Aug. 1, 1944. C. I. LONGENECKER 2,355,001

PULSATION DAMPENER FOR CONCRETE-CONVEYING PIPE LINE SYSTEMS

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Fig. 1.

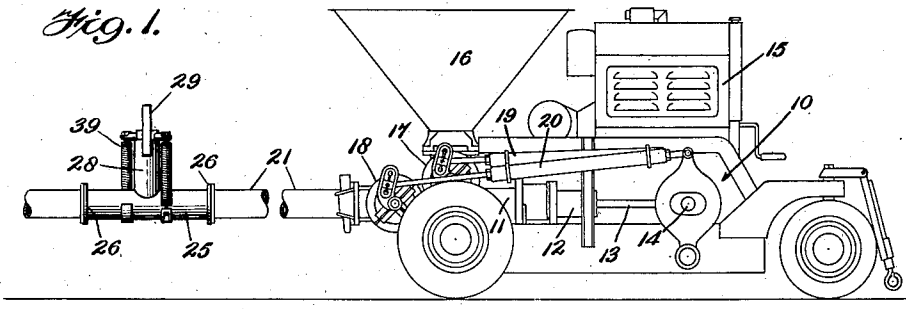

Fig. 2.

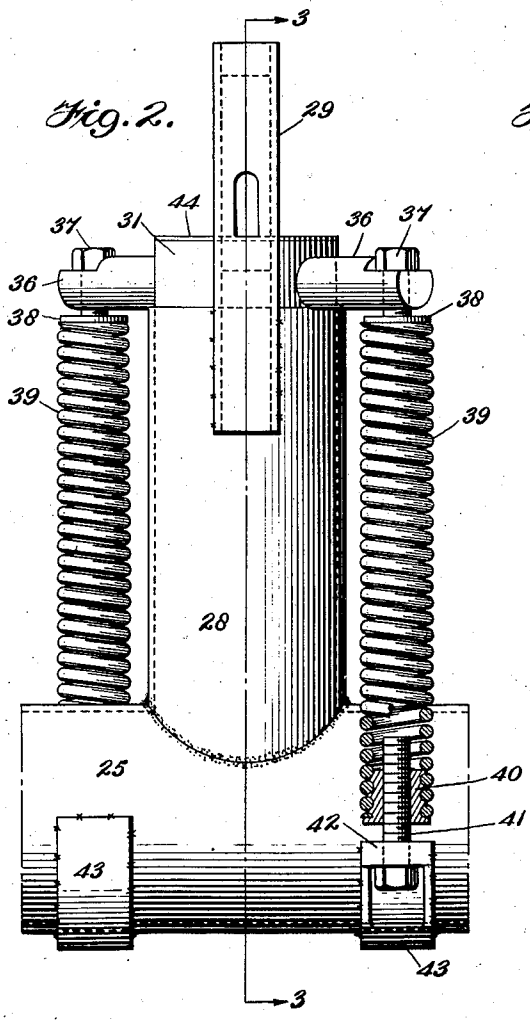

Fig. 3.

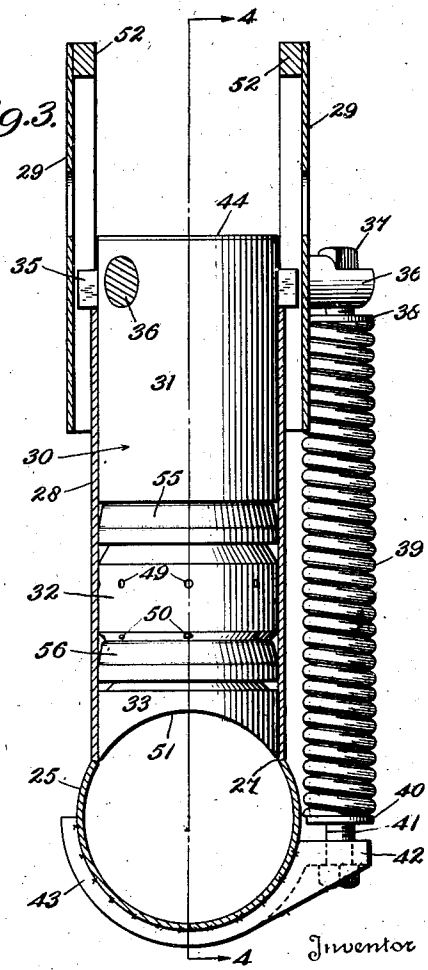

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Fig. 4.

