

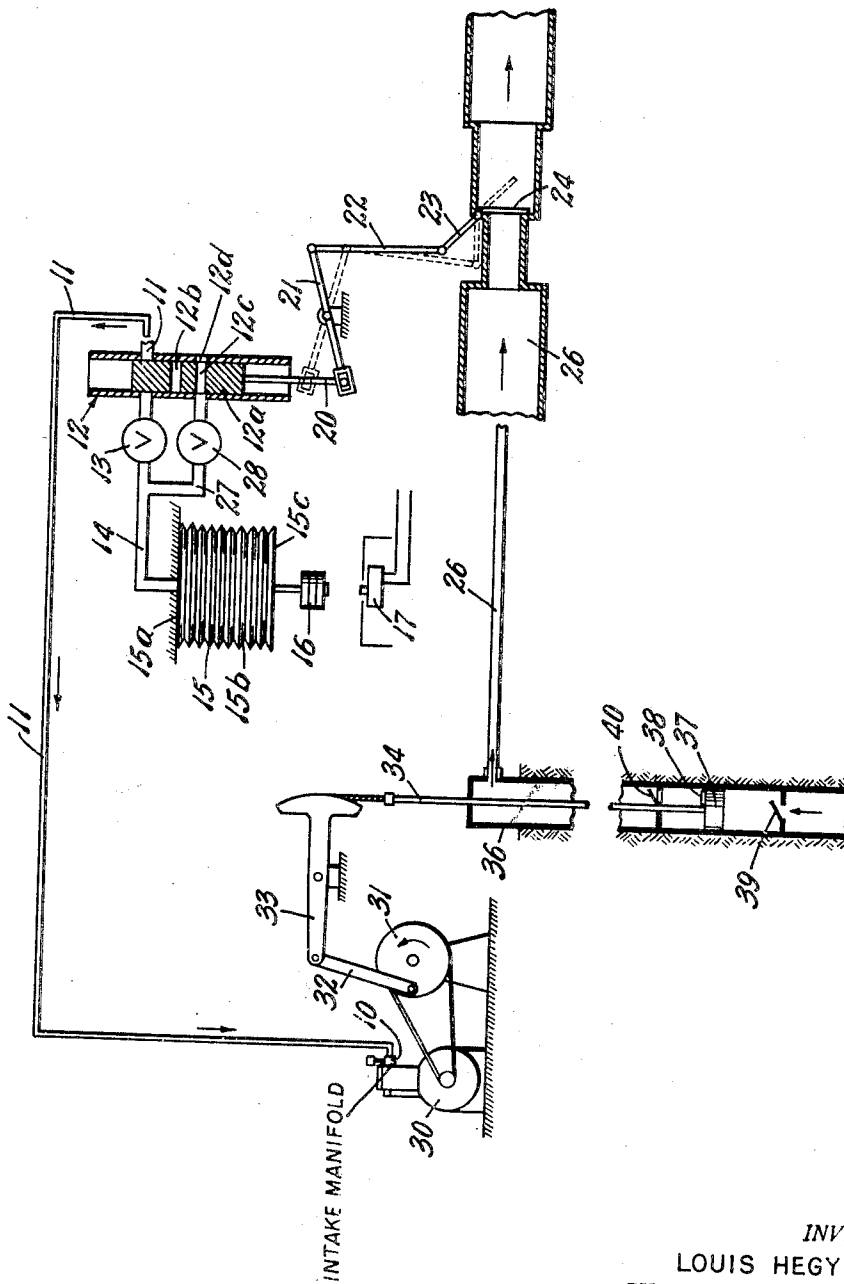
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ALARM INITIATOR FOR PUMPING SYSTEMS

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## ALARM INITIATOR FOR PUMPING SYSTEMS

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This invention relates to systems for automatically indicating an abnormal condition in a pumping system involving a reciprocating pump, and is particularly adapted for use in systems of this type in which the pump is driven by an internal combustion engine, although it is not limited thereto.

An object of the invention is to provide an alarm initiator that will produce an alarm in response to a reduction in the average flow of the pumped liquid after the reduction has continued for an appreciable interval of time, but will not produce false alarms in response to momentary interruptions of flow.

