Oct. 16, 1962 E. HANDL 3,058,430

PUMP FOR CONCRETE AND MORTAR MIXTURES AND THE LIKE

Filed Aug. 13, 1959 3 Sheets-Sheet 1

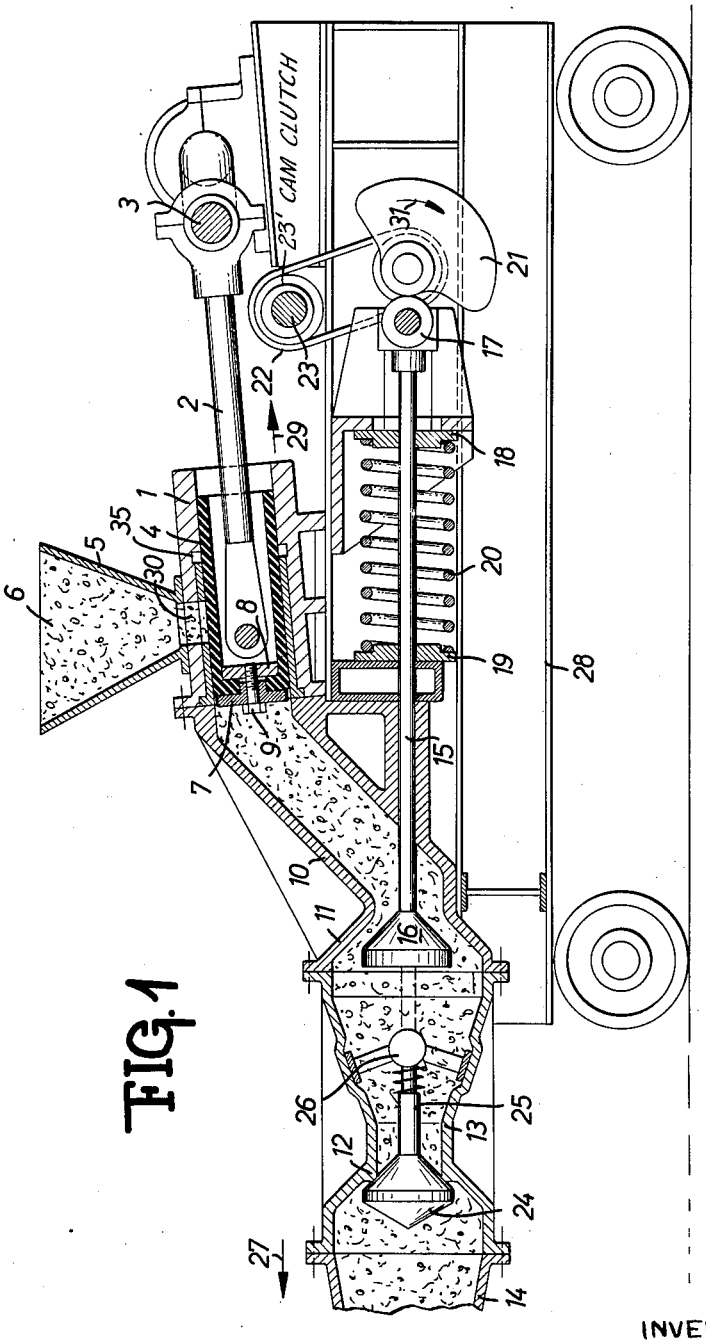

FIG. 1

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Filed Aug. 13, 1959 3 Sheets-Sheet 2

