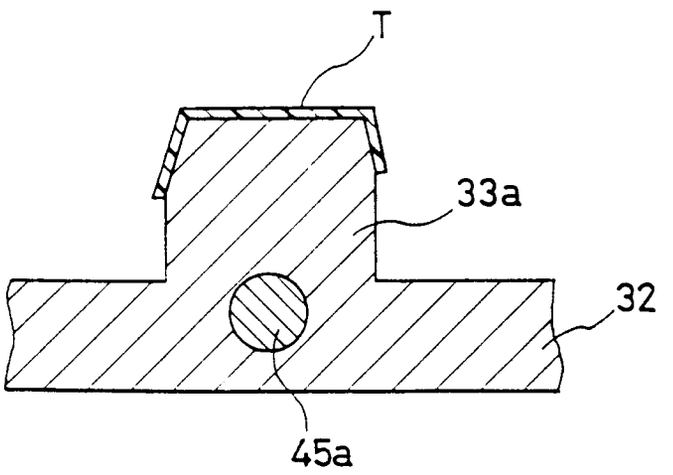

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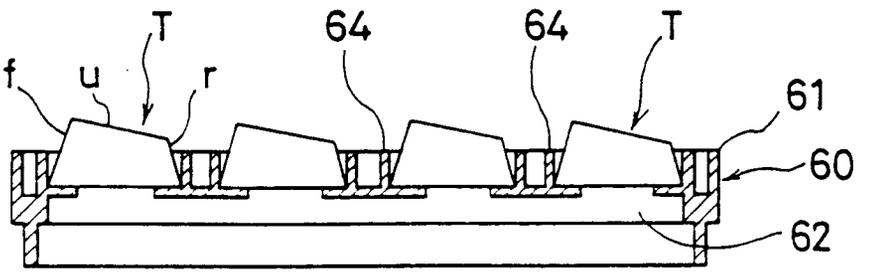

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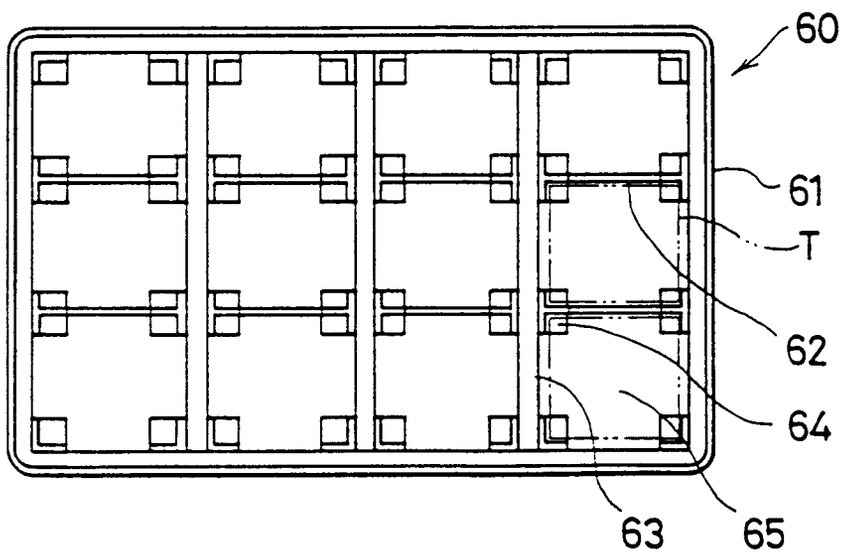

