# United States Patent [19]

**Leibinsoh**

[11] **3,780,732**

[45] **Dec. 25, 1973**


[54] **NON-GRAVITATIONAL INFUSION SET**


[76] Inventor: **Saul Leibinsoh,** 11 Hagardom St., Rishon Lezion, Israel



[22] Filed: **Apr. 8, 1971**

[21] Appl. No.: **132,516**

**Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 753,405, Aug. 19, 1968, Pat. No. 3,595,232.

[52] **U.S. Cl.** ..... **128/214 F,** 128/DIG. 12, 222/336

[51] **Int. Cl.** ..... **A61m 5/14**

[58] **Field of Search** ..... 128/214 F, 214 R, 128/DIG. 12, DIG. 15, DIG. 20, 402; 222/95, 97, 102, 336



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 1,663,678 | 3/1928 | Byerly | 222/95 X |
| 2,600,631 | 6/1952 | Freedman | 222/103 |
| 3,120,846 | 2/1964 | Fletcher | 128/DIG. 20 |
| 3,086,529 | 4/1963 | Munz et al. | 128/DIG. 15 |
| 3,153,414 | 10/1964 | Beall et al. | 128/DIG. 12 |
| 2,749,914 | 6/1956 | Braley | 128/402 |
| 2,776,077 | 1/1957 | Freedman | 222/103 |



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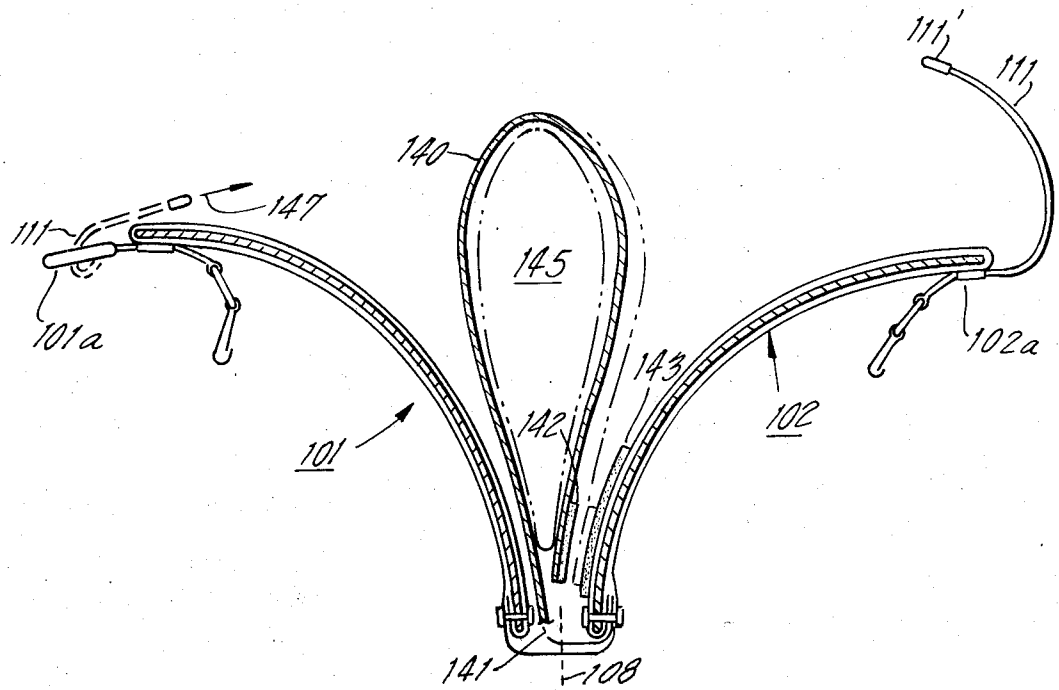
[57] **ABSTRACT**

A pressure-applying device for use in an infusion set for feeding blood, saline solution or other fluids from a compressible bag to a catheter or needle for administration to a patient. The device comprises at least a pair of highly resilient, arcuate shaped metallic plates pivoted along their adjacent edges and drawn together along their free edges by buckles or clasps. When pivoted into facing relation the adjacent convex surfaces of the plates act to squeeze fluid from the compressible bag when positioned therebetween. Use of the device obviates the necessity to elevate the infusion bag during use, since infusion is effected by positive pressure rather than by gravity alone.


**2 Claims, 13 Drawing Figures**



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SHEET 1 OF 4

FIG. 1a.

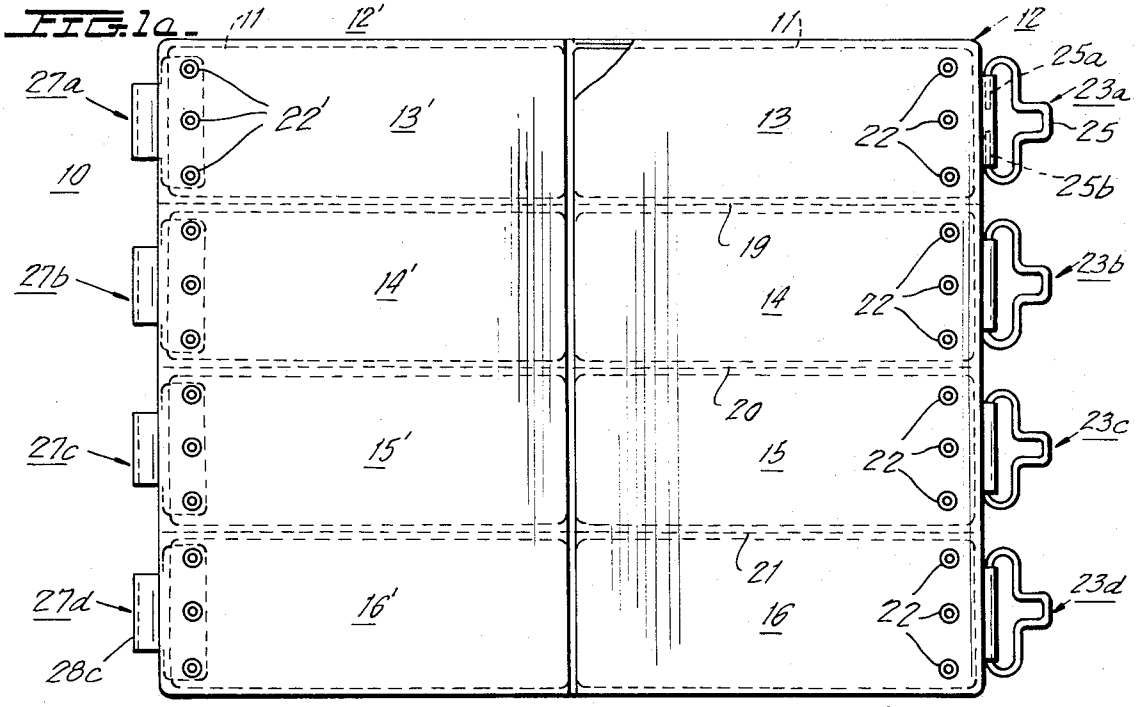


FIG. 1b.

