

April 20, 1971

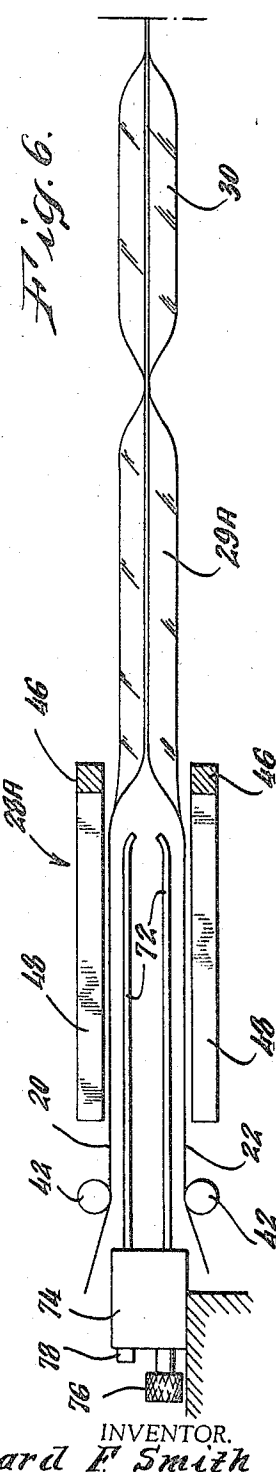
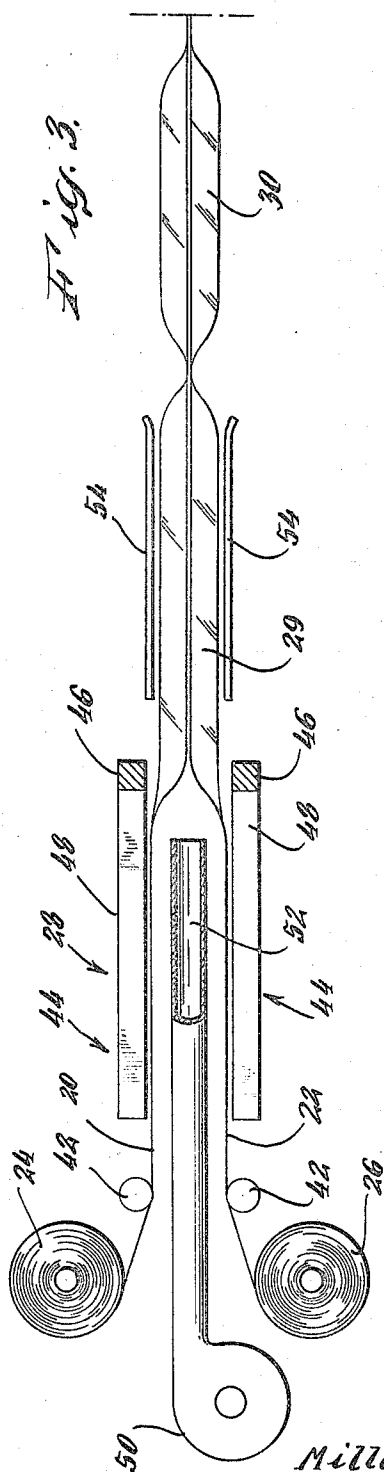
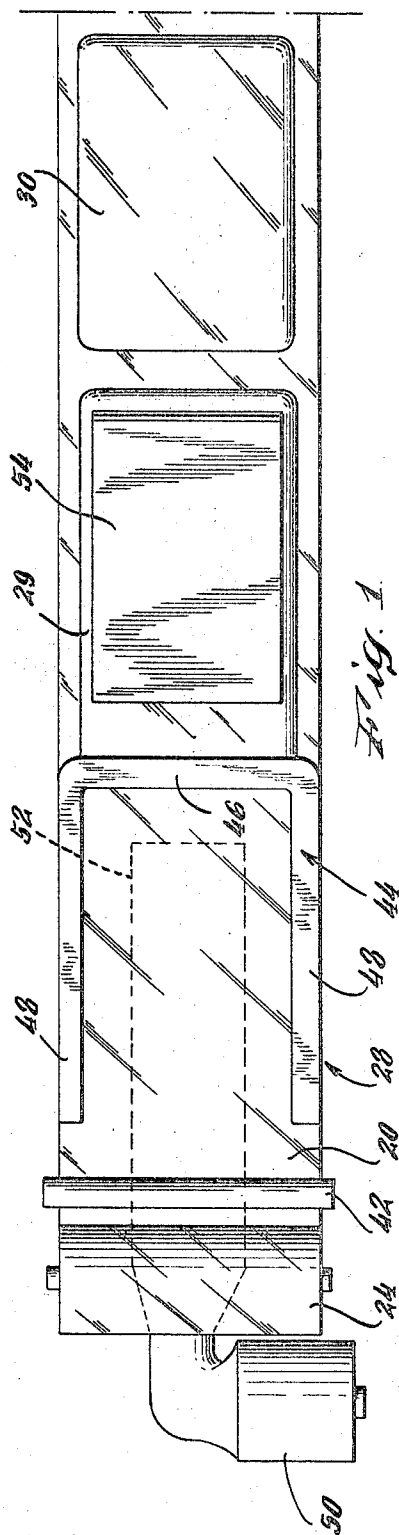
M. F. SMITH

