Jan. 17, 1950 W. H. GRANT 2,495,059

APPARATUS FOR MAKING METALLIC BELLOWS

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Fig. 8

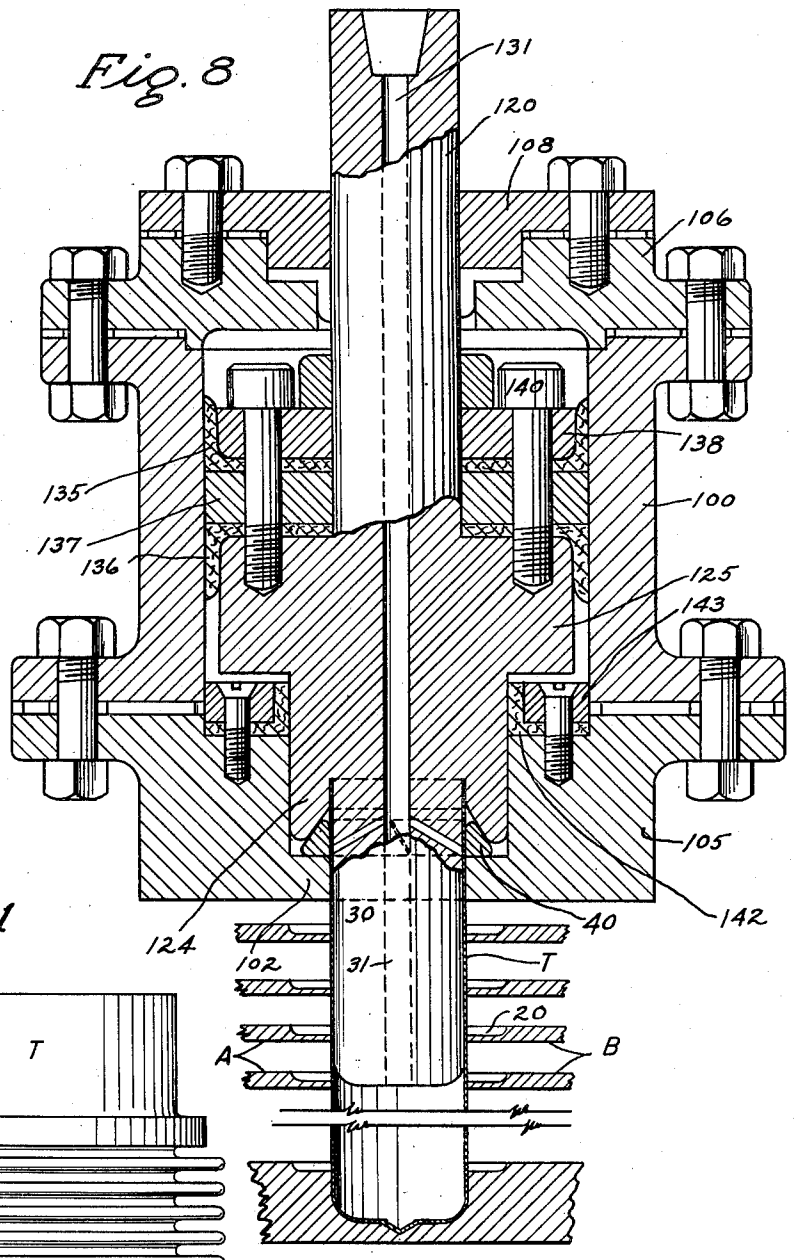
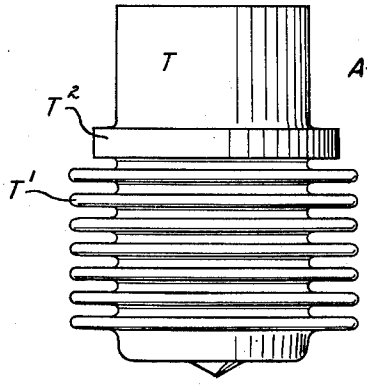


