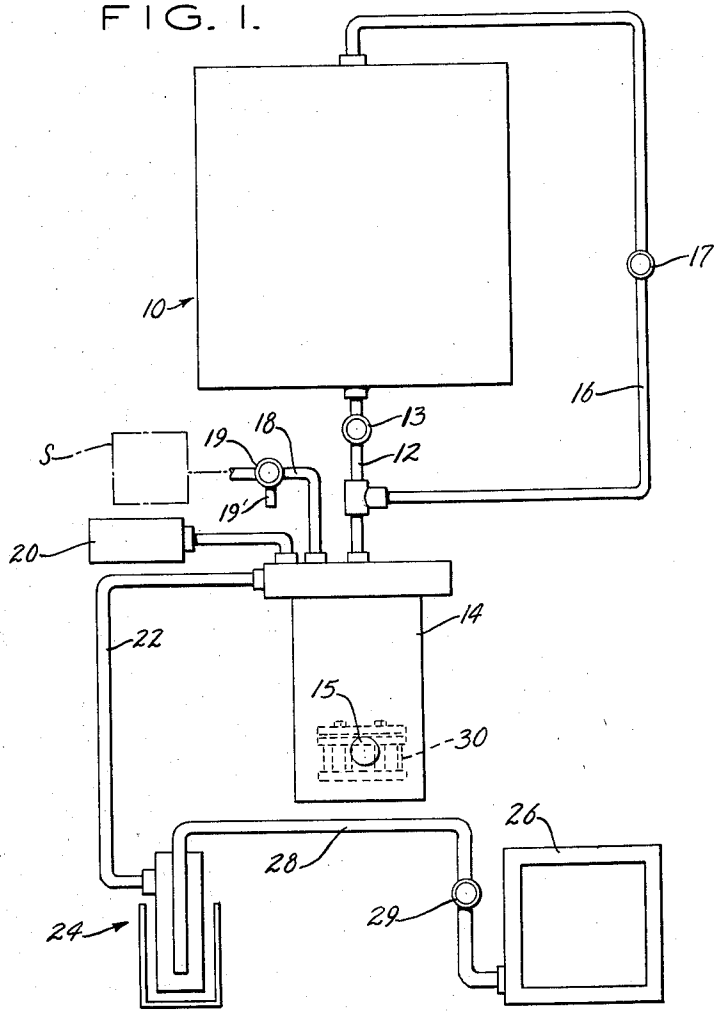
Jan. 5, 1960 G. N. CONTI ET AL 2,919,524

LIQUID FILLING SYSTEM FOR BELLOWS ASSEMBLY

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FIG. 1.



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FIG. 2.

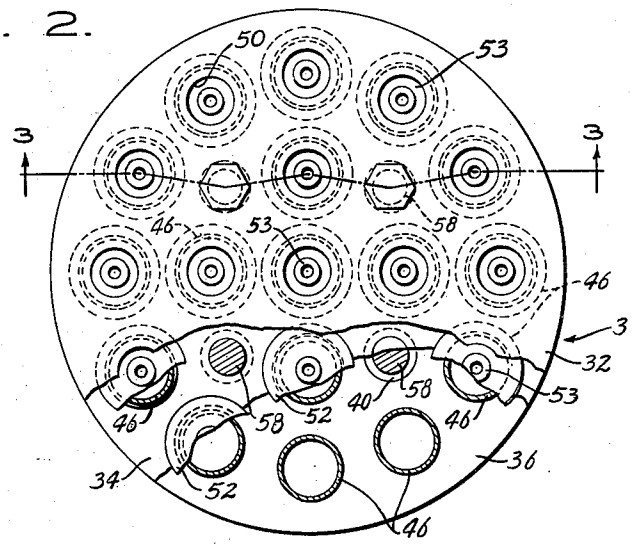


FIG. 3.

