April 16, 1929. J. ROSENBERG 1,709,323

METAL WORKING

Original Filed Jan. 9, 1925

Fig. 1

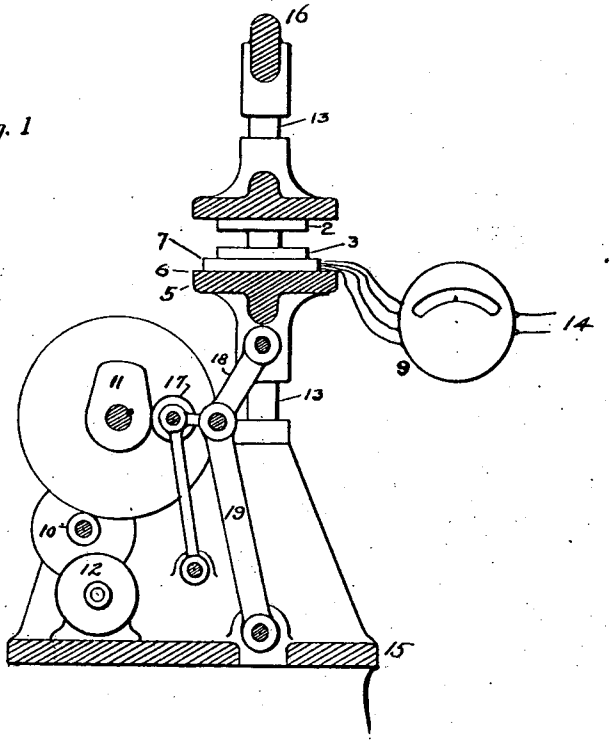


Fig. 2

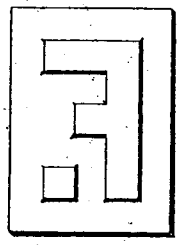


Fig. 3

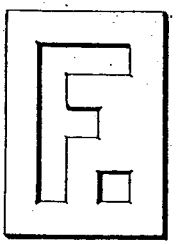
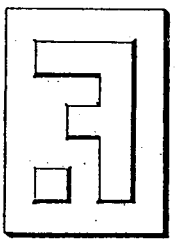


Fig. 4



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UNITED STATES PATENT OFFICE.

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METAL WORKING.

Application filed January 9, 1925, Serial No. 1,450. Renewed July 18, 1928.

This invention relates to metal working and more particularly to duplicating in form and size, in multiple if desired, metal objects of various details of form, outline and surface.

The primary object of the invention is to produce duplicates more exact and accurate in even minute details of surface finish than has heretofore been accomplished. Another object is to produce such duplicates in a small fraction of the time heretofore required in the production of inferior copies. A further object is to attain these results at a minimum of expense. A still further object and advantage made possible by my invention is the employment to these ends of metal in the form of relatively thin flat pieces which may be easily cut from commercially available rolled sheets of metal which have already been hot or cold worked, acquiring thereby the superiority of greater uniformity and density throughout. It is apparent that these objects are highly desirable especially in any situation where the first requirement is very great accuracy in detail of reproduction, for example in the reproduction of plates for printing, lithographing, and embossing, in the production in large quantities of phonograph records from a master record, etc.

I have attained these objects by the use of various alloys of non-ferrous metals in a process which, while neither casting nor forging, yet somewhat resembles each of these well known operations and might be considered as lying somewhere between them.

In the drawings:

Fig. 1 represents diagrammatically in partly sectional elevation a press the bed of which is equipped with a heating device, and which comprises the apparatus employed in carrying out my invention.

Fig. 2 shows figuratively an original or master pattern.

Fig. 3 shows similarly a matrix, pattern or mold.

Fig. 4 shows the duplicate reproduction of the original shown in Fig. 2.

While not entirely comprehensive of my invention, yet as the best means of disclosing the same, I have chosen as an example illustrative thereof the object shown in Fig. 2 as the original, the visible or nearest face of which suppose it is desired to duplicate. This object for simplicity of illustration is provided with only the one face in relief and represents the example of a printing plate.

Here the surface of the reversed capital letter " F " is raised in cameo above the surface of the plate to form the actual printing surface, the letter being an integral part of the whole piece of say copper metal.

The first step in the process of duplication is to produce a matrix or mold pattern from the original object, using the original as a master pattern.

This I accomplish by first, selection of the proper material for the matrix, second, heating the material to the proper temperature, and lastly, forming the matrix by a direct impression therein of the original.

The material required for the matrix must be of substantially lower melting point than that of the original, and depending upon the hardness and thermal properties of the original I have successfully used numerous of the non-ferrous alloys. In this particular illustration, an aluminum base alloy might be employed.

The material chosen, before and during the time when the impression by the original is being taken, is subjected to a continuous heating, which may be to the point of annealing, or even beyond to a somewhat plastic condition, or therebetween, according to the state of malleability or ductility at which the matrix material is desired, and depending also somewhat upon the depth and dimensions of the impression desired. It is well known in metallurgy that viscosity in a non-ferrous metal or alloy is generally speaking a function of its temperature. Consequently in some cases a means of close heat control must be provided, and I have accomplished this by placing on the bed 5 (Fig. 1) of the press used, between the working face 6 of the bed and the matrix or copy material, an electric heating element as shown symbolically at 7 in the present instance, of smooth flat upper surface to contact thermally with the copy material, and controlled by the thermo electric unit as shown diagrammatically at 9.

