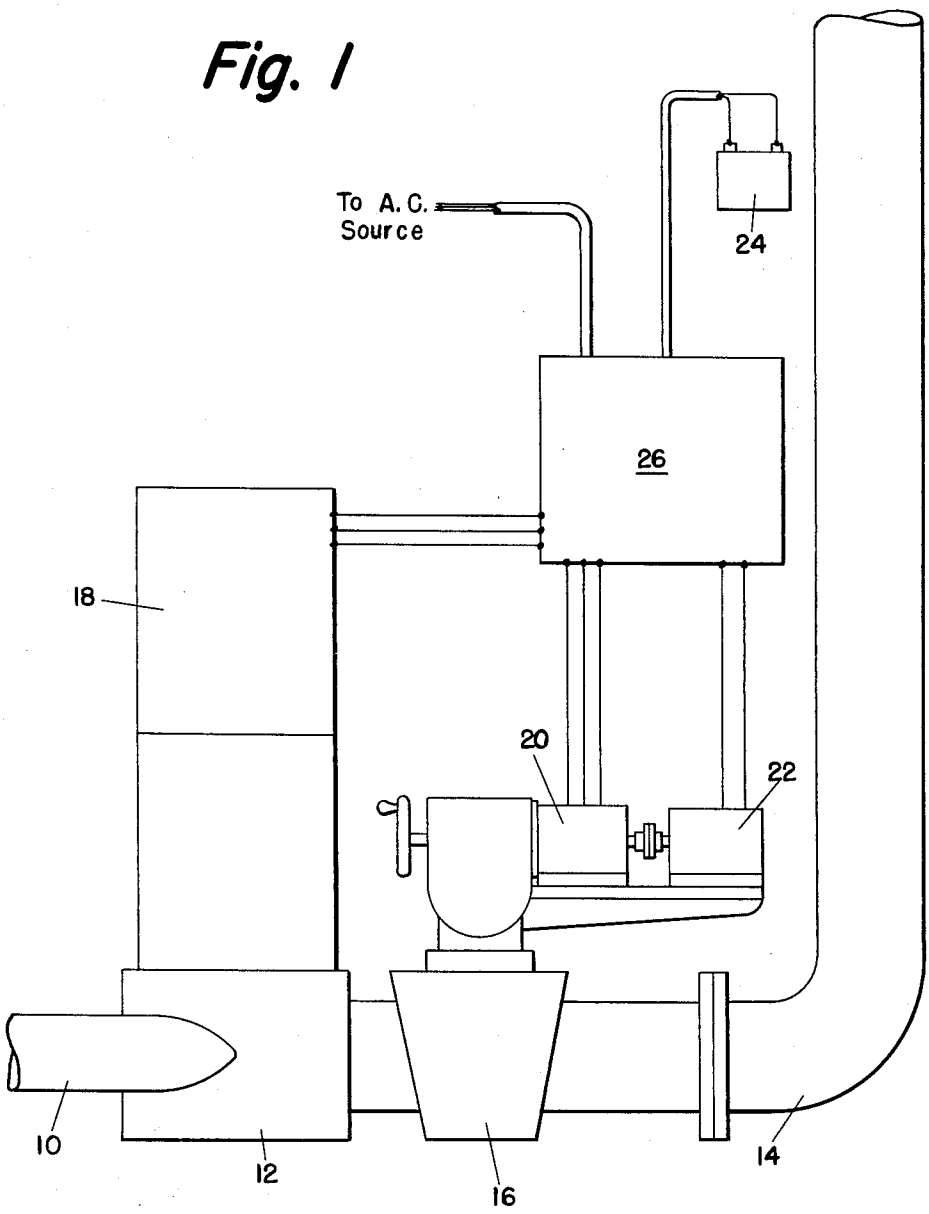
Dec. 12, 1961 L. KUSNER 3,012,510

SEWAGE PUMPING SYSTEM WITH ELECTRIC MOTOR OPERATED DISCHARGE VALVE

Filed Feb. 21, 1958 2 Sheets-Sheet 1

Fig. 1



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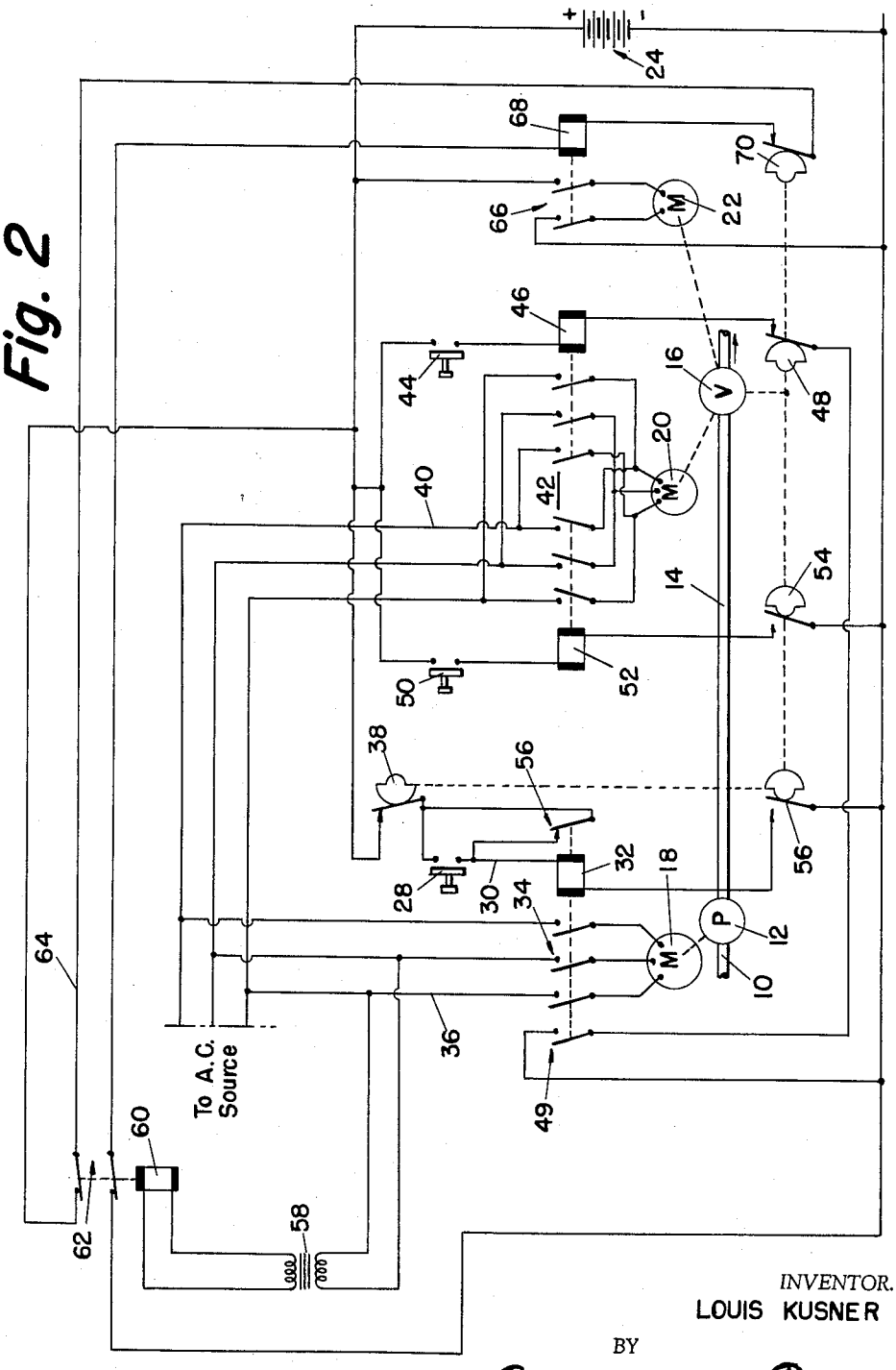
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Filed Feb. 21, 1958 2 Sheets-Sheet 2

Fig. 2



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United States Patent Office 3,012,510 Patented Dec. 12, 1961

3,012,510

SEWAGE PUMPING SYSTEM WITH ELECTRIC MOTOR OPERATED DISCHARGE VALVE

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Filed Feb. 21, 1958, Ser. No. 716,597
4 Claims. (Cl. 103—40)

This invention relates to a sewage, water, oil or chemical pumping system, the primary object of which is to provide an economical, efficient, safe and automatic means for closing the discharge valve in the event of failure or interruption of power to the pump motor.

When power failure or interruption occurs, it becomes necessary to shut the valve at the discharge end of the pump to minimize reverse flow of liquid through the pump to the suction well. In large pumping installations, such as municipally operated sewage and water works, the reverse flow may be sufficient to unscrew the pump impeller and to set up vibrations which will damage the pump motor and associated piping.

