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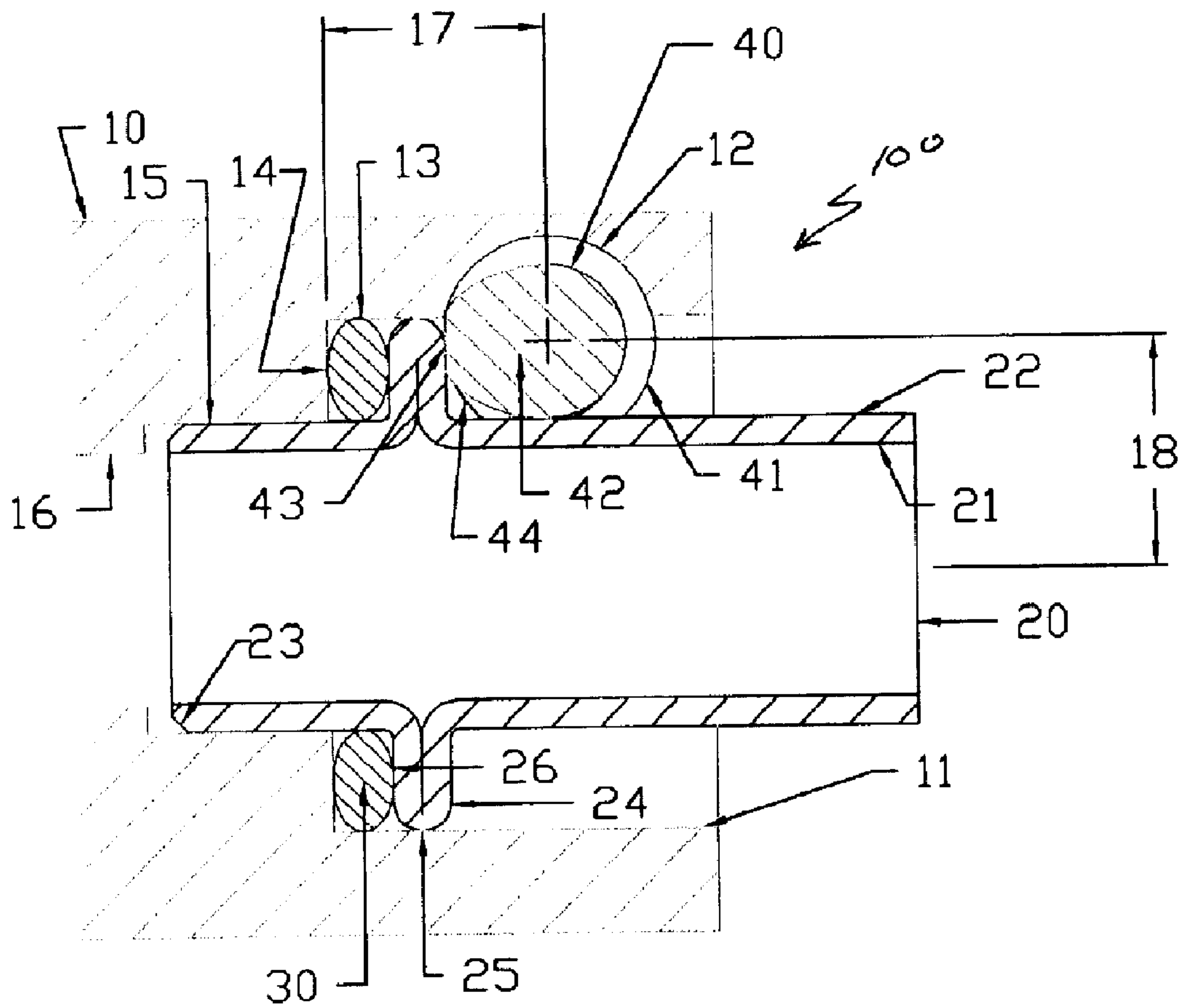
(54) Titre : JOINT DE FLUIDE A CYLINDRE DE VERROUILLAGE A EXCENTRIQUE A ROTATION
(54) Title: FRACTIONAL TURN CAM LOCK FLUID JOINT



(57) Abrégé/Abstract:
A fractional turn fluid joint for a fluid body. The fluid body includes a port which accommodates a tube having a tube shoulder. The port has 2 concentric port bores and a lock bore transverse to the port bores. A lock, placed in the lock bore, includes 2 lock

(57) Abrégé(suite)/Abstract(continued):
profiles and is rotateably operable between an open and a locked position. One lock profile has a cam profile and the other profile defines a flat catch section adjacent two sections of greater diameter than the catch section. A resilient element is mounted next to the shoulder. In the open position the lock is removable from the bore. In the closed position, the cam of the first lock profile acts on the tubing for preventing removal of the lock and the catch section urges the shoulder against the annulus for a sealed passageway between the fluid body and the tube.

ABSTRACT

A fractional turn fluid joint for a fluid body. The fluid body includes a port which accommodates a tube having a tube shoulder. The port has 2 concentric port bores and a lock bore transverse to the port bores. A lock, placed in the lock bore, includes 2 lock profiles and is rotateably operable between an open and a locked position. One lock profile has a cam profile and the other profile defines a flat catch section adjacent two sections of greater diameter than the catch section. A resilient element is mounted next to the shoulder. In the open position the lock is removable from the bore. In the closed position, the cam of the first lock profile acts on the tubing for preventing removal of the lock and the catch section urges the shoulder against the annulus for a sealed passageway between the fluid body and the tube.

FRACTIONAL TURN CAM LOCK FLUID JOINT

TECHNICAL FIELD OF THE INVENTION

A fluid joint, specifically a fractional turn cam lock fluid joint.

BACKGROUND OF THE INVENTION

Medium and high-pressure fluid joints are most commonly made with ferrule type compression fittings, o-ring sealed face-seal fittings, or o-ring sealed flare fittings. All are expensive and each one has a specific set of drawbacks. For instance, all 3 are threaded and typically require 4+ turns, plus a specific installation torque, to properly install the fittings. Next, all 3 use tubing nuts, which also typically require 4 full turns (plus a specific torque level) to clamp and seal the tube to the fitting.

All 3 styles add a bulky and expensive external fitting to the fluid body.

The compression type fitting has 2 or 3 parts requiring high dimensional accuracy plus mirror-finish surfaces (i.e. the fitting body and 1 or 2 ferrules). The compression type fitting relies on relatively high degree of installer skill to properly assembly and judge a finished joint. An improperly made joint may be missed during inspection and subsequently come apart under pressure. Lastly, as the ferrule type fitting has a metal-to-metal seal, it is quite intolerant of tube imperfections. That is, it requires the end of the tube to be dimensionally correct plus free of any axial or spiral scratches.

O-ring sealed face-seal fittings require a special, very flat bushing to be welded to the end of the tube. As the exterior end of the bushing creates the seating face, it is quite prone to accidental damage as the tube is shipped and handled. The sealing diameter of the face seal fitting is quite large and it must manage much larger forces.

The o-ring sealed flare fitting is also prone to damage of the sealing surface on the tube end.

SUMMARY OF THE INVENTION

This invention provides a fractional turn fluid joint for a fluid body, the fluid body comprising a fluid chamber, comprising:

- a tube including a circumferential tube shoulder, a tube end portion, a tube body portion, and defining a tube core;

- a port defined by the fluid body, the port in fluid communication with the fluid chamber and receiving at least the tube shoulder and tube end portion, the port further defining:

  first and second approximately concentric port bores, each bore having walls;

  an annulus positioned between the walls of the two port bores; and

  a lock bore transverse to the port bores;

- a lock, comprising a first and second longitudinal lock segment, the lock rotateably operable between an open and a locked position when the lock is inserted in the lock bore, the first lock segment defining a cam and the second lock segment defining a catch section adjacent two sections of greater diameter than the catch section; and

- a resilient element mounted on the tube end portion;

wherein in the open position the lock is removable from the lock bore, and in the closed position, the cam acts on the tubing for preventing removal of the lock from the lock and the catch section urging the shoulder against the annulus intermediated by the resilient element for defining a sealed passageway between the fluid chamber and the tube core.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1: a cross-sectional view of the joint taken through its axial centreline.

Figure 2: a radial cross-sectional view of the joint taken through the axial centreline of the locking cam.

Figure 3(a-e): Figure 1 repeated through 5 stages of the locking cam being engaged.

Figure 4: cross-sectional radial views showing the 5 distinct profiles sectors of the locking cam.

Figure 5: an alternative embodiment where the tube shoulder is 75°.

Figure 6: an alternative embodiment where the shoulder is formed into a retainer.

Figure 7: an alternative embodiment where a smaller shoulder outer diameter and a backing ring is used.

