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BY A. P. C.

B. WEMPE
PROCESS AND APPARATUS FOR MAKING SPINNING NOZZLES
Filed March 8, 1941

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2 Sheets-Sheet 1

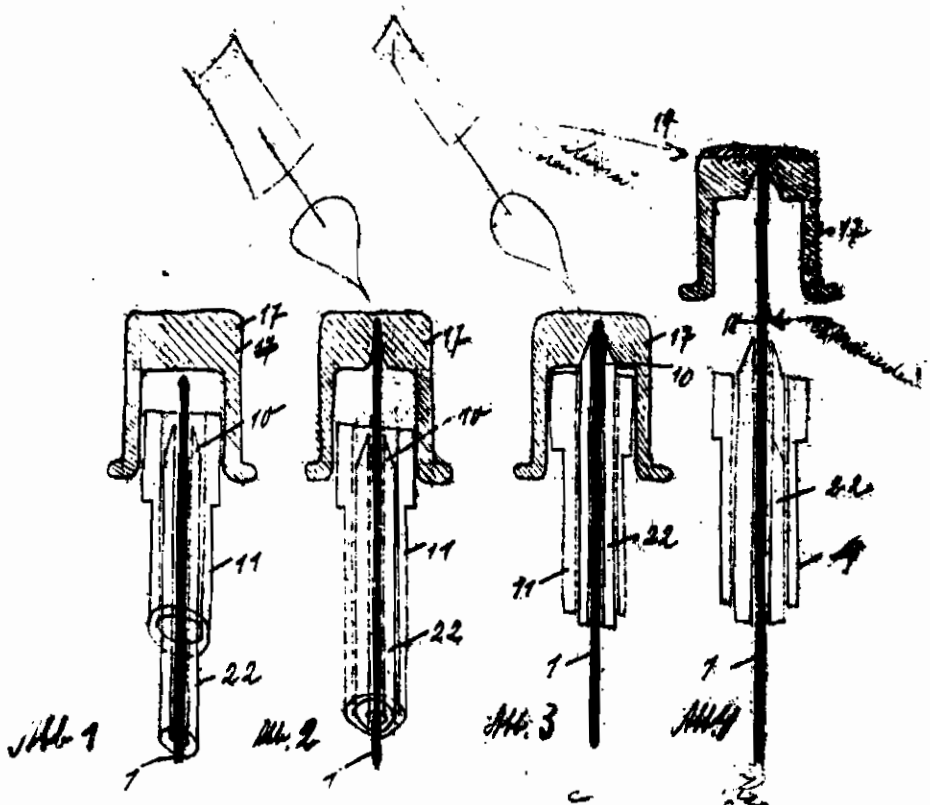

Fig. 1 Fig. 2 Fig. 3 Fig. 4

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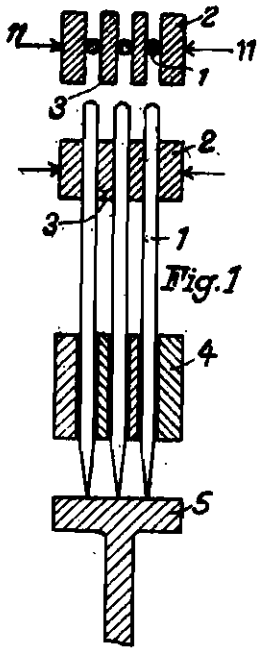


Fig.1

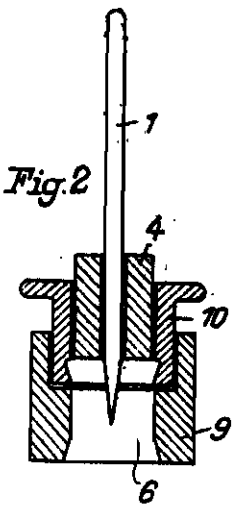


Fig.2

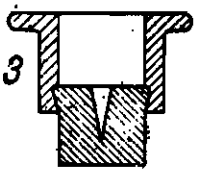


Fig.3

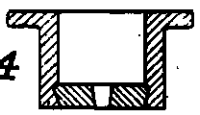


Fig.4

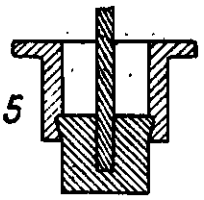


Fig.5

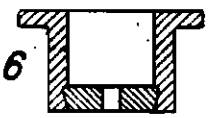
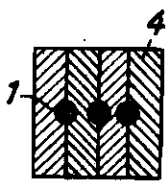
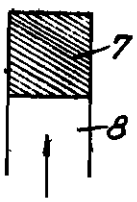


