Aug. 18, 1959 J. J. BECHER 2,899,907

ROLLER PUMP

Filed March 17, 1958 2 Sheets-Sheet 1

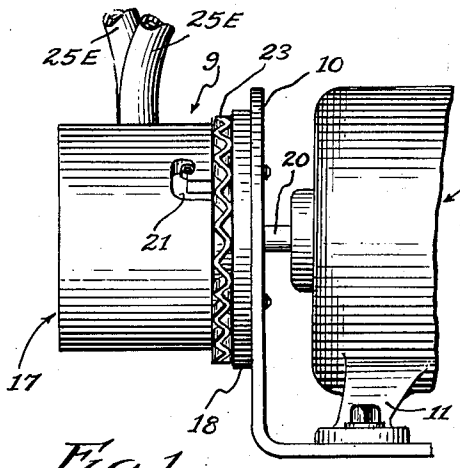


Fig. 1.

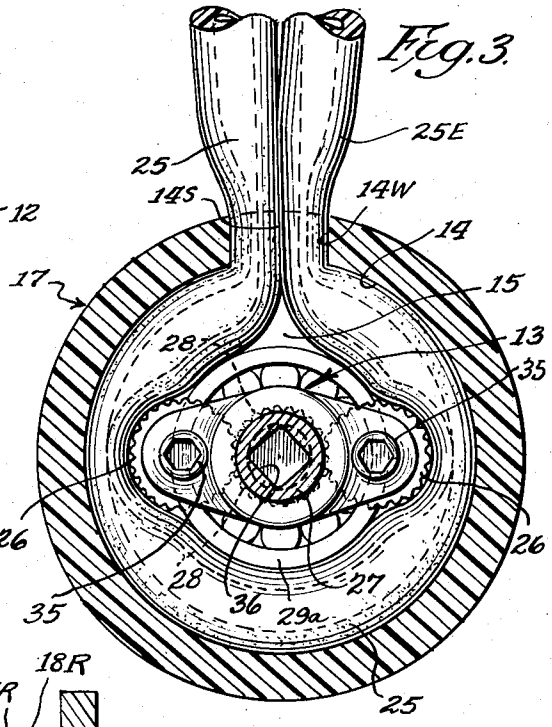


Fig. 3.

