Feb. 16, 1965 E. MONETT 3,169,522

SPRING RIMMED DIAPHRAGM AND METHOD OF PRODUCING THE SAME

Filed March 6, 1962

FIG. 1.

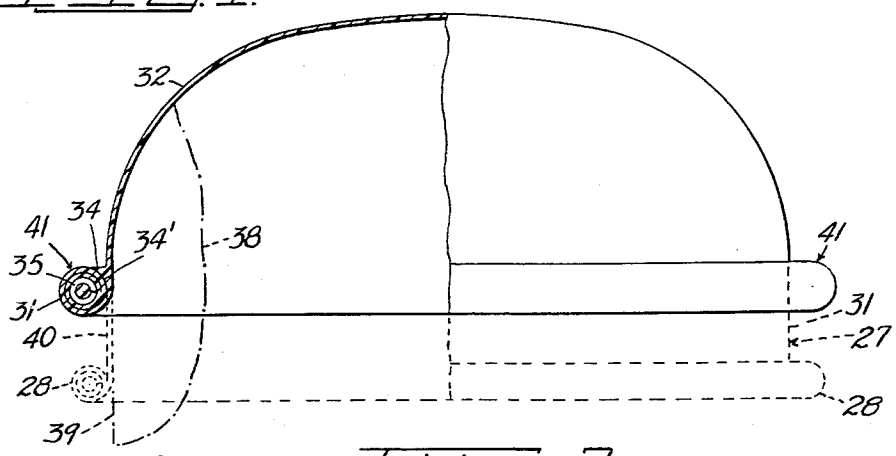


FIG. 2.

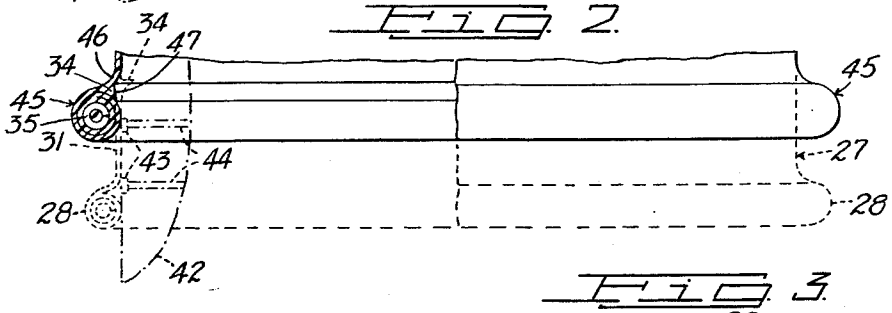


FIG. 3.

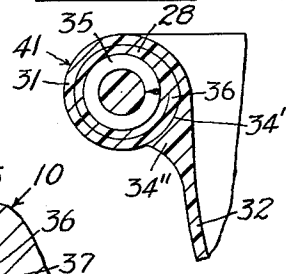
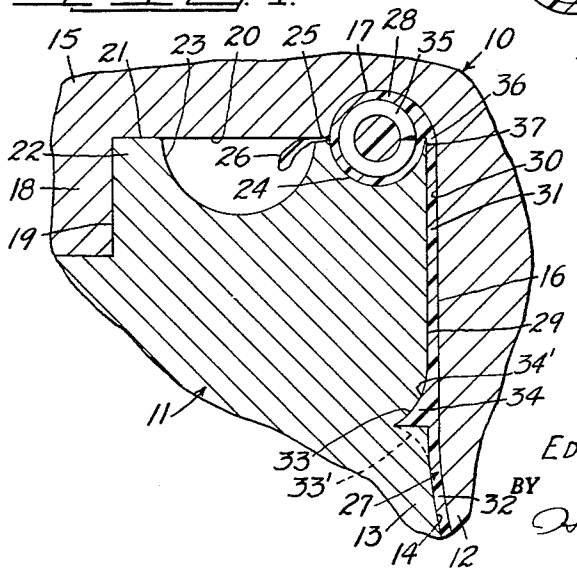


FIG. 4.



