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TIMED SURGE NEUTRALIZER

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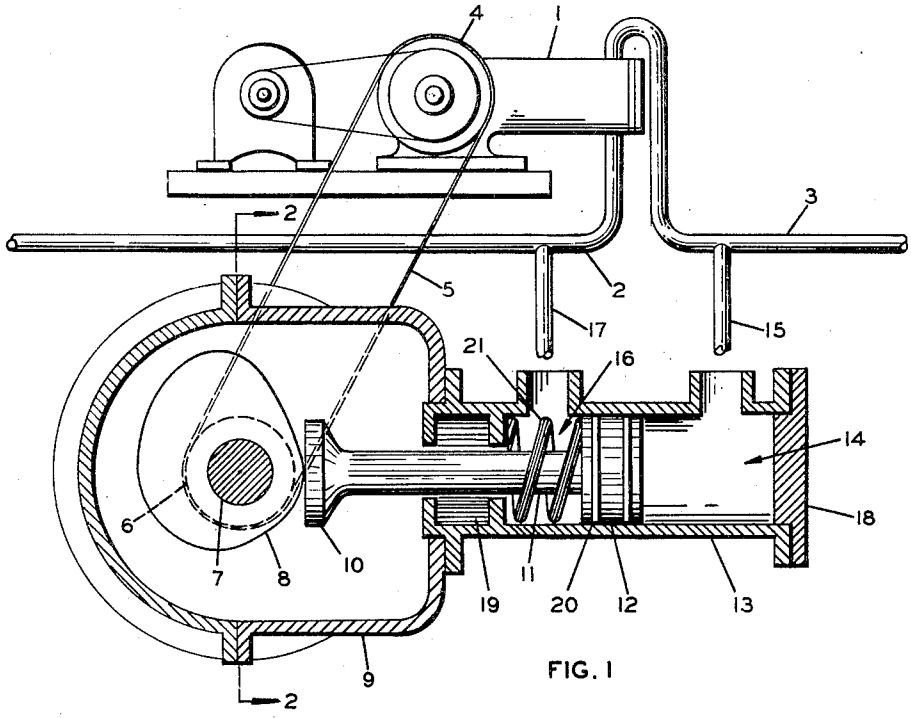


FIG. 1

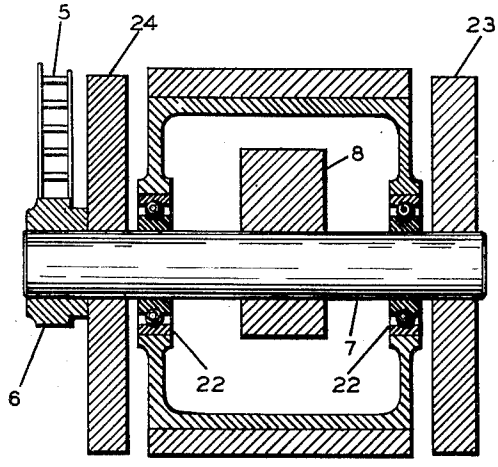


FIG. 2

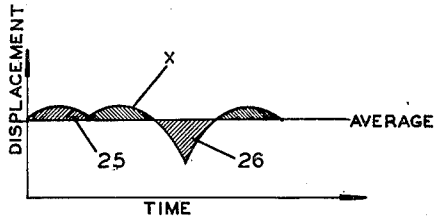


FIG. 3

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TIMED SURGE NEUTRALIZER

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9 Claims. (Cl. 103—223)

The present invention relates to a surge neutralizer and more particularly to a timed surge neutralizer for neutralizing or equalizing the surges or pulsations of fluids in conduits wherein the fluid is forced through the conduits in surges or pulsations by means of reciprocating pumps, compressors, engines, or similar sources of power which produce fluid flow.

Conventional reciprocating pumps, compressors, or the like produce undesirable surges in the fluid stream thereof, and accordingly various devices have been developed for damping out these surges. Such devices are adapted to be incorporated in the conducting conduits of the system and are well known, as shown, for example, in U. S. Patent No. 2,530,190. Prior art devices merely serve to cushion the pulsations of the fluid, thereby affording only limited attenuation of the undesirable surges.

The present invention utilizes a pump cylinder which is connected to the inlet and/or outlet conduit of a conventional reciprocating pump or compressor, whereby fluid is withdrawn from and replenished to the conducting conduits in just the right amount and at just the right time to completely neutralize surges of fluid in the conducting conduits.

An object of the present invention is to provide a new and novel timed surge neutralizer which will substantially eliminate surges produced by reciprocating pumps, compressors, or like machinery in a fluid conveying system.

Another object is to provide a timed surge neutralizer which will be uniformly efficient over all pulsation frequencies and pressures produced by the pump or compressor.

