Sept. 4, 1956 L. O. PARKER 2,761,443

MOLDABLE AND READILY REMOVABLE SURGICAL CASTS AND MOLDS

Filed Oct. 30, 1951 3 Sheets-Sheet 1

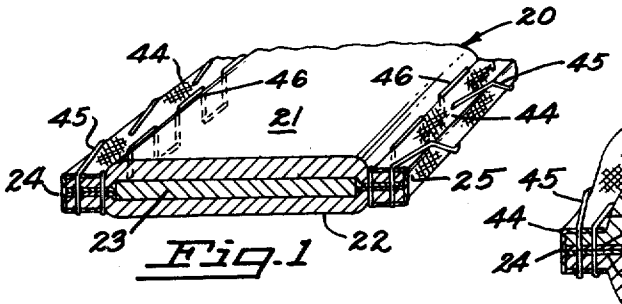


Fig. 1

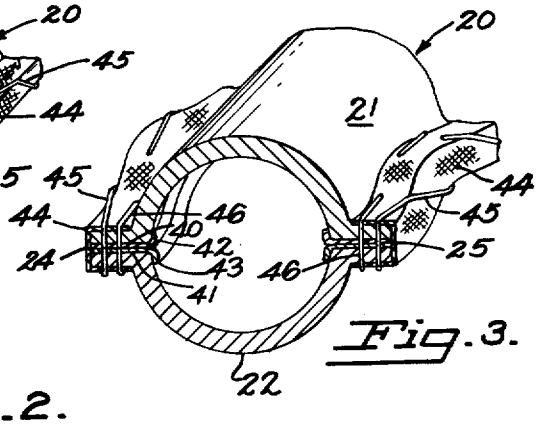


Fig. 3.

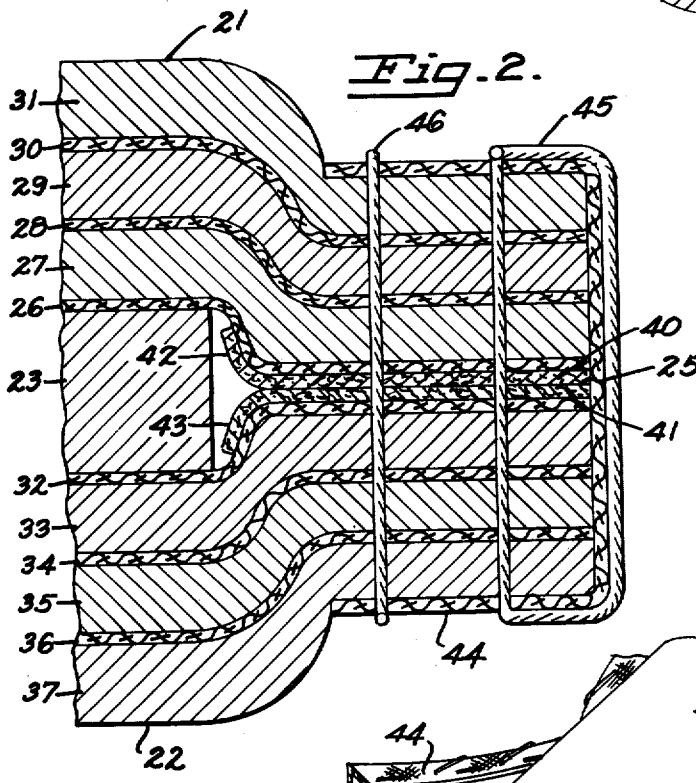


Fig. 2.

Fig. 4.

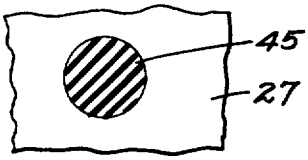
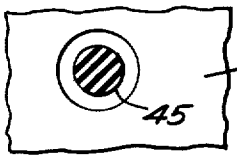


Fig. 5.



