J. L. FITTS.

MEANS FOR MAKING ELASTIC VESSELS.

APPLICATION FILED SEPT. 22, 1915.

1,271,455.

Patented July 2, 1918.

2 SHEETS—SHEET 1.

FIG. 1.

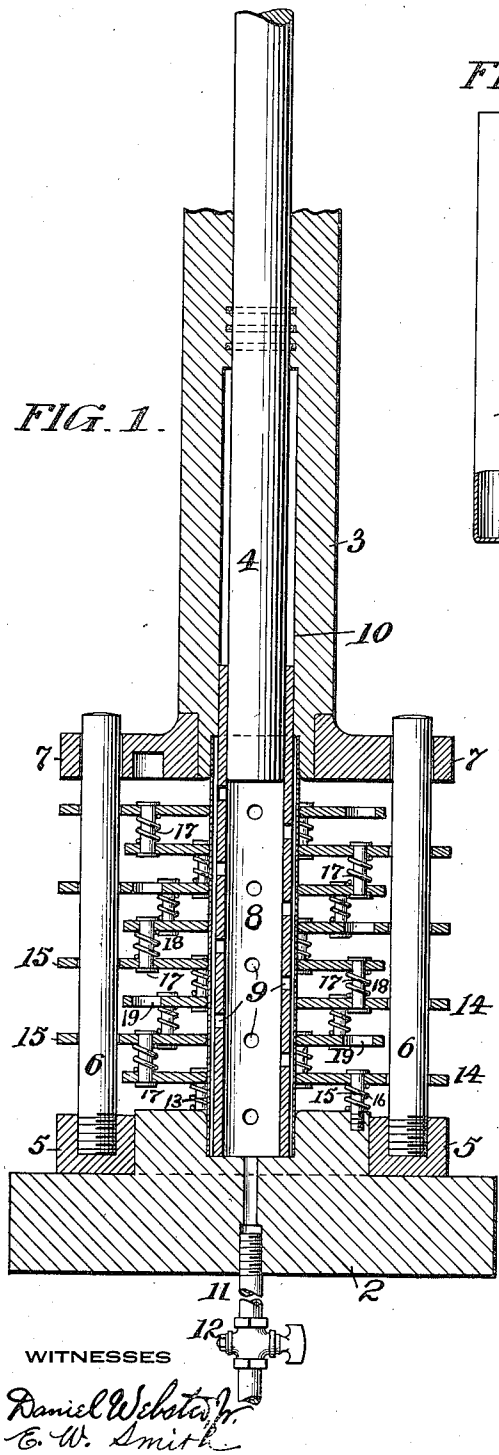


FIG. 7

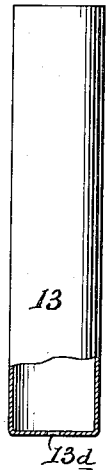
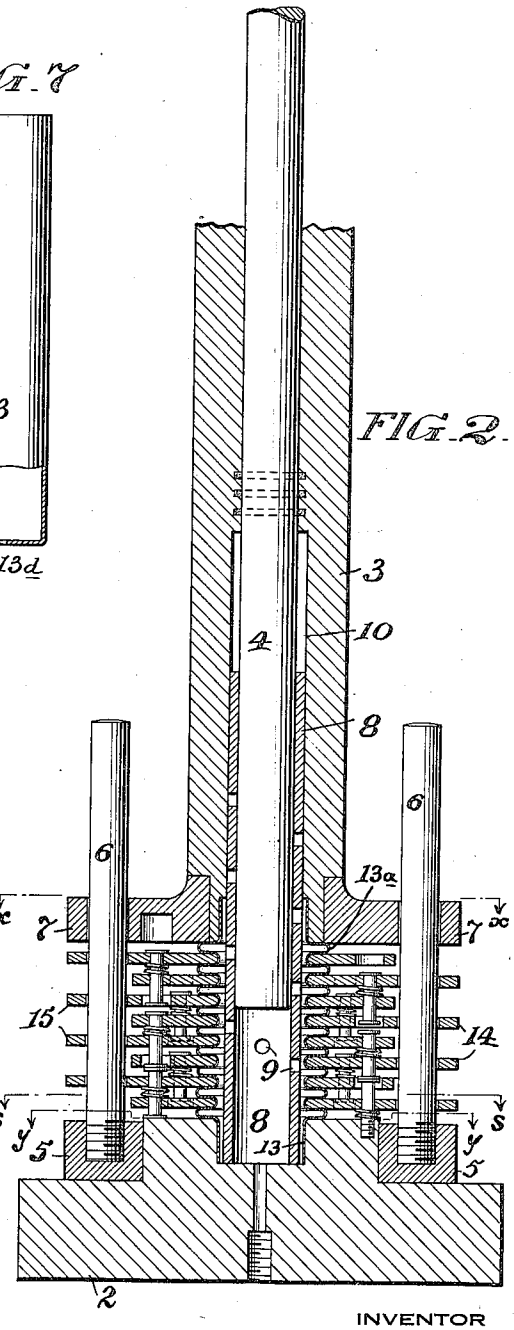


