

Sept. 4, 1945.

D. W. SHERMAN

2,384,349

FORGING DIE

Filed Jan. 27, 1944

FIG. 1.

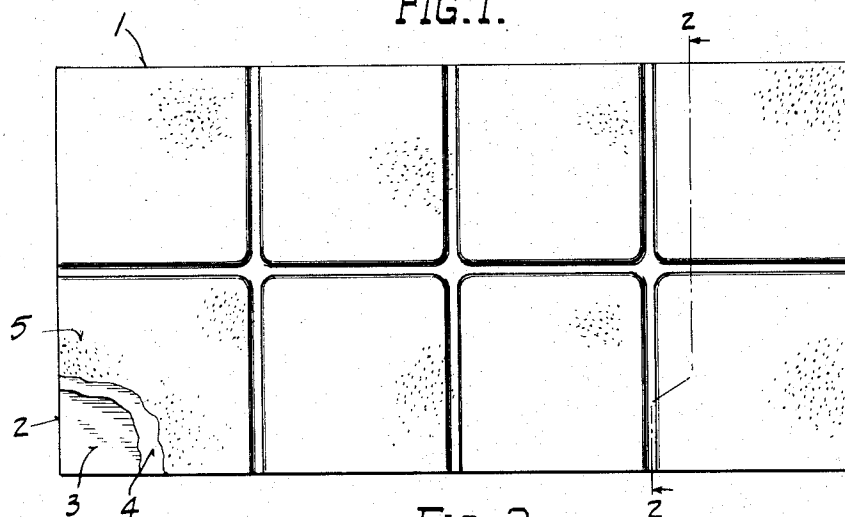


FIG. 2.

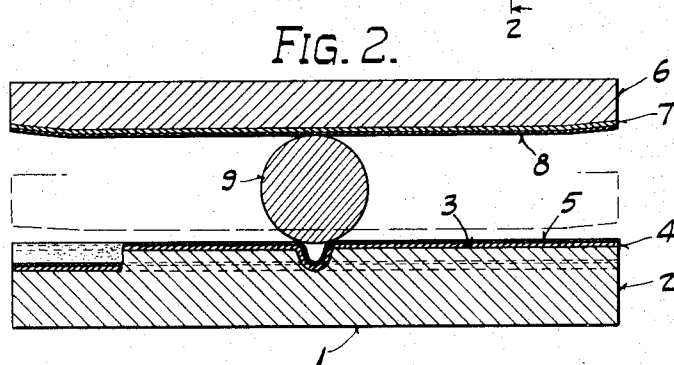


FIG. 3.

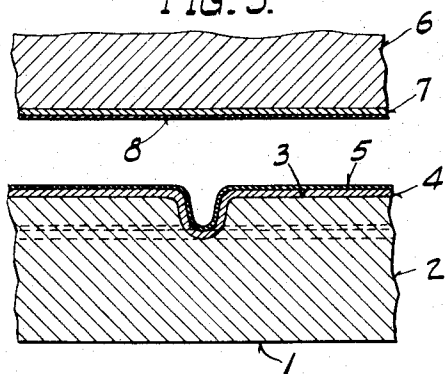
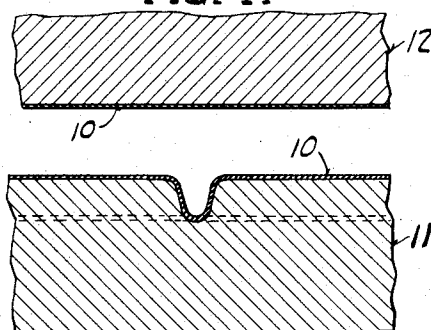


FIG. 4.



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FORGING DIE

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5 Claims. (Cl. 78-60)

This invention relates to forging dies.

The principal object of the invention is to provide a forging die for high temperature forging and in which a lubricant is secured to the working face of the die.

According to the invention, the working surface of the die or of a thin liner therefor has a coating of ceramic enamel or the like bonded thereto to serve as a lubricant.

The invention has been applied to the forging of thin sections in one forging operation as set forth in applicant's copending application, Serial No. 519,940, filed on even date herewith for Method of forging and lubricant therefor.

An embodiment of the invention is illustrated in the accompanying drawing in which:

Figure 1 is a plan view of the face of a forging die;

Fig. 2 is an enlarged transverse section of the die taken on line 2-2 of Fig. 1, together with its mate;

Fig. 3 is an enlarged fragmentary section similar to Fig. 2; and

Fig. 4 is a similar transverse section showing a modified construction of die without employing a replaceable lining.