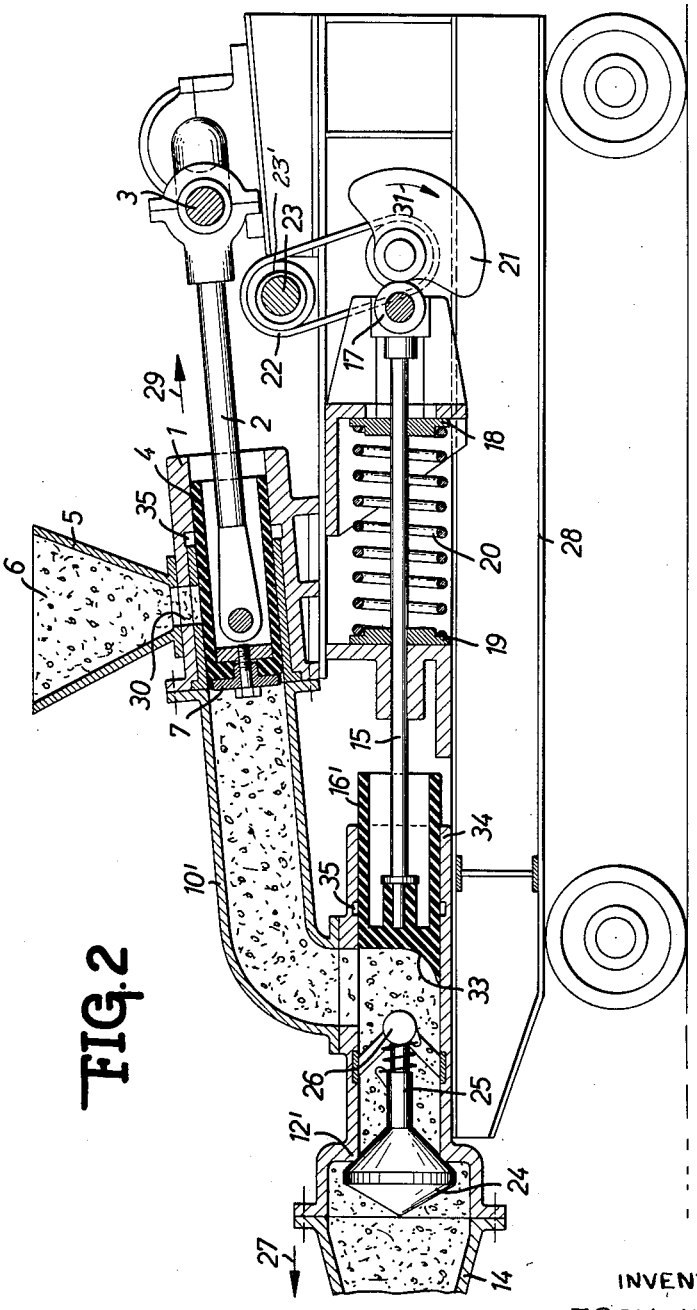

FIG. 2

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Filed Aug. 13, 1959 3 Sheets-Sheet 3