FIG. 2.



WITNESSES

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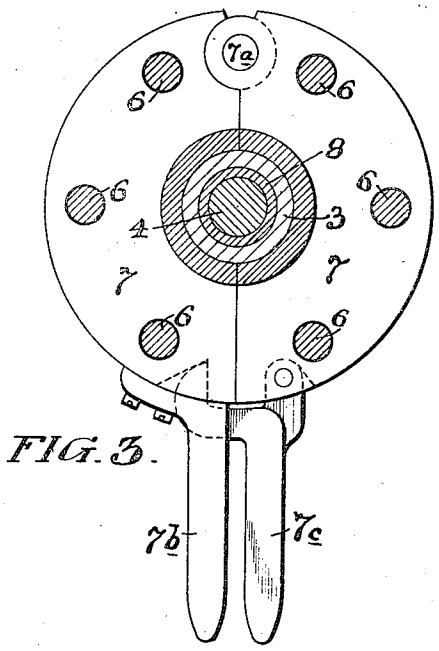


FIG. 3.

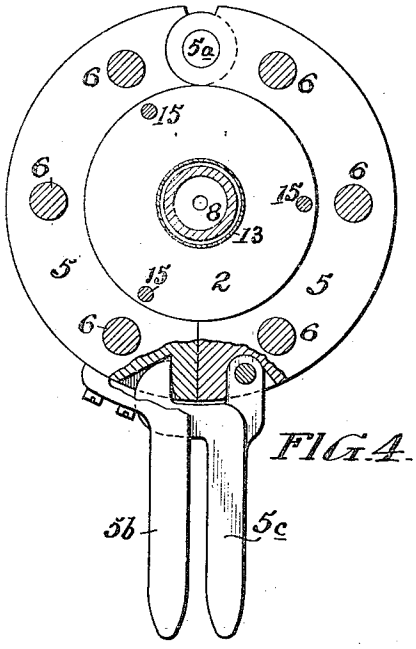
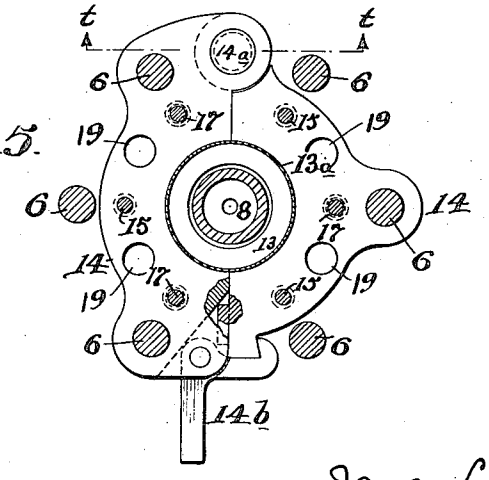


FIG. 4.

FIG. 6.



FIG. 5.



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MEANS FOR MAKING ELASTIC VESSELS.

