

May 23, 1933.

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APPARATUS FOR PRODUCING SHAPED SECTIONS OF UNIFORM
THICKNESS FROM SHEET METAL STRIPS
Filed Sept. 20, 1929

1,909,930

3 Sheets-Sheet 1

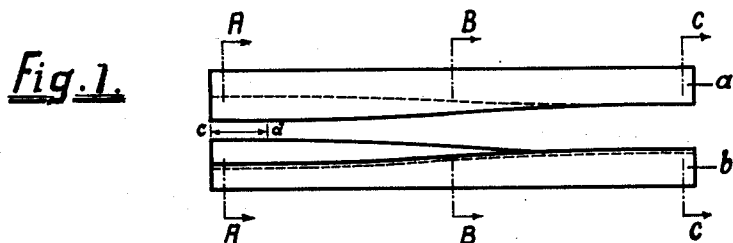
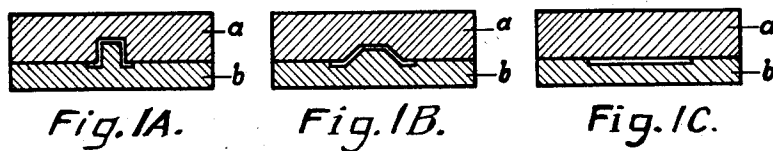


Fig. 2.

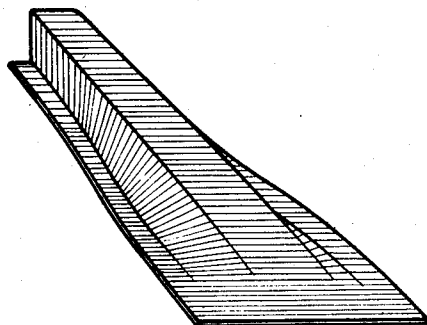


Fig. 3A.

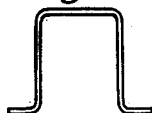


Fig. 3B.



Fig. 3C.

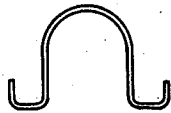


Fig. 5.

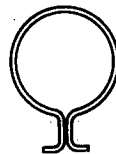


Fig. 4A.

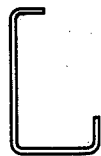


Fig. 4B.

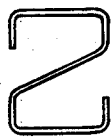


Fig. 4C.

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Fig. 6A.

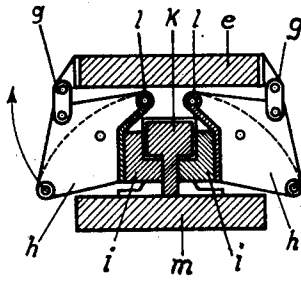


Fig. 6.

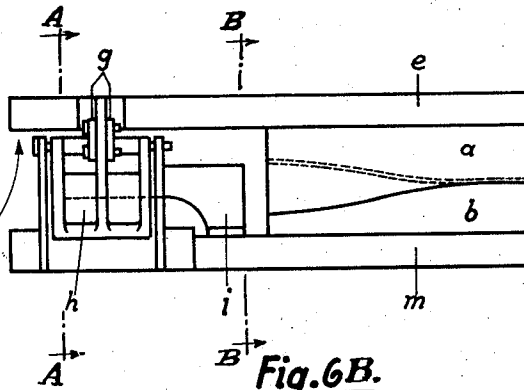


Fig. 6B.

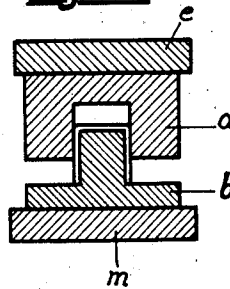


Fig. 7A.

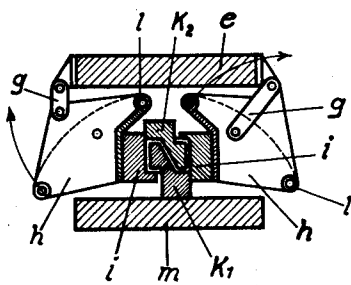
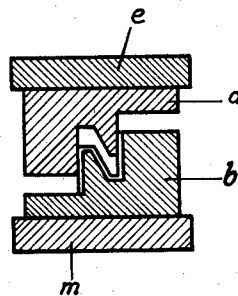


Fig. 7B.



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Fig. 8A.