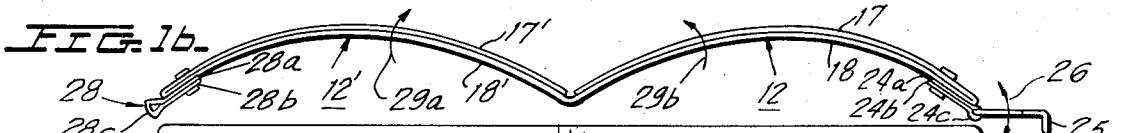


FIG. 1c

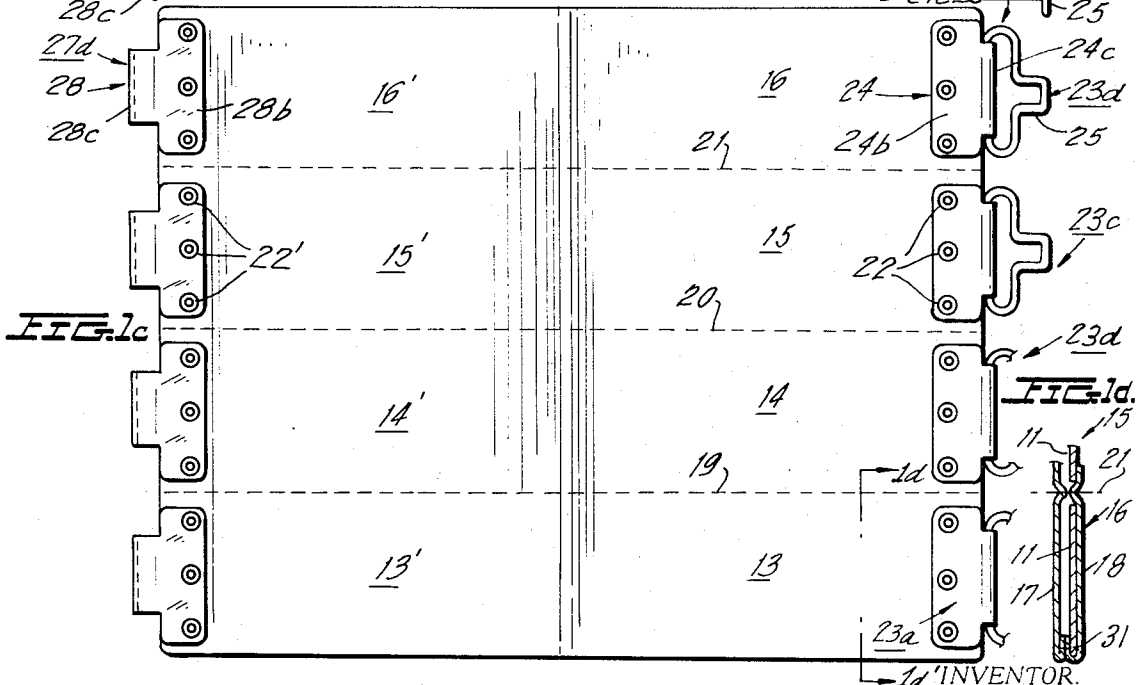


FIG. 1d.




FIG. 1e.

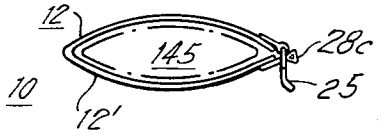


FIG. 1f.

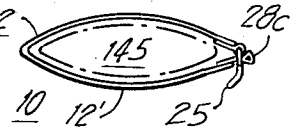


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FIG. 2a.

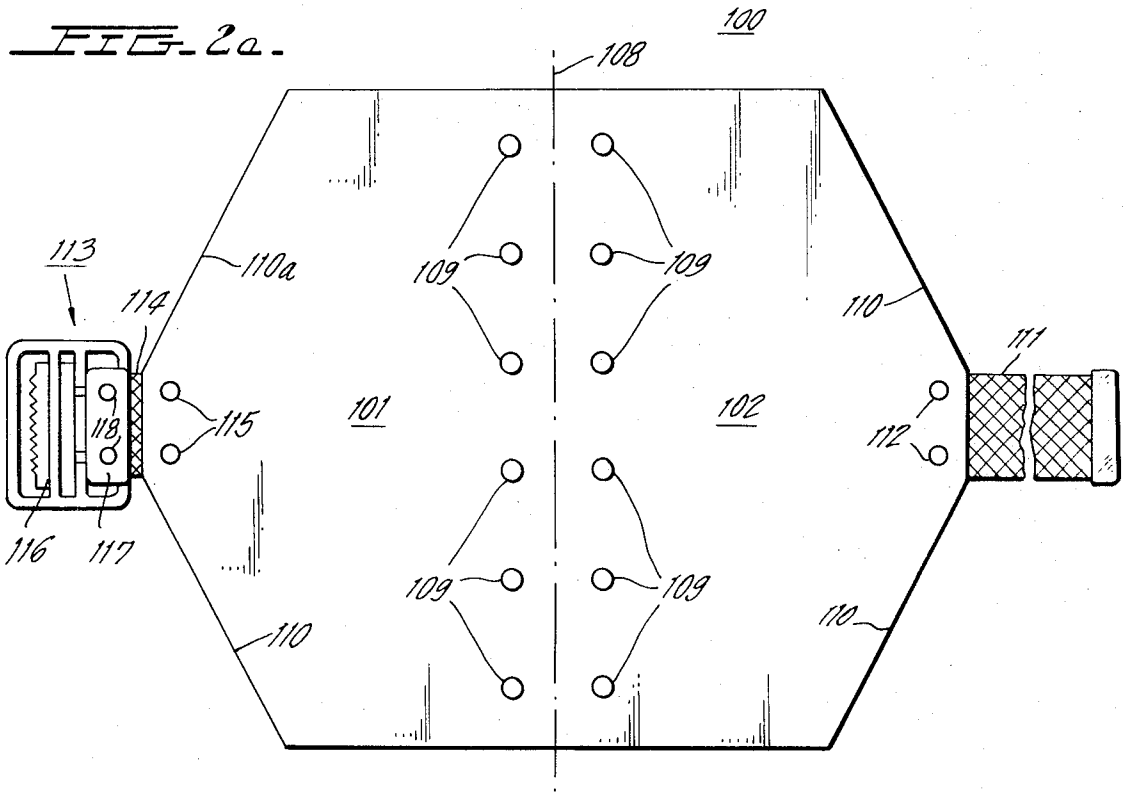



FIG. 2c.

