

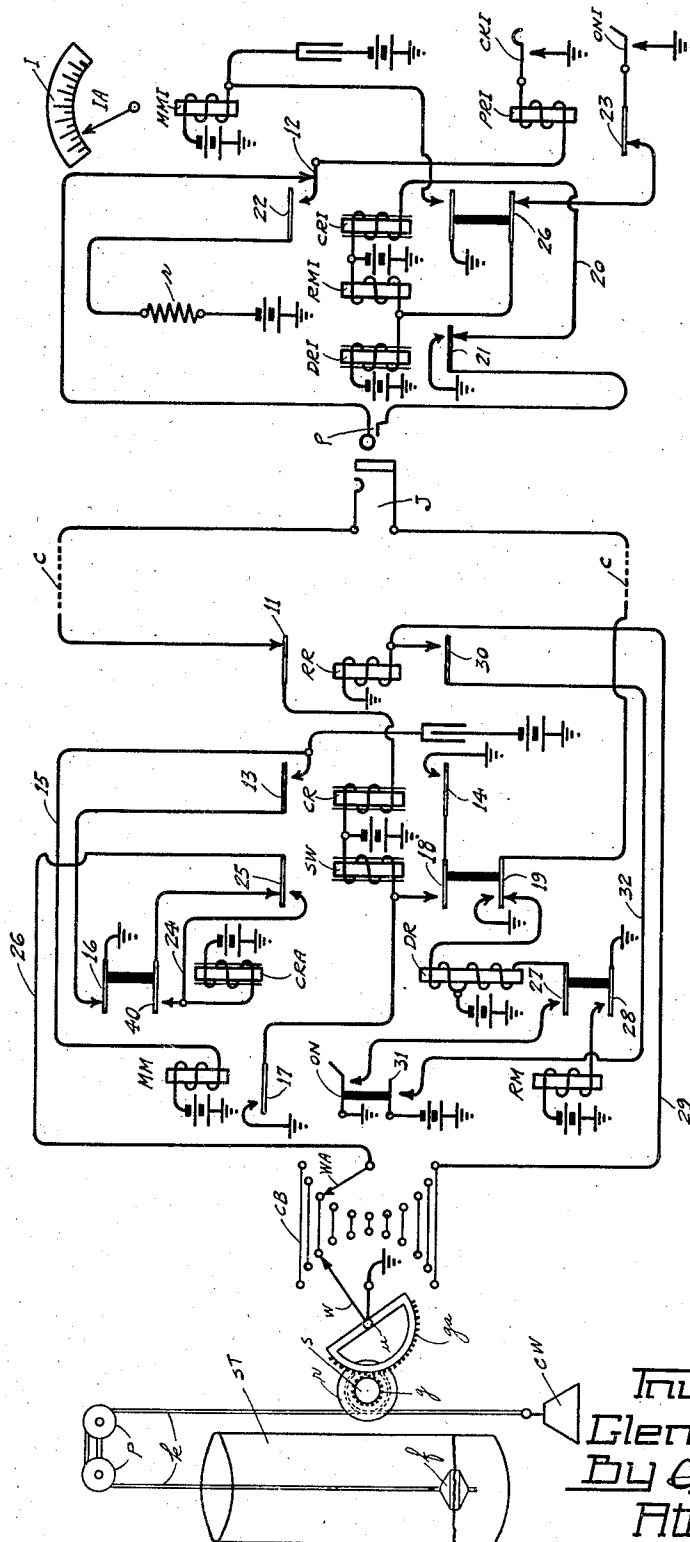
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SWITCH SYNCHRONIZING SYSTEM

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SWITCH SYNCHRONIZING SYSTEM

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My present invention relates to the synchronizing of apparatus located at widely separated points and the utilization of said synchronizing means to provide a reliable indicating system whereby an indication is given at a central point of the movement of certain movable members located at a distant point.

The devices heretofore generally used to indicate the fluctuations of the contents of large storage tanks such as those used by oil refineries have not been particularly satisfactory as it has been necessary to visit each tank individually and inspect its associated indicator to ascertain the amount of liquid in the tank. The information must then be relayed to the central office or pumping station which in large refineries may be a considerable distance from the tank inspected which may cause a considerable lapse of time in relaying the information to the central point from which point the contents of the tank may be controlled. It is an object of my invention to provide a simple, efficient and practical means for indicating directly at the central point the amount of the contents in the respective tanks.