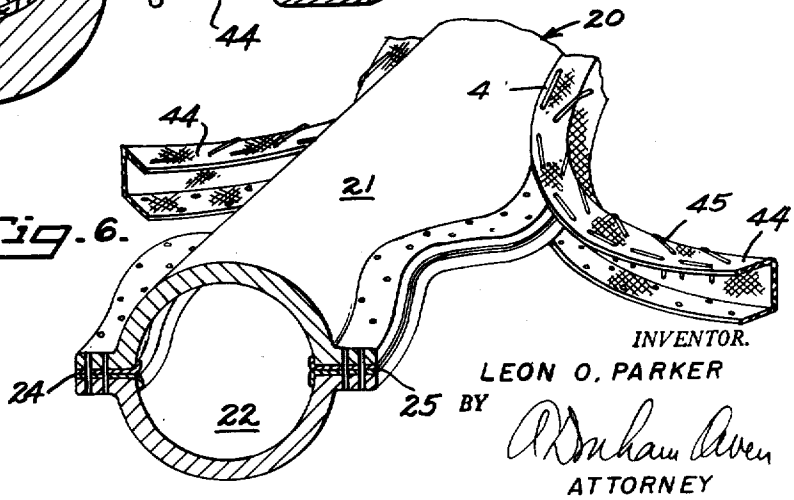


Fig. 6.

INVENTOR.
LEON O. PARKER
BY
ATTORNEY

MOLDABLE AND READILY REMOVABLE SURGICAL CASTS AND MOLDS

Filed Oct. 30, 1951 3 Sheets-Sheet 2

Fig. 7.

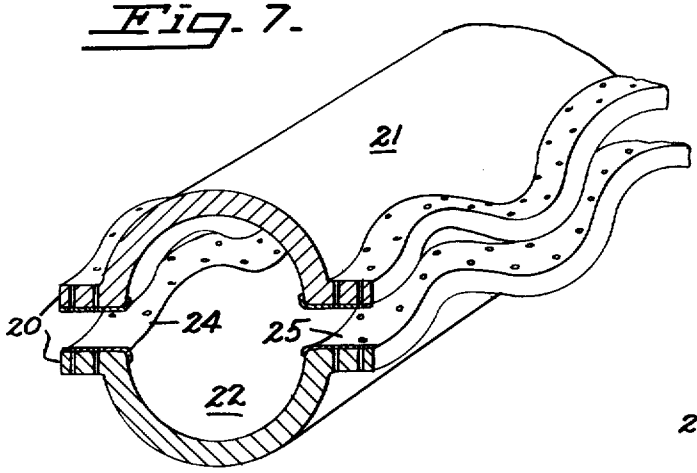


Fig. 8.

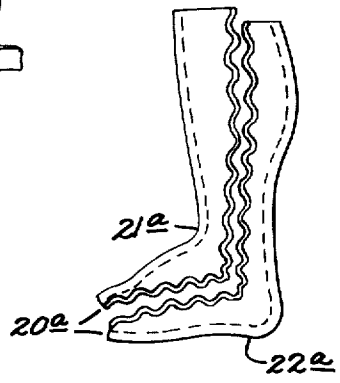


Fig. 9.

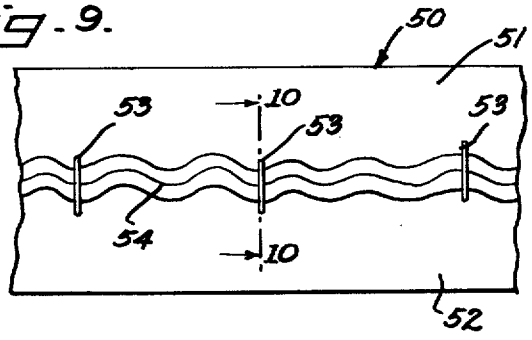


Fig. 10.

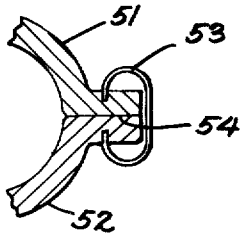


Fig. 12.

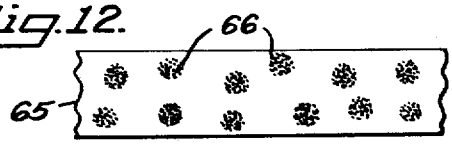
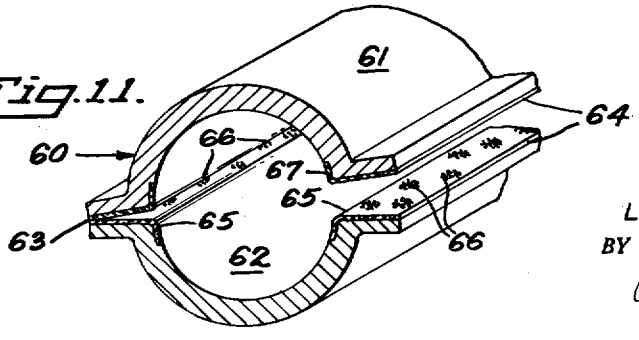


Fig. 11.



