United States Patent [19]

Keeham

[11] **3,843,759**

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[54] **METHOD FOR PRODUCING A REINFORCED RESINOUS HOUSING**

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[52] **U.S. Cl.** **264/135,** 264/137, 264/229, 264/231

[51] **Int. Cl.** **B29d 3/02**

[58] **Field of Search** 264/229, 231, 135, 136, 264/137; 156/172, 160

[56] **References Cited**

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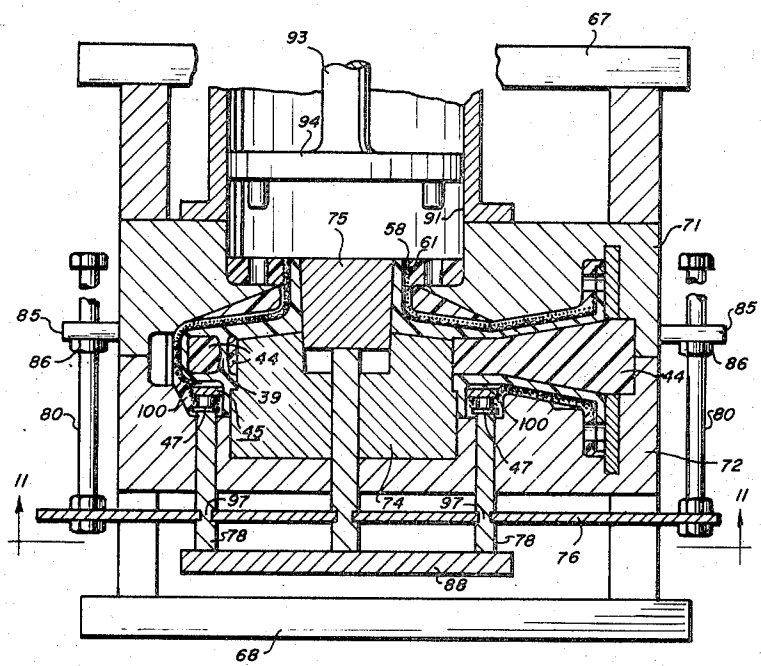
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Primary Examiner—Richard R. Kucia
Attorney, Agent, or Firm—Woodling, Krost, Granger & Rust

[57] **ABSTRACT**

The present invention discloses a method of making a reinforced, cured, resinous housing such as a pump housing which has high strength and a high resistance to corrosive and errosive fluids. The method includes the steps of forming an initial housing from a synthetic resin which has an internal portion which is essentially in its finished form and which will be subjected to the action of fluids, and an exterior, with the exterior of the initial housing being in unfinished form. A tensioning member is movably located adjacent or contiguous the exterior of the initial housing and has wall means for receiving and securing portions of an elongated reinforcing member. The elongated reinforcing member is wrapped about the exterior of the initial housing to cover at least a portion thereof and separated portions of the reinforcing member are secured to the wall means of the tensioning member. Thereafter, a force is exerted on the tensioning member to move the same relative to the initial housing to tension the wrapped reinforcing member and after this is accomplished, the wrapped reinforcing member is covered with a resin to finish the exterior of the housing. The resins which are capable of use in the method are quite varied and may be either thermosetting of thermplastic in nature. It has been found in the practice of the present invention that an epoxy resin system works extremely well.

19 Claims, 13 Drawing Figures



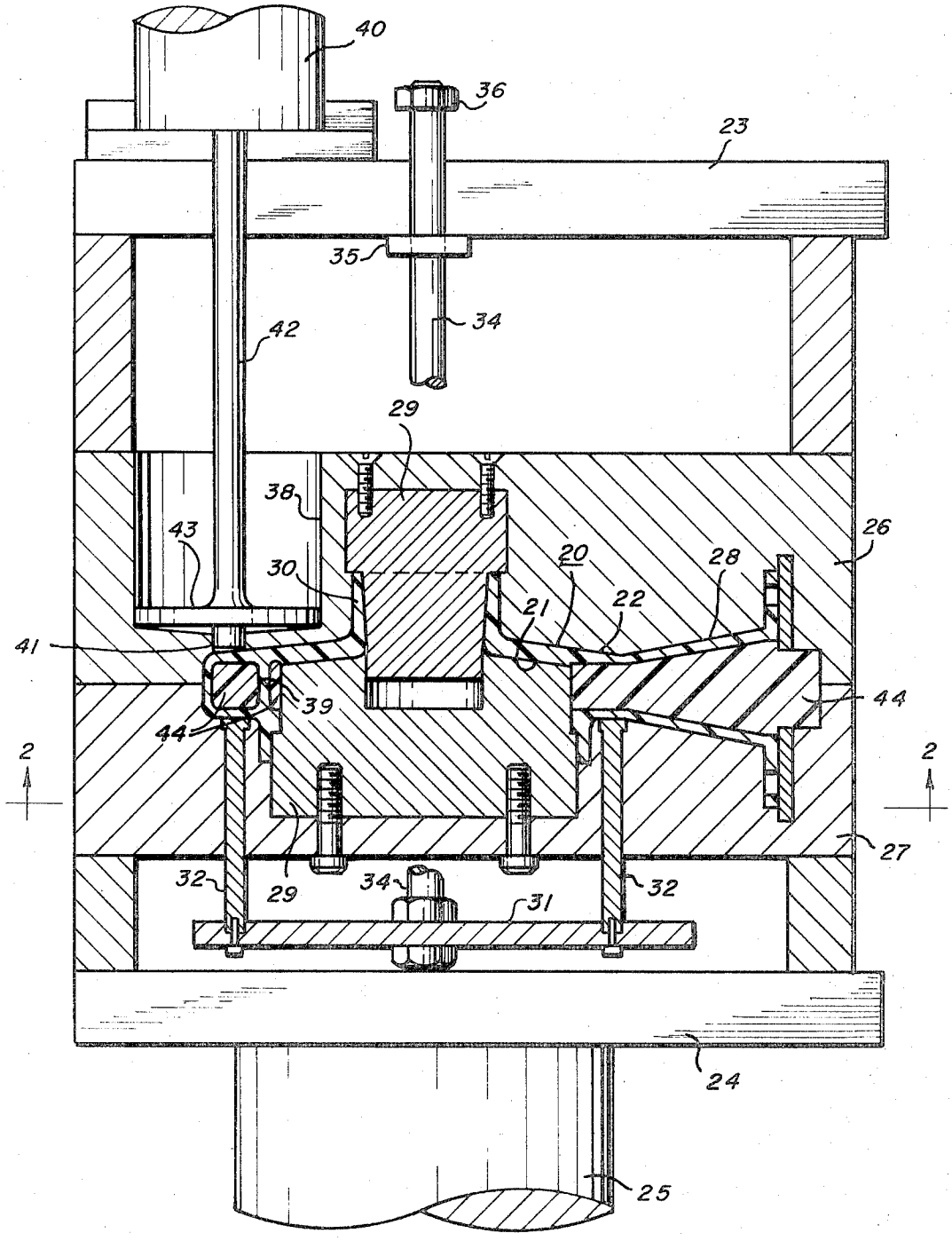
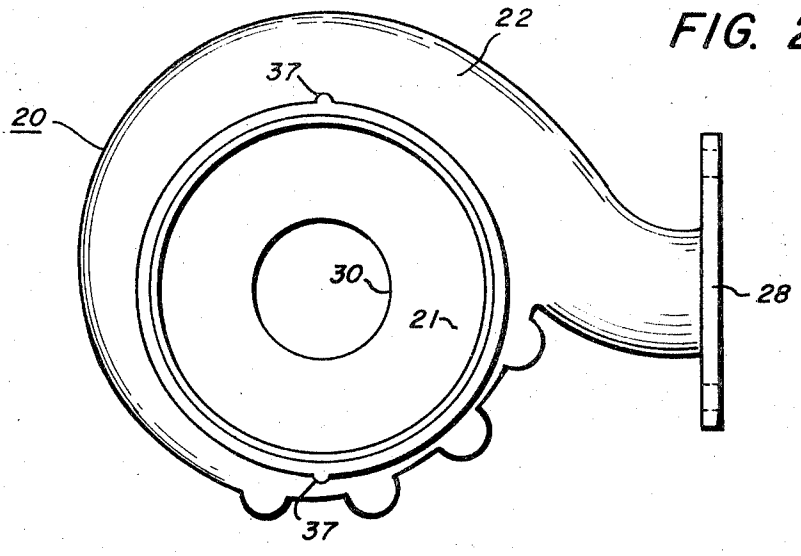