Fig.6





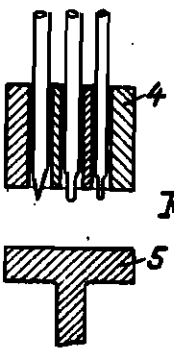


Fig.9

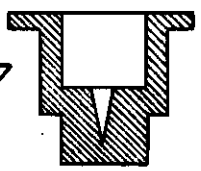


Fig.7

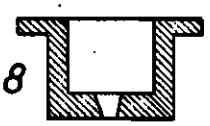


Fig.8

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ALIEN PROPERTY CUSTODIAN

PRODUCING HOLES IN GLASS PLATES

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Application filed March 8, 1941

The present invention relates to a method of and a device for producing in glass plates a plurality of holes of cylindrical, conical or any other form. In a similar manner, the new method may be used for the treatment of other materials which, as far as the thermal plasticity is concerned, are of relation to glass plates, for instance quartz glass. Moreover, the organic artificial materials, particularly the thermoplastic artificial materials, whether plasmolysation products or condensation products known now-a-days in the industry may be treated in the same manner.

The essence of the novel method consists in transferring into the plastic state, preferably by heating, the body of material to be provided with holes and using form members to provide the desired holes in the plastic material, whereby in accordance with the invention these form elements are passed through guides in such a manner that the latter serve to strip off material of the body to be provided with holes which may stick to these form elements, i.e. during the production of holes this guide remains in permanent contact with the thermoplastic material.

Of course, it is known per se to produce holes or small openings by sticking in of wire for instance into soft glass. So for example, a method has become known according to which thin wires molten into a glass disc are stuck in in soft glass in such a manner that the wires are inserted longitudinally into the glass softened by a source of heat.

It would be impossible to exert a considerable pressure on inserting the glass wires, because the holding disc in which the wires are fixed consists of glass and, therefore, during operation also becomes hot and consequently has too slight a technical tensile strength.

When carrying out this known method, the wires after having been pressed in are withdrawn from the softened glass particle. Hereby evidently difficulties arise because the specification about this older method contains the prescription that for the purpose of sticking in wires must be employed under all circumstances which are not wetted by glass, i.e. melting together of glass and metal in the limit layer must be prevented. Practically, therefore, noble or precious metals, molybdenum or tungsten wires may only be used.

The holes which may be produced in accordance with these known methods are not of cylindrical shape. They are flared out upwardly in the form of a funnel, thereby rendering glass plates, provided in this manner with holes, useless for many purposes.

An attempt to produce for instance spinning nozzles according to this method for which as a rule 50 to 200, often, however, 600 to 3000 bores are required failed, because it is technically impossible to withdraw this large number of wires from the glass and this for the simple reason already that glass cannot bear such a strain.

These difficulties are obviated in accordance with the present invention by the fact that for guiding the ends of the holes a guide body is provided which is formed in such a manner, that the glass sticking to the needles is stripped off after withdrawal of the needles from the glass and moreover, as guide body ensures absolute parallelism of the individual holes. This guide body preferably is made of steel and the holes provided therein and serving as guides for the needles are of such diameter that the stick in needles may just be guided in these holes without practically any play remaining between the wall of the hole and the needle.

Such guide bodies which also must have 500 to 2500 bores or more may be made from a solid body or from a pile of sheet metal, whereby in the latter case half a groove only is pressed into each part of the sheet metal. If this pile of sheet metal now is so arranged that groove comes to lie upon groove, cylindrical guides are formed.

The invention, furthermore, relates to a device according to which a large number of holes may be produced in thermoplastic masses by means of wires, movably arranged in a guide body, whereby the wires together with the specially formed guide body are pressed into the thermoplastic bodies. In this manner with a large number of holes also holes of uniform diameter may always be obtained even when operating on a large scale which is important, if the production of spinning nozzles used in the artificial silk industry is concerned.

In the accompanying drawings some modifications of devices for carrying out the method according to the invention are shown by way of example.