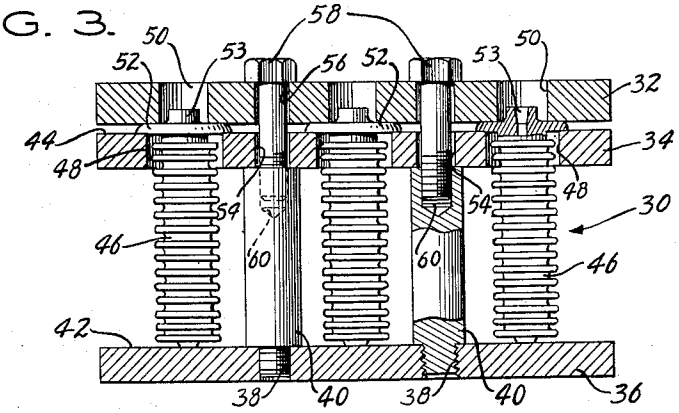
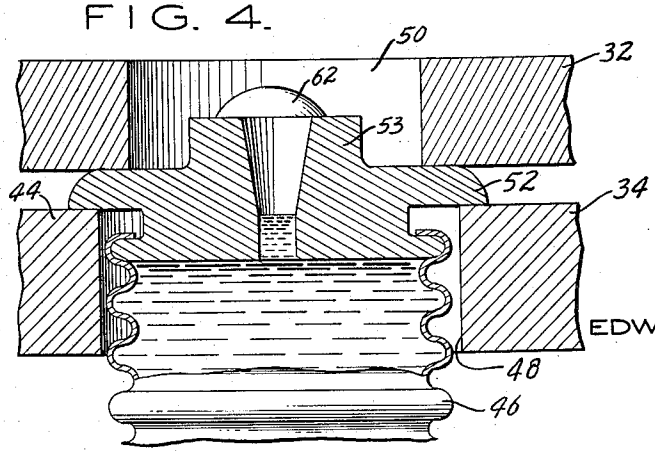


FIG. 4.



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LIQUID FILLING SYSTEM FOR BELLOWS ASSEMBLY

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12 Claims. (Cl. 53—22)

This invention relates generally to liquid filled bellows and, more specifically, to a method and system employed in filling the bellows.

Whenever highly sensitive bellows are liquid filled, it becomes necessary to remove all traces of any gases and moisture from the inside of the bellows. If these are not removed, the subsequent performance of the bellows will be affected disadvantageously.

The object of this invention is to present a method and apparatus by which the gases and moisture may be positively and easily removed.

Another object is to provide a method having the foregoing object, in accordance with which a fixture holding a number of bellows to be filled, is placed in a fill tank and successively subjected to sub-atmospheric, atmospheric and super-atmospheric pressures, with the aim of voiding of vapors from the bellows prior to filling, and the accomplishment of the proper and complete filling thereof.

A still further object is to provide an improved fixture of simple design for the purpose of accurately positioning and holding bellows for the filling operation.

The foregoing as well as other objects will become more apparent as this description proceeds, especially when considered in connection with the accompanying drawings illustrating a preferred embodiment of the invention, wherein:

Fig. 1 is a schematic layout of the entire system used in filling the bellows;

Fig. 2 is a plan view, partially broken away and horizontally sectioned, of a fixture used to hold the bellows during filling;

Fig. 3 is an elevation partially broken away and in vertical section on line 3—3 of Fig. 2, illustrating typical fixture details; and

Fig. 4 is an enlarged fragmentary view of the fixture and a bellows supported thereby.

Fig. 1 illustrates a supply tank generally at **10**, which contains liquid, such as para-cymene, with which the bellows are to be charged. A conduit **12** equipped with a hand valve **13** leads from the bottom of the tank **10** to the top of the bellows fill tank **14**, which has a sight gage **15**. A second conduit **16** containing a hand valve **17** leads from the top of the tank **10** to the conduit **12** and communicates with it between the valve **13** and the fill tank **14**. A third conduit **18** has a three-way hand valve **19** therein which controls its communication either with atmospheric pressure, as through a pipe **19'**, or with a source S of pressure greater than atmospheric; and conduit **18** opens to the top of the bellows fill tank **14**. The top of the fill tank **14** is also connected by a conduit to a suitable vacuum gage **20**, in this case a micron gage.

Another conduit **22** leads from the top of fill tank **14** to a vacuum trap flask indicated generally at **24**; and a vacuum pump **26** communicates with the vacuum trap flask **24** through a suitable conduit **28** in which a hand valve **29** is provided.

A fixture, indicated generally at **30** in Figs. 1, 2 and 3, is located in the fill tank **14**. As illustratively shown, the fixture is comprised of three circular plates **32**, **34** and **36**, i.e., upper, intermediate and bottom, respectively.

Bottom plate **36** contains four threaded holes **38**, equally spaced adjacent and about its center, which coact with the threaded bottom portions of post-like spacers **40**, and the spacers **40** are used in order to obtain the correct dimension between the upper surface **42** of plate **36** and the upper surface **44** of intermediate plate **34**. This dimension is calculated on the basis of the length of bellows being filled.

The fixture **30** is pre-loaded with the respective bellows, generally indicated **46**, before the actual filling operation is started, to receive which bellows the intermediate plate has a number of circular holes **48**. Top plate **32** has a corresponding number of correspondingly spaced, registered fill holes **50** of smaller diameter; and each bellows **46** has an annular flange **52** adjacent its open top filling end **53**, which flange is larger in diameter than either of the holes **48**, **50**.