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SPRING RIMMED DIAPHRAGM AND METHOD OF PRODUCING THE SAME

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5 Claims. (Cl. 128—127)

This invention relates to diaphragms having spring rims, with the body portion of the diaphragm generally dome-shaped in form and, particularly, to devices of this type and kind prescribed by physicians in the practice of birth control, the diaphragms being made in numerous diameters controlled by the spring rimmed portion thereof. More particularly, the invention deals with a novel method of producing devices of the character defined, which results in production of a high percentage output, as compared with old methods.

The novel features of the invention will be best understood from the following description, when taken together with the accompanying drawing, in which certain embodiments of the invention are disclosed and, in which, the separate parts are designated by suitable reference characters in each of the views and, in which:

FIG. 1 is a diagrammatic side and sectional view of a diaphragm made according to my invention, the finished product being shown in full lines and the product, as molded, being indicated in dotted lines, a mandrel for use in converting the mold device to the finished product being indicated, in part, in dot-dash lines.

FIG. 2 is a view, similar to FIG. 1, showing only parts of the construction in illustrating another method of forming the end product.

FIG. 3 is an enlarged detail sectional view of the rim portion of a diaphragm showing a slight modification; and

FIG. 4 is an enlarged sectional view through a portion of male and female dies for forming the diaphragm, diagrammatically illustrating part of the formed diaphragm and indicating the flash thereon.

In the construction of diaphragms of the type and kind under consideration, extreme problems have existed over a period of many years in successfully producing spring rimmed diaphragms with any reasonable degree of percentage or, in other words, without the necessity of discarding the major portion of the products produced, due to flaws in the products, particularly in the spring rimmed portion thereof. As a result of this procedure and due to the extremely high rate of discards, devices of the type and kind under consideration have been merchandised at a high price.

From experiences with molding devices of the kind under consideration, it has been substantially impossible to locate the spring ring, constituting an integral part of the rim, centrally within the rim. In most instances, part of the spring would be exposed at the periphery of the rim, or so close to exposure as to render the molded product a reject in inspection thereof.

After long and continued experimentation, I finally conceived a relatively simple method, whereby the spring ring of the rimmed diaphragm would, at all times, be completely enveloped and disposed substantially centrally with respect to the rim, thereby eliminating all such rejects, as noted above, and maintaining a hundred percent production, insofar as tests of the rimmed structure of the device are concerned. I have also found that, with my improved process, a substantially perfect one-dimensional thickness is maintained throughout the domed portion of the diaphragm and, from this standpoint, also maintaining a high rate and/or percentage of perfect end products.

In forming my improved diaphragm, a pair of male and female dies are employed, part of the male die being shown in section at 10 in FIG. 4 of the drawing and part of the female die being shown in section at 11. The

sectional portion of the die has been restricted to the rim forming portion of the resulting end product. The male die has a dome forming portion, illustrated, in part, at 12 spaced from the dome forming portion 13 of the female die to form a cavity 14. The dome portion 12 of the male die joins the base 15 of the die in a neck portion 16, which is slightly tapered in order for free removal of the dome portion 12 from the finished molded end product. The neck portion 16 extends to a half-round annular recess 17 formed in the body portion 15, the recess 17 forming part of the rim forming cavity of the dies. The male die has, at its periphery, a depending rim 18 fitting over a shoulder portion 19 on the female die. The lower surface 20 of the die 10 seats snugly upon the surface 21 of the female die, this surface being on what might be termed an annular ring 22 forming the outer wall of a flash receiving annular chamber 23.

Inwardly of the chamber 23, the female die includes a rim forming cavity 24 in registering alinement with the cavity 17 and between the chamber 23 and cavity 24 is a microscopically fine flash passage 25 partially formed by the surface 20 and the showing of which is exaggerated in order to clearly illustrate a flash 26 of the molded material extending into the chamber 23. As known in the art, this flash is trimmed from the molded workpiece 27, or the rim portion 28 thereof as formed in the cavities 17–24.

The female die includes a surface 29 spaced from the neck portion 16 of the male die to form a cavity 30, in which the rim facing part 31 of the resulting diaphragm is formed. This part forms what might be termed a skirt which joins the molded part 28 with the dome portion 32 of the resulting end product.

The female die 11 includes, between the surface 14 and the surface 29, an annular recess 33, generally of the contour shown in full lines in FIG. 4 of the drawing in forming a fillet portion 34 on the mold product, that is to say, a fillet portion as employed in connection with the diaphragms, as illustrated in FIGS. 1 and 2 of the drawing. However, at 33' I have indicated in dotted lines a modified form of recess which would form a fillet portion, such as shown at 34'' in FIG. 3 of the drawing.