Heretofore a hydraulic power accumulator was employed automatically to close the discharge valve upon power failure or interruption. Hydraulic pressure was applied to a double acting piston whose rod was operatively connected to the rotary or gate discharge valve closing mechanism. The power accumulator has several disadvantages. First, the power accumulator system occupies a large volume so that its use is prohibited where spatial considerations apply, as in underground pumping systems. Second, it is expensive to install and maintain and depends greatly upon the reliability of the hydraulic power source. Third, when the hydraulic system goes into operation at pump power failure, the accumulated pressure becomes depleted as the discharge valve is closed. Thus should pump power again fail before hydraulic power is accumulated, the accumulator system could not function to close the valve. Furthermore, valve closure is relatively slow because the accumulator steadily loses hydraulic power as the valve is actuated.

It is an important object of this invention to provide a valve closing mechanism which overcomes the disadvantages of the hydraulic pressure accumulator system. This is accomplished by operatively connecting the discharge valve to a direct current source via controls which automatically go into operation when the alternating current power to the pump motor fails or is interrupted.

Another object of the invention is to provide a valve control system of the character described whereby complete and uninterrupted closure of the discharge valve by the direct current motor is effected even though the alternating current to the pumping system may return to the system prior to complete valve closure.

These and other objects of the invention will become more apparent as the following description proceeds in conjunction with the accompanying drawing, wherein:

FIG. 1 is a diagrammatic view of the pumping and valve closing mechanism embodying the present invention; and

FIG. 2 is a wiring diagram of the mechanism.

Specific reference is now made to the drawing wherein like reference characters are used for like parts throughout.

The overall pumping and discharge valve control system is shown in FIG. 1 and consists of an intake pipe **10** connected to a pump **12**, preferably centrifugal or mixed flow, a discharge pipe **14** connected to the pump and a discharge valve **16**, preferably rotary or gate, interposed in the discharge pipe. The pump is driven by a motor **18** which is operatively connected to a source of alternating current.

The valve **16** is operatively connected to the shaft of an A.C. motor **20** which derives its power from the same

A.C. source as the pump motor **18**. The A.C. motor **20**, when actuated after the pump motor **18** has acquired the desired speed, acts to open the valve **16**.

A D.C. motor **22** is coupled to the shaft of the A.C. motor **20**, the D.C. motor deriving its power from a direct current source such as a storage battery **24**.

The pump motor **18**, valve opening A.C. motor **20**, valve closing D.C. motor **22**, A.C. source and D.C. source **24** are operatively interrelated by controls **26** so that upon failure or interruption of the A.C. source, the D.C. motor **22** will automatically take over and close the valve **16**, the valve closure operation going to completion even if the A.C. power should return prior thereto, as will appear in greater detail hereafter in connection with the description of FIG. 2.

A switch **28** is interposed in a control circuit **30** which is connected to a magnet coil **32** that is operatively connected to a circuit breaker **34** in the lines **36** leading from the pump motor **18** to the A.C. source. The control circuit is carried through a conventional gear operated limit switch **38** which is closed when the valve **16** is closed, thus preventing energizing of the pump motor **18** until the valve closing is complete. The motor, of course, is started by actuation of the switch **28**.

After the pump motor has attained the desired speed, it is necessary to open the discharge valve **16**. The valve **16** is connected by appropriate gearing or other mechanical elements to the valve motor **20** which is operatively connected to the A.C. source by conductive wires **40** carrying a circuit breaker **42**. The circuit includes a switch **44**, a magnet coil **46** and a gear operated limit switch **48** in series which is normally closed. Actuation of the switch **44** energizes the magnet coil **46** which is connected to the reversing type magnetic motor starter of the valve motor **20** thereby causing the motor to move the valve **16** in the opening direction. Completion of valve opening opens limit switch **48** thereby deenergizing magnet coil **46** and stopping the valve motor **20**. An open auxiliary switch **49** may be included in this circuit which is actuated by the closing of the pump motor circuit breaker **34** to prevent opening of the discharge valve **16** until the pump motor is energized.

The valve control circuit also includes another switch **50** which is operatively connected in series to another magnet coil **52** associated with the starter of motor **20**, the circuit being carried through a normally closed gear operated limit switch **54** which is in turn operatively connected to the circuit breaker **34** via a normally closed limit switch **56** connected to magnet coil **32**. Thus when switch **50** is actuated, the valve motor **20** operates in a reverse direction to close the valve and when the valve operation is completed, the limit switch **54** opens deenergizing coil **52** and stopping the valve motor **20**. At the same time, limit switch **56** opens, deenergizing coil **32** and stopping the pump motor **18**.