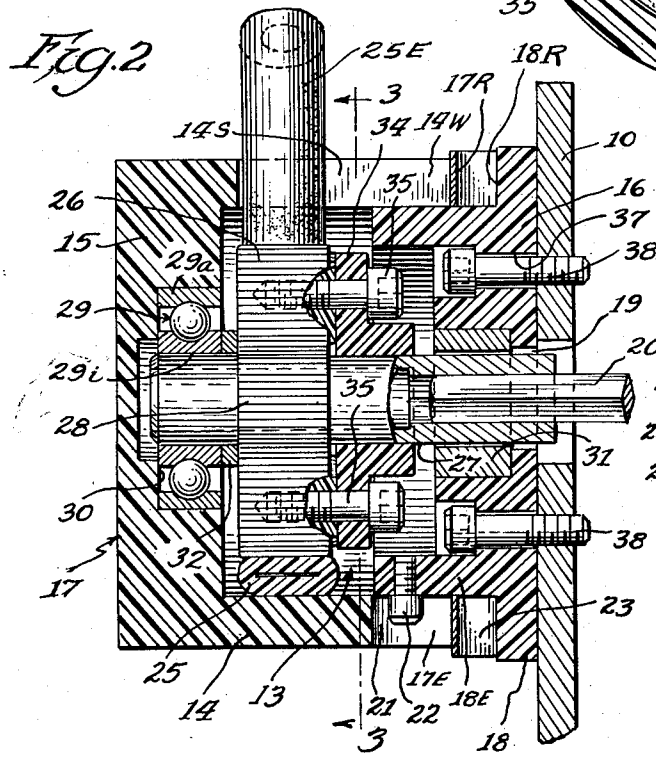


Fig. 2

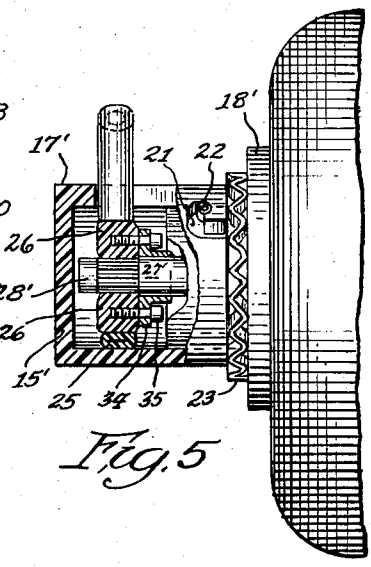


Fig. 5

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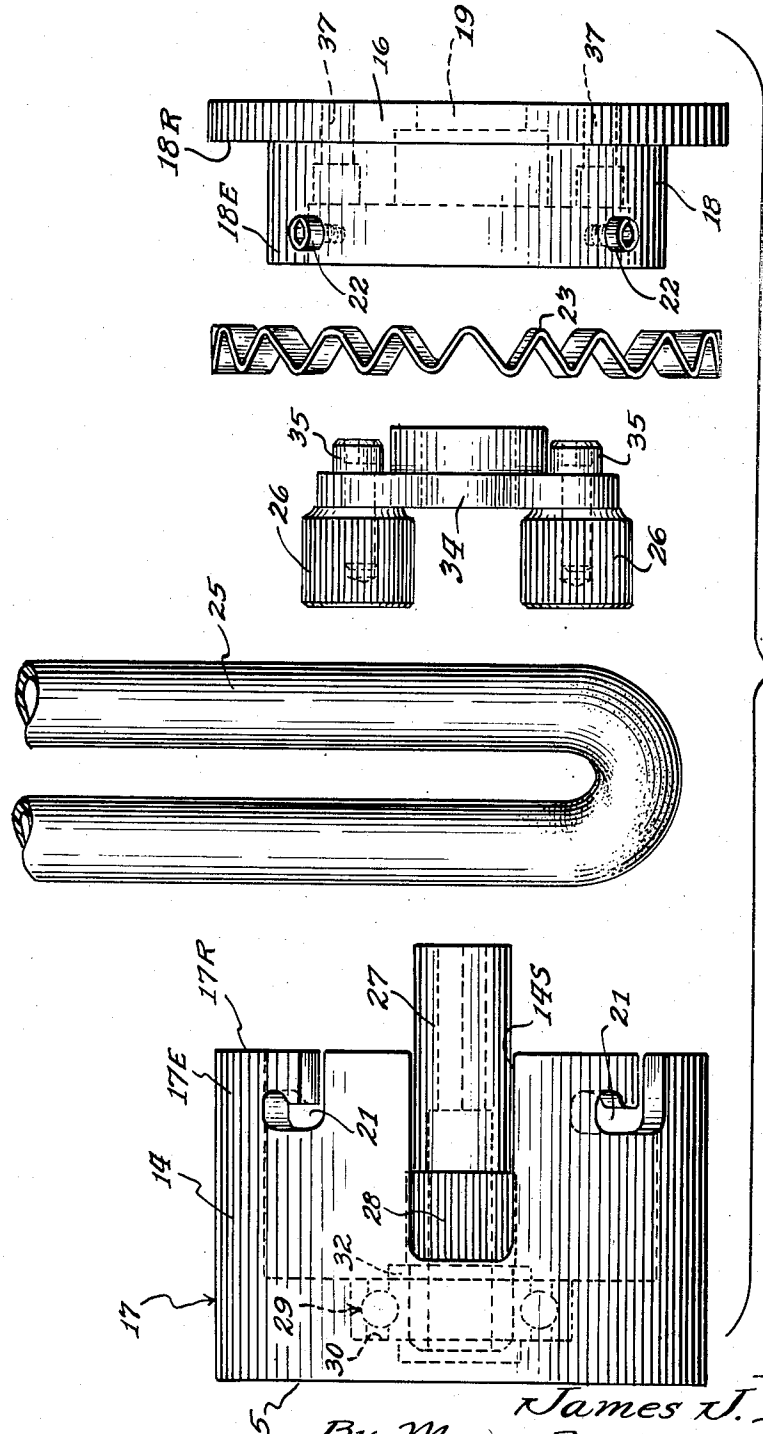


Fig. 4.