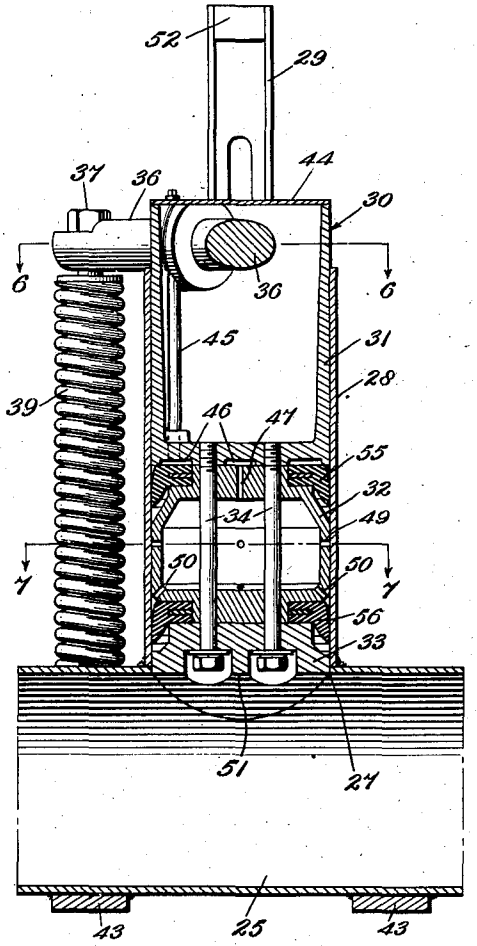


Fig. 5.

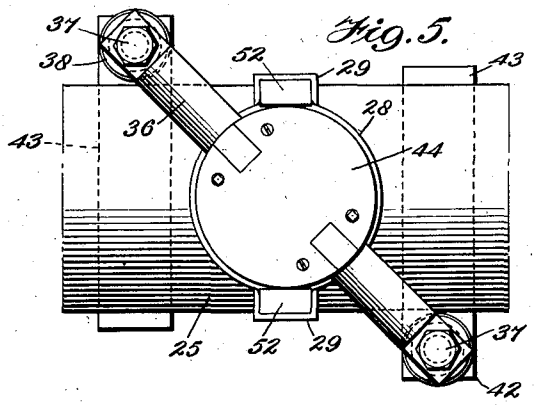


Fig. 6.

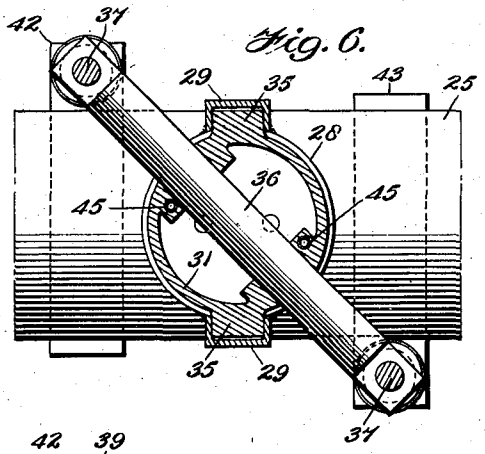
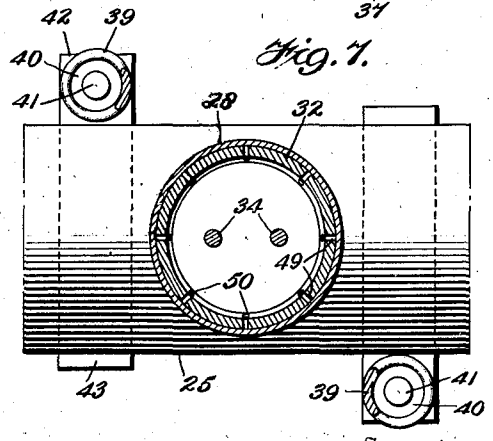


Fig. 7.



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PULSATION DAMPENER FOR CONCRETE-CONVEYING PIPE-LINE SYSTEMS

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Application May 21, 1942, Serial No. 443,998

3 Claims. (Cl. 138—31)

The invention relates to pipe line systems for the conveyance of plastic concrete mixtures under pressure, and more particularly to such a system wherein the plastic mixture is moved by intermittent impulses imparted to it, as for example by the piston or pistons of a reciprocating concrete pump of the type disclosed in U. S. Patent No. 2,017,975 granted October 22, 1935, to Jacobus C. Kooyman; and it has for one of its principal objects the provision of a simple and effective mechanism for smoothing out and eliminating or materially reducing the harmful effects of the pressure fluctuations and/or pulsations in the concrete stream which accompany such intermittent impulses.