INVENTOR.
LEON O. PARKER
BY
A. Dunlaw Owen
ATTORNEY

Sept. 4, 1956 L. O. PARKER 2,761,443

MOLDABLE AND READILY REMOVABLE SURGICAL CASTS AND MOLDS

Filed Oct. 30, 1951 3 Sheets-Sheet 3

Fig. 13.

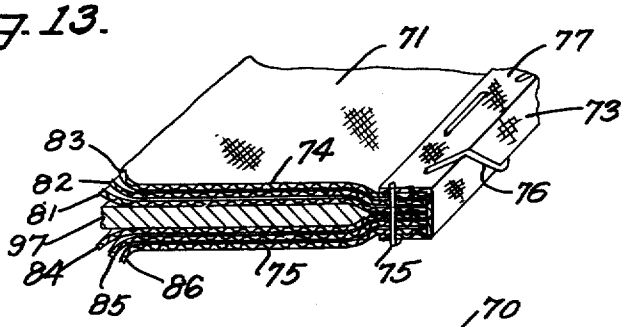


Fig. 14.

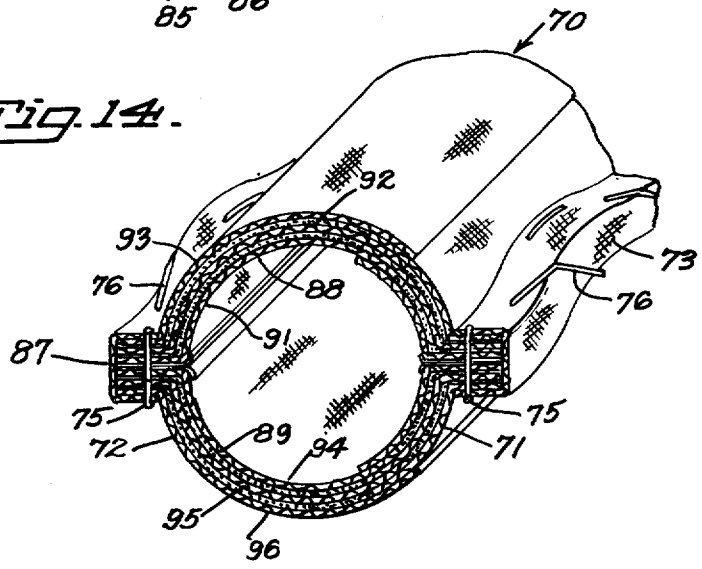
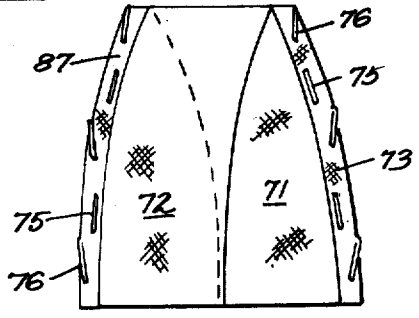


Fig. 15.



INVENTOR.
LEON O. PARKER
BY
A. Durham Owen
ATTORNEY

United States Patent Office 2,761,443 Patented Sept. 4, 1956

2,761,443

MOLDABLE AND READILY REMOVABLE SURGICAL CASTS AND MOLDS

Leon O. Parker, San Francisco, Calif., assignor to San Francisco Research Corporation, San Francisco, Calif., a corporation of California

Application October 30, 1951, Serial No. 253,829

17 Claims. (Cl. 128—91)

This invention relates to improvements in prefabricated casts and molds. More particularly it relates to a seamed or jointed cast or mold which is easily put on and removed from patients or models and which may be reassembled after removal.