3,575,757

PROCESS FOR MAKING INFLATED ARTICLES

Filed Dec. 8, 1967

3 Sheets-Sheet 1



INVENTOR.
Millard F. Smith

BY

Mattern, Ware & Davis,
ATTORNEYS.

April 20, 1971

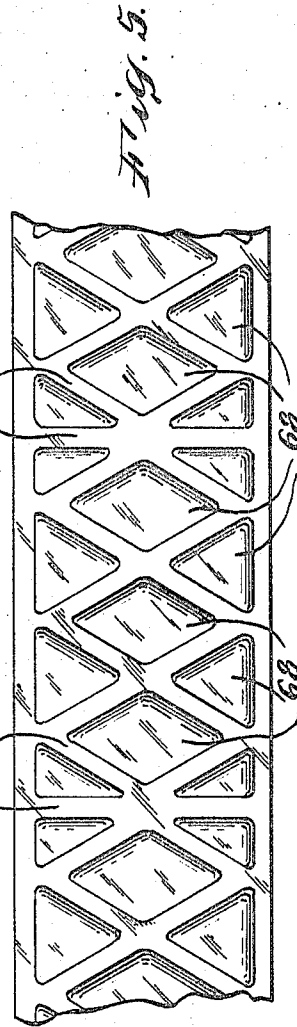