In these drawings:

Fig. 1 diagrammatically and in section shows the general arrangement of a device for carrying out the new method,

Fig. 2 is a diagrammatic side elevation showing the stick in needles in the operative position,

Figs. 3 to 9 inclusive show various successive steps in carrying out the new method, and

Figs. 10 to 13 inclusive illustrate various operative positions of a modified device according to the invention.

The device according to the first example shown in Figs. 1–9 is adapted to produce cylindrical as well as conical holes.

The stick in needle 1 may be made of any hard material. The clamping member 2 for all the needles 1 has the purpose of maintaining all the needles in the fixed position after adjustment to uniform height has been effected. 3 are the intermediate members in this hard body. The wire guide body according to the invention provided with the capillaries is designated 4. The needles are adjusted to uniform height upon the surface 5. This is effected by unloading the sheet metals or the clamping body 2 so that all the needles may move with play in the guide body 4. If the needles occupy a vertical position, they adjust themselves to uniform height. The surface 5 is removed after the needles have been adjusted. Before removing this surface the needles are fixed in their adjusted position by pressing together the clamping body or the holding sheet metals 2. 6 is the hollow space into which the thermoplastic mass 7 is pressed with high speed by a blow-like pressure. The thermoplastic mass, for instance glass, is pressed into the space 6 by a stamp 8. If the thermoplastic mass is heated it rests upon the stamp 8. The high speed and the blow-like pressure are of great importance as far as the invention is concerned. It is, however, possible to operate with a lower speed, but then the advantages are not obtained which are achieved by the use of a high speed.

The guide body 9, consisting for instance of heat resisting steel, has the purpose to exactly press the thermoplastic mass, heated to about 600 to 900° C, to the predetermined place. The reference character 10 designates for instance a nozzle fitting or sleeve for the perforated plate. This mainly consists of acid resisting metal, but porcelain or the like material also may be used.

If now the softened glass or the thermoplastic mass respectively is pressed into the space 6 in a blow-like manner it tends to fill even the smallets hollow space. Now, if for instance a plate is to be produced having 50 holes then small needles project from the guide body 4 which in the selected example are conically ground. If the finished hole has to have a diameter of 0,1 mm, then for practical reasons the needle has a diameter of 0,3 mm.

After the thermoplastic mass has been pressed into the space 6 and immediately after a slight solidification of the limit layer glass-metal, the pointed bundle of wires is withdrawn with a jerk. This is effected by lifting the holding bodies 2 and 3, forming a rigid system, for such an amount that all the points disappear in the guide body 4.

After withdrawal, the sleeve 10 is ejected out of the machine by a suitable device and then has the appearance shown in Fig. 3.

To render the pressed thermoplastic mass free from internal stresses this body is cooled in a furnace.

It is not absolutely necessary to use metal or glass as a fitting and to press glass into this fitting, but the fitting and the glass to be pressed in may consist of a single piece. In this case, the glass to be pressed in preferably is preliminary pressed and has the appearance shown in the Fig. 7 without, however, being provided with a hole. This glass body is mounted in a holding body, not shown in the drawings which now is heated to a temperature of about 600 to 900° C. At this temperature the thermoplastic mass is soft. Then this body is moved upwardly as indicated in Fig. 2 by the arrow shown in the part designated 8. Hereby the needles are pressed into the bottom of this hat which then has the appearanee shown in Fig. 7.

The holes to be pressed in may have any desired form preferably, however, are of conieal form. Fig. 9 shows a number of pointed forms. If now a cylindrical hole is to be produced which may cause difficulties to withdraw all the wires simultaneously, the operation is effected in connection with this device in such a manner that stick in wires are not repeatedly but once only used and the stuck in end remains in the thermoplastic mass. This is effected as follows:

In Fig. 2 the conical stick in needle is replaced by a wire having a diameter equal to that which the hole to be produced is to have. If now a plate having a bottom thickness of about 2 mm is to be produced, the end of the wire projects from the capillary body 4 about 2,5 to 3 mm. Then the usual operations follow, i. e. the pressing in of the heated body 7 which then surrounds the end of the wire. In contradistinction to the operation previously described, the wire end is not withdrawn but remains in the pressed mass. The removal of the pressed body from the device is effected by pushing the wires so far that the many wires may closely be cut off in the guide body 4 by means of a revolving separating disc. Then another adjustment of the height follows.

