United States Patent

[11] 3,602,256

[72] Inventors **Jerzy Olszewski**
Aegidienberg;
Rolf Honicke, Cologne; Reiner Moeres,
Siegburg, all of, Germany

[21] Appl. No. **873,308**
[22] Filed **Nov. 3, 1969**
[45] Patented **Aug. 31, 1971**

[73] Assignee **Klockner-Humboldt-Deutz**
Aktiengesellschaft
Cologne-Deutz, Germany

---

[54] **LIQUID CONVEYING ARRANGEMENT, ESPECIALLY FOR FUEL INJECTION INSTALLATION**
8 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **137/567,** 137/561, 138/89
[51] **Int. Cl.** **F04b 23/04**
[50] **Field of Search** ..... 137/566, 567, 561 A; 222/255; 251/145; 239/450, 547, 550, 551; 138/89; 285/220, 212, 206, 204

[56] **References Cited**

UNITED STATES PATENTS

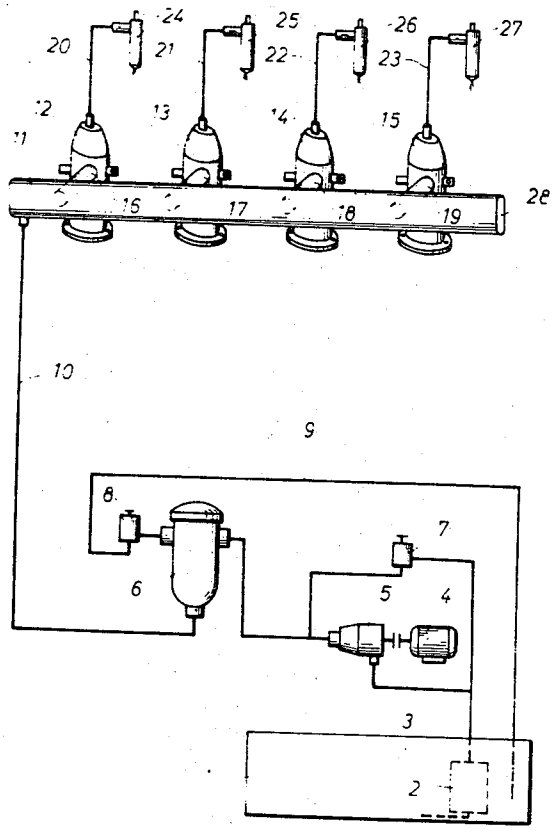
908,893	1/1909	Shade	138/89
2,145,451	1/1939	McCoy	239/547
2,475,007	7/1949	Carlson	285/204
2,652,069	9/1953	Goheen	137/561.1 X
2,811,392	10/1957	Warp	239/547
3,052,378	9/1962	Wright et al.	222/255 X
3,175,578	3/1965	Patterson et al.	137/561.1

FOREIGN PATENTS

564,252	2/1958	Belgium	138/89

Primary Examiner—M. Cary Nelson
Assistant Examiner—R. B. Rothman
Attorney—Walter Becker

ABSTRACT: A liquid conveying arrangement with one or more intermittently operating consumers, for instance, an installation with a plurality of intermittently conveying pumps directly or through short connections connected to a collecting feeding pipe, especially for fuel injection installations for internal combustion engines, in which the feeding pipe of each consumer at least in the vicinity of the withdrawing area from the feeding pipe is provided with a cross section which differs from a circular cross section and, for instance, has a flat rectangular or flat oval cross section.