2e

FIG. 2e.

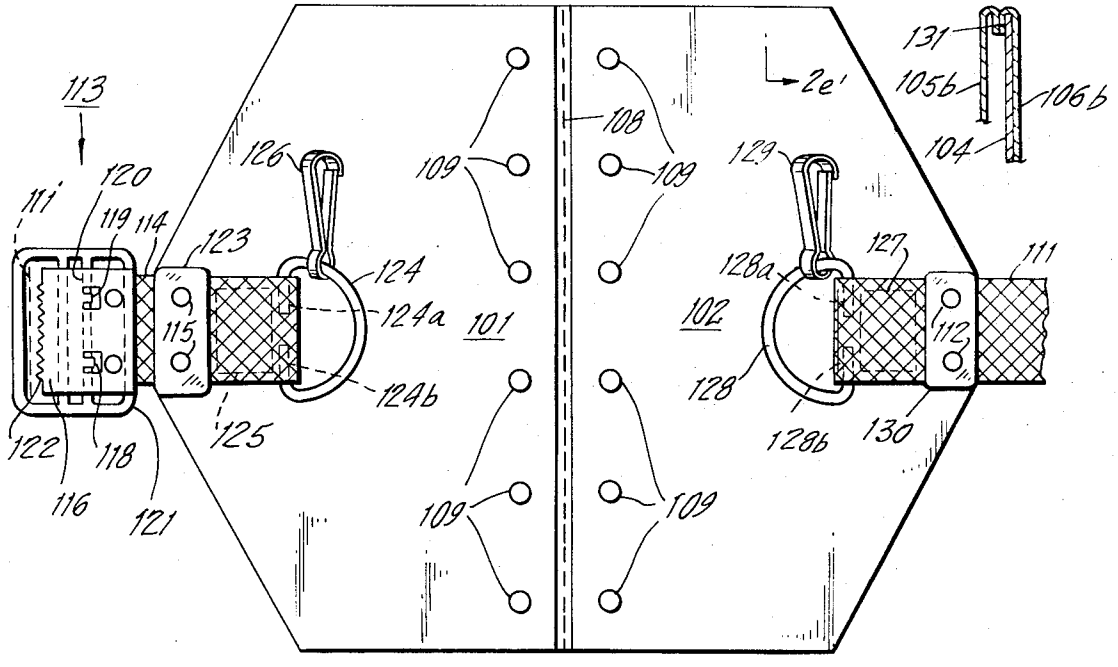
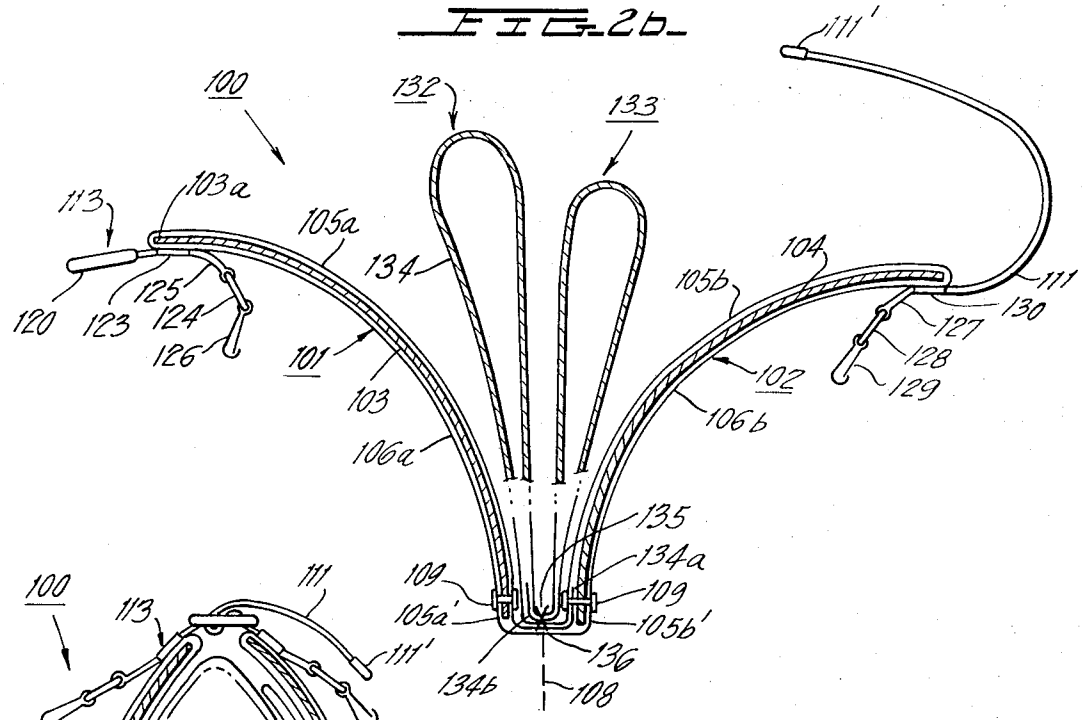


