

July 2, 1946.

B. L. LUBELSKY ET AL

2,403,386

BLASTING PLUG

Filed Jan. 30, 1941

3 Sheets-Sheet 1

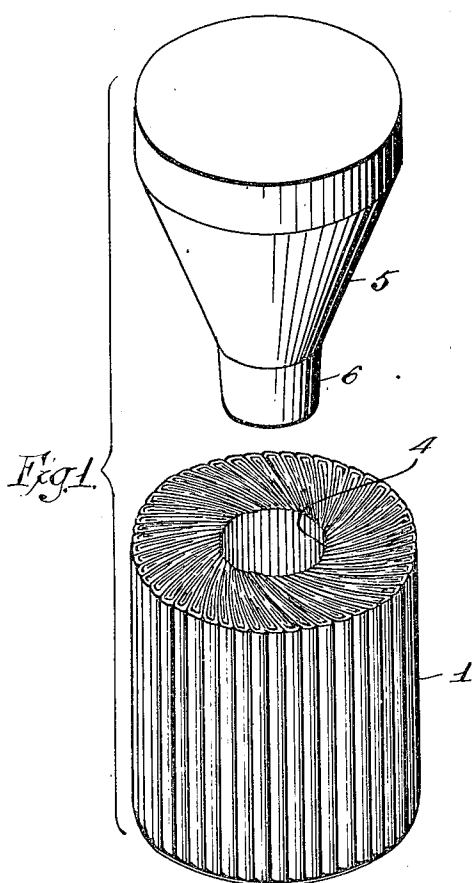


Fig. 13.

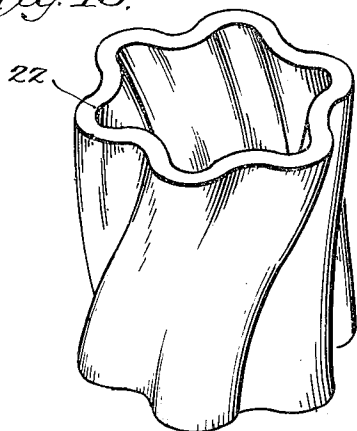


Fig. 2.

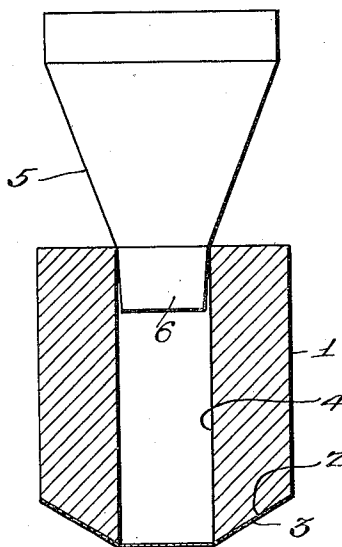


Fig. 11.

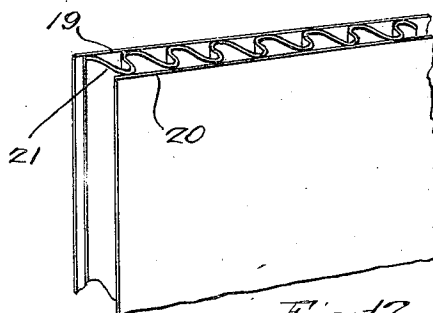
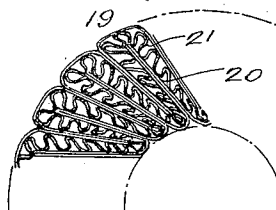


Fig. 12.