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ROLLER PUMP

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16 Claims. (Cl. 103—149)

This invention relates to improvements in a sanitary, leak-proof pump of the type in which the material being pumped is progressively forced through a loop of collapsible pumping hose and, more particularly, is concerned with pumps of the general class characterized by a casing that provides a cylindrical pumping chamber in which a rotatably mounted drive shaft progresses one or more compression rollers along an annular path to compress the walls of the pumping hose radially outwardly against a peripheral wall of the casing. Thus, the rollers force the material being pumped forwardly through the hose and set up a suction force in their wake.

In the usual sanitary application, such as for pumping blood or dispensing milk or similar liquids, it is important to replace the pumping hose frequently for sterilizing purposes, and the present invention provides a novel pump construction of the aforementioned type that facilitates replacement of the pumping hose. It will be apparent that this construction also finds important use in situations where the duty requirements impart excessive wear of the pump parts which, hence require frequent replacement. In addition, the invention is of important application in situations wherein frequent inspection of the pump parts is necessary to insure dependable service.

According to the invention, a cooperating pair of housings are secured together to form the pump casing, with one of the housings being adapted for fixed mounting on a supplemental structure and with the other housing being releasably secured thereto and containing the working parts of the pump. Not only do the readily separable housings afford ease of access to the pump parts but the parts are contained in the removable one of the housings. This eliminates the usual difficulty involved in servicing mechanisms when they are in place on the equipment with which they are used.

Further features of the invention relate to the releasable connection for securing the housings together and to the particular arrangement for removably mounting the pumping hose and the compression rollers.

Other objects and advantages will become apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same;

Fig. 1 is an elevational view illustrating the pump of the invention in operative association with its driving motor;

Fig. 2 is a longitudinal sectional view through the pump.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2 but omitting the parts of the inner housing and illustrating the rollers at a different position with respect to the periphery of the pump housing;

Fig. 4 is an exploded elevational view illustrating the parts of the pump and their order of insertion; and

Fig. 5 is a longitudinal sectional view of an alternative pump arrangement according to the invention.

Referring now to Fig. 1 wherein, for purposes of disclosure, the pump of the invention, designated generally as 9, is shown mounted on a suitable supporting structure in the form of a bracket 10 that is rigid with the base frame 11 of the driving motor 12 for the pump. The pump casing forms a cylindrical pumping chamber 13 (see Figs. 2 and 3) bounded by a peripheral wall 14 and opposite end walls 15 and 16 and consists of outer and inner housings designated 17 and 18, respectively, that are releasably interconnected by a spring-held bayonet slot arrangement.

The outer housing 17 includes the peripheral wall 14 and the outer end wall 15, while the inner housing 18 provides the inner end wall 16, which is formed with an opening 19 through which the shaft 20 of the driving motor extends.

The housings include endwise extending, radially overlapping end portions 17E and 18E, respectively, and radially extending, endwise overlapping portions 17R and 18R, respectively, with the end portion 17E of the outer housing being formed with a plurality of bayonet slots 21 facing and opening through the open end thereof and with the end portion 18E of the inner housing having lugs 22 insertable endwise into the slots 21 for engagement in the slot pockets. An annular wave spring 23 reacts between the oppositely facing end portions 17R and 18R to bias the housings apart and maintain the lugs 22 engaged in the pockets of the bayonet slots 21 to secure the parts in place. The housings are readily disconnected by first forcing them together against the action of the spring 23 and rotating one housing with respect to the other to free the lugs. The housings are preferably of a transparent plastic material, such as Lucite, though they need not be transparent and may be made of metal, for example, cast iron, or any other suitable material.

The working parts of the pump comprise a length of collapsible pumping hose 25 of resilient material, such as latex, formed into a loop within the pumping chamber 13 and disposed at the outer regions thereof, and one or more compression rollers 26 rotatably mounted within the loop for compressing the hose outwardly against the peripheral wall 14.

In the preferred arrangement, a drive shaft 27 is rotatably mounted centrally within the hose loop. The drive shaft 27 includes a slotted driving surface 28 for peripheral frictional driving contact with the rollers 26. While axial slots are shown, herringbone or other comparable slot patterns are also suitable. The rollers may be of nylon with their surfaces pre-slotted or they may be smooth-surfaced initially. With either arrangement, during usage, they will develop a slotted surface complemental to the slotted driving surface 28 of the shaft so that the peripheral engagement therebetween duplicates the action of conventional gear teeth. Obviously, other positive-drive mechanical arrangements may be employed.