FIG. 2b



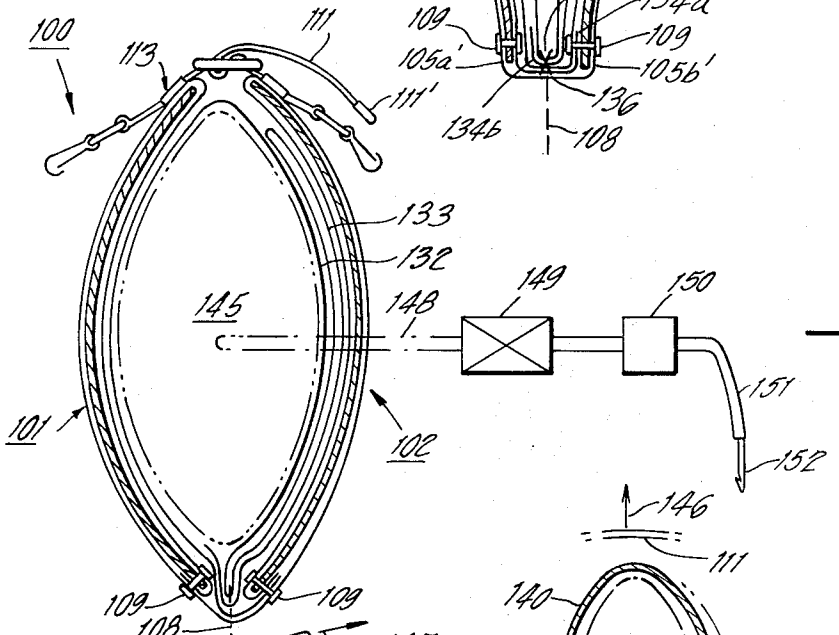




FIG. 2d

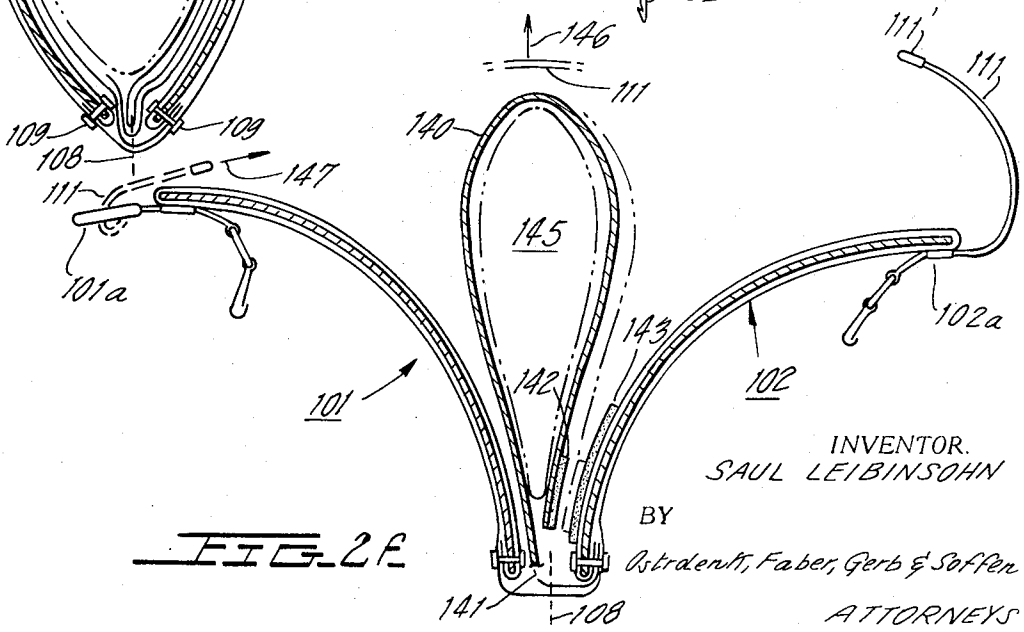



FIG. 2f

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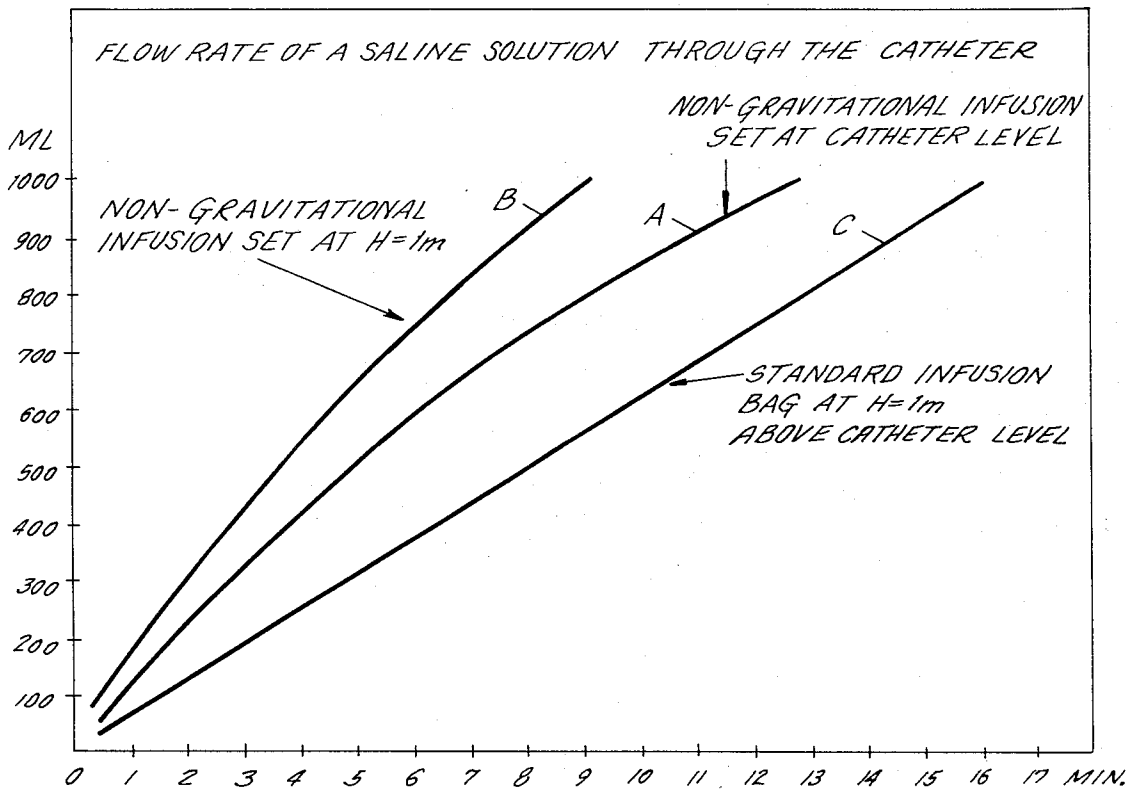
FIG. 3

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# NON-GRAVITATIONAL INFUSION SET

## BACKGROUND OF THE INVENTION

This application is a continuation-in-part of my application, Ser. No. 753,405, filed Aug. 19, 1968, now U.S. Pat. No. 3,595,232 granted July 27, 1971, and is directed to an improved form of the infusion device thereof.

The present invention relates to infusion apparatus, and more particularly to a novel sterile fluid infusion set of the non-gravitational type which is adapted to provide positive fluid flow for infusion, regardless of the relative positioning of the infusion set with regard to the patient. The infusion set may be provided with a drip chamber which prevents air from entering into the flow of the exiting fluid even in cases where the orientation of the drip chamber may become accidentally altered during use.

Infusion apparatus finds widespread use in the medical field. For example, when it is desired to infuse blood or other sterile fluids into the body of a patient being treated, the fluid to be introduced into the body is typically fed from a suitable container (e.g., of glass or plastic) supported a predetermined distance above the patient's body, infusion being effected by gravity flow. In military or other field applications when, for example, the patient is carried on a stretcher an extra person is needed to hold the infusion bottle or other container above the patient and thus provide gravitational infusion of the fluid. In such situations, which may occur during warfare, riots, or other disaster conditions, it is extremely advantageous to permit infusion while eliminating the necessity for a third person to carry the fluid container.

One obvious technique for eliminating the noted problem involves the provision of a structure mounted to the stretcher to support the fluid container a predetermined height above the person being carried. In most cases, this approach is either awkward or impossible. It thereby becomes extremely important to provide suitable alternative means for carrying out such infusion, while, at the same time, eliminating the need for a third person to accompany the stretcher bearers or eliminating the awkward support assembly which must be secured to the stretcher.

