Nov. 6, 1945. J. S. CURTISS, JR 2,388,528

DIES AND METHOD OF MAKING SAME

Filed April 7, 1944

Fig.4

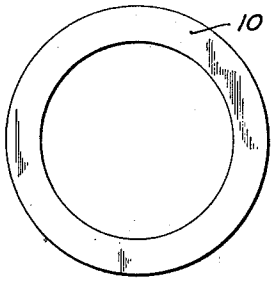


Fig.1

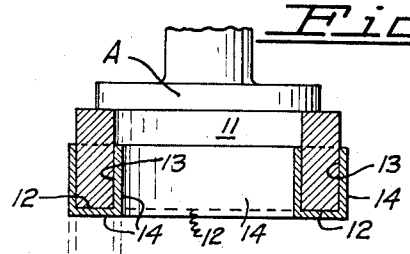


Fig.2

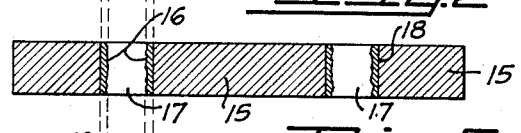


Fig.3

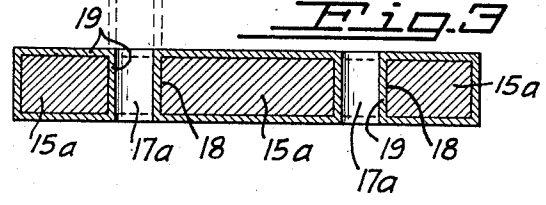


Fig.5

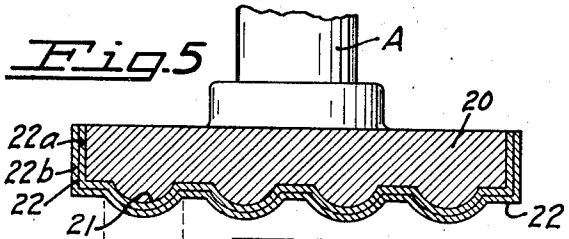


Fig.6

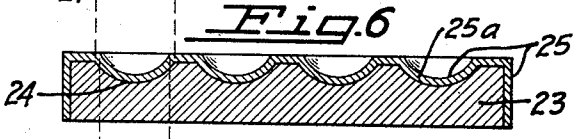


Fig.7



Fig.8

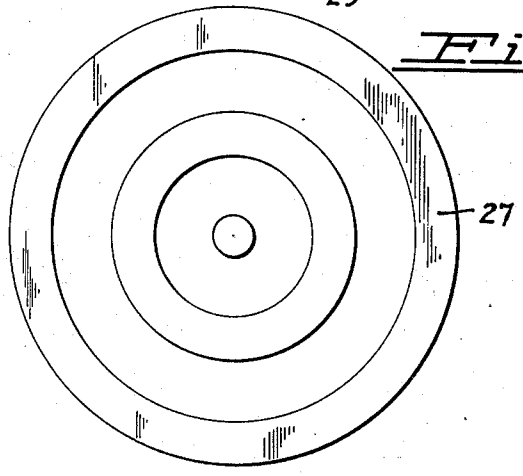


Fig.9

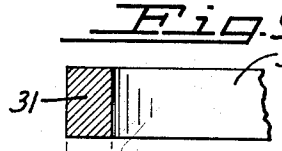


Fig.10

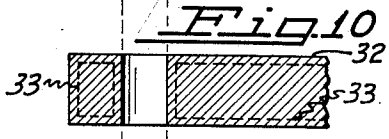
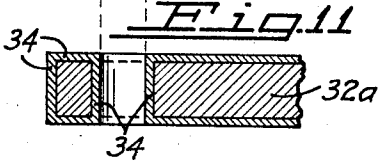


Fig.11



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DIE AND METHOD OF MAKING SAME

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Application April 7, 1944, Serial No. 529,985

7 Claims. (Cl. 76—107)

This invention relates to dies and method of making same, and more particularly relates to such dies and method wherein a first die member of a complementary pair of die members is employed to cut the other or second die member, or have said second die member shaped by the first die member as by pouring or molding thereabout. In its illustrated and preferred form herein, the invention relates to dies and method of making same wherein a die member having a relatively hard working face may be first formed and the other die member shaped therefrom, the latter of which may be a softer die member than the first or hard die member. The invention also relates to dies in which a spacing is provided between respective working faces of complementary die members, one of which is of harder material than the other, and providing in said space between the working faces of the complementary die members a plating of hard material on the working face of the softer die member, and in which the plating is of substantially the same thickness as the space between the working faces and substantially fills such space, with allowance in the case of forming dies for the thickness of the work-piece upon which the dies are to operate.