1,271,455. Specification of Letters Patent. Patented July 2, 1918.

Application filed September 22, 1915. Serial No. 52,086.

To all whom it may concern:

Be it known that I, JAMES LOGAN FITTS, a citizen of the United States, and resident of Pensauken township, county of Camden, and State of New Jersey, have invented an Improvement in Means for Making Elastic Vessels, of which the following is a specification.

The object of my invention is to provide improved means for the production of an elastic vessel of the bellows fold type, more especially suitable for an expansible or thermostatic element for valves and control devices generally.

More particularly, my object is to provide an improved means for forming the bellows fold article with any desired number of internal and external folds by one operation, whereby the article may be made quickly and accurately and at a low cost.

Heretofore, vessels of this character have been formed by rolling or swaging tubes or sheets of metal, said operations being done in a slow manner in that they are performed only on one portion of one fold at any one time, so that each fold requires a plurality of operations, and these are multiplied by the number of folds required. By my improved method, all of the folds may be simultaneously formed at one operation and hence at a very much less expense.

In using my improved means a tube or shell is first formed by drawing operations in a suitable press and may be cut into the desired length according to the number and depth of the folds to be made in it. The tube or shell so formed may be annealed to suit the working requirements wholly before the forming of the bellows folds or partly before and partly during the latter operation, as desired. The tube or shell is then placed in a press having suitable formative dies or devices of annular shape, about and between which the sides of the shell or tube are expanded by hydraulic action produced within the shell or tube during the manipulation in the press, the operation being such that as the sides expand between the annular dies or formers, the latter are gradually moved toward each other until they are spaced to correspond to the thickness of a bellows fold. Upon completion of the formative process, the press is adjusted to remove pressure upon the tube or shell and the annular or formative dies are opened to release the completed article.

My improved process also comprehends minor steps which, together with the general method above stated, will be better understood by reference to the drawings, in which:—

Figure 1 is a sectional elevation of portions of a press and formative dies constituting a specific adaptation of my improved means and showing the parts preliminary to the formative operation; Fig. 2 is a similar sectional view of the same parts after the formative operation has been completed; Fig. 3 is a cross section taken on line *x*—*x* of Fig. 2; Fig. 4 is a cross section taken on line *y*—*y* of Fig. 2; Fig. 5 is a cross section taken on line *s*—*s* of Fig. 2; Fig. 6 is a cross section on line *t*—*t* of Fig. 5; and Fig. 7 is an elevation with part in section of a shell with a partly closed bottom from which to form the article.

2 is the bed or lower die of a press, and is formed with a central hub portion having a socket in its upper part for receiving the lower end of the tube or shell 13 to be formed into the bellows fold shape. Detachably fitted about the central hub of part 2 is an annular frame formed of two parts 5, 5, hinged together at 5^a and having latching means 5^b, 5^c, at the side diametrically opposite the hinge. The part 5, 5, are each provided with upright guide rods 6.

Arranged at a higher elevation and guided upon the rods 6 is a second annular frame similar in general form to the lower frame, and is also formed of two parts 7, 7, hinged together at 7^a and provided, diametrically opposite to the hinge, with latching means 7^b, 7^c. These two annular frames may be simultaneously opened or closed according to whether the finished article is to be removed or a new tube or shell inserted and held for formative action. The upper annular frame 7, 7, is detachably fitted to the lower portion of the cylindrical platen 3 which is

formed with a recess for receiving the upper rim of the tube or shell. Fitting within the bore 10 of the cylindrical platen and extending down into the lower bed or die 2, is a tubular frame 8 having a plurality of apertures 9 through it for easy passage of fluid, said tubular frame loosely fitting within the tube or shell 13 to be formed into the finished vessel. Also fitting through the cylindrical platen 3 is a plunger 4 whose function is to apply pressure upon the water or other fluid contained within the tube or shell 13 and to cause it to expand the said tube or shell radially, as hereinafter explained. The lower bed or die 2 is provided with a pipe 11 having a valve 12 and by which the water or other fluid is admitted to within the tube or shell. This water or fluid (liquid or gaseous) may be admitted in any other manner, if so desired.