Figure 8: an alternative embodiment with a larger shoulder outer diameter and a wave washer energizer.

Figure 9: an alternative embodiment with a backing washer to increase the strength of the joint.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

By comparison to the 3 conventional fluid joint types mentioned above, this invention:

- replaces these 8+ turns of the conventional types with a small number of different wrench sizes, plus 2 torque settings, with inserting a cam and turning it a fractional turn;
- primarily uses the parent metal containing the fluid body, adding only a small cam, which need not protrude from the body;
- would have 1 precision bore, with less demanding tolerances and coarser surface finishes;
- would have the function as an inherent feature machined into the fluid body rather than being part of a purchased part;
- has the joint requiring essentially no interpretation: if a cam can be inserted and turned to lock, the joint is properly assembled;
- is quite tolerant of tube imperfections, and by virtue of the tube-end forming, is tolerant of dimensional variations in the raw tube; and
- forms a clamping shoulder on the tube end. As the sealing surface is the outer diameter of the tube immediately adjacent to the shoulder, it is much more difficult to damage the sealing surface during handling. The sealing diameter of the face seal fitting is much larger than the sealing diameter of this invention.

Referring to **Figure 1**, a side cross-sectional view of a preferred embodiment, this invention comprises: a female port **10** in a fluid body; the tube end **20**; an o-ring **30**; and the cam lock **40**. The fluid body has an inner chamber in fluid communication with the port **10**, The port **10** has a first largest diameter **11**, whose size is accurately machined in tube bore area **13**, so as to allow the o-ring **30** to provide a leak-free seal and to also avoid high-pressure extrusion. A relatively fine surface finish (≤ about 100 μ-in) is also maintained in area **13**. Otherwise, the diameter **11** may be significantly oversized, bell mouthed, oval, and coarsely finished (all for minimizing cost). Bore **11** terminates at a face **14** (about 90°), which may also have a 100 μ-in surface finish and a relatively larger tolerance on the about 90° feature **14**. A second smaller bore **15** is sized to just allow the tube outer diameter **22** to fit, but to prevent any significant tilting of the tube **20** in the body. An optional third smallest diameter **16** is nominally the same size as the inner diameter **21** of the tube **20**, so as to minimize turbulence and pressure losses. A cross-drilled stepped-bore **12** accepts the locking cam **40**. The centre of bore **12** specifically located "dimension **17**" from face **13** and "dimension **18**" from the axial centreline of the port **10**.

The fluid tube **20** has a tube core with an inner diameter **21**, and an outer diameter **22**. Of these, only the outer diameter **22** is significant. Thus, tube wall thickness may vary with no or minimal impact on the joint **100**. A slight chamfer **23** on the terminal end of the tube **20** helps guide the tube **20** into the pocket created by bore **15**. A shoulder **24** (about 90°) is formed into the tube **20**, with its outer diameter **25** being only slightly smaller than the diameter of bore **11**. In most cases, the forming of the shoulder outer diameter **25** to size should not be sensitive to tubing outer diameter **22** (again reducing cost). The terminal side of the shoulder **26** would be formed against a high quality die face, assuring a surface finish of about ≤ 100 μ-in.

This joint **100** would preferably use commercially available o-rings (again to reduce costs). O-ring **30** serves 2 functions. Firstly, it ensures that the joint **100** is leak-free. Secondly, it acts as an energizer, ensuring that the cam lock **40** cannot become loose and vibrate into an unlocked position. In order to provide adequate energizer displacement, most popular size joints **100** would be expected to use ϕ0.103 or larger cross-section o-rings **30**.

Figure 2, an axial cross-sectional view of the preferred embodiment of **Figure 1**, portrays the joint **100** as being made in a hexagonal shaped body (e.g. as a fitting). More commonly, the joint **100** would be made in a larger and more complex fluid body that more typically would be round, square or rectangular. The function and description do not vary based on the body's shape.

The cam lock **40** is made from a suitably strong material, preferably metal, depending on the application. It is generally round in shape. A preferred embodiment has the cam lock **40** with 5 distinct longitudinal segment, each having different profiles. Once the o-ring **30** and tube **20** are inserted and bottomed in the port formed by bore **11**, the cam **40** is slid through cross-drilling bore **12** (**Figure 1**). The cam lock **40** must be specifically oriented so that its lobes will clear the tube and permit insertion (discussed below re. **Figure 3**). The cam lock **40** has a 1st profile **41**, which is approximately circular and serves as a 1st bearing to support and locate the cam lock **40**. The cam lock **40** has 2 identical profiles **42**, as the 2nd and 4th profile, which have the lobed shape of a cam. Their angular orientation can either: locate the lobe away from the tube **20** permitting insertion; or, locate the related lobe adjacent to the tube **20** wall preventing the removal of the lock **40**. As shown in **Figure 2**, the profiles **42** are in the locked position so that any attempt to move the cam lock **40** in either axial direction would be prevented by the lobes' edges **46** hitting the outer diameter **22** of the tube **20**. As shown in **Figure 3a**, 3rd profile **44** also has the lobed shape of a cam, including a catch section **43**. Boundary regions of catch section **43** are at a smaller radial distance from the centre of the cam than the immediately adjacent lobe crests on either side of the section **43**.

As the lock **40** is rotated, the lobe of the 3rd profile **44** increasingly deflects tube **20** more deeply into the port by displacing the shoulder **24**. This motion compresses o-ring **30**, which acts as a spring resisting the deflection. When the catch section **43** reaches the shoulder **24**, tube **20** moves back out of the port by the spring action of the o-ring **30**. This snap action acts as an over-centre lock, keeping tube **20** against catch section **43** and preventing the lock **40** from vibrating loose.

A 4th profile **45** is also circular with a smaller diameter than that of the 1st profile **41**. 4th profile **45** serves as a 2nd bearing to support and locate the lock. Diameter of the 4th profile **45** is chosen so that it will just clear the outer diameter of tube **22** during insertion. Accordingly, diameter of 4th profile **45** must be smaller than the diameter of the 1st profile **41**. The contour at the far end of the 4th profile **45** maybe adjusted based on clearance or aesthetic issues for the individual application. Preferably the end would be cut square 90° to the axis of the lock. As shown in **Figure 2**, the end is cut at about 60° to the axis, with the cut oriented angularity so that it's end will not extend past the face of the body when turned to the locked position. The outer shape of the 1st profile **41** is similarly variable. As shown, it is square cut about 90° to the axis. However, its contour could also be adjusted to fit a specific purpose. The outer end of the 1st profile **41** would have an integral shape allowing the cam lock **40** to be turned by a suitable tool. This form could be of any type, including but not limited to: a hex socket; 2 wrench flats; hex wrench flats; a screwdriver pocket (standard, Phillips, Robertson, Torx, *etc.*). A hex socket can be seen in **Figure 4**.

The mechanism as a whole when the cam lock **40** rests in the locked position (facing shoulder **40**) defines a local energy well, requiring an input of mechanical energy to compress the o-ring sufficiently to bring the cam lock **40** to an unlocked position. Although a preferred embodiment has the catch section **43** being a flat surface, other shapes of the catch section **43** are also included in this invention, including a convex surface. The area and shape of catch section **43** should be chosen so that it does not create unacceptably high surface pressure on shoulder **24** at the maximum pressure the joint **100** will experience.

The maximum lift of the lobe of the 3rd profile **44** is chosen so as to facilitate manufacturing and to accommodate the uncertainties in all dimensions of the joint **100**. For example, a maximum lift of 0.0001" could not be made with practical means and would be too small to accommodate the typical ±0.002" in joint **100** dimensions. The choice of lift dictates the minimum cross-sectional diameter of o-ring **30**. That is, the cross-sectional diameter essentially defines the ideal gland dimensions. Those dimensions must be such that at the maximum lift point, the o-ring **30** would not be compressed to the point that its volume exceeded the gland's volume. In such a case, as solids are not compressible, the force would become infinite and the cam lock **40** could not be rotated to the locked position. If the maximum lift compressed the O-ring **30** to exceed the gland volume, either the cam lock **40** could not reach the energy well (*i.e.* the locked position), or the cam lock **40** or tubing lip **24** would break, or the wrench used would be stripped. For tube outer diameter **22** sizes below 1" standard O-rings **30** with cross-sectional diameters of $\phi0.103$ and larger are likely to be selected. The combination of bearing diameters (**41, 45**) and materials should be selected so that the cam lock **40** will not deflect or break under the maximum design pressure. For example, a 3/8" tube **20** sealed with a $\phi0.103$ o-ring **30** would experience ~2150 lbs. of force at 10,000 psig. Accordingly, relative strong materials and bearing sizes would be chosen for such an application. If the same joint **100** only experienced 400-psi, the maximum force would be 86 lbs., permitting weaker materials and bearing sizes.