The procedure to be followed in loading the fixture **30** is as follows:

After assembling spacers **40** to the plate **36**, the respective bellows **46** are slipped through the holes **48** in plate **34**. The bellows will fall through said holes up to the open end **53** of the bellows and its flange **52**, which engages on plate surface **44** and prevents any further movement of bellows **46**.

The upper plate **32** is placed directly atop intermediate plate **34**, engaging bellows flanges **52** in such a position that the fill holes **50** in plate **32** will be in line with the holes **48** of plate **34**. Bolt clearance holes **54** in plate **34** and similar clearance holes **56** in plate **32** will also be in line. The plates **34** and **32** and assembled bellows **46** are then placed atop the spacer posts **40**, with their holes **56** and **54** in line with the four spacers, and bolts **58** are then inserted through the clearance holes **54** and **56** and screwed into threaded holes **60** in the tops of the respective spacers **40**. So mounted, the bottoms of the bellows abut and are restrained by bottom plate **36** from axial extensible movement; while their tops are rigidly clamped between plates **32**, **34** to prevent movement in both axial directions and relative to the bottom plate.

As thus fully loaded the fixture **30** is placed in the bellows fill tank **14**, as shown in Fig. 1.

Filling operation

At the start of the operation valves **13** and **19** are closed and valve **17** is opened (Fig. 1). The vacuum pump **26** is then started and allowed to run until the required vacuum is obtained, as indicated by the vacuum gage **20**. When this desired vacuum is obtained, the conduit **28** is closed at the valve **29**. Valve **17** is closed and valve **13** is opened after valve **29** has been closed.

The chamber of the fill tank **14** is then flooded by liquid from tank **10** until a predetermined level is obtained as indicated at the sight gage **15** of the fill tank. The valve **13** is then closed, and the fluid thusly introduced is allowed to set for a desired length of time before the next step of the operation.

After the fluid has sufficiently set, valve **19** is manipulated to allow atmospheric pressure to enter from pipe **19'** and fill the chamber of fill tank **14**. The chamber is allowed to be subjected to this pressure for a desired length of time, in order that the bellows **46** may be slowly relieved of their possible internal stresses. After such period of time the conduit **18** is connected by valve **19** with the source S of higher than atmospheric pressure. This pressure is directed to the same chamber of the fill tank **14**, for the same purpose as the atmos-

pheric pressure was used, plus the additional function of positively forcing the fluid into the bellows convolutions.

After this pressure has been applied a suitable length of time, the valve 19 is closed and the fixture 30 containing the filled bellows 30 is removed and placed in a temperature controlled medium so that the said bellows may become stabilized. When this is finished the bellows 46 are sealed by soldering their upper ends 53 at 62, as shown in Fig. 4.

The drawings and the foregoing specification constitute a description of the improved liquid filling system for bellows assembly in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What we claim as our invention is:

1. A method of filling bellows and like flexible, liquid receiving tubular units, comprising mounting a plurality of the units in a way to determine and rigidly maintain a uniform and predetermined axial dimension of all thereof and to prevent axial movement of a part of each thereof in both axial directions, placing said mounted units within and in fluid communication with a sealed container, flooding said container with a filling liquid to immerse and fill said units, and subjecting said container to super-atmospheric pressure to void said units of vapor.

2. A method of filling bellows and like flexible, liquid receiving tubular units, comprising mounting a plurality of the units in a way to determine and rigidly maintain a uniform and predetermined axial dimension of all thereof and to prevent axial movement of a part of each thereof in both axial directions, placing said mounted units within and in fluid communication with a sealed container, flooding said container with a filling liquid to immerse and fill said units, and subjecting said container successively to atmospheric and super-atmospheric pressure to void said units of vapor.

3. A method of filling bellows and like flexible liquid receiving tubular units, comprising mounting a plurality of the units in a way to determine and rigidly maintain a uniform and predetermined axial dimension of all thereof and to prevent axial movement of a part of each thereof in both axial directions, placing said mounted units within and in fluid communication with a sealed container, subjecting said container to sub-atmospheric pressure to evacuate said units, flooding said container with a filling liquid to immerse and fill said units, and subjecting said container to super-atmospheric pressure to void said units of vapor.

4. A method of filling bellows and like flexible liquid receiving tubular units, comprising mounting a plurality of the units in a way to determine and rigidly maintain a uniform and predetermined axial dimension of all thereof and to prevent axial movement of a part of each thereof in both axial directions, placing said mounted units within and in fluid communication with a sealed container, subjecting said container to sub-atomspheric pressure to evacuate said units, flooding said container with a filling liquid to immerse and fill said units, and subjecting said container successively to atmospheric and to super-atmospheric pressure to void said units of vapor.

