Oct. 4, 1938. H. M. PRYALE ET AL 2,132,185

METHOD OF FORMING COVERINGS AND THE LIKE

Original Filed Aug. 9, 1935 4 Sheets-Sheet 1

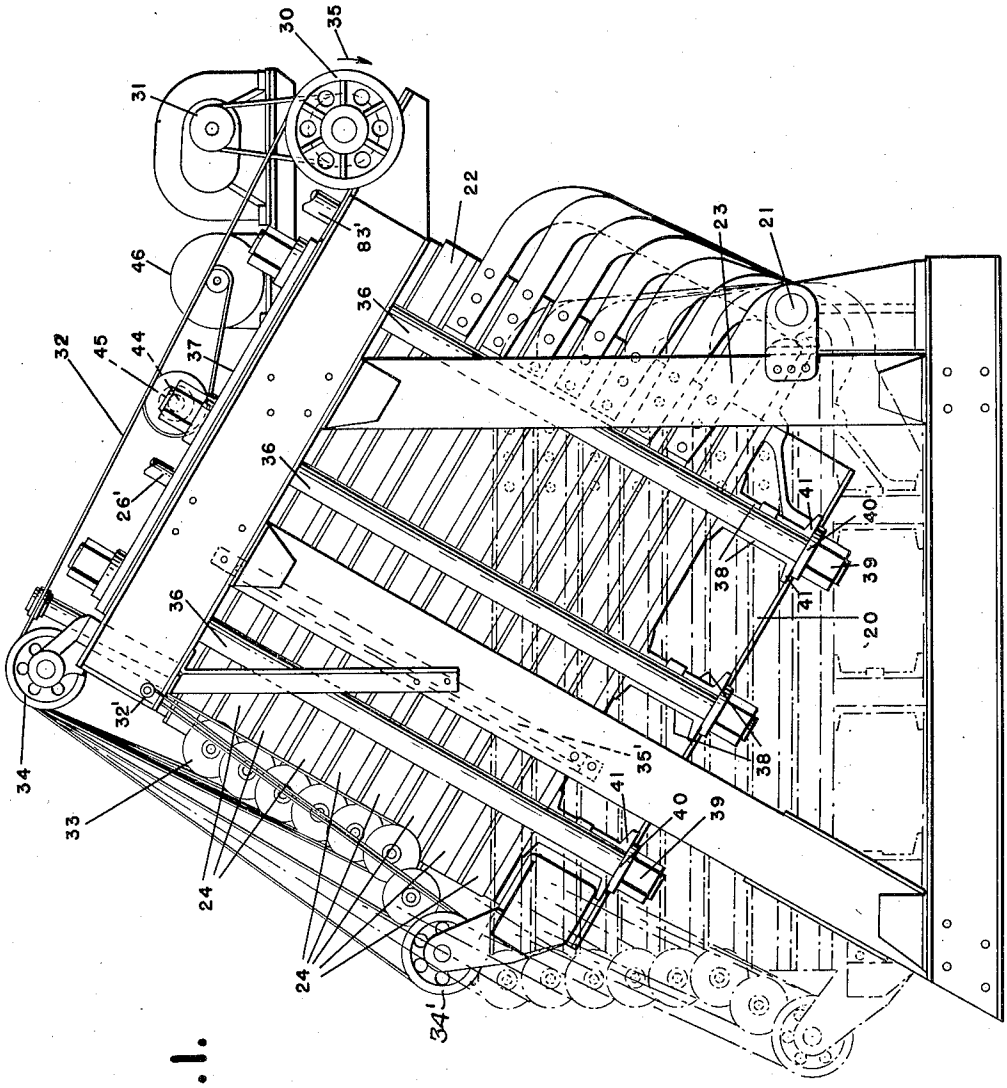


FIG. I.

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METHOD OF FORMING COVERINGS AND THE LIKE

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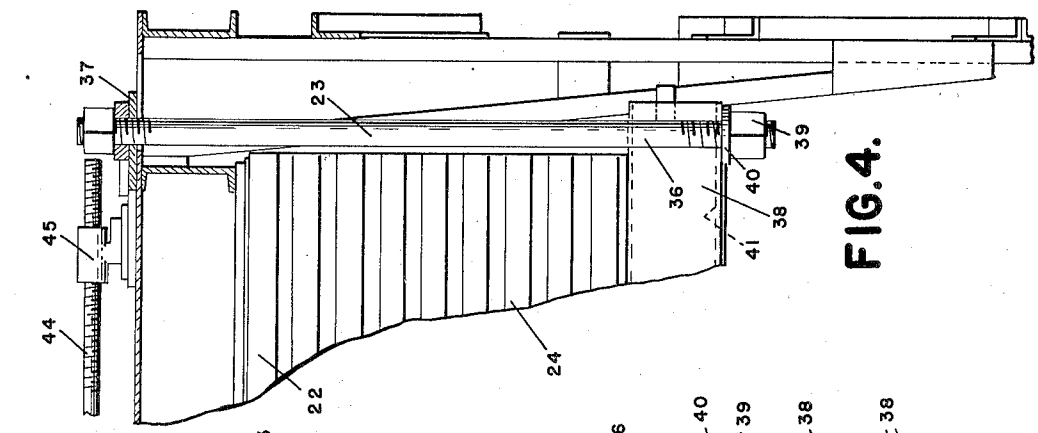


FIG. 4.