A further object of the invention is the provision of a timed surge neutralizer which is simple in construction, sturdy, and reliable, and requires no more maintenance or servicing than the pump or compressor with which it operates.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood, by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Figure 1 shows a sectional view of a preferred embodiment of the invention with a conventional reciprocating pump connected in parallel with the invention device.

Figure 2 is a sectional view of the device shown in Figure 1 taken on the line 2—2, looking in the direction of the arrows.

Figure 3 is a displacement versus time chart characteristic of a typical reciprocating pump.

Referring now to the drawing wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in Figure 1 a conventional reciprocating pump 1 which is connected with a source of fluid by means of an inlet conduit 2 and is connected on the pump discharge to a discharge reservoir by means of an outlet conduit 3. Fixed to the crankshaft of the pump is a timing sprocket 4 which actuates a timing chain 5 and driven timing sprocket 6. The pump furnishes power by means of the aforementioned transmission assembly for turning the camshaft 7 and cam 8 assembly which is rotatably mounted in housing 9. Cam 8, fixed to camshaft 7, actuates the cam follower, piston rod and piston, numbers 10, 11, and 12 respectively; piston 12 is slidably mounted in cylinder 13.

Cylinder 13, together with cylinder head 18 and piston 12 define a forward chamber in the form of a cavity 14 connected by means of connecting conduit 15 to outlet conduit 3 in order to provide communication between said outlet conduit and cavity 14. Similarly, the cylinder 13, together with stuffing box 19 and piston 12 define a rear chamber in the form of cavity 16 connected by means of connecting conduit 17 to the inlet conduit 2 for the purpose of providing communication between said inlet conduit and cavity 16. The volume of said cavities 14 and 16 is varied by movement of said piston 12.

Piston 12 fitted with piston rings 20 is mounted on the piston rod 11. A cam follower 10 mounted on the end of piston rod 11 bears against cam 8. Contact is always maintained between cam 8 and cam follower 10, because the pump discharge pressure is communicated to the face of piston 12 through connecting conduit 15 and cavity 14. A spring 21 is inserted in cavity 16 and bears against stuffing box 19 and piston 12. Spring 21 counteracts the force of the pump discharge pressure on the face of piston 12 and only permits sufficient pressure to maintain contact between cam follower 10 and cam 8.

The cam 8 is contained in a housing 9 to which cylinder 13 is secured. Also, camshaft 7 is supported in a housing 9 by means of bearings 22. A timing sprocket 6 is fixed to the outer end of shaft 7, and a first flywheel 23 is secured to the opposite end of the shaft. A second flywheel 24 is fixed to the shaft 7 adjacent to sprocket 6. Said flywheels 23 and 24 serve to reduce the variable torque developed by the invention device by serving as a convenient form of inertia means.

The speed at which the camshaft rotates is determined by the characteristics of the pump 1. If, for example, it is a three cylinder plunger pump, the camshaft 7 is driven at three times pump speed by suitable choice of the diameter and number of teeth of the timing sprockets 4 and 6.

It can readily be seen that as the camshaft 7 is rotated and with the cam follower 10 bearing on the cam 8, the piston 12 slides in the cylinder 13 in a manner depending on the profile of the cam 8. As the piston 12 moves towards the stuffing box 19, the volume of cavity 14 is increased, and the fluid is withdrawn from outlet conduit 3 through connecting conduit 15. Since the volume of cavity 16 is decreased, fluid is discharged into suction conduit 2 through the connecting conduit 17. The reverse occurs as the piston moves toward the cylinder head 18.

Figure 3 is a chart of displacement versus time produced by a triplex plunger pump. Surges or pulsations are a manfestation of the varying displacement of the pump as shown in line X. The shaded area 25 indicates a displacement or fluid flow above the average, and shaded area 26 indicates a fluid flow below the average. The outer periphery of cam 8 may be so shaped and the diameter of piston 12 and cylinder 13 so chosen that for a given time interval fluid will be drawn into cavity 14 from outlet conduit 3 in such a manner as to exactly equal the above average displacement of the reciprocating pump, as shown by shaded area 25. Similarly in a subsequent time interval, fluid will be discharged from cavity 14 into outlet conduit 3 in such a manner as to exactly equal the below average displacement of pump 1, as shown by shaded area 26. It will be apparent that if cam 8 is in proper phase relation with the crankshaft of pump 1, the above average flow as shown by shaded

area 25 and the below average flow as shown by shaded area 26 will be completely neutralized by the invention device, and a steady nonpulsating flow from the pump will result.