The aforementioned control system prevents deenergizing of the pump motor **18** before the discharge valve **16** is completely closed. If the pump stopped before valve closure was completed, the head in the discharge pipe **14** would cause a back flow of fluid into the pump and suction well.

In the event of power failure or interruption in the A.C. source, magnet coil **32** becomes deenergized, circuit breaker **34** opens and contact **56** in the circuit **30** closes, but no power is available to close the discharge valve **16** by its A.C. motor **20** which is necessary to prevent liquid flow reversal and reverse rotation of the pump **12** and its motor **18**.

To provide a means for automatically closing the valve when A.C. power fails or is interrupted, a transformer **58** is provided whose primary is operatively connected to

the A.C. power source, the secondary winding of which is connected to the magnet coil **60** of an undervoltage relay whose contacts **62** are inserted in a control circuit **64** which includes the direct current source or storage battery **24**, said contacts **62** remaining open in the presence of A.C. voltage and closing in the absence of A.C. voltage. The motor **22** is coupled to the shaft of the valve A.C. motor **20** and is operatively connected to the D.C. source **24** via contacts **66** of the motor's non-reversing starter. Control circuit **64** includes a magnet coil **68** which is operatively connected to contacts **66** and a normally closed limit switch **70**. Thus when A.C. power fails or is interrupted, the contacts **62** of the undervoltage relay close. This energizes magnet coil **68** closing the contacts **66** of the starter of the motor **22** causing the latter to drive the valve **16** towards the closed position. When the valve is completely closed, limit switch **70** opens, de-energizing magnet coil **68** and stopping the D.C. motor **22**.

Since undervoltage relay **60** is of the time-delay type arranged so that the contacts **62** do not reopen until the time required for closing valve **16** by the D.C. motor **22** transpires, return of A.C. power prior to complete closing of the valve will not reopen contacts **62** and complete closing of the valve by the D.C. motor will be permitted.

While a preferred embodiment of the invention has been shown and described herein, a skilled artisan may make minor variations without departing from the spirit of the invention and the scope of the appended claims. Thus, for example, instead of employing a separate D.C. motor, the motor **20** for operating the discharge valve **16** may be of the A.C.-D.C. type (universal). The principles of the invention are also applicable to the case where the pump motor **18** and valve operating motor **20** are energized from a common direct current source and when said direct current source fails or is interrupted, the direct current motor **22**, deriving its energy from a separate source, such as a storage battery **24**, automatically acts to close the valve.

I claim:

1. In a pumping system, a pump motor, an A.C. power source, a source of D.C. power, a control circuit electrically connecting said pump motor to said A.C. power source, a pump operatively connected to said pump motor, a discharge pipe connected to said pump, a discharge valve in said pipe, and A.C. and D.C. motors operatively connected to and selectively operating said valve, said A.C. motor being in circuit with said A.C. power source for energization thereby and said D.C. motor being in circuit with said source of D.C. power for energization thereby, a limit switch assembly operatively

connected to said control circuit for opening and closing said control circuit, means operatively connecting said valve to said limit switch assembly to open and close said control circuit in unison with the opening and closing of said valve, said limit switch assembly including means operatively connected to said valve for maintaining said valve closed until said pump motor is energized, said limit switch assembly also including means operatively connected to said pump motor for maintaining said pump motor energized while said valve is open, and means operatively connected to said D.C. motor for selectively maintaining said D.C. motor de-energized when said A.C. motor is energized by said A.C. power source and maintaining said D.C. motor energized when said A.C. motor is de-energized.

2. The pumping system of claim 1 wherein said last mentioned means comprises a transformer having one winding operatively connected to said A.C. power source and the other winding operatively connected to a solenoid, and switch means interposed in the circuit between said D.C. motor and said source of D.C. power, said switch means being controlled by said solenoid, said switch means being constructed and arranged to be maintained open by said solenoid when said solenoid is energized by said A.C. power source and to be closed when said solenoid is de-energized.

3. The pumping system of claim 2 wherein said switch means is constructed and arranged to be maintained closed for a predetermined time interval after re-energization of said solenoid.

4. The pumping system of claim 1 wherein said A.C. motor is reversible and is in circuit with said A.C. power source through a pair of opposed relay means, said relay means being selectively actuatable to connect said A.C. motor to opposite sides of said A.C. power source to selectively open and close said valve.

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