The driving shaft is rotatably supported at its outer end in anti-friction bearing facilities 29 mounted in a suitable bearing pocket 30 provided in the outer end wall 15 and at its inner end in a brass bearing sleeve 31 mounted in the opening 19 through the inner end wall 16. It will be apparent that in certain situations, the motor shaft 20 can adequately support the inner end of the driving shaft 27, in which case the bearing sleeve 31 is unnecessary.

As illustrated the bearing 29 may be a conventional ball bearing assembly having its outer race 29*a* fixed within the pocket 30 against accidental removal therefrom and having its inner race 29*i* fixed to the shaft to prevent endwise removal of the shaft. Thus the bearing 29 and shaft 27 form a unit assembly which accommodates free rotation of the shaft. In the disclosed construction, the outer race 29*o* is arranged for a snug press fit within the pocket 30 to forcibly retain the bearing and, hence, the shaft, against accidental removal. Obviously, suit-

able fasteners could be provided to engage the outer race for retaining this assembly. Between the slotted portion 28 of the shaft and the bearing 29 is fixed an annular washer 32 having an outside diameter slightly greater than that of the slotted surface 28 to provide an endwise-facing annular track along which the outer end faces of the rollers 26 may move with a minimum of friction. In the preferred arrangement, there are shown two rollers in order that the pump will maintain compression at all times, and they are preferably mounted on a nylon yoke 34 that telescopes over the shaft 27 in freely rotatable and loose sliding engagement thereon. The yoke includes oppositely radially extending arms which rotatably carry stainless steel roll pins 35 that are fixed to the rollers 26 for supporting the same from the yoke. Abutment between the outer end face of the rollers 26 and the washer 32 spaces the yoke 34 free from conflict with the slotted surface of the shaft.

The operation of the pump may be described briefly as follows:

The shaft 27 is driven by the rotating shaft 20 of the motor which, as shown, is of square cross-section and is engaged within a mating square-shaped bore 36 at the inner end of shaft 27 to provide a self-aligning positive lock coupling. As the shaft portion 28 is thus rotated, it drives the rollers 26, which are of appropriate size for compressing the region of the pumping hose with which they are in contact, and they progressively roll along the loop of pumping hose to develop the desired pumping action. The yoke 34 undergoes rotation relative to the shaft 27 as it is, in effect, driven by the rollers 26, which continuously roll around the pumping chamber.

The arrangement of the present invention is characterized by the ease with which the parts thereof may be removed and handled. Since there are numerous sanitary applications requiring frequent replacement and sterilization of the hose, the provision of a readily removable pumping hose is of primary concern.

As shown, the opposite end portions 25E of the length of hose which is formed into the pumping loop are brought through the peripheral wall 14 in side-by-side abutting relation. For this purpose the peripheral wall is formed with a slot 14S extending lengthwise therealong to open through the inner end face of the outer housing 17. The opposing lengthwise extending slot walls 14W, as best seen in Fig. 2, are preferably straight-sided and provide sharp corners at the opposite radial extremities thereof which assist in gripping the hose end portions 25E and, in effect, hold these end portions stationary against the normal tendency thereof to creep in an annular path at the periphery of the pumping chamber under the peripheral drag imposed thereon by the rollers 26. In preventing such undesired creeping, attention is given to the proportioning of the width of the slot 14S with respect to the wall thicknesses of the pumping hose. In one constructional embodiment, the slot has a width of ½" and the walls of the hose have a thickness of 3/32". Since four layers of the hose wall are to be interposed in the slot, the overall thickness of these walls becomes 3/8". This specific arrangement thus leaves 1/8" clearance for handling the incoming and outgoing flow of the material being pumped, and this has been found adequate for preventing creeping of the hose without impairing the capacity and efficiency of the pump.

To insert the hose 25, it is formed into a generally loop shape and introduced into the pumping chamber through the open end of the outer housing 17. Preferably, initially it is inserted only part way into the pumping chamber and is arranged with the hose end portions 25E in side-by-side engagement across the width of the slot 14S. At this point the yoke and roller assembly is introduced through the open end of the outer housing; and with a slight twisting action applied to the yoke, the hose and yoke are advanced to their operating positions. Finally the outer housing is attached to the inner housing through the medium of the bayonet slot arrangement.