Other more specific objects and features of the invention will become apparent from the detailed description to follow.

The present invention utilizes a switch-actuating element that is movable through a path of substantial length in either direction and which actuates a switch to produce an alarm when it reaches one end of its path. This movable element is periodically urged in direction away from the switch in response to the flow of pumped liquid, but is urged toward the switch in response to lack of flow of pumped liquid. So long as the average flow approximates a predetermined value, the element will be urged away from the switch to an equal or greater extent than it is moved toward the switch, so that no alarm will be given. Furthermore, reduction in the flow of liquid for a short period will not produce an alarm, because the element must travel a substantial distance before it reaches the switch. However if the average flow of pumped liquid falls below the predetermined value for a substantial period of time, the element will gradually move toward and finally contact the switch, thereby initiating an alarm.

Various methods can be employed to move the switch-actuating element in each direction. In accordance with the present invention it is urged away from the switch by a piston element constituted by the end wall of an expansible and contractable bellows which is connected to the intake manifold of an internal combustion engine that drives the pump. A valve mechanism is provided for connecting the bellows to the engine manifold during flow of pumped liquid and for disconnecting the bellows from the manifold and connecting it to the atmosphere during intervals when there is no liquid being pumped.

A thorough understanding of the invention may be had from the following detailed description when read in conjunction with the drawing, the single figure of which discloses schematically one embodiment of the invention.

The invention is disclosed in connection with an oil well pump for actuating a switch if and

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when the delivery of pumped oil falls below a predetermined average value.

Referring to the drawing: There is shown a well casing 36, a lower portion (deep in the well) which comprises a pump cylinder containing a piston 37 which is reciprocated by a sucker rod 34 extending to the top of the well. The piston 37 is shown provided with a valve 38. Immediately below the piston there is provided a barrier containing an inlet valve 39 and above the piston there is provided a barrier containing an outlet valve 40. It will be apparent from the structure disclosed that in response to reciprocation of the piston 37, liquid will be drawn in through the valve 39, then passed through the valve 38 in the piston and thereafter discharged through the valve 40 into the casing 36, where it is gradually raised to the surface and discharged through a pipe 26. As long as there is an ample supply of oil in the casing below the valve 39, a predetermined value of liquid will be discharged through the pipe 26 on each upward stroke of the piston 37. If the oil supply is insufficient to satisfy the demand of the pump, or if the amount of gas increases, then the quantity of liquid discharged through the pipe 26 will decrease. Whenever oil is being pumped it will be discharged in surges through the pipe 26.

The surging of the oil is caused to actuate a flap valve 24 which is provided in the pipe 26. Valve 24 is normally in closed position but is swung open each time the oil surges through the pipe 26 in response to movement of the pump piston 37. This valve is caused to control the movement of a reciprocal element 16 so that normally this element is maintained clear of a controlled means shown as a switch 17, but if the flow of oil diminishes substantially for a substantial interval of time, the reciprocal element 16 is permitted to move downwardly to actuate the switch, thereby initiating an alarm.

Thus the valve 24 has secured thereto an arm 23 which is connected by a link 22 to one end of a lever 21. The other end of lever 21 is connected to a rod 20 of a slide valve 12a. When the flap valve 24 is in closed position, as shown in full line, the slide valve 12a is in a lower position in which it connects a vent 12d through a passage 12c in the slide valve 12a to a valve 28 which in turn is connected by a pipe 27 and a pipe 14 to a bellows 15.

This bellows 15 has an extensible side wall 15b and a closed bottom wall 15c constituting a piston element which supports the reciprocal element 16. The upper end of the bellows is anchored, as indicated.

It will be apparent that with the flap valve 24 closed as shown in full line, atmospheric air is admitted through the valve 28 to the interior of the bellows 15, and the bellows will be permitted

to slowly expand and lower the reciprocal element 16 (by its own weight) toward the switch 17. The rate of downward movement of reciprocal element 16 under these conditions can be regulated by means of the valve 28.