For illustrative purposes and to characterize the present invention comparatively with known dies and methods of making same, it may be stated that it is well known to employ complementary dies, of which one is relatively hard and the other is relatively soft, and forming the softer die member from the harder die member. As compared with cutting and finishing two die members of equal hardness this method has obvious advantages of economy and operative fit of the working faces. It also has disadvantages because of relative softness of one die member.

The die member of the hard metal is made with care as a perfect die of the desired shape, whereas the die member of the softer metal is only roughly cut to general conformity with the shape of the hard die member, whereupon the two members are mounted in a press and the hard die member is employed to complete the cut in the soft die member by so-called broaching or shearing of the remaining rough edge material of the soft die member. Thus the soft die member is cut to exact size and conformity with the hard die member with sliding clearance only. A set of complementary dies so made can be employed only in blanking or forming work-pieces or materials to be acted upon which are soft enough to be cut by the soft die member, and the life and efficiency of the soft die member is relatively short.

One of the objects of the present invention is to provide die members one of which is cut by the other or formed by it, such as by pouring or molding against or around it. Another object is to provide a space between co-operating working faces of complementary die members, wherein a coating may be disposed upon the effective co-operating working face and edge of one of the die members for regulating a predetermined desired clearance between the co-operating working faces of complementary die members. A further object is to provide for forming a soft die member from a hard die member, provide a hard working face for the soft die member, yet maintain the exact predetermined relationship and conformity between the die members.

With the foregoing and other objects in view, as will more fully appear from this description, one exemplification of the invention consists of the steps of the method and the die apparatus described herein and exemplified in the accompanying drawing, wherein like reference characters designate corresponding parts in the several views, it being understood that changes in form, degree, size and proportions of the dies, as well as variations of steps of the method, may be resorted to within the scope of the appended claims without departing from the spirit or sacrificing any of the advantages of the invention.

Referring to the drawing showing one exemplification of the invention and by which the method may be illustratively described.

Fig. 1 is a cross-section transversely vertical of a circular force or male blanking die for cutting rings shown in Fig. 4.

Fig. 2 is a cross-section transversely vertical at one stage of manufacture of a receiving die complementary to the force die of Fig. 1.

Fig. 3 is a cross-section transversely vertical at a completed stage of manufacture of the receiving die of Fig. 2.

Fig. 4 is a plan view of article cut by the dies of Figs. 1 and 3.

Fig. 5 is a modification showing in cross-section a transversely vertical circular force or male die for forming plates shown in Fig. 8, showing stages or production and completion.

Fig. 6 is a cross-section transversely vertical of a receiving forming die complementary to the force die of Fig. 5.

Fig. 7 is a cross-section transversely centrally of a plate formed by dies of Figs. 5 and 6.

Fig. 8 is a plan view of obverse face of plate

shown by Fig. 7 and formed by dies of Figs. 5 and 6.

Figs. 9, 10 and 11 are fragmentary sectional views of a modified form of practice of the invention.

Referring to Figs. 1 to 4, inclusive, of the drawing, let it be assumed that it is desired to stamp out the ring member 10 of Fig. 4, then the male or force die generally indicated 11 in Fig. 1 is prepared and finished as a master die, preferably of hard metal, having its cutting or working face 12 of the same size and configuration as the design to be cut or formed, such as the plan view of ring 10 in Fig. 4. The working face 12 and its adjoining walls 13 are then plated, preferably by the well-known electrolytic process, with a coating of relatively hard plating metal such as chromium plate as at 14, providing it with what may be termed an oversize build-up of its shearing edges. The hard force die is then ready to cut the receiving die generally indicated 15 in Fig. 2 and 15*a* in Fig. 3. The receiving die 15, 15*a* is preferably of relatively softer metal than the force die, since this usually results in economy of time and expense in die making. The receiving die 15, 15*a* is in usual practice first roughly cut by any suitable means so that there remains around and about the walls of the intended die opening a thin body of surplus material indicated 16. The force die member 11, including plating 14 and the softer receiving die member 15, including surplus metal 16, are then placed in a die press (the hammer block A being illustrated only), and the surplus metal 16 is broached out of the receiving die openings 17 so that the openings 17 are of the same size and configuration as the shearing face of the force die 11, including its plating 14, as indicated at 18, thus allowing operating sliding clearance only between the two die members.