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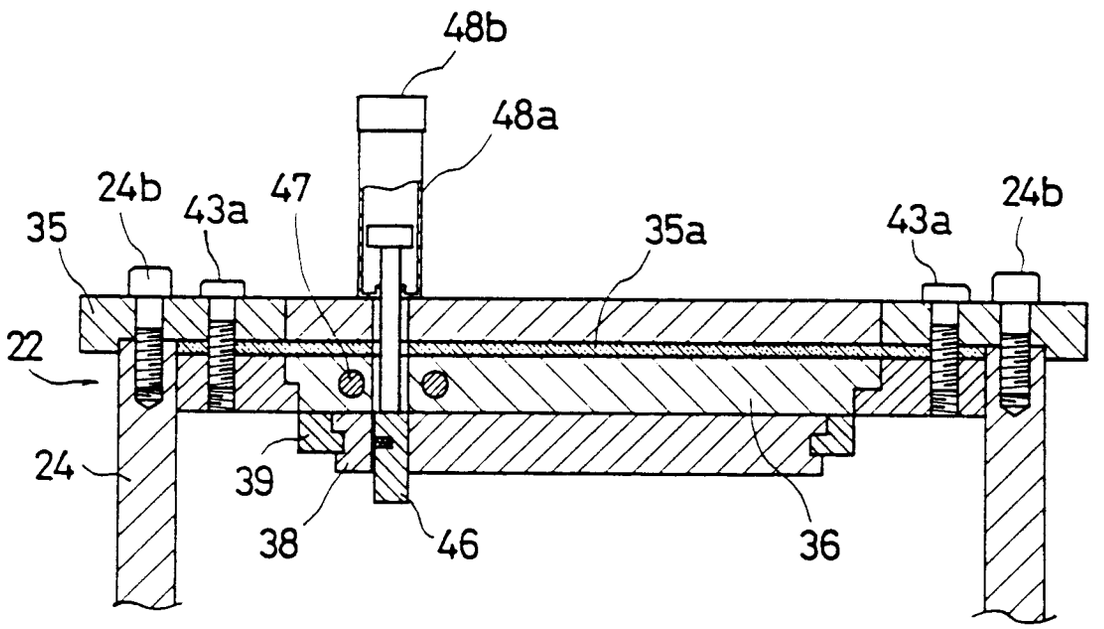

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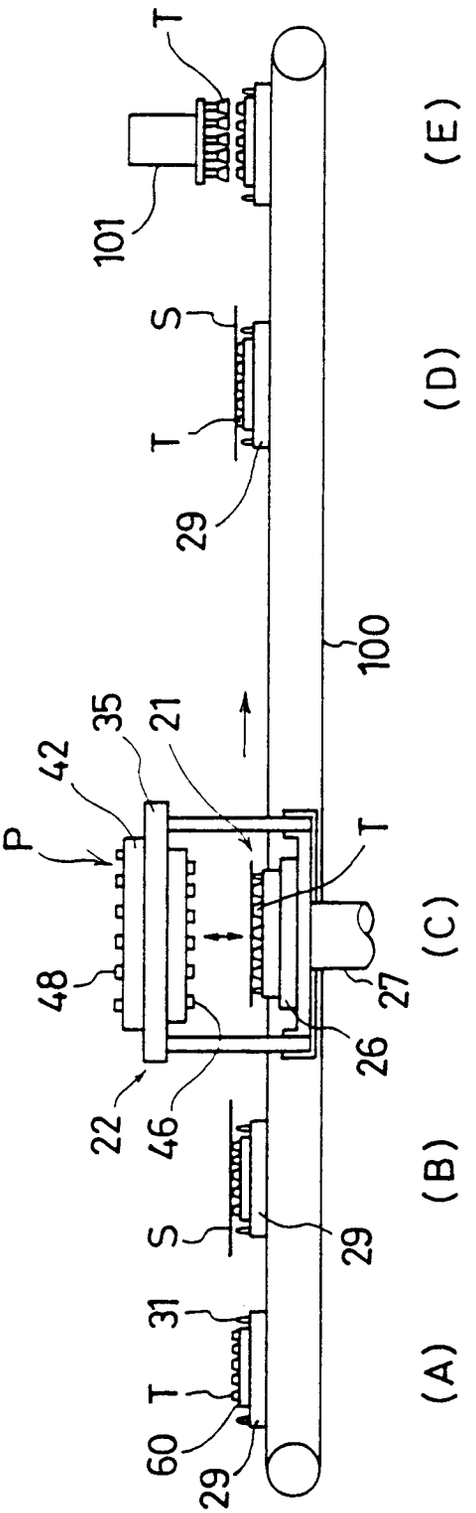

