

Jan. 2, 1945.

C. E. BURGESS

2,366,487

STAMPING AND FORMING

Filed June 12, 1943

2 Sheets-Sheet 1

FIG. 1.

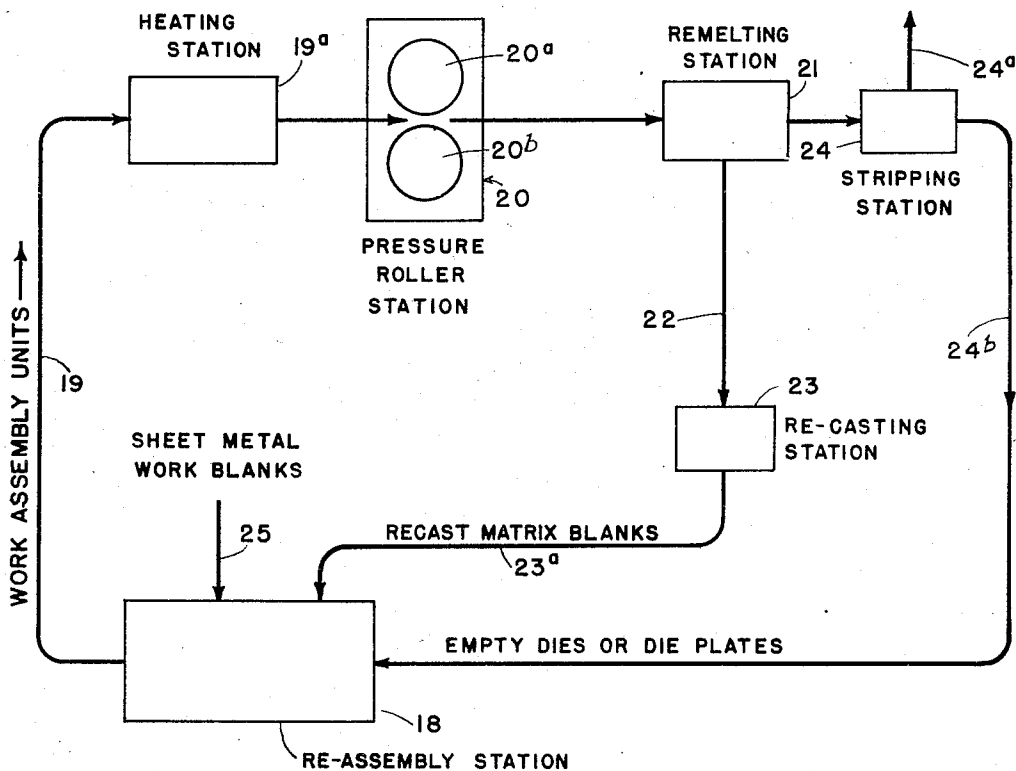
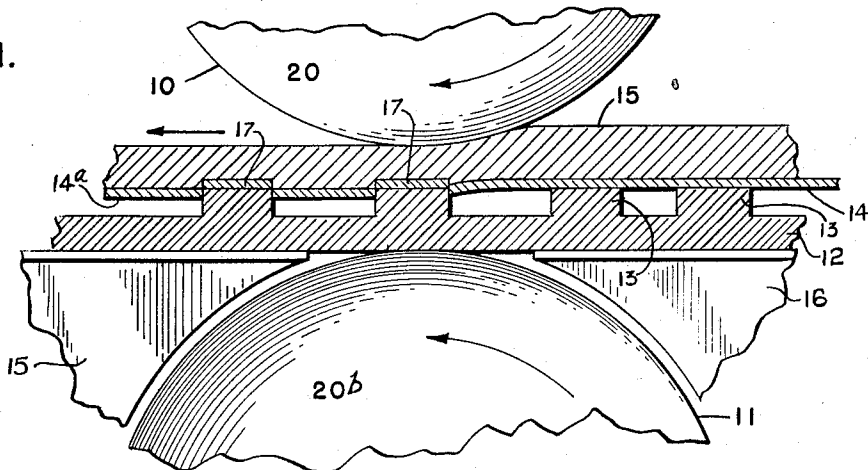


FIG. 2.

INVENTOR.

CHARLES E. BURGESS

BY

Arthur Nielsen

ATTORNEY

Jan. 2, 1945.

C. E. BURGESS
STAMPING AND FORMING
Filed June 12, 1943

2,366,487

2 Sheets-Sheet 2

FIG. 3.

