Aug. 18, 1936. F. WERTH 2,051,663

PROCESS OF OBTAINING PERFORATIONS IN METAL

Original Filed Dec. 30, 1933

Fig. 1

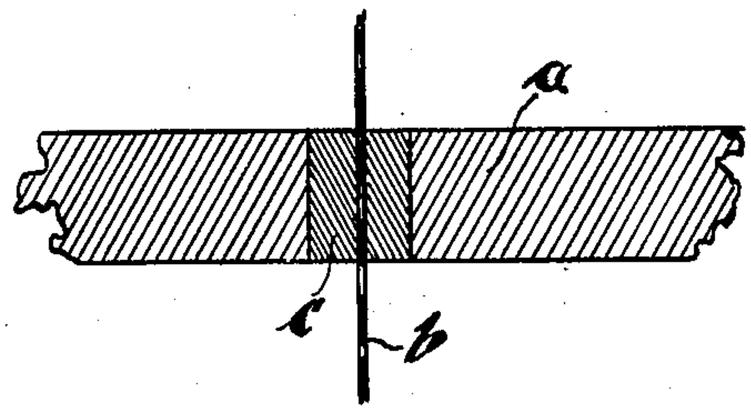


Fig. 1a

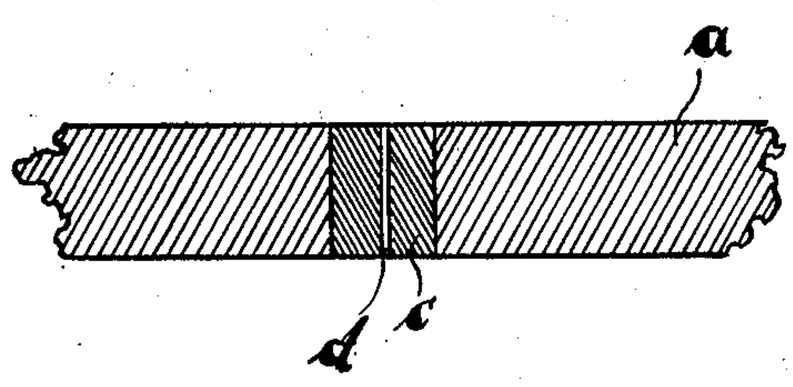


Fig. 2

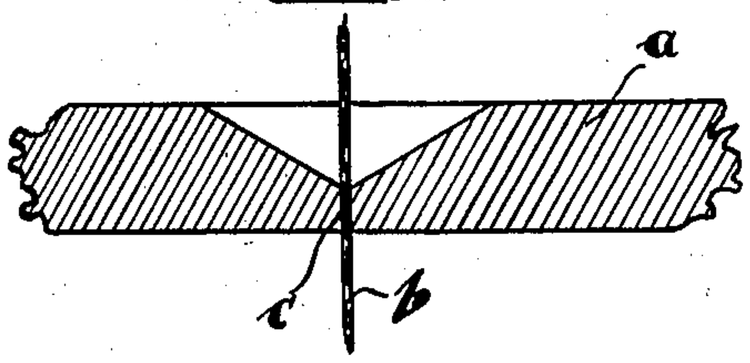