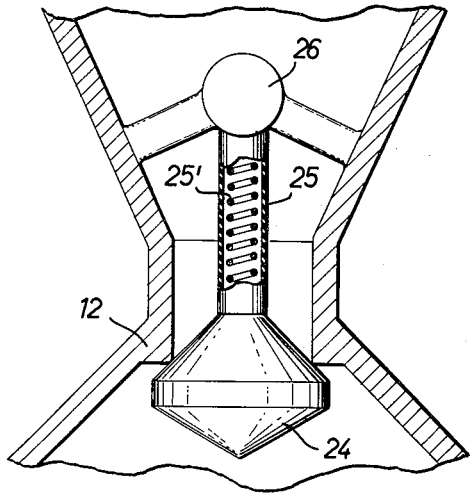

FIG. 3

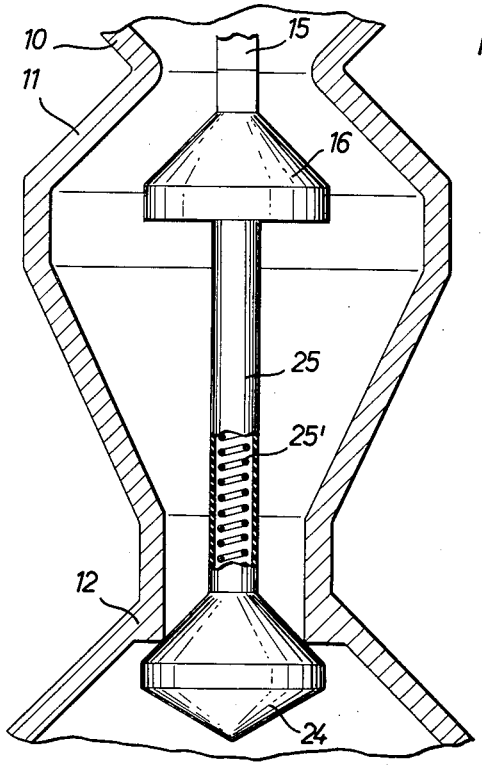

FIG. 4

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PUMP FOR CONCRETE AND MORTAR MIXTURES AND THE LIKE

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12 Claims. (Cl. 103—167)

The present invention relates to a reciprocating pump for conveying building materials, such as concrete or mortar mixtures or the like.

A reciprocating pump of a known design built for the same purpose consists of a cylinder containing a reciprocating piston and provided with an inlet opening underneath a filling funnel, and a reciprocating valve within the conveying pipe and spaced at a distance from the cylinder. During the operation of the pump, the piston and the valve carry out certain controlled reciprocating movements. Such a reciprocating pump is capable of conveying a certain amount of concrete or the like within a certain length of time, for example, 8 to 10 cubic meters per hour. If a greater amount of material is required, for example, twice as much, it is necessary to install a second pump unit of the same kind. This, in effect, also means that a second group of workmen is required for servicing the pump, apart from the fact that the additional driving power for operating the second pump also has to be furnished.

It is the principal object of the present invention to provide a reciprocating pump of a type similar to that as described above which, however, is adapted to convey either a certain normal amount or twice that amount of mixed material.

This object is attained according to the invention by providing the conveying pipe of such a reciprocating pump with a second piston at a point between the cylinder in which the first piston reciprocates and the mentioned control valve, and by providing suitable resilient means which are adapted to act upon the valve to maintain the same normally in a closed position. Within the area of its reciprocating movement within the conveying pipe, the second piston is preferably made of an outer diameter which is only approximately half as large as the inner diameter of the respective part of the conveying pipe so that an annular passage will remain at all times between the second piston and the wall of the conveying pipe permitting the mixture to pass freely around the piston. In this event, the second piston as well as the surrounding part of the conveying pipe may be made of a frustoconical shape. However, the second piston may also be designed so that, when it is disposed in its retracted position, its working face will serve as a part of the wall of the conveying pipe. Although the second piston may be driven in any desired manner, it is preferable to connect the piston to one end of a piston rod the other end of which carries a roller which is adapted to engage resiliently with a rotatable cam plate which may be driven, for example, by the same shaft which operates the crank drive of the first piston. A suitable clutch mechanism may be provided to operate either the first piston alone or to drive both pistons. The cam plate is preferably designed so that, when the clutch mechanism is engaged to drive both pistons, the cam plate will act upon the piston rod of the second piston to carry out its conveying stroke after the first piston has completed its conveying stroke, and to retract the second piston quickly when the first piston has been retracted to a position in its cylinder in which the filling funnel thereon communicates with the inside of the cylinder. If the clutch mechanism is engaged to drive only the first piston, the second piston will remain inoperative and the amount of material conveyed will depend solely upon the operation of the first piston.

While the piston and control valve of the known pump as first described consisted of steel, it is a further object of the invention to make both pistons as well as the control valve of a resilient material, preferably rubber. The control valve may then consist of the actual valve member and a valve stem which may be integrally connected to each other and be reinforced by one or more springs. The end of the valve stem may be secured either to the wall of the conveying pipe or to the second piston.

These and other objects, features, and advantages of the present invention will become further apparent from the following detailed description thereof, particularly when read with reference to the accompanying drawings, in which—

FIGURE 1 shows a longitudinal cross section of a reciprocating pump according to the present invention, in which the second piston is disposed within the conveying pipe;

FIGURE 2 shows a longitudinal cross section of a reciprocating pump according to a modification of the invention, in which the second pump, when in one of its two end positions, serves as a wall portion of the conveying pipe for closing the same toward the rear; FIGURE 3 shows a partial cross-section through a valve member shown in either FIGURE 1 or FIGURE 2; and

FIGURE 4 shows a view similar to FIGURE 3 of a further embodiment of the present invention.