The cylindrical platen 3 and the plunger 4 are respectively forced down by any suitable press, the platen being moved a less distance than the plunger.

In addition to the parts above described, I provide a plurality of annular formers 14, 14, in the shape of relatively thin disks split across their diameters and the two parts hinged together at 14^a very similar to the lower annular frame fitted to the bed or die part, so as to be capable of being opened at the same time said annular frame is opened when removing the finished article. These split annular disk-shaped formers 14, 14, are also each provided with a latching device 14^b for normally holding their parts firmly connected during the formative process. There may be any desired number of these annular formers, according to the number of bellows folds or corrugations to be given to the article. The general construction of these formers may be substantially the same, and the two halves 14, 14, are respectively guided upon the guide rods 6 of the corresponding parts 5, 5, of the lower annular frame, and thereby kept in alinement with the upper and lower annular frames 5, 5, and 7, 7, as well as being opened and closed with them. For convenience of giving the latching devices more room for being operated, I prefer to invert every other one of the annular formers upon the guide rods, for while this maintains the vertical alinement of the central apertures, it permits spreading of the latch levers 14^b, to enable them to be more easily manipulated by hand. It is further important that, at the beginning of the operation the formers 14, 14, shall be uniformly spaced apart and this may be accomplished by headed bolts extending through adjacent formers and lower annular frame, said bolts having surrounding coil springs which act to push the formers and frame apart to the limit allowed by the bolts. More specifically, 17 are bolts extending through holes in the formers; the heads of these bolts being larger than the holes limit the extent of separation of the formers. Surrounding these bolts are coil springs 18 which force the adjacent formers apart and against the bolt heads. Holes 19 may be provided in the formers to permit the heads of the bolts to come close together or touch, if desired. In the case of the bottom former 14, 14, and the lower annular frame 5, 5, I employ screw bolts 15 extending through the former and screwed into the annular frame, said bolts also having heads to limit the separation of the annular former from the annular frame, and surrounding coil springs 16 for normally forcing these portions apart to a maximum distance.

There may be a plurality of these spacing bolts and springs between each adjacent pair of formers as shown, and also between the lowermost former and the lower annular frame, and I do not restrict myself in this respect.

The apparatus which I have above described may be part of a fully organized press of suitable construction, or employed as a sub-press to enable a plurality of similar apparatus for making bellows fold bodies of different diameters and lengths to be used in the same power press for economy, as will be fully understood by those familiar with stamping and drawing presses.

If the shell 13 is left with a bottom as shown in Fig. 7, there may be a small hole 13^d in the bottom for passage of liquid, but this may be omitted where the liquid is supplied otherwise than by the pipe 11 at the bottom of the bed 2. The shell may be filled with the fluid before being inserted, if so desired.

The operation of the apparatus and the carrying out of my improved method of forming elastic or bellows fold vessels will now be readily understood. The latches of the formers and annular frames having been released, these parts are opened about their hinges, the platen 3, plunger 4 and tubular frame 8, are raised and a tube or shell 13 is inserted. The tubular frame 8 is then dropped down within the tube or shell, and the platen is next lowered to put sealing pressure upon the upper edge or rim of the tube or shell 13 and force it to tightly seat upon the recess in the bed or lower die 2. Before excessive pressure is applied by the platen, the formers 14, 14, and upper and lower annular frames are closed about the tube or shell 13 and latched. Water is then admitted by pipe 11, and when the interior space of the tube or shell is filled, the valve 12 is closed. The platen 3 and plunger 4 may then be put under a little pressure to cause the tube or shell 13 to expand radially to seat circumferentially upon the inner