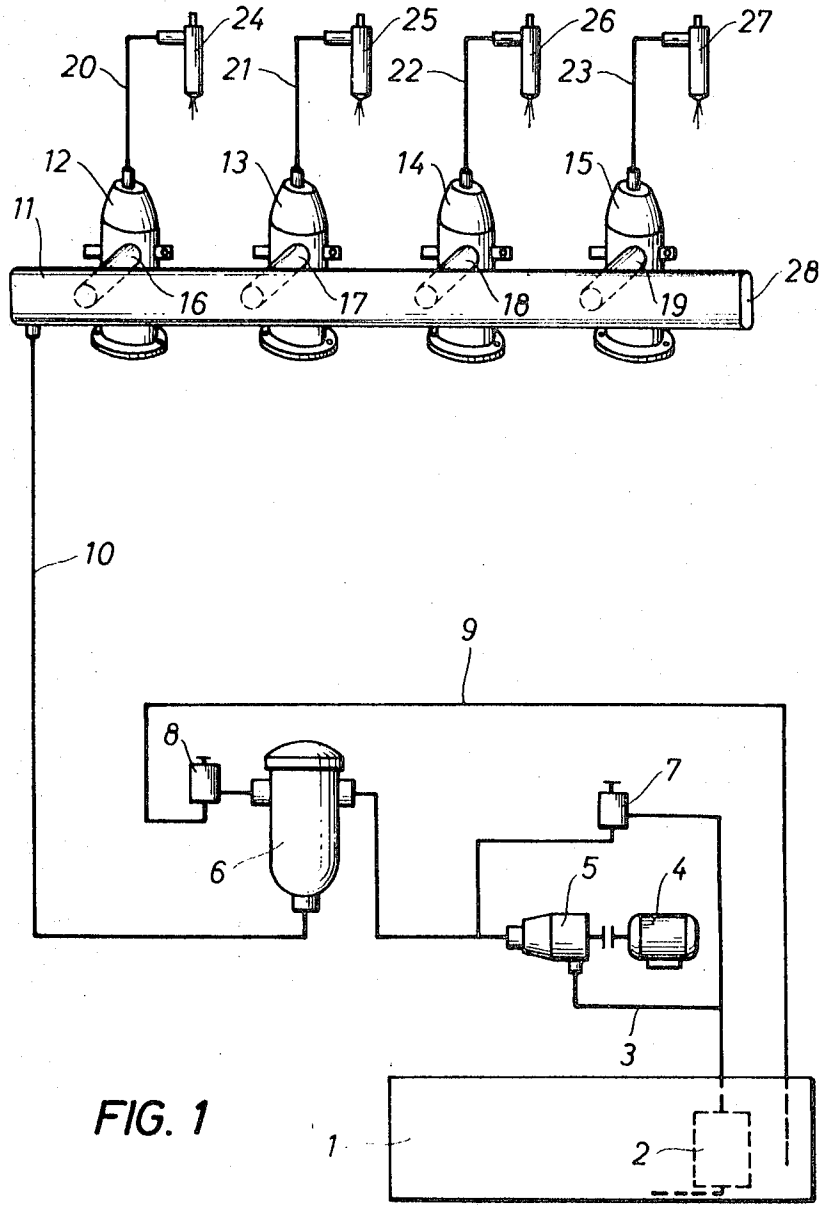
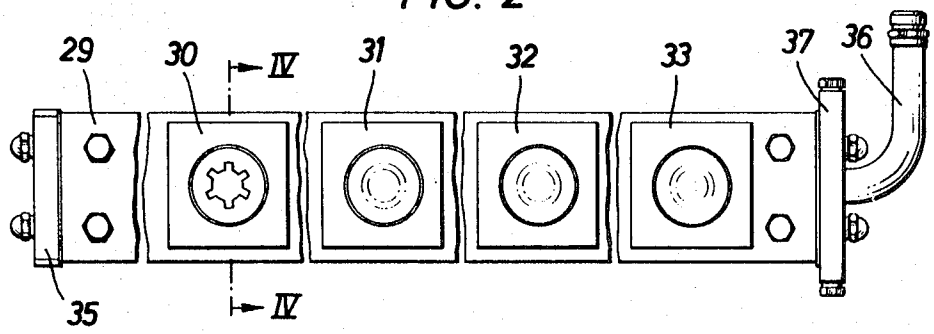