Figures 3(a-e) show 5 successive stages of the cam lock **40** being rotated to its locked position. **Figure 3a** shows the cam lock **40** inserted but not yet rotated towards lock. At this point, tube **20** is just deep enough in the cavity **11** to allow the cam lock **40** to be inserted. As a result, o-ring **30** is uncompressed and is still in its as-moulded circular shape. The location of the catch section **43** is preferably about 50° from vertical. In this orientation, the lobes of 2nd and 4th profiles **42 44** will clear the tube outer diameter **22**.

Figure 3b shows the joint **100** after the cam lock has been rotated about 60° towards the shoulder **24**. At this point, the rising profile of lobe **44** has just contacted the shoulder **24**. However it has not yet begun displacing tube **20** towards the female port 10 and thus the o-ring **30** is still in its as-moulded circular shape.

Figure 3c shows the joint **100** with the cam lock **40** nearing its maximum lift point. As this point tube **20** has been displaced a significant amount towards the female port **10**, compressing o-ring **30** into a shape approximately elliptical. At this point, the o-ring **30** is compressed more than it will be in the locked position. Accordingly, its effective spring force has become relatively large.

Figure 3d shows the joint **100** with the cam lock **40** in its maximum lift position. That is, it **40** is at the point where the "lower" corner of catch section **43** is engaging shoulder **24** to provide the maximum deflection of tube **20** towards and into the female port **10**. Notably, the o-ring **30** is significantly deformed now and almost completely fills the available space. It is thus important that the design ensures that the space available for the o-ring **30** is greater than the volume of the o-ring **30**. Otherwise, either something will break, or it will not be possible to turn the cam lock **40** all the way to its locked position.

Figure 3e shows the joint **100** with cam lock **40** turned to its locked position. At this point, the lift is smaller than in **Figures 3c** or **3d** and the spring action of o-ring **30** has forced tube **20** to back away from the port **10**, keeping it in contact with catch section **43**. As the pressure inside the joint **100** increases above atmospheric pressure, more force will exerted to keep shoulder **24** against catch section **43**. Thus, vibration or shaking forces cannot cause the cam lock **40** to rotate out of its locked position. To get out of lock, a significant rotational force is needed to re-engage the edge of catch section **43**, deflecting tube **20** away form the port **10** and further compressing o-ring **30**. Thus, once locked, the joint **100** stays locked. Also at this point, the o-ring **30** will have rebounded to the elliptical shape normally expected when an o-ring **30** is in-place and compressed, thereby providing a sealed passageway between the inner chamber of the fluid body and the tube core.

The angle of rotation of the cam lock **40** from its inserted position (**Figure 3a**) to its locked position (**Figure 3e**) may range and should be preferably about 60 degrees or more. If inserted any closer to the locked position than 60° away, the lock **40** is likely to interfere with the tubing lip **24** and prevent insertion. A preferred angle is about 90 degrees.

Figure 4 provides more details on the cam lock **40**. The end view portrays the cam lock **40** with a hex socket, permitting the cam lock **40** to be turned by an Allen wrench. As noted, other screwdriver and wrench profiles are also usable, without preference. The side view shows the various surface profile zones. The cross-sectional views depict the shapes of each zone. Section A-A describes 1st profile **41**, which is purely circular (this is the 1st bearing journal). Section B-B describes 2nd profile **42**, which is the cam lobe that serves to prevent the cam lock **40** from moving further into or out of the bore 12. (note: there are 2 cams in the 2nd and 4th profiles **42**, one on each side of 3rd profile **44**). Section C-C describes 4th profile **44**, which is the cam lobe that serves to displace and clamp the tube's shoulder **24**. Section D-D describes 5th profile **45**, which is the 2nd purely circular profile (the 2nd bearing journal).

A minimal configuration of the cam lock **40** requires only 2 profiles: (1) a profile, currently the 2nd profile **42** described above, with a cam to prevent the removal of the lock **40** from the lock bore **12**; and (2) a profile with a catch section **43**, *e.g.* the 3rd profile **44** described above, to prevent the tube **20** from being removed. In this case, the lock port **12** does not completely extend through the entire transverse width of the port **10** but has only sufficient depth to accommodate the cam lock **40** such as bring the catch section **43** to bear on the shoulder **24** and allow cam edge **46** of the 2nd profile **42** to prevent the cam lock **40** from being removed from the bore **12**. For example, the cam lock **40** may have 4 profiles: the 4th and 5th profiles may have the same shape since there is no need for a cam edge on the 4th profile to restrict movement of the lock **40** into the bore **12**. The 1st and 2nd profiles may have the same shape since there is no reason for a completely

The above mentioned figures relate to a joint **100** configuration the end of the tube **20** is formed with an about 90° shoulder and where the outer diameter **25** of the shoulder **24** can be controlled to acceptable limits. **Figures 5 - 8** reveal other tube forming profiles that are within this invention.

Instead of a 90° angle, lesser shoulder angles are possible. **Figure 5** depicts an application where the angle of shoulder **24A** is instead about 75°. In this case, the o-ring **30** can still be used as an effective seal, and will seal directly against the rearward shoulder face **26A** (which should have an appropriately smooth surface finish). However, since cam lock **40** cannot seat against an about 75°-angled surface on its own, accordingly, a wedge-shaped shim **50** is added to provide an about 90°-seating surface for the cam lock **40**. Shim **50** has an appropriate outer diameter **51** and inner diameter **52** to ensure that joint **100** is properly clamped, to minimize tubing tilt, and to avoid stress concentrations on the bore **11** and tube **20**. As part of those features, appropriate radii or chamfers would be used on the shim **50** margins to avoid sharp edges. Mating face **53** on the shim **50** would have an angle matching the angle of shoulder **24A**. Mating face **54** on the shim **50** would be formed preferably 90° to the axis of the port **10** and provide a seating surface for and to match catch section **43**. As the internal joint **100** depth has been increased by the extra width of shoulder **24A** and by the width of shim **50**, the centre of bore **12** is relocated to new distance **17A** from the base of the port **10**. This centre may be relocated to new distance **18A** from the centreline of the port **10** if the tubing **20** diameter changes.

Another possible alternative to a 90° shoulder is a shoulder **24B** with a lesser angle and a smaller outer diameter **25B**. In that case, a clamp ring **60** would be used. **Figure 6** depicts an application where the angle of shoulder **24B** is instead 75° and the outer diameter **25B** is much smaller. In this case, the o-ring **30** cannot seal against shoulder **24B** nor can the cam lock **40**. Accordingly, a clamp ring **60** is added to provide those functions. Clamp ring **60** would have 2 vertical (90°) faces **61** and **62** against which O-ring **30** and cam lock **40** seats. Clamp ring **60** also has an outer diameter **63** and inner diameter **64** that prevent o-ring **30** extrusion under high pressure, minimize tube tilting, and avoid stress concentrations on bore **11** or tube **20**. As the internal joint **100** depth has been increased by the width of clamp ring **60**, the centreline of cam lock **40** bore **12** is relocated to new distances **17B** and **18B** from the base of the port **10** and the centreline of the port **10** respectively. The tube **20** would be formed so that the material deflected into the cavity **65** of clamp ring **60**, making them joined to each other. Both mechanical and hydraulic systems are capable of so joining them. The engagement depth of shoulder **24B** into clamp ring **60**, and the selection of the material for clamp ring **60**, would be chosen to ensure that the neither part could shear or extrude at the maximum design pressure.

Referring to **Figure 7**, another possible embodiment would be an approximately 90° shoulder **24** where outer diameter **25C** of shoulder **24C** is not accurately controlled. In that case, extrusion of the o-ring **30** under high pressure could occur. Accordingly, a back-up ring **70** would be added. Back-up rings 70 are known in the art and can be formed of rubber, plastics, or metals and may be solid or split. Almost any type could be used. As shown, a formed, solid rubber back-up ring **70** is used (such backup rings **70** are commercially available including one sold by Parker-Hannifin™ Corporation under the trade name ParBAK™). As the internal depth of the joint **100** has increased by the width of the backup ring **70**, the centreline of cam lock **40** bore **12** is relocated to new distances **17C** and **18C** from the base of the port **10** and the centreline of the port **10** respectively.