The wires in this case are exactly held as the stick in needles, i. e. by the clamping bodies 2 and 3. Preferably the stick in needles 1 are pointed by an automatically operating grinding machine. Machines of this kind adapted to produce points of any form at the pins, see Fig. 9, may be had on the market.

Mainly glass is used as material for producing perforated plates. However, quartz glass and other plastic materials may be used for this purpose.

It is still to be observed that the needle must be protected against oxidizing to ensure a sufficient long life. With the small diameters of the holes, amounting to 0,05 to 0,2, a slight oxidation may already change the circumference of the needle. For this reason this entire part or the space 6 respectively and the members 7 and 8 are to be maintained in a hydrogen atmosphere or an atmosphere of neutral gas respectively.

As indicated already, Figs. 3 to 8 represent the continuous operation, i. e. Figs. 3 to 6 show the operation in connection with a bottom consisting as shown in Fig. 2 of another material than the ring 9. Figs. 7 and 8 show the successive operations when using a bottom of the same material as the ring. In Figs. 3, 4 and 7, 8 the production of a bore of conical shape is shown, whereas Figs. 5 and 6 represent the production of a cylindrical bore. Fig. 9 shows by way of example various shapes which the stick-in needles may have. In this Figure, for instance, three different modifications of needles are represented.

The stick in needles 2 may consist of any desired hard metal. In practice platinum alloys, eventually containing a very high content of iridium or rhodium or other hardening additions have proved to be satisfactory.

In the modification according to Figs. 10 to 13 the wire 1 is shown in Fig. 10 in its starting position. Fig. 11 diagrammatically illustrates the melting of the wire into the thermoplastic mass. Fig. 12 shows the pressing of the cone into the

plastic mass around the molten in wire and Fig. 13 illustrates how the guide member is withdrawn from the thermoplastic mass and the upper part molten into the thermoplastic mass is cut off, whereupon etching out of the wire to finish the nozzle is effected which is not specially shown in the figures.

The wire 1 consists of any desired hard material, preferably tungsten, molybdenum free of carbon and eventually alloyed with cobalt and/or nickel. A capillary 22 surrounds the wire 1, and the one end 10 of this capillary is conically pointed in the selected modification. Of course, it is not necessary that the capillary 22 is pointed at 10 as shown in the drawings and described in the example selected. It is also possible that this capillary cylindrically closes. The capillary 22 slides in a guide 11 one end of which is so constructed as to simultaneously form the bottom. 17 designates the thermoplastic mass into which the wire 1 is to be pressed in or molten in respectively. The body surrounding this thermoplastic mass and the guide members are not particularly shown in these figures.

From Fig. 10 it is to be seen that the guide body 11 together with the capillary 22 sliding therein is inserted in a recess of the thermoplastic mass 17 so that the wire 1 projects from the latter. Fig. 11 shows how the wire 1 from the above described position is pressed into the thermoplastic mass 17. To this purpose the thermoplastic mass is heated which is diagrammatically indicated in the drawings. If the mass is heated the guide 11 and the capillary 22 are projected towards the mass 17 so that in the modification selected the conical point 10 of the capillary 22 also is prepressed into the thermoplastic mass. Thereupon the capillary 22 together with the guide 11 are quickly returned again, whereby the guide and the capillary either are simultaneously withdrawn or the guide of the stripping device for the capillary is used, whereupon a state is reached as represented in Fig. 13. The thermoplastic body 17 then is allowed to cool, the wire 1 is cut about at 10 and the bottom of the body 17 is ground at 19 until the wire is reached. If this state is reached, the wire is removed in well known manner from the now cooled body 17 and a hole of absolute definite dimensions is obtained in this body.

The new mode of operation allows to produce a large number of holes side by side in a narrow space and to obtain spinning nozzles in this manner having a very short cylindrical passage conically enlarging towards the interior. This is of advantage, because hereby a thick glass bottom is obtained which on the one hand exerts large pressures and on the other hand may operate with relatively low spinning pressure.

As stated already, as material for the wire molybdenum and tungsten have proved to be of advantage which for the purpose of increasing the hardness may have a nickel content which, however, practically must be free of carbon. To prevent an attack of the wires formed of metallic material, the operation preferably is carried out in an atmosphere of a natural gas, advantageously in hydrogen.

BERNHARD WEMPE.