The removal of casts and molds from the human body has long been a serious problem. The conventional method of cutting them open by plaster-cutting instruments was arduous and time-consuming. In a large percentage of surgical cases, the patients suffered considerable mental anguish during cast removal, and in many cases, there was actual physical injury, such as tearing or cutting the patient's skin.

My invention solves this problem and others by providing a cast having a preformed seam or joint that may easily be opened when the cast is to be removed. Moreover, the opened cast may be rejoined on or off the patient or model; when rejoined on the patient, the cast may perform its original functions; when rejoined off the patient, it may be used as a mold for reproducing the part of the body around which it was formed.

In my invention the seam is made directly in the plaster-of-Paris or other mold-forming material, so that the cast is as rigid along the seam or joint as elsewhere. My seamed and jointed casts are therefore completely different from casts like those exemplified by the Gillin patent, No. 2,103,942, where the seam is formed in a fabric member that underlies the cast and where the seam is not covered with plaster made from two components that fit together. In such prior art structures, the seam was a weak, unclosed portion of the cast; moreover, such prior art casts cannot be used where the cast must be completely rigid at all points. Neither can these prior art casts be fitted back together off the patient for use as a mold. In my cast, the seam or joint is rigid, tight, and interlocking, though severable, because it is part of the cast and not merely part of a fabric base.

Other advantages and additional features of my invention will appear from the following description of several preferred embodiments. It is not, however, intended to limit the invention narrowly to the illustrative examples, the scope of the invention being defined by the appended claims.

In the drawings:

Fig. 1 is a view in perspective and in section of a portion of a seamed prefabricated tubular cast embodying the principles of the invention, the seam in this instance being held together by threads.

Fig. 2 is an enlarged fragmentary view in elevation and in section of a portion of Fig. 1, taken in the vicinity of one seam.

Fig. 3 is a view similar to Fig. 1 of the same cast after it has been formed into a tube so that it may be put around a limb. The seam has been formed into a zig-zag pattern.

Fig. 4 is an enlarged view in section of a portion of the cast of Figs. 1–3, showing an elastic type of thread in the plaster at the seam, as it appears at the time the

cast is applied and when the cast has set, but before the seam is to be opened.

Fig. 5 is a view similar to Fig. 4 showing the thread at the time of removal, at which time it has been cut and stretched lengthwise, with the result that it has contracted in diameter and broken loose from the plaster.

Fig. 6 is a view in perspective showing the cast of Fig. 3 in the process of being opened. The threads have been cut, and the outer facing pulled to one side, carrying the broken threads with it.

Fig. 7 is a view similar to Fig. 6 showing the cast after it has been opened at the seams and pulled apart.

Fig. 8 is a view in elevation of a complete leg cast made like the cast of Fig. 3, with the seams opened and the two sections held apart.

Fig. 9 is a view in side elevation of a modified form of cast, in which a joint is held together by a series of metal rings.

Fig. 10 is a fragmentary view in section taken along the line **10—10** in Fig. 9.

Fig. 11 is a view in perspective and in section of another modified form of cast, in which the joint is held together by a series of discrete particles of glue. The cast is shown with the joints opened.

Fig. 12 is a plan view looking down on one half of one joint, showing how the glue may be distributed thereon.

Fig. 13 is a view in perspective of a modified form of prefabricated cast section which is adapted for combination with another like section.

Fig. 14 is a view in perspective of a tubular cast formed from two sections like the one in Fig. 13.

Fig. 15 is a plan view of the cast of Fig. 14 showing how the cast may be made to fit a limb.

The preferred cast of this invention may be built up in the manner described in my copending application, Serial Number 248,065, filed September 24, 1951, and refiled as Serial Number 325,001, filed December 9, 1952, although this is not absolutely necessary. An example of a suitable structure is shown in Figs. 1 and 2. The prefabricated seamed cast **20**, a portion of which is shown in Fig. 1, is made up of two generally flat cast members **21** and **22**, positioned around a central board or stiffening member **23**, and seamed along both outer edges at **24** and **25**.