It is also an object of my invention to provide an indicating system wherein the indicator and the movable member at the initiating point are always coordinated in their movement.

A further object of my invention is the provision of circuit arrangements whereby the distance between the indicator and the tank is inconsequential so that the same indicator can be used to measure the contents of different tanks.

Another object of my invention is the provision in a synchronizing system of means permitting the severing of the connection between the initial point and the indicator whereby the indicator coordinates itself with the initial member upon their subsequent reconnection.

Further objects of my invention will be readily apparent from the following specification considered with the accompanying drawing which represents a particular preferred embodiment of my invention.

To the left of the drawing I indicate a storage tank ST the fluctuation in the contents of which is shown upon the indicator I at the right of the PRI which prevents the premature disconnection drawing which is located at any desired point such as a pumping station or the like. The apparatus shown to the right of the dotted lines *c—c* is located at the central station or office and comprises the above mentioned indicator I which is operated by a motor magnet MMI controlled

by control relay CRI. A disconnect relay DRI and a release magnet RMI are controlled through off-normal contacts ONI and protective relay of the indicator. Relays DRI and CRI are provided with copper sleeves to make them slow to release. A control key CKI governs the operation of the system.

A single pair of conductors *c—c*, shown as dotted lines, connect the apparatus located at the central point with the apparatus located at the remotely situated storage tank ST. The mechanism located at the central station may be directly and permanently connected to the conductors *c—c* leading to the storage tank ST or a plug P and jack J or suitable switch mechanism may be provided to permit the said indicator mechanism to be connected to any one of a number of other pairs of conductors, similar to conductors *c—c*, leading to other storage tanks.

The equipment located at the tank end of the system comprises a float *f* which moves up or down as the contents of the tank ST increase or decrease. The movement of the float *f* is transmitted by means of a cable *k* traveling over a pair of pulleys *p—p* and a reel *r* secured to a shaft *s*. A gear *g* on shaft *s* engages a second gear *ga* pivoted at *u* and provide with a wiper W associated with a contact bank CB. When the contents of the tank ST decrease the float *f* is lowered which causes the cable *k* to rotate the shaft *s* and gear *g* in a clockwise direction and the gear *ga* in a counterclockwise direction. This causes the tip of the wiper W to travel in an upward direction as viewed in the drawing. When the contents of the tank are increased the movement of the parts is reversed. The mechanism shown in the drawing for transmitting the movement of the float to the wiper is simply one form of many which can be used and as it does not form a part of applicant's invention it is thought unnecessary to describe its construction in more detail. A counterweight CW serves to balance the cable *k* and float *f*. The contact bank CB may consist of any number of contacts; the one shown in the drawing comprising ten contacts on the tank side.

If the tank ST is ten feet high the wiper arm W will move from one contact to the next upon a rise or fall of one foot in the contents of the tank ST. If the tank is fifty feet high a rise or fall of five feet in the contents of the tank will be necessary to move the wiper W to the next contact in either direction. In actual practice, of course, a sufficient number of contacts will be provided to measure much smaller varia-

tions in the contents of the tank. The indicator I is provided with a graduated scale over which an indicating arm IA travels. The action of the indicator arm IA is controlled by a selector-arm or wiper WA co-operating with the bank of contacts before mentioned. Each time the wiper arm WA moves from one contact to the next the indicator arm IA moves to the next graduation on the scale. If the indicator I is associated with a ten foot tank, with the number of contacts illustrated, each mark on the scale will indicate an increase or decrease of one foot in the contents of the tank and if the tank ST is a fifty foot tank each mark will indicate five feet. If the indicator I is associated with tanks of different heights the attendant must be provided with a chart or code to determine the meaning of the indication by the indicator arm. The controlling factor is that the indicator arm IA moves one step each time the wiper arm WA at the connected tank steps to the next contact.