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Fig. 4

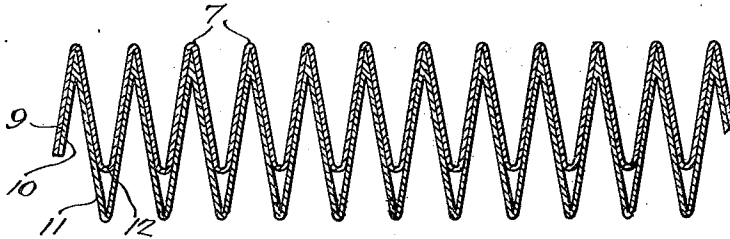


Fig. 8

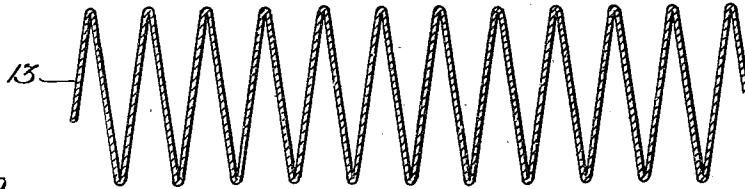


Fig. 9

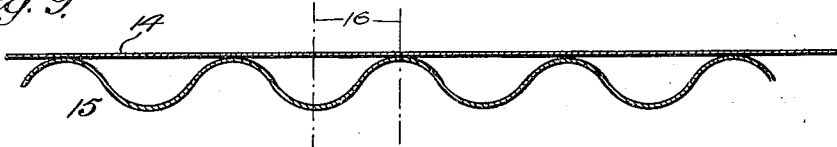


Fig. 10

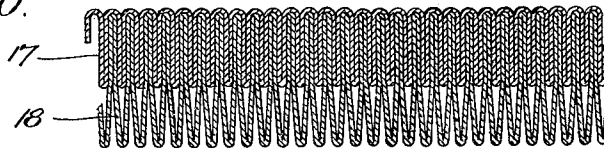
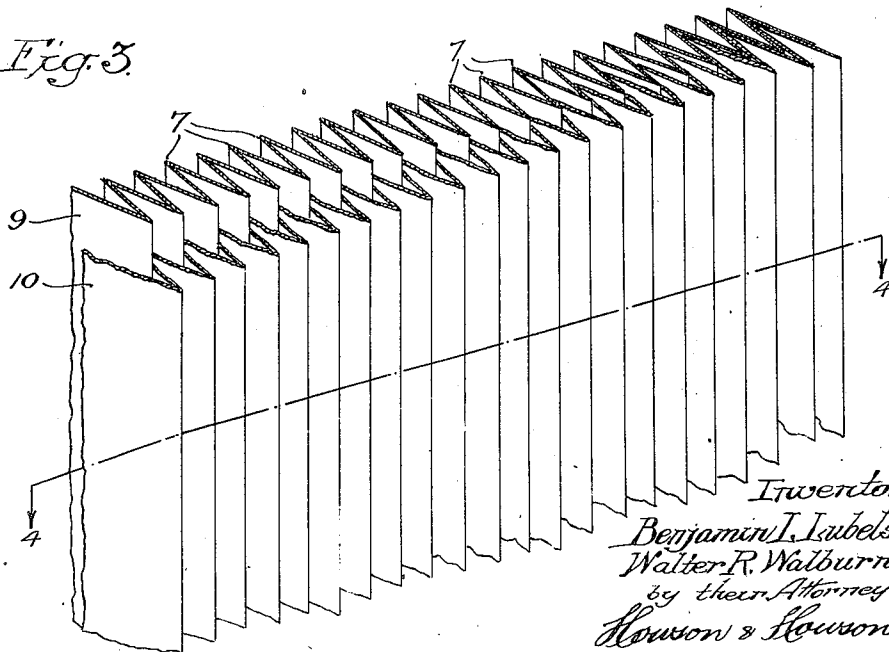