Referring to **Figure 8**, another possible alternative would have a 90° shoulder **24** but would not use the o-ring **30** to provide the force to keep the cam lock **40** and shoulder **24** together. In such a case, a spring **80** could be added to provide that force. As shown, spring **80** is a Belleville spring. However, other types of compression springs are known and could be used instead. For this configuration, shoulder **24D** would be wider, having a larger outer diameter **25D** than seen in the other forms. The body **10D** would have an additional larger bore diameter **11E** to accommodate shoulder outer diameter **25D**. Compression spring **80** would sit at the bottom of bore **11E** and press against shoulder **24D**. A second bore diameter **11D** would be the same size as the bores **11** in the other forms and would provide the outer sealing surface for o-ring **30**. If o-ring **30** were used by itself, the o-ring **30** could extrude under high pressure into the gap between the shoulder and the bore left by spring **80**. Accordingly, high-pressure joints **100** would add a backing ring **70** to prevent extrusion. As the internal depth of this joint **100** is modified by the new bore **11E** and by the presence of the backing ring **70**, the depth of bore **11D** is adjusted to dimension **19** and the position of cam lock bore **12** is adjusted to dimensions **17D** and from the base of bore **11D** and the centreline of port **11D** respectively.

In some instances it may be desirable to dramatically increase the strength of the joint **100** without increasing the strength of the tube **20**, that is, without changing its wall thickness or material type. In such cases, features such as those shown in Figures 9a and 9b could be added, as required to achieve the desired strength. As a first step, lip **24E** of the tube **20** would have a much larger inner radius **27E**, serving to reduce stress the presence of any stress risers and to move the stress concentration to a larger diameter. For example, by increasing inner radius **27E** from 0.010" to 0.032", the burst strength of a 3/8" joint **100** would increase by more than 30%. As a second step, a backing washer **90** could be added. Washer **90** would also have an appropriate inner diameter **93** which was smooth in nature (to minimize the creation of any stress risers on the outer diameter of the tube **20**) and suitably close to the formed outer diameter of the tube lip **25E** of the tube **20** to minimize tilting of the tube **20** and thus to minimize stress on the tubing lip **24**. Finally washer **90** would have an inner diameter radius **94** large enough to ensure that no sharp edge on the washer **90** could contact the companion radius **27E** or OD **22** of tube **20**. In this fashion, the backup washer **90** would ensure that the load created by the fluid pressure was equally distributed around the OD **22** of tube **20**. Otherwise the stress is concentrated at the tangential intersection of the OD **22** and a chord parallel to the centreline of the cam lock **40**. The use of such a back-up washer **90** dramatically reduces the stress concentration and has been shown to easily double the burst strength of the joint **100**. It can be appreciated that the material used in making washer **90** and the selection of its axial length would be dependent on the strength requirements of the specific application. For example, the use of a washer **90** may not be required for burst ratings less than 5,000 psig. At increasingly higher burst pressures, washer **90** would be added and its axial thickness progressively increased. As shown in Figure 9a, the joint **100** has a back-up ring **70** for O-ring **30** and also a spring energizer **80**. However, it can be appreciated that any combination, or omission, of these parts would be possible. Figure 9b shows the simplest form, where the joint **100** has only the O-ring **30**, cam lock **40** and backing washer **90**. (Note: in Figure 9b, the distance **17F** is less than the distance **17E** in Figure 9a, because the energizer spring **90** was omitted.) For example, the angle between the two faces of the tubing lip **20** could be different from the 180° included angle shown. In fact, a lesser angle with generous inner diameter radii (such as shown in Figure 6) could be quite advantageous. In such case, the angle of face **92** would be adjusted to mate with the tubing lip **24** angle, while the angle of face **91** would remain as shown.

The invention also includes the preferred variation with a visible indicator showing direction of rotation and where the cam lock **40** should be positioned when in the locked position. For example, such indicator could be any number of graphic symbols, including but not limited to: an arrowhead; a raised dot; a padlock symbol (open & closed); the words "open and closed". Whatever symbol(s) chosen may be formed, stamped or silk screened or other marking method used, to attach to the part.

It will be appreciated that the above description relates to the preferred embodiments by way of example only. Many variations on the system and method for delivering the invention will be clear to those knowledgeable in the field, and such variations are within the scope of the invention as described and claimed, whether or not expressly described.

Claims:

1. A fractional turn fluid joint for a fluid body, the fluid body comprising a fluid chamber, comprising:

- A tube comprising a circumferential tube shoulder, a tube end portion, a tube body portion, and defining a tube core;
- A port defined by the fluid body, the port in fluid communication with the fluid chamber and receiving at least the tube shoulder and tube end portion, the port further defining;

  first and second approximately concentric port bores, each bore having walls;

  an annulus positioned between the walls of the two port bores; and

  a lock bore transverse to the port bores;
- a lock, comprising a first and second longitudinal lock segment, the lock rotateably operable between an open and a locked position when the lock is inserted in the lock bore, the first lock segment defining a cam and the second lock segment defining a catch section adjacent two sections of greater diameter than the catch section; and
- A resilient element mounted on the tube end portion;

wherein in the open position the lock is removable from the lock bore, and in the closed position, the cam acts on the tubing for preventing removal of the lock from the lock bore and the catch section urging the shoulder against the annulus is intermediated by the resilient element for defining a sealed passageway between the fluid chamber and the tube core.

