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GASEOUS DISCHARGE DEVICE CIRCUIT

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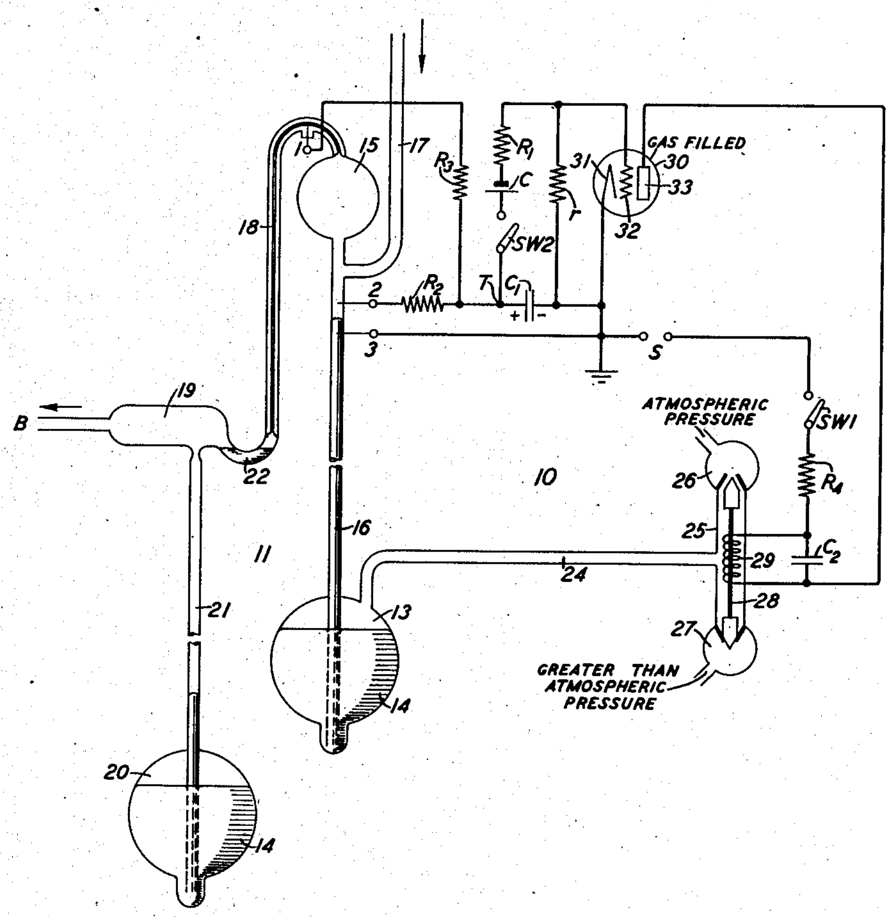

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GASEOUS DISCHARGE DEVICE CIRCUIT

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3 Claims. (Cl. 230—83)

This invention relates to gaseous discharge device circuits, and, more particularly, to process control circuits or systems.

There frequently arises in industrial or experimental process control the problem of keeping an indicator, such as a mercury manometer or a moving pointer, between a pair of index marks or contacts definitive of the limits of motion or action of the process, or regulative of the portions of the cycle of operations involved in the process. Such an arrangement requires that the circuit shall initiate a reversal of function upon momentary conductive engagement with one contact, but shall be unaffected by the immediate cessation of such conductive engagement.

An object of the invention is to enable in any type of process control where there is a necessity to reverse the direction of movement of a moving object, a more reliable control and a simplified control circuit.

In accordance with the invention, the control circuit comprises a gaseous discharge device having a cathode, input control electrode and anode, with a load and a source of low-voltage, low-frequency, current in series with the cathode and anode; a fluid or mechanical limit switch comprising a movable conductor, for example, mercury, and a plurality of contacts or terminals for conductive engagement with or by the movable conductor; and connections between the contacts and the electrode and cathode; including networks of preassigned time-constants that determine for preassigned relative positions of the movable conductor and the contacts whether the electrode or the anode of the tube has control of the current flow through the tube, and, consequently, whether the process is on the forward or reverse portion of its cycle.