As Fig. 2 shows, the upper member **21** may have an inner lining **26** made from fabric. Preferably the fabric **26** is of a type which, when stretched in length, loses in width, and when stretched in width, loses in length. Over the layer **26**, and partially impregnated into it, there may be a layer **27** of plaster-of-Paris or other mold-forming material. Over the layer **27** there may be a second fabric member **28**, also preferably stretchable, over which is a second layer **29** of plaster-of-Paris or other mold-forming material. There may also be a third layer **30** of fabric and a third layer **31** of the mold-forming material. The cast member **22** may be similarly made with fabric layers **32**, **34**, and **36** and plaster layers **33**, **35**, and **37**.

Along the edges that are to be seamed, the cast section **21** may have a layer **40** of crepe paper or of some other separating material, preferably stretchable, which will serve to keep the plaster from joining to itself at the seams **24**, **25**. The section **22** may have a similar layer **41**. The layers **40**, **41** separate the plaster that might seep through the fabric members **26**, **32** and prevents the mold-forming material from joining and crystallizing across the seams **24**, **25**. If the cast were to join at the seams, it could be opened only by cutting instruments, and the purpose of this invention would be defeated.

Crepe paper is suitable material for the separating members **40**, **41**. It does not prevent the seams **24**, **25** from fitting together, and it will stretch and conform

to the desired shape of the cast **20** and its seams. At the same time, crepe paper prevents the plaster-of-Paris or other mold-forming material from joining across the seams by crystallization or adhesion. In place of crepe paper, finely divided separating materials such as paper pulp, shreadded cellulose, or rags or glass cloth fiber or wool or rubber particles may be used. If desired, these separating materials may be placed in between nets which are fitted in the prospective seams. Or there may be a layer of these particles just under the inner net in the vicinity of the seam.

It is sometimes desirable to line the cast with padding additionally in the vicinity of the inner part of the seams. The padding or lining may be a continuation of the separating members **40**, **41** as shown in the portions **42**, **43** in Fig. 2. Such padding **42**, **43** prevents the cast **20** from pinching the patient's body along the seams and makes the cast more comfortable.

Around the outside of the seams **24**, **25** there is preferably an outer facing **44** of suitable fabric, which aids the sewing of the seams **24**, **25** and also aids in removing the threads, as shown in Fig. 6. When knit fabric or a net on the bias is used for the facing **44**, the stretchability of the seam will be maintained, provided that its other elements are stretchable. After the facing **44** is in place, the seams **24**, **25** may be sewed together. One suitable stitching arrangement is shown in the drawings, where two pairs of elastic threads **45**, **46** are used on each seam. The thread **45** may be sewn in a whip-over stitch. The whip-over stitch **45** being inserted from the same side each time so that it comes out the opposite side and is carried around the seam. The thread **46** is sewn in the machine type, in-and-out, through-and-through stitch; the thread **46** goes through both cast sections **21**, **22** from one side to the other, then down the outside of the facing **44** for a short distance and then back through the cast sections **22**, **21**, then for a short distance down the outside of the facing **44** on the other side of the seam, and so on.

At the time of application, the cast-forming unit **20** may be moistened and the water worked into the plaster. Then the center board **23** may be removed, and the cast-forming unit **20** opened as shown in Fig. 3 so that it can go around a body member, such as an arm or a leg. The cast-forming unit may, when made from the proper materials, be stretched out in diameter so that it will go around the widest portion of the body member. Later the cast-forming unit may be pulled in the opposite direction to constrict it in diameter and to conform its circumference to the body member. When the seam is wet, the tension exerted by the whip-over stitch **45** will cause the seams or joints **24**, **25** to undulate or zigzag, as shown in Fig. 3. When the cast sets, the undulation will look similar to that shown in Fig. 8, except that the sections will be secured together.

The use of the elastic threads **45** and **46** makes removal of the cast relatively simple. As shown in Fig. 4, the elastic thread **45** will, when applied, lie next to the plaster and there will be no space between them. However, as shown in Fig. 5, when the elastic thread **45** is stretched out in length, it contracts in diameter and pulls away from the plaster so that it can be taken out. The thread **46** acts in the same manner. Ordinary threads would stick to the plaster and would break when pulled; whereas elastic threads pull free by virtue of their contraction in diameter. Moreover, the use of elastic threads **45**, **46** in conjunction with a stretchable facing **44**, a stretchable layer **25**, and stretchable cast bodies **21**, **22**, makes possible a seam that will stretch as may be needed at the time of application.