Referring first to FIGURE 1 of the drawings, the pump according to the invention essentially consists of a cylinder 1 in which a piston 4, at least the outer wall of which preferably consists of rubber, may be reciprocated by a crank drive 3 through a piston rod 2. Cylinder 1 is provided with an inlet opening 30 and a filling funnel 6 thereon in a position so that the mixture 6 which is inserted into funnel 6 will pass by gravity into cylinder 1 when piston 4 is withdrawn toward its rear end position. Since piston 4 has to sever the amount of material 6 which is to be conveyed at each forward stroke from the amount remaining within funnel 5, its head is covered by a steel plate 7 which is secured thereto by a bolt 9 which is screwed into an inner plate 8.

The outlet side of cylinder 1 is secured by flanges to a downwardly inclined pipe 10, the front end 11 of which tapers conically outwardly and is connected by flanges to a pipe 13 which has a neck 12 of a smaller diameter intermediate its two ends which are of substantially equal diameter. The front end of this neck 12 forms a valve seat. The outer end of pipe 13 is connected by flanges to a pressure sure pipe 14. The inclined pipe 10 carries, preferably integrally therewith, a bracket in which a rod 15 is mounted so as to be slidable in its longitudinal direction. Rod 15 carries on one end a second piston 16 and on the other end a roller 17. Intermediate its ends, rod 15 carries a disk 18, which is secured to rod 15, and a second disk 19 which is slidable relative to rod 15 and rests directly or indirectly against the rear end of the bracket on pipe 10. A coil spring 20 around rod 15 is interposed between and acts upon the two disks 18 and 19. Roller 17 is associated with a cam plate 21 which may be driven, for example, through a chain 22 by the same shaft 23 which drives the crank shaft drive 3. This shaft 23 is preferably provided with a suitable clutch 23', to permit either piston 4 alone or both pistons 4 and 16 to be operated depending upon the amount of material which should be conveyed. Cam plate 21 is made of such a shape and associated with crank drive 3 in such a manner that the second piston 16 will not start its conveying stroke until the first piston 4 has completed its forward stroke, and so that it will be quickly retracted to its starting position but not until after the first piston 4 has been retracted

behind the inlet opening 30 so that a new charge of material can pass from funnel 5 into cylinder 1.

Pipe 13 contains a valve member 24 which is secured to a resilient valve stem 25 so as to enable the valve member 24 to move in the longitudinal direction of the apparatus. The resilient valve stem 25 is reinforced by a spring 25'. As shown in FIGURE 3, the rear end of valve stem 25 may be secured to pipe 13, for example, by a support member 26 having radial support arms, or it may be secured to the second piston 16 as shown in FIGURE 4. Due to such resilient construction, valve member 24 may open in the direction as shown by arrow 27 under the pressure of the material in pipe 13 produced by the conveying strokes of piston 4 or both pistons 4 and 16.

Although the entire pump unit may be mounted in a stationary position, it is in many cases more preferable to mount it on a wheel-supported base 28.

The reciprocating pump according to the present invention operates as follows: At the beginning of the operation, piston 4 is in the position as indicated in FIGURE 1. Funnel 5 is then filled with a concrete or mortar mixture 6, whereupon the pump motor (not shown) is started to retract piston 4 in the direction as shown by arrow 29 and thereby to free the inlet opening 30. Piston 4 is preferably retracted to such an extent that the front surface of disk 7 will clear the opening 30 for an adequate length of time to permit the material 6 to slide into cylinder 1 before piston 4 starts its forward movement. The charge of material is then compressed by piston 4 into pipe 10. After several reciprocating movements of piston 4, the accumulated material in pipe 10 will engage with valve member 24 and, when the material has attained a sufficient forward pressure, it will open valve member 24 and enter into pressure pipe 114. During this entire period, piston 16 remains in its inoperative position, as shown in FIGURE 1. After piston 4 has compressed the concrete or other mixture against valve 24 and into pipe 14 and then starts its return stroke, it produces a suction in pipes 10 and 13 through which valve 24 returns upon its seat 12 and closes pipe 13 toward pipe 14. As soon as piston 4 has been retracted sufficiently in the direction shown by arrow 29 so that the inside of cylinder 1 communicates with funnel 5, the mixture contained in the latter will be drawn by suction into pipe 10. When piston 4 then starts its forward stroke, it presses the indrawn mixture through pipes 10 and 13 against valve 24 and then into pressure pipe 14. This operation may be repeated continuously as long as required.