Fig. 1



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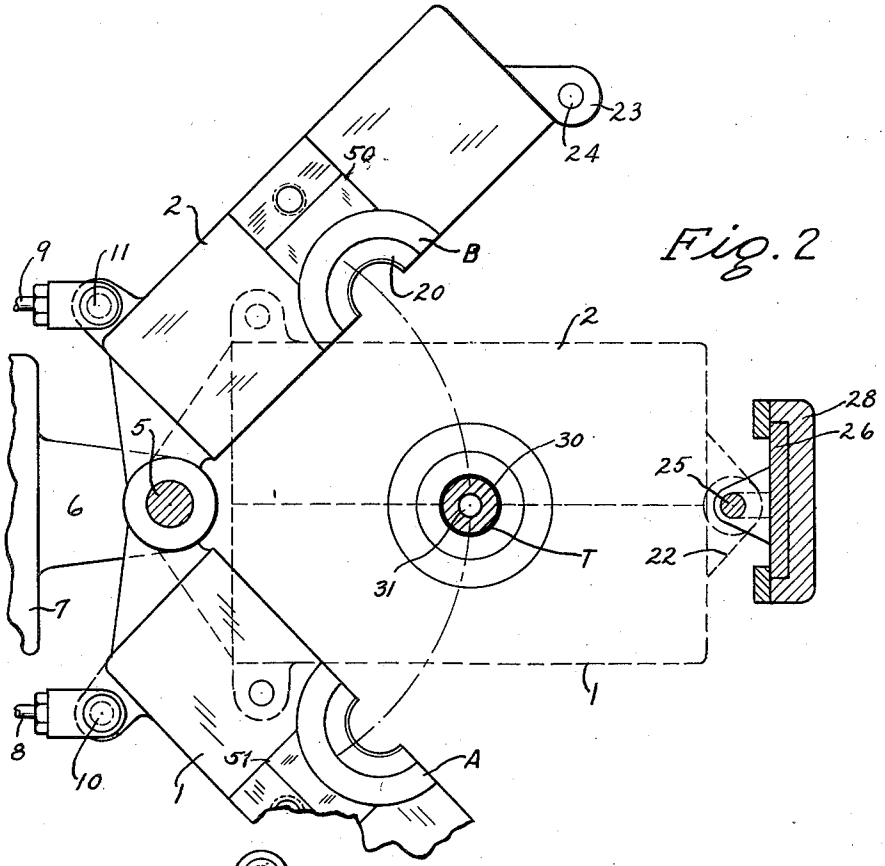