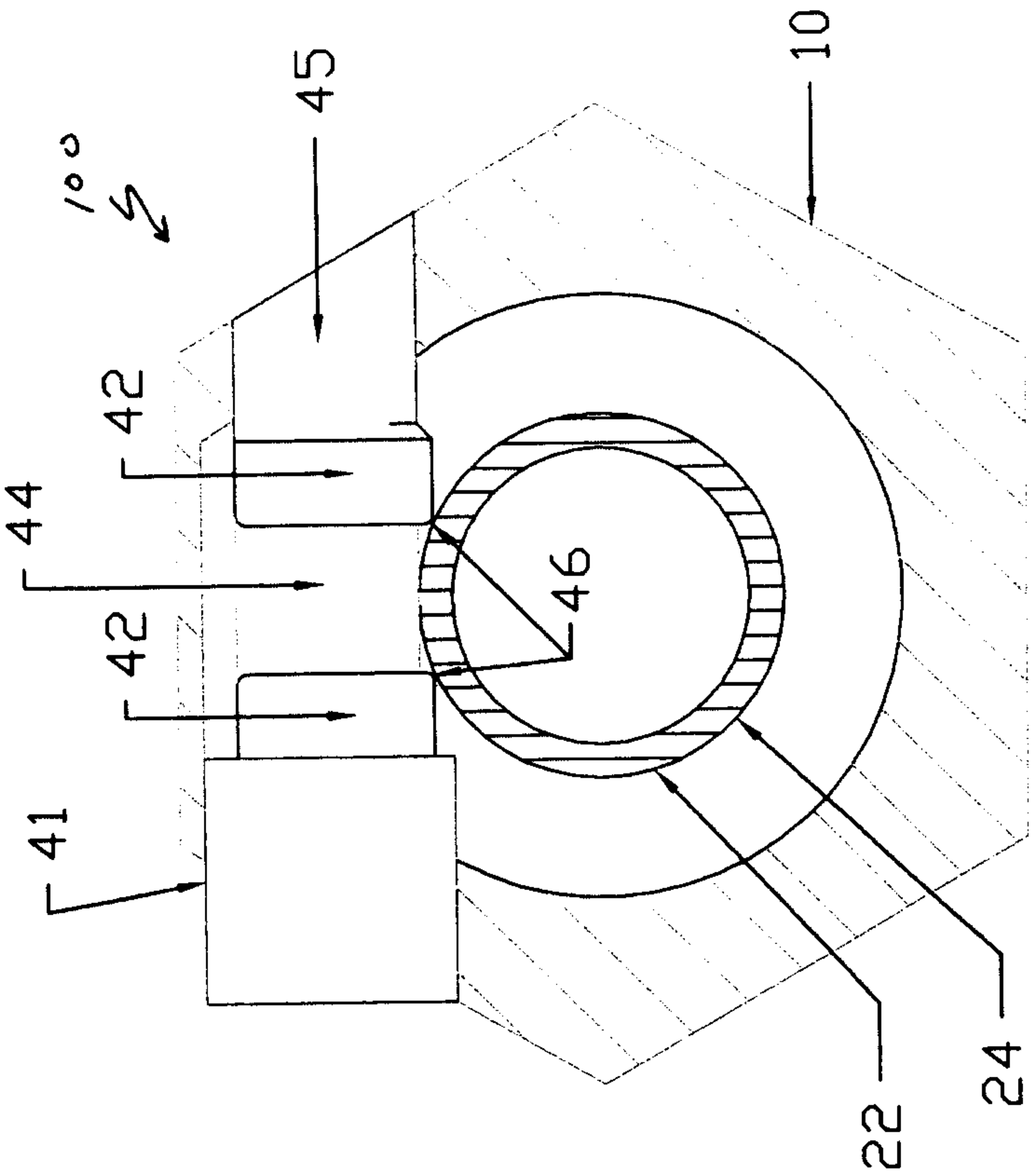


Figure 2

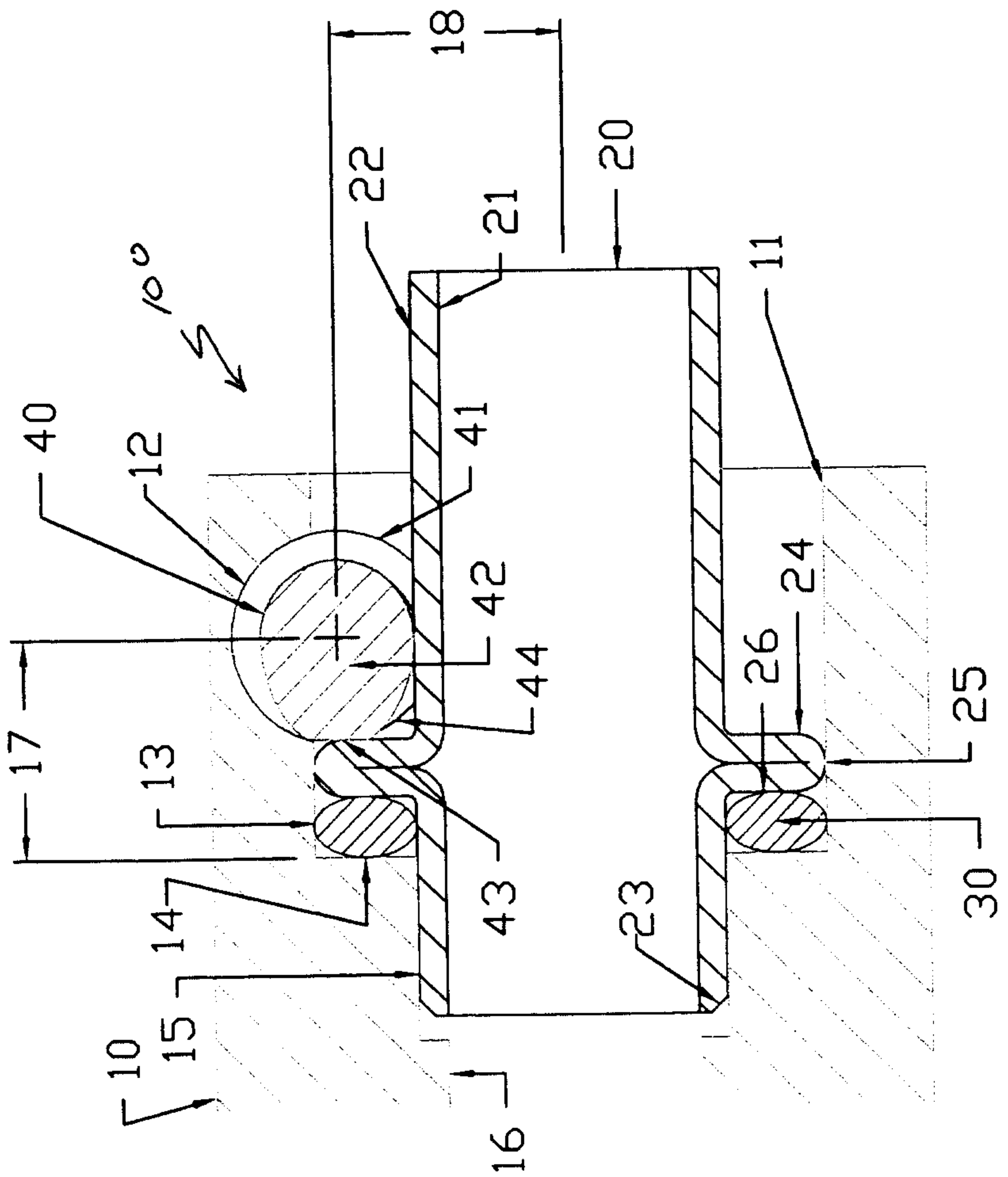


Figure 1

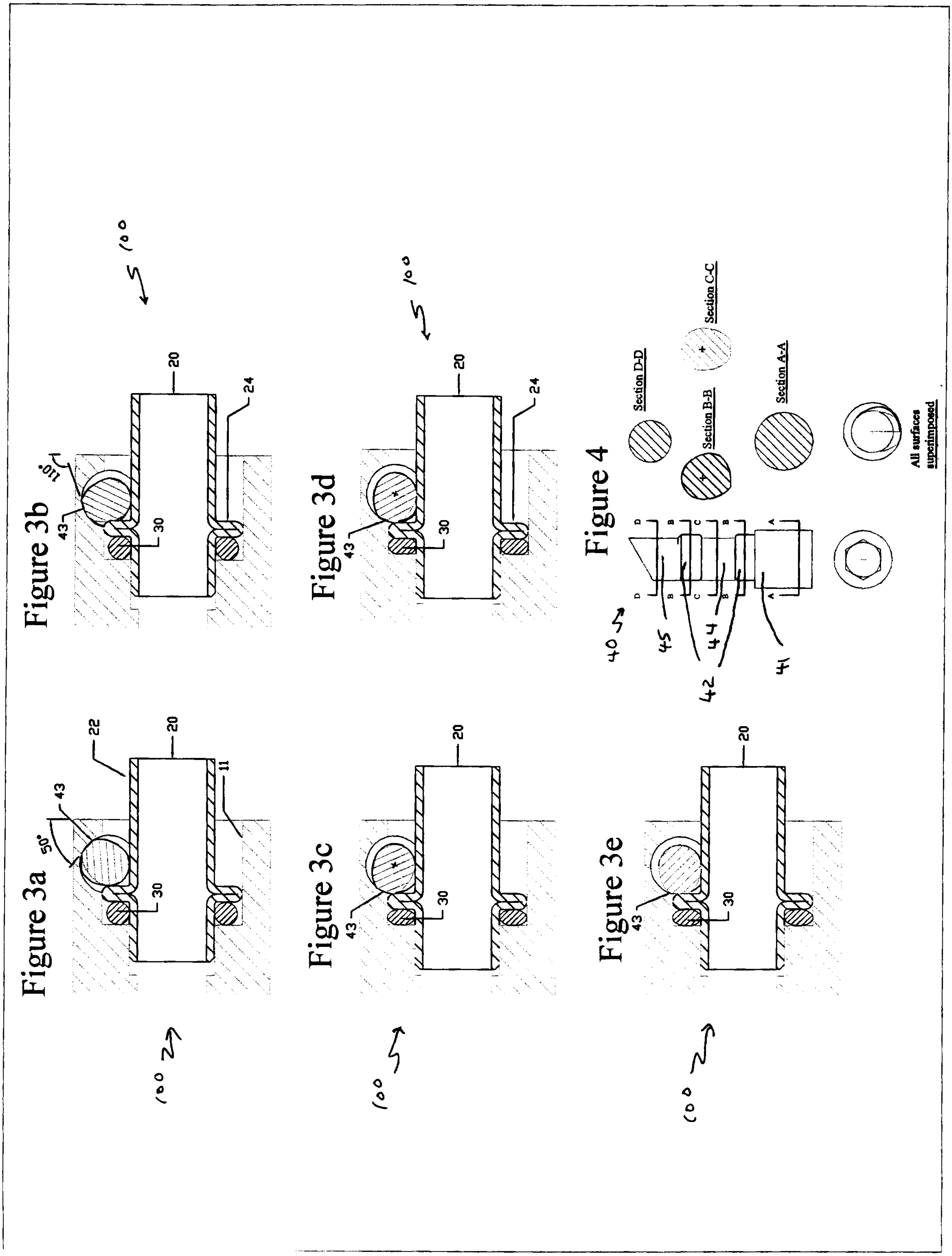


Figure 3a
Figure 3b
Figure 3c
Figure 3d
Figure 3e
Figure 4
100
20
22
24
11
30
43
50°
110°
40
41
42
44
45
A
B
C
D
Section A-A
Section B-B
Section C-C
Section D-D
All surfaces superimposed