## SUMMARY OF THE INVENTION

The present invention is characterized by providing an infusion set which may be readily and simply attached to a stretcher, or any other support or surface, which need not be elevated above the patient treated and, in fact, may be suspended a predetermined distance below the patient or may simply be laid upon a hospital bed or stretcher alongside the patient, and which, at the same time, effects fluid infusion at a substantially controlled and constant rate.

THe present invention comprises an assembly having at least first and second arcuate shaped highly resilient members adapted to receive a compressible fluid-containing bag between their convex surfaces. The resilient members are covered by suitable heavy-duty woven fabric sheets which further serve as pivoting means aligned along a pair of adjacent edges of the arcuate shaped sheets. The opposite free ends of the fabric sheets are provided with suitable fastening means adapted to retain the arcuate sheets in close proximity to one another so as to exert a large compressive force upon the compressible fluid-containing bag positioned therebetween. The force exerted upon the compressible bag by the arcuate shaped resilient sheets is of significant magnitude as to enable and provide for fluid flow of a sufficient magnitude, regardless of the relative positioning between the infusion set and the body of the patient receiving the sterile fluid, thereby enabling the bag to be supported at a height which is the same as or even below that of the patient, while still providing for adequate fluid flow from the compressible bag to the patient, which flow may further be controlled by valve and/or drip chamber means.

In accordance with a further feature of the invention, the pressure-applying device includes restraining means for limiting or preventing lateral movement of the fluid-containing bag during compression thereof. Such means, which may comprise a sleeve for receiving the infusion bag, a belt for winding about the bag, or simply an adhesive surface for engaging the bag or the belt, frictionally engages the infusion bag to prevent its expulsion from, and maintain it within, the pressure-applying means during compression thereof and thus facilitate substantially continuous and uniform dispensing of the blood, saline solution or other fluid.

The basic components of an infusion set include the fluid container and a catheter or needle coupled thereto by suitable tubing. The pressure-applying means of this invention is suitably employed in combination with these components and, typically, a stopcock or other valve means and a drip chamber for regulating the flow of the fluid infused. Whereas infusion sets provided in accordance herewith may incorporate conventional catheters, drip chambers and stopcock elements, it is preferred that the drip chamber employed be of the type described in my copending application entitled "Drip Chamber For Infusion Set", Ser. No. 132,789, filed Apr. 7, 1971, now U.S. Pat. No. 3,721,689.

The infusion set described hereinabove is especially adapted for use in military applications and is ideally suited for battlefield conditions. The compressive forces developed by the arcuate shaped springy members assure continuous, uniform infusion and further act to prevent cannula clogging and reverse flow. Upon appropriate operation of the valve means controlling flow, the contents of an infusion bag may be rapidly emptied. For example, 1000 ml. may be infused through an 8 × 5 inch Fr. cannula within 10–12 minutes and through a 14 gallon needle in less than 5 minutes.

The compressive forces eliminate the need for a support normally required for conventional gravity flow systems in that the structure is capable of developing pressure equivalent to a head of 150 cc. In use, the structure permits easy transportation of casualties - in battlefield conditions — as well as in ambulances, helicopters, planes or other air or ground vehicles. Obviously, the versatility of the infusion set permits its use under normal conditions such as exist in hospitals, clinics and the like. The infusion set is adaptable for use with all commercially available infusion bags (i.e., 400, 500 or 1000 ml.), is simple to use requiring no instruments or tools of either special or general purpose design, is quite durable and is capable of being applied in an unlimited number of applications. The nature of the compressive structure is such as to provide an extremely rugged, unbreakable device having an indefinite shelf-life under any climatic conditions, and having

the further added feature of providing excellent protection from an infusion bag which may be stored therein, thus minimizing the risk of rupture or other damage, when, for example, an infusion set incorporating the same is dropped by parachute to a battlefield site or the like.

## THE DRAWINGS

The preceding and other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings in which:

FIG. 1*a* is a top plan view of an infusion apparatus embodying the principles of the present invention;

FIG. 1*b* is an end view of the embodiment of FIG. 1*a*;

FIG. 1*c* is a bottom plan view of the embodiment of FIG. 1*a*;

FIG. 1*d* is a sectional view of a portion of the infusion apparatus of FIG. 1c looking in the direction of arrows 1*d*—1*d'*;

FIG. 1*e* is an end view of the embodiment of FIGS. 1*a* – 1*c* in the closed (operating) position and containing a compressible fluid bag;

FIG. 1*f* is an end view of the embodiment of FIGS. 1*a* – 1*c* in the closed (storage) position;

FIGS. 2*a* and 2*c* are top and bottom plan view, respectively of another, preferred embodiment of the present invention;

FIG. 2*b* is an end view of the embodiment of FIGS. 2*a* and 2*c*, showing the infusion assembly in the open position preparatory to use;

FIG. 2*d* is an end view of the embodiment of FIGS. 2*a* – 2*c* showing the infusion assembly in the closed (operating) position and containing a compressible fluid container;

FIG. 2*e* is a sectional view of a portion of the embodiment of FIG. 2*c* looking in the direction of arrows 2*e* — 2*e'*;

FIG. 2*f* is an end view of another preferred embodiment of the present invention;

FIG. 3 is a plot showing curves useful in explaining the advantages of the present invention as compared with conventional gravity-flow techniques.

## THE PREFERRED EMBODIMENTS

One preferred embodiment of the present invention is shown in FIGS. 2*a* – 2*e*. Turning initially to a consideration of FIGS. 2*a* – 2*c*, the apparatus **100** shown therein is comprised of a pair of arcuate-shaped members **101** and **102** which consist of first and second arcuate-shaped metallic plates **103** and **104,** shown best in cross-sectional view of FIG. 2*b*. The plates, in addition to being arcuate in shape, have a high degree of resiliency so as to retain their arcuate configuration in the absence of any external forces. Whereas the plates are described as being formed of metal, it should be understood that the plates may also be formed of a resilient plastic or other suitable material.

The plates **103** and **104** are covered on both surfaces thereof, as well as along their perimeters, with a heavy duty fabric such as, for example, a heavy canvas material. As shown best in FIG. 2*b*, one continuous piece of fabric, comprised of top portions **105***a* and **105***b*, covers the convex surfaces of metallic sheets **103** and **104,** respectively. The concave surfaces are also covered by the single sheet of fabric, whereby portions **106***a* and **106***b* are folded around the edges of plates **103** and **104** to cover the concave surfaces of sheets **103** and **104,** respectively. The fabric sheets are joined to one another along the remaining portions of the perimeter of each of the metallic plates **103** and **104,** preferably by being sewn together.