Fig. 2

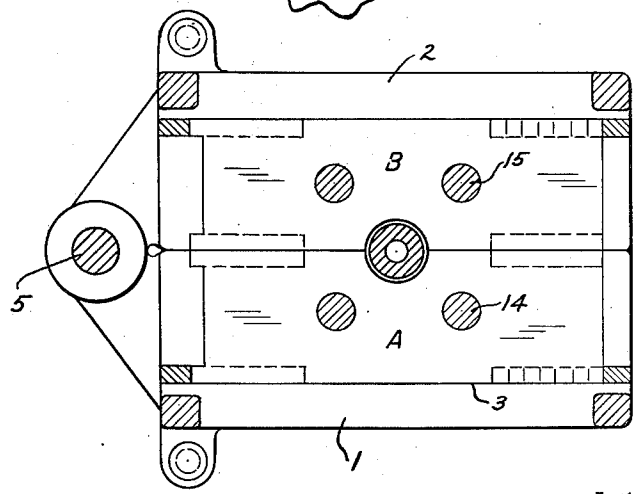


Fig. 3

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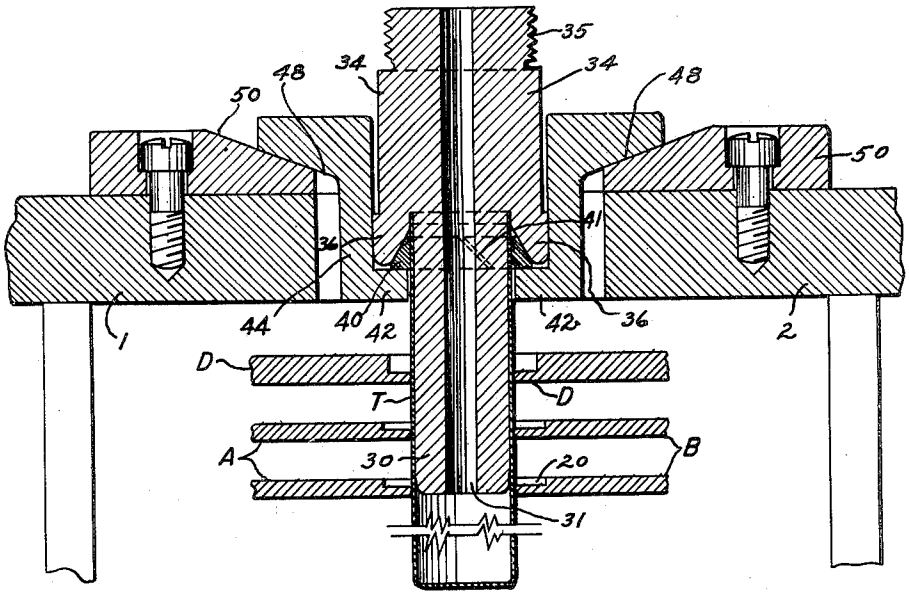


FIG. 4.

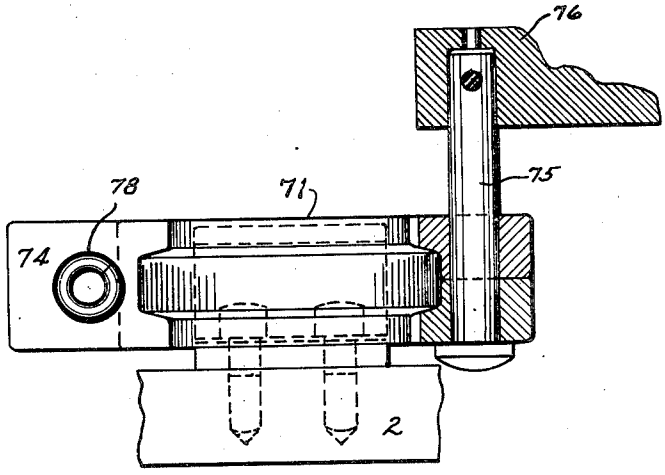


FIG. 5.

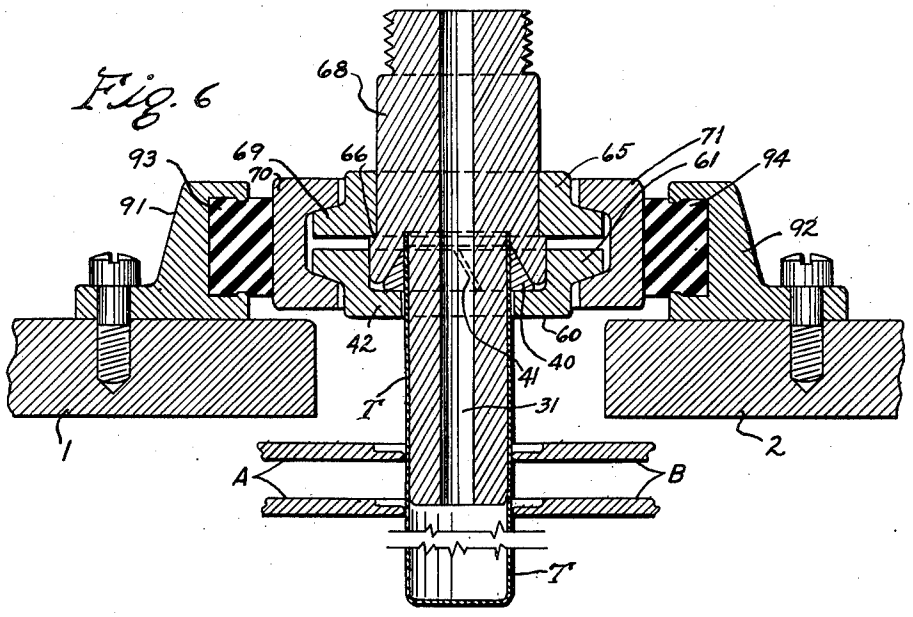
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APPARATUS FOR MAKING METALLIC BELLOWS