FIG. 1

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FIG. 2



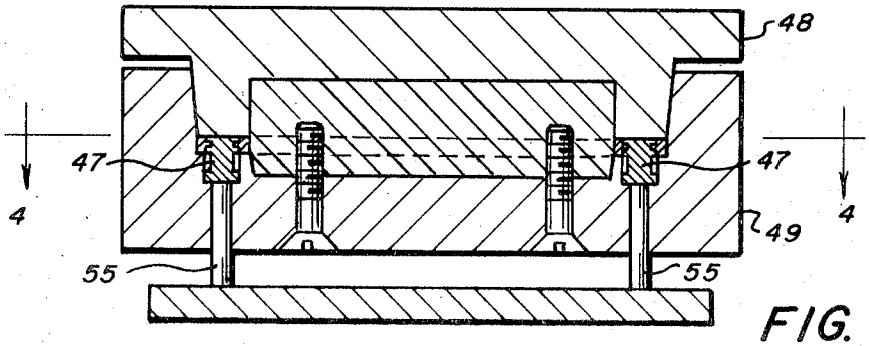


FIG. 3

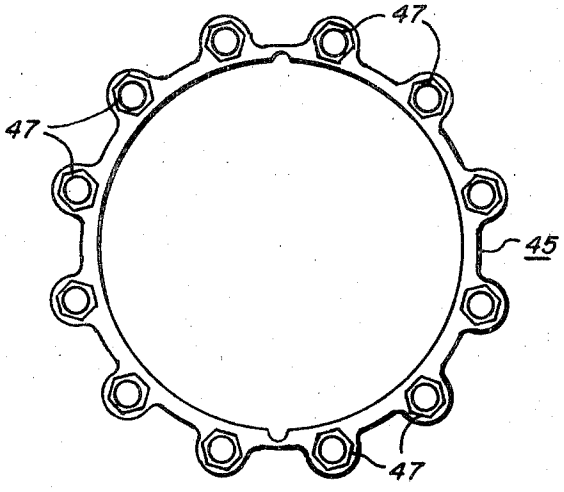


FIG. 5

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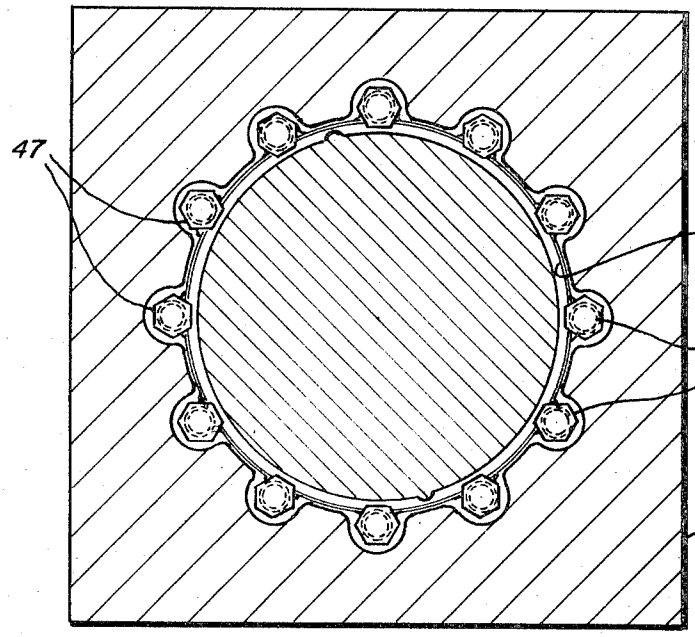