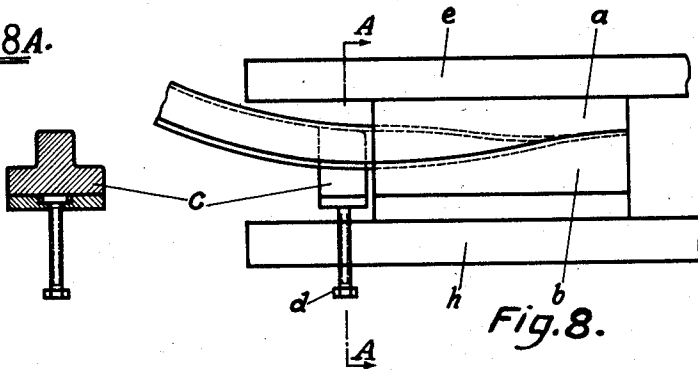


Fig. 8.

Fig. 9.

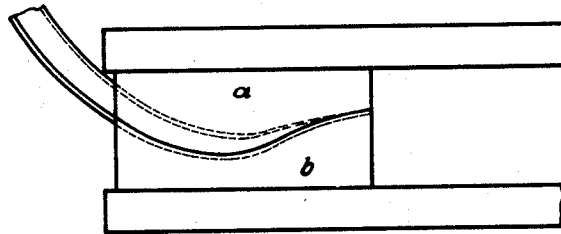


Fig. 10.

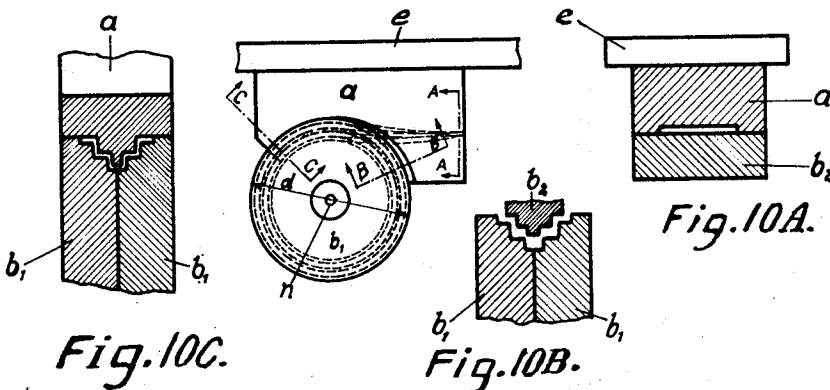


Fig. 10A.

Fig. 10B.

Fig. 10C.

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TO MAGNESIUM DEVELOPMENT CORPORATION, A CORPORATION OF DELAWARE

APPARATUS FOR PRODUCING SHAPED SECTIONS OF UNIFORM THICKNESS FROM
SHEET METAL STRIPS

Application filed September 20, 1929, Serial No. 394,120, and in Germany October 3, 1928.

This invention relates to a method of manufacturing shaped sections of uniform thickness from sheet metal strips.

A number of methods have already been proposed for the manufacture of shaped sections of uniform thickness. Thus, for example, it has been proposed to draw the sheet metal strips through one or more dies corresponding to the desired sections or to pass them between profiled rolls. Another method, namely, shaping by pressure, is employed in folding sheet metal strips.

The mere application of the foregoing methods to the working of magnesium and its alloys has however presented difficulties. In the drawings the metal is subjected to very heavy stresses which may adversely affect its strength. In the employment of more than two dies, which are necessary for sections of complicated shape, intermediate heating operations are required in order that the total friction in the dies, and consequently the stress, may not exceed the capacity of the material. Moreover, particularly when working at high temperatures, grooves are readily produced in the softened metal, which tend to diminish the strength of the material. In the shaping of sections by folding at high temperatures irregularities are frequently produced in the cross-section, since the chucks of the folding machine often become distorted by the heat; moreover the chucks are easily liable to bend when making sections from very thick sheet metal, so that even when working cold, irregular cross-sections are frequently obtained. Finally, it is also necessary in the case of the folding process, to employ a number of operations and to provide a number of dies for the more curved sections because shaping in one operation would lead to an overstraining of the material. In this way the process is rendered uneconomical.

It has now been ascertained that it is possible to combine the advantages of both of the aforesaid methods of operation and at the same time to avoid their disadvantages by subjecting the sheet metal strips to a step-by-step shaping by one and the same die which on the inlet side has the cross-section of the

strip to be shaped and which gradually merges in the direction of travel of the strip into the cross sectional shape conforming to the shape desired for the metal strip section.

The invention will hereinafter be more fully described with reference to the accompanying drawings.

In said drawings Fig. 1 illustrates by way of example a lateral elevation of one embodiment of die suitable for carrying the invention into practical effect, and Figs. 1A, 1B and 1C are cross sections through the same die along the lines A—A, B—B and C—C respectively.