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Fig. 6



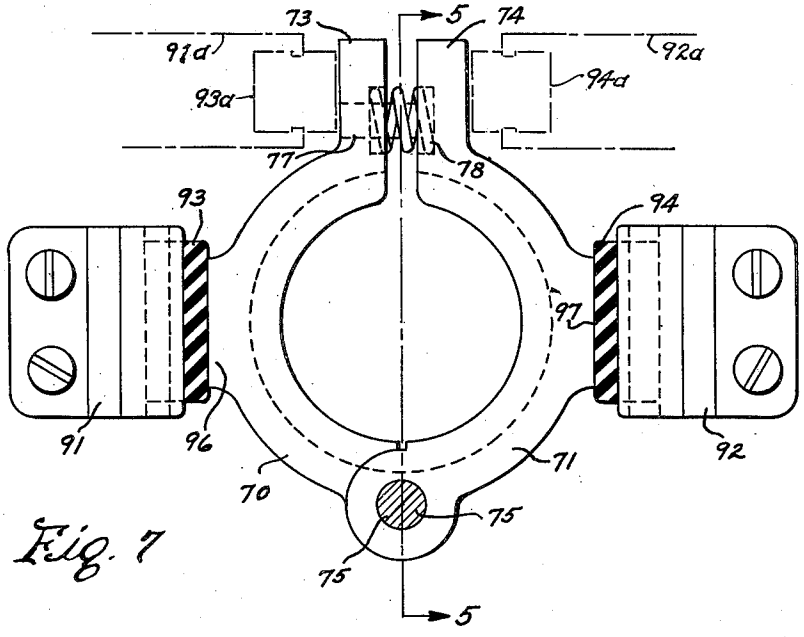


Fig. 7

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APPARATUS FOR MAKING METALLIC BELLOWS

William H. Grant, Cleveland, Ohio

Application August 17, 1946, Serial No. 691,216

9 Claims. (Cl. 153—73)

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This invention relates to a new and improved apparatus for making expansible and collapsible hollow walls in the form, for example, of metallic bellows, formed from a tube and comprising a plurality of coaxial convolutions or folds.

An apparatus and method of this character is shown, described and claimed in my prior application, Ser. No. 568,038, filed December 13, 1944. As there described, thin walled tubes are formed into bellows by expanding them between separable die rings which form the corrugations while subjecting the tube to internal fluid pressure.

As there shown, and as is frequently practiced, the tubes are formed of one closed end, and the open end is fitted over a cylindrical projection having a passage leading to the interior of the tube.

It is an object of the present invention to provide means engaging the interior of the tube for coacting with a contractible gripping means embracing the exterior of the tube and acting to seal the end of the tube to hold the internal pressure during the formation.

Another object of the invention is to so arrange the sealing means that as the dies are brought into engagement with the unformed tube blank, the sealing means may be automatically, effectively operated to grip and embrace the end of the tube surrounding the projecting guide without distorting the tube. A related object is to so arrange the parts effecting the gripping and sealing action that the seal is maintained during the formation, and which act after the formation and release of the pressure, and consequent upon opening of the dies shall be loosened to release the tube, allowing it to be easily removed.

In said earlier application a comparatively brief description was made of the operation of such a tube sealing means, and notice was given of the intent to file an application presenting the subject matter of this gripping and closing means.

In the present application is presented a more detailed illustration and description of the sealing means shown and described in the prior application, and in addition I have shown in the present application two modified forms of tube sealing means.

All these forms have a common object of simply, effectively and automatically sealing of the tube when it is placed in position and is gripped by the dies, and which will release the grip allowing the removal of the tube consequent upon finishing of the tube and the opening of the dies.

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More specific objects will become apparent in the following description which relates to the accompanying drawings, and the essential characteristics are summarized in the appended claims.

In the drawings,

Fig. 1 is a side elevation of a tube bellows.

Fig. 2 is a plan of die carriers, partly in section, and shown in open position.

Fig. 3 is a similar view in the nature of a horizontal section through the die carriers, showing the closed position.

Fig. 4 is an enlarged sectional view taken on a plane through the axis of the tube, and dies showing the gripping means in closed operative position.

Fig. 5 is a sectional view of a modified form of means for closing the gripping ring being taken on a plane indicated by the line 5—5 of Fig. 7.