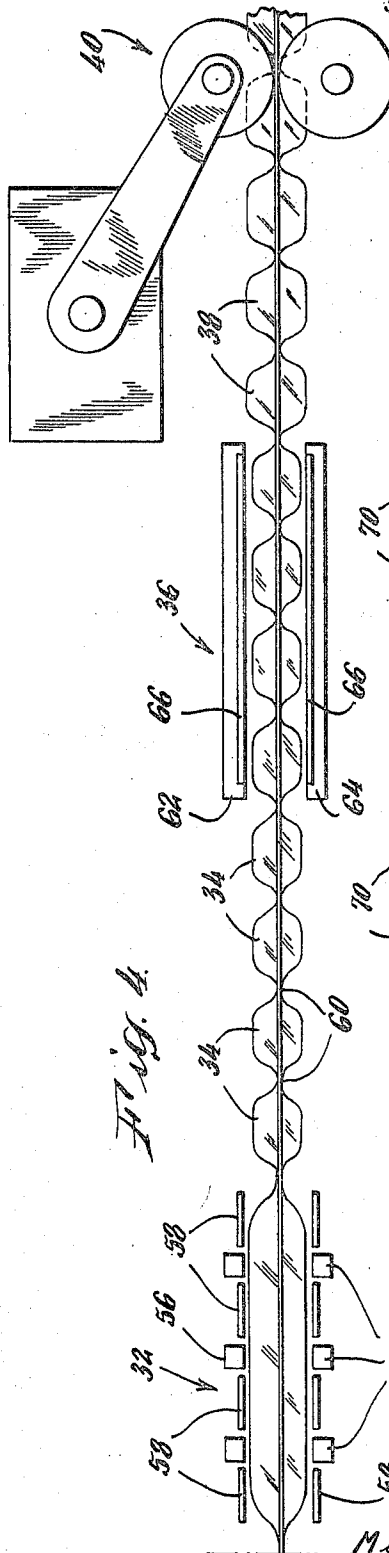
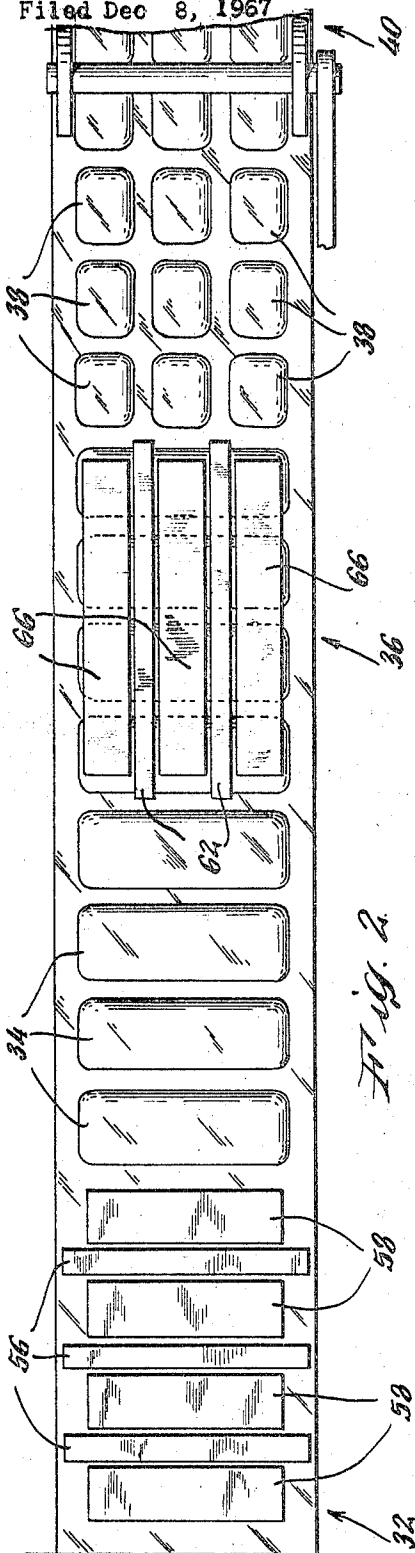
M. F. SMITH

3,575,757

PROCESS FOR MAKING INFLATED ARTICLES

Filed Dec 8, 1967

3 Sheets-Sheet 2



INVENTOR,
Millard F. Smith
BY

Mattern, Ware & Davis,
ATTORNEYS.