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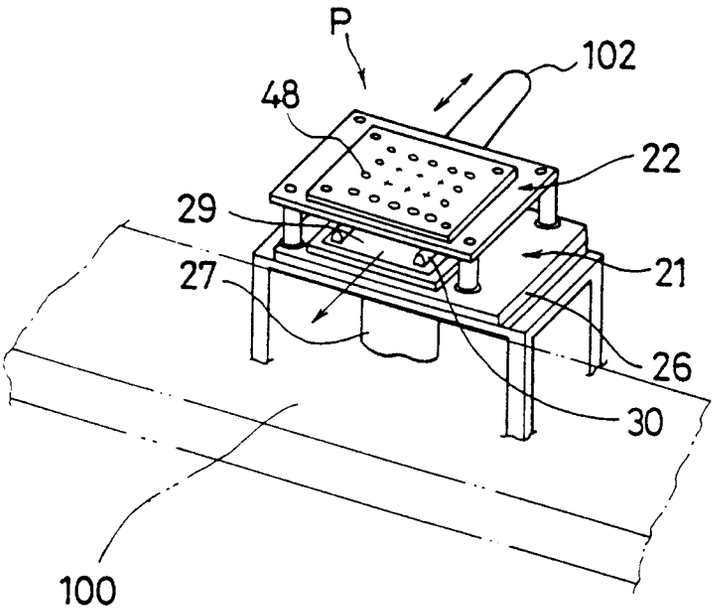

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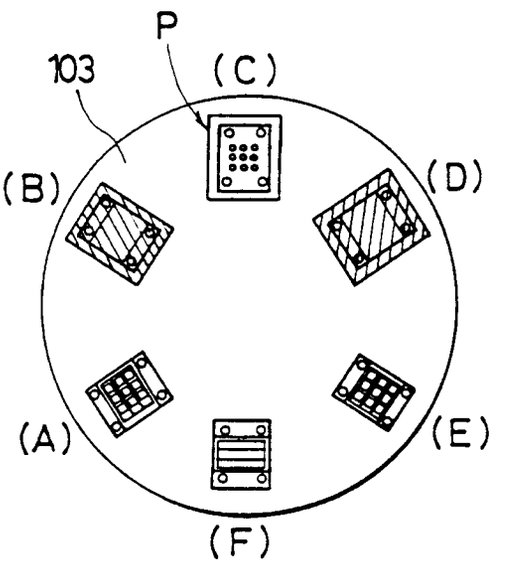

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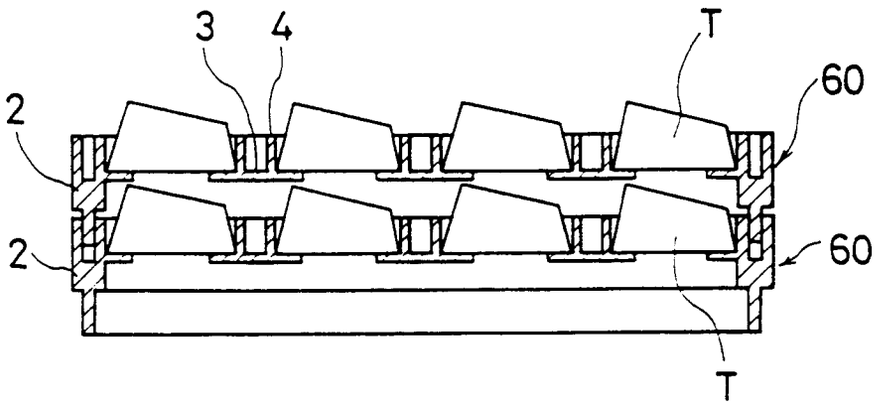