Fig. 6 is an axial section through the tube and gripping means; and

Fig. 7 is a plan of the same.

Fig. 8 is a modified form in the nature of an axial section through the tube and pressure fluid passage leading thereto with a piston and cylinder arranged to contract the sealing ring.

Referring first to the form shown in Figs. 2, 3 and 4 which corresponds to like parts described in my said prior pending patent application, I will refer briefly to the die carriers which are fully shown and described in said prior application.

The carriers comprise frame members 1 and 2, hinged to a pintle 5 carried on a bracket 6 projecting from a frame 7 of a machine, not shown, but which may be of the general nature shown in my said prior application. Push and pull rods 8 and 9, hinged at 10 and 11 to the frames 1 and 2 serve to swing them from the open position shown in solid lines to the closed position shown in dotted lines in Fig. 2.

A series of pairs of die plates A and B are normally spaced as indicated in Figs. 4 and 8, and are mounted to move upwardly by the action of the plunger acting on the bottom die C (Fig. 8) to bring the pairs of die plates together forming the convolutions T1 (Fig. 1) in the tube T being guided during this closing or collapsing movement axially along the tube by pairs of guide rods 14 and 15 in the frames 1 and 2, respectively.

Each of the pairs of die plates A and B are formed with tube embracing recesses 20, extending half way around the tube and cut away to form a cavity into which the folds of the con-

volutions T1 are extended. At T2 (Fig. 1) is a more rectangular fold which may be formed by a complementary recess as at D1 in a thicker pair of die plates D at Fig. 4.

Overlapping projections 22 and 23 on the carrier frames 1 and 2 are provided with openings 24 for receiving a vertically movable locking pin 25 carried on a slide 26, slidable in a rigidly mounted guideway 26, and serving to lock the die carrying members and dies in closed position during the formation of the tube as described in my aforesaid application.

Projecting into the tube blank T for a distance no greater than the collapsed length of the corrugated tube, when it is in the form shown in Fig. 1, is a guide stud 30 having a passage 31 leading therethrough to the inside of the tube.

The tube T fits slidably over this projection 30. A head member 34 rigid with the projection 30 is shown as having threads 35 for rigidly carrying it in the frame, and for suitable tubular connections, not shown, for the high pressure fluid.

The head portion is shown as having a slight enlargement at 36 which is provided with a downwardly and outwardly sloping beveled face receiving a tapered ring 40 split at 41 to allow it to contract and tightly embrace the upper end of the tube blank T when it is forced upwardly by a flange 42 on a collar 44. This collar is slidably fitted over the head member 36 and is provided with outwardly extending wedge surfaces 48 adapted to be moved upwardly by wedge surfaces 50 on wedge blocks secured to the top members of the frame 1 and 2.

It will be seen that with the tube blank in the position shown in Fig. 4, as the die carrier frames are brought together, the surfaces of the wedges 50 will engage the surfaces 48 moving the collar 44 and its flange 42 upwardly forcing the split ring into its tapered surface contracting it tightly around the tube.

This ring is preferably of hard material and may be split on an angle, as shown at 41, and the amount of contraction required is only a few thousandths of an inch to cause a tight gripping. Thus, the danger of pinching or folding the thin metal of the tube is eliminated.

As the die carriers are swung apart from the position in broken lines in Fig. 2 to that shown in solid lines in that figure, the wedge surfaces 50 are withdrawn from the surfaces 48, and the sleeve 44 thus drops, releasing the ring 40, which tends to expand slightly assuring immediate loosening of the upper end of the tube and allowing it to drop free or to be removed easily.

The wedge blocks 50 may be adjusted by loosening and then tightening the screws to position the blocks toward or away from the center, and thus to increase or decrease the wedging action on the surfaces 48.

As pressure is applied to the interior of the tube, and during the formation of the folds, considerable force is required to counteract the tendency of the tube to slide axially, withdrawing the upper end from the gripping means.

More specifically, as the fold is being formed between the upper pair of dies D and the flange 42, the high internal pressure exerts a strong pull downwardly upon the portion of the tube within the gripping ring 40.