April 20, 1971

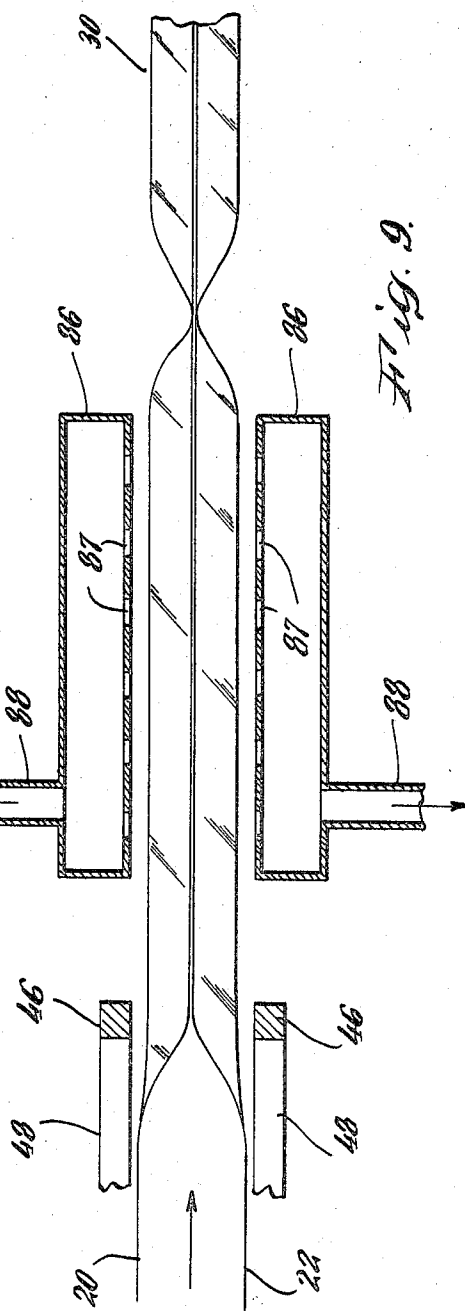
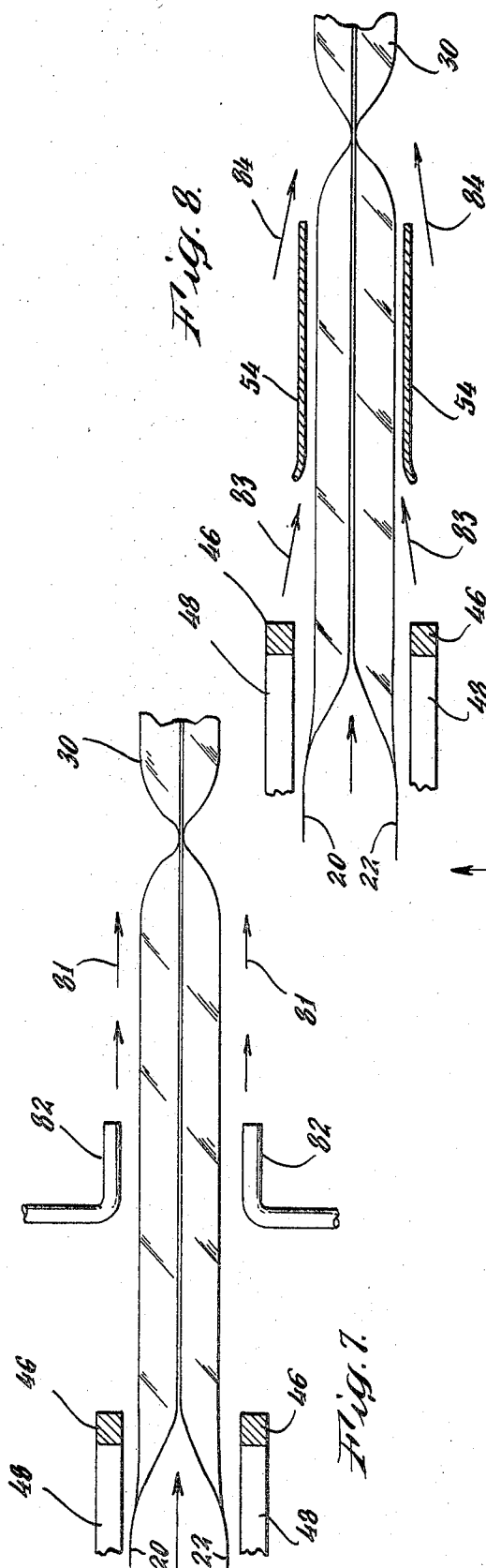
M. F. SMITH

3,575,757

PROCESS FOR MAKING INFLATED ARTICLES

Filed Dec. 8, 1967

3 Sheets-Sheet 3



INVENTOR.
Millard F. Smith
BY

Mattern, Ware & Davis.
ATTORNEYS.