Concrete pumps of the Koyman type are now commercially available in both single and double cylinder models, in each of which the pistons are single acting. Because of the inertia and sticky nature of the mixture, and the relatively high coefficient of friction between it and the wall surfaces of the pipe line, its forward motion stops substantially simultaneously with the cessation of piston movement at the completion of the working stroke of the latter. Thus, in the case of a single cylinder pump the entire stream is stationary during the return stroke of the piston, and while the pumps are normally operated at from 45 to 60 working strokes per minute, there nevertheless is a noticeable pulsation in the discharge. In the case of the double cylinder models, although the pistons are ordinarily set 180° apart so that their working strokes alternate, there is still a point at the end of each stroke when both pistons are stationary, and in such systems the pulsations are twice as frequent as when single cylinder pumps are employed.

While in many instances the use of these pipe line systems is highly desirable for the placement of concrete into forms for walls, piers and the like, such use is frequently not without its difficulties. From considerations of facility and cost in setting up and/or extending the line, it is often wished to mount at least portions of it upon the forms. However, because of the incompressibility of the concrete mixture, and the sluggishness with which it moves over itself, the pressure fluctuation with each pulsation or stroke of the pump is extremely high and results in a reaction or "kick" in the line, particularly if there be bends or elbows therein, which makes it inadvisable to mount it directly on the forms as to do so would be likely to result in their derangement and/or other serious damage. Hence it has been heretofore customary in many instances to support the pipe line independently of the forms, but since this involves additional equipment, labor and expense, and is not practical in all cases, it is desirable that some means be provided for eliminating or very materially reducing the reaction or "kick" resulting from the wide pressure fluctuations so that the line may be mounted directly on the forms.

As is set forth at some length in the specification of the said Koyman patent, plastic Portland cement concrete mixtures which embody relatively high percentages of large aggregates such as gravel, crushed stone, cinders and the like, possess a "stowing" property which distinguishes them from practically all other materials which are commonly transported through pipe lines by pressure. This stowing exhibits itself particularly wherever an obstruction, constriction or other sudden reduction in the cross sectional area of the pipe or passage is encountered by the confined mixture, and while advantage may be taken of it at certain places and under certain conditions, as for example in the valves of the pump, it must be constantly borne in mind and usually studiously avoided if the system is to give continuous trouble-free operation. To this end the pipe line and all passages through which the mixture is to be forced should be free of obstructions, sudden constrictions and curves of too short radius which would tend to impede the flow.

The water-cement paste constituting the binding constituent of the mixture, while in a measure serving as a lubricant so long as it is in a semi-fluid state, is constantly tending to set or harden into a rigid mass, due to the chemical reactions taking place between the water and the cement. So long as the mixture is kept in motion this setting is delayed sufficiently to permit of a reasonable amount of handling for placement, but if the motion ceases for a moderate length of time the setting accelerates and the hardening mass adheres to any surface with which it may be in contact. It is therefore important that recesses or pockets be avoided in the system in which portions of the mixture might become quiescent or stagnant, for if this occurs such portions set relatively rapidly. Once begun, the hardened mass collects additional portions of the mixture, with the rapidly cumulative effect that an obstruction or restriction to the free flow of the stream is soon set up which induces stowing. When this occurs it is usually necessary to cease operations, dismantle the line at the trouble point and clean it out by hand,

since in most cases no pressures within the limits of the apparatus are sufficient to clear the obstruction.

The apparatus of the present invention has been developed for the purpose of damping or smoothing out the pulsations and/or pressure fluctuations referred to above so as to eliminate or materially reduce the reaction or "kick" in the line so that it may be mounted directly on the forms, while keeping in mind the unusual properties of the material being handled so as to avoid the just-mentioned possible detrimental effects of such properties; and the invention resides in the novel details of construction and combinations and arrangements of parts more fully described below.

For purposes of disclosure only, but not by way of limitation, one form of the invention has been illustrated in the accompanying drawings forming a part of this specification, in which drawings like reference characters designate like parts throughout the several views, and in which

Figure 1 is a side elevational view of a commercial form of a single cylinder reciprocating piston pump of the type referred to above, and a portion of a pipe line connected thereto for conveying a plastic concrete mixture to a distant point of placement, such as a wall form, and with a dampening device constructed in accordance with the present invention operatively associated therewith;

Fig. 2 is an enlarged side elevational view of the said device per se;

Fig. 3 is a vertical sectional-elevational view of the device, taken approximately on the plane indicated by the line 3—3 of Figure 2, looking in the direction of the arrows;

Fig. 4 is a vertical sectional view at right angles to Figure 3, taken approximately on the plane indicated by the line 4—4 of the latter figure;

Fig. 5 is a top plan view of the device; and

Figs. 6 and 7 are cross sectional views taken approximately on the planes indicated by the lines 6—6 and 7—7 respectively of Figure 4, looking down.