FIG. 4

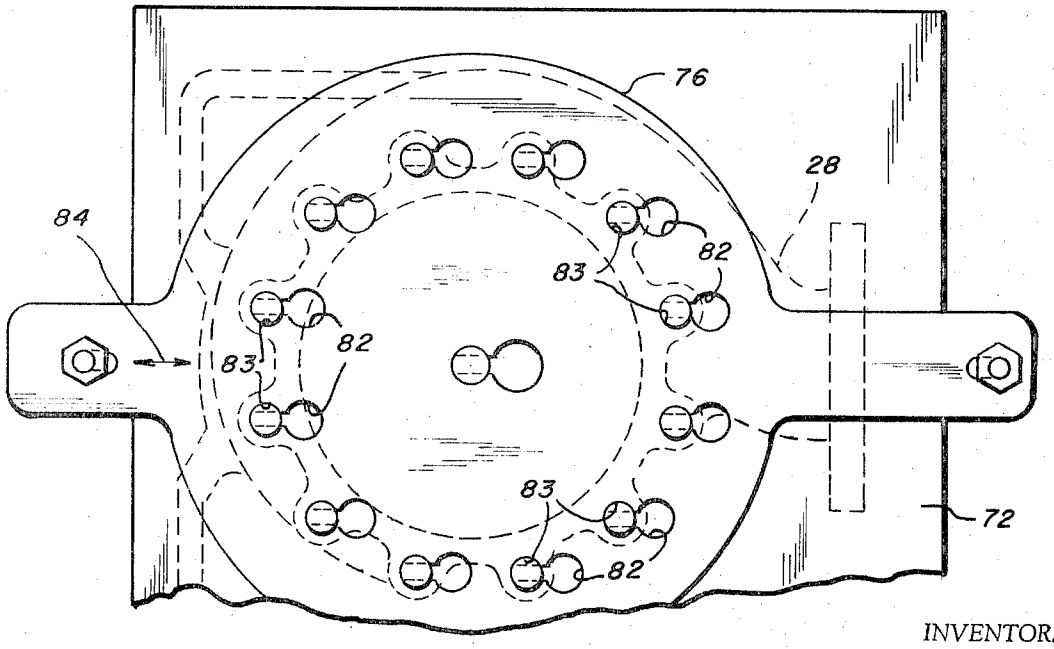


FIG. 11

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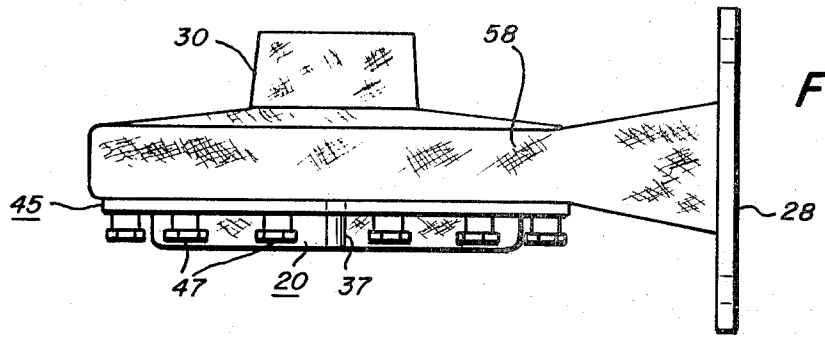