As suggested hereinbefore, one of the features of the invention resides in the fact that the inner housing is securely anchored in place, either on a bracket that is rigid with the motor or at some other suitable location. For this purpose the inner housing is formed with a plurality of countersunk bores 37 which receive anchoring screws 38 for attachment to the bracket 10 or other suitable supporting structure.

In one important application, the pump of the invention is employed for dispensing liquids in vending machines, in which case it may be mounted at a relatively inaccessible location within the machines, and it is an important advantage of the present arrangement that all of the working parts of the pump are contained in the outer, removable housing 17. Thus the maintenance man may reach into the machine, disengage the hose ends from their connection in the supply circuit of the machine, and remove the outer housing with all of the working parts of the pump therein. Then the parts may be removed, as is apparent, while holding the housing in one's hand or with it set at a suitable working location. Furthermore, it will be noted that the hose and the yoke and roller assembly are the parts which will usually require replacement, whereas the shaft is a relatively permanent mechanism. There is added convenience in the present arrangement since the shaft is firmly held in the outer housing and will not become dislodged as the hose and the roller and yoke assembly are withdrawn.

In replacing the parts, if such is necessary, the various parts are inserted into the outer housing in the manner described above and the outer housing is then mounted to the inner housing, and, finally, the hose ends are connected into their appropriate supply circuit.

A more simplified pump construction is shown in Fig. 5 in which the inner housing 18' is shown formed as an integral part of the end bell of the motor 12 and the shaft 27' is a rigid, and preferably, permanent extension of the motor shaft. In this instance the slotted driving surface 28' of the drive shaft is stepped down to allow the yoke 34 and rollers 26 to be withdrawn over the free end of the shaft.

With the arrangement of Fig. 5, the outer housing 17' is releasably engaged on the inner housing 18' by a bayonet slot mounting arrangment to facilitate removal thereof. In this instance, the tube 25, rollers 26, and yoke 34 will come off with the housing 17' to facilitate replacement of one or more of these parts while the shaft, which will not require repair or replacement, remains firmly in place.This construction eliminates the necessity of providing a bearing for the free end of the shaft, though, if desired, a suitable bearing may be provided in the end wall 15'. In addition, a washer may be fixed on end wall 15' to present an annular track for the outer end faces of rollers 26.

It should be understood that the description of the preferred form of the invention is for the purpose of complying with section 112, title 35, of the U.S. Code and that the claims should be construed as broadly as prior art will permit.

I claim:

1. In a pump including a casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, a driving shaft supported in said casing for rotation about the axial center line of said chamber, a generally annular loop of collapsible pumping hose within said chamber in the outer regions thereof, and roller means actuated by said shaft and rotatably mounted within said loop to compress said hose outwardly against said peripheral wall; the improvement wherein cooperating outer and inner housing members comprise said casing, releasable means secure said members in

case-forming relation, with the outer housing member including one of said end walls and said peripheral wall and with the inner housing member including the other of said end walls and being adapted for rigid mounting on a supporting structure, the end wall of said inner housing having a shaft access opening therethrough and the end wall of said outer housing having a bearing pocket formed therein, and a bearing fixed in said pocket against accidental removal therefrom, said bearing receiving one end of said shaft to rotatably support the same, and said shaft and said bearing having interengaging portions cooperating to resist endwise removal of said shaft from said bearing such that when said outer housing member is removal, said loop of hose, said roller means and said shaft are retained in said outer housing member.

2. In a pump including a casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, a driving shaft supported in said casing for rotation about the axial center line of said chamber, a generally annular loop of collapsible pumping hose within said chamber in the outer regions thereof, and roller means actuated by said shaft and rotatably mounted within said loop to compress said hose outwardly against said peripheral wall; the improvement wherein cooperating outer and inner housing members comprise said casing, releasable means secure said members in case-forming relation, with the outer housing member including one of said end walls and said peripheral wall and with the inner housing member including the other of said end walls and wherein the hose loop has inlet and outlet end portions extending through said peripheral wall for external connection, said peripheral wall being formed with slot means extending from the point at which said end portions pass through said peripheral wall to open through the end of said outer housing remote from the end wall thereof and provide an access slot through which each end portion is moved during removal and insertion of said hose loop.