Fig. 3



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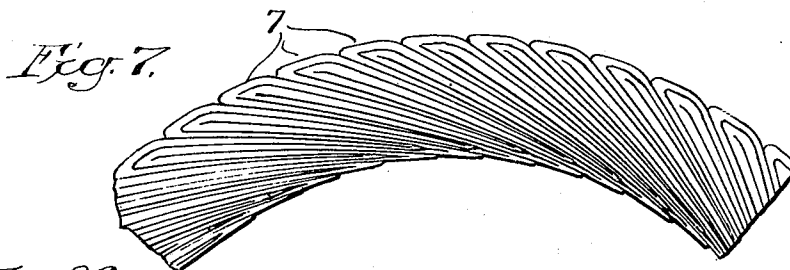
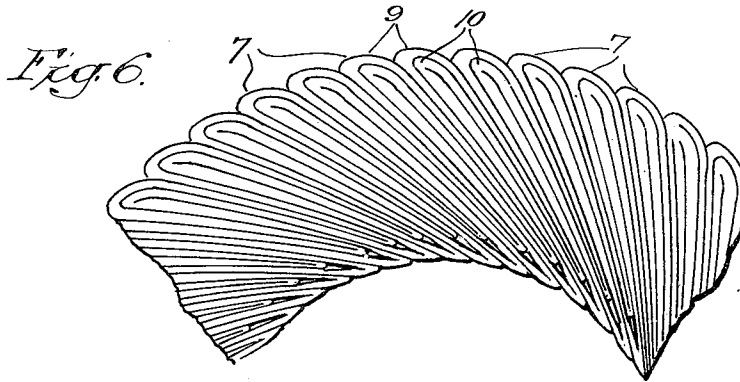
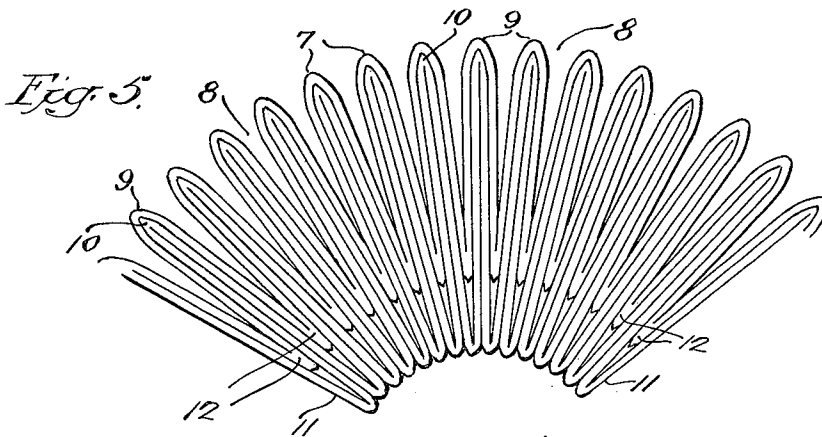
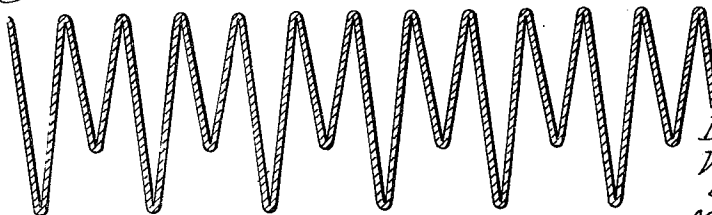


Fig. 8a



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UNITED STATES PATENT OFFICE

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BLASTING PLUG

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Application January 30, 1941, Serial No. 376,684

13 Claims. (Cl. 102—30)

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This invention relates to improvements in blasting plugs of the type comprising a radially expandible plug body which, after insertion in a bore hole, is expanded against the wall of the hole by means of internal pressure applied usually through the medium of a tapered expander element.

Heretofore, it has been the conventional practice to form the expandible body of the plug in part or in whole of flexible rubber or rubber composition. These plugs, while highly satisfactory for certain purposes, are not well adapted for blasting operations in closed spaces, such as mines, by reason of the malodorous fumes resulting from the combustion of the rubber composition and, sometimes, of the fire hazard.

A principal object of the present invention is to provide a plug of the stated type which shall not be subject to the aforesaid objectionable properties of the conventional rubber plug.

More specifically, an object of the invention is to provide a plug of the stated type which shall be composed of a material which is either inherently incombustible or which, if combustible, will not generate noxious or objectionable fumes.

The invention further contemplates provision of a plug which shall be relatively inexpensive to manufacture, less subject to deterioration, and substantially more efficient than plugs of the prior types.

The invention further resides in certain novel structural features hereinafter described and illustrated in the attached drawings, wherein:

Figure 1 is a view in perspective of a plug made in accordance with the invention, the two major elements of the plug, namely, the expandible body and the tapered expander, being separated;

Fig. 2 is a vertical sectional view of the plug showing the aforesaid major elements in the initial position and prior to expansion;

Fig. 3 is a fragmentary sectional perspective view illustrating one type of material of which the body of the plug is formed;

Fig. 4 is a fragmentary sectional view on the line 4—4, Fig. 3;

Figs. 5 and 6 are fragmentary top end views of the plug body illustrating successive steps of manufacture;

Fig. 7 is a view corresponding to those of Figs. 5 and 6 showing the body of the plug in its expanded condition;

Fig. 8 is a view corresponding to that of Fig. 4 illustrating a modified form of body structure;

Fig. 8a is a view corresponding to Fig. 8 and illustrating a preferred form of body structure

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employing a crimped or folded sheet material or single ply;

Fig. 9 is a corresponding view showing still another type of base material which may be used to advantage in the manufacture of the plug body;

Fig. 10 is a fragmentary sectional view showing the base material illustrated in Fig. 9 as compressed in an initial step of producing the plug body;

Fig. 11 is a fragmentary view in perspective of still another type of base material which has been found suitable for the production of plugs in accordance with the invention;

Fig. 12 is a fragmentary end view of a plug body made of the material shown in Fig. 11, and

Fig. 13 is a view in perspective of a modified form of plug body falling within the scope of the invention.