If drive shaft 23 is engaged to reciprocate both pistons, the following will result: If both pistons 4 and 16 are first in the position as illustrated in FIGURE 1 and the pump motor is then started, cam plate 21 will be rotated in the direction as shown by arrow 31 and then act upon roller 17 to move piston 16 in the direction as shown by arrow 27. Piston 16 then presses the amount of material which lies in front of it past valve 24 into pipe 14. This will produce a suction behind piston 16 which will draw the material contained in pipe 10 forwardly. This suction in pipe 10 will be further increased by the simultaneous movement of piston 4 in the direction of arrow 29. Consequently, when piston 4 moves back sufficiently to clear the inlet opening 30, a very strong suction will be exerted to draw a new charge of material 6 from funnel 5 into cylinder 1 and pipe 10. Cam plate 21 is made of a shape so that, before piston 4 again returns to the position shown in FIGURE 1, the other piston 16 will be just as quickly retracted as it was previously pushed into pipe 13. This, in turn, results in a suction in pipe 13 through which the material to be conveyed is drawn into pipe 13 since valve member 24, which was lifted off its seat 12 when piston 16 moved forwardly in the direction of arrow 27, has in the meantime returned upon its seat and closed off pipe 13 from pipe 14. Piston 4 then pushes the indrawn mixture into pipe 10 and past piston 16 into pipe 13, whereupon piston 16 pushes the mixture further forwardly. Since there is an annular space between the conical end 11 of pipe 10 and piston 16 even when piston 16 is fully retracted, the mixture can always move freely past piston 16 into pipe 13.

The pump unit according to the modification shown in FIGURE 2 is substantially similar to the embodiment according to FIGURE 1 and the corresponding parts in both drawings are therefore identified by the same reference numerals. In place of a piston 16 of a frusto-conical shape as shown in FIGURE 1, the pump according to FIGURE 2 is provided with a piston 16', the front surface 33 of which is designed so as to serve as a part of the wall of the conveying pipe when the piston is retracted and in a stationary position. In place of pipe 10 as in FIGURE 1, a pipe 10' is provided which is secured by flanges to a cylinder 34 which terminates into an end portion of a larger diameter with an intermediate valve seat 12' which is adapted to be closed by a valve member 24. The operation of this pump according to FIGURE 2 is similar to that as described with respect to FIGURE 1.

In all embodiments it is advisable to make the pistons 4, 16, and 16', as well as the valve member 24 and its valve stem 25 of a resilient material, for example, rubber. Each cylinder 1 and 34 is preferably provided with an annular groove 35 through which water may be passed which is preferably supplied from above and discharged in the downward direction, so that any solid particles of the mixture, particularly sand, which might adhere to the wall of the respective rubber piston and might have become impressed therein will be removed and washed off when these particles move along the piston or with the piston until they pass into groove 35.

Since the return of the second piston 16 or 16' is effected by spring 20, the motor output required for operating the pump will be practically the same regardless of whether one or both pistons are driven. Consequently, a considerable amount of energy will be saved as compared with two separate pump units as previously required. Also, the pump according to the invention is subject to considerably less wear than the known concrete pump and will therefore have a much longer service life than the known pump.