In carrying out my improved method, the cavity forming portions of the two dies are cleaned and treated in manners well-known in the art and, if the molding operation is performed in the position of the die parts as shown in FIG. 4, a standard type of coil spring 35 is positioned in the cavity 24, a measured quantity of crude rubber compound, synthetic rubber compound, plastic compound or the like is placed in the bottom of the female die 11 and, at this time, it is pointed out that a Hypolyn compound or a Silicone compound can be used.

The male die is then brought into firm engagement with the female die under high pressure and required temperatures to form the resulting molded and cured workpiece, from which the end product is ultimately produced.

In FIG. 4 of the drawing, I have diagrammatically illustrated the formation of the workpiece 27 and it will be noted that the rim portion 28 of this workpiece substantially envelopes the spring 35 and that the rim facing part 31 joins the rim 28 at 36, where a slight crevice is formed by the wall portion 37 of the cavity 24.

Upon completion of the formation of the workpiece, the male die 10 is removed, leaving the workpiece 27 in contact with the female die 11, after which, the workpiece is stripped from the female die and the flash 26 is trimmed from the initially molded rim 28.

The next step in producing the resulting end product, as illustrated in FIGS. 1 and 3 of the drawing, consists in mounting the molded workpiece on a mandrel, generally of the contour of the male die 10, including the dome forming portion 12, but with a longer neck portion

than the neck portion 16 and such a mandrel is indicated in dot-dash lines at 38 in FIG. 1 of the drawing, the extended neck portion being indicated, in part, at 39. In other words, this neck portion is extended beyond the initially formed bead 28 to provide freedom of movement and engagement of the bead 28. Then a suitable adhesive or solvent is applied to the outer exposed surface of the rim facing part 31, in other words, the surface 40 between the initially formed bead 28 and the fillet 34, including the rounded surface 34' of the fillet; whereupon, the initially formed bead 28 is simply rolled under pressure on the mandrel 38 up to and into abutting engagement with the surface 34'. In this operation, the rim facing part will completely envelop the initially formed rim and the spring 35 in production of the finished rim 41 on the resulting end product. Upon setting of the adhesive or solvent, the end product is removed from the mandrel 38 and suitably packaged. It will be understood that the dome portion 32 of the molded workpiece will be checked prior to performance of the last operation to determine that the dome portion meets the required inspection.

It will be apparent that the facing part 31 insures full coverage of the spring ring and in production of the resulting end product. It will be understood that the thickness of the rim facing part 31 will be controlled to provide on top of the initially formed rim 38 the desired thickness coating enveloping the rim 28, and from this standpoint, this thickness can be less than the thickness of the material as employed in the dome 32. It will also be apparent that the fillet 34 forms a neat and finished surfacing on the finished product which will render the product more sanitary in use, particularly in dispensing with any deep crevices. As noted in FIG. 3, this protection can further be extended by forming the fillet portion, as shown in 34''.

In FIG. 2 of the drawing, I have shown another method of procedure utilizing the same molded workpiece as produced by the dies shown in FIG. 4 of the drawing. This is accomplished by simply inverting the dome on the rim 28, so as to dispose the fillet portion 34 on the inner surface of the dome, as indicated in dotted lines in FIG. 2, and then to mount the inverted molded workpiece on a mandrel 42, differing from the mandrel 38 in preferably having annular grooves 43 on the surface thereof at a position registering with the dotted line position of the workpiece 27, as shown in FIG. 2, and employing radial passages 44 in the mandrel for timely injecting into the annular grooves 43 an adhesive or solvent, which can be picked up by the rim 28 and the rim facing part 31 as the rim 28 is curled inwardly upon the inner surface of 31 and moved upwardly until finally checked by the fillet 34 which has been expanded by the mandrel 42, substantially into the position as shown in full lines in FIG. 2. The dotted line showing in FIG. 2 is simply to generally locate the fillet 34 in its dotted line position. This construction results in forming a finished rim 45, which differs from the rim 41 in that the dome portion joins the rim 45 in a rounded portion 46 and the fillet 34 will form an annular recess 47 on the inner surface of the end product adjacent the rounded portion 46, as clearly shown at the left of FIG. 2 of the drawing. This construction is advantageous from the standpoint that the recess 47 provides, adjacent the inner surface of the rim 45, a portion facilitating engagement of the diaphragm, particularly in the handling thereof and especially in removal from the body of the wearer. It will be apparent that, with the structure shown in FIG. 2, the spring 35 will be fully covered by the facing portion 31, thus insuring that the spring is fully covered at all times.