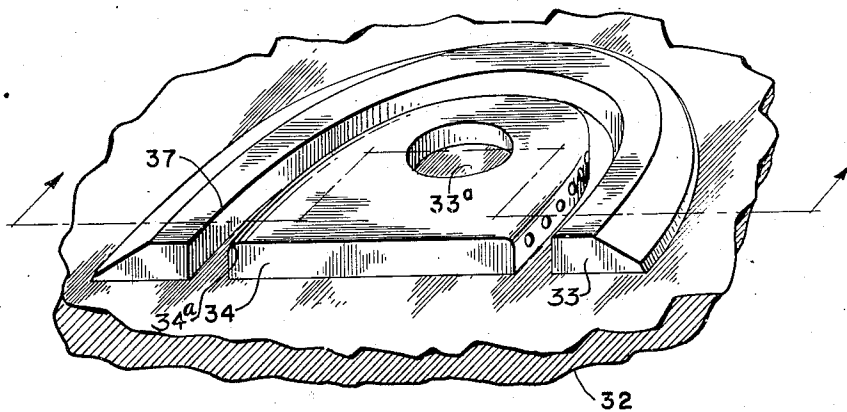


FIG. 4.

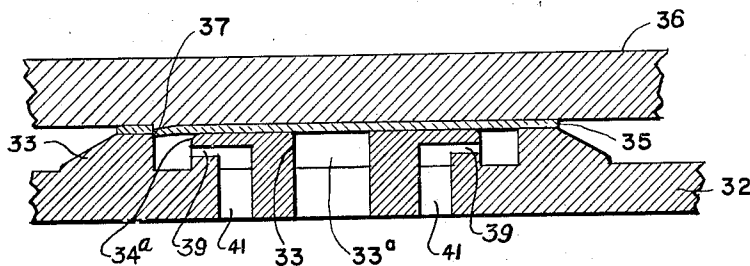


FIG. 5.

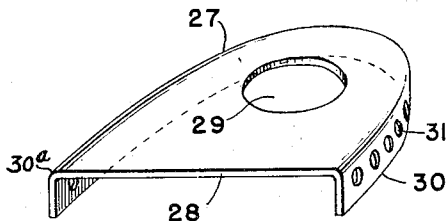
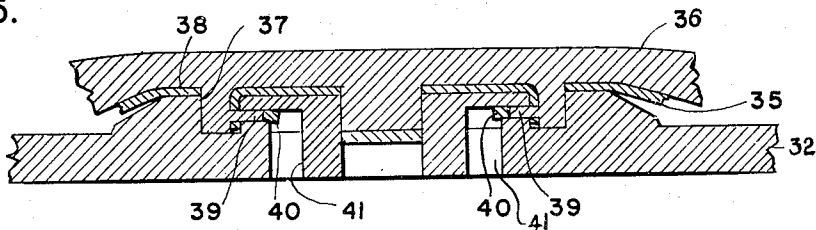


FIG. 6.

INVENTOR.
CHARLES E. BURGESS
BY
Arthur Middleton
ATTORNEY

UNITED STATES PATENT OFFICE

2,366,487

STAMPING AND FORMING

Charles Edward Burgess, Trenton, N. J.

Application June 12, 1943, Serial No. 490,606

9 Claims. (Cl. 113—51)

This invention relates to a method of stamping as well as to a method of compound stamping and forming, and more in particular it relates to such methods involving the use of a deformable matrix whereby sheet metal is forced over a rigid die.

The method proposed according to this invention differs from a known process in which a matrix of resilient material such as rubber is used and whereby stampings and formed parts have been produced even though under certain limiting conditions, without the necessity of specially made female dies.

This invention proposes the use of a matrix of a non-resiliently deformable or malleable material as a matrix and a suitable metal alloy of suitable characteristics is herein proposed for that purpose. It is among the objects of this invention not only to avoid the necessity of making the female dies but to obtain more sharply defined stamped and formed sheet metal products, and to avoid certain manufacturing limitations inherent to the older method of using a rubber matrix.

According to one embodiment of this invention, an assembly of a male die structure or die plate, a sheet metal work blank, and a non-resiliently deformable matrix material is subjected to the pressure of pressure rollers. Thus the deformable material is caused to stamp out blanks from the sheet metal, or to form a work blank over a die, or if the die be accordingly constructed as a compound stamping and forming die to perform both steps, namely the blanking and forming in one operation.