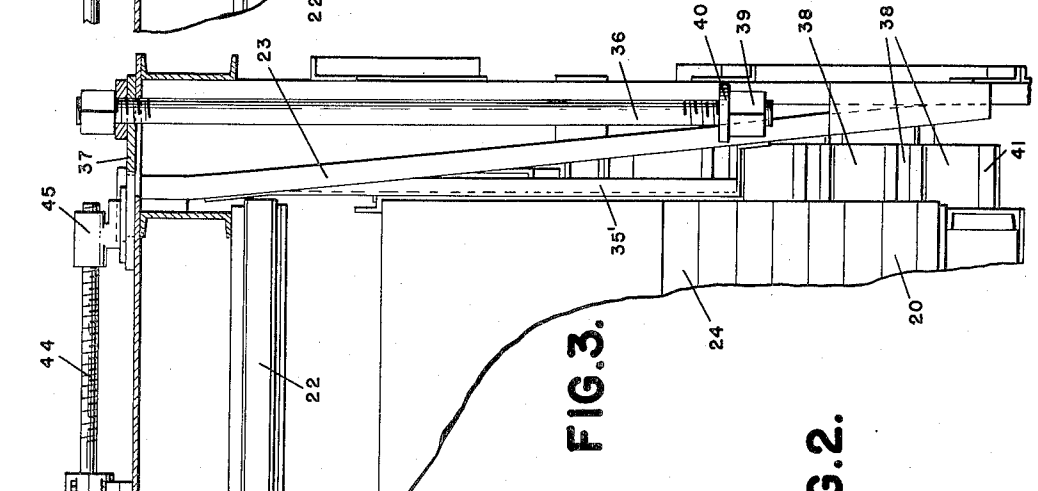


FIG. 3.

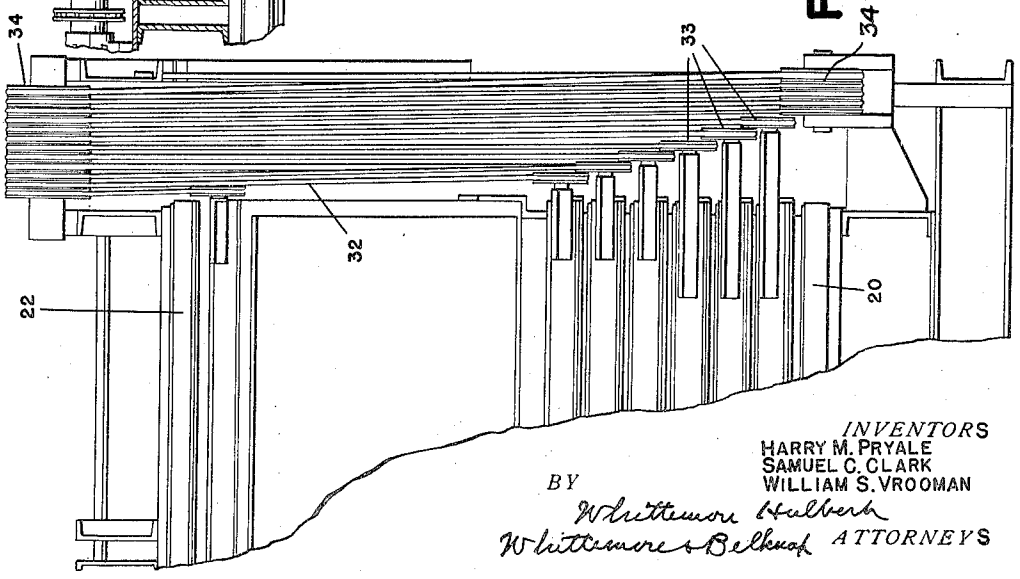


FIG. 2.