The previous example refers only to the outlet conduit 3 and cavity 14. Of course, a similar situation is occurring on the inlet conduit 2 and cavity 16. The proper angular phase relation of cam 8 with crankshaft of the pump 1 is accomplished by shifting the timing chain on the teeth of timing sprocket 6.

In the foregoing example, it will be readily seen that if the size of the piston 12 is selected so as to exactly neutralize the surges in the outlet conduit 3, only approximate neutralization of the surges in the suction conduit 2 will occur because of the displacement of the piston rod 11. If exact neutralization is required for both suction and discharge, then two of the invention devices would be provided with connections reversed on one of the cylinders 13. That is to say, cavity 14 of one of the devices would be connected to inlet conduit 2 and cavity 16 to outlet conduit 3.

A plurality of the invention devices may be provided in the case where the pump 1 has pistons of different displacement, as for example, a double acting pump with different displacement at rod end and head end of the cylinder.

From the foregoing, it is evident that the present invention provides a new and novel timed surge neutralizer which will substantially eliminate surges produced in fluid conveying systems by reciprocating pumps, compressors, and like machinery. The device is simple in construction and employs a minimum of parts, yet is sturdy and efficient in operation.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. A device for neutralizing surges in a fluid flow system created by the operation of reciprocating fluid actuating apparatus, said device comprising, in combination: an inlet conduit and an outlet conduit communicating with said apparatus, said inlet and outlet conduits being subject to said surges; means defining a closed cylindrical chamber; cam means drivingly connected to said apparatus; a piston slidably positioned within said chamber, said piston defining a first portion and a second portion of said chamber, and said piston having a member coupled thereto, said member having a portion thereof sealably extending through said cylinder and positioned for actuation by said cam means; means defining a passage communicating between said first portion and said inlet conduit; means defining a passage communicating between said second portion and said outlet conduit; said cam means having a given periphery whereby said piston will be actuated inversely according to the given displacement versus time characteristics of said apparatus so as to balance said surges by a correspondingly timed withdrawing and replenishing of fluid to said inlet and outlet conduits, respectively.

2. A device according to claim 1, in which spring means are disposed within said first portion so as to bias said piston towards said second portion in a direction away from said cam means.

3. A device according to claim 1, in which at least one flywheel is coupled for movement with said cam means for leveling the torque variance created by said cam means.

4. A device for neutralizing surges in a fluid flow system created by the operation of a given reciprocating, fluid actuating apparatus, said device comprising, in combination: a fluid conducting conduit communicating with said apparatus and subject to said surges; eccentric means rotatably driven by said apparatus at a speed proportional to a constant of said apparatus; movable means having one portion thereof in coupling engagement with said eccentric means, said movable means having another portion defining an end wall member; a closed chamber defined in part by said end wall member, said chamber having a volume varied according to movement of said end wall member; means defining a passage communicating between said chamber and said conduit; said eccentric means being of given configuration to actuate said movable means inversely according to the predetermined displacement versus time characteristics of said apparatus so as to balance said surges by a correspondingly timed withdrawal and replenishing of fluid to said conduit.

5. A device as defined in claim 4, in which said chamber is cylindrically shaped, and in which said another portion of said movable means comprises a piston slidably mounted therein.

6. A device as defined in claim 4, in which said eccentric means comprises a cam with a varying profile, as predetermined by the given displacement versus time characteristics of said apparatus.

7. A device for neutralizing surges in a fluid flow system created by the operation of a given reciprocating, fluid actuating apparatus, said device comprising, in combination: an inlet and an outlet conduit communicating with said apparatus, said inlet and outlet conduits being subject to said surges; eccentric means rotatably driven by said apparatus at a speed proportional to a constant of said apparatus; movable means having one portion thereof in coupling engagement with said eccentric means, said movable means having another portion defining an end wall member; a first chamber defined in part by said end wall member; a second chamber defined in part by said end wall member, whereby said first chamber and said second chamber have a common wall formed by said end wall member such that the volume of said first chamber and said second chamber, respectively, is varied according to the movement of said end wall member; means defining a passage communicating between said first chamber and said inlet conduit; means defining a passage communicating between said second chamber and said outlet conduit, said eccentric means being designed to actuate said movable means inversely according to the predetermined displacement versus time characteristics of said apparatus so as to balance said surges by correspondingly timed withdrawing and replenishing of fluid to said inlet and outlet conduits, respectively.

8. A device according to claim 7, in which said first and second chambers are integrally formed by a common cylindrical housing, and in which said end wall member comprises a piston slidably mounted within said housing so as to define said first chamber on one side of said piston and said second chamber on the other side of said piston.

9. A device as defined in claim 7, in which said eccentric means comprises a cam with a varying profile as determined by the given displacement versus time characteristics of said apparatus.

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