edges of the several annular formers 14, 14, and thereafter to maintain strong frictional contact with them. Yielding pressure upon the platen 3 is maintained to at all times prevent the escape of the water and also to lower the upper annular frame 7, 7, as the vessel is being brought into corrugated form. While this pressure is maintained by the platen 3, the plunger or ram 4 is gradually forced down with the result that the water presses upon the shell between the annular lines of support by the formers, and produces annular corrugations 13^a outwardly, shaping the metal of the shell about the inner annular edges of the formers. The radial extent to which these corrugations 13^a may be carried, will depend upon the operation of the plunger or ram 4, assuming of course, that the metal of the shell 13 is of the proper structure to permit of desired expansion. During the formative action, the annular formers 14, 14, are forced nearer together by the corrugations of the shell, and the operation may continue until the desired outside diameter has been secured. Any suitable means may be employed for limiting the expanding operation, and this may be done by the press proper or by stops in the formative apparatus itself, as for instance, the bolts 17, the heads of which may abut when a full or maximum formative action has taken place.

When the formative operation begins, the parts are in the relative positions shown in Fig. 1, and when completed the same parts are in the relative positions shown in Fig. 2. To remove the finished article, the pressure is removed from the platen and plunger, the several latches are released and the upper and lower annular frames and annular formers are opened and the corrugated vessel withdrawn with the tubular frame 8, which latter is then removed.

The tubular frame or mandrel 8 is employed to prevent any inward springing or buckling of the walls of the shell 13 at the initial operation when the shell is of very light sheet metal, especially at a time when the platen 3 is seating itself to hold the shell and make a water-tight joint. In thicker shells, this inner frame or mandrel 8 may be omitted. With thin shells, once the plunger or ram 4 begins to move down, the radial expansion of the walls will make them seat tightly within the sockets in the bed and platen and not rely wholly upon the end thrust of the platen.

It will be understood that the apparatus above described is given by way of specific example of my improved means for making elastic vessels, and while embodying the essential elements, the details may be greatly modified, if so desired.

It will be observed that the process performed with my improved apparatus consists of the combination of internal liquid or fluid pressure to produce outward expansion of the shell simultaneously with the action of mechanically operated formative parts providing an opposing resistance along certain lines to the expansion, whereby the action of the fluid pressure is made effective only along annular lines; and moreover, the operation takes place simultaneously at spaced intervals throughout the length of the shell, whereby all of the corrugations or bellows fold formative actions occur at one time, as distinguished from consecutive formative actions as heretofore produced by employing rolling tools, etc.

In case the nature of the metal should require annealing during the formative operation, the article in its partly finished condition may be removed from the apparatus and subjected to annealing. When annealed, it may be returned to the apparatus and the formative operation completed. By reason of this capacity of annealing and further treatment, it is possible by this process to form vessels of greater depth of corrugations or folds than by any other of the methods heretofore in use.

I have shown the annular formers as spaced equally apart, so as to form corrugations of equal depth, but this is not at all necessary, for if they are spaced alternately close and far apart, the depth of the corrugations will be alternately radially shallow and deep, and such variations in the process will be understood by those skilled in the art of sheet metal drawing and not as a departure from the spirit of the invention.

It will also be apparent that while, in most uses, the vessel will be cylindrical, this is in no wise necessary in the use of my improved means, as the corrugations may, for example, be made of successively increasing diameters to produce a cone effect on the outside; and likewise, the depths of the corrugations may be the same or gradually increasing by merely changing the spacing of the formers or by increasing the diameters of the internal apertures of the successive formers, all of which will be readily understood.

I have described my improved apparatus in respect to the making of the expansible vessels generally and more especially of the cylindrical form, such as employed as a thermostatic member for valves, and the description herein contained is by way of example and not as a restriction to the invention generically considered, and hence the method and apparatus may be both varied within reasonable limits to suit the specific form of the article to be made and the character of the metal to be employed, without being considered as a departure from the invention.

In this application no claim is made to the method of operation as the same will form subject matter of another application.