FIG. 6

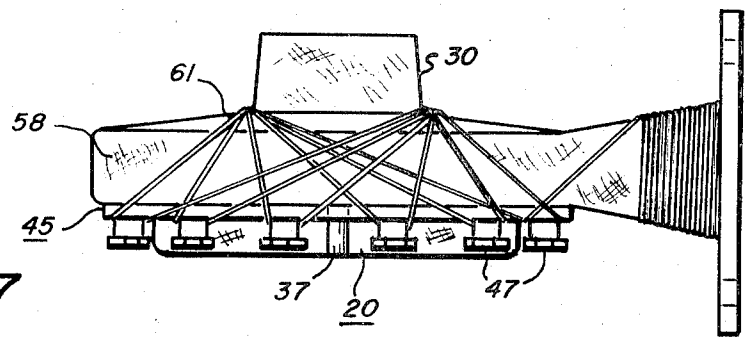


FIG. 7

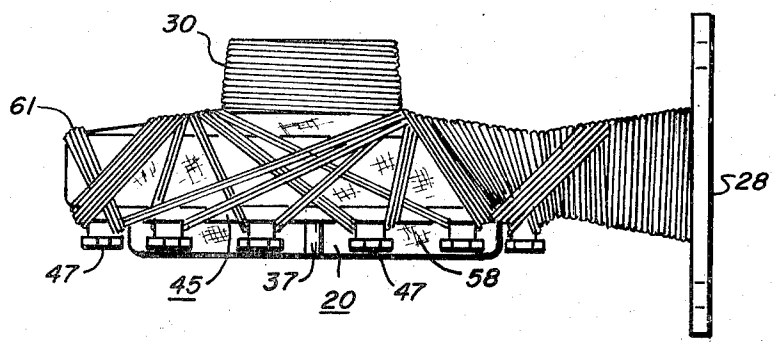


FIG. 8

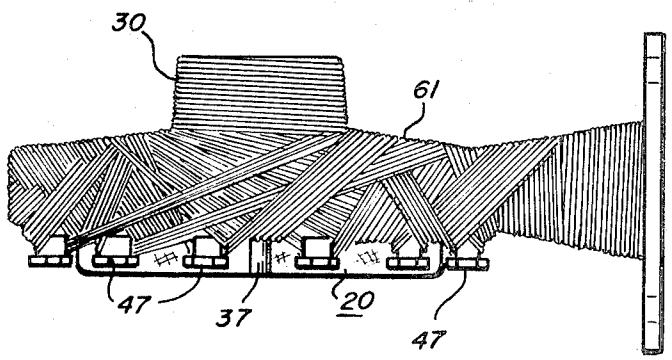


FIG. 9

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FIG. 10

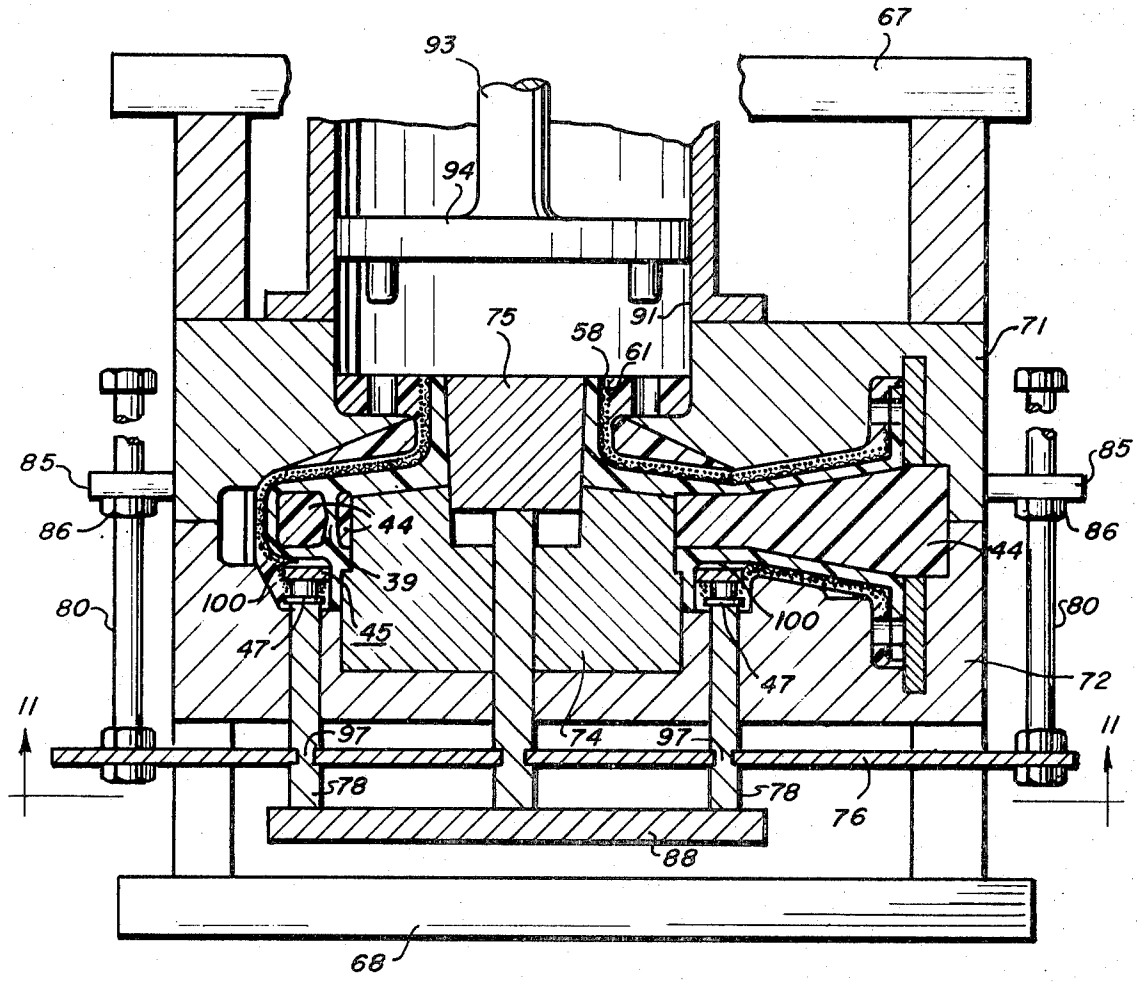
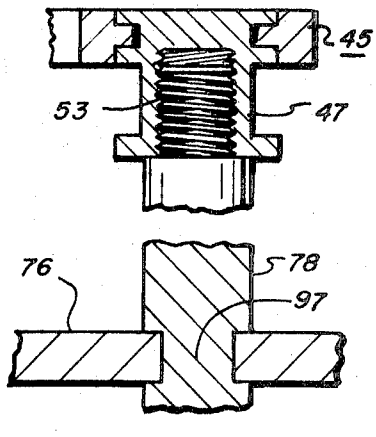


FIG. 12



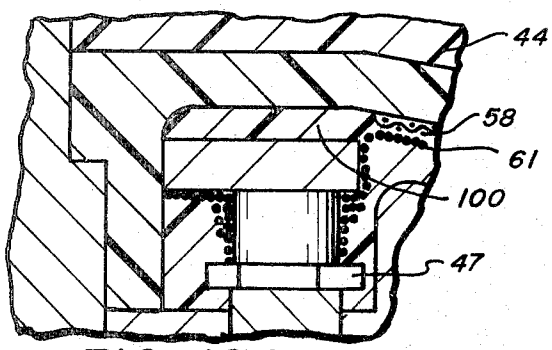


FIG. 10A

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METHOD FOR PRODUCING A REINFORCED RESINOUS HOUSING

The method outlined above produces a finished reinforced resinous housing which comprises an initial resinous housing having an internal surface and having an exterior surface. The finished product includes a tensioning member adjacent the initial housing which has wall means and an elongated reinforcing member wrapped about the exterior surface of the initial housing with spaced portions secured by the wall means of the tensioning member. Means are provided which urge the tensioning member relative to the initial housing to maintain a constant tension on the wrapped elongated reinforcing member and a resinous covering is located over the wrapped reinforcing member to secure the same in position and complete the exterior surface of the housing.

The apparatus of the present invention is for the purpose of completing the finished housing after the elongated reinforcing member has been wrapped about the initial housing and includes in combination upper and lower mold parts which form a cavity which has the shape of the finished housing and into which the reinforcing member wrapped initial housing is placed. Ram means are provided in the apparatus for forcing a resinous material into the cavity. A plurality of openings extend into the cavity, preferably through the lower mold part and tensioning pins reside in these openings and at the cavity ends of these pins they are secured respectively to portions of the tensioning member and at their other ends extend exteriorly of the lower mold part. Means are provided for securing all of the tensioning pins together at their ends exterior of the lower mold part and means are then provided for exerting a force on the means which secure the ends of the tensioning pins together to pull the tensioning pins in a direction, which direction is outwardly of the cavity. This serves to move the tensioning member and apply a consistent tension to the wrapped elongated reinforcing member. In the preferred embodiment this tensioning force is exerted as a function of the closing of the mold parts.