After the proper temperature has been attained, the impression is made by forcing the original down upon the heated blank matrix or copy material, and maintaining

the contact at the proper pressure for a period of from a few seconds to about one minute, depending here again upon the materials, temperatures, and depth of impression. The type of press illustrated produces a short dwell in the contact at maximum pressure, but I have found it desirable in some cases to increase the dwell, which is easily done by temporarily slowing or stopping the rotation of the pinion 10 at the proper time as required, or may obviously be obtained automatically by proper alteration in the design of the cam 11.

Having in this manner produced from the cameo original 2, the intaglio matrix 3, an exact duplicate in form except of course the converse in working surface, the next step is to produce from the matrix, as a pattern or mold, the desired duplicate. This I accomplish in exactly the same manner as the matrix was produced, except that a material of still lower melting point is selected, as for example an alloy of lead base, and obviously the result (Fig. 4) of this step, being the converse of the intaglio matrix, is identical in its working surface with the original.

It has been found that the duplicate thus obtained is far beyond the product of any process employed heretofore, in faithfulness of reproduction. Not only are the surface dimensions of the duplicate those of the original, and the process completed without shrinkage, expansion or warping of either the matrix or duplicate; but also the minutest details of surface finish are reproduced with such great fidelity that even a highly polished surface in the original appears with an equal polish in the duplicate.

While I have illustrated and described by way of example an application of my invention more readily adapted to the printing industry, I do not wish to limit myself thereto, since my invention is equally useful in any instance where a like reproduction of particularly great accuracy upon one surface is acquired. Nor is my process to be construed as limited in application to the reproduction of a single surface. By the insertion of a second mold or pattern of sufficient heat resistant and conductive qualities between the heating element and the copy material, both sides of the product may be finished in the same operation; and likewise by the use of matrix molds of generally concave faces, a product finished all over may be obtained.

As to specific metals used, my process may be applied to any metal where I can utilize a pattern, mold or die of substantially higher melting point and of sufficient hardness to withstand the requisite pressure, and I have been able to operate with ease on metals of: lead-base, tin-base, zinc-base, aluminum-base, copper-base, silver-base and gold-base. In fact, in cases I have been able by application of more pressure and less heat, to use metal of the same base, notably aluminum, for both pattern material and copy material provided the material of the pattern was of either a stronger alloy or harder temper. In this connection I have been particularly successful in the use of various compositions of the wrought light hard alloy of aluminum known to the trade as duralumin, the principal constituents of which in addition to aluminum, are between 3% and 5% of copper and less than one per cent each of magnesium, silicon, manganese and iron. It is to be understood, however, that I do not wish to limit myself to the use of non-ferrous metals, but obviously for example a steel original would be thoroughly serviceable, and I contemplate forming of ferrous alloys by my process, as well as those already designated.

I have also been able to employ in my process, copy material already polished and electro-plated with copper, brass and nickel, resulting in great economy in obtaining a finished surface upon the completed product.

In my process a great advantage results from the application of the high pressure required in compressing the heated copy material, in that by this means a greater density is obtained in the product than that of the materal, and the tendency is obviously to eliminate air holes and reduce the pores within the metal itself as well as merely upon its surfaces. Moreover my process does not leave the metal in the product in a state of strain, as would be the case in a cold working process.

An advantage of heating the copy material directly upon the press is the saving of labor, time and thermal efficency by obviating such a preliminary step as separate annealing.

A still further advantage of my process is that of turning out the product of the press at a sufficiently high temperature to allow of the immediate application of some desired heat treating process.

Having thus illustrated and described my invention, what I claim is:

1. The process of metal working consisting in raising the temperature of a piece of metal sufficiently to materially reduce its resistance to change in form, subjecting the said piece to a gradually increasing pressure by a form changing tool, and maintaining the temperature of the said piece and the pressure thereon at maximum value an interval sufficient to allow the said piece to completely conform in contour with that of the said tool, but removing the said tool before it is itself affected in form.

2. The process of metal working con-

sisting in raising the temperature of a piece of metal sufficiently to materially reduce its resistance to change in form, subjecting the said piece to a gradually increasing pressure by a form changing tool of substantially similar composition, and maintaining the temperature of the said piece and the pressure thereon at maximum value an interval sufficient to allow the said piece to completely conform in contour with that of the said tool, but removing the said tool before it is itself affected in form.

3. A method of metal working comprising raisng the temperature of a piece of metal by contact with a press bed member sufficiently to materially reduce its resistance to change in form, subjecting the piece to a gradually increasing pressure by a form changing tool mounted in the press, and maintaining the temperature of the piece through said contact, and said pressure thereon, an interval sufficient to allow the piece to conform in contour with that of said tool, but withdrawing the tool before it is itself affected in form.

Signed by me, this 6th day of January, 1925.

JAMES ROSENBERG.