PUBLISHED MAY 11, 1943. BY A. P. C.

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METHOD AND DEVICE FOR MANUFACTURING DIAPHRAGMS

Filed Nov. 20, 1940

Serial No. 366,470

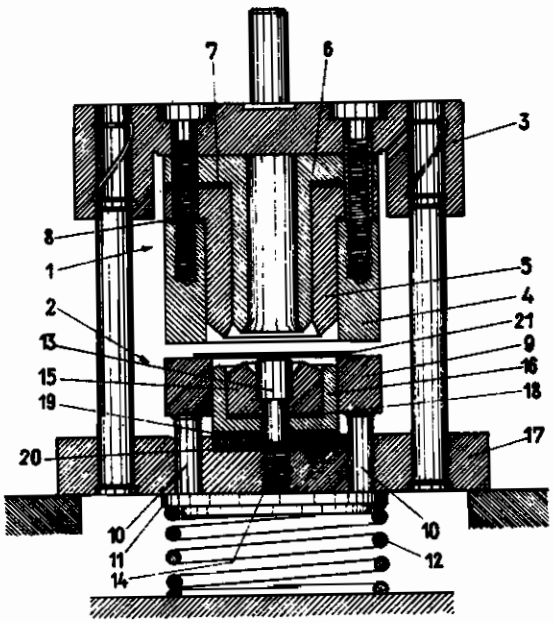

Fig. 1

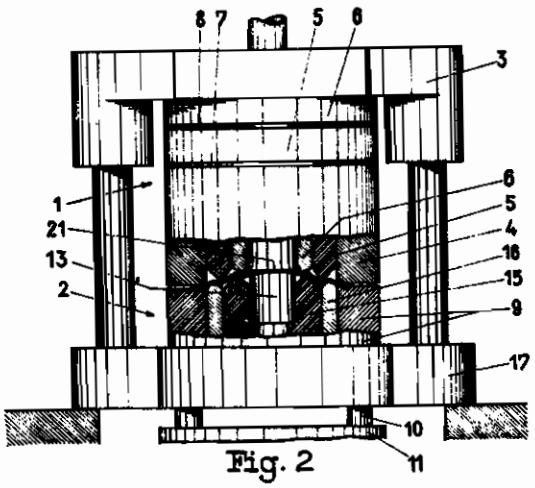

Fig. 2

Fig. 3

Fig. 4

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Published May 11, 1943

Serial No. 366,470

ALIEN PROPERTY CUSTODIAN

METHOD AND DEVICE FOR MANUFACTURING DIAPHRAGMS

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Application filed November 20, 1940

The present invention relates to the manufacturing of diaphragms as used, singly, for instance in pressure metering devices or connected in pairs so as to form a diaphragm capsule for a variety of purposes. Such diaphragms are made of materials adapted to be plastically formed, preferably metal, and are usually manufactured by stamping. This is done in such a way that a disc shaped piece or plate is placed in a stamping tool of a form corresponding to the desired form of diaphragm, i. e. a tool the upper part of which is mostly provided with ring shaped ridges and grooves corresponding to respective grooves and ridges in the bottom part of the tool. Upon the lowering of the upper part, these ridges and grooves are stamped on the metal piece placed between the two parts so as to form a diaphragm having a corrugated cross section.

Such a manufacturing method is quite satisfactory for flat diaphragms and for such manufacture of material which may be deformed relatively easily. In the case of diaphragms of great depth, however, and even of flat diaphragms the method has the drawback that the outer rim thereof is strongly corrugated. The degree in which this phenomenon may be observed depends on the hardness of the material used, i. e. the harder the metal the most strongly marked is the corrugation at the rim. This drawback becomes more particularly noticeable where two diaphragms are connected and is due to the fact that the material in the stamping operation is drawn from the periphery towards the center of the disc. In this respect certain advantages are offered by a method according to which the diaphragm is not formed by stamping but by drawing. This method is only used for diaphragms of considerable depth. As in the stamping method, the work piece is disc shaped. It is placed in a drawing tool, the rim of the disc being gripped by a holder, and by means of a "drawing stamp" the material so held is drawn into a corresponding depression in the bottom part of the tool. As the trough shaped piece thus formed lacks stiffness, concentric grooves are usually stamped into the bottom thereof. In a known construction a ring is soldered into the inner edge of the diaphragm before the stamping of the grooves.

The invention consists in the use of a disc shaped or trough shaped work piece gripped tight at the rim being subjected to a combined drawing and stretching process. The difference of this method from the usual stamping method consists therein that here the material is deformed between free edges while according to the stamping method the stamping is not done between free edges but between two surfaces as for instance by a V-shaped stamp being pressed on to a correspondingly V-shaped depression.