5. A method of filling bellows and like flexible, liquid receiving tubular units, comprising mounting a plurality of the units in a way to determine and rigidly maintain a uniform and predetermined axial dimension of all thereof and to prevent axial movement of a part of each thereof in both axial directions, placing said mounted units within and in fluid communication with a sealed container, subjecting said container to sub-atmospheric pressure to evacuate said units, flooding said container with a filling liquid to immerse and fill said units, subjecting said container successively to atmospheric and to super-atmospheric pressure to void said units of vapor, stabilizing the mounted units, and sealing the same.

6. A method of filling bellows and like flexible, liquid-receiving tubular units each characterized prior to filling by an open axial end, comprising mounting a plurality of the units in a way to determine and rigidly maintain uniform and predetermined axial dimension of all thereof, placing said mounted units, open ends up, within and in fluid communication with a sealed container, flooding said container with a filling liquid to cover said units and fill the latter gravitationally, removing said units from said container, and closing and sealing the open upper ends of said units.

7. A method of filling bellows and like flexible, liquid-receiving tubular units each characterized prior to filling by an open axial end, comprising mounting a plurality of the units in a way to determine and rigidly mantain uniform and predetermined axial dimension of all thereof and to prevent axial movement of a part of each thereof in both axial directions, placing said mounted units, open ends up, within and in fluid communication with a sealed container, flooding said container with a filling liquid to cover said units and fill the latter gravitationally, removing said units from said container, and closing and sealing the open upper ends of said units.

8. A method of filling bellows and like flexible, liquid-receiving tubular units each characterized prior to filling by an open axial end, comprising mounting a plurality of the units in a way to determine and rigidly maintain uniform and predetermined axial dimension of all thereof and to prevent axial movement of a part of each thereof in both axial directions, placing said mounted units, open ends up, within and in fluid communication with a sealed container, evacuating said container to evacuate said units, flooding said container with a filling liquid to cover said units and fill the latter gravitationally, successively subjecting said container to atmospheric and super-atmospheric pressures to void said units of vapor, and to force the liquid into the latter, removing said units from said container, thermally stabilizing said units and closing and sealing the open upper ends of said units.

9. A system for filling bellows and like liquid receiving units, comprising a sealed fill tank to receive said units in open communication with its interior, a source of supply of filling liquid, sources of supply of subatmospheric and super-atmospheric pressure, conduitry communicating said fill tank with said liquid supply and pressure sources and provided with valves to control said communication, and a fixture removably immersible in liquid in said fill tank and having means to clamp and maintain a plurality of said units in a uniform axial dimension, and to restrain a part of each of said bellows from movement in either axial direction.

10. A fixture for clamping a plurality of bellows or like units, comprising parallel and parallel surfaced top, intermediate and bottom plates adapted to be clamped in predetermined axially aligned spacing, said bottom plate having spacer means fixed thereto and projecting normal to its upper surface, said intermediate plate downwardly abutting said spacer means to determine the spacing of its upper surface from that of the bottom plate, said top and intermediate plate having registering openings axially receiving said units, with the bottoms of the latter engaging the upper surface of said bottom plate, said intermediate plate being engaged by and vertically sustaining said units when so disposed, said top plate rigidly and axially clamping the units as thus sustained.

11. A fixture for clamping a plurality of bellows or like units, comprising parallel and parallel surfaced top, intermediate and bottom plates adapted to be clamped in predetermined axially aligned spacing, said bottom plate having spacer posts fixed thereto and projecting normal to its upper surface, said intermediate plate downwardly abutting said spacer posts to determine the spacing of its upper surface from that of the bottom plate, said top and intermediate plate having registering

openings axially receiving said units, with the bottoms of the latter engaging the upper surface of said bottom plate, said intermediate plate being engaged by and vertically sustaining said units when so disposed, said top plate rigidly and axially clamping the units as thus sustained.

12. A fixture for clamping a plurality of bellows or like units, comprising parallel and parallel surfaced top, intermediate and bottom plates adapted to be clamped in predetermined axially aligned spacing, said bottom plate having spacer posts threadedly fixed thereto and projecting normal to its upper surface, said intermediate plate downwardly abutting said spacer posts to determine the spacing of its upper surface from that of the bottom plate, said top and intermediate plate having

registering openings axially receiving said units, with the bottoms of the latter engaging the upper surface of said bottom plate, said intermediate plate being engaged by and vertically sustaining said units when so disposed, and bolts extending through said top plate in threaded engagement with said post and rigidly and axially clamping said top plate against the units as thus sustained.

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