Fig. 6 illustrates how simply the cast of Figs. 1–3 may be removed. When the threads **45**, **46** have been cut along the outside of the seams **24**, **25**, the facing **44** is pulled off, and it carries with it most, if not all, of the broken elastic threads **45**, **46**. Any remaining threads may be pulled out separately. Then the cast sections **21**, **22** may be lifted apart, as shown in Fig. 7.

In Fig. 8 a leg cast **20***a* has been partially disassembled, the two sections **21***a* and **22***a* having been lifted apart. This figure shows how the zigzag pattern of the seams makes it possible to rejoin the cast on or off the patient. For example, a dressing on the patient may be changed and then the old cast put back on instead of putting on a new cast. Or, the cast may be rejoined off the patient to serve as a mold for the part of the body around which it was formed. This kind of seam may be used in casts or molds for any part of the body or for all of the body or for any other type of mold.

In place of the elastic threads **45**, **46**, it is also possible to make threads from a material that is soluble in a liquid that does not dissolve the mold-forming material. For example, where the cast is plaster-of-Paris, acetone-soluble rayon threads may be used. When the cast is to be separated, acetone may be poured on the seams, and the threads will disintegrate. Then the seams may be pulled apart.

Figs. 9 and 10 show a modified form of seam or joint which may be prefabricated with a prepared cast or may be formed at the time the cast is applied. The cast **50** is composed of two sections **51** and **52** which are held together by metal clamps, such as pig rings **53** (of the type used in pigs' noses), that go through a portion of and substantially encircle the joint and hold the cast portions **51**, **52** together without interfering with the stretchability or compressibility of the cast when it is wet. The pig rings **53** may be inserted in place before the cast sections are wetted or after they have been moistened. Preferbly, the jointure edges **54** are worked when the cast is put on, to form serrations as shown in Fig. 9, so that the cast **50** may be rejoined more easily after it has been taken apart.

After the cast **50** has set, the pig rings **53** may be removed with pliers, and the cast **50** may then be lifted apart. When the cast **50** is to be rejoined, the pig rings **53** may be put back in place. Instead of pig rings, bolts or a simple wire loop may be used instead. Also, such rings, bolts, or loops may be used as reinforcements in conjunction with the other types of joints or seams.

Figs. 11 and 12 show another modified form of the invention in which the joint is held together by glue. The cast **60** comprising the sections **61** and **62** is joined together at **63** and **64**. Again there may be a separate strip **65** or other built-in component that prevents the cast sections from joining across the seams by crystallization. On the strip **65** a number of discrete particles **66** of glue or cement may be applied. An opposing strip **67** may be similarly treated or all the glue may be applied to one separating strip. In a prefabricated joint or seam, the sections **61**, **62** may be glued together before the cast **60** is to be applied, or the glue is put on at another time. Since the glue is applied in discrete spots **66**, the joints **63**, **64** may be stretched with the cast **60** as it is put on.

With plaster-of-Paris casts, the glue is preferably not water soluble. Cellulose acetate, which is soluble in acetone, may be used, as may other glues that are soluble in solvents that do not affect the skin of the patient. Where plastics are used as mold-forming material, and where the cast is not affected by water, then the glue may be water soluble. In either event, the joint **63**, **64** may be separated by applying the proper solvent along edges of the joint, permitting the solvent to soak in, and then lifting the two sections **61**, **62** apart as shown in Fig. 11. The joint may be refastened by using more glue or cement, or otherwise.

In all the above forms of the invention, the seams or joints obviate the use of the cast cutting instruments. In the case of a cast, the joint may be opened and the cast temporarily removed for X-ray examination, or some other examination or treatment, and may then be re-applied. In the cast of a mold, as soon as the mold has

been applied and has set, the joint may be opened and the mold removed. Then the mold may be put together and a reproduction of the body part poured.

These prefabricated casts are applicable to parts or all of the human body. The joints may be placed anywhere they are needed: on the sides, the front, the back, or wherever desired, including any combination of places. A joint may pass around the circumference of the cast and separate it into two generally tubular parts. There may also be a joint or seam around a window in the cast, so that the window can be taken out and replaced for treatment or examination.