With reference to Figs. 1 and 2 of the drawings, the plug therein illustrated comprises a substantially cylindrical hollow body member 1 which in the present instance is composed of an inherently substantially non-stretchable material, such as paper or cardboard. One end of the wall of the body member 1 is beveled, as illustrated at 2 in Fig. 2, and this beveled end of the body has attached thereto by suitable means, such as adhesive, a cap 3 which may be made of the same material as the body 1 and which closes one end of the central cylindrical bore 4 of the body. The other end of the bore 4 is left open for reception of a suitable tapered expansion element 5 which may be made of wood or other suitable material and which preferably is provided at its reduced end with a substantially cylindrical extension 6, which as shown in Fig. 2 is adapted to neatly fit within the open end of the bore 4 of the body member.

As previously set forth, the body member 1 is made of an inherently substantially non-stretchable material, such as paper. In the production of the body, this material in sheet form is folded or crimped, as illustrated in Figs. 3 and 4, and the crimped mass then shaped to the form of the finished body member with the contiguous folds 7 arranged more or less radially and providing for the necessary radial expansion of the walls of the body. In producing the cylindrical body of the plug, a section of the crimped or folded material of suitable length is shaped into the cylindrical form of the body, as illustrated in Fig. 5, which figure shows a segmental portion of the complete cylinder. In this initial cylindrical form, the folds or crimps 7 extend in sub-

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stantially exact radial direction, as illustrated in Fig. 5, and in this condition, the outer ends of the folds are separated, leaving therebetween voids 8 which extend inwardly and substantially radially of the cylindrical body. The wall of the cylindrical body thus produced is then compressed in a suitable die or mold in a manner to increase the internal diameter of the cylinder and to deflect the folds 7 from the original radial positions to the positions shown in Fig. 6 in which they are somewhat inclined to the radius. This compression of the wall of the body and the resulting deflection of the folds 7 as described has the effect, as illustrated in Fig. 6, of substantially eliminating the voids 8 and affording a wall formation in which the folds 7 lie flatly against each other. If now the body as a whole is expanded radially, as illustrated in Fig. 7, the folds assume an even closer relation, with a substantial solidification of the wall of the body.

It will be noted by reference to Figures 3 and 4 that the sheet material of which the body is composed as described above is, in the present instance, composed of two plies designated respectively 9 and 10. The depth of the folds in the ply 10 is somewhat greater than the depth of the folds of the ply 9, and the folds are so relatively arranged that at one side the edge portions 11 of the folds of the ply 10 extend beyond the corresponding edges 12 of the folds of the ply 9. When the crimped two-ply sheet is shaped to the cylindrical form of the plug body, as shown in Fig. 5, the projecting edge portions 11 form the inner peripheral portion of the body. Thus each of the folds 7 has a greater mass of material in the outer than in the inner part, and this condition assists in the subsequent compacting or compressing operation, in which as previously described the wall of the body is substantially solidified and freed from voids. This device, in other words, provides for a greater mass of the material in the outer peripheral portion of the body member and a lesser mass of the material in the inner peripheral portion prior to the compacting operation illustrated in Fig. 6 and described above, so that after this operation, the mass of the material in the various portions of the wall of the body is more nearly uniform.

It is apparent, however, that in the production of a plug body in accordance with the invention, a single ply crimped sheet 13 of the general character shown in Fig. 8 may be used, although where a single ply sheet is used, it is preferable to form the crimps or folds as shown in Fig. 8a. In this case, the interspersed arrangement of major and minor folds affords substantially the same effect obtained by the two-ply folded sheet illustrated in Figs. 3 and 4 and described in the preceding paragraph. Substantially the same effect afforded by the two-ply crimped sheet illustrated in Figs. 3 and 4 may be obtained by use of a composite corrugated structure of the character illustrated in Fig. 9. In this instance, the composite material comprises a plane sheet 14, to one face of which is adhesively or otherwise attached a corrugated sheet 15. When this blank is crimped on lines 16 extending through the apices of the corrugations of the component sheet 15, a crimped body is obtained corresponding to that illustrated in Fig. 10, it being noted that the mass of material in the one face portion 17 of this body is materially greater than the mass of the material in the other face portion 18. In forming this crimped body into the shape of the hollow cylindrical plug, the portion 18 will con-

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stitute the inner peripheral part of the plug body, and the portion 17 the outer peripheral part.