Noting FIG. 2*b*, sheet portion **105***a* has its extreme left-hand edge surrounding the left-hand edge **103***a* of plate **103.** Lower sheet portion **106***a* is bent inwardly upon itself, as shown at **106***a'*, with the two sheets being sewn together, as shown at **107.** The fabric sheet portions **105***b* and **106***b* are joined together about the remaining perimeter of metallic sheet **104** in a similar fashion and are sewn together along their engaging margins at the location shown by the numeral **106***b'*. Sheets **105***a* and **105***b* terminate at the center line of the structure designated by phantom line **108** and are folded under, as shown at **105***a'* and **105***b'*. The metallic rivets **109** pierce these fabric sheet portions and metallic sheets and act to firmly secure the heavy-duty fabric to the arcuate shaped metallic sheets. The rivets **109** are shown best in the top view of FIG. **2***a* which shows the convex surfaces and the bottom view of FIG. **2***c* which shows the concave surfaces of the pair of arcuate assemblies **101** and **102.**

Assemblies **101** and **102** are of equal length and have their free ends respectively tapered at **110** and **110***a*. A heavy-duty woven fabric belt **111** is joined to arcuate assembly half **102** by means of rivets **102.** Although not shown for purposes of simplicity, belt **111** is substantially an elongated member and, in one actual embodiment, has a length of approximately **20** inches.

A buckle assembly **113** is mounted to assembly half **101** and is comprised of a short section **114** of a heavy duty woven fabric belt secured to assembly half **101** by rivets **115.** The free end of the short belt portion **114** is secured between a slightly curved metallic sheet **116** and a narrow, elongated metallic sheet **117** by means of rivets **118.** The slightly arcuate shaped metallic sheet **116** is provided with a pair of ears **118** and **119** which are bent to surround a rod **120** secured at its opposite ends to a rectangular-shaped buckle member **121.** The left-hand end of slightly arcuate shaped member **116** is provided with a serrated edge **122** which cooperates with the buckle member **121** to lock belt portion **111** which has passed through the region designated by dotted line **111'** so as to retain the assembly in the infusion state, which will be more fully described hereinbelow.

As can best be seen from FIG. **2***c*, the short belt section **114** is secured between a narrow, elongated plate **123** and assembly half **101** by the rivets **115.** The belt extends further to the right of plate **123** and is looped over itself to form a narrow opening for a substantially C-shaped clip **124** whose free ends **124***a* and **124***b* extend into the opening formed in belt portion **114.** The looped over belt portion is sewn to the remaining belt portion, as shown by dotted lines **125.** Clip **124** is further provided with a second clip **126** which may be utilized to releaseably support or hang the infusion bag assembly upon a belt loop, or any other structure for that matter, to facilitate either carrying or actual usage of the assembly.

The belt **111** is provided with a similar overlapped portion which is retained against the main body of the belt by sewing the two portions together, as designated by dotted lines **127.** The bent-over portion of the belt provides a narrow opening for receiving the free ends **128***a* and **128***b* of a second clip **128** which, in turn, is

provided with an additional clip **129** for releaseably mounting the assembly to any suitable structure or to a belt loop field pack, or any other apparatus. Belt **111** is secured between assembly half **102** and an elongated metallic plate **130** by means of the rivets **112.**

FIG. **2e** is a sectional view of a portion of assembly half **102** looking in the direction of arrows **2*e*—2*e'*** and shows the manner in which the fabric sheets are joined together along the lower edge. Metallic sheet **104** is positioned between the fabric sheets **106*b*** and **105*b***. The marginal edge of fabric sheet **105*b*** is bent under, while the marginal portion of fabric sheet **106*b*** is bent around the marginal edge of metallic sheet **104.** The engaging marginal portions are sewn together at **131.** The perimeters of both assembly halves **101** and **102** have their fabric sheets joined together in a similar fashion.

FIG. **2b** shows the assembly as being further provided with a retaining means comprising a pair of sleeves **132** and **133** for retaining compressible bags of fluids which may, for example, be blood plasma, or any other sterile fluid which is to be infused into the body of a patient. The sleeves are formed from a single sheet of heavy-duty woven fabric material **134.** One free end **134*a*** of the single sheet is secured to assembly half **102** by means of the rivets **109.** The sheet extends away therefrom to first form the left-hand side, top side and right-hand side of sleeve **132.** The sheet then extends upwardly to form the left-hand side, top side and right-hand side of sleeve **133,** with the extreme free end **134*b*** extending beneath point **135** where the right-hand side of sleeve **132** and the left-hand side of sleeve **133** share a common boundary. The single sheet is then sewn together at location **136.** The thread employed to sew the single sheet of fabric **134** to itself is also further sewn through the center line of the single sheet comprised of sheet halves **106*a*** and **106*b*** along the line coincident with the central axis **108** of the assembly. If desired, one end of each sleeve may then be sewn closed to form corresponding pockets.

It should be noted that sleeve **132** is larger than sleeve **133** so as to accommodate a compressible plastic bag of larger size (and hence, volume). For example, sleeve **133** may be adapted to accommodate a compressible plastic bag of sterile fluid having a capacity of 500 milliliters, while sleeve **132** may be adapted to receive a compressible plastic bag having a capacity of 1000 milliliters. The sleeves (**132** or **133**) serve to retain a compressible fluid bag between the arcuate plates while during the time the plates are moved to the operating position. The manner of use of the sleeves is as follows:

The compressible bag is inserted into the sleeve whose opening is closest in size to the compressible fluid bag. Once the fluid bag is inserted, the free ends of springy plates **103** and **104** are moved from the position substantially as shown in FIG. **2*b*** to the position shown in FIG. **2*d*.** Closure and locking of the plates is accomplished by drawing belt **111** (see FIG. **2*d***) through buckle assembly **113.** Although the closing of the plates **103** and **104** would otherwise tend to urge the compressible bag out from between the plates, the sleeve prevents this from occurring.

One alternative arrangement to the sleeves **132** and **133** which may be employed is shown in FIG. **2*f*** and is comprised of an elongated strap **140** having a first end thereof **141** sewn or otherwise secured to assembly half **101.** The marginal portion of the free end of strap **140** may be provided with a strip **142** of an adhesive material which may be releaseably secured to surface portion **143** provided along the convex surface of assembly half **102** in close proximity to the center line **108** of the assembly. As another alternative, a VELCRO fastener assembly may be employed, wherein the strip **142** may be comprised of the loop portion of a VELCRO fastener, while the strip **143** may be comprised of the hook portion of a VELCRO fastener so as to releaseably join strap **140** to surface **143.** As is well known with regard to VELCRO fasteners such assemblies, when joined together, are capable of remaining joined together even in the presence of great shearing stresses which may be exerted thereupon.