Features of this invention relate to the use of non-resiliently deformable matrix material or alloy of special characteristics. These features also have to do with the conditions under which the material is to be used, and the ways and means of stripping the deformed material from the assembly.

According to one feature, the operation is executed by means of a suitable metal alloy serving as a matrix, and while maintaining it at a temperature corresponding to its optimum point of malleability or plasticity, but not high enough to affect adversely the metallurgical structure of the material of the die and/or of the work.

According to another feature the matrix material is a metallic substance or alloy which if cooled within the temperature operating ranges of this process, will expand rather than shrink; in other words, so to speak, has a negative factor of thermal expansion.

A material having optimum malleability characteristics in an elevated temperature range, but which will relatively expand in a lower temperature range, is selected according to this feature, so that the stripping of the material may be facilitated after the non-resilient deformation of the matrix has taken place as a result of the pressure or rolling operation.

Still another feature requires that the metallic deformable matrix material or alloy be melted directly off the work assembly instead of being first bodily stripped therefrom, and it further requires that the thus molten material be directly recast into new matrix blanks for reuse in the process. Consequently the matrix material in that instance should not only have suitable malleability characteristics, but should moreover have a low enough melting point so that the metallurgical structure of neither the die nor the sheet metal work piece should be adversely affected by the melting temperature. A special advantage resulting from the practice of this feature lies in the fact that it allows the performance of combined stamping and forming operations in one pressure operation as will be explained more fully hereinafter.

The invention possesses other objects and features of advantage, some of which with the foregoing will be set forth in the following description. In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit. In the accompanying drawings there has been illustrated the best embodiment of the invention known to me, but such embodiment is to be regarded as typical only of many possible embodiments, and the invention is not to be limited thereto.

The novel features considered characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings in which

Figure 1 shows a simple diagrammatic example of an assembly of a die plate carrying fixed thereon the dies proper, a sheet metal work blank, and a non-resiliently deformable matrix passing through a pressure roller device.

Fig. 2 is a flowsheet-like diagram of the manufacturing steps comprising the feature of melting

the matrix material off the work assembly prior to stripping the sheet metal work parts off the dies.

Figs. 3 to 6 illustrate the production of a relatively more complicated part by way of a combined stamping and forming operation in the manner according to this invention.

To illustrate a simple stamping operation as performed according to this invention with the aid of a non-resiliently deformable matrix material or metal alloy, Fig. 1 shows a pair of pressure rollers 10 and 11 between which passes a work assembly comprising a die plate 12 having mounted thereon or integral therewith the stamping dies 13, a sheet metal strip 14 representing the work blank into which holes are to be stamped by the dies 13, and a matrix 15 of non-resiliently deformable material, that is a material capable of assuming a permanent deformation under pressure, such as a suitable metal alloy having adequate plasticity or malleability, and optionally also having suitable temperature characteristics such as certain thermal expansion or contraction factors and a certain melting point.

A number of such materials includes metal alloys of which the bismuth containing alloys are an example, and such as are exemplified by the kind of materials known as Cerro base metal and Cerrobend and otherwise proportioned similar alloys. Cerro base metal and Cerrobend are products of the Cerro de Pasco Copper Corporation of New York city. They are bismuth and lead containing alloys of which Cerrobend for instance is represented by the following average composition:

Cadmium	-----	Approx.	10.0
Tin	-----	do.	13.0
Bismuth	-----		40.0-49.0
Lead	-----		28.0-32.0

It is among the advantages of the bismuth alloys that they have a relatively low melting point, allowing the alloy to be melted off the stamped or formed article without affecting the properties of the articles formed. Furthermore, the malleability and the flowability of such alloys compare with that of lead when heated or chilled. And furthermore, with such alloys substantially no change in volume is experienced on solidification.

The die plate 12 is shown to be supported or guided fore and aft the pressure rollers by guide members 15 and 16. According to Fig. 1 the work assembly as above defined has partly passed through the pressure roller device, so that the forward portion of the assembly shows the deformable forward portion of the matrix as having embedded in it the punched out metal portions 17 while the punched portion of the metal strip 14 is being shown forced down over the stamping dies 13 as at 14^a.