The joint may be located on one side of the cast at right angles to the longitudinal axis of the cast. A joint that runs around the cast may be used for the purpose of changing the angle of the cast, to accomplish results similar to those obtained by cutting a cast open for a portion or all of the way around it and inserting a wedge in one side. The joint itself may be straight, curved, or zigzagged, the zigzagged joint tending to give additional strength and making it easier to hold the parts and to fit the cast together again. The joint may be normal or oblique to the surface of the cast, or it may be any combination of angles. By using alternate bevels in the cast, an interlocking effect may be obtained that strengthens the joint before it is separated and also makes it easier to put the cast back together again.

Figs. 13 and 14 show how a practical seamed prefabricated cast may be made from a non-elastic, non-stretchable fabric. In this instance the cast **70** (Fig. 14) has been built from two similar or identical components **71** and **72** that originally appear as in Fig. 13. The component **71**, shown there, is made with a seam **73** that joins two sections **74** and **75**. The seam **73** may be held by elastic threads **75** and **76** that are sewed through and around a facing **77**, in a manner similar to that described in the discussion about Figs. 1–6.

The section **74** may have one or more bases or skeletons, each made from a rigid, woven fabric. In this case three layers **81**, **82**, and **83** are shown. The section **75** has three corresponding layers **84**, **85**, and **86**. Between adjacent layers there is plastic, or other mold-forming material, except at the edge which appears at the left of Fig. 13. There the fabric is left free.

The cast component **72** is like the component **71** in every way. It has a seam **87** where the sections **88** and **89** are held together by elastic thread. The section **88** has three layers **91**, **92**, and **93** of fabric that may be of a woven, rigid type, and the section **89** has corresponding fabric layers **94**, **95**, **96**.

In application, the components **71** and **72** are mositened and worked in the usual manner. Then they may be removed from the stiffening cardboard layer **97** and placed around a limb or other body part. They are joined along their open edges by lapping the fabric layers. Although made of rigid fabric, the cast **70** may be adjusted to the size of the limb by varying the degree of overlap. The layers **91**, **92**, and **93** interlock with the layers **81**, **82**, **83**, and the layers **94**, **95**, **96** interlock with the layers **84**, **85**, **86**. The plaster at these regions may be worked together after the correct amount of overlap is obtained, and the cast **70** may be joined firmly together at these points by two permanent seams.

Meanwhile, the seams **73** and **87** may be undulated somewhat, if desired. When the cast sets the seams **73** and **87** perform the same functions as the seams previously described in connection with Figs. 1–8.

This example shows how rigid fabric materials may be used in conjunction with a prefabricated seamed cast. However, these other variations are possible. For example, portions appearing somewhat like the member **71** in Fig. 13 may be prefabricated with the free edges adapted to go in casts or molds that are made up at the time the casts or molds are applied.

I claim:

1. A prefabricated cast-forming unit having a separable joint and including in combination two cast-forming portions, which upon the addition only of fluid become workable during a period before setting in a rigid form; releasable means along said joint, securing said portions together, said means being in place before, during, and after application of the cast and to be released only after application, for allowing parting of said portions; and means between said portions at said joint to prevent slurry from striking across said joint, thereby preventing permanent locking of the joint by the cast-forming material.

2. The unit of claim 1 in which the last-named means is substantially impermeable to a suspension and a slurry of the cast-forming material in the liquid used in making the unit workable and is also stretchable so that it is greatly extendible.

3. The unit of claim 2 in which said last-named means is crepe paper.

4. The unit of claim 2 in which said last-named means comprises a stretchable cloth carrier supporting a mass of discrete particles.

5. The unit of claim 2 in which said releasable means comprises an elastic thread sewn through said two portions.

6. The unit of claim 5 in which there is a cloth facing of stretchable fabric around the joint, on the edge of said portions and on the outside of both said portions near their edge, said elastic thread passing therethrough.

7. The unit of claim 1 in which said releasable means comprises a thread soluble in a solvent that does not adversely affect the cast-forming material.

8. The unit of claim 1 in which said releasable means comprises a glue joining a pair of separating means, the latter comprising the last-named means in claim 1 and lying between said portions, said glue being soluble in a solvent that does not adversely affect the cast-forming material.