The plating 14 is then removed in any suitable manner from the force die member 11, this de-plating being preferably by commonly used reversal of the electrolytic process. A plating 19 of hard metal such as chromium is then applied to the soft receiving die 15, 15*a* of a thickness similar to the thickness of the plating 14 which was originally added to the force die 11 and later removed therefrom, thus building up the walls of opening 17*a* as shown in Fig. 3, whereby the working face and edges of the finished openings 17*a* of the soft receiving die member 15, 15*a* are provided with a hard working face and edge and wear-resisting openings of the same size and contour as shearing edges 12 of the original finished blanking force die 11, with allowance only for a predetermined desired working clearance between them. By timing and recording the electrolytic plating process in plating the force die 11 and allowing for differences and choice of die materials of one die member relative to the other, the thickness of plating of the respective dies may be gauged and predetermined with extreme accuracy. The predetermined desired working clearance will depend on the purpose of the dies, the material they are to work upon, and also the thickness of that material. If the material to be worked upon is thin and hard, there may be only a shearing sliding clearance, but if the material is thick and relatively soft, a great clearance is desirable, or, if a flange is to be formed on the work-piece, a suitable clearance is allowed for thickness of the flanged material.

It will be observed that the invention above described contemplates providing or shaping a first die member, preferably with a hard, effective or working face, and making a second, and preferably a relatively softer die member from the first or hard die member, so that the two die members have co-operating working faces to operate upon a work-piece therebetween, and providing a space between said co-operating faces within which a relatively thin plating of hard material may be interposed for providing a hard working face and a wear-resisting surface to the effective cutting or forming portion of the second, and preferably softer, die member. The second die member need not necessarily be made by impressing the first die member thereupon, since the second die member may be also made by pouring the metal thereof into contact with the working face of the first die member and thereby molding it.

Manifestly, it is not necessary that the force or male die as exemplified in the preceding description shall always be the master or finished hard die. The opposite or receiving die may be the master or hard die and the male die may be made therefrom as the softer die, electrolytically reduced and then plated with a hard metal to build it up to the desired size to allow for the predetermined desired clearance between the die members. Or after both dies are made, one from the other, preferably a softer die from a harder die, with corresponding and similar contour of working faces and edges, the invention contemplates the reduction of either the dies in any suitable manner, as by the electrolytic process, to provide a space between the opposed effective die faces sufficient to allow for a hard plating on said effective face of one of the dies to the extent of the thickness removed from the opposing or complementary die.

Alternately, as shown in Figs. 9, 10 and 11, the first die 30 may be completed in its finished size and contour, and its effective face 31 be employed to make the receiving die 32, whereupon the second or receiving die 32 may have its working face reduced, as by electrolysis, to the dotted lines 33 in Fig. 10 and 32*a* in Fig. 11. Then the reduced die 32*a* is plated with a hard plating 34 of the proper thickness to establish the predetermined desired clearance between the co-operating working faces of the complementary dies.

When referring herein to the "hard" die member, it is not essential that it be made of steel or other inherently relatively hard material throughout its entire body, provided its effective cutting face is hard or hardened sufficiently to be used to make the original cut in the receiving die. Thus, in the die 11 of Fig. 1, if the shape of the die is irregular and intricate in the configuration of its cutting face 12, then it may be found convenient and more economical in time and expense to cut the force die 11 from relatively softer material to a size and configuration of lesser dimensions than the ultimate or final die desired, apply thereto an extra thick plating 14 which will oversize the working face 12 of the force die, whereupon the receiving die 15 may be broached, and thereafter plated to build it up to a predetermined size and contour. Then the extra thick oversizing plating may be electrolytically removed from the force die, and the working face thereof re-plated to a thickness which will build up the working face thereof to conform to the working face of the receiving die, which likewise has had the plating 19 applied thereto. Thus, the working face of the force die

would be of the size and configuration intended for the completed and finished force die, and the effective working face of both dies would comprise a hard coat of plating enclosing a softer inner body.

It is to be understood that forming dies may also be made by this method in accordance with the modification exemplified in Figs. 5, 6, 7, and 8. In making forming dies there is normally a sheet or body of material to be fed and formed between the working faces of the forming dies. Therefore, allowance must be made not only for a thickness of hard plating on the softer die, but also for the thickness of body material to be acted on between the dies.

Illustrating and describing by reference to the drawing, one example of employment of the method of making forming dies, a hard or force die 20 is formed having its ultimate finished working face 21 conforming to the intended planar finished contour of the obverse face 28 of the material which is to be acted upon and formed by the dies. This finished face is indicated 21 in Fig. 5. Upon this finished ultimate face 21 of the force die there is deposited, preferably electrolytically, a plating 22 of metal of the combined thicknesses indicated 22*a* and 22*b*. It is to be understood that plating 22 may be a single plating, but is shown in the drawing as though it comprised two layers, solely in order to describe the purpose and combined thickness of the plating 22. The thickness 22*a* represents the thickness of the work-piece to be acted on, and the thickness 22*b* represents thickness of plating it is desired to employ as a deposit upon the working face of the softer receiving or intaglio die 23 for purposes of hardening the face of the latter. (See plating 25 of Fig. 6). The intaglio die having been roughly routed in the indentations 24 thereof, the two die members are placed in a die press and brought into contact under pressure whereupon the hard forming die 20, including the combined plating 22, makes an intaglio impression upon the face of softer die 23, conforming in planar contour to the face 21 of die 20, plus the thickness 22*a* and 22*b* represented by the indent 24. As previously stated, the receiving die may be molded against the plated face of the force die, rather than being formed by pressure thereagainst.