Thus, it will be seen that it is important not only to seal the tube to retain the internal pressure, but that to assure formation of the fold this gripping and sealing must resist a substantial pull downwardly upon the upper end of the tube. Not only should the tube fit closely over the projecting stud, particularly at its upper end, but the contracting action of the ring 40 should actually squeeze the tube between it and the ring, and this squeezing action must be without any wrinkling or distortion of the metal of the tube.

Having in mind that the thickness of the tube may be only a few thousandths of an inch, it is important that the closing action of this gripping ring should be only a very slight contracting motion, and that the split in the ring at 41 should normally be opened only sufficiently to allow the tube to slidably fit within it, and when in the gripping position the opening at the split should have only a few thousandths of an inch clearance.

In the modified form shown in Figs. 5, 6 and 7, greater flexibility and assurance of the tightening of the sealing ring, without necessity for frequent adjustment, may be attained by the use of rubber or like cushioning blocks effecting the wedge action, as will be described.

Referring particularly to Fig. 6, the split guide ring 40 is moved axially into its tapered seat by a flange 42 formed on a collar 60 having a wedge flange 61 in the form of a ring having a sloping wedge surface. A corresponding ring 65 is fitted over the head 68 and seats against a shoulder 66, and presents a flange 69 with an upwardly facing wedge surface.

Drawing the wedge ring 60 and its flange 42 upwardly, contracting the split sealing ring onto the tube T, may be effected by wedging the two flange rings 60 and 65 toward each other. In this form I may accomplish this movement simply and very effectively by using a pair of half rings 70 and 71 having complementary wedge surfaces engaging the surfaces of the flanges 61 and 69, and shown as pivotally carried on a pin 75 depending from a fixed portion of the frame designated 76.

Each of the flanged half rings 70 and 71 is shown as having an extension, 73 and 74 respectively, the one carrying a pin 77 for positioning an expanding spring 78 tending to open the rings, while permitting them to be closed to wedgingly embrace the flanges 61 and 69.

The upper portions of the frame members 1 and 2 are shown as carrying brackets 91 and 92 in which are mounted resilient blocks of rubber or the like, designated 93 and 94, which in turn bear against flattened portions 96 and 97 on the embracing wedge rings 70 and 71.

Thus, it will be seen that as the frame members, carrying dies A and B are brought to the closed position embracing the tube T, that the resilient blocks 93 and 94 will force the wedge ring members 70 and 71 into close engagement with the wedge flanges 61 and 69, moving the flange 42 upwardly, and thus forcing the sealing ring 40 into its tapered seat, and effectively gripping the tube and effecting a seal.

Instead of the arrangement of blocks 93 and 94 positioned to bear against the middle portion of the half rings, I may position the blocks to bear against the extensions 73 and 74. This is shown in broken lines in Fig. 7. Resilient blocks 93*a* and 94*a* may be mounted in bracket members 91*a* and 92*a*, movable with the die frame members as are the brackets 91 and 92, described.

As liquid under pressure is admitted through the opening 31, the tube may be formed, while any desired pressure is being maintained. After

forming is completed the die carrying frame members, 1 and 2, swing apart, the closing pressure against the wedge ring members 70 and 71 is released, and the lower flanged ring 61 moves axially downwardly, allowing the sealing ring 40 to expand, releasing the grip on the upper end of the tube.

The modified form shown in Fig. 8 comprises an arrangement for forcing the tapered sealing ring 40 into its tapered seat by the action of a piston and cylinder. As shown, the cylinder comprises a central section 100, with a lower removable head member 105, a removable packing head comprising a plate 106, and a gland plate 108 fitting around a piston rod 120 which has an axial bore 131 communicating with the bore 31 leading to the interior of the tube T.

Rigid with the piston rod 120 is an enlarged head portion 125 having a reduced extension 124 provided with a tapered seat for receiving the tapered sealing ring 40 which is seated at its flat lower side against an inwardly projecting flange 102, corresponding to the flange 42 of Fig. 4.

Above the head portion 125 is shown a double arrangement of packing piston ring 135 and 136, extending each way from a spacer 137, and clamped by a plate 138 and screws 140 threaded into the head 125.