1

3,575,757

PROCESS FOR MAKING INFLATED ARTICLES
Millard F. Smith, Westport, Conn., assignor to Reinforced
Air Corporation, Old Lyme, Conn.
Filed Dec. 8, 1967, Ser. No. 689,155
Int. Cl. B32b 31/00
U.S. Cl. 156—147

14 Claims

ABSTRACT OF THE DISCLOSURE

Parallel opposed sheets are bonded together in a U-shaped seal to form a pocket. The pocket is inflated by a controlled amount, then sealed off by forming a new pocket wherein the bottom of the second U-shaped seal overlaps the ends of the first U-shaped seal. The sealed inflated pocket may be further sub-divided into smaller inflated pockets by further sealing.

The present invention relates to a process for making inflated articles from plastic sheets. More particularly, the invention relates to a process involving forming sealed inflated pockets, and then sub-dividing the inflated pockets into smaller compartments by further sealing.

Materials with low density and high volume have a broad variety of commercial utility for such uses as insulation and packing materials. Such products are typically produced at a central factory location, and are then shipped to the point where they will be used. In view of the high volumes of these materials, shipping expenses are considerable. The present invention provides a process adapted for forming such low density materials at remote locations.

A primary object of the invention is to provide a process for forming low density materials.

A further object is to provide a process for the above character wherein the low density materials are formed by sealing together and inflating two plastic sheets in a particular fashion.

A further object is to provide a process of the above character wherein sealed, partially inflated pockets are first formed.

A further object is to provide a process of the above character in which the sealed, partially inflated pockets are then further sub-divided into sealed inflated compartments.

A further object is to provide a process of the above character which is adapted for practice at remote locations.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others thereof, which will be exemplified in the process hereinafter disclosed, and the scope of the invention will be indicated in the claims.

For a more complete understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a top plan view, partly in section, of exemplary apparatus for carrying out the first steps of the process according to the invention;

FIG. 2 is a top plan view of exemplary apparatus for carrying out the remainder of the process of the invention;

FIGS. 3 and 4 are side elevation views, partially in section, of the apparatus shown in FIGS. 1 and 2 respectively;

FIG. 5 is a plan view of an alternative product which may be made by the process of the invention;

2

FIG. 6 is a side elevation view, similar to FIG. 3, showing apparatus for carrying out the first step of the process, incorporating another embodiment of the invention; and

FIGS. 7, 8 and 9 are similar fragmentary side elevation views, partially in section, showing modified portions of different embodiments of the apparatus of FIG. 3.

As shown in FIGS. 1 and 3 or 6, two continuous lengths of thermoplastic film 20 and 22 are fed from supply rolls 24 and 26 respectively. Sheets 20 and 22 are substantially the same width, and converge in the vicinity of the first processing station 28, where they are bonded together to form open pockets 29 which are next inflated and closed to form sealed pockets 30, as will be more fully described below. Sealed pockets 30 next progress to a first subdividing station 32 (FIGS. 2 and 4) where they are subdivided into transverse sealed compartments 34 by a further heat sealing step. Transverse compartments 34 next proceed to the second sub-dividing station 36, where they are longitudinally further sub-divided into the final sealed compartments 38. The finished product is forwarded by a take-up mechanism 40.

Referring now more specifically to FIGS. 1 and 3, sheets 20 and 22 are withdrawn from respective supply rolls 24 and 26, passing around guide rolls 42 and between opposed, U-shaped heat sealing bars 44. Bars 44 are heated by any suitable means to a temperature sufficiently high to effect sealing of sheets 20 and 22 when clamped together. Each bar 44 has a bottom section 46 which extends transversely substantially the entire width of sheets 20 and 22, and arm sections 48 which extend from bottom section 46 toward guide rolls 42. When sealing bars 44 are clamped together, sheets 20 and 22 are heat-sealed in a U-shaped pattern to form a pocket 29 having its open end facing the sheet supply.