Fig. 2a

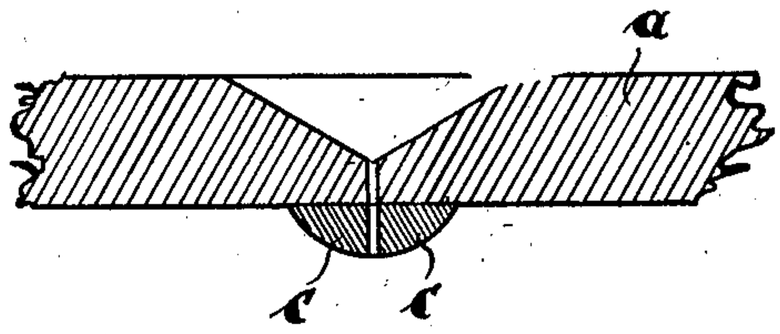


Fig. 3

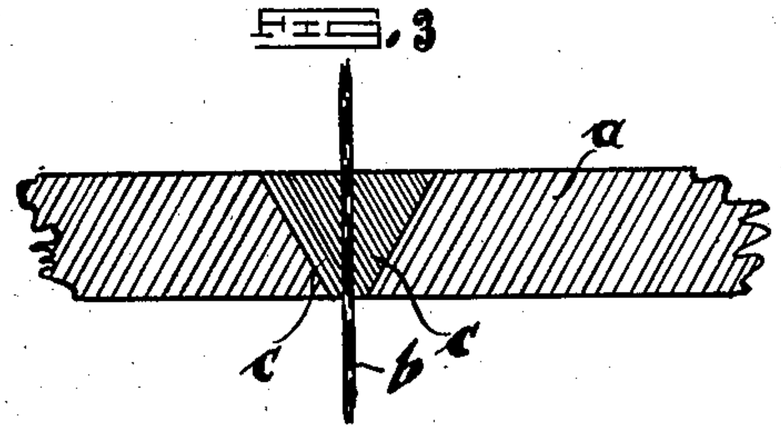


Fig. 3a

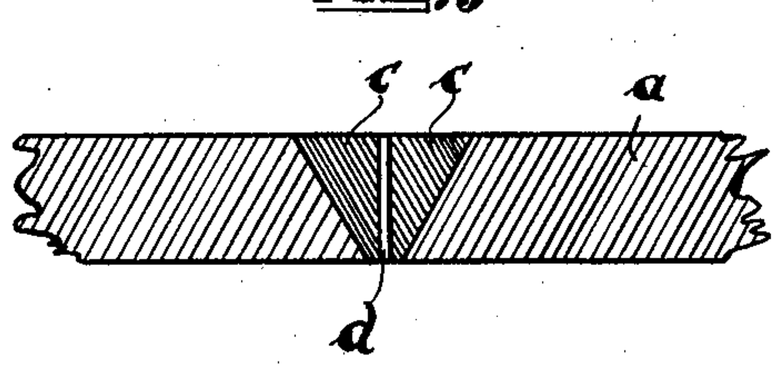


Fig. 4

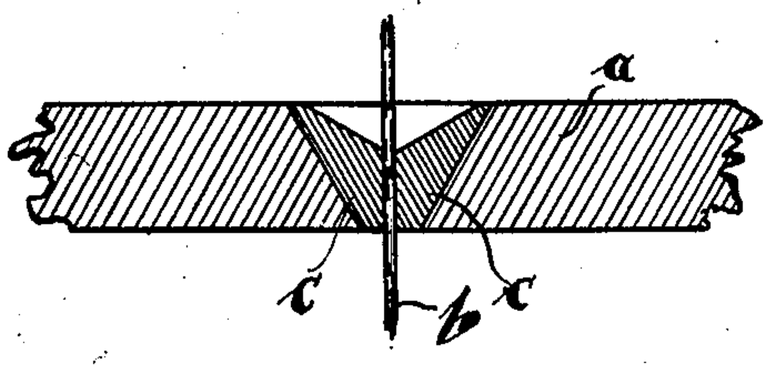
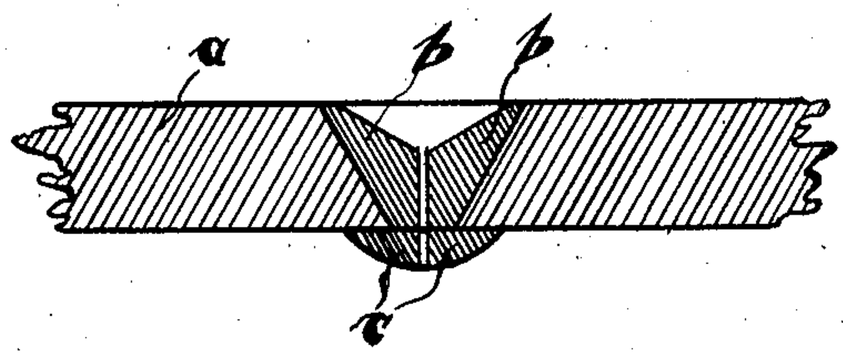