Whenever an outward surge of oil occurs in the pipe 26 the flap valve 24 is opened into the dotted line position, in which it moves the valve slide 12a upwardly to move the passage 12c therein out of registration with the atmospheric vent 12d and move another passage 12b therein into registration with a pipe 11, which is connected through a valve 13 to the pipe 14. The pipe 11 is connected to the intake manifold 10 of an internal combustion engine 30 which is used to reciprocate the sucker rod 34 of the pump. Thus the engine 30 is shown connected by a belt to a pulley 31 which is connected by a connecting rod 32 to one end of a walking beam 33, the other end of which is connected to the upper end of the sucker rod 34.

As long as the engine 30 is operating under normal conditions a low pressure or partial vacuum is maintained in the intake manifold 10 and the pipe 11. Therefore with the valve slide 12a in the upper position as last described, air is sucked from the interior of the bellows 15 through the pipe 14, the valve 13, and the pipe 11 to the intake manifold 10.

Whenever the bellows 15 is connected to the pipe 11, and the engine 30 is operating, air is drawn out of the bellows and the piston element 15c and the reciprocal element 16 are slowly raised.

During normal operation of the system, the flap valve 24 is in the open or dotted line position a sufficient portion of the time to cause the reciprocal element 16 to be moved upwardly as much or more than it is moved downwardly during the intervals when the valve 24 is closed. Hence the switch 17 will not be actuated. Furthermore the flow of oil can be materially reduced for a short time without actuating the switch 17 because of the distance that the reciprocal element 16 must travel before it reaches the switch. Then when the normal flow of oil is restored the reciprocal element 16 is gradually moved back up to a position near the upper limit of its travel.

However, if the flow of oil ceases entirely for a predetermined length of time, the reciprocal element 16 will be lowered into contact with the switch 17 and will actuate it. Likewise, if the flow of oil is materially reduced, but not fully stopped, it will eventually permit the reciprocal element 16 to reach and actuate the switch 17.

It is not essential that the source of vacuum be the intake manifold of an internal combustion engine. However it has the additional advantage that if the engine is greatly overloaded, the pressure in the manifold will rise and actuate the switch 17 even though the oil flow is normal.

For the purpose of explaining the invention one embodiment thereof has been disclosed in the drawing in highly schematic form and its operation described herein. However various changes and modifications can be made in the particular system shown and the invention is therefore to be limited only to the extent set forth in the appended claims.

I claim:

1. Apparatus of the type described comprising in combination: a flow pipe; flow responsive means responsive to fluid in said pipe to move

into a first position during fluid flow and into a second position during no fluid flow; a reciprocal element reciprocal between spaced apart first and second positions; controlled means responsive to movement of said reciprocal element into said second position; and means controlled by said flow responsive means for moving said reciprocal element toward its second position at a controlled rate while said flow responsive means is in its second position and moving said reciprocal element toward its first position at a controlled rate while said flow responsive means is in its first position.

2. Apparatus as described in claim 1 in which said means for moving said reciprocal element comprises a piston element movable in one direction in response to application of a reduced pressure thereto and movable in the opposite direction in response to application of a higher pressure thereto; a source of fluid at said reduced pressure; a source of fluid at said higher pressure; and means for connecting one of said sources to said piston element in one position of said flow responsive means and connecting said other source to said piston element in said other position of said flow responsive means.

3. Apparatus as described in claim 1 in which said means for moving said reciprocal member comprises a piston element movable in one direction in response to application of a reduced pressure thereto and movable in the opposite direction in response to application of a higher pressure thereto; a source of fluid at said reduced pressure; a source of fluid at said higher pressure; means for connecting one of said sources to said piston element in one position of said flow responsive means and connecting said other source to said piston element in said other position of said flow responsive means; and means for relatively adjusting the resistance to flow of fluid from said two sources to said piston element.

4. In a pumping system comprising a pump actuated by an internal combustion engine having an intake manifold, apparatus responsive to a decrease in the discharge from said pump, said apparatus comprising: flow responsive means responsive to fluid discharge from said pump to move into a first position during fluid discharge and into a second position during intervals between fluid discharge; a piston element movable between first and second positions; controlled means responsive to movement of said piston element into said second position; means including a valve actuated by said flow responsive means for connecting said piston element to said intake manifold while said flow responsive means is in its first position; and means for connecting said piston element to the atmosphere in response to movement of said flow responsive means into its second position.

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