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METHOD OF FORMING COVERINGS AND THE LIKE

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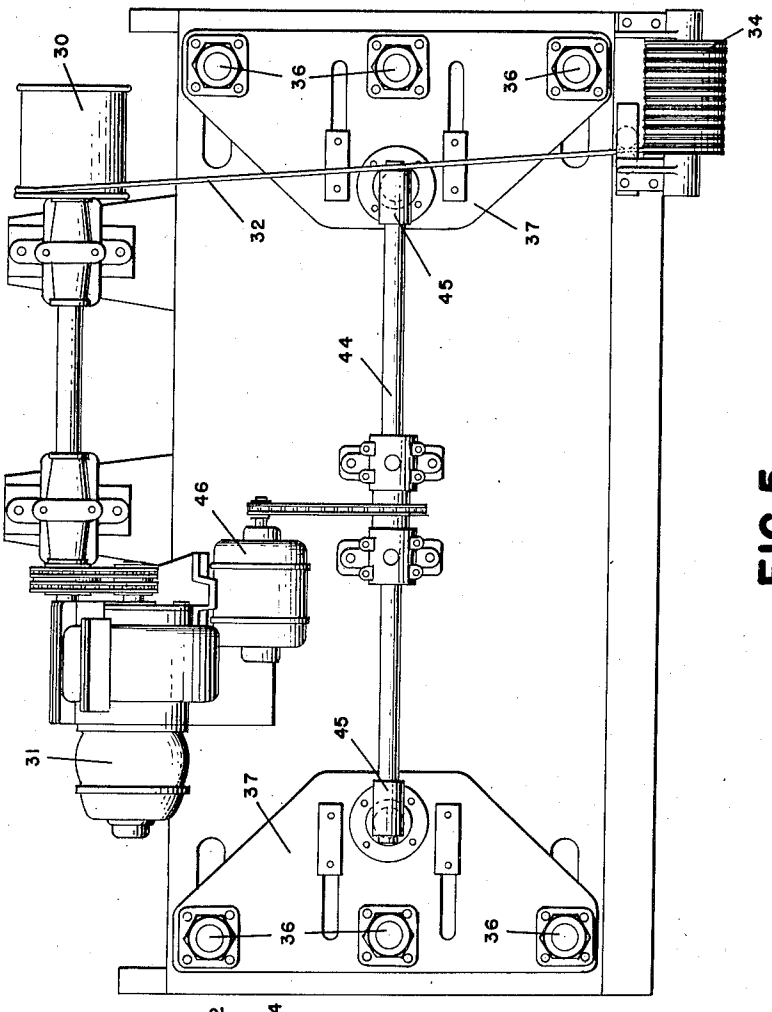


FIG. 5.

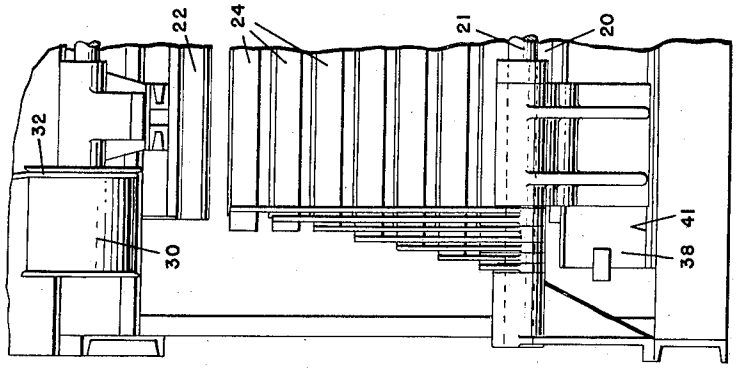


FIG. 6.

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METHOD OF FORMING COVERINGS AND THE LIKE

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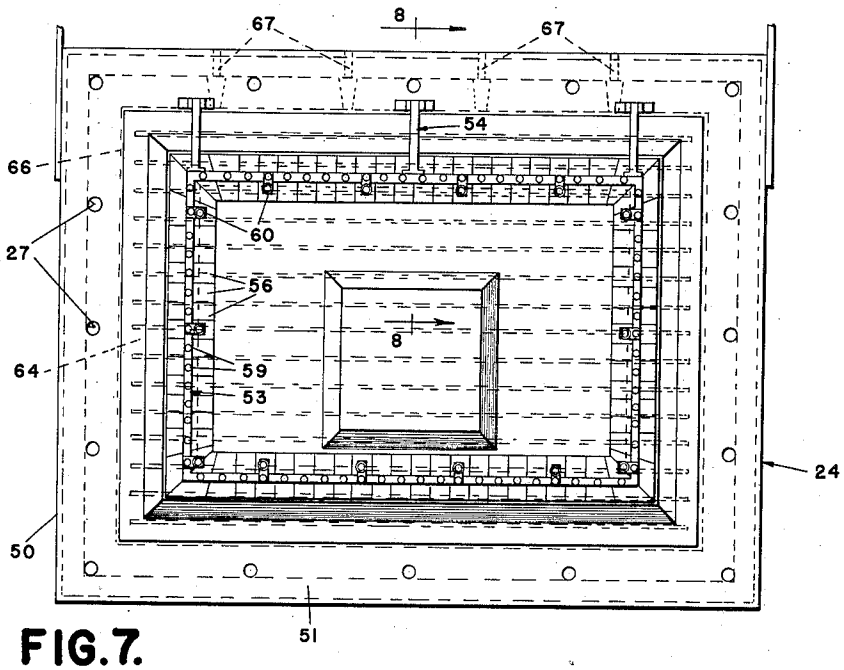


FIG.7.