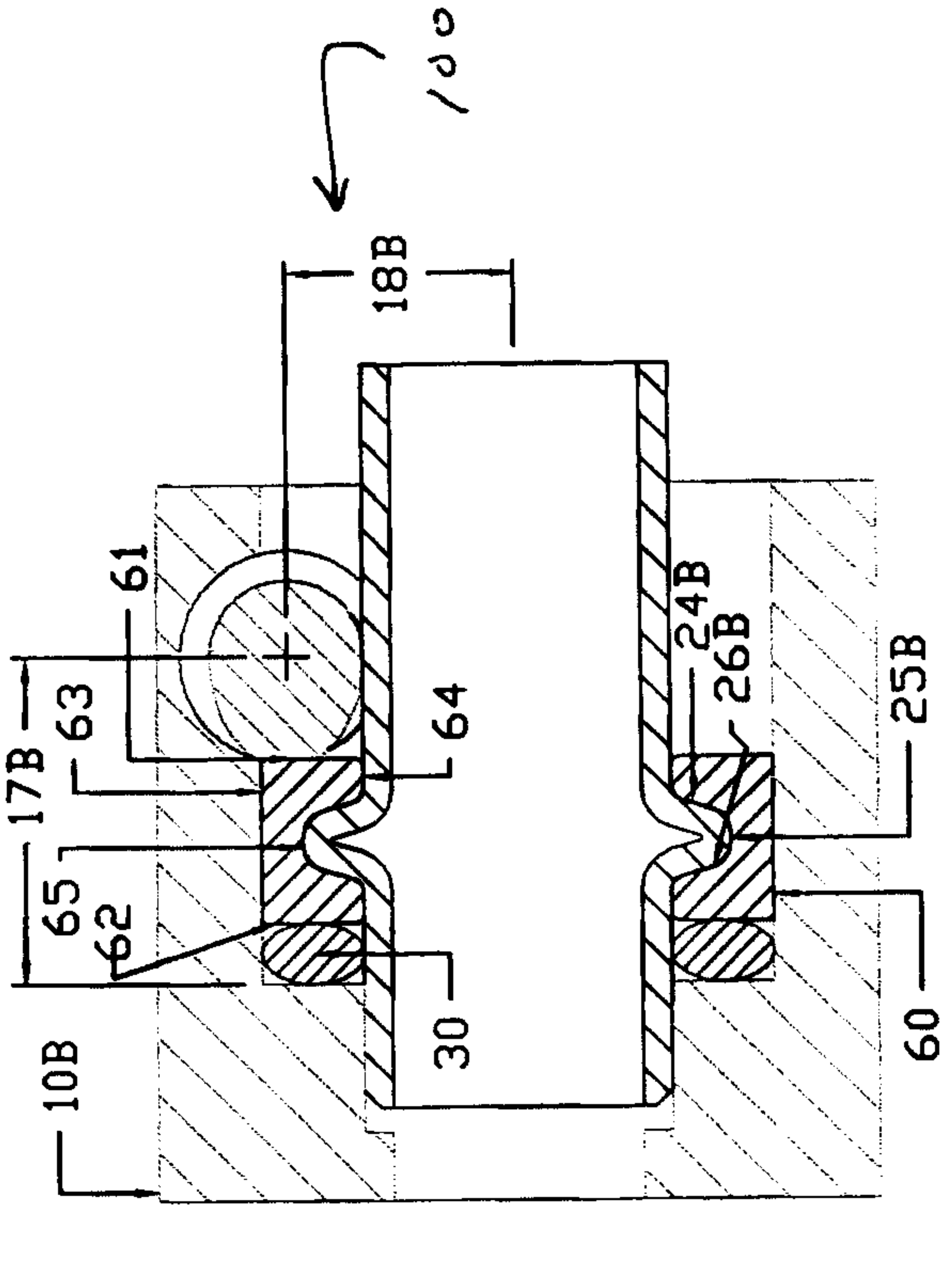


Figure 6

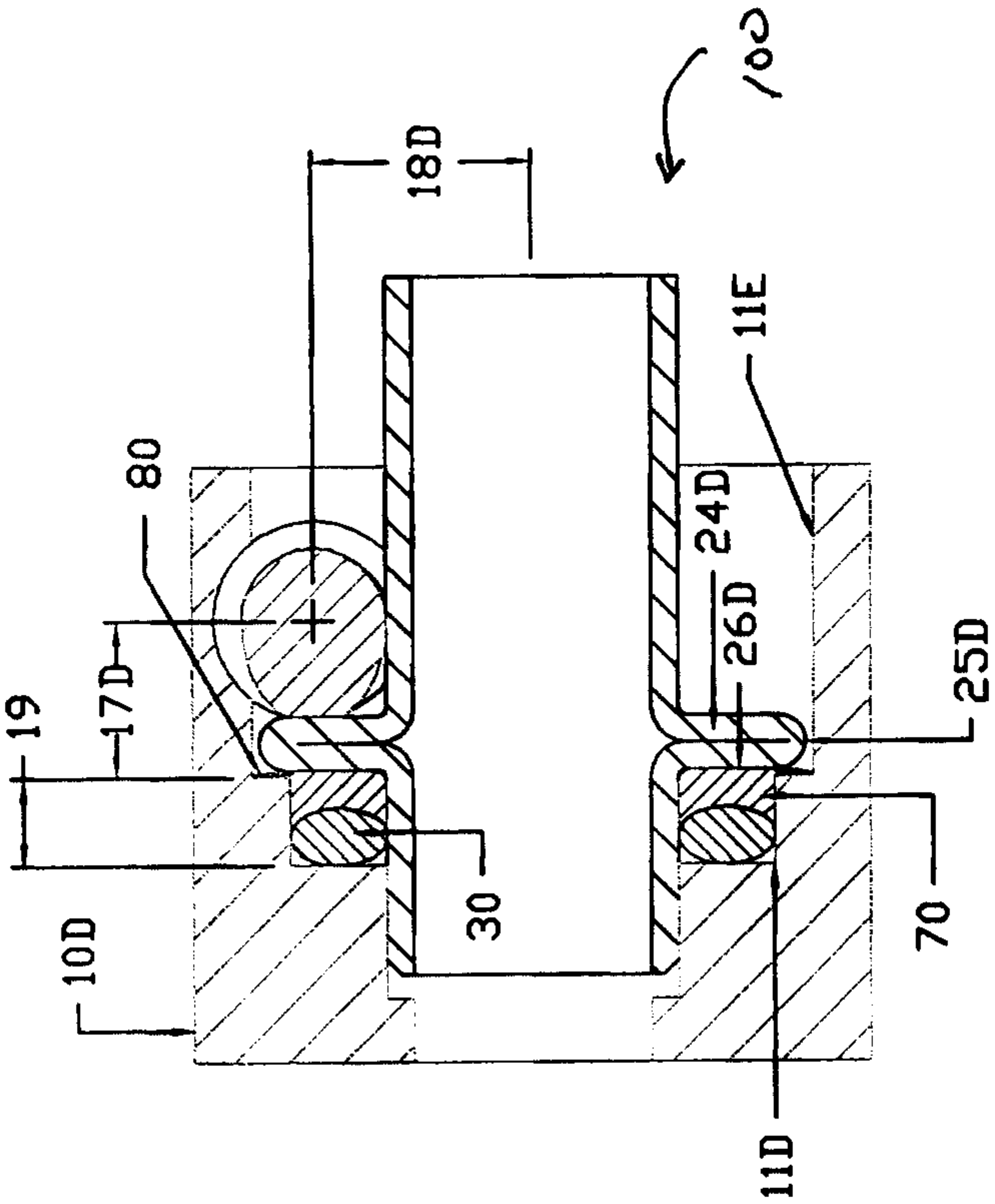


Figure 8

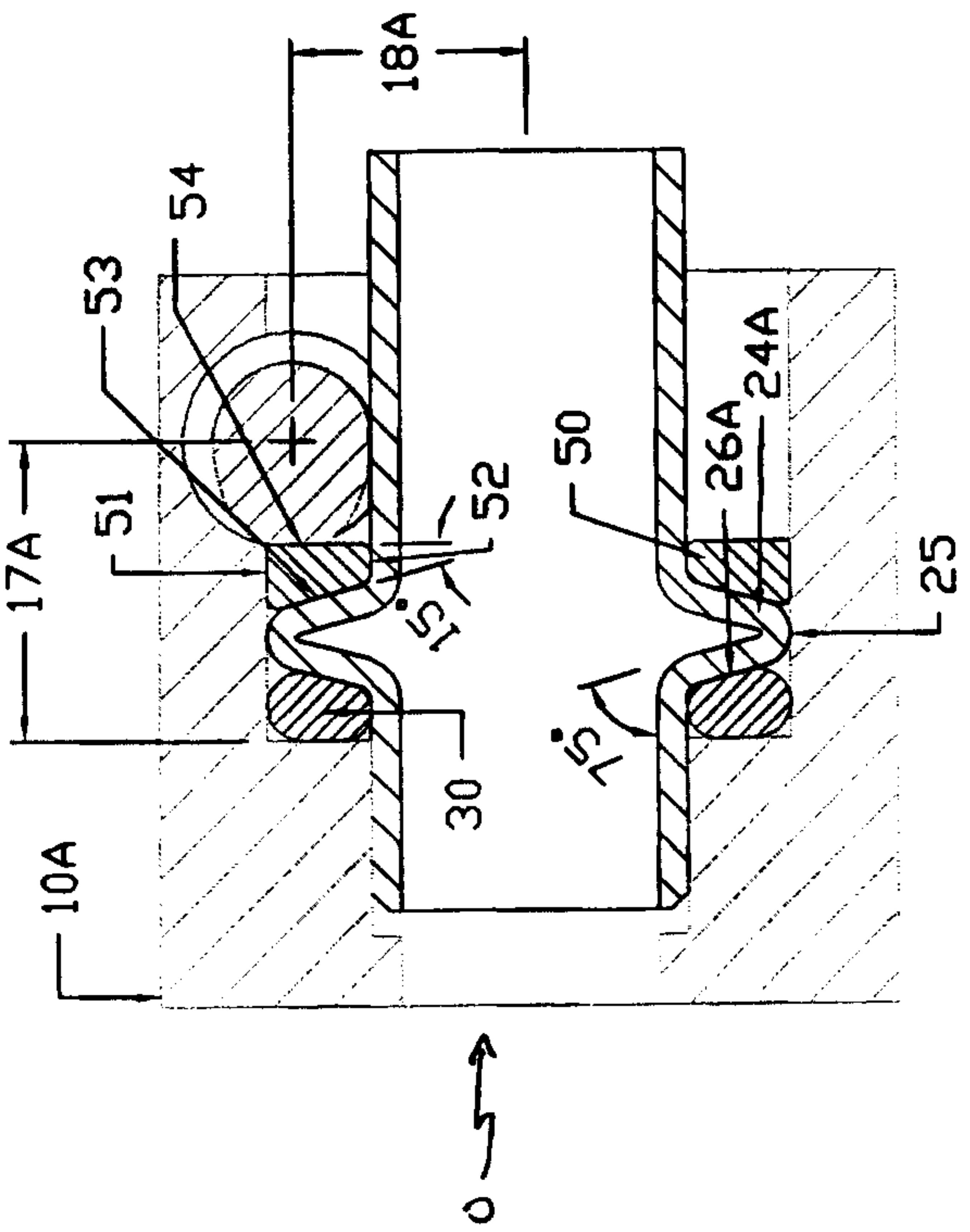


Figure 5