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

1. In an apparatus for shaping sheet metal bodies, the combination of a bed and a platen movable to and from the bed, with a detachable hinged frame resting upon the bed and provided with guides extending toward the platen, a plurality of annular formers each composed of two hinged sections and said sections of the formers guided upon the guides of the detachable frame whereby they are removably supported between the bed and the platen and adapted to be properly alined relatively to each other and to said bed and platen, spring actuated spacing devices between the adjacent sections of the plurality of annular formers whereby said formers are automatically normally spaced apart and capable of being moved toward each other during the forming operation of the platen upon a tubular shell placed within the annular formers and between the bed and platen and which is to be formed, and means to supply the interior of the shell between the platen and bed with a fluid under pressure.

2. In apparatus for making expansible vessels, the combination of a bed and a platen between which a tube or shell is held and crushed axially, a plurality of annular formers spaced apart and arranged between the bed and platen and adapted to encircle the tube or shell when in position, means to positively space the formers apart and enable the said formers to move toward each other when the platen is moved toward the bed, means for supplying fluid into the tube or shell when between the bed and platen, and means for producing a relatively great expanding pressure within the tube or shell comprising a plunger or ram in the platen to put fluid within the tube or shell under pressure to expand the same.

3. In an apparatus for shaping sheet metal bodies, the combination of a bed and a platen movable to and from the bed, with a detachable hinged frame resting upon the bed and provided with guides extending toward the platen, a plurality of annular formers each composed of two hinged sections and said sections of the formers guided upon the guides of the detachable frame whereby they are removably supported between the bed and the platen and adapted to be properly alined relatively to each other and to said bed and platen, spring actuated spacing devices between the adjacent sections of the plurality of annular formers whereby said formers are automatically normally spaced apart and capable of being moved toward each other during the forming operation of the platen upon a tubular shell placed within the annular formers and between the bed and platen and which is to be formed, means to supply the interior of the shell between the platen and bed with a fluid under pressure, perforated means within the annular formers and between the bed and platen to prevent inward collapsing of the shell to be formed, and a plunger associated to increase the pressure of the fluid which is inclosed within the shell being formed for the purpose of expanding the shell against and between the formers.

4. In apparatus for making expansible vessels, the combination of a bed and a platen between which a tube or shell is held and crushed axially, a plurality of annular formers spaced apart and arranged between the bed and platen and adapted to encircle the tube or shell when in position, means to normally adjust the formers in definite spaced relation and permit them to move toward each other when the platen is moved toward the bed, a tubular frame extending between the bed and platen within the annular formers and tube or shell to prevent collapsing of the tube or shell and having a sliding support whereby the platen may move relatively to the bed without crushing said tubular frame, said tube providing a passage for fluid from within to outside of it, and means for producing an expanding pressure within the tube or shell comprising a plunger or ram fitting into the tubular frame for providing a fluid pressure upon the inside of the shell when in position.

5. In apparatus for making expansible vessels, the combination of means for holding a tube or shell and applying pressure thereto axially, means for forcing an expansible fluid against the interior walls of the tube or shell, a plurality of relatively thin annular formers arranged to surround the tube or shell and arranged between the means for applying the axial pressure to the tube, and spacing means between the annular formers for spacing them normally apart, consisting of bolts connecting adjacent plates to permit them to approach but limit their separation, and coil springs surrounding the bolts to normally force the plates apart to the limit permitted by said bolts.

6. In apparatus for making expansible vessels, the combination of means for holding a tube or shell and applying pressure thereto axially, means for forcing an expansible fluid against the interior walls of the tube or shell, a plurality of annular formers to surround the tube or shell and arranged between the means for applying the axial pressure to the tube said formers adapted to be opened to permit removal of the formed vessel, a two-part hinged removable base and guides upon said parts for sup-

porting the annular formers and controlling them as a unit, and yielding means for causing the formers to be supported in normal spaced relation and permitting them to yieldingly move toward each other.

7. In apparatus for making expansible vessels, the combination of means for temporarily holding a sheet metal tube or shell, a plurality of thin annular metal formers normally spaced apart to provide annular lines of external resistance about which the tube or shell is bent, means for applying an axial pressure upon the tube or shell to seal it and reduce its length, means for mechanically supporting the tube or shell on the inside against inward bending or crushing during the axial pressure upon the said tube or shell, and means for applying an internal pressure within the tube or shell to expand it between the annular formers to form a plurality of annular folds.