Fig. 4a



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2,051,663

PROCESS OF OBTAINING PERFORATIONS IN METAL

Friedrich Werth, Frankfort-on-the-Main, Germany

Application December 30, 1933, Serial No. 704,697. Renewed January 24, 1936. In Germany October 20, 1931

1 Claim. (Cl. 204—1)

The present invention has for its object a method to obtain finest perforations in metal-plates or pieces of every kind, as needed and of great importance for different fine-mechanical industries and specially for obtaining nozzles of precious metal for the manufacture of artificial silk or the like, in threads, tapes, also films and artificial horse hair and draw-plates for drawing finest wires etc.

In opposition to the well known devices used for the same matter and representing most troublesome and expensive methods, the process according to the present invention makes it possible to obtain this minute work more easily and with relatively moderate expenses. This can be obtained by providing the plates etc. of metal of any kind and form with such fine bore-holes as can be now-a-days easily produced and as they are manufactured in the fine-mechanical industry, i. e. in the horology etc. The arrangement of the bore-holes can be made in any desired way and in any number which the plate is able to receive.

The bore-holes drilled today by every fine-instrument maker are easily made down to 0.3 mm. In order to obtain still finer holes, a thread is drawn through the larger bore-hole, which thread can consist of insulating material and must in diameter and form conform to the finer bore-hole or passage which is to be obtained. For the manufacture of nozzles in precious metal the thread can be also of a noninsulating material i. e. of base metal, insulated in suitable manner and easily to be dissolved in acids etc. which do not decompose the precious metal. The position of these threads within the bore-holes can be held exactly in the center and also laterally displaced and in slanting direction by a device adapted to the purpose.

The various forms of my invention are described in Figs. 1 to 4 and 1*a* to 4*a*.

Suppose that one wished to make 100 bore-holes of 0.05 mm. diameter in a metal plate *a* of Fig. 1 (enlarged scale) of 30 x 30 cm. and 1 mm. thick in rectangular disposition, one makes 10 x 10 bore-holes of 0.3 mm. diameter or less, in distances of 1–2 mm. from each other. Through each of these bore-holes the insulating thread *b* is drawn, the thread being of the smaller diameter 0.05 mm. and of the exterior state preferred (or burnished, finely ground, matted or rough surface etc.).

Then an electrolytic deposit of the metal required for the purpose is made on the plate. As nearly all metals requested for such work may be deposited, the preferred metal may be chosen. The electrolytic baths may be selected so as to produce the finest deposit. After a certain time the open space of the bore-hole will be closed entirely by the deposit but for the space *c* occupied by the thread (Fig. 1).

A narrowing of the bore-hole may also be done in a similar way by modifying the surface of the metal by chemical or electrical influences. Afterwards the thread can be removed or if necessary burnt out and the residue removed. In the metal plate the passage *d* remains then in the diameter of the removed thread, (Fig. 1*a*). Experiments in this direction have brought the result that passages in the size of 0.03 mm. (finest hair) or 0.015 mm. (natural silk thread) can be obtained without difficulty. The complete filling up of the hole has certain limits as to the thickness of the metal-plate or -piece. As for the purpose in question the thickness would be scarcely greater than 2 mm., the penetrating effect of the deposit must be only 1 mm., as the deposit can be produced on both sides. The thinner the metal-plate is, the greater is the security for a perfect filling up of the bore-hole. A mechanical stress on the thread is not required and therefore it does not alter in form or diameter.

As illustrated in the enclosed drawing, Fig. 2 (enlarged scale) the metal-plate *a* can be drilled one-sided countersunk, so that the fine bore-hole passes only through a thin layer *c* of the plate *a*, facilitating in this way the perforation, or by drilling a fine hole directly with the corresponding countersink and then inserting the insulating thread *b*.

If desired the plate can be covered completely with an insulating varnish, leaving only a small space around the hole and the metal can be deposited only around the hole, on the side opposite to the countersink. Then the deposit will be formed only in the noninsulated place and forms an elevation as shown in *c* of Fig. 2*a*. The height of this elevation can be increased to a certain amount, eventually to form a small tube provided with a hole of the diameter of the insulating thread.