A more complete understanding of the invention will be obtained from the detailed description that follows read with reference to the appended drawing, the single figure of which shows a pump whose cycle of operations is controlled by a circuit in accordance with the invention.

The single figure of the drawing discloses an embodiment of the invention. The circuit arrangement 10 controls the operation of a Toepler pump 11. Such a pump is of the type in which mercury, or some other liquid, is used as a medium for displacing gas or material to be pumped from one vessel, for example, at A, to another, for example, at B, and that utilizes liquid valves or seals.

The pump comprises a bulb or receptacle 13 for mercury 14, connected to a second bulb or receptacle 15 by the tube 16 to which tube or conduit 17 from the vessel at A is connected. Overflow conduit or tube 18, which may be a capillary, connects bulb 15 to expansion joint 19 and, through the latter to conduit or tube 23 leading to the vessel at B. The bulb or receptacle 20 which is open to the atmosphere, connects through tube 21 with the expansion joint 19, and collects the mercury that spills over from the bulb 15 when the pump is in operation. The elbow 22 collects a small amount of the mercury spilled over on the first cycle of the pump's operation, or may be provided initially, to provide a seal against gas flowing back from B or against impairment of the vacuum established in bulb 15 and tube 16 when the pump is in operation. The interior of the bulb 13 is connected through tube 24 and the double valve 25 to a source of atmospheric pressure or to one of greater than atmospheric pressure through the valves 26, 27, respectively. The closure member for the double valve 25 comprises the plunger or core 28 of the solenoid 29, the normal, i. e., non-operated, position of the plunger being such that the valve 26 is open and the valve 27 is closed.

Contacts or terminals 1, 2, 3 are embedded in tubes 16, 18 of the pump and extend across the bore thereof so that the mercury 14, in its normal or initial position in the tube 16, conductively engages with the terminal 3, and on operation of the pump, is adapted to conductively engage with terminals 1, 2.

The control circuit comprises a gas-filled discharge device 30 comprising a cathode 31, an input control electrode 32 and a plate or anode 33. A high resistance r is connected between the grid and cathode. A comparatively small resistance R_1 is connected in series with the grid biasing battery C and the control grid. The cathode is connected to ground, to terminal 3, and through condenser C_1 to the positive terminal of battery C. A high resistance R_2 is connected between the terminal 2 and the terminal T common to battery C and condenser C_1, and another resistance R_3 is connected between terminals 1 and T. The anode is connected through the solenoid 29, a low resistance R_4, and a source S of low-voltage, low-frequency alternating current to ground. The solenoid may be by-passed by a condenser C_2. In one arrangement constructed in accordance with this invention, the components had the following values:

R_1=6000 ohms	C_1=.1 μf.
r=R_2= 1 megohm	C_2=5 μf.
R_3= .1 megohm	C=45 volts
R_4= 100 ohms	S=110 v., 60 C. P. S.

Normally open switches SW1 and SW2 are connected between the anode and the source S and between the terminal T and battery C, respectively.