The wiper arm WA is associated with contacts electrically connected to the contacts associated with the wiper W and is stepped from contact to contact in the group by a motor magnet MM which in turn is controlled by relays CR and CRA. An extra contact 80 is provided in the bank engaged by the wiper WA to control the restoration of the wiper WA to its zero or normal indicating position. A switching relay SW is provided and a disconnect relay DR, restoring relay RR and release magnet RM control the restoration of the switch wiper WA to normal. The relays CRA, CR and SW are of the slow to release type. The details of the magnet control of the step by step *f* feed and the return set up, of both wiper WA and indicator arm IA, by motor magnets MM, and MMI, respectively: release magnets RM and RMI, respectively, and off-normal contacts ON and ONI, respectively, may be those disclosed in U. S. Patent No. 1,520,821 granted to W. Kaisling on December 30, 1924, wherein the like motor magnets, release magnets and off-normal contacts are identified, as in this application, by reference characters, MM, RM and ON, respectively, and are illustrated in Figure 1 and described on page 2, lines 105-135 and page 2, lines 1 to 95. However I do not claim these details and I do not consider my invention confined to this particular showing, which is merely cited to show a known means to the end. My drawing being diagrammatic the various magnets are shown in positions to facilitate the following of the various circuits controlled, instead of in relation to their mechanical operation which is understood in the art.

Having generally indicated the character of the equipment I will now describe the operation of my system as used for a tank gauge. The attendant desiring to ascertain the amount of the contents of tank ST will place plug P in jack J corresponding to tank ST and operate control key CKI thereby closing an energizing circuit for control relay CR and relay PRI which relays operate by current flowing from grounded battery through the coil of control relay CR, normally closed contact 11 of relay RR, conductor C, connected jack J and plug P, normally closed contact 12 of relay CRI, the winding of protective relay PRI, the closed contact of key CKI to ground. The control relay CR closes its contacts 13 and 14, contact 13 closes an energizing circuit for the motor magnet MM from grounded battery through the winding of magnet MM, conductor 15, alternate contact 13 of CR, to ground at closed contact 16

of relay CRA. The motor magnet MM is energized and attracts its armature 17 to close an energizing circuit for switching relay SW which operates by current flowing over an obvious circuit. Relay SW attracts its armature 18 to establish a locking circuit for itself through its said contact 18 and alternate contact 14 of relay CR to ground. The closure of alternate contact 19 of relay SW establishes an energizing circuit for control relay CRI which may be traced from grounded battery through the winding of CRI, conductor 20, normally closed contact 21 of relay DRI, plug P and jack J, conductor C and alternate contact 19 of SW to ground. Relay CRI closes its alternate contact 81 to cause the energization of motor magnet MMI by current flowing over an obvious circuit.

Both the motor magnets MM and MMI are in an energized condition at this time. The closing of alternate contact 22 of relay CRI opens the original energizing circuit of relays CR and PRI but a substitute circuit for relay PRI is established and the relay PRI remains energized by current flowing from grounded battery through resistance *r*, alternate contact 22 of CRI, through the winding of PRI to ground at key CKI. This substitute circuit is established for relay PRI to prevent the premature closing of contact 23 and an unauthorized restoration to normal.

The opening of the circuit of relay CR causes it to open contacts 13 and 14 thereby opening the circuits of motor magnet MM and switching relay SW which restore to normal. The restoration to normal of contact 19 of relay SW opens the energizing circuit of the control relay CRI which restores its contact 81 to normal to open the energizing circuit of motor magnet MMI. The motor magnets MM and MMI are of the type in which the wipers associated therewith step upon the deenergization of their stepping magnets. The wiper WA associated with the contact bank CB will now move to the first contact of its bank and wiper IA associated with the indicator I will move to the first graduation on the scale of the indicator. The restoration of control relay CRI reestablishes the energizing circuits for the control relay CR and relay PRI and they again energize as above described to cause the energization of the motor magnets MM and MMI as well as the subsequent deenergization of the control relay CRI which again opens the circuits of the relays CR and PRI to cause the deenergization of the motor magnets MM and MMI and the movement of the wipers WA and IA to the second contact and the second mark on the scale of the indicator, respectively.