The present invention which will be discussed in detail hereinafter relates generally to a reinforced housing or other structure which is in substance constructed of a hardenable or curable synthetic resin material either of the thermosetting or thermoplastic type. The invention is particularly adaptable for use in producing shapes which are irregular or in other words which do not follow a definite geometric form. In order to illustrate the unique advantages of the present invention, it will be described in conjunction with a centrifugal pump housing, however, it will be readily appreciated by those skilled in the art that the present invention is susceptible of much broader application and to this end it might be pointed out (for the sake of example) it is equally susceptible of use in the production of reinforced housings for valves, which are constructed essentially of hardenable synthetic resin materials.

With the above in mind, it may be said in the pump art, it is the custom that pumps be constructed from a metal because of the unique strength advantages which are realized from practically all metals. One of the considerable disadvantages of metal pumps is evident when the metals are subjected, primarily in the chemical industry, to the highly corrosive and errosive nature of many chemicals, for example, acids and alkalis. Pump

manufacturers have attempted to combat these particular problems by constructing the metal pumps of highly sophisticated and expensive combinations of metals, and have in some instances attempted to coat the surfaces of the pumps which are to be subjected to the fluids with non-corroding materials, for example rubbers. In some instances attempts have been made to construct pumps of non-corroding synthetic resinous materials. While the constructions which have included the synthetic resinous materials have been highly advantageous from the standpoint of attack by corrosive fluids, they have essentially met with failure because they have not had sufficient strength to withstand the fluid pressures to which the parts have been subjected.

The present invention is therefore directed to the method, apparatus and finished product of a reinforced synthetic resinous housing uniquely susceptible for use in the pump industry which enables pump housings to be constructed which have the unique advantages of high corrosive and errosive resistance to the fluids which they are to handle but which also have burst strengths which equal and at times exceed those of metal pump constructions. It had also been found that because of the nature of the synthetic resinous materials, that the efficiencies of these pumps are higher because the friction between the fluids and the synthetic resinous materials is less than between fluids and the metal constructions.

Other specific objects will be appreciated from the following detailed description and drawings, which point out the steps of the method of the present invention as well as the construction of the product and the apparatus.

Other objects and a fuller understanding of this invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an elevational view in section of a transfer molding apparatus which is utilized to produce the initial resinous housing;

FIG. 2 is a bottom plan view of the initial resinous housing removed from the molding apparatus of FIG. 1 and taken generally in the direction of line 2—2 of FIG. 1;

FIG. 3 is an elevational view in section of a mold which is utilized in producing the ring-shaped tensioning member which is utilized in the finished housing construction;

FIG. 4 is a plan view of the mold shown in FIG. 3 and illustrating how a fiberglass reinforcing member is wrapped about the pins prior to introducing the resinous molding material into the mold;

FIG. 5 is a plan view of the finished ring-shaped tensioning member produced in the mold of FIGS. 3 and 4;

FIG. 6 is an elevational view of the initial resinous housing which is shown in FIGS. 1 and 2, in full elevation and taken in the direction of the view of FIG. 1 with a layer of resin pre-wetted cloth such as fiberglass adhered thereto and with the ring-shaped tensioning member of FIG. 5 positioned relative thereto;

FIG. 7 is a view similar to FIG. 6 but showing the cloth of FIG. 6 being partially covered by wrapping an elongated reinforcing member such as a fiberglass fiber completely thereabout as shown and intermittently at-

taching same at spaced portions to the pins which are secured to the tensioning member;

FIG. 8 is a view similar to FIG. 7 but showing the initial housing in a more complete state of being wrapped by the reinforcing member;

FIG. 9 is a view similar to FIGS. 7 and 8 but showing the reinforcing member completely wrapped about the exterior of the initial housing;

FIG. 10 is an elevational view in section of another transfer molding apparatus showing the initial housing covered as in FIG. 9 and placed in a mold therein which mold is adapted to have injected thereinto a synthetic resinous material which is to cover the wrapped initial housing to produce the final exterior surface of the pump housing;

FIG. 10A is an enlarged view of a portion of FIG. 10;

FIG. 11 is a view taken generally along the line 11—11 of FIG. 10; and,

FIG. 12 is an enlarged elevational view in section showing the threaded connection between the tensioning pins of FIG. 10 and the pins of the tensioning member.

The present invention will be more specifically illustrated in connection with the construction of a double volute housing for a centrifugal pump construction which housing is constructed of a thermosetting, curable, resin composition, in this particular instance specifically an epoxy resin composition which is reinforced in the manner described generally above and which is more specifically described hereinafter.

An initial resinous housing **20** is produced in the apparatus illustrated in FIG. **1** which initial housing **20** is shown removed from the molding apparatus in FIGS. **2** and **6–9.** This particular initial housing in its completed form has an interior surface **21** and an unfinished exterior surface **22.** The finished interior surface **21** is adapted to be subjected to the action of fluids which are to be handled by the pump and this surface is the one which the impeller (not shown) of the pump construction rotates adjacent.

The apparatus of FIG. **1** includes an upper fixed platen **23** and a lower movable platen **24** which is movably supported by a motive power source which includes a piston **25.** Upper and lower mold parts **26** and **27,** respectively, are secured to the upper and lower platens and these mold parts are provided with mold inserts both identified by the reference numeral **29** which are secured in position by threaded members as shown. The apparatus also includes a knock-out plate **31** which has knock-out pins **32** secured thereto which find access to the mold cavity through openings in the lower mold part **27.** The purpose of pins **32** is to remove the finally molded part from the mold cavity as will be more fully described hereinafter. A tie rod **34** is secured to the knock-out plate **31** and extends upwardly to terminate in an upper end which has an actuating shoulder **36** secured thereto which in traveling downwardly from the position shown in FIG. **1** will be in position to strike a fixed abutment **35.** Also included as part of the apparatus is the mechanism for injecting resinous material into the mold cavity and this portion of the apparatus comprises a pressure pot **38** which is adapted to receive and contain the resinous material and a transfer piston **40** which includes a piston rod **42** and a plug **43.** Prior to the molding operation, the transfer piston **40** is in raised position from that shown in FIG. **1** and resinous material is contained in the pot **38** and upon downward movement of the transfer piston the resinous material is injected into the mold cavity by the action of plug **43** injecting the resin into the mold cavity by way of port **41.**