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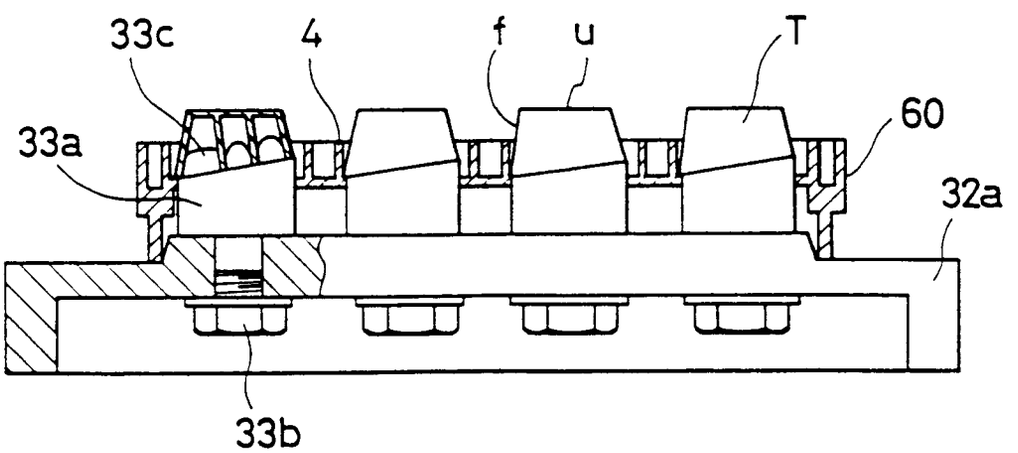