This energization and deenergization of the relays and magnets continues until the wiper WA engages the contact which is grounded by the wiper W actuated by the cable *k*, at which time an energizing circuit is established for the control relay CRA from grounded battery through the winding of relay CRA, conductor 24, alternate contact 25 of switching relay SW, conductor 26, wiper WA, contact bank CB, wiper W to ground. The relay CRA opens normal contact 16 which prevents the further operation of motor magnet MM. The relay SW restores to normal and thereby opens the original energizing circuit of relay CRA but as CRA is slow to release a substitute or locking circuit is established through alternate contact 40 of CRA and normal contact 25 of SW. Inasmuch as MM does not operate the switching relay SW cannot operate and the indicator arm IA will remain stationary on the third

mark of the scale of the indicator I to indicate that the contents of the switch tank ST are at the level corresponding to that position on the scale of the indicator.

5 The operator noticing the stationary position of the indicator arm IA will take the reading of the same and by means of the code previously provided may ascertain the amount of the contents of the storage tank ST.

10 To release the apparatus the operator will open the key CKI to cause the deenergization of control relay CR and protective relay PRI which relays thereupon restore their contacts to normal. The restoration to normal of contact 23 of relay

15 PRI establishes an energizing circuit for the disconnect relay DRI and release magnet RMI which relays are operated by current flowing from battery through their respective windings in parallel, normal contact 26 of CRI, normal contact 23 of

20 PRI, alternate contact of the off-normal contact ONI to ground. The off-normal contact ONI is associated with the motor magnet MMI and assumes its alternate position upon the first movement of the motor magnet MMI. The release

25 magnet RMI energizes and causes the indicator arm IA to restore to its normal position and also restores the off-normal contact ONI to its normal position thereby opening the energizing circuit of the disconnect relay DRI which places all the apparatus at the central point at normal.

30 The disconnect relay DRI energizes and attracts its contact 21 to close an energizing circuit for the disconnect relay DR traced from grounded battery through the upper winding of relay DR, the

35 normal contact 19 of SW, conductor C, jack J, plug P, alternate contact 21 of DRI to ground. Relay DR closes its contact 27 to close a locking circuit for itself through its lower winding and alternate contact of off-normal contact ON;

40 which contact assumes its alternate position upon the first energization of the motor magnet MM. Relay DR also closes an energizing circuit for release magnet RM at its alternate contact 28 which magnet operates to cause the wiper WA to assume

45 its normal position. The release magnet RM also returns the off-normal contact ON to its normal position thereby opening the locking circuit of the disconnect relay DR which also restores to normal placing all the apparatus at the tank end of the system in its normal position.

50 If the contents of the tank ST decrease while the wiper WA is engaging a particular contact the wiper W will disengage the contact upon which it was resting and move to the next contact.

55 This will remove ground from the contact upon which wiper WA had been resting. The removal of ground from the contact engaged by wiper WA opens the energizing circuit of relay CRA which denenergizes and closes normal contact

60 16 which again causes the energization of motor magnet MM. Upon the energization of magnet MM relays SW and CRI and magnet MMI energize and deenergize as before described.

65 The alternate energization and deenergization of the motor magnets MM and MMI continues until the last contact in the bank CB is reached by the wiper WA. When the wiper WA reaches the last contact in its bank an energizing circuit for the relay CRA and the release relay RR is

70 established. This circuit can be traced from the battery through the winding of the relay CRA, conductor 24, alternate contact 25 of SW, conductor 26, wiper WA, contact 80, conductor 29, winding of relay RR to ground. The energization of

75 relay CRA prevents the further operation of mo-

tor magnet MM as above described. The relay RR energizing closes a locking circuit for itself through its alternate contact 30 which circuit can be traced from battery, alternate contact 31 of off-normal contact ON, conductor 32, alternate contact 30, through the winding of relay RR to ground. The relay RR also opens at contact 11 the energizing circuit of relays CR and PRI which restore their contacts to normal. The closure of normal contact 23 of PRI establishes energizing circuits for the disconnect relay DRI and release magnet RMI which cause the restoration to normal of all the apparatus as before described. However, as the control key CKI is still in its operated position the apparatus upon its restoration to normal will function as though it was being initially operated and the magnet MM will step the wiper WA to seek the contact which is now grounded and the indicator arm IA will move to the corresponding point on the scale I.