Fig. 2 is a perspective view of a sheet metal strip in the course of its being shaped.

Figs. 3A, 3B, 3C, and 4A, 4B, 4C, and 5 show different specimens of sections obtained by the process of the invention.

Fig. 6 illustrates a lateral elevation of an embodiment of the invention adapted to produce semi-open sections (of the types shown in Figs. 4A and 4B), and Figs. 6A and 6B are cross-sections along the lines A—A and B—B, respectively, of Fig. 6.

Figs. 7A and B represent cross-sections (taken along lines corresponding to A—A and B—B in Fig. 6) of an embodiment of the invention adapted to produce semi-open sections of a more complicated character (as shown in Fig. 4C).

Fig. 8 is a lateral elevation of an embodiment of the invention adapted to produce sections having a prescribed longitudinal curvature, and Fig. 8A is a cross-section of certain details of said embodiment taken along lines A—A in Fig. 8.

Fig. 9 is a lateral elevation of a modification of the embodiment shown in Fig. 8.

Fig. 10 is a lateral elevation of an embodiment of the invention adapted to produce profiled rings, and Figs. 10A, 10B, 10C are cross-sections of said embodiment taken along the lines correspondingly indicated in Fig. 10.

With reference to Fig. 1 and Figs. 1A, 1B, and 1C, the die shown consists of an upper member *a* and a lower member *b*. The end portions of the die are parallel for the distance *d—c*.

The sheet metal strip is shaped as follows:—The upper portion of the die is moved up and down by a suitable mechanical device. During the lifting movement the sheet metal strip is advanced stepwise, if desired by means of an adjustable automatic advancing device, along part of the length of the die and, by the lowering movement of the die, it is shaped stepwise to the desired section, the extent of the advance being made to correspond to the deformability of the alloy employed. In this way, the high tensional stresses in the direction of drawing which are unavoidable when drawing through dies are avoided altogether, while on the other hand the employment, as in the folding method, of a number of different dies corresponding to the individual shaping steps is equally rendered superfluous. Expelling devices of known construction may advantageously be provided in the die for the purpose of enabling the sheet metal strip to be readily pushed forward after every pressing stage.

Fig. 2 shows a sheet metal strip during the course of its being shaped to the desired section with the aid of the die illustrated in Fig. 1. With the aid of such dies, in two parts, all fully open shapes, a few examples of which are shown in Figs. 3A, 3B, and 3C may be manufactured.

In order to manufacture semi-open sections as shown in Figs. 4A, 4B, and 4C or completely closed sections as shown in Fig. 5 it is necessary to employ a die consisting of a plurality of parts. The sheet metal strip is in such a case first converted into an entirely open preliminary section, by the process herein before described, in a pre-shaping die of the kind described. At the same time as the pre-shaping die is operated, a final-shaping die of the same kind is set into operation. The final die is advantageously positively coupled with the pre-shaping die in regard to its operating movements, and the die members thereof move laterally towards the strip and gradually give it its final shape, the strip being passed over a mandrel which is secured to the base plate.

Figs. 6, 6A and 6B illustrate by way of example the operation for the production of a semi-open strip of the kind shown in Figs. 4A, 4B, and 4C. The plate *e* which holds the upper die member *a* and which is moved up and down by an eccentric press, operates, through the rods *g*, the levers *h* which in turn press the side portions of the end die *i* against the strip and the mandrel *k*. In this case the levers *h* pivot round the points *l* in the direction shown by the arrows. The side portions of the end die correspond in principle with the first die, that is to say, on the inlet side they conform to the final cross-section of the pre-shaping die and gradually merge into the final shape of the desired section.

The fulcrum *l* of the levers *h* may be moved relatively to each other according to the kind of section.

Figs. 7A and 7B show by way of example the lever arrangement for another section of the kind shown in Figs. 4A, 4B, and 4C. In this case the mandrel consists of two parts *k*¹ and *k*². The lower portion *k*¹ of the mandrel is secured to the base plate *m* while the upper portion *k*² of the mandrel is rigidly connected with the lower plate by means of a frame not shown in the figure. The actuating arrangement for the lateral dies illustrated, is given merely by way of example; the lateral dies may be actuated by any suitable mechanical device fulfilling the desired object namely, the simultaneity of movement of the first and second dies in accordance with the step-by-step advance of the sheet metal strip. Thus, the rotary movement of the lateral dies can be replaced especially by a rectilinear movement.