The operation of the apparatus is essentially as follows. The lower movable platen **24** is in a lowered position from that shown in FIG. **1,** causing the cavity in both of the mold parts **26** and **27** to be exposed and a meltable core **44** is placed in position in the lower mold cavity. The meltable core **44** is seen both in the right portion as well as in the left portion of the cavity. The meltable core does not form any essential part of the present invention and is provided for the purpose, which will be appreciated by those skilled in the art, of forming the internal portion of the discharge port **28** of the housing **20** at the right end and at the left end providing for the construction of a wall **39** in the housing **20** which forms the double volute construction. In the event a housing were to be constructed which was not to be of the double volute type, then the wall **39** would be unnecessary, thereby making the core **44** less complicated in its construction. The two mold parts **26** and **27** are next brought into mating engagement by raising of the piston **25** and with the transfer piston **40** in raised position, resinous material is introduced into the pressure pot **38** after which the transfer piston is forced downwardly injecting resinous material through port **41** into the mold cavity formed by the upper and lower mold parts **26** and **27.** The resinous material will be described in more detail hereinafter; however, it is sufficient to point out at this time that it includes both the resinous material as well as a catalyst system and the mold parts are kept in mating engagement with each other until the formed housing **20** is of sufficient cured strength to be removed from the mold parts **26** and **27.** The time that the parts are maintained in the mold can vary substantially, depending upon the curing system utilized, which may or may not include the use of heat.

After the initial housing has been sufficiently cured under the conditions set forth hereinabove, the mold parts are separated by lowering the piston **25** which at the same time causes lowering of the tie rod **34** and the attached knock-out plate and knock-out pins. When the piston **25** has been lowered sufficiently in accordance with the construction shown in FIG. **1,** it will be noted that the shoulder **36** will strike abutment **35** thereby prohibiting further lowering of the tie rod and attached knock-out plate and knock-out pins. Further lowering of the piston **25** will thus cause the knock-out pins to urge the finished initial housing **20** from the lower mold cavity, thus aiding in its removal. With the mold parts in open condition, the initial housing **20** with core **44,** is removed therefrom and may or may not be cured further. The finished initial housing shape is additionally illustrated in FIG. **2** with this view taken generally along the line **2—2** of FIG. **1.** It will be noted in FIG. **2** that the as-formed initial housing includes two bosses **37** which are used for positioning a tensioning ring member **45** which is best shown in FIG. **5.**

The next description will be that of the tensioning ring member **45** just previously referred to. In this regard, FIGS. **3** and **4** illustrate the construction of a mold and somewhat schematically the system used in this construction. In this regard, the mold includes an upper mold part **48** and a lower mold part **49.** The

lower mold part **49** and an insert secured thereto provides an annular cavity as shown which conforms to the shape of the finished ring member as seen in the plan view of FIG. **5**, and in the bottom of this annular cavity is provided a plurality of hexagonally shaped recesses within which to receive the ends of a plurality of insert pins **47**. FIG. **12** shows quite well the construction of each of the insert pins **47** and in this regard it will be seen that three hexagonally shaped shoulders are provided since the part is machined with hexagonal bar stock. The end of the pins **47** are inserted into the cavities as shown in FIG. **3** to position the same. The intermediate shoulder on the insert pins **47** just coincides with the top of the recess and prevents resinous material from traveling down into the recess within which the one end of the pins reside. FIG. **4** demonstrates the initial wrapping of a strand of fiberglass about the ends of the insert pins which are to be imbedded in the finally molded resinous part. After the fiberglass has been wrapped as indicated, resinous material is introduced into the annular cavity in sufficient quantity to produce the molded part and the upper mold part **48** is then brought into closed engagement with the lower mold part **49**. A kick-out plate **54** and kick-out pins **55** are provided in this construction for the purpose of removing the finally molded part. The resin from which this part is constructed will be discussed in more detail hereinafter; however, it may be of the same material as used in forming the initial housing **20**. It will be noted from viewing FIG. **12** that the insert pins **47** are all provided on an interior surface with female threads **53** for a purpose to be described hereinafter.

FIG. **6** shows the next step in the method of the present invention and involves the placing of a layer of woven cloth (for example of fiberglass) which has been pre-wetted with a resinous material. The woven cloth material **58** is suitably cut so as to conveniently form and fit the contours of the exterior of the housing and the generally tacky nature of the resin enables it to be conveniently placed and initially maintained on the exterior surface **22**.

FIG. **7** demonstrates the next step in the process of the invention which involves wrapping an elongated reinforcing member **61** which has been previously wetted with a resinous material about the exterior surface. As noted in FIG. **7**, the discharge port **28** is initially wrapped with the elongated reinforcing member (which may be a fiberglass fiber) and after a short distance the reinforcing member is brought down around one of the pins **47** and thereafter passes up around the portion identified as the inlet port **30** of the housing. The reinforcing member is then continued around the inlet port and various of the pins **47** in the manner shown in FIG. **7**.

FIG. **8** shows the inital housing more completely wrapped with the elongated reinforcing member and FIG. **9** shows the initial housing as completely wrapped with the reinforcing member.

It should be pointed out at this juncture that the present invention contemplates the step of FIG. **6** to be an alternate step which may or may not be utilized in conjunction with the wrapping of the elongated reinforcing member as shown in FIGS. **7**, **8** and **9**. In other words, the use of the woven cloth material as in FIG. **6** may or may not be utilized as desired and this will be essentially determined by the ultimate environment within which the housing is to reside.

The materials of construction of the woven cloth material **100** as well as the elongated reinforcing member may be varied substantially; however, some of the preferred materials of construction are fiberglass, metal, graphite, and such synthetic fiber materials as nylon and dacron.