Referring more particularly to the said drawings, 10 indicates the concrete pump which may be briefly described as having a cylinder 11 in which a piston 12 is reciprocated by a connecting rod 13 and a crank shaft 14 through power supplied by any suitable source, such for example as an internal combustion engine mounted within a housing 15. The pump is provided with a hopper 16 for receiving the plastic concrete and supplying it to the cylinder 11 through an inlet valve 17. An outlet valve 18 controls the discharge from the cylinder, and the two valves are operated in appropriately timed relation to the movements of the piston 12 by the valve rods 19 and 20 respectively, which in turn are actuated by cams upon the crank shaft 14. The conveying pipe line 21 leads from the outlet valve 18 to the point at which the mixture is to be placed, such for example as a wall form, said line being usually composed of any required number of readily detachably connected pipe sections of not exceeding 10 feet in length to facilitate handling in the assembly and dismantling of the line. The internal diameter of the pipe is preferably approximately the same as that of the pump cylinder, usually 6, 7 or 8 inches.

The fluctuation dampening device of the present invention may be introduced into the said pipe line at any appropriate place between the pump and the form or other discharge point. As here shown the said device comprises a pipe section 25 of the same internal diameter as the sections of the line 21, and preferably of relatively short length to facilitate handling, although of course it may be one of the standard 10 foot sections. The ends of the section 25 may be flanged as indicated at 26 (Fig. 1) whereby it may be secured to the adjacent pipe sections; or they may be equipped with the elements of any suitable quick-detachable pipe coupling.

Intermediate its ends the wall of the said section 25 is apertured as at 27 and a short length of pipe 28 of the same, or as here shown, of slightly smaller diameter is welded to section 25, providing a lateral chamber in communication with the interior of such section through the said aperture. Guiding members in the form of channels 29 are secured to the pipe 28 and extend upwardly therefrom, as will be clear from Figs. 2, 3 and 4. Mounted for reciprocation in the said chamber is a plunger structure 30, comprising three elements 31, 32 and 33, which are retained in assembled relation by bolts 34. The outermost element 31 is provided with exterior lugs 35 fitting in and slidably guided by the channels 29 whereby rotational movements of the plunger structure are prevented. A rod or shaft 36 passes transversely through the outer end portion of the said element 31, extending diagonally with respect to the longitudinal axis of the pipe section 25. At each end this shaft is apertured to receive bolts 37 which are threaded into bushings 38 secured to the end coils of helical tension springs 39, the other ends of which are secured to bushings 40 which are threadedly engaged by bolts 41 passing through apertures provided in the ears 42 of strap or bracket members 43, welded or otherwise rigidly secured to the pipe section 25, substantially as shown. A removable cover plate 44 may be secured over the open outer end of the member 31 to exclude dirt or other extraneous matter.

The intermediate plunger element 32 is hollow, as will be clear from Figs. 4 and 7, and provides a lubricant containing reservoir. Grease or other lubricant, preferably of a nature which also inhibits or retards the setting of the concrete mixture, is supplied thereto through one or more pipes or tubes 45 extending longitudinally through the element 31 and communicating with the said reservoir through passages 46, formed on the head of the said element 31, and 47 extending through the outer end wall of element 32. The side walls of the latter element are provided with other ducts or passages 49 and 50 through which the lubricant may find its way to the working surfaces of the plunger structure and the pipe or chamber 28.

The inner face of the plunger element 33 is normally positioned at the aperture 27 in pipe section 25, and is concaved or otherwise appropriately shaped—depending upon the cross section of said pipe section—and substantially flush with the inner surface of section 25 to preserve the contour of the passage, without shoulders or pockets which might impede or collect the plastic mixture and thus induce stowing. Inward movement of the plunger is limited by engagement of the lugs 35 with the outer end of the pipe 28 so that the face 51 may move only to a position flush with the inner surface of the pipe 25, while the said lugs in conjunction with the guides 29 prevent rotational movements of the plunger which would longitudinally misaline the said face and pipe surface. The said guides 29 may be provided at their outer ends with stops 52 engageable by the

lugs 35 to limit outward movement of the plunger assembly.

Packing rings 55 and 56 of leather, rubber or any other appropriate material, are clamped between the elements 31, 32 and 33, as clearly shown in Figs. 3 and 4.