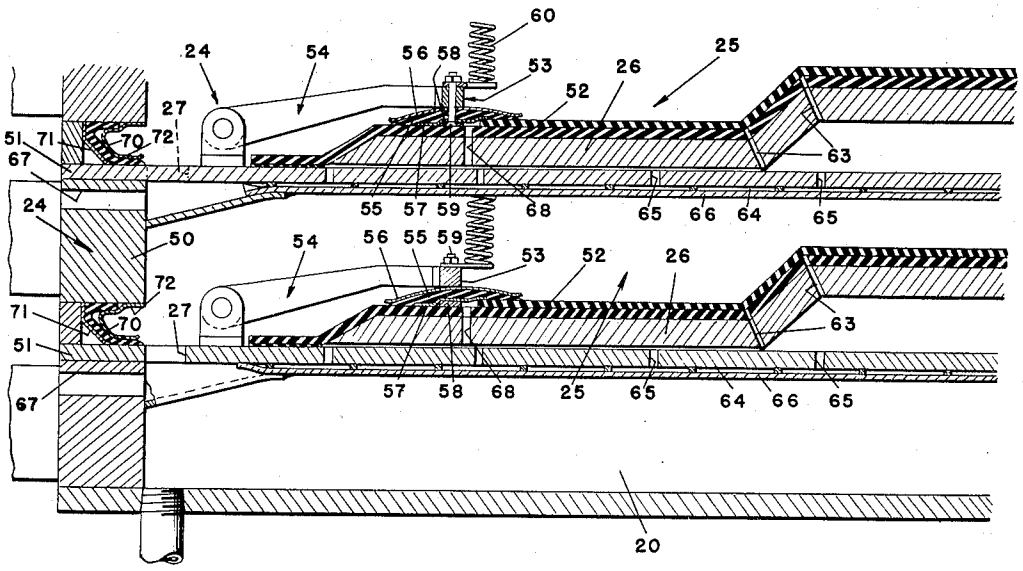


FIG.8.

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UNITED STATES PATENT OFFICE

2,132,185

METHOD OF FORMING COVERINGS AND THE LIKE

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Original application August 9, 1935, Serial No. 35,532. Divided and this application December 23, 1935, Serial No. 55,890

4 Claims. (Cl. 18—56)

This invention relates to a new and novel method of manufacturing contoured articles from vulcanizable material and is a division of our co-pending application Serial No. 35,532 filed August 9th, 1935, now patent No. 2,109,908.

More particularly, the invention contemplates an improved method of manufacturing contoured rubber mats, although it will be apparent as this description proceeds that the invention may be employed, in whole or in part, to manufacture various different types of articles or coverings having a predetermined contour.

In manufacturing contoured mats and the like on a production basis, it has been customary in the past to place a sheet of uncured rubber stock of the requisite size in a pressure chamber between a form or die, conforming in shape to the contour of the covering desired, and a diaphragm having sufficient flexibility to permit the same to be readily deformed against the stock by fluid pressure possessing the temperature required to vulcanize or cure the stock to the contour of the die. While it is possible to manufacture satisfactory coverings by the above practice, nevertheless, the latter has certain definite limitations, and one of the most serious of these limitations is the inability of the diaphragm to deform sufficiently to force the stock into any sharp corners that may be incorporated in the pattern of the die. It necessarily follows, therefore, that there are certain types of contours that cannot be secured by apparatus embodying a diaphragm of the type previously set forth. In addition, the foregoing practice is objectionable from the standpoint of quantity production, not only because the diaphragms are relatively unserviceable and require the operation of the apparatus to be frequently interrupted for the purpose of replacement, but, also because a relatively long interval of time is required for the heat of the fluid to be transferred through the diaphragms to the stock to be vulcanized. Furthermore, in cases where a plurality of fluid pressure chambers or units are combined into a single apparatus, such as illustrated in the Harry M. Pryale and Samuel C. Clark application, Serial No. 716,772, filed March 22, 1934, a plurality of flexible hose connections are required for each chamber and, like the diaphragms, must be frequently replaced. Replacement of the elements previously referred to is not only costly from the standpoint of maintenance of the apparatus, but, also necessitates discontinuing the operation of the entire apparatus, during the interval the elements are replaced or repaired, and this temporary delay materially reduces the productive capacity of the apparatus.