In use, the compressible bag of sterile fluid **145** is positioned between the two convex surfaces of assembly halves **101** and **102.** Strap **104** is positioned around the bag **145** in the manner shown best in FIG. **2f.** The strip **142** provided near the marginal end of strap **140** is then pressed against strip **143** so as to secure the compressible bag **145** and prevent the bag from moving in the direction shown by arrow **146.** The free end of belt **111** is threaded through the buckle assembly **113** in the manner shown in FIG. **2*f***, and is then pulled in the direction shown by arrow **147** to draw the outermost edges **101*a*** and **102*a*** of assembly halves **101** and **102** toward one another until the two outermost edges are either in close proximity or engage one another. The resilient arcuate shaped metallic sheets **103** and **104** exert a counter-force which tends to urge the infusion assembly halves **101** and **102** apart. However, the belt **111,** in attempting to be pulled away from the buckle assembly **113,** engages the serrated edge **122** of plate **116** so as to remain tightly fastened or wedged between the serrated edge **122** and buckle member **121** to prevent the assembly halves from moving apart.

The resilient metallic sheets thereby exert significant force upon the surfaces of the compressible bag of sterile fluid to cause the sterile fluid to be urged out of the bag through (see FIG. **2d**) a piece of hollow tubing **148,** valve **149,** drip chamber **150** and tubing **151,** whose free end is provided with a suitable hypodermic needle **152** which may be inserted into the body to infuse the fluid into the body of the patient. Valve assembly **149** may be employed to selectively cut off or enable fluid flow, while drip chamber assembly **150** may be utilized to regulate the rate of flow.

The manner of use of the embodiment of FIG. **2*b*** is substantially similar to that shown in FIG. **2*f***, except that the compressible bag of fluid is first inserted into the appropriate sleeve **132** or **133.** The free end of belt **111** is then inserted through the buckle assembly in similar fashion to that described hereinabove to draw the outer ends of assembly halves **101** and **102** together so as to exert a significant compressive force upon the compressible plastic bag of sterile fluid.

The primary and significant feature of the infusion bag assembly resides in the fact that the assembly need not be positioned above the body of the patient so as to rely upon gravity to insure flow of the fluid from the bag or sterile container into the body. For example, in battlefield situations, it may be quite impractical, if not impossible, to mount a container of sterile fluid upon a stretcher, whereby the container of sterile fluid is positioned well above the height of the person being carried. With the present invention, the infusion bag as-

sembly may even be mounted at or below the height of the person being carried or treated, since the relatively large compressive forces of the assembly are more than sufficient to squeeze the sterile fluid from the bag and into the body of the patient. Accurate regulation of fluid flow may be controlled through the use of valve **149** and drip chamber **150**, or through the use of any other suitable flow-regulating means.

FIG. **3** shows curves comparing the flow rate through the infusion set of FIGS. **2***a*–**2***c*. As shown in FIG. **3**, Curve A represents the infusion or expelling of a saline solution contained in a 1000 ml bag for an apparatus as shown in FIGS. **2***a*–**2***c* which is located at the same height as the catheter. The curve indicates that the entire contents are expelled in **12** minutes. Curve B represents the flow rate for an infusion set of the type shown in FIGS. **2***a*–**2***c* which is located at a height of one meter above the catheter level. It can be seen that the entire contents are expelled within nine minutes.

Curve C represents the flow rate for a sterile fluid bag elevated at a height of one meter above the catheter level and in the absence of the infusion set hereof. It can be seen that **16** minutes are required to expel the entire contents of the fluid container. Similar results have been obtained for other solutions such as, for example, a dextrin solution from which the entire contents of a 560 ml fluid container are expelled within 11½ minutes, while 17 minutes are required to expel the entire contents of a bag positioned at one meter above the catheter level in the absence of the non-gravitational infusion set. The entire contents of a 560 ml container can be expelled within 9 minutes when the infusion set of FIG. **2***a*–**2***c* is positioned one meter above the catheter level. Similar results have been obtained for other fluids, including blood.

When not in use, the assembly **100** may be made quite compact by threading the belt **111** through the buckle assembly **113** in a manner similar to that described above, with the exception that no compressible bag of fluid be inserted between the assembly halves **101** and **102**. The assembly **100** may then be carried in any suitable mmanner such as inside of a field pack, clipped to the exterior of a field pack, or clipped to a waist belt or any other suitable place or location.

The assembly **100**, which is formed of a very heavy-duty fabric and a heavy-duty buckle assembly and fabric belt, is relatively indestructible and have an extremely long, useful operating life. In addition, the effectiveness of the assembly **100** will not be reduced or significantly altered as a result of exposure to outside elements or influences, such as rain, sleet, snow, salt water, dirt, dust, or any other influences which may normally be considered to be harmful. The arcuate shaped metallic sheets, in one preferred embodiment, are preferably formed from a springy, resilient steel, and it has been found that no significant reduction in effectiveness of the plates has occurred even after continued use, regardless of the conditions or situations in which the assembly is used.

FIGS. **1***a*–**1***f* show another preferred embodiment **10** of the present invention, which is comprised of a plurality of arcuate shaped metallic sheets **11** (a total of eight being employed in the assembly shown in FIGS. **1***a* and **1***c*, for example). The assembly half **12** utilizes four of the arcuate shaped metallic sheets which are arranged in side-by-side fashion and inserted within separate sleeves **13**–**16**, which sleeves are formed from a pair of heavy-duty woven fabric sheets **17** and **18**, which are sewn together along the top, bottom and right-hand edges of assembly **12** and are further sewn along lines **19**, **20** and **21** so as to form four individual sleeves which are open along their left-hand edges to permit insertion of each of the associated arcuate shaped metallic sheets **11**.

The metallic sheets **11** are each retained within their associated sleeves by rivets **22**. The rivets **22** further serve to secure one cooperating portion of a clasp assembly, which portions are designated by the numerals **23***a*–**23***d*, respectively. Since the clasp portions **23***a*–**23***d* are substantially identical in design and function to one another, only one such assembly will be described herein for purposes of simplicity.

Considering assembly **23***a*, this clasp portion can be seen to be comprised of a mounting bracket **24** having a pair of mounting portions **24***a*–**24***b* (see FIG. 1b), which portions are joined to sleeve **13** by rivets **22**. Mounting portions **24***a* and **24***b* are integrally joined to one another by means of a yoke portion **24***c*, which yoke portion forms an opening for receiving the free ends **25***a* and **25***b* of a clasp membler. Clasp member **25** is free to pivot about the yoke portion in either direction, as shown by the double-headed arrow **26** of FIG. **1***b*.

The remaining half **12'** of infusion bag assembly **10** is formed of two heavy-duty fabric sheet members **17'** and **18'** similar to those described hereinabove, which sheets are joined or sewn together so as to form the separate sleeves **13'**–**16'**, each of which receives one of the arcuate-shaped metallic plates **11**.