An additional sealing ring 142 is shown as clamped by a screw held ring 143 to effect a seal between the head and the extension on the piston head 140. Thus, it will be seen that the piston which is allowed a very short movement may be moved upwardly and downwardly by admitting fluid alternately to the upper and lower sides of the pack 135 and 136 through passages not shown. This may be effected under the control of parts cooperating with and actuated in consequence to the opening and closing of the die carrying frames.

Having thus described my invention, what I claim is:

1. In a machine for shaping a hollow metal article by internal liquid pressure separable dies for engaging the hollow article, and means for closing the dies around the article a split ring and a stud adapted to engage a neck portion of the article between them, a tapered seat for the ring, and means actuated by the first named means for moving the ring into its seat consequent on closing of the separable dies.

2. The combination with separable dies adapted to embrace a metal tube while forming it in the dies by applying liquid pressure to the inside of the tube, of a stud for projecting into the tube, a split ring adapted to fit over the tube and positioned around the stud, a tapered seat for the ring, and wedging means for forcing the ring into its seat to tighten it upon the tube as the dies are closed.

3. In a tube bellows forming device having separable dies and carrier means for bringing them together on a tube to be formed, a guide stud for receiving the open end of the tube, a split ring and a seat therefor having a conical beveled surface, means connected with the carrier means for moving the ring and seat axially of the tube to grip the tube against the stud consequent upon closing and opening of the die carrier means.

4. In an apparatus for shaping a hollow metal article while applying internal liquid pressure, a cylindrical member projecting into an open neck of the article, a split metal ring embracing the neck and a fixed tapered seat therefor surrounding the said cylindrical member, separable dies and carrying means therefor, means for bringing the dies together, means for applying power to relatively move said ring and its seat to cause the ring to contract tightly upon the neck of the article pressing it to the cylindrical member as the dies are brought together.

5. The combination with separable dies for embracing a metal tube during forming by applying liquid pressure to the inside of the tube, of a stud projecting into the tube, a split ring around the stud and arranged to fit over the end of the tube, a tapered seat for the ring rigid with the stud, and movable wedging means for forcing the ring into its seat to tighten it upon the tube as the dies are closed, means carrying the separable dies and having surfaces for actuating said wedging means.

6. In a device of the character described, the combination of a cylindrical stud adapted to receive the open end of a tube to be formed, a concentric tapered seat rigid with the stud, a split tapered gripping ring fitted into the tapered seat and adapted to embrace and grip the tube between it and the cylindrical stud, a plurality of dies arranged in pairs and carrier members for the dies adapted to bring them into engagement with the tube and to open to release the tube, a member movable axially of the tube and stud, and wedging surfaces carried by the die carriers for moving said last named member and the tapered gripping ring toward gripping engagement upon closing of the dies.

7. In a device for forming tubular bellows between a series of pairs of separable dies under hydraulic pressure within a tube blank and including radially movable die carriers, of means for projecting into and fitting one end of the tube, a split ring surrounding said projecting means, a tapered seat for said ring rigid with said projecting means, said ring having a complementary tapered surface, an axially movable member for urging the ring into its seat and having a wedging surface, wedging elements mounted on the die carriers and adapted to act when moved radially toward the tube to seat the ring in tube gripping engagement.

8. In a device of the character described, the combination of a projection adapted to fit into the end of a tube to be formed by internal hydraulic pressure, an annular seat surrounding the projection and rigid therewith, a split gripping ring having a surface fitting the annular seat and fitting over the end of the tube, an axially slidable collar engaging said ring and having outwardly projecting sloping surface, a corresponding collar having a surface sloping toward the first mentioned collar, a divided wedge ring having complementary wedging surfaces for engaging the last two mentioned sloping surfaces, means for movably supporting said divided wedge ring members, separable die carrier members and resilient means interposed between them and said rings effective to cause the wedging and gripping action consequent upon closing the dies into tube-forming position.

9. In an apparatus of the character described, the combination of a projection adapted to fit into the end of a tube blank, a split ring surrounding the projection for receiving the tube end, a means for engaging and contracting the split ring to effect a seal and to effect a gripping action resisting longitudinal motion, separable dies for embracing the tube, carriers for the die members for bringing them together around the tube, and means connected with and actuated by

movement of the carriers for operating the means for engaging and contracting said ring when the dies are moved to closed position.

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