After the first pocket 29 has been formed by clamping together sealing bars 44, sheets 20 and 22 are forwarded to the right as viewed in FIG. 1 a distance slightly less than the length of arms 48. A gas supply means, illustrated as blower 50, has its nozzle 52 located between sheets 20 and 22 near bottom section 46 of bars 44, to partially inflate the pocket. Means are provided, such as the illustrated backing plates 54, for limiting the degree to which the pockets may be inflated by supply source 50. When the pocket between plates 54 has been inflated to the proper degree, sealing bars 44 are again clamped together to form a new pocket. As best illustrated in FIG. 3, formation of the new U-shaped seal closes the previous pocket by forming the new one: in other words, the seal formed by bottom section 46 overlaps the seal previously made by arms 48.

If pockets 30 are to be further subdivided into smaller hermetically sealed compartments, the total possible enclosed volume will decrease. Accordingly in this case pockets 30 may be slackly filled to a degree depending on the number and configuration of the desired final compartments 38. Selection of the degree to which pockets 30 should be inflated can readily be accomplished by those skilled in the art. If pockets 30 are not to be further subdivided, they may be fully inflated if desired.

Referring now to FIGS. 2 and 4, slackly filled pockets 30 are next fed to the first subdividing station 32. As illustrated, station 32 includes three parallel sealing bars 56 arranged transversely above pocket 30, and three parallel sealing bars 57 below pocket 30 and opposed to bars 56. Volume distribution plates 58 are located on either side each of sealing bars 56 and 57 to control the volume distribution when sealing bars 56 and 57 are clamped together to form transverse seals 60. Plates 58 insured that compartments 34 have a predetermined volume relation to one another, such as equal volumes.

Still referring to FIGS. 2 and 4, compartments 34 next pass to the second subdividing station 36, which includes

3

upper axial sealing bars 62 and lower axial sealing bars 64 opposed to bars 62. Volume distribution plates 66 are provided on either side of the heat-sealing bars 62, and 64, to control the volume distribution among the final sealed compartments 38 which are formed when sealing bars 62 are clamped against bars 64. In the illustrated embodiment, volume distribution plates 54 in FIG. 1 and plates 56, 57, and 66 in FIGS. 2 and 4 are so adjusted that the final compartments 38 are of equal volume. Other volume distributions may be desirable for particular end uses, and can be obtained by suitable adjustment of the volume distribution plates.

The volume distribution plates may be attached to the sealing bars, or to a stationary portion of the apparatus; while the preferred embodiment of the invention shown in FIGS. 1-4 produces final compartments 38 which are generally rectangular in configuration, the invention is not restricted thereto, and FIG. 5 shows a further exemplary configuration. As shown in FIG. 5, compartments 68 may be formed by seals 70 which are neither parallel nor perpendicular to the axes of the original films. It should be understood that other sealing configurations are within the contemplation of the invention.

In general, sheets 20 and 22 may be formed of virtually any heat-sealable thermoplastic film, such as polyethylene, polypropylene, polyvinyl chloride, etc. The surfaces of one or both sheets may be metallized if desired, using well-known techniques, either before or after undergoing the present process. For maximum gas retention, materials such as polyethylene may be specially treated to reduce leakage of the gas through the sheet. Various techniques for reducing such leakage are known. By way of example, a polyethylene sheet can be made considerably more leak resistant by coating with "polymeric vinylidene chloride," which term as used herein means polymers, copolymers, and interpolymers of vinylidene chloride wherein the polymerized vinylidene chloride is present in predominant amount. Such polymeric vinylidene chloride may be obtained, for example, by polymerizing together 85% by weight monomeric vinylidene chloride with one or more other polymerizable materials such as 15% by weight vinyl chloride. The resulting polymer may be coated onto sheets 20 and 22 from a 15% by weight solution of the polymer in a solvent such as methylethyl ketone, by evaporating the solvent. The resulting polymeric vinylidene chloride film renders sheets 20 and 22 substantially impervious to gases so that pockets 30 or compartments 34 or 38 will retain their volume over long periods of time, even when subjected to load. It should be understood that this particular treatment to reduce gas leakage through the sheets is merely exemplary, and that other coating compositions or other techniques to achieve this result are within the contemplation of this aspect of the invention.