FIG. 1

INVENTORS:
Jerzy Olazenski
Rolf Hönicke
Reiner Moeres
BY
Walter Becker

FIG. 2



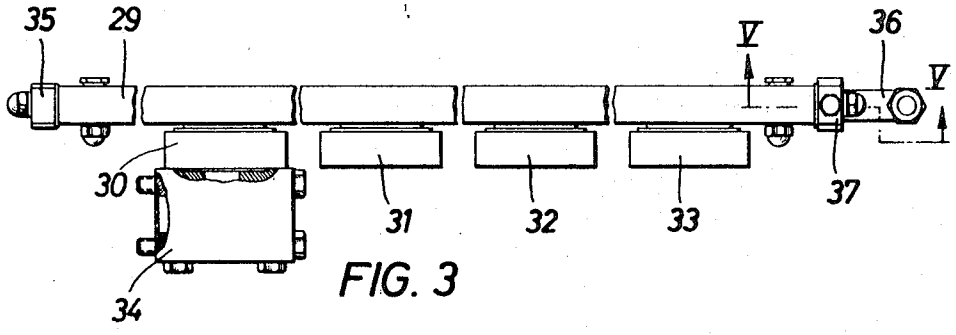


FIG. 3

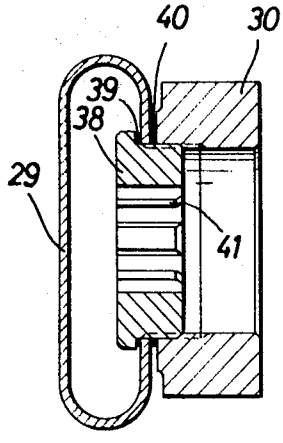


FIG. 4

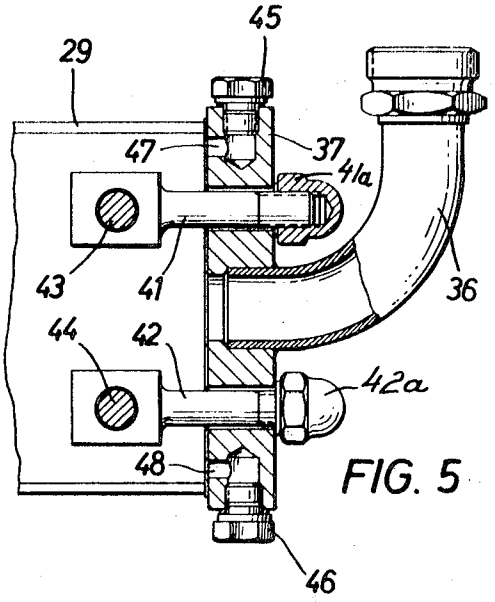


FIG. 5

INVENTORS:
Jerzy Olszewski
Rolf Mönicke
BY Heiner Moores
Walter Bailey

FIG.6

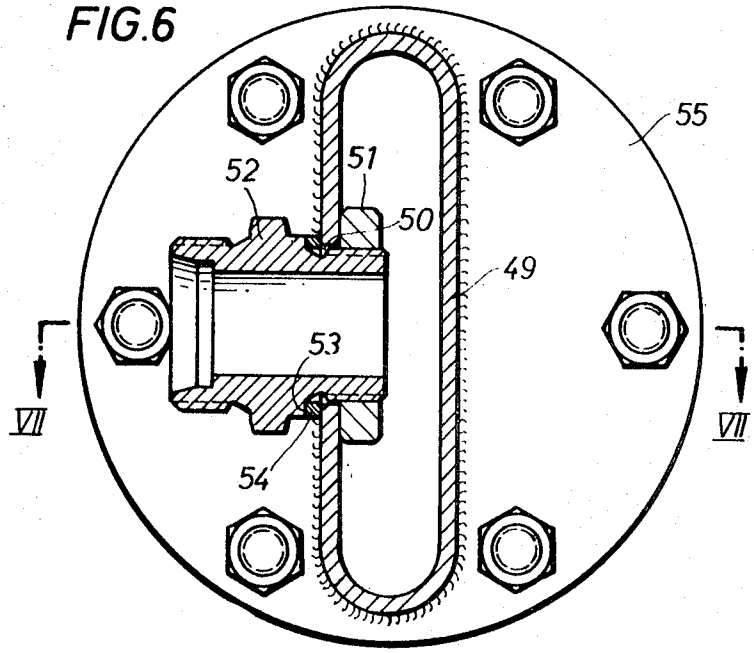
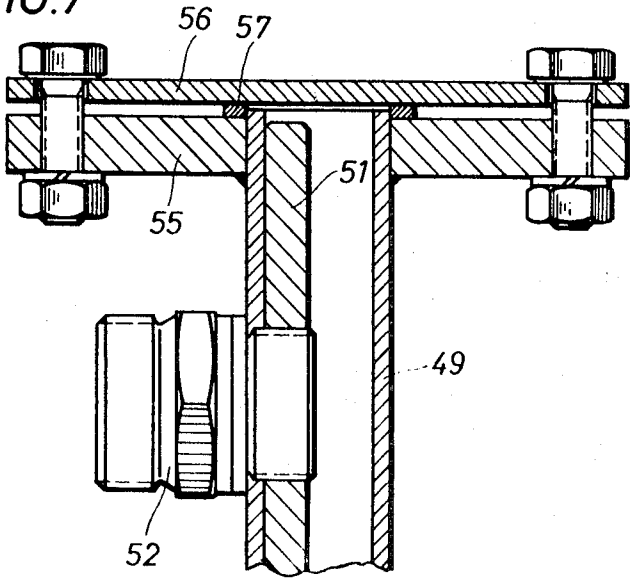


FIG.7



INVENTORS:
Jerzy Olszenski
Rolf Hönicke
Reiner Moeres
BY Walter Beier

LIQUID CONVEYING ARRANGEMENT, ESPECIALLY FOR FUEL INJECTION INSTALLATION

The present invention relates to a liquid conveying installation with a single supply station or with a plurality of intermittently withdrawing supply stations, for instance an installation with a plurality of intermittently conveying pumps which are connected directly or through short pipe connections to a collecting feeding pipe or through longer individual feeding pipes. The present invention is particularly but not exclusively directed to fuel injection installations in connection with injecting internal combustion piston engines.

With installations of this type, the pressure variations occurring during the intermittent withdrawal cause a nonuniform delivery to the consumer or consumers, especially when short delivery sequences and high delivery pressures are involved. With a fuel injection internal combustion piston engine which, as a rule, is equipped with injection pumps having an inclined edge control, these pressure variations in the feeding line bring about different quantities of delivery and displacements of the injection time, which in its turn has a disadvantageous effect on the combustion in the engine, the noise development of the engine, the color of the exhaust gas, the power output, and the fuel consumption. Moreover, the coordination of a plurality of individual pumps is made more difficult. Finally, these pressure variations in the suction line frequently bring about cavitation with the known drawbacks inherent thereto. With injection pumps of internal combustion piston engines the cavitation is noticeable, for instance, at the so-called control hole markings.

It is therefore, an object of the present invention to provide a liquid conveying installation of the above-mentioned general type which will overcome the drawbacks inherent to heretofore know liquid conveying installations of the type involved.

This object and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings in which:

FIG. 1 is a diagrammatic illustration explaining the invention in connection with a fuel injection installation of a four cylinder injection piston-operated internal combustion engine.

FIG. 2 shows the collecting feeding pipe of the individual pumps of a four cylinder internal combustion piston-operated engine with the connecting flanges for the injection pumps seen from above.

FIG. 3 is a top view of the collecting feeding pipe of FIG. 2 pivoted about its longitudinal axis by 90°.

FIG. 4 represents a section taken along the line IV—IV of FIG. 2.

FIG. 5 is a section taken along the line V—V of FIG. 3.