In the practice of the invention as diagrammatically represented in the embodiment of Fig. 1, one or more of the following operating conditions or requirements may be present:

(a) The matrix material is a metal alloy strip or blank of suitable dimensions and of sufficient natural malleability or plasticity to permit its direct use as a matrix at, say, room temperature and under otherwise suitable physical and mechanical operating conditions.

(b) The matrix material is a metal alloy having its optimum point of malleability or plasticity at an elevated temperature which should not be higher than compatible with the metallurgical

nature of the sheet metal work and of the dies. The use of this matrix material would require preheating it together with the other component parts of the work assembly, that is, together with the work blank and with the dies, to a suitable degree of temperature and substantially maintaining that temperature while subjecting the work assembly to the operating pressure between the pressure rollers whereby the stamping and/or forming in the work assembly is effected. Furthermore, if the matrix material is of the kind that expands with rising temperature, care must be taken to remove the matrix from the assembly while hot. Thereupon the stamped or formed work can be stripped from the dies on the die plate, and the deformed matrix material can be reconditioned, for instance by remelting, for reuse in the process.

(c) The matrix material operates under conditions similar to those described under (b), but has a factor of thermal expansion according to which it will expand with a lowering of temperature. A material of this nature will facilitate removing the deformed matrix from the work assembly since the elevated temperature necessary for the pressure operation need not be maintained.

(d) The matrix material operates under conditions similar to those described under (b) or (c), with the addition that the material has a melting point of such order that the material can be melted directly off the work assembly instead of being bodily stripped or forced therefrom. Respective operating temperatures under such conditions may therefore suitably be placed at about 150° F. for attaining the optimum of malleability or plasticity, and at about 300° F. for remelting the deformed matrix material for the work assembly.

The manufacturing process involving the conditions specified under (d) is more fully illustrated in the flowsheet-like diagram of Fig. 2, and is described as follows:

In an assembly station 18 the die plate 12 with its dies 13, the sheet metal blank or work blank 14, and the matrix 15 are composed to form what is herein termed the work assembly unit. The thus-composed assembly moves as indicated by the line 19 to a heating station 19^a where the assembly is brought up to the temperature at which the matrix material or alloy exhibits substantially its optimum of malleability or plasticity. The thus heat conditioned work assembly unit passes to and through a pressure roller device 20 whereby concentrated and relatively high pressure is caused to traverse over the length of the assembly unit, thereby stamping the work blank as in the manner shown in Fig. 1 due to the non-resilient deformation of the matrix. This pressure operation may be used to perform a plain stamping or a plain forming, or a combined stamping and forming operation, an example of which latter is given further below (see Figs. 3 to 6).

While the work assembly unit passes through the pressure roller device 20 its temperature is kept up by some supplementary heating means, for instance, by means of heated pressure rollers 20^a and 20^b. The assembly unit, including the now deformed matrix leaving the pressure roller device, is received by a remelting station 21 in which the assembly is heated to a temperature at which the matrix material alone will melt off the rest of the assembly, thus leaving the die plate and the dies free for the work, that is the stamped or formed article, to be stripped therefrom.

The molten matrix material is collected in the station 21 and in its molten state it is passed on as indicated by line 22 to a recasting station 23 where it is cast to form new matrix blanks which, as indicated by the line 23^a, are sent to the assembly station 18 for reuse in the process. At the same time the die plate with the stamped or formed sheet metal work thereon is passed to a stripping station 24 where the work is stripped off the dies and removed from the process cycle as indicated by the line 24^a.

From the stripping station 24 the empty die plates or dies are passed on to the assembly station 18 as indicated by the line 24^b. The recast matrix material or matrix blanks from the recasting station 23 and the empty die plates from the stripping station 24 as well as newly introduced work sheet blanks as designated by the line 25 enter into and meet in the assembly station 18 where they are composed to make new work assembly units to enter the process anew as indicated by the line 19 by way of entering the heating station 19^a.

In Figs. 3 to 6 the manufacturing process of this invention, and more specifically the one illustrated in the cycle shown in Fig. 2, is shown to be applied to produce a more complicated article produced by a combined stamping and forming pressure operation. The article 27 (see Fig. 6) to be produced comprises a flat body portion 28 having a hole 29 and a flange or skirt portion 30 struck marginally at right angles from the body portion 28, forming a rounded corner portion 30^a. In addition, the flange portion 30 is shown to be provided with a row of holes 31 of relatively small diameter. This example of a stamped and formed sheet metal product is being presented in view of the fact that the holes 31 could not be produced in such a pressure operation by means of a matrix of the known resilient kind, and it is also presented in order to demonstrate that with the sharper demarcation made possible by the use of the novel non-resiliently deformable matrix material, holes of relatively small diameter can be stamped out of a sheet metal blank, whereas the effect of the known resiliently deformable material or rubber matrix was limited to the stamping out of relatively larger diameter holes.