The construction of FIG. **9** is next placed in the transfer molding apparatus of FIG. **10**. The transfer molding apparatus of FIG. **10** is in many respects similar to the molding apparatus of FIG. **1**; however, some detail will be resorted to in describing this particular construction. In this regard, the apparatus includes upper and lower platens **67** and **68** respectively, having secured thereto upper and lower molds parts **71** and **72**. The mold parts **71** and **72** have been appropriately machined so as to form the exterior configuration of the finished housing. Mold insert **74** is suitably secured to the lower mold part and an insert **75** is provided to fit within the inlet port **30** as shown. The construction also comprises a plurality of tensioning pins **78** which find access to the mold cavity through openings in the lower mold part **72**. The lower ends of the tensioning pins **78** are secured together by means of a tension plate **76** which has a plurality of openings extending therethrough as best seen in FIG. **11**. Each of the tensioning pins is provided with a reduced diameter portion **97** and these reduced diameter portions are located laterally in line with pairs of openings for cooperation with the reduced diameter portion of each of the tensioning pins. The large diameter opening of each pair is identified by the reference numeral **82** and the small diameter portion is identified by the reference numeral **83** and as will be noted, each of the openings **82** and **83** are interconnected. The tension plate **76** is movable back and forth in the direction of **84** shown in FIG. **11** to either lock all of the tensioning pins **78** to the tension plate **76** when the reduced diameter portions **97** are located in the small diameter portions **83** or to release the tensioning pins **78** from the tension plate **76** when the reduced diameter portions are located in line with the large diameter openings **82**. The tensioning pins **78** also perform another function upon opening of the mold parts and this is the same function that is performed by the knock-out pins **32** in the apparatus of FIG. **1**. In this particular regard, the lower ends of each of the tensioning pins is secured to a knock-out plate **88** as shown.

The apparatus also comprises what are referred to as tension plate tie rods **80** which are fixedly secured at their lower ends to the tension plate **76** and their upper ends extend through openings in abutments **85** and may travel therethrough freely until the abutments are engaged by stop nuts **86** secured to the tie rods **80**. The function of these parts will be described briefly hereinafter.

The apparatus also includes a pressure pot **91** for the reception of resinous material which is to be subsequently injected into the mold cavity as well as a transfer piston which is not shown and which includes a piston rod **93** and a plug **94** which has projections thereon which serve to provide openings for the reception of bolts in a finished flange which is formed on the inlet port of the pump housing.

Briefly, the operation of the apparatus of FIGS. **10** and **11** is as follows. The lower platen **68** is lowered by means of a motive power piston not shown but similar to piston **25** in the apparatus of FIG. **1**, so as to separate the upper and lower mold parts **71** and **72**. The tension

plate **76** is moved to the left in the direction of arrow **84** from the position shown in FIG. **11** so as to disconnect the tensioning pins **78** from the tensioning plate. The tensioning pins **78** are previously rotatably secured in respective pins **47** by means of the female threads **53** on pins **47** and the male threads on tensioning pins **78** as more clearly shown in the enlarged view of FIG. **12.** The pins **78** may be attached to pins **47** prior to the winding operation of FIGS. **7, 8** and **9** if desired. This enables one to have a slightly longer pin to string the reinforcing member around. The attaching of pins **78** to pins **47** may be (as shown) accomplished subsequent to the wrapping operation which is shown completed in FIG. **9.** In any event, the wrapped initial housing with the attached tensioning pin is inserted into the cavity in the lower mold part **72** as shown in FIG. **10.** The lower platen **68** with the attached lower mold part is then raised (after moving tension plate **76** back to the right) and brought into closed position as shown in FIG. **10.** In the process of raising the lower mold part the stop nuts **86** are caused to engage the abutments **85** which prevents further upward movement of the tie rids **80** which by the connection previously described to the tensioning pins **78** causes the tensioning pins to be pulled downwardly through the openings in the lower mold part **72.** This in turn causes the pins **47** to be forced downwardly as well as the tensioning ring member **45** which causes the wrapped reinforcing member which is secured about the plurality of pins **47** to be consistently tensioned.

After this resinous material which is contained within the pressure pot **91** is injected into the mold cavity by bringing the piston rod **93** and plug **94** downwardly from the position shown to its lower-most position which places the protrusions on plug **94** into the position indicated by the finished holes in the inlet port flange.

As will be noted in FIG. **10,** the downward pull which is exerted on the pins **47** and tensioning member **45** causes a space **100** to be provided between a side of the tensioning ring member and a portion of the initial housing. As the resinous material is injected into the mold cavity the force exerted thereon causes the mold cavity to be completely filled with the resin thereby completely covering the wrapped reinforcing member and also causes the space **100** to be completely filled with resin. FIG. **10** shows the space **100** to be empty for more ease in illustrating the invention; however, it is in fact full of resin as is illustrated in the enlarged view of FIG. **10A.** This prevents the ring member **45** from returning and keeps the elongated reinforcing member constantly tensioned. It will be appreciated that other means can be utilized to move the ring member and keep it in position for example by using shims. The part is maintained within the mold cavity for a sufficient time to harden the injected resin and thereafter the mold parts are separated by lowering the lower platen **68** and when the lower platen reaches its lowermost position the tensioning pins **78** act as knock-out pins by a mechanism similar to that shown in FIG. **1** but not shown in this Figure and identified in FIG. **1** as the parts **34, 35** and **36.**

After the finished housing is removed from the mold cavity it is placed in an oven for a suitable additional cure and the oven is also raised to a temperature which permits the intricate shape of the meltable core **44** to be melted from the configuration of the finished housing. This meltable core is preferably constructed of a thermoplastic type resin which has a lower melting temperature than the temperature which would provide any particular damage to or melting of the resinous material from which the finished housing is constructed. The oven is also utilized to give additional cure to the housing.

After this operation is completed, specifically the pump housing is ready for its ultimate use and the pump of course must be assembled by appropriately mounting an impeller appropriately within the confines of the interior surface **21** of the initial housing and the impeller is driven by a shaft which is suitably mounted on bearings which are carried by a back plate not shown which back plate covers the opening into the housing and which is formed by means of the mold insert **74** as seen in FIG. **10.**

As mentioned hereinabove, the resins which may be satisfactorily utilized as the materials of construction for both the initial housing which is produced in the apparatus of FIG. **1** and the finished exterior surface as accomplished in the apparatus of FIG. **10,** may be quite varied and may be either thermosetting of thermoplastic in nature. They may also contain suitable fillers and/or reinforcing agents which are injected into the mold cavities during the molding operation and an example of a reinforcing agent would be chopped fiberglass. The thermosetting resins which have been found to be quite satisfactory are varied with one of the preferred being a commercially available epoxy resin combination. Other thermosetting resins suitable for the purpose are polyesters, phenolics, melamines and urethanes. Examples of suitable thermoplastic resinous materials which can be utilized are polyvinyl chloride and polyvinylidene chloride. The cloth covering **58** which is alternatively utilized in this invention and which is demonstrated in FIG. **6** is preferably pre-wetted with a resinous material which is compatible with the resinous material of the initial housing as well as the resinous material which is utilized to pre-wet the reinforcing member **61** which is shown in FIGS. **7, 8** and **9.** The resin utilized for the final finishing of the exterior which is accomplished in the apparatus of FIG. **10,** should also be compatible with the resins used in the rest of the housing construction. The resins therefore can be quite varied from the standpoint of the teachings of the present invention; however, in any given housing the basic chemical constitution of all of the resins should be compatible.