Although the usual gas which will be entrapped within the compartments 38 will be air, other gases may be preferable for particular end uses. Thus entrapment of gases such as nitrogen or carbon dioxide would be advantageous if fire resistance is desired. If sheets 20 and 22 have the correct widths, the finished product including inflated pockets 30 or compartments 34 or 38 may be directly installed within walls or ceilings as insulation, which can be made on the site.

While the invention has been specifically described as using the preferred heat-sealing bars, which may be coated with polytetrafluoroethylene if desired, other means for forming the seals may be used, such as ultrasonic energy, etc.

Products made by the present process are not restricted to use as insulation, but may also be used as dunnage bags, packing and shipping materials, etc., since a wide range of properties may be obtained by selecting the appropriate starting materials, the width and thickness of sheets 20 and 22, final compartment size and pressure, etc. The process is particularly adapted for practice at remote

4

locations, since the necessary apparatus can readily be mounted on a truck or trailer.

Sealing bars 44 are movable automatically or upon command between two positions, the spaced-apart position shown in FIG. 4, and a clamped-together position in which the bars 44 are closely juxtaposed, applying heat by direct conduction to the two plastic films 20 and 22 sandwiched between them. Sealing bars 56-57 and 62-64 are similarly movable between like spaced-apart and clamped-together sealing positions. In automatic production lines, sheets 20 and 22 are automatically advanced in incremental steps while all heating bars are spaced apart, and sheets 20 and 22 are then held stationary while all sealing bars are clamped together for a short period of time, just long enough to complete the desired sealings of sheets 20 and 22 together without burning, degrading or rupturing sheets 20 and 22.

In the modified embodiment of the invention shown in FIG. 6, a pair of adjustably movable spacer plates 72, spaced apart by a predetermined distance, are interposed between sheets 20 and 22 at the first processing station 28A. Spacer plates 70 are roughly parallel to the sheets 20 and 22, and may extend laterally and longitudinally over approximately the same area as nozzle 52 of blower 50. Plates 72 do not extend beyond the base 46 of the U-shaped sealing member 46-48, but they serve to space apart sheets 20 and 22 in the partially formed pocket 29A until the following sealing operation is completed.

Spacer plates 72 may be used along or in conjunction with a blower 50 if desired. The plates 72 are preferably supported cantilever-fashion by an adjustable support means 74 extending between the supply rolls 24 and 26, and providing selectably variable spacing between the plates 72. In this manner the size of pocket 29 may be selected and changed as desired. Spacing mechanism in unit 74 may be controlled by a thumbscrew 76 cooperating with a vernier scale 78 if desired, for increased separation of a few thousandths of an inch between plates 72 produces a noticeable difference in the size and shape of the resulting pocket 29. Edge guide plates (not shown) may also be employed just downstream from first processing station 28A to maintain sheets 20 and 22 arched apart in a pocket-shape until the air between the sheets is trapped by the next sealing operation.

As shown in FIGS. 7, 8 and 9, various different means may be employed to draw the sheets 20 and 22 apart during the initial pocket-forming steps. Flowing streams 81 of air or other compressed gas directed from delivery jets 82 at moderate velocity past the outward faces of the sheets 20 and 22 will serve to draw the sheets apart, as in FIG. 7. Volume distribution plates 54 may be combined with such flowing streams directed at their entrance end 83, or past their exit end 84, or both, as shown in FIG. 8, will also serve to draw and space sheets 20 and 22 apart. Again, as shown in FIG. 9, vacuum manifolds 86 may be positioned with perforated intake plates 87 adjacent and parallel to the outward faces of sheets 20 and 22. A partial vacuum connected to outlets 88 of manifolds 86 will draw the ambient atmosphere through perforated plates 87, likewise drawing sheets 20 and 22 apart to the required spacing. Each of these sheet spacing means may be employed in cooperation with a blower 50 if desired, and the blower intake may provide the source of negative pressure for connection to vacuum manifold outlets 88.

Repositioning or eliminating certain of the sealing bars 56-57 or 62-64 provides flexible variation in the shape and position of the resulting pockets 38, and staggered or otherwise varied sizes of pockets are often desired in the packaging of irregular shaped products such as business machines or machine parts.