By the method according to the invention flat or depressed diaphragms of equally good quality may be manufactured. Moreover the disadvantage that concave diaphragms frequently tear at the rim due to the tight gripping thereof is avoided. That cannot happen according to this method as the drawing and stretching is not effected from one single gripping zone toward the center but as it were between several gripping places which are formed by free edges. This involves a further advantage of the application of the inventive principle. Diaphragms manufactured by stamping have been exposed to the stamping pressure over their entire surface. Thereby tensions have been set up in the material which are only relaxed after a time and which cause changes in the instruments provided with a such diaphragms as to the zero position. In the diaphragms manufactured according to the invention only those parts which have been in contact with the tool edges have been affected by pressure, the intervening parts having merely been plastically deformed. Therefore the diaphragm manufactured according to the inventive principle due to their having been exposed to lesser pressures are subject to only immaterial changes compared to those manufactured by stamping.

If a disc shaped plate is used as primary work piece, it is nevertheless advantageous to give this a trough-like shape, which may be done by means of the same tool and in the course of the same working phase in which the combined drawing and stretching is done.

In the following the method according to the invention is further explained with reference to the accompanying drawing, of which

Fig. 1 shows a section of the tool used in the open position and

Fig. 2 the same in the closed position.

Figs. 3 and 4 represent different diaphragms manufactured by the tools according to Figs. 1 and 2.

In Figs. 1 and 2 the numeral 1 denotes the upper part of the tool, 2 the lower part of same. The upper part 1 is provided with the usual gripping arrangement, 3. The parts required for the combined drawing and stretching operation are disposed on said gripping arrangement 3, namely the upper part 4 of the holder and the tools 5

and 6. The upper part 4 of the holder and the tools 5 and 6 are separated by plates 7 and 8 which serve a purpose described later on. The lower tool part possesses a construction corresponding to that of the upper part; it consists of the lower holder part 9 which is supported on a compression spring 12 by means of pins 10 and a pressure plate. In the initial position the lower holder is above, or at least level with the tool edges of the lower part. In the embodiment shown the lower tool part consists of three parts, namely the center part 13 which together with its screw piece 14 serves to secure the two outer parts 15 and 16 on the base plate 17. Here, too, the individual parts are separated by plates 18, 19 and 20.

The manufacturing method is the following:

The disc shaped plate 21, as seen from Fig. 1, is placed on the edge of the holder 9. When the press is set going, the upper tool part 1 approaches the lower tool part 2. In the first instance the upper part of the holder 4 becomes operative by gripping the plate 21 between its effective surface and that of the lower holder part 9. Affected by the compressing force the lower holder part moves downwardly due to the spring 12 becoming compressed via the pressure plate 11 and the pins 14. (Instead of a spring some other force produced either hydraulically or pneumatically may of course be used.) Thereby the other tool edges—5, 6 in the upper part and 13, 15 and 16 in the lower part—come into play. They deform the plate in a manner apparent from Fig. 2. The tool edge 16 serves to produce the trough formed diaphragm rim. The edge 5 is pushed down between the tool edges 16 and 15 causing the material to be drawn and stretched, and the edge 6 is pushed down between the edges 15 and 13 causing a corresponding deformation. In order to facilitate the drawing and stretching process the form of the tool edges is chosen so as to be less steep towards the periphery. For a better understanding of the drawing and stretching process described it may be observed that the deformation of the metal takes place between free edges in contradistinction from what happens in the stamping method, i. e. the material, for instance, contacts at the edges 5 and 15 and is stretched between these two edges.

The tool represented in Figs. 1 and 2 possesses a further advantage. As the tool edges are formed as cylindrical or shell shaped bodies separated by plates, preferably made of ground steel plate, it is possible by exchanging the plates in question by others of a different thickness to produce different diaphragms and moreover to compensate for slight deviations in work pieces.

Figs. 3 and 4 show diaphragms manufactured by means of the tool shown in Figs. 1 and 2. As the position of the diaphragms represented in the drawing corresponds to that of the tool shown in the first two figures, it is apparent how the diaphragms were produced. Thus to produce the diaphragm shown in Fig. 3 the tool edge 16 would have to be raised and the edge 5 pushed upwardly, the plate at 8 having been removed. To produce the diaphragm in Fig. 4 the tool edge 15 would have to be raised and the plate at 18 complemented by another. The center 13 and the tool edge 6 would have to be shifted correspondingly.

The tool shown in Figs. 1 and 2 naturally represents merely an example of the application of the inventive principle. Instead of supporting the holder part on a spring plate 11, it may of course be mounted in the way shown in Fig. 2. In this case it would be necessary to adjust the tool edges 13, 15 and 16 in working position only when the plate 21 has been placed in position, i. e. to provide a special drive for this latter. The depth to which—in this embodiment—the upper part is pushed down onto the lower part depends on the holder. By inserting a thicker plate at 7 the depth is reduced and if a thinner plate is inserted, the depth is increased. Naturally any other means may be used for determining the depth of impression.

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