A highly desirable type of composite material for use in the production of plugs in accordance with the invention is illustrated in Fig. 11. This material is of the conventional corrugated cardboard type, consisting of two plane sheets 19 and 20 which are spaced apart and joined together by an intervening corrugated sheet 21. In this case, the corrugations of the intermediate sheet, preferably, are relatively small as compared with the depth of the folds or crimps in the finished body of the plug. The small corrugations of the intermediate sheet 21 have the faculty of adjusting themselves to the changes of form resulting from the initial crimping of the material and the subsequent shaping of the crimped mass into the form of the hollow cylinder of the plug body, as illustrated in Fig. 12, with the result that the radially expandible wall of the finished plug exhibits a high degree of solidity and freedom from undesirable voids.

As previously set forth, the material of which the body of the plug is produced in accordance with the invention described above may be composed of paper or cardboard. It is apparent, however, that sheet material of any composition or internal structure, which is capable of being shaped to the required crimped or folded form and which has the essential characteristic of flexibility coupled with a degree of moldability, may be used in a practice of the invention. Where non-combustible characteristics are required, the base material may suitably be composed of asbestos. Since the character of construction possesses certain advantages of simplicity, economy, and functional efficiency which at least in part are independent of the materials used, there is no restriction in this respect either real or implied.

As illustrative of a possible modification within the scope of the invention, we have shown in Fig. 13 a plug body composed of molded fibrous material, such as flexible paper or asbestos board. In this case, the molded monolithic wall of the hollow plug body is of corrugated contour, and preferably the corrugations 22 are spirally or otherwise arranged so that they extend longitudinally of the plug at an angle to the longitudinal axis of the latter. These corrugations, as also do the folds or crimps of the previously described embodiments, afford in effect longitudinal reentrant portions in the wall of the body which, by providing for increase in the effective circumferential dimension of the wall, permit the required expansion of the body radially of the longitudinal axis. The molded fibrous material is inherently flexible to permit the corrugations to straighten out under the effect of pressure internally applied through the medium, for example, of an expander element of the general character shown in Figs. 1 and 2. The said fibrous material may be water-bonded, or may be bonded through the medium of any suitable agent, which preferably will be of a non-combustible character or in any event of a character which shall not be productive upon combustion of objectionable fumes or odors. It will be understood that in this embodiment of the invention, as in those previously described, one end of the plug body will be closed or sealed by means of a suitable closure element (not shown) corresponding to the cap illustrated in Fig. 2.

If, in expanding this plug in the bore hole, the corrugations are not completely extended, the

inclination of the remaining voids between the wall of the hole and the plug body to the longitudinal axis of the hole will act in effect as a gas trap and will retain the full effect of the blast in the hole.

We claim:

1. A blasting plug comprising a substantially tubular body composed of flexible sheet material, the wall of said body exhibiting a plurality of pleats extending longitudinally of the body in planes intersecting the inner and outer surfaces of said wall and being formed so as to provide a greater mass of said material in the outer circumferential portion of the wall than in the inner portion, said pleats providing for increase in the effective circumferential dimension of the wall and expansion of said body radially with respect to its longitudinal axis.

2. A blasting plug comprising a substantially tubular body composed of flexible sheet material, the wall of said body exhibiting a plurality of pleats extending longitudinally of the body in planes intersecting the inner and outer surfaces of said wall, certain of said pleats being of relatively great depth radially of said body and being interspersed with others of said pleats of lesser depth, the pleats of lesser depth being confined to the outer circumferential portion of the body so as to provide in that portion a greater mass of said material than in the inner portion, said pleats providing for increase in the effective circumferential dimension of the wall and expansion of said body radially with respect to its longitudinal axis.

3. A blasting plug comprising a substantially tubular body composed of flexible sheet material, the wall of said body exhibiting a plurality of pleats extending longitudinally of the body in planes intersecting the inner and outer surfaces of said wall and providing for increase in the effective circumferential dimension of the wall and expansion of said body radially with respect to its longitudinal axis, the individual pleats having a multiple ply of said sheet material in the portions thereof which are more remote to the axial center of said body.