In addition, the pressures within adjacent subdivided pockets 34, 38 or 68 may be varied as desired by loading volume distribution plates 58 with different weights, or with resilient springs applying different biasing loads.

5

By this means the subdivided pockets 34 produced at the first subdividing station 32 may be successively increasing in thickness, or successively decreasing, or the central pockets 34 may be either higher or lower than the first and last pockets if desired. Such variable-size pockets are highly useful for cradling of a machine part in its packing container, for example.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in carrying out the above process and in construction set forth without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

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

1. The process for making inflated structures comprising the steps of:

(A) feeding parallel opposed thermoplastic sheets having substantially the same width and continuous lengths together in parallel paths from a supply source to a takeup means, said sheets converging at a processing station;

(B) sealing said sheets together in a U-shaped seal to form an open-ended pocket, said U-shaped seal having a bottom end extending across said sheets and having arms extending generally parallel to and along the edges of said sheet, the open end of said U-shaped seal facing said supply source;

(C) and repetitively:

(1) advancing said sheets substantially the length of the arms of said U-shaped seal;

(2) spreading said sheets to cause partial inflation of said pocket by spacing the sheets apart between the arms of the U-shaped seal; and

(3) sealing said pocket by sealing said sheets together in a U-shaped seal, said U-shaped seal having a bottom end extending across said sheets and having arms extending generally parallel to and along the edges of said sheets with the open end of said U-shaped seal facing said supply source, the bottom of each U-shaped seal except the first overlapping the ends of the arms of the preceding U-shaped seal, whereby said partially inflated pockets are successively sealed off to form sealed pockets.

2. The process defined in claim 1, wherein the degree of spreading of said sheets is adjusted to control the volume to which said pockets are inflated.

3. The process defined in claim 1, further comprising the step of sub-dividing said sealed pockets by further

6

sealing said opposed sheets to convert said pockets into a plurality of smaller inflated hermetically sealed compartments.

4. The process defined in claim 3, wherein the volume distribution among said compartments is controlled by maintaining predetermined spacing of the sheets during said sub-dividing step.

5. The process defined in claim 1, wherein at least one of said sheets is metallized.

6. The process defined in claim 1, wherein said sheets are substantially impervious to the gas filling said pockets.

7. The process defined in claim 1, wherein said sheets are coated with polymeric vinylidene chloride.

8. The process defined in claim 1, wherein said gas is selected from the group consisting of nitrogen and carbon dioxide.

9. A process for making an inflated article, comprising the steps of:

(A) forming a sealed, partly inflated pocket from parallel plastic sheets by juxtaposing zones of the two sheets peripherally surrounding the pocket, and sealing the juxtaposed zones of said sheets together into a peripheral seal around said pocket; and

(B) sub-dividing said pocket into smaller compartments by forming sub-dividing seals between said sheets, said sub-dividing seals intersecting said peripheral seal whereby said pocket is sub-divided into hermetically sealed smaller inflated compartments.

10. The process defined in claim 9, wherein at least one of said sheets is metallized.

11. The process defined in claim 1, wherein the spreading of said sheets producing inflation of the pocket is achieved by directing a stream of compressed gas into the pocket.

12. The process defined in claim 1, wherein the spreading of said sheets producing inflation of the pocket is achieved by interposing a pair of spacer plates between the sheets at the processing station.

13. The process defined in claim 4, including the juxtaposing of pairs of distributor plates flanking said compartments in predetermined spaced-apart relationship.

14. The process defined in claim 13, wherein the pairs of distributor plates are individually urged together by predetermined differing biasing forces, producing differing volume distribution between separate compartments.

References Cited

UNITED STATES PATENTS

2,665,739	1/1954	Carlson et al.	156—306X
3,206,345	9/1965	Stickel	156—145
3,454,447	7/1969	Corbett et al.	156—358X

BENJAMIN R. PADGETT, Primary Examiner

S. HELLMAN, Assistant Examiner

U.S. Cl. X.R.

156—145