Although my invention has been illustrated and described with reference to the preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

What I claim is:

1. A reciprocating pump for concrete or mortar mixtures and the like comprising a cylinder having an inlet opening and filling means associated therewith, a first piston, means for reciprocating said first piston within said cylinder, conveying pipe means connected to one end of said cylinder and having an outlet spaced from said cylinder, a control valve within said conveying pipe means for opening and closing said outlet, resilient means operatively associated with said valve for normally maintaining said valve in the closed position, a second piston within said conveying pipe means between said one end of said cylinder and said valve, said conveying pipe means in the region between said first and said second pistons having a substantially unobstructed flow path, and means for reciprocating said second piston in a timed relation to the reciprocation of said first piston.

2. A reciprocating pump for concrete or mortar mixtures and the like comprising a cylinder having an inlet opening and a filling funnel above said opening, a first piston, means for reciprocating said first piston within said cylinder, conveying pipe means connected to one end of said cylinder and having an outlet spaced from said cylinder, a control valve within said conveying pipe means for opening and closing said outlet, resilient means operatively associated with said valve for normally maintaining said valve in the closed position, a second piston within

said conveying pipe means between said cylinder end and said valve, said second piston having an outer diameter substantially equal to one half of the inner diameter of the part of said conveying pipe means surrounding said piston so that an annular passage is formed around said second piston, and means for reciprocating said second piston in a timed relation to the reciprocation of said first piston.

3. A reciprocating pump as defined in claim 2, wherein said piston and said past of said conveying pipe surrounding said piston are of a substantially frusto-conical shape.

4. A reciprocating pump as defined in claim 1, wherein said conveying pipe means has a substantially circular shape, said second piston being disposed within said pipe means so that, when retracted to its rear end position, its front surface serves as a part of the wall of said pipe means.

5. A reciprocating pump as defined in claim 4, wherein said circular conveying pipe means comprises a first substantially cylindrical portion and a second portion branching off laterally from said first portion intermediate its ends and leading to the cylinder of said first piston, said first portion serving as a cylinder for said second piston, said front surface of said second piston being substantially in line with the rear inner edge of the lateral branch opening in said first portion, when said second piston is fully retracted.

6. A reciprocating pump as defined in claim 1, wherein said means for reciprocating said second piston in a timed relation to the reciprocation of said first piston comprise a piston rod on said second piston, a roller on the free end of said piston rod, a cam plate rotatable about an axis transverse to the axis of said piston rod, spring means for maintaining said roller in engagement with said cam plate, common driving means for rotating said cam plate and for reciprocating said first piston, said cam plate being shaped so as to act upon said piston rod to start the conveying stroke of said second piston when said first piston has completed its conveying stroke, said cam plate being also shaped so as quickly to retract said second piston at the end of its conveying stroke when said first piston has been retracted sufficiently so that said filling means and said inlet opening of said cylinder communicate with the inside of said cylinder and said conveying pipe means.

7. A reciprocating pump as defined in claim 6, further comprising means for disconnecting said cam plate from said common driving means so as to stop the reciprocation of said second piston and to permit said first piston to reciprocate alone.

8. A reciprocating pump as defined in claim 1, wherein said first and second pistons substantially consist of a resilient material.

9. A reciprocating pump for concrete or mortar mixtures and the like, comprising a cylinder having an inlet opening and a filling funnel above said opening, a first piston, means for reciprocating said first piston within said cylinder, conveying pipe means connected to one end of said cylinder and having an outlet spaced from said cylinder, a control valve within said conveying pipe means for opening and closing said outlet, resilient means operatively associated with said valve for normally maintaining said valve in the closed position including a valve stem of a rubber-like resilient material integrally connected at one end to said control valve, a second piston within said conveying pipe means between said cylinder end and said valve, said first and second pistons and said control valve consisting substantially of a resilient material, and means for reciprocating said second piston in a timed relation to the reciprocation of said first piston.

10. A reciprocating pump as defined in claim 9, wherein said resilient means further comprise spring means for reinforcing said valve stem.

11. A reciprocating pump as defined in claim 9, further comprising means for securing the other end of said valve stem to the inside wall of said conveying pipe means.

12. A reciprocating pump as defined in claim 9, wherein the other end of said valve stem is secured to said second piston.

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