The present invention has as one of its principal objects to eliminate the objections noted above in connection with the foregoing practice, by providing a method of manufacture rendering it possible to not only eliminate the flexible diaphragms and consequent complications from the apparatus, but, to also eliminate practically all flexible hose connections in cases where a plurality of fluid pressure chambers are combined in one apparatus. In accordance with this invention, the heated fluid under pressure is applied directly to the uncured stock and provision is made for the fluid under pressure admitted to the uppermost chamber of the apparatus to flow directly into the next succeeding chamber. This procedure permits the expensive rubber diaphragms, as well as the flexible hose connections employed in the past to be dispensed with, and has the effect of: (1) reducing the maintenance cost of the apparatus to the minimum; (2) materially increasing the productive characteristic of the apparatus, without increasing the size of the latter, since the time required in the past to replace the diaphragms and hose connections is not only saved, but, also because the direct application of the heated fluid to the stock effects a reduction in the vulcanizing time; (3) providing a uniform fluid pressure in each chamber, due to the fact that all of the chambers are in constant communication with each other; and, (4) obtaining a higher grade product because of the ability of the stock to flow into or properly fill the die cavities.

Another advantageous feature of our improved method consists in the manner in which the marginal edges of a sheet of uncured material is clamped to the die or pattern, and also, in the manner of effecting a seal around the marginal edges of the material to prevent the fluid under pressure introduced into the chamber from finding its way between the die and stock. In accordance with this invention, the combined sealing and clamping of the stock to the die is effected by differential pressure means utilizing the fluid pressure applied to the stock to effect both the clamping and sealing functions.

A further feature of our improved method consists in the manner in which a plurality of articles may be contoured simultaneously and this step, as well as the foregoing, will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a side elevational view of one type of apparatus that may be successfully used in carrying out our improved method of manufacture;

Figure 2 is a fragmentary front elevational view of the construction shown in Figure 1;

Figure 3 is a fragmentary sectional view illustrating one side of the apparatus shown in Figure 1 and featuring the guide means for the several units of the press;

Figure 4 is a view similar to Figure 3, showing the several units of the press in a different position;

Figure 5 is a fragmentary top plan view of the construction shown in Figure 1;

Figure 6 is a fragmentary rear elevation of the construction shown in Figure 1;

Figure 7 is a plan view of one of the units employed in the press featured in Figure 1; and

Figure 8 is an enlarged sectional view taken substantially on the plane indicated by the line 8—8 of Figure 7.

The method of manufacturing contoured coverings from a material containing rubber, in accordance with this invention, is relatively simple and consists generally in positioning a flat sheet of uncured stock of the required size upon a die shaped to correspond exactly to the desired contour of the covering to be formed. After the stock has been properly positioned upon the die, the marginal edges of the former are clamped to the latter, by means having the additional function of forming a seal around the margin of the stock to prevent fluid pressure from finding its way beneath the stock. Upon completion of the clamping operation, fluid under pressure having the temperature required to vulcanize the stock to the contour of the die is applied directly upon the top surface of the stock and the marginal sealing means is such that the fluid under pressure applied to the stock actually increases the efficiency of the seal. In quantity production, it is desired to form a plurality of contoured articles simultaneously, and the method of accomplishing this result will perhaps be more readily apparent upon considering a description of the apparatus.

In general, the apparatus selected herein for the purpose of illustrating this invention is provided with a bottom header **20** pivotally supported at the rear end thereof upon a shaft **21** for swinging movement from a position in a substantially horizontal plane indicated in Figure 1 by the dot and dash lines to the full-line position thereof shown in this figure, wherein the same is located in a plane inclined in an upward direction with respect to the horizontal. In addition, the apparatus is provided with an upper header **22** fixedly supported above the lower header in a plane parallel to the inclined plane of the latter by means of suitable frame work **23**. Supported in superposed relation between the two headers is a plurality of forming units **24** of identical construction and mounted for pivotal movement independently of each other about the axis of the shaft **21**.

As shown in Figure 8, the forming units **24** cooperate with each other in the operative or full-line positions thereof illustrated in Figure 1, to form fluid pressure chambers **25**, and each unit is provided with a die **26** supported in the fluid pressure chamber formed by adjacent units in a manner to be more fully hereinafter set forth. In accordance with this invention, fluid under pressure is introduced into the top header **22** from a source of supply, through the medium of a conduit **26'** and communication is established between the adjacent chambers **25**, through a plurality of openings **27** having a combined area sufficient to insure a uniform pressure throughout the entire apparatus.