Accordingly Fig. 3 shows a die plate 32 having provided on it in combination a horse-shoe shaped stamping die 33 and a forming die 34 having a rounded corner portion 34^a surrounded by the stamping die 33, a hole 33^a shown to be provided in the forming die 34. In order to simplify matters the die plate 32 and the dies 33 and 34 are shown as one integral part.

In Fig. 4 the dies are assembled with a sheet metal work blank 35 and a matrix blank 36, this assembly to be passed through a pressure roller device under the conditions described in conjunction with Fig. 2.

Fig. 5 shows the result of the pressure operation, namely the fact that the matrix material distributing itself under pressure into the accessible places of the die arrangement has sheared off or stamped out a blank along the cutting line 37 of the stamping die 33, leaving excess sheet material 38 on top of the stamping die 33; furthermore the fact that a portion equivalent to the diameter of the hole 33^a in the forming die has been stamped out of the sheet metal blank; further that a portion of the matrix material being plastically deformed under the pressure has been displaced into the space between the stamping or shearing die 33 and the forming die 34, thereby

forming the flange portion 30 upon the body portion 28 of the sheet metal article 27, by bending the flange portion 30 over the rounded corner portion 34^a of the forming die 34; and finally that the matrix material by virtue of its adequate plasticity and because of the high specific roller pressure employed, has forced itself through passages 39 provided in the forming die 33 and extending in a direction at an angle to the direction of the pressure force applied, thereby stamping out the holes 31 of the article 27 as substantiated by the showing of the stamped out slugs of sheet metal 40.

Each of the horizontal passages 39 provided in the forming die terminates in a downward opening or downward passage 41 for receiving and discharging the stamped out slugs 40.

After the combined stamping and forming operation in this instance has been completed according to Fig. 5, the work assembly unit is subjected to a temperature at which the matrix material is melted off the assembly, and especially melted out of the passages 39 and 40, so that the stamped and formed sheet metal article can be stripped from the die.

I claim:

1. The method of producing articles from sheet metal, which comprises confining a sheet metal work blank between a die member and a matrix member of a metal alloy permanently deformable under pressure, and applying to the assembly of die member, sheet metal and matrix member a locally concentrated rolling pressure force effective to progressively deform the matrix material at the rate at which the rolling pressure progresses over the assembly and thereby to cut an article from said blank.

2. The method according to claim 1, in which the article is being cut as well as formed by the co-action of said die member and said matrix material.

3. The method according to claim 1, in which the matrix material is heated to a temperature at which the material shows substantially an optimum degree of plasticity and is subjected to said pressure operation at substantially that temperature, said temperature being below that which might adversely affect the metallurgical structure of the work blank or of the die member and of the work blank.

4. The method according to claim 1, in which the assembly of said work blank, die member, and matrix member following the pressure operation is subjected to heating whereby matrix material is melted directly off the remainder of the assembly, the melting temperature of the material of said matrix member being below any that would adversely affect the metallurgical structure of the die member and of the work blank.

5. The method according to claim 1, in which the matrix material is heated to a temperature at which the material shows substantially an optimum degree of plasticity and in which the material is selected to have a negative coefficient of expansion, causing the material to contract due to heating effects.

6. The method according to claim 1, in which a matrix material alloy is selected, containing a substantial proportion of bismuth.

7. The method according to claim 1, in which the matrix material is brought to a temperature at which the material shows a sufficient degree of plasticity, and is subjected to said pressure operation at substantially that temperature, in which the deformed matrix material is melted directly

off the remainder of the assembly at a temperature below that which adversely affects the metallurgical structure of the work blank and of the die member, and in which said material in the thus molten state is recast in the thus molten state to form matrix blanks for reuse in the process.

8. The method according to claim 1, in which a matrix material alloy is selected having an ade-

quate degree of plasticity at about 150° F., and a melting point of about 300° F.

9. The method according to claim 1, in which a matrix material alloy is selected having a melting point of about 300° F., and having adequate plasticity at intermediate temperatures.

CHARLES EDWARD BURGESS.