9. The unit of claim 1 in which said releasable means comprises a plurality of separate clamping means.

10. The unit of claim 1 in which said cast-forming portions and the last-named means in that claim are stretchable in the sense of being extendible in one dimension at the expense of contraction in the other dimension, whereby the unit can be conformed to an irregular body during the workable period before setting.

11. A prefabricated seamed tubular cast, including in combination two mating prefabricated, generally-flattened cast portions, each comprising alternate layers of fabric that is stretchable for substantial extension and contraction along its major dimensions and cast forming material; a removable stiffening and separating member between said cast portions; a non-removable, stretchable, separating member adjacent the edges of said cast portions where their surfaces abut, to prevent them from joining by crystallization when they are moistened; and means securing said cast portions together along the said edges, said securing means being removable to enable opening of the cast at a seam along each said edge, without destroying said cast or cutting through its body, said cast being preassembled as described before application and requiring only moistening to ready it for application.

12. A prefabricated seamed cast, including in combination: two cast-forming portions incorporating a material which, upon the application of liquid, first becomes pliable and later sets by crystallization each having inner and outer faces and meeting along at least one edge, said cast portions being out-turned at said edge so that their inner faces face each other, said out-turned portions being provided with a separating member that prevents the two cast-forming portions from joining together permanently when the cast is moistened and set; and seaming means holding said out-turned portions together, said seaming means being removable from the rest of the cast after application

so that the cast-forming portions may then be separable along said edge.

13. A prefabricated seamed tubular cast, including in combination: a tube formed by two flat cast-forming portions incorporating a material which, upon the application of liquid, first becomes pliable and later sets each having inner and outer faces out-turned at their longitudinal edges so that their inner faces face each other, the cast-forming material of said out-turned portions being prevented from joining together when the cast is moistened by a separating member incorporated thereat; and threads sewed through said out-turned portions and forming there a lengthwise seam holding said two cast portions together, said threads being removable from the rest of the cast after application so that the cast-forming portions may then be separable along said edge.

14. A prefabricated seamed tubular cast-forming unit, including in combination: two generally flat cast-forming portions each comprising plaster-of-Paris and a stretchy skeleton of reinforcing material, so that said cast is distortable in length and width when the plaster-of-Paris is wet for application, said flat portions lying over one another, so that their facing surfaces comprise the inner surface of the tubular cast; first separating means narrower than said portions interposed between them except at the lengthwise edges, said first separating means being removable when the cast is prepared for application and serving during the moistening operation to hold the portions apart so that the cast is then a flattened tube; second separating means permanently disposed between the facing surfaces at the edge to prevent the two cast-forming portions from joining together permanently when the cast is moistened and set; and seaming means temporarily holding only the portions separated by said second means so as to make a unitary article during moistening and application, said seaming means being removable from the rest of the cast after the cast has set so that the cast-forming portions may then be separated along said edges.

15. A prefabricated seamed cast, including in combination: two cast-forming portions each having inner and outer faces, with the inner faces meeting along at least one edge to form an out-turned seam area, said portions incorporating a material which, upon the application of liquid, first becomes moldable and then sets permanently; a separating member between the cast-forming material in the two portions at said seam area, so as to prevent the two cast-forming portions from joining together permanently at the seam when the cast is moistened and set; and elastic threads sewn through said seam so as to hold the abutting cast portions together at said seam, said threads being removable from the rest of the cast after application by cutting them and pulling them out, so that the cast-forming portions may then be separated along said seam.

16. In a cast- and mold-forming unit having a suitable settable material, including in combination at least one cast-forming element having certain portions normally held together in a prefabricated configuration by a releasable means extending lengthwise thereof, said releasable means and said certain portions defining a separable joint, and separating means interposed in said separable joint preventing striking of the material across said joint during the setting thereof.

17. The unit of claim 16 in which said element and said separating means are stretchable, in the sense of being extendible in a substantial amount in one dimension at the expense of contraction in the dimension substantially perpendicular thereto, for conforming said unit about an irregularly shaped body.

References Cited in the file of this patent

UNITED STATES PATENTS

800,467	Myers	Sept. 26, 1905
1,532,432	Morse	Apr. 7, 1925
1,556,802	Page	Oct. 13, 1925
1,640,586	Tusup	Aug. 30, 1927
2,267,817	Costa	Dec. 30, 1941
2,512,081	Young	June 20, 1950