It will, of course, be understood that the several forming units must be in their uppermost or full-line positions shown in Figure 1 before the fluid under pressure is introduced into the press, and, in accordance with this invention, the units are successively moved about the axis of the shaft **21** from the dot-and-dash line positions thereof illustrated in Figure 1 to the full-line positions shown in the same figure. In actual practice, a sheet of uncured stock of the required size is placed upon the die **26** when the unit carrying the die is in its inoperative or dot-and-dash line position shown in Figure 1. After the fluid-tight seal, about to be described, is operatively positioned with respect to the marginal edge of the sheet, the unit is moved upwardly into a position adjacent the header **22** and a sheet of uncured stock is similarly placed on the die carried by the next adjacent unit. The latter unit is then moved up to its operative position adjacent the unit aforesaid, wherein the die of the former unit cooperates with the die of the latter unit to form a fluid pressure chamber **25** above the stock. This procedure is followed until all of the units, including the header **20**, are in their operative or full-line positions shown in Figure 1, and the fluid under pressure is then introduced into the chamber **25** formed by the several units to vulcanize the stock to the contour of the dies.

The means for independently moving the several units about the axis of the shaft **21** comprises a drum **30** driven by a prime mover, such as the electric motor **31**, and operatively connected to the front or swinging side of each of the pivotally mounted units **24**. In the present instance, the connection between the drum **30** and pivotally mounted units is effected by means of a flexible cable **32** having one end secured to the drum **30** in any suitable manner and having the opposite end successively reeved around pulleys **33** respectively carried by the front or swinging sides of the units **24**. As shown in Figure 1, the cable **32** extends forwardly from the drum **30** around a freely rotatable drum **34** journaled upon the top of the press at the forward end thereof and from the drum **34** the cable is reeved around the pulley **33** associated with the uppermost pivotally mounted unit **24**. From the aforesaid pulley **33**, the cable is again rotated around the freely rotatable drum **34** and is reeved around the pulley **33** at the forward end of the next adjacent unit **24**. This method of connection is repeated with the remaining number of units **24** and after being passed several times around the drum **34** and a second drum **34'**, carried by the lower header **20**, is secured to the machine frame as at **32'**. The arrangement is such that when the several units of the apparatus are in their inoperative positions shown by the dot-and-dash lines in Figure 1, initial rotation of the drum **30** in the direction of the arrow **35** causes the top unit **24** to move to its uppermost position adjacent the header **22** without disturbing the remaining units. However, as rotation of the drum is continued, the next adjacent units will successively move into their uppermost positions, indicated by the full lines in Figure 1. It is to be understood, of course, that any suitable means may be employed to interrupt the rotation of the

drum after the uppermost unit is in its operative position so as to permit loading the unit beneath the same. It may also be pointed out at this time that the units are accurately positioned with respect to each other as they are moved to their operative positions, by means of guides 35' shown in Figure 3 as positioned at opposite sides of the press.

When the sections are in their operative positions shown by the full lines in Figure 1, it is desired to positively hold the same in this position in order to prevent the reaction of the fluid under pressure in the chambers 25 from separating the units. The above is accomplished in the present instance by providing a plurality of bolts 36 on each side of the press having the upper ends thereof secured to plates 37 mounted upon the top frame structure for sliding movement in opposite directions in a plane parallel to the inclined plane of the upper header 22. Upon reference to Figure 5, it will be noted that the bolts on one side of the press are secured to one of the plates 37, while the bolts at the opposite side of the press are secured to the other of the plates 37, so that as the plates are moved toward each other from their outermost positions, the bolts 36 will be moved as a unit therewith toward the adjacent sides of the press. Referring again to Figure 1, it will be observed that the bolts extend downwardly from the plates perpendicular to the plane of sliding movement of the plates, and the lower end portion of each bolt is adapted to assume a position between the base portions of a pair of channel-shaped members 38 extending laterally outwardly from opposite sides of the lower header 20 of the press. The extreme lower ends of the bolts are threaded for receiving the adjusting nuts 39, and the latter are flanged as at 40 to form an abutment for the oppositely extending flanges 41 on the channel-shaped members 38. It will, of course, be understood that the extent of sliding movement of the plates 37 is so determined that when the plates are in their outermost positions with respect to opposite sides of the press, the bolts will assume positions laterally beyond the ends of the members 38, and when the plates are in their innermost positions, the bolts move into locking position between the base portions of the channel-shaped member 38, wherein the flanges 40 on the adjusting nuts at the extremities of the bolts serve to prevent displacement of any one of the units from their operative positions.

While any suitable means may be employed for actuating the plates 37 to effect the desired movement of the locking bolts, nevertheless, for the purpose of illustration, we have shown this means as comprising a rotatable screw 44 having the opposite ends threadedly engaged in the nuts 45 respectively mounted on the plates 37. As shown in Figure 5, the screw 44 is journaled upon the top frame structure and is driven from a prime mover 46 also suitably supported on the top frame structure of the press.