3. In a pump including a casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, a driving shaft supported in said casing for rotation about the axial center line of said chamber, a generally annular loop of collapsible pumping hose within said chamber in the outer regions thereof, and roller means actuated by said shaft and rotatably mounted within said loop to compress said hose outwardly against said peripheral wall; the improvement wherein co-operating outer and inner housing members comprise said casing, releasable means secure said members in case-forming relation, with the outer housing member including one of said end walls and said peripheral wall and with the inner housing member including the other of said end walls and wherein the hose loop is formed from a length of hose having inlet and outlet portions at its opposite ends with said peripheral wall having a common slot formed therein to receive said inlet and outlet end portions in outwardly extending side-by-side contact across the width of said slot, said slot opening through the end of said outer housing remote from the end wall thereof and providing a lengthwise-extending access slot through which said end portions move during removal and insertion of said hose loop.

4. In a pump including a casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, a driving shaft supported in said casing for rotation about the axial center line of said chamber, a generally annular loop of collapsible pumping hose within said chamber in the outer regions thereof, and roller means actuated by said shaft and rotatably mounted within said loop to compress said hose outwardly against said peripheral wall; the improvement wherein said driving shaft is in peripheral driving engagement with said roller means and a removable yoke is telescoped over said shaft and rotatable thereon and rotatably carries said roller means, said yoke having an endwise extending opening therethrough for surrounding said shaft in endwise slidable relationship.

5. The arrangement of claim 4 wherein a washer is fixedly mounted on said shaft with said washer extending radially to overlap a portion of one end face of said roller means and provide an annular abutment track therefor and wherein said yoke includes a roll pin for roller means, said roll pin being rotatably mounted in said yoke and projecting into said roller means through the other end face thereof.

6. In a pump including a casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, a driving shaft supported in said casing for rotation about the axial center line of said chamber, a generally annular loop of collapsible pumping hose within said chamber in the outer regions thereof, and roller means actuated by said shaft and rotatably mounted within said loop to compress said hose outwardly against said peripheral wall; the improvement wherein cooperating outer and inner housing members comprise said casing, said housing members include endwise extending portions overlapping in the radial direction and radially extending portions overlapping in the endwise direction, with one of said endwise extending portions being formed with a bayonet slot opening endwise thereof and with the other of said endwise extending portions carrying a lug member for engagement in said bayonet slot, and yieldable means reacting between said radially extending portions to bias said housing members apart in the endwise direction and maintain said lug member in engagement in said bayonet slot.

7. The arrangement of claim 1 wherein the hose has inlet and outlet end portions extending through the peripheral wall thereof for external connection and a slot extends from the point at which said end portions pass through said peripheral wall to open through the end of said outer housing remote from the end wall thereof and provide an access slot facilitating the removal and insertion of each end portion.

8. The arrangement of claim 1 wherein the hose loop is formed from a length of hose having inlet and outlet portions at its opposite ends, with said inlet and outlet portions extending outwardly through a common slot formed in the peripheral wall of said outer housing, said portions being arranged side-by-side across the width of said slot, said slot opening lengthwise through the end of said outer housing remote from the end wall thereof and providing an access slot for said portions facilitating the removal and insertion of said hose.

9. The arrangement of claim 8 wherein the slot width is of a dimension slightly greater than the combined thickness of the hose walls of said inlet and outlet portions to retain said inlet and outlet portions against circumferential creeping in response to continuous frictional drag imposed thereon by said roller means.

10. In a pump including a casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, a driving shaft supported in said casing for rotation about the axial center line of said chamber, a generally annular loop of collapsible pumping hose within said chamber in the outer regions thereof, and roller means actuated by said shaft and rotatably mounted within said loop to compress said hose outwardly against said peripheral wall; the improvement wherein cooperating outer and inner housing members comprise said casing, releasable means secure said members in case-forming relation, with the outer one of said housing members including one of said end walls and said peripheral wall for removably receiving and retaining said roller means and said hose therein when said outer member is separated from said casing, and with the inner one of said housing members including the other of said end walls with a shaft access opening formed therethrough for receiving the shaft in rotatable driving engagement

with said roller means and being adapted for rigid mounting on a supporting structure.