FIG. 6 illustrates a modified collecting feeding pipe according to the invention for the injection pump of a multicylinder internal combustion piston-operated engine.

FIG. 7 is a section taken along the line VII—VII of FIG. 6.

The liquid conveying installation according to the present invention is characterized primarily in that the feeding pipe of each withdrawing station, at least in the vicinity thereof, or the collecting feeding pipe, in case a plurality of withdrawing stations are provided, has a cross section which is not circular, as for instance a flat-rectangular or flat-oval cross section. In view of this special cross-sectional design, the feeding conduits are volume-elastic which means that in case of pressure variations delivery liquid is stored directly ahead of the withdrawing station or stations which results in a reduction of the pressure variations.

The readiness of the feeding line to breath is all the greater the more pronounced the deviation is of the cross section of the feeding line from the circular shape, in other words the greater the proportion is of the circumferential surface of the pipe which proportion when subjected to bending stress will in response to pressure variations in the pipe flex in the manner of a diaphragm. In view of the cross-sectional shape of the feeding pipe according to the present invention, it is not necessary to provide special or separate storing devices which incidentally have the following drawbacks. If when a plurality of withdrawing stations are used not each station has associated therewith such storing device, there exists the danger that the intended effect will not occur to the same extent at all withdrawing stations.

When providing a plurality of withdrawing stations with a collecting feeding pipe extending along said withdrawing stations, it will suffice to design only the collecting feeding pipe in a volume manner provided the withdrawing stations are connected to the collecting pipe by means of short pipe sections. When longer connecting lines are provided, it may be necessary also to design the cross section of said last-mentioned lines in conformity with the present invention. The connecting areas for the withdrawal on the collecting pipe have basically to be designed in such a way that their stiffening influence which affects the breathing ability of the collecting pipe is as small as possible and that furthermore an easy assembly will be assured. The heretofore employed welding or hard-soldering method used when building up distributing pipes is not employed in connection with the present invention because it is as a rule unavoidable that welding and soldering pellets remain in the collecting pipe which pellets are difficult to eliminate and later on during the breathing of the collecting pipe may detach themselves and may together with the medium to be conveyed pass to the frequently very sensitive withdrawing stations. According to a favorable design in conformity with the present invention, it is suggested to provide at least one end of the collecting feeding pipe with a detachable cover which when removed will free the entire inner pipe cross section as far as possible. It is furthermore suggested in conformity with the present invention to screw a hollow screw having inner teeth to a connecting flange for the pump while the inner teeth of the hollow screw have to be accessible through the connecting flange. The hollow screw is within the area of each withdrawing connection introduced into the collecting pipe from an open end thereof through a window in the collecting pipe and is tightly mounted in the collecting pipe wall.

Another possibility of designing the connecting sections of collecting pipes consists in that a rail provided with threaded bores is introduced into the collecting pipe and at each connecting station a pipe nipple is through a window in the wall of the collecting pipe screwed into the said rail while the window frame means together with a seal are firmly clamped in between the nipple and the rail.

The conveying medium is advantageously introduced through one end of the covers in order to save a further connection which would affect the breathing ability of the collecting pipe. This also applies for pipe venting and emptying stations which may be necessary. In this connection it is suggested to have the venting passages end in the end closure means in such a way that they lead thereinto radially and are closed by screws.

When designing end closures means for collecting feeding pipes and also the connecting flanges for individual pipes or individual pipe sections having a cross-sectional shape according to the invention, it is also of importance to see to it that the breathing ability of the pipes is affected as little as possible and that these particular areas do not form areas where impurities can get into the medium to be conveyed. An advantageous design of these elements in this connection consists in conformity with a further development of the invention in that the end closure means of collecting feeding pipes and connecting flanges, in case individual pipes are used, sealingly engage the pipe ends and are braced to the pipe by means of tie rods which are inserted into or suspended within said pipe and lead to the outside through the closure means or through the connecting flange in case individual pipes are involved.