With switch SW1 open, atmospheric pressure is normally acting on the surface of mercury 14, and the latter assumes the position in the tube 16 as shown in the drawing; with SW2 open the condenser C_1 cannot be charged by the battery C through resistances R_1 and r. When it is desired to operate the pump, switch SW2 is closed enabling condenser C_1 to charge up to a value equal and opposite to that of battery C, thereby reducing the bias on the control grid to a point that positive potential on the anode will cause the tube to discharge or "ionize" and the grid to lose control of the plate current. Closure of SW1 connects the alternating current power supply to the anode. On the first positive half-cycle, the tube becomes conducting, valve 26 is closed and valve 27 is opened, connecting the interior of the bulb 13 to a source of pressure greater than atmospheric. This results in the mercury rising to engage with contact 2. Once conduction has started the tube remains conducting because of the time-constant of R_2—C_1; during the half-cycle that the anode is positive, the positive ion grid current drawn by the grid charges the condenser C_1 to the polarity shown, and with a magnitude approximately equal to that of battery C. The time-constant is sufficiently long so that the grid potential will be less than the critical negative or discharge control potential on succeeding positive half-cycles of the anode potential, until the mercury is forced up tube 16, into bulb 15 and out through tube 18 and into conductive engagement with contact 1. When the latter occurs, the network R_3—C_1 controls and its time-constant is too small to permit the condenser C_1 to retain its charge during the half-cycle when the anode is negative. Consequently the grid is again in control on the succeeding positive half-cycle, and the tube deionizes. The plunger 28 returns to its initial position, opening valve 26 and closing valve 27 to connect the bulb 13 interior with a source of atmospheric pressure. The mercury will return to its original level producing a vacuum as it descends. The gas or other material to be transferred from A to B will be drawn into the tube 16 and bulb 15 as the mercury descends below the junction of tubes 16, 17. When the mercury level falls below that of contact 2, the operations already described are repeated, with the rising mercury forcing the gas or other material in tube 16 and bulb 15 out through tube 18. Mercury that spills over past the contact 1 is collected in bulb 20, and the elbow 22 is provided to collect a small amount to provide a seal to preserve the vacuum established by the mercury movement past the contacts 1, 2. This cycle of operations continues so long as the switch SW1 remains closed.

The single embodiment of the invention that has been described hereinabove is believed at this time to be a preferred form thereof, but it is to be understood that the invention is not limited thereto but only by the scope of the appended claims.

What is claimed is:

1. In combination, a gaseous discharge device comprising a cathode, an input control electrode and an anode; a load and a source of alternating current potential in series with said cathode and anode; means for biasing said input electrode to a potential such that current cannot flow between said cathode and anode; means comprising a condenser for balancing said biasing potential so that said cathode and input electrode are at the same potential whereby discharge within said device occurs when the anode is at a positive potential; a plurality of terminals, one of which is connected directly to said cathode; a resistance in each connection between two other terminals and said condenser; and a movable conductor for conductive engagement with said terminals, engagement of said conductor with all of said three terminals providing a resistance-condenser network having a time-constant such that the input grid is biased between successive positive half-cycles of the anode potential to a potential that prevents continued discharge.

2. In combination, a tubular member, a conductive column adapted to be raised and lowered in said member, a source of atmospheric pressure and of greater than atmospheric pressure, means for applying such pressures alternately to said column whereby under greater than atmospheric pressure said column rises to a preassigned level in said tubular member and under atmospheric pressure falls to a preassigned lower level, and means for regulating the intervals for which the respective pressures are effective on said column, said means comprising a gaseous discharge device, an input circuit for said device including terminal members located in the path of movement of said column and adapted for conductive engagement therewith, and an output circuit for said device including said first-mentioned means.

3. In combination, a tubular member, a conductive column adapted to be raised and lowered in said member, a plurality of terminals extending through said tubular member and positioned at different levels in the path of movement of said conductive column, a source of atmospheric pressure and of greater than atmospheric pressure, means for applying such pressures alternately to said column whereby under greater than atmospheric pressure said column is caused to rise to a preassigned level and to engage with all of said terminals and under atmospheric pressure is lowered to a preassigned level and engages not more than one terminal, and means for regulating the intervals for which the respective pressures are effective on said column and for producing a cyclical alternation in such pressures, said means comprising a gaseous discharge device having a cathode, a grid and an anode, an input circuit for said device comprising said terminals, a plurality of resistance-condenser networks of different time constants, and a source of biasing potential for said grid, and an output circuit for said device comprising a source of alternating current potential and said first-mentioned means.

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