The hereinbefore described method of operation enables both straight and bent sections to be manufactured. For the manufacture of sections with a prescribed curvature there is for example placed at the end of the disc, as shown in Figs. 8 and 8A, a jack which conforms to the desired shape of section. For high degrees of curvature the die itself as shown in Fig. 9, may be shaped to conform to the curvature aimed at.

Figs. 10, 10A, 10B and 10C show the application of the process to the manufacture of profiled rings from sheet metal strips. In this case the upper portion *a* of the die is made to conform to the external shape in section of the ring, as may be seen from section 10C. The lower die member consists of two main parts *b*¹ and *b*². The part *b*² serves to shape the sheet metal strip section in accordance with the principle hereinbefore described, while the part *b*¹, which is in the form of a drum like metal body rotatable about the point *n*, bears on its periphery the finished shape of the inside of the ring and serves merely for effecting the bending of the profiled strip into the shape of a hoop.

On the inlet side of the die, the free cross-section pertaining to the upper portion *a* of the die and lower portion *b*² (see section 10A) is again made to correspond to the cross-section of the unshaped sheet metal strip and merges gradually, in the direction of advance of the strip, into the desired section shape, the lower portion *b*² of the die extending close up to the drum *b*¹. The distance between the two lower parts *b*¹ and *b*² is somewhat greater than the thickness of the sheet metal being worked in order that the beginning of the shaped strip may pass through it after it has run round the drum and close itself into a ring with the end of the strip. The drum *b*¹ is divided in the medial plane in order to permit the ring to

be removed from the drum b^1 after its completion; both parts are firmly connected with each other during the shaping operation.

The shaping of the sheet metal strip and its closing into a ring begins with the insertion of the sheet metal strip into the die aperture on the inlet side. This is then followed by the shaping until the final shape of section is obtained in the manner hereinbefore described by the step-by-step lifting and lowering of the upper die member. After the sheet metal strip has run through the lower die member b^2 , it begins to wind itself on the drum b^1 when the curving of the strip in the longitudinal direction is brought about by the pressure of the upper die a , with its bent portion lying above the drum, on the sheet metal strip every time the upper die a is lowered on to the drum. As the operation proceeds, the beginning of the sheet metal strip finally enters between the two lower die members b^2 and b^1 and arrives at the upper die member a at the instant at which, if the length of the sheet metal strip be correctly adjusted, its end has reached the drum, so that the ring is closed (see section 10A).

In cases in which hot-working of the metal strips is indicated the dies can be directly provided with a suitable heating device.

The hereindescribed method and apparatus are especially intended for the working of magnesium and magnesium alloys but they may naturally also be employed in connection with any other suitable metals.

I claim:

1. Apparatus for producing shaped sections of uniform thickness from sheet metal strips comprising at least one pair of relatively oscillable preliminary dies having along the whole of their length complementary confronting faces both merging gradually in cross-section from the cross-section of the original strip into an intermediate open cross-section, a pair of relatively oscillable final dies merging gradually in cross-section from the part of said intermediate cross-section corresponding to the outer part of the finished cross-section into the cross-section of said finished outer part, a mandrel corresponding, in cross-section, to an inner part of the finished cross-section, and means for simultaneously actuating said preliminary and said final dies.

2. An apparatus for producing shaped sections from sheet metal strips, comprising at least one pair of relatively oscillable preliminary preshaping dies, said dies having complementary confronting faces along the whole of their length and merging gradually in cross-section from the original cross-section of the strip of material to an intermediate cross-section, and a final shaping die positively operated by said preshaping dies, a mandrel corresponding in cross-section to an inner part of the desired finished cross-

section, said final shaping die comprising members adapted to be moved laterally towards the intermediate cross-section to compress the same over said mandrel and partially close the intermediate cross-section. 70

3. An apparatus for producing shaped sections from sheet metal strips, comprising at least one pair of relatively oscillable preliminary dies, said dies having complementary confronting faces along the whole of their length and merging gradually in cross-section from the original cross-section of the strip of material to a final shaped section, and a final die in cooperation with said preliminary dies adapted to receive the shaped section and impart a definite curvature thereto in the direction of its longitudinal axis. 75 80

4. An apparatus for producing shaped sections having a curvature in the direction of their longitudinal axes from sheet metal strips, said apparatus comprising at least one pair of relatively oscillable preliminary dies having complementary confronting faces along the whole of their length and merging gradually in cross-section from the original cross-section of the strip of material to a final profile section, a rotatable drum in cooperation with said preliminary dies adapted to receive the profiled sections from the preliminary dies and impart a definite curvature thereto. 85 90 95

In testimony whereof I have hereunto set my hand.

ERNST DE RIDDER.

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