Within the framework of the present invention, the end covers of collecting feeding pipes or connections of individual feeding pipes may also be formed by a flange mounted on the

pipe end which flange is firmly connected to a counter flange through the intervention of a seal.

Referring now to the drawings in detail, with the fuel injection installation illustrated therein the fuel is withdrawn from a storage container **1** through a prefilter **2** and passed through a conduit **3** to the suction side of a delivery pump **5** which is operated by an electric motor **4**. The pump **5** delivers the fuel through a fine filter **6** to the injection pump unit of the internal combustion engine (not shown). The delivery pump **5** as well as the fine filter **6** are each bridged by an overflow or relief valve **7**, **8** respectively, while the return flow conduit **9** of the valve **8** leads back to the storage container **1**. The output line **10** of the fine filter **6** is connected to a collecting feeding pipe **11** for the four injection pumps **12**, **13**, **14**, and **15** of the internal combustion engine. The pumps **12–15** respectively communicate with the pipe **11** through short pipe sections **16**, **17**, **18** and **19**. From each injection pump, one injection line each **20**, **21**, **22** and **23** respectively leads to an injection nozzle **24**, **25**, **26** and **27** of the respective associated engine cylinder (not shown). A view of the right-hand end face **28** shows that the collecting feeding pipe **11** has a cross section which, in conformity with the present invention, differs considerably from a circular cross section. In other words, the cross section of pipe **11** is flat oval. Consequently, this collecting feeding pipe **11** is volume-elastic. This means that when pressure variations occur during the operation, fuel accumulates whereby a reduction in the pressure variations will be realized.

The collecting feeding pipe **29** illustrated in FIG. **2**, which likewise pertains to an injection internal combustion piston-operated engine with four cylinders, has a very flat oval cross section as is particularly clearly evident from FIG. **4**. Moreover, the pipe **29** is provided with four flanges **30**, **31**, **32** and **33** for a direct connection of four individual injection pumps of which only the shutoff valve **34** connected to the flange **30** and pertaining to a nonillustrated injection pump is shown in top view in FIG. **3**. The left-hand side of the collecting feeding pipe **29** is closed by a blind flange **35** whereas the other end of pipe **29** is closed by a flange **37** which in turn is provided with a connection **36** for the pressure line of a delivery pump not shown.

The section shown in FIG. **4** illustrates the structure of the connecting area or connecting station in the region of the flange **30**. Similar to the other flanges **31**, **32** and **33**, flange **30** is firmly connected to the pipe **29** by means of a hollow screw **38** extending through a window in the pipe wall. The window forming section, in other words the pipe wall, is clamped between the head screw **38** and the threaded opening of the flange **30** while gaskets **39** and **40** are respectively interposed between the pipe, the screwhead and the flange **30**.

As will be evident from FIG. **5**, the end closure means **37** is formed by a smooth flange which sealingly engages the end face of the pipe **29**. As will also be seen from FIG. **5**, bolts **43** and **44** extend through the interior of the last-mentioned end of pipe **29** and have suspended thereon tie rods **41** and **42** respectively for firmly clamping the closure means **37** to the pipe **29**. The tightening is effected by means of nuts **41***a* and **42***a* respectively. For purposes of venting or emptying the collecting pipe **29**, there are provided two passages **47** and **48** which are located in the closure means **37** and radially lead out of the same. These passages **47** and **48** are respectively closed by screws **45** and **46**.

Referring now to FIGS. **6** and **7**, these figures show a collecting feeding pipe **49** which has a flat oval cross section and is intended for the injection pumps (not shown) of a likewise not illustrated internal combustion engine. At the connecting areas for the individual pumps, pipe **49** is provided with windows **50** (one only being shown) through which a pipe nipple **52** is passed from the outside, said nipple within the pipe **49** being threadedly connected to a rail **51** located within pipe **49**. Between a shoulder **53** and the area defining the window **50** there is provided a gasket **54**. The rail **51** is common to all connecting stations.