In use the dampener is introduced into the pipe line 21 at any suitable point, and as the pressure in the line rises on each working stroke of the pump piston 12, such pressure is transmitted to the face 51 of the plunger structure 30, and tends to force the latter outwardly against the action of the springs 39. These of course will yield upon the attainment of a predetermined pressure—the value of which may be varied through adjustment of the bolts 37 and/or 41—and the plunger will move outwardly. When the pump piston reaches the end of its working stroke and the pump outlet valve 18 closes, which under usual conditions would mean substantially instantaneous cessation of movement of the mixture stream in the line 21, the energy which has been absorbed by the springs 39 returns the plunger 30 inwardly, and since retrograde movement of that portion of the stream between the dampener and the pump is prevented by the closed valve 18, the portion of the stream ahead of the dampener will be forced forwardly by the said plunger in much the same manner as by the pump piston. Thus there is at all times at least some pressure upon the stream tending to keep at least those portions ahead of the dampener in forward motion, with the result that when the piston begins its succeeding working stroke it does not have to overcome the inertia of a completely static stream, and the reaction or "kicking" tendency of the pipe line is reduced at least to the point where it is safe to mount it directly upon the forms if desired. The pulsations in the discharge normally occasioned by stoppage of the flow during the return or suction stroke of the piston are also materially lessened and smoothed out.

While one specific embodiment of the invention has been illustrated and described, it is obvious that those skilled in the art may vary the details of construction as well as the precise arrangement of parts without departing from the spirit of the invention and therefore it is not intended to be limited to the above disclosure except as may be required by the prior art.

What is claimed is:

1. In a device for dampening pressure fluctuations and pulsations in the flow of a stream of plastic concrete mixture moving under intermittent pressure impulses through a pipe line, a pipe section having a circular contour and cross sectional area substantially the same as the pipe line and introducible therein intermediate the source of pressure and the discharge point of the line, said pipe section being provided with an aperture in its circumferential wall; a chamber extending from the pipe section and communicating therewith through said aperture; a plunger in the chamber having a face for contact with the mixture stream whereby the plunger may be moved outwardly in the chamber by pressure on the stream, said plunger face being curved to conform to the inner curvature of the pipe section and being normally positioned at the aperture to preserve the contour of the pipe section unbroken, thereby avoiding pockets in which portions of the mixture might stagnate, harden, build up and induce stowing thereof; means for insuring the alinement of said curved plunger face and pipe section; and means for returning the plunger inwardly upon reduction of pressure upon the mixture stream.

2. In a device for dampening pressure fluctuations in a stream of plastic concrete mixture moving under intermittent pressure impulses through a pipe line, whereby to materially reduce reaction or "kick" in the line, a pipe section introducible into the line intermediate the source of pressure and the discharge point of the line, the perimetric wall of said section being provided with an aperture; a chamber extending laterally from said pipe section and communicating therewith through the aperture; a plunger in the chamber having a face normally positioned at the aperture and engageable by the mixture whereby the plunger may be moved outwardly in the chamber in response to increases in stream pressure, said plunger face being shaped to preserve the contour of the pipe section at the aperture whereby to avoid pockets in which portions of the mixture might stagnate, harden, build up and induce stowing of the mixture; means insuring proper alinement of the plunger face and pipe section to normally preserve said contour; and spring means anchored to the pipe section and to the plunger, tending to maintain the latter in said normal position and yieldably opposing outward movements thereof.

3. In a device for reducing pipe line reaction due to pressure fluctuations and pulsations in the flow of a stream of plastic concrete mixture moving through said line under intermittent pressure impulses: a pipe section having a circular cross sectional contour and area substantially the same as that of the pipe line and introducible therein intermediate the source of pressure and the discharge point of the line, said pipe section being provided with an aperture in its corcumferential wall; a chamber extending radially from said pipe section and communicating with the interior thereof through said aperture; a plunger mounted for reciprocation in said chamber, having a face engageable by the mixture stream, whereby the plunger may be moved outwardly in the chamber by pressure on the stream, said plunger face being curved to conform to the inner curvature of the pipe section and being normally positioned at the aperture to preserve the contour of the pipe section unbroken; means for preventing rotation of the plunger about its axis of reciprocation, and for limiting its inward movement, whereby to insure proper alinement of said curved plunger face and pipe section in the inward position of the former to avoid pockets or obstructions tending to induce stowing of the mixture; and spring means for returning the plunger inwardly upon reduction of pressure on the mixture stream.

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