Assembly half **12'** is provided with four clasp portions **27***a*–**27***d*, each of which cooperate with an associated clasp portion **23***a*–**23***d*, respectively, in a manner to be more fully described. Since each of the clasp portions **27***a*–**27***d* are similar in design and function, only one will be described herein for purposes of simplicity.

The assembly **27***a* is comprised of a mounting bracket **28** having a pair of similar mounting halves **28***a* and **28***b* secured to sleeve **13'** by rivets **22'**. The mounting portions **28***a* and **28***b* are integrally joined to one another by a yoke portion **28***c* which has a substantially triangular shaped configuration, as can best be seen from FIG. **1***b*, so that the head portion may be snappingly received by the associated buckle **25**, in a manner to be more fully described.

The manner in which the infusion bag assembly **10** is put into use is as follows:

A compressible plastic bag of sterile fluid **145** is positioned between the convex surfaces of assembly halves **12** and **12'** in the manner shown best in FIG. **1***b*. Halves **12** and **12'** are then moved toward one another in the directions shown by arrows **29***a* and **29***b* until the outer free ends of assembly halves **12** and **12'** are brought into engagement. Each of the buckles **25** is then snapped over its associated head **28***c* where they remain locked in the position shown best in FIG. **1***e*. The highly resilient arcuate shaped metallic members exert a relatively high compressive force against bag **145** to squeeze the fluid from the bag and preferably through the valve, drip chamber and injection or hypodermic needle assembly of the type shown best in FIG. **2***d*. It should be understood that all four clasp assemblies are locked into position in the manner shown best in FIG. **1***e*.

For a device of the type similar to that shown in FIGS. 1*a*–1*c* comprising three pairs of curved, springy, metallic sheets (formed by cutting a cylinder of metallic material in half and by cutting each of the halves into three parts), the initial pressure applied to a compressible fluid bag was 0.15 atmospheres (equal to about 1.5 meters of water) which yielded a flow rate of approximately 100 ml per minute at the initial stages, which flow rate decreased to about 70 ml per minute near the end of the infusion.

The use of separate arcuate shaped metallic sheets in each half **12** and **12'** of the assembly as opposed to the use of only a single arcuate-shaped metallic sheet as in the case of assembly **100** of FIG. **2**, for example, facilitates locking of the clasp assemblies, since the arcuate shaped metallic sheets of significantly smaller size individually exert smaller counteracting forces, thereby making it easier to latch each of the individual clasps.

Although not shown for purposes of simplicity, the assembly **10** of FIGS. 1*a*–1*f* may be provided with a releaseable clasp or other hardware for suspending the infusion bag assembly **10** from a stretcher or a field pack, for example, either during use or while being transported.

FIG. 1*d*, which is a sectional view of a portion of the assembly shown in FIG. 1c taken along the lines 1*d*—1*d'*, shows the manner in which the fabric sheets are sewn together. Fabric sheet **18** has its marginal edge folded around the marginal edge of the arcuate metallic sheet **11.** Fabric sheet **17** has it marginal portion folded under so that the two engaging portions may be sewn as shown at the location designated by numeral **31.** The fabric sheets are further sewn together as shown by numeral **21** to form the two separate sleeves **16** and **15,** each of which is adapted to receive one of the arcuate shaped metallic resilient sheets **11, 11.** The remaining peripheral portions of the assembly halves **12** and **12'** are sewn together in a similar fashion.

When not in use, the assembly **10** may be made quite compact either by drawing the two concave surfaces toward one another in the manner shown in FIG. 1*f* or, alternatively, by bringing the two convex surfaces toward one another in the manner shown in FIG. 1*e*, with the exception that no compressible sterile fluid bag is inserted therebetween. The clasps are then joined either in the manner shown in FIG. 1f, or in the manner shown in FIG. 1e to render the assembly quite compact during either storage or transportation thereof. If desired, a compressible bag may be stored between the members **12** and **12'** when in the position of FIG. 1*f*. The plates exert only a mild force upon the compressible fluid bag so as not to stress the bag when not in use. The distinct advantage of storing compressible bags in this manner is to protect the compressible bag during storage, handling or transportation. The embodiment of FIG. **2** may be utilized in a similar fashion.

As another obvious alternative, the assembly **10** of FIGS. 1*a*–1*f* may be provided with a strap of the type shown in FIG. 2*e*, or one or more sleeves of the type shown in FIG. 2*b* to facilitate retention of the compressible sterile fluid bag between the convex surfaces of the assembly halves **12** and **12'** so as to retain a compressible fluid bag between the assembly halves when they are moved to the position of FIG. 1*e*.

As another possible alternative to the preferred embodiments of the present invention, any other suitable hinge means may be employed for pivotally connecting the curved, springy, metallic sheets in addition to the employment of the heavy-duty fabric sheets as the means for pivotally connecting the metallic sheets.

It can be seen from the foregoing description that the present invention provides a novel non-gravitational infusion bag set for squeezing sterile fluid, and the like, from a compressible fluid bag, wherein the assembly is quite compact to facilitate storage and transportation, while having a unique design to enable infusion of sterile fluid, and the like, from a compressible bag in a non-gravitational manner, thus eliminating the need for mounting or supporting the sterile fluid container a significant distance or height above the body of the patient, as is required in conventional infusion techniques which primarily rely upon gravitational flow. The assembly is thus uniquely adapted for use in situations in which fluid flow by gravity is either impractical or impossible, such as, for example, the use in battlefield, riot or other disaster conditions which restrict or otherwise render impossible the infusion of a fluid into a patient through normal gravity flow techniques.

Although this invention has been described with respect to particular embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and, therefore, the scope of this invention is limited not by the specific disclosure herein, but only by the appended claims.

What is claimed is:

**1.** An assembly for exerting pressure upon a compressible fluid container, comprising:

a. a pair of curved resilient plates having respective inner and outer planar edges extending transversely of the curvature thereof;

b. hinge means for hingedly mounting said inner edges of the plates to one another in substantial parallelism for pivotal movement of the plates into facing relation with the convex surfaces of the plates facing one another;

c. clasp means mounted along said outer edges of the plates for securing said edges to one another and thereby holding the plates in close proximity to one another with the convex surfaces thereof adapted to apply pressure to a compressible fluid container positioned between said plates;

d. restraining means for limiting movement of the compressible fluid container transversely of said first and second plate edges to facilitate compression of the container and dispensing of the fluid therefrom by said assembly;

e. said restraining means comprises a hollow sleeve secured to said sheath in the region of said hinge and along the concave side of said plates for receiving a compressible fluid bag to prevent movement of said bag when said plate halves are being moved to the operating position.

**2.** The assembly of claim **1,** wherein said restraining means further comprises a plurality of hollow sleeves of different diameters secured to said sheath in the region of said hinge and along the concave side of said plates for receiving compressible fluid bags of varying sizes, each of said sleeves preventing movement of the bag received therein as said plate halves are moved to the operating position.

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