As will be evident in particular from FIG. **7**, the end cover of the pipe **49** is formed by a circular flange **55** which is connected to the end of pipe **49** in any convenient manner, for instance, by welding, and which is firmly screwed to a blind flange **56**. Between the two flanges there is provided a gasket **57** which is radially fixed as to its location by that end of pipe **49** which extends to and protrudes beyond the flange **55**.

It is, of course, to be understood that the present invention is, by no means, limited to the particular designs shown in the drawings but also comprises any modifications within the scope of the appended claims. Thus, the design of the feeding lines according to the invention may also be used with the same advantage in connection with conveying installations in which the withdrawal of the respective conveyed medium is effected continuously at one or more withdrawing stations whereas the supply is effected intermittently.

It is, furthermore, to be understood that the pipe **29**, **49** may be of any metal or synthetic material adapted to withstand bending stresses. Material and cross section are selected in conformity with the respective conditions of operation, i.e. how frequent the pressure variations are which have to be absorbed and how great the quantities are which have to be stored temporarily. It is self-understood that the material selected for the pipes **28**, **49** will have the necessary elasticity.

What we claim is:

1. A liquid conveying arrangement comprising intermittently operating consumer means extracting liquid in quick sequence, especially fuel injection pumps of internal combustion piston engines, which includes: feedpipe means having opening means for connection with said intermittently operating consumer means, said feedpipe means at least adjacent said opening means having a thin-walled volume-elastic cross section differing from a circular cross section and being of material flexible in the manner of a diaphragm.

2. A liquid conveying arrangement comprising intermittently operating consumer means, especially fuel injection pumps of internal combustion piston engines, said consumer means comprising a plurality of pumps having connecting flange means with passage means therethrough, which includes: feedpipe means having opening means for connection with said intermittently operating consumer means, said feedpipe means including a collecting feedpipe provided with windows and common to and in communication with said pumps through said windows and said passage means of said connecting flange means, screw means threadedly engaging said flange means and firmly connecting the latter to said collecting feedpipe, said screw means having passage means therethrough establishing communication between the interior of said collecting pipe means and said pumps through the windows of said pipe means, said feedpipe means at least adjacent said opening means having a cross section differing from a circular cross section, end closure means closing the ends of said collecting feedpipe, tubular connecting means leading into one of said end closures means and communicating with the interior of said collecting feedpipe for supplying liquid thereto, one of said end closure means being provided with radial venting passages communicating with the interior of said feedpipe means, and threaded closure means detachably sealing closing said venting passage means.

3. An arrangement according to claim **2**, in which said feedpipe means at least adjacent said opening means has a relatively long and narrow cross section.

4. An arrangement according to claim **2**, which includes gasket means respectively interposed between said collecting feedpipe and said flange means and between said flange means and the pertaining pumps.

5. An arrangement according to claim **2**, in which said screw means are provided with inner threads defining the passage means thereof.

6. An arrangement according to claim **2**, in which said end closure means include flange means and tie rod means suspended within said feedpipe means and sealingly securing said flange means to the ends of said feedpipe means.

7. An arrangement according to claim 2, in which said end closure means includes a flange mounted on and fixedly connected to an end of said feeding pipe means and also includes a counter flange and gasket means interposed between said first-mentioned flange and said counter flange, and means firmly connecting said flanges together.

8. A liquid conveying arrangement comprising intermittently operating consumer means, especially fuel injection pumps of internal combustion piston engines which includes: feedpipe means having opening means for connection with said intermittently operating consumer means, said feedpipe means at least adjacent said opening means having a cross section differing from a circular cross section, said feedpipe means including a collecting feedpipe adapted to be connected to a fluid supply source and provided with a plurality of windows in conformity with the number of consumers, a rail arranged within said collecting feedpipe and provided with a plurality of threaded bores corresponding in number to the number of said windows and in alignment therewith, and a plurality of tubular nipples respectively threadedly engaging said threaded bores and sealing connected to corresponding wall portions of said collecting feedpipe for connection with said consumers.