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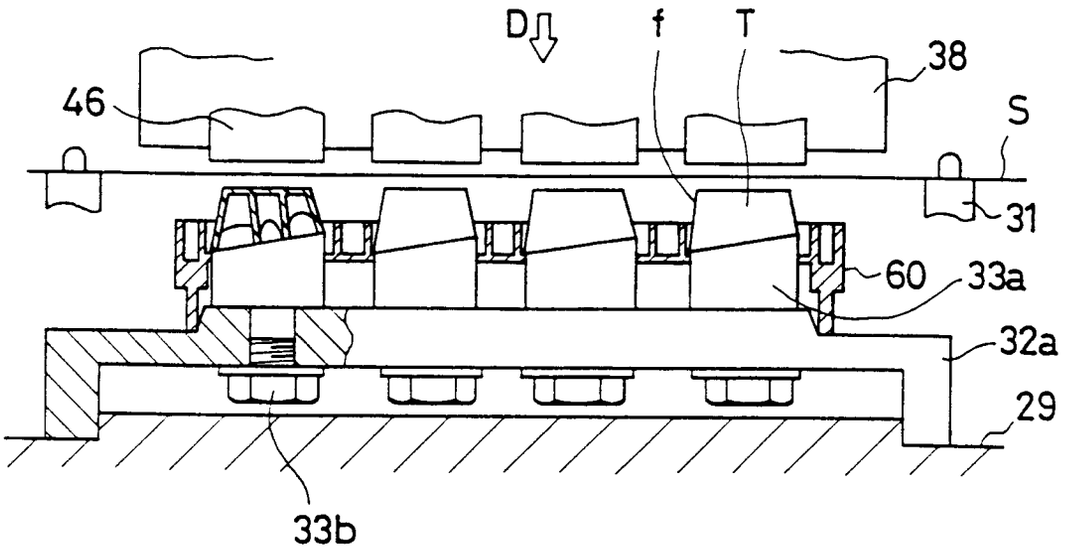
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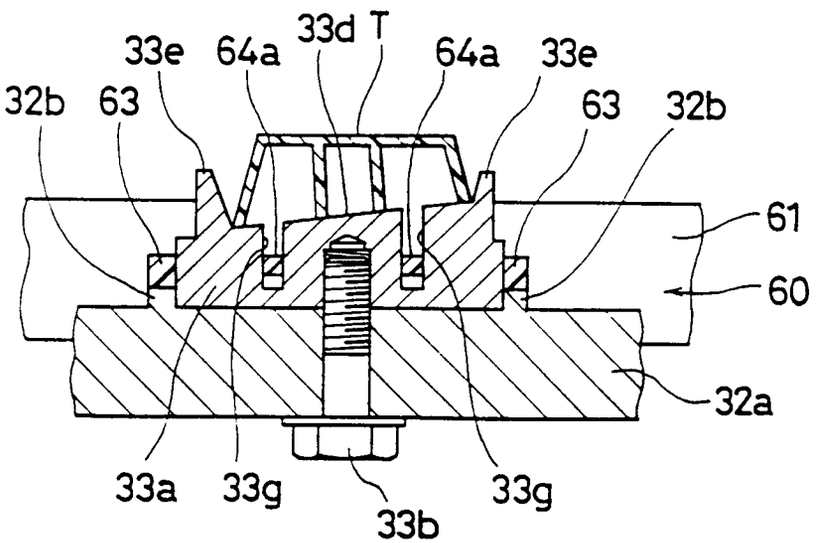
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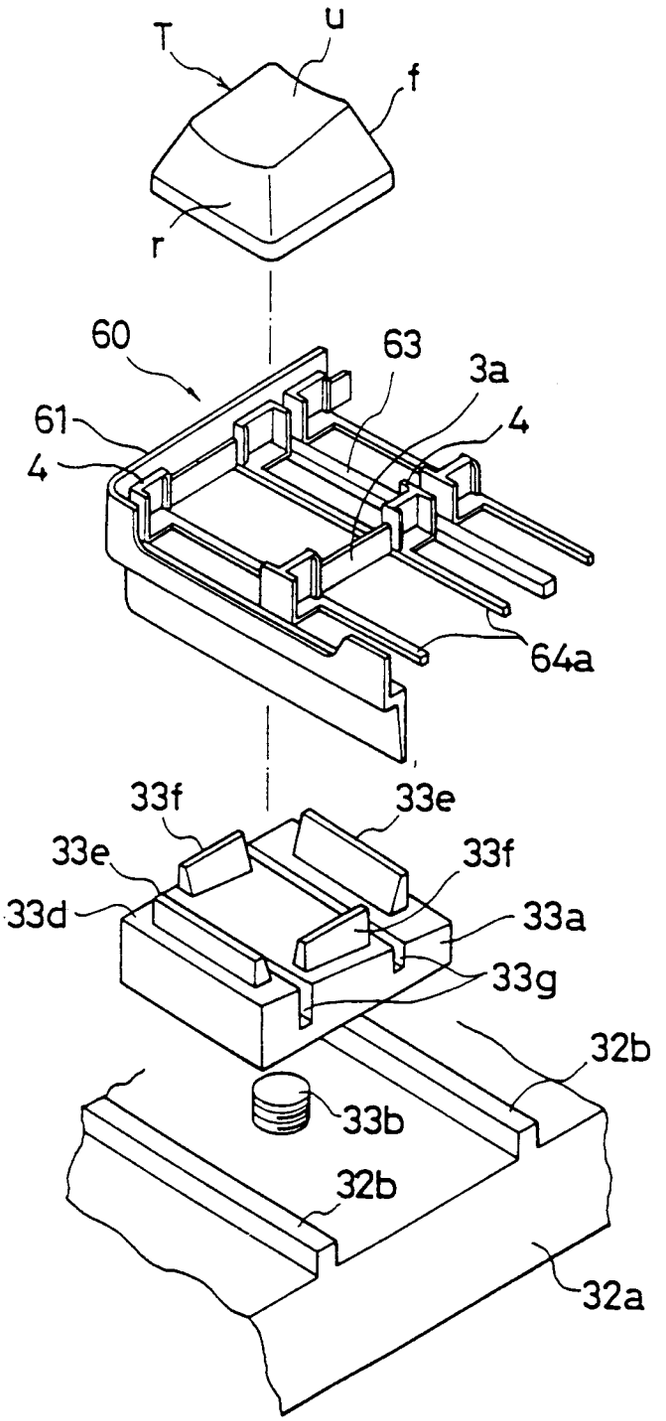
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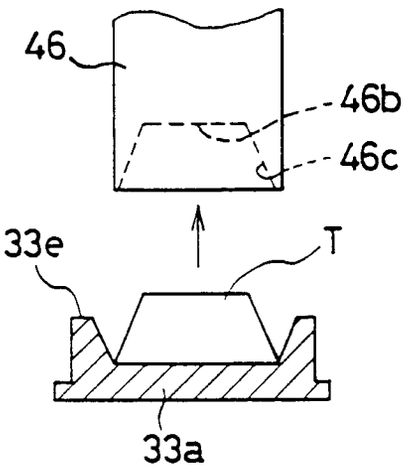