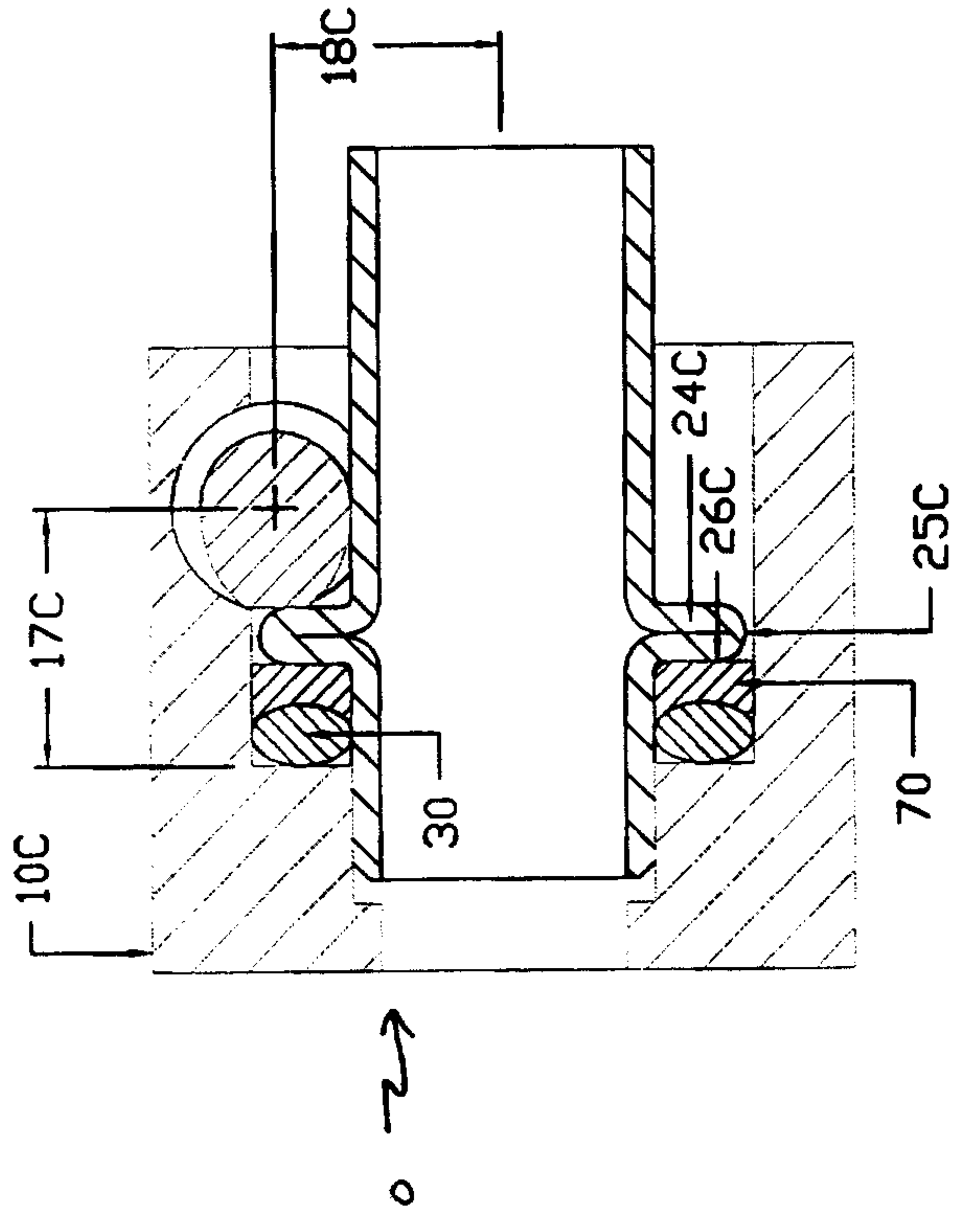


Figure 7

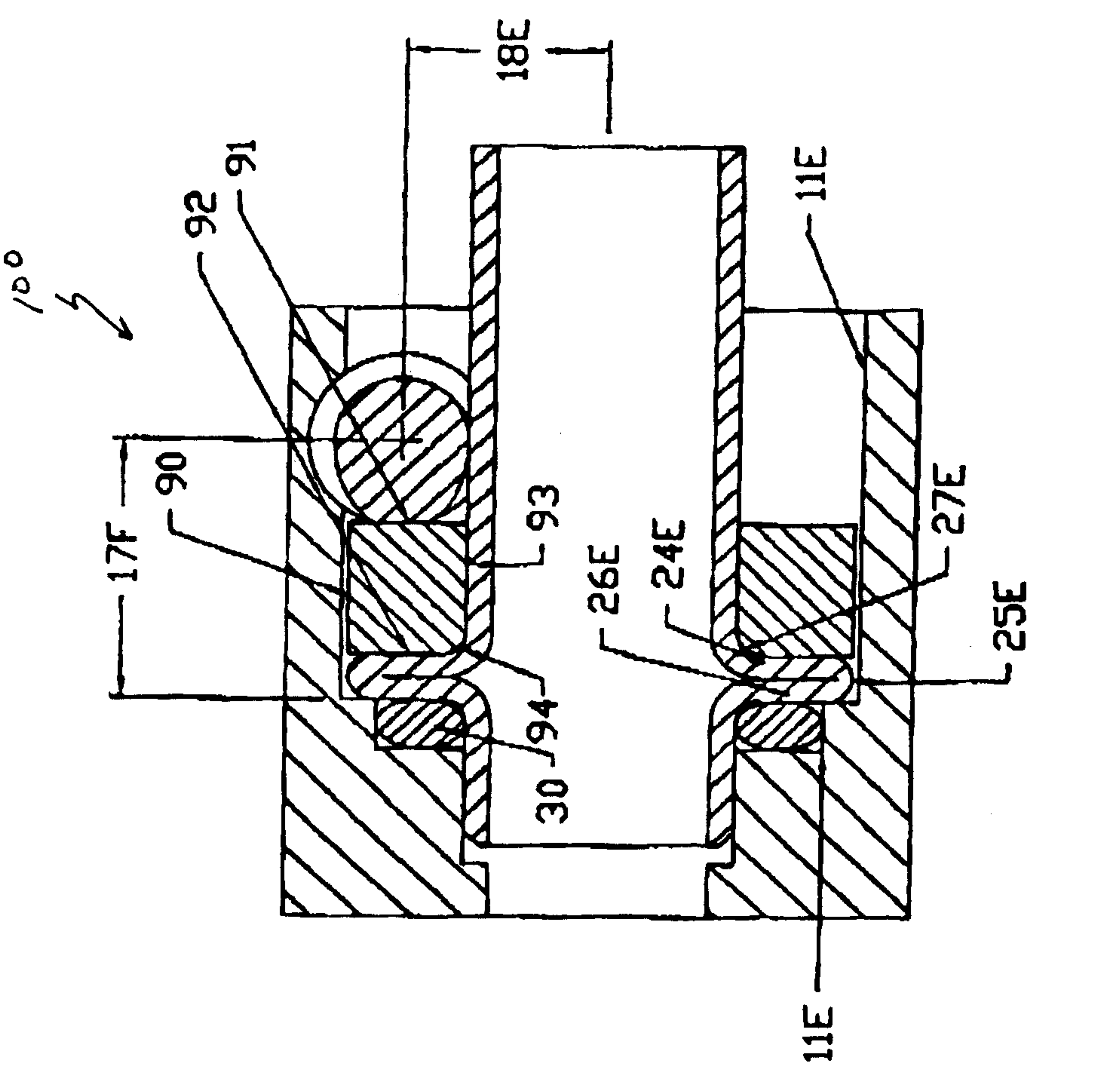


Figure 9b

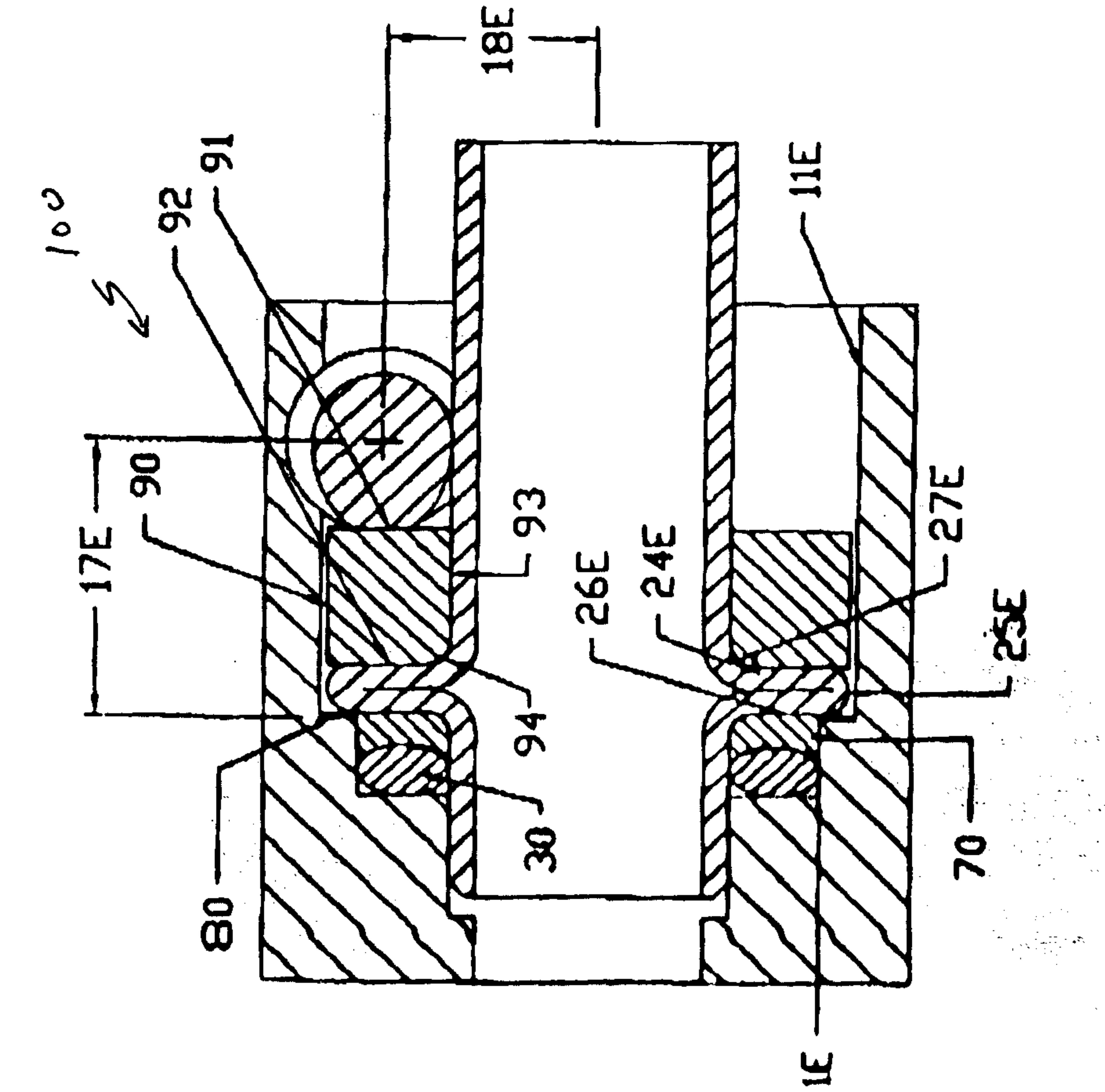