On the other hand one can proceed in the opposite sense, drilling the metal-plate *a* like Fig. 3 with countersink and bore-hole, filling up the countersunk part within a certain time and with such metal as is required for the work. Hence it follows that for instance a steel plate Fig. 3*a* can be provided with a hollow *c* filled up with copper, nickel, chrome, platinum etc. or alloys, oxides etc. of same, in which in consequence of

the insulating thread remains the finest passage *d* of Fig. 3*a*, after removing the thread. These finest passages can be obtained also in any other desired shape, as slits, ovals, cross-shape or the like, using an insulating core of suitable shape.

As a matter in question is to obtain only finest passages, the deposit of the precious metal must be only quite thin because even an insignificant wear enlarges the exactly limited diameter and the nozzle would have to be discarded as soon as the diameter of the passage changes only for abt. 0.01 mm.

In all cases where the deposit should be applied only in finest film, or where the countersunk part of the hole must not be filled up completely, the method of galvanic deposit will be most suitable. For instance the process of depositing metal by means of electric current can be stopped as soon as the deposit is obtained in the manner indicated in *c* of Fig. 4, because the deposit increases always from the metal-base and grows pretty uniformly in all directions. The remaining hollow space of the countersink can be useful in many cases and is of advantage when straining viscid or thick materials. A passing over of the deposit towards the side opposite to the countersink can be prevented by suitable covering (with insulating varnish or the like) but such a deposit can also be desired in some cases, and then the deposit must be made on both sides, in order to bring about the form according to *b* and *c* of Fig. 4*a*.

The invention avails also the possibility of reobtaining the original diameter of the holes in the way described above, in case an extensive wear of the passages having occurred. By these means not only a long lifetime of the nozzles in precious metal is guaranteed, but also an exchange of the nozzles will not be required, whereby a real advantage will be obtained in expenses and investment of capital.

As described before, the tightness of the thread is easily to be obtained by a stretcher-mechanism, but can be omitted in all those cases where the direction of the passage is of no importance. The disposition of the anodes on both sides or only on one side is easily to be adapted to the requirements of the single case.

Regarding the electrolyte, preference is given to such baths which furnish the finest grained deposit because it adheres better and is less brittle.

The superiority of this invention is not only in the simplicity in the production of finest perforations also in metals resistant to alkalies or acids, hard or hardest metals as platinum, palladium, beryllium, iridium, chromium, etc., alloys and oxides of same or the like, so far as the deposit is possible, but also in the general economy in expensive metals, if such metals must be used. This economy will be produced by covering only the passages (holes) with precious metals or hardest oxidations of them, while the metal-base can be of cheap material like steel, copper, aluminium etc. which can receive if necessary also a small deposit of the precious metal. The use of solid nozzles of precious metal is no more necessary. It is also possible to cast fine perforated plates or to punch thin plates with fine passages with or without countersink and apply then the deposit of one or more metals on the metal-base, as this may be required in certain cases. When depositing chrome, for instance, it is possible to electroplate first with copper, then with nickel and at last with chrome, or to plate first with copper, if the metal-base is iron and then to deposit the precious metal. The progress in depositing chrome etc. makes it possible to accomplish passages in the hardest metal, which allows an enormous mechanical stress on the passage and is of special importance as the mechanical perforation of this hardest metal is not possible according to the present state of technical science.

The improving effect of the invention results clearly out of the preceding description, but specially the possible great decrease of the production-costs and of the consumption of nozzles is to be taken in consideration. The manufacture of finest passages in metals by means of drilling or punching, as it has been done up to the present time, is a very particular work. The finest drills do not give smooth holes and therefore they must be readjusted if a burnished surface of the hole is required. The tools are also extremely frail and fragile and machinery of highest precision is requested for such work.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim and desire to secure by Letters Patent is:

A method for obtaining minute perforations in metal objects which comprises forming therein bore holes of any desired size but larger than the perforation desired, drawing through each hole a thread of insulating material of the conformation of the perforation desired, electrolytically depositing metal to fill the space between the thread and the walls of the bore hole, and removing the thread.

FRIEDRICH WERTH.