8. In apparatus for making expansible vessels, the combination of means for subjecting a tube or shell of ductile metal simultaneously to an expanding force throughout its entire interior and to a compressive force axially, a plurality of means spaced apart to provide resistant annular lines about the outer surface of the tube or shell and over which the same is bent into folds, means for producing an axial froce longitudinally of the tube or shell and casting said plurality of annular means to be gradually brought closer together during the formative operation, and spacing means to limit the approach of the plurality of annular means to each other and to automatically return the said means into their normally spaced relation after the completion of the operation.

9. In apparatus for making expansible vessels, the combination of a bed having a socket for receiving an upright tube or shell to be treated, a lower annular frame adapted to the bed and provided with upright guides, an upper annular frame guided upon said guides, a platen for operating the upper annular frame and recessed to receive the upper end of the tube or shell, a plurality of annular formers guided upon the guides and each consisting of hinged portions capable of being separated to permit discharge of the finished vessel, and a plunger working through the platen and into the space within the annular formers for providing a compression of fluid within the tube or shell to be treated.

10. In apparatus for making expansible vessels, the combination of a bed having a socket for receiving an upright tube or shell to be treated, a lower annular frame adapted to the bed and provided with upright guides, an upper annular frame guided upon said guides, a platen for operating the upper annular frame and recessed to receive the upper end of the tube or shell, a plurality of annular formers guided upon the guides and each consisting of hinged portions capable of being separated to permit discharge of the finished vessel, a plunger working through the platen and into the space within the annular formers for providing a compression of fluid within the tube or shell to be treated, and spacing means for automatically spacing the formers apart when the platen is raised.

11. In apparatus for making expansible vessels, the combination of a bed having a socket for receiving an upright tube or shell to be treated, a lower annular frame adapted to the bed and provided with upright guides, an upper annular frame guided upon said guides, a platen for operating the upper annular frame and recessed to receive the upper end of the tube or shell, a plurality of annular formers guided upon the guides and each consisting of hinged portions capable of being separated to permit discharge of the finished vessel, and a plunger working through the platen and into the space within the annular formers for providing a compression of fluid within the tube or shell to be treated, the said upper and lower annular frames also formed of hinged parts whereby they may be opened and through the guides cause the formers to be opened for releasing the formed article.

12. In apparatus for making expansible vessels, the combination of a bed having a recess for supporting a tube or shell to be operated on, vertical guides, an annular frame guided by the guides, a platen carried by the annular frame and having a socket for receiving the upper end of the tube or shell, a plurality of annular formers guided upon the guides and surrounding the tube or shell, means for spacing the formers at different predetermined distances above each other when the platen is raised, means for supplying a fluid into the space within the tube or shell, and means independent of the platen for producing a quick pressure upon the fluid for causing a lateral pressure of the fluid upon the tube or shell intermediate of the formers.

13. In apparatus for making expansible vessels, the combination of a bed having a recess for supporting a tube or shell to be operated on, vertical guides, an annular frame guided by the guides, a platen carried by the annular frame and having a socket for receiving the upper end of the tube or shell, a plurality of annular formers guided upon the guides and surrounding the tube or shell, means for spacing the formers at different predetermined distances above each other when the platen is raised, means for supplying a fluid into the space within the tube or shell, means independent of the platen for producing a quick pres-

sure upon the fluid for causing a lateral pressure of the fluid upon the tube or shell intermediate of the formers, and a tubular frame extending through the space within the formers and from the platen to the bed for providing a support for the tube or shell to prevent it being crushed inwardly and constructed to permit flow of fluid from its interior to the outside of its walls under the action of the quick pressure producing means.

In testimony of which invention, I hereunto set my hand.

JAMES LOGAN FITTS.

Witnesses:
PHILIP Y. QUINN,
WILLIAM H. SNYDER.