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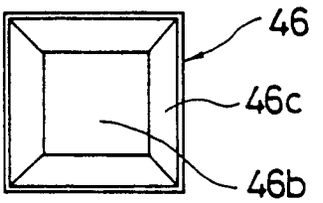

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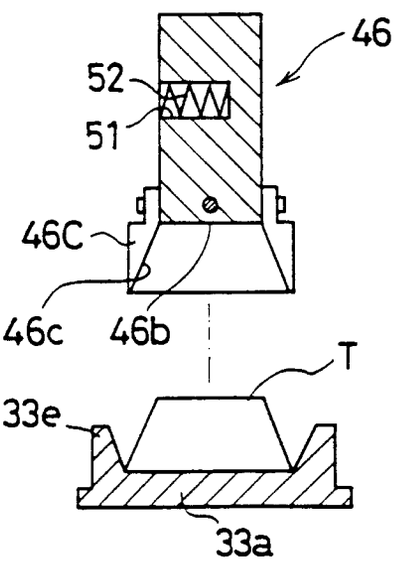

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP91/00614

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl[5] B41F16/00, B41F17/14, B41F17/34

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	B41F16/00, 17/14, 17/34

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho 1920 - 1991
Kokai Jitsuyo Shinan Koho 1971 - 1991

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	JP, A, 63-230341 (Nissha Printing Co., Ltd.), September 26, 1988 (26. 09. 88), (Family: none)	1, 4, 5, 6
Y	JP, A, 63-82746 (Tosuka K.K.), April 13, 1988 (13. 04. 88), (Family: none)	9, 10
Y	JP, A, 59-199251 (Nissha Printing Co., Ltd.), November 12, 1984 (12. 11. 84), (Family: none)	13, 17
Y	JP, A, 61-227096 (Dainippon Printing Co., Ltd.), October 9, 1986 (09. 10. 86), (Family: none)	13, 17, 18, 6
Y	JP, A, 59-215867 (Nissha Printing Co., Ltd.), December 5, 1984 (05. 12. 84), (Family: none)	14

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
June 5, 1991 (05. 06. 91)	June 10, 1991 (10. 06. 91)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	JP, A, 58-191162 (Kii Sangyo K.K.), November 8, 1983 (08. 11. 83), (Family: none)	7, 6
Y	JP, B_2, 57-20147 (Johnson Matthesy & Co., Ltd.), April 27, 1982 (27. 04. 82) & DE, C2, 2318466 & FR, A5, 2180340 & BR, A0, 7302630 & AR, AI, 200260 & IT, A, 983802 & GB, A, 1429928	16, 15, 14, 12

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers . because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers , because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims.

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.