20 If the contents of the tank ST increase while the indicator I is connected thereto the wiper W will move in the opposite direction to the next contact under the influence of the float f. It is to be noted that the contacts in the bank of contacts CB are close together and the brush is so constructed that when the wiper W moves from one contact to the next, one or another of the contacts is grounded at all times but due to the construction of the switch this does not interfere with its operation. As soon as ground is removed from the contact engaged by the wiper WA the motor magnet MM will operate to step the wiper WA to seek the grounded contact. In this instance the magnet will only operate once as the next contact in the bank in the direction of movement of the wiper will be grounded. It is thus apparent that as the contents of the tank increase the wiper WA follows the wiper W in each step it makes, but upon a decrease in the contents of the tank ST the wiper WA will move to the last contact, return to normal, and then again step until it reaches the grounded contact.

45 The embodiment of my invention shown and described is one satisfactory and practical form of it, but the system is equally applicable anywhere it is desirous to synchronize two movable members which are designed to operate in a series of spaced steps. For instance, the wiper WA might be located at one telephone exchange to locate a calling telephone line while the wiper IA might be located at another exchange and engaging a contact bank similar to the bank CB shown to cause the operation of certain apparatus to indicate the seizure of the wiper WA of the calling line.

55 While I have shown a particular embodiment of my invention, it will be understood that I do not wish to be limited thereto since many modifications both in the circuit arrangement and instrumentalities employed may be made and I therefore desire to cover any such modifications as may come within the spirit and scope of the appended claims.

60 Having thus described my invention, what I claim as new and desire to secure by United States Letters Patent is:

1. An electric system for indicating at one station conditions at another station and for automatically varying any indication so made if the conditions vary, comprising a bank of electric contacts, means for providing an electric potential for one contact thereof and to shift it in response to said conditions from one contact to another, in one direction at one time and in the

opposite direction at another, a selector-wiper shiftable over said contacts, a shiftable indicator arm, means to shift said indicator arm and said selector-wiper in synchronism in one direction and to stop both when the latter registers with a potentialized contact, whereby if the potential is shifted in the same direction, the selector-wiper and indicator arm will follow in the same direction and if the potential is shifted in the opposite direction the selector-wiper and the indicator arm will move in the same direction as before until they reach a new extreme position, and means operating in the latter event to independently return each to a prior normal position independently of the shifting means, to thereafter cause said first means to shift them in synchronism until the selector-wiper reaches the potentialized contact.

2. An electric system for indicating at one station conditions at another station, comprising a bank of electric contacts, means for providing an electric potential for one contact thereof and for shifting said potential from one contact to another in response to said conditions; a control key; a selector-wiper, means acting upon closing of said control key, to shift said selector-wiper from one contact of said bank, to another; an indicator arm, means to shift said arm synchronously with said selector-wiper and means to stabilize both when the latter registers with a potentialized contact of said bank, and means operated upon opening of the control key to individually restore said selector-wiper and said indicator arm irrespective of their respective posi-

tions at the time, to corresponding, normal initial or zero positions.

3. An electric system for indicating at one station conditions at another station and for automatically varying any indication so made if the conditions vary, comprising a bank of electric contacts, means for providing an electric potential for one contact thereof and to shift it in response to said conditions from one contact to another, in one direction at one time and in the opposite direction at another, a selector-wiper shiftable over said contacts, a shiftable indicator arm, means to shift said indicator arm and said selector-wiper in synchronism in one direction and to stop both when the latter registers with a potentialized contact, whereby if the potential is shifted in the same direction, the selector-wiper and indicator arm will follow in the same direction and if the potential is shifted in the opposite direction the selector-wiper and the indicator arm will move in the same direction as before until they reach a new extreme position, and means operating in the latter event to independently return each to a prior normal position independently of the shifting means, to thereafter cause said first means to shift them in synchronism until the selector-wiper reaches the potentialized contact, a control-key, means whereby said shifting means are rendered operative upon the closure of the key and means whereby the selector-wiper and indicator arm are returned to said normal position upon the opening of said key.

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