Having described the general structure of the apparatus illustrated herein for carrying out the improved method of manufacturing contoured coverings from a material containing rubber, particular reference will now be made to the detailed construction of one of the units 24, since these units are preferably, although not necessarily, exactly the same in construction. As shown in Figure 8, each of the units 24 comprises a rectangular frame 50 having a plate 51 secured to the upper side of the frame and forming a support for the die 26 which is preferably, although, not necessarily, formed of aluminum alloy. The die 26 corresponds in shape to the contour it is desired to impart to the covering material to be formed, and the working surface of the die is covered by a suitable material 52 such as hard rubber. The hard rubber covering, of course, conforms to the contour of the die, and a design may be provided on the top surface of the covering 52 corresponding to a specified pattern on the article to be formed. The die 26 and plate 51 preferably form a unit and the marginal edges of the hard rubber covering 52 are vulcanized or otherwise suitably secured to the top surface of the plate 51 beyond the die 26 so as to prevent the passage of fluid between the hard rubber cover and the plate.

As hereinbefore stated, the uncured rubber material to be vulcanized to the contour of the die 26 is placed upon the rubber covering 52 and the marginal edges of the material are clamped to the die in such a manner as to form an effective seal around the marginal edges. The means for accomplishing the above result comprises a frame 53 shown in Figure 7 as defining a slightly larger area than the area of the material to be vulcanized, but, as conforming in shape to the outline of the material. Referring again to Figure 8, it will be noted that the edge of the frame 53 adjacent the back of the press is hingedly connected to the plate 51 by means of a plurality of hinge units designated by the reference character 54. Secured to the underside of the frame 53 and coextensive with the latter is a rubber sealing strip 55 having a width substantially greater than the width of the frame 53. It will be apparent from Figure 8, that the inner edge of the sealing strip 55 is adapted to overlap the covering material to be vulcanized, while the outer edge of the sealing strip is adapted to engage the upper surface of the hard rubber covering 52 laterally beyond the marginal edges of the material to be vulcanized, and the aforesaid edges of the sealing strip 55 are normally urged into engagement with the above mentioned surfaces by means of a plurality of spring fingers 56 arranged in juxtaposition to each other around the frame between the lower side of the latter and the sealing strip. It will also be observed from Figure 8, that the central portion of the sealing strip 55 is reinforced by a strip 57 having an outline corresponding to the outline of the frame 53 and engaging the underside of the sealing strip 55 between the side edges of the latter. The strip 57, sealing strip 55, and spring fingers 56 are secured to the underside of the frame 53 as a unit, by means of an auxiliary frame 58 also corresponding in outline to the frame 53 and secured thereto at spaced points, through the medium of the fastener elements 59. The frame 53, in addition to carrying the sealing strip assembly previously described, also carries a plurality of spaced coil springs 60 secured to the frame by the fastener elements 59 and having a length slightly greater than the height of the fluid pressure chamber 25 provided between the plates 51 of the adjacent units, so as to engage the plate 51 of the next adjacent unit upon relative movement of the units toward each other and thereby yieldably urge the marginal edges of the sealing strip 55 into engagement with the surfaces adjacent thereto.

With the foregoing construction, it will be observed that the combined clamping and sealing unit for the material to be vulcanized is mov-

able as a unit with the frame 53 about the axis of the hinge units 54 connecting the frame 53 with the plate 51. Hence, when it is desired to place a sheet of uncured rubber material upon the die, the frame 53 is merely moved upwardly about the axis of the hinge units a sufficient distance to permit properly positioning the sheet on the die, whereupon the frame is returned to its normal position and the unit is moved upwardly about the axis of the shaft 21 in the manner previously set forth to form a fluid pressure chamber 25 with the unit directly above the same. Incidentally, the aforesaid relative movement of the units causes the springs 60 to compress and initially clamp the material to be vulcanized to the die. After all of the units 24 have been properly loaded and moved to the full-line positions thereof shown in Figure 1, fluid under pressure is admitted to the uppermost unit through the conduit 26' and is uniformly distributed throughout each of the units by reason of the holes 27 formed in the plates 51. The fluid under pressure admitted to each of the units, of course, serves to press the sheet of material to be vulcanized against the die and furthermore, is of such a temperature as to cure this material to the contour of the die. In order to insure proper contact of the sheet of material to be vulcanized with the die, it is necessary to provide for the escape of any air that may be trapped beneath the sheet, and this is accomplished in the present instance by forming a plurality of air bleeds 63 through the die. As will be observed from Figure 8, the air escaping through the bleeds 63 enters a chamber 64 beneath the plate 51 through a plurality of openings 65 formed in the plate 51. The chamber 64 is formed by a plate 66 secured in spaced relation to the underside of the plate 51 and communicating with the atmosphere through a plurality of holes 67 formed in the frame 50 of the unit.