In some cases, the adhesive or solvent can be injected through the upper groove 43 of FIG. 2 to localize the adhesive properties adjacent the fillet 34 and this can be relied upon to retain the finished rim 45 in position.

The same would be applied to localizing the adhesive adjacent the rim in FIG. 1 of the drawing.

It might also be mentioned, at this time, that the spring 35 employed is of a type maintaining its shape and contour at all times and, as with known devices of this kind, the ends of the coils are interlocked and suitably secured together, so as to maintain one diameter thickness of the spring throughout the entire circumference thereof and, in the molding operation, the material forming the initial rim 28 extends between the windings of the spring and into the core of the spring, as will clearly appear from the showing in FIG. 4 of the drawing.

For purposes of description, the rubber, synthetic and other materials employed in producing the diaphragm may be generally said to comprise extensible materials.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A diaphragm of the character defined comprising a molded and cured workpiece consisting of a circular dome of extensible material, a rim integral with said dome and an annular coil spring embedded in said rim, a rim facing portion secured to and encircling said rim and the spring therein, and said rim facing portion including a fillet closing the crevice between the faced rim and adjacent portion of the dome.

2. A diaphragm of the character defined comprising a circular dome of extensible material, a rim integral with said dome, an annular coil spring embedded in said rim, a rim facing portion formed between the dome proper and said rim, said facing portion encircling said rim and being adhesively secured thereto, said rim facing portion including a fillet closing the crevice between the faced rim and adjacent portion of the dome, and said fillet having a round surface snugly engaging and secured to part of said rim facing portion.

3. The method of producing diaphragms of the character described, which comprises molding and curing a diaphragm workpiece of extensible material, said workpiece comprising a dome portion, a rim with an annular coil spring enveloped therein, a dome portion joining the rim in a cylindrical rim facing portion, removing the workpiece from dies molding the same, trimming said workpiece, then placing the workpiece on a mandrel, inverting the dome portion to dispose the molded outer surface of the dome portion upon the inner surface, applying an adhesive to the inner surface of the facing portion, then tightly rolling the workpiece rim upon said inner surface while supported on the mandrel in enveloping the workpiece rim by and securing the same to said facing portion, forming on the rim facing portion an integral projecting fillet, and securing the fillet to an adjacent part of the facing portion as rolled upon said workpiece rim.

4. The method of producing diaphragms of the character described, which comprises molding and curing a diaphragm workpiece of extensible material, said workpiece comprising a dome portion, a rim with an annular coil spring enveloped therein, a dome portion joining the rim in a cylindrical rim facing portion, removing the workpiece from dies molding the same, trimming said workpiece, then placing the workpiece on a mandrel, inverting the dome portion to dispose the molded outer surface of the dome portion upon the inner surface, applying an adhesive to the inner surface of the facing portion, then tightly rolling the workpiece rim upon said inner surface while supported on the mandrel in enveloping the workpiece rim by and securing the same to said facing portion, forming on the rim facing portion an integral projecting fillet, securing the fillet to an adjacent part of the facing portion as rolled upon said workpiece rim, and utilizing said fillet to form an annular groove on the inner surface of the resulting diaphragm.

5. The method of producing diaphragms of the character described, which comprises molding and curing a diaphragm workpiece of extensible material, said work-

piece comprising a dome portion, a rim with an annular coil spring enveloped therein, the dome portion joining the rim in a cylindrical rim facing portion, removing the workpiece from dies molding the same, trimming said workpiece, then placing the workpiece on a mandrel, then enveloping the workpiece rim with said facing portion while the workpiece is supported on said mandrel, securing the facing portion to said rim, forming on the rim facing portion an integral projecting fillet, and securing the fillet to an adjacent part of the facing portion as rolled upon said workpiece rim.

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