The intaglio or receiving softer die 23 may then be plated with hard metal, such as chromium plate, to build it up with an added hard facial coating 25 of the same thickness as the plating 22*b* of the hard forcing die 20, said plating 22*b* representing, as previously stated, the same thickness of plating to be applied to the working face of receiving die 23. Thus a hard finished face of soft die member 23 is provided conforming to the contour of faces 22 and 24, plus the thickness of plating 25*a*, which is the same as the thickness 22*b*. Thus allowance is made for the thickness of material of the work-piece 27, said thickness being represented by the thickness 22*a* of plating 22.

The force die 20 having been prepared of an initial size and finish of its face 21 to conform to the upper or obverse face 28 of the work-piece 27, it is only necessary to remove plating 22 by any suitable means, such as by reversing the electrolytic process by which the face plating 22 was deposited on hard die member 20. Thus sheet of work-piece material 27, having the thickness indicated 22*a* in plating 22, would, by operation of the forming dies thereon, have its obverse planar face 28 formed similar to the originally finished face 21 of hard force die 20, and have its reverse face 29 formed similar to the plated face 25 of soft die member 23, as shown in cross-section in Fig. 7, and in plan view of the obverse face shown in Fig. 8.

Having thus described the invention, what I claim as subject matter for patent is:

1. A method of making die members comprising the steps of shaping a first die member to an oversize of a finally desired configuration of effective die face, forming a second complementary die member by relative contact between the said oversize first die member and the second die member, removing a layer of material from the effective die face of the said first die member to reduce the oversize of said effective die face to a finally desired configuration of said die, and adding to the effective die face of the said second die a layer of material of a thickness such as to provide a desired predetermined clearance between the effective working faces of the respective die members.

2. A method of making die members comprising the steps of shaping a first die member to a finally desired configuration of effective die face, adding a layer of relatively hard material to the effective die face to make said face oversize with relation to the finally desired configuration, forming a second relatively softer and complementary die member against the effective die face of the said first oversized die member, removing the added layer of the first die member to again reduce the effective die face thereof to the finally desired configuration of said die, and adding to the effective die face of said second die a layer of material harder than the body material of said second die member and of a thickness such as to provide a desired predetermined clearance between the effective working faces of the respective die members.

3. A method of making die members comprising the steps of forming on the effective die face of a first die member a finally desired configuration, oversizing said desired configuration by electrolytically depositing thereon a plating of relatively hard material, forming a second relatively softer and complementary die member by contact against the said oversized first die member, removing the oversizing plating from said first die member and electrolytically depositing upon the effective die face of said second die member a plating of material of a thickness sufficient to provide a desired predetermined clearance between the effective working faces of the respective die members.

4. A method of making die members comprising the steps of shaping a first die member to a desired configuration of effective die face, adding a layer of relatively hard material to the effective die face to make said face oversize with relation to the finally desired configuration, forming a second relatively softer and complementary die member against the effective die face of said first oversized die member, removing the added layer of the first die member, and depositing upon the respective effective faces of each of said die members a plating of material the sum of the thicknesses of which layers of added material leaves a desired predetermined clearance between the two die faces so plated.

5. A method of making die members comprising the steps of shaping a first die to an oversize of a finally desired configuration of effective die face, forming a second and complementary die member by relative contact between the said oversized

first die member and the second die member, removing a layer of material from the effective die face of the said first die member to reduce the oversize thereof to less than its finally desired effective die face, and adding to the die face of each of said dies a layer of material sufficient to build each of said die faces to a finally desired configuration, the sum of the thicknesses of which layers leaves a desired predetermined clearance between the effective final working faces of the respective die members.

6. A method of making die members comprising the steps of shaping the female of a pair of die members composed of male and female to an undersize of desired configuration of opening, forming the male complementary die member by relative contact with the undersized working face of the female die, removing a layer of material from the undersized face of the said female die member and thereby enlarging the opening thereof to a finally desired configuration, and adding to the effective die face of the said male die member a layer of material of a thickness sufficient to provide a desired predetermined clearance between the final effective working faces of the respective die members.

7. A method of making die members comprising the steps of shaping the female of a pair of die members composed of male and female to an undersize of finally desired configuration of opening, forming the male complementary die member by relative contact with the undersized working face of the female die, removing a layer of material from the effective die face of said female die member and thereby enlarging the opening thereof greater than the finally desired configuration of the opening, and adding to the effective die faces of each of said die members a layer of material of a thickness sufficient to provide each of said die faces with its finally desired configuration, the sum of the thicknesses of which layers leaves a desired predetermined clearance between them.

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