The specific pump housing which has been disclosed in the present teaching of one of the preferred embodiments of the present invention is extremely desirable and has an extremely high burst strength. This is particularly true when the resinous material of construction is a thermosetting epoxy resin and when the elongated reinforcing member utilized is a continuous strand of fiberglass. Fiberglass has a high tensile strength and when wound about the rather inconsistent or odd geometrical shape of the housing and then consistently tensioned by the present method, the relatively low strength of the plastic or resinous material is enhanced by the fiberglass material. By the same token the fiberglass is completely covered or contained between the exterior of the initial housing and the finished exterior coating of resin and is not subject to the action of fluids handled by the pump. The portion of the housing which is exposed to the action of errosive and corrosive fluids

in the interior surface of the initial housing and is comprised of the basic resin utilized.

For the purpose of further describing a suitable resin formulation to enable those skilled in the art to adequately practice the invention, one may use for forming the initial housing **20** of FIG. **1** an epoxy resin which comprises a diglycidyl ether of Bisphenol PA which includes 2 parts per 100 of resin of a hardener (or catalyst) of imidazole. Also included as part of the formulation is 25 parts per 100 of hexahydrophthalic anhydride and 0.5 parts per 100 of stannous octate. Also included as part of the formulation is 1½ parts by weight of ground carbon to one part of resin and hardener.

A satisfactory resin formulation of the final molding step which is shown in FIG. **10** comprises an epoxy resin of a diglycidyl ether of Bisphenol PA with 2 parts per 100 of resin of a hardener of imidazole. 25 parts per 100 of a polyamide is added and 0.5 parts per 100 of stannous octate is added. To this formulation is added a 50 percent by weight of chopped fiberglass fibers.

As a result, the objects of the present invention are uniquely accomplished in that the corrosion and erosion resistant qualities of the appropriate resin are utilized while the high strength characteristics are attained by the wrapping and appropriate winding and tensioning of the elongated reinforcing member which has high strength characteristics.

Although this invention has been described in its preferred form and preferred practice with a certain degree of particularity, it is understood that the present disclosure of the preferred form and preferred practice has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts and steps may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. The method of making an irregularly shaped, reinforced resinous pump or valve housing having high strength and a high resistance to corrosive fluids including the steps of forming an initial housing from a resin which initial housing has an internal portion and an exterior with the exterior of the initial housing being in unfinished form and having a tensioning member located contiguous to the exterior of the said initial housing and movable relative thereto which tensioning member has wall means for receiving and securing portions of an elongated reinforcing member, wrapping an elongated reinforcing member about the exterior of the initial housing to cover at least a portion thereof and securing separated portions of the reinforcing member to the wall means, exerting a force on the tensioning member to move same relative to the housing to tension the wrapped reinforcing member, and thereafter covering the wrapped reinforcing member with a resin to finish the exterior of the housing.

2. The method as claimed in claim **1**, wherein the resin is a thermosetting resin.

3. The method as claimed in claim **1**, wherein the elongated reinforcing member is selected from the group of materials consisting of metal, graphite, nylon, polyester resin, fiberglass and combinations thereof.

4. The method as claimed in claim **3**, wherein the resin is a thermosetting resin.

5. The method as claimed in claim **3**, wherein the resin is a thermoplastic resin.

6. The method as claimed in claim **4**, wherein the thermosetting resin is an epoxy resin.

7. The method as claimed in claim **4**, wherein the thermosetting resin is selected from the resins consisting of polyesters, phenolics, melamines and urethanes.

8. The method as claimed in claim **2**, wherein the elongated reinforcing member is pre-wetted with a thermosetting resin.

9. The method as claimed in claim **3**, wherein the elongated reinforcing member is pre-wetted with a thermosetting resin.

10. The method as claimed in claim **3**, wherein the elongated reinforcing member is pre-wetted with a thermoplastic resin.

11. The method as claimed in claim **3**, wherein a layer of woven cloth constructed of said selected material is placed on the exterior of the housing prior to the wrapping of the reinforcing member.

12. The method as claimed in claim **11**, wherein the cloth is pre-wetted with a resin.

13. The method as claimed in claim **1**, wherein the resin is applied to the wrapped reinforcing member by placing the housing and wrapped reinforcing member in a mold and forcing the resin thereinto.

14. The method as claimed in claim **4**, wherein the resin from which the initial housing is constructed or the resin covering the wrapped fiberglass may have chopped fiberglass therein.

15. The method as claimed in claim **1**, wherein the internal portion of the initial housing is in its finished condition as formed and is the portion to be subjected to corrosive fluids.

16. The method as claimed in claim **1**, wherein the wall means of the tensioning member are pins.

17. The method as claimed in claim **1**, wherein when the tensioning member is moved relative to the housing in exerting a tensioning force on the reinforcing member a space is created between the tensioning member and the initial housing and means are inserted in the space to prevent return relative movement and untensioning of the reinforcing member.

18. The method as claimed in claim **1**, wherein when the tensioning member is moved relative to the housing in exerting a tensioning force on the reinforcing member a space is created between the tensioning member and the initial housing and the resin which covers the wrapped reinforcing member also fills the space preventing return of the tensioning member and untensioning of the reinforcing member.

19. The method as claimed in claim **13**, wherein when the tensioning member is moved relative to the housing in exerting a tensioning force on the reinforcing member a space is created between the tensioning member and the initial housing and the resin which covers the wrapped reinforcing member also fills the space preventing return of the tensioning member and untensioning of the reinforcing member.

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