4. A blasting plug comprising a substantially tubular body composed of flexible sheet material, the wall of said body exhibiting a plurality of pleats extending longitudinally of the body in planes intersecting the inner and outer surfaces of said wall and providing for increase in the effective circumferential dimension of the wall and expansion of said body radially with respect to its longitudinal axis, the individual pleats having a greater number of plies of said sheet material in the portions thereof which are more remote to the axial center of said body than in the portions that are less remote to said center.

5. A blasting plug comprising a substantially tubular body composed of corrugated flexible sheet material, said material being folded so as to provide in the wall of said body a plurality of closely set pleats extending longitudinally of the body and providing for increase in the effective circumferential dimension of the wall and expansion of said body radially with respect to its longitudinal axis.

6. A blasting plug comprising a substantially tubular body composed of flexible sheet material, said material comprising two flat surface webs and an intermediate corrugated web and being folded so as to provide in the wall of said body a plurality of closely set pleats extending longitudinally of the body, said pleats providing for

increase in the effective circumferential dimension of the wall and expansion of said body radially with respect to its longitudinal axis.

7. A blasting plug comprising a substantially tubular body composed of flexible sheet material, the wall of said body exhibiting a plurality of pleats with edges disposed at the inner and outer peripheral surfaces of the wall and extending longitudinally of the tubular bore of the body, said pleats lying substantially flat in face to face relation so as to afford a compact wall of thickness materially in excess of the thickness of said sheet material and providing for increase in the effective circumferential dimension of the wall and expansion of the body radially with respect to the longitudinal axis of the bore.

8. A blasting plug comprising a substantially tubular body composed of flexible sheet material, the wall of said body exhibiting a plurality of pleats with edges disposed at the inner and outer peripheral surfaces of the wall and extending longitudinally of the tubular bore of the body, said pleats providing for increase in the effective circumferential dimension of the wall and expansion of the body radially with respect to the longitudinal axis of said bore, and the longitudinal edges of the pleats being contiguous so as to afford substantially even and continuous inner and outer wall surfaces.

9. A blasting plug comprising a substantially tubular body composed of flexible sheet material, the wall of said body exhibiting a plurality of pleats with edges disposed contiguously at the inner and outer peripheral surfaces of the wall and extending longitudinally of the tubular bore of the body so as to afford inner and outer substantially even and continuous wall surfaces, and said pleats lying individually in planes tangent to a circle concentric with the axis of said bore and providing for increase in the effective circumferential dimension of the wall and expansion of the body radially with respect to the longitudinal axis of said bore.

10. A blasting plug comprising a substantially tubular body composed of flexible sheet material, the wall of said body exhibiting a plurality of pleats with edges disposed at the inner and outer peripheral surfaces of the wall and extending longitudinally of the tubular bore of the body, said pleats lying substantially flat in face to face relation and having their outer longitudinal edge portions of greater thickness than the inner edge portions so as to afford a compact wall having inner and outer substantially even and continuous surfaces and capable of expansion as to the effective circumferential dimension of the wall and radially with respect to the longitudinal axis of said bore.

11. A blasting plug comprising a substantially tubular body composed of flexible sheet material, the wall of said body exhibiting a plurality of pleats with edges disposed at the inner and outer peripheral surfaces of the wall and extending longitudinally of the tubular bore of the body, said pleats lying substantially flat in face to face relation and having their outer longitudinal edge portions of greater thickness than the inner edge portions so as to afford a compact wall having substantially even inner and outer surfaces and of thickness materially in excess of the thickness of said sheet material, and said pleats lying individually in planes tangent to a circle concentric with the axis of said bore.

12. A blasting plug comprising a substantially tubular body composed of flexible sheet material,

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said material being folded so as to provide in the wall of said body a plurality of closely set contracted pleats extending longitudinally of the body and providing for increase in the effective circumferential dimension of the wall and expansion of said body radially with respect to its longitudinal axis, the inner longitudinal edges of said pleats being in contacting relation with each other so as to form a substantially even and continuous surface in the interior of the tubular body.

13. A blasting plug comprising a substantially

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tubular body composed of corrugated flexible sheet material, said material being folded so as to provide in the wall of said body a plurality of closely set contracted pleats extending longitudinally of the body and providing for increase in the effective circumferential dimension of the wall and expansion of said body radially with respect to its longitudinal axis, said pleats lying flatly one against another so as to provide a compact wall formation substantially free from voids.

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