It has been stated above that the fluid pressure in the chambers 25 cooperates with the springs 60 in deforming the strip 55 to provide an effective seal around the marginal edges of the covering to be vulcanized, and in order to obtain the differential pressure between the space beneath the strip 55 and the chamber 25 required to secure the above mentioned seal, communication is provided between the space beneath the strip 55 and the atmosphere. This is accomplished herein by forming openings 68 in the die, in such a manner that the openings establish communication between the space enclosed by the sealing strip 55 and the chamber 64, which as previously stated, communicates with the atmosphere through the openings 67.

Of course, it will be apparent that since the several units cooperate with each other in their operative positions to form fluid pressure chambers therebetween, some means must be provided for effectively sealing the joint between adjacent units, and this is accomplished herein by a sealing strip 70 formed of a flexible material such as rubber. A sealing strip 70 is secured to the bottom surface of each of the frames 50 and is continuous with the frame. The preferred cross sectional contour of the sealing strip 70 is shown in Figure 8, and, as will also be observed from this figure, the strip is secured to the frame 50 by a retainer strip 71 welded or otherwise suitably secured to the frame 50. The inner edge of the sealing strip 70 extends laterally inwardly beyond the corresponding edge of the retainer and is normally urged into frictional engagement with the plate 51 of the next adjacent lower unit, by means of the springs 72. The springs 72 are secured to the bottom of the frame 50 in juxta-relationship and also cooperate with the retainer 71 to secure the sealing strip 70 to the frame 50. From the foregoing description, it will be noted that the fluid pressure in the chambers 25 cooperates with the springs 72 in effecting a tight seal between the strip 70 and the adjacent plate 51.

Thus from the foregoing, it will be observed that we have provided a relatively simple and inexpensive method for forming contoured articles from vulcanizable material. It will also be apparent that our improved method, previously described, materially reduces maintenance cost by the elimination of the relatively unserviceable diaphragms heretofore employed in the apparatus to contour the stock and, inasmuch as reducing the maintenance cost also renders continuous operation possible, it necessarily follows that the rate of production is materially increased. It will further be observed that our method effects a saving in material, since the pressure differential seal renders it possible to utilize stock of the exact size of the finished covering and thereby offers the possibility of eliminating the edge trimming operation required in the past. In addition, the elimination of the rubber diaphragms utilized in connection with prior practice offers the possibility of forming a superior product, since it permits accurately duplicating the contour of the pattern.

Although the description of the apparatus selected herein for the purpose of illustration is relied upon to exemplify the particular method forming the subject matter of this invention, it should be understood that our improved method is by no means limited to the specific apparatus, and reservation is made to make such changes in the method as may come within the purview of the accompanying claims.

What we claim as our invention is:

1. Those steps in the method of forming a covering of predetermined contour from deformable stock which consist in positioning a sheet of stock on a supporting surface having openings therethrough beyond the marginal edges of the stock communicating with a low pressure area, bridging the marginal edges of the stock and the portion of the supporting surface having the openings therethrough with a deformable member, and pressing the stock and deformable member toward the supporting surface by subjecting the surfaces of said stock and member opposite the surfaces thereof adjacent the supporting surface to the direct action of fluid under pressure.

2. Those steps in the method of forming a covering of predetermined contour from vulcanizable stock which consist in positioning a sheet of stock on a form of the desired contour, enclosing the sheet of stock to form a closed chamber, introducing fluid under pressure into the chamber in a manner that the fluid acts directly on the sheet of stock to urge the sheet into intimate contacting relation with the form, preheating the fluid to a temperature sufficient to vulcanize the sheet of stock to the contour of the form, and exposing the marginal edge portions of the sheet of stock to an area having a pressure less than the pressure introduced into the chamber to provide a tight seal between the stock and the form.

3. Those steps in the method of forming a cov-

ering of predetermined contour from vulcanizable stock which consist in positioning a sheet of stock on a form of the desired contour, bridging the marginal edge portions of the stock and a portion of the form spaced outwardly from the marginal edges of the stock with a deformable member, enclosing the stock and deformable member to provide a closed chamber, introducing fluid under pressure into the chamber in a manner that the fluid acts directly upon the deformable member and stock to intimately urge the same against the adjacent surface of the form, and exposing the surface of the deformable member adjacent the form to a pressure which is less than the pressure of the fluid so as to effect an effective seal around the marginal edges of the stock.

4. Those steps in the method of forming floor coverings of vulcanizable material which consist in successively placing sheets of material on a plurality of forms carried by relatively movable mold sections which are adapted to cooperate with each other in one relative position to form closed chambers, relatively moving the mold sections to form the said closed chambers, introducing fluid under pressure into the chambers in a manner that the fluid acts directly on the sheets of material to urge the same into intimate contacting relation with the adjacent forms, and exposing the surfaces of the sheets of material adjacent the forms to an area having a pressure less than the pressure in said closed chambers to effect a fluid tight seal between the sheets of material and forms.

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