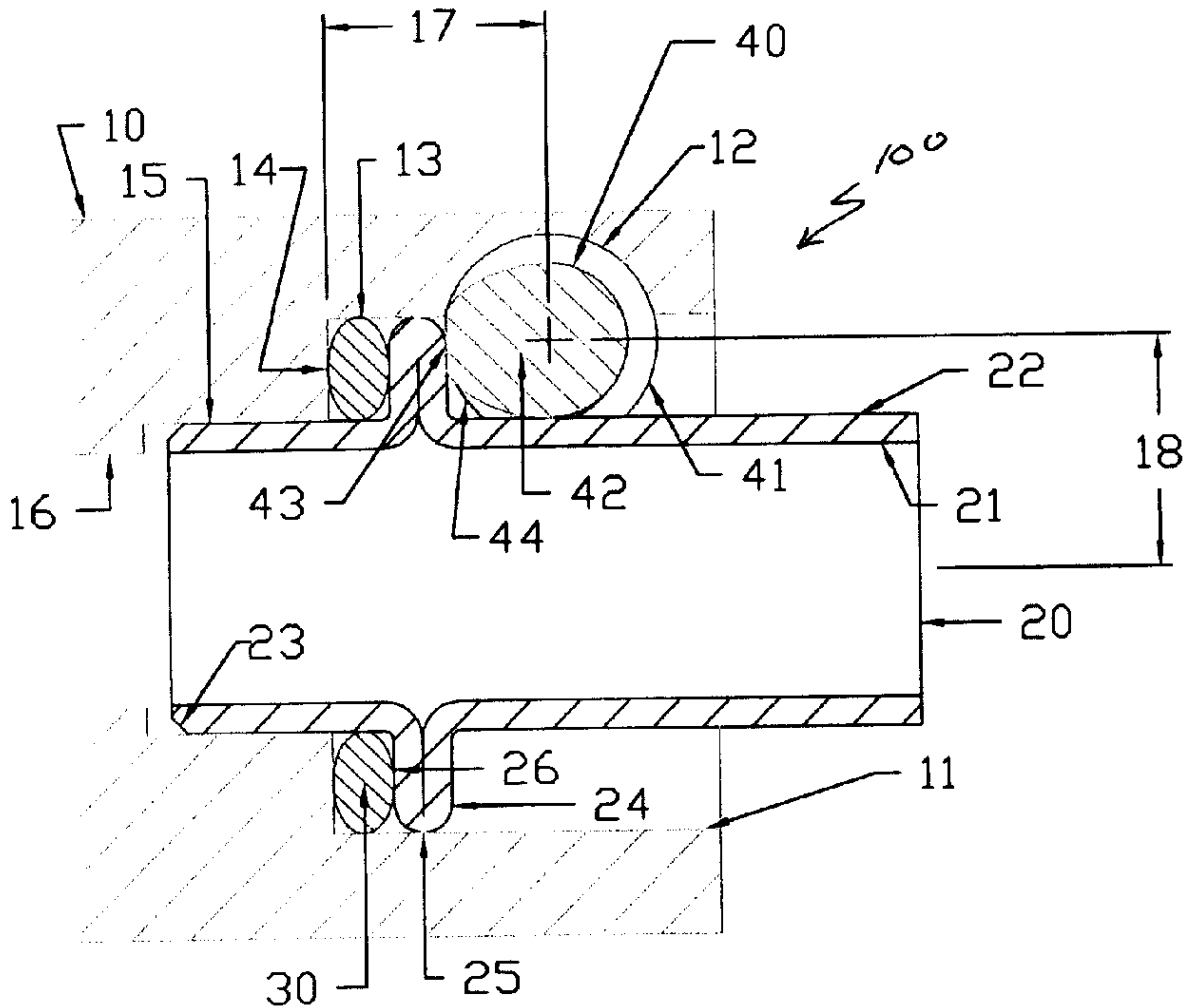


Figure 9a


17
40
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100
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