The dies illustrated in the drawing were constructed for the forging of a specially shaped steel plate having thin sections of considerable surface area. The plate is forged from a round bar about three inches in diameter and several feet long in a single operation of the forging press. In order to accomplish this, and in accordance with the method set forth in the copending application above specified, the bar is heated to a point close to the melting point of the steel and a ceramic enamel lubricant is employed to line the dies.

The present invention is directed to the construction of the dies and the application of the ceramic enamel lubricant thereto to obtain the most satisfactory forging results.

The lower die 1 constitutes a block of metal 2 having a face 3 generally shaped according to the article being forged and provided with a relatively thin replaceable lining of sheet metal 4, and the latter has bonded to its working face a continuous uniform coating of ceramic enamel 5.

The lining 4 may be formed directly against the face 3 of the block 2 so as to fit tightly and uniformly thereagainst.

The enamel 5 is applied to the working face of the lining by first spraying a vitreous enameling material over the surface to be coated and

then firing the same at about 1600° F. The firing operation fuses the enameling material and bonds the same to the steel lining 4 throughout.

The upper die 6 is of similar construction with a lining 7 and ceramic enamel coating 8. The face of the upper die 8, however, is usually of different shape than that of the lower die 1, depending upon the shape of the piece to be formed.

In carrying out the forging operation, the bar 9 to be forged is first heated thoroughly to above 2400° F. and then subjected to the forging pressure of the two opposed dies 1 and 6. In the forging operation the bar 9 is first engaged by the dies along the center line of the latter, and as the metal of the bar flows laterally under the pressure of the dies thereon, it progressively engages more and more of the die faces until it substantially fills the die cavity and takes on the shape of the finished forged article.

The ceramic enamel 5 and 8 bonded to the working faces of the lining becomes plastic from the heat of the forging blank 9 and serves as a lubricant for the dies. It was found in tests that without the enamel it took about 1,800 tons pressure to form the forged product described; whereas with the enamel lubricant it took less than 200 tons of pressure. The softening of the enamel occurs progressively as the metal being forged gradually flows laterally in the dies, and therefore a fresh supply of lubricant is always being supplied at the point of flow of the metal. The bonding of the enamel to the working surface of the die prevents its being scraped off or pushed ahead of the flowing metal.

The enamel coating should be at least ten thousandths of an inch thick and preferably comprises two or more coatings, one applied on another. The first coat should be of a composition giving good bonding characteristics. The enamel is preferably of the hard or glass type firing at above 1600° F. as distinguished from softer types firing as low as 1300° F. However, this may depend upon the shape and composition of the article being forged and the forging temperature employed. As explained in the copending application referred to, the spread between the firing temperature of the enamel and the temperature to which the work blank is heated for forging should be such as to effect a heating of the hard enamel to a plastic state to provide its lubricant effect. If the enamel remains too hard, it may objectionably affect the surface of the forging. On the other hand, if the enamel melts to a liquid state too soon it may be scraped off and thereby fail to lubricate.

In the modified embodiment of the invention

illustrated in Fig. 4, the enamel 10 is bonded directly to the working faces of the dies 11 and 12 which are dimensioned to shape the article without a liner. In employing this embodiment, the working face of the die is cleaned between each one or two forging operations and then reenameled. In the preferred embodiment of Figs. 1, 2 and 3, however, the liner is sufficiently cheap to permit it to be discarded and a new enameled liner placed in the die as soon as the enamel has become sufficiently destroyed to prevent its use. It is usually best to use the enamel only once and to replace the liner between each forging operation. It is also possible to clean and reenameled the liners for repeated use.

Various embodiments of the invention may be employed within the scope of the accompanying claims.

The invention is claimed as follows:

1. A die for forging operations comprising a die member having a working face for shaping an article, and a coating thereon of ceramic enamel bonded thereto.

2. A die for metal forging operations comprising a die member having a working face for shaping a heated metal article, and a hard refractory lubricant which softens under the heat of the forging operation lining the working face of the die.

3. A die for metal forging operations, comprising a die block, a sheet metal liner for the face of the die block and providing a working face for the die, and a ceramic enamel coating covering said working face and bonded to said sheet metal liner.

4. In a die for high temperature metal forging operations, a replaceable metal lining having its working surface coated with a vitreous material fired and bonded thereto.

5. In a die for high temperature metal forging operations, a glass enamel lubricant coating and bonded to the working surface of the die.

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