11. In a pump including a casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, a driving shaft supported in said casing for rotation about the axial center line of said chamber, a generally annular loop of collapsible pumping hose within said chamber in the outer regions thereof, and roller means actuated by said shaft and rotatably mounted within said loop to compress said hose outwardly against said peripheral wall; the improvement wherein cooperating outer and inner housing members comprise said casing, said driving shaft is in peripheral driving engagement with said roller means and a removable yoke is telescoped over said shaft and rotatable thereon and rotatably carries said roller means, said yoke having an endwise extending opening therethrough for surrounding said shaft in endwise slidable relationship, with the outer one of said housing members including one of said end walls and said peripheral wall for removably receiving said yoke, said roller means, and said hose therein, and with the inner one of said housing members including the other of said end walls with a shaft access opening formed therethrough for receiving the shaft in rotatable driving engagement with said roller means and being adapted for rigid mounting on a supporting structure.

12. The arrangement of claim 11 wherein the opening in said yoke is larger than the outer end of the shaft and accommodates simultaneous withdrawal of the yoke, roller means, and hose over the outer end of the shaft when said outer housing is removed.

13. In a pump of the type having a generally annular loop of collapsible pumping hose and a plurality of rollers rotatably mounted within said loop in outwardly compressing engagement against the walls of said hose, the combination of a cooperating pair of housing members that define a hollow pump casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, said housing members including endwise extending portions overlapping in the radial direction and radially extending portions overlapping in the endwise direction, with one of said endwise extending portions being formed with a bayonet slot opening endwise thereof and with the other of said endwise extending portions carrying a lug member for engagement in said bayonet slot, yieldable means reacting between said radially extending portions to bias said housing members apart in the endwise direction and maintain said lug member in engagement in said bayonet slot, each housing member including one end wall, one of said housing members being adapted for rigid mounting on a supporting structure and the end wall thereof having a shaft access opening therethrough, the end wall of the other of said housing members having a bearing pocket formed therein, a bearing fixed in said pocket against accidental removal therefrom, and a shaft rotatably mounted in said bearing and projecting through said loop for driving said rollers, said shaft and bearing having interengaging portions cooperating to resist endwise removal of said shaft from said bearing.

14. In a pump including a casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, a driving shaft supported in said casing for rotation about the axial center line of said chamber,

a generally annular loop of collapsible pumping hose within said chamber in the outer regions thereof, and roller means actuated by said shaft and rotatably mounted within said loop to compress said hose outwardly against said peripheral wall; the improvement wherein said driving shaft is in peripheral driving engagement with said roller means, a removable yoke is in telescoping relation over said shaft and rotatable thereon and rotatably carries said roller means, said yoke having an endwise extending opening therethrough for surrounding said shaft in endwise slidable relationship, a cooperating pair of housing members comprise said casing, releasable means secure said members in casing-forming relation with each housing member including one end wall, one of said housing members being adapted for rigid mounting on a supporting structure and the end wall thereof having a shaft access opening therethrough, the end wall of the other of said housing members having a bearing pocket formed therein and a bearing fixed in said pocket against accidental removal therefrom, said bearing receiving one end of said shaft to rotatably support the same, and said shaft and bearing having interengaging portions cooperating to resist endwise removal of said shaft from said bearing.

15. The arrangement of claim 14 wherein a washer is mounted on said shaft adjacent to and inwardly of said bearing, with said washer extending radially to overlap a portion of one end face of said roller means and provide an annular abutment track therefor and wherein said yoke includes a roll pin for said roller means, said roll pin being rotatably mounted in said yoke and projecting into said roller means through the other end face thereof.

16. In a pump including a casing having a cylindrical pumping chamber bounded by a peripheral wall and opposed end walls, a driving shaft supported in said casing for rotation about the axial center line of said chamber, a generally annular loop of collapsible pumping hose within said chamber in the outer regions thereof, and roller means actuated by said shaft and rotatably mounted within said loop to compress said hose outwardly against said peripheral wall; the improvement wherein cooperating outer and inner housing members comprise said casing, a removable yoke having an endwise extending opening therethrough is in endwise slidable, telescoping relation over said shaft and includes means for maintaining said roller means in operative position between said hose and said shaft, with the outer one of said housing members including one of said end walls and said peripheral wall for removably receiving said yoke, said roller means, and said hose therein, and with the inner one of said housing members including the other of said end walls with a shaft access opening formed therethrough for receiving the shaft in rotatable driving engagement with said roller means and being adapted for rigid mounting on a supporting structure.

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