# United States Patent

**Hayre**

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[54] **REMOTE ACTUATED POLLUTION AND OIL FLOW CONTROL SYSTEM**


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[52] **U.S. Cl.**.....**340/147 R,** 340/235 R, 340/163 R

[51] **Int. Cl.**.....**H04q 7/00**

[58] **Field of Search** .....343/225, 228; 340/163, 147



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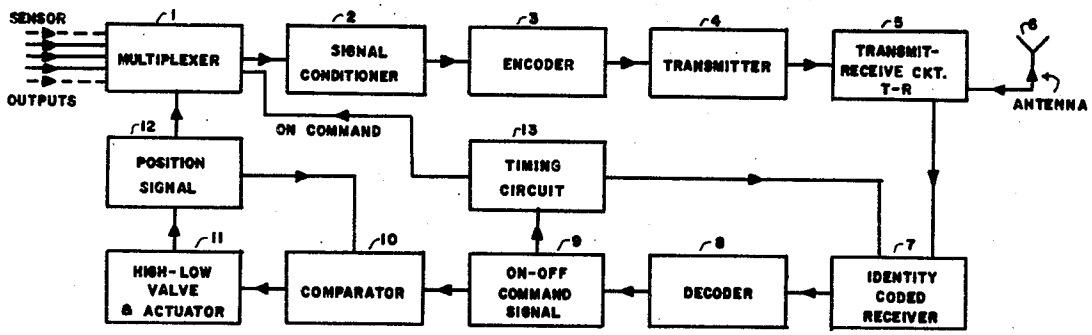
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[57] **ABSTRACT**

The position of a high-low valve on oil wells is remotely controlled and monitored from a distant control station in order to either shut the said valve or other associated valves and controls in case of severe environmental oil pollution/emergency conditions, or to open it during otherwise inaccessible periods or to remote control it at all times in order to conserve manpower. Such cases cover possibilities of oil leakage at a well, and failure of the usually provided shutoff valves at the well head.


**5 Claims, 2 Drawing Figures**




SATELLITE WELL/STATION (RAPOCS)

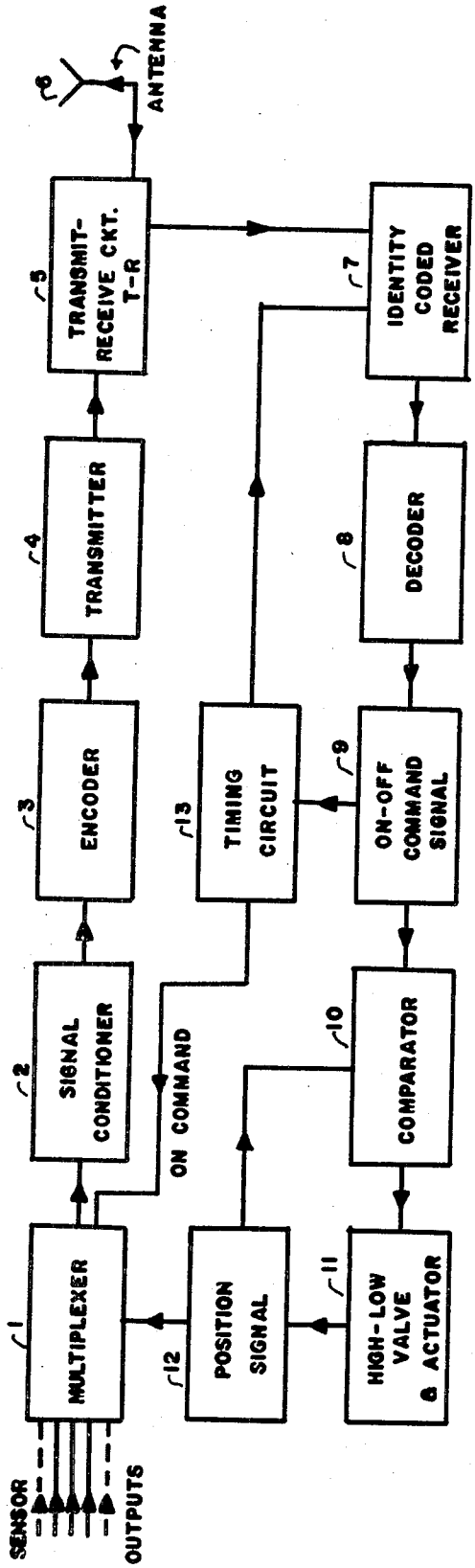



FIG. 1. SATELLITE WELL/STATION (RAPOCS)

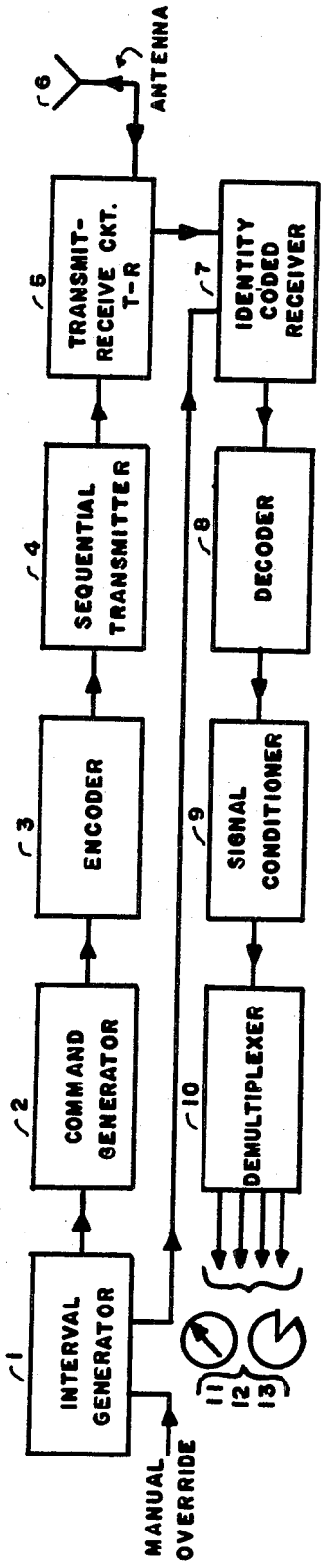



FIG. 2. CENTRAL PLATFORM/STATION (RAPOCS)

# REMOTE ACTUATED POLLUTION AND OIL FLOW CONTROL SYSTEM

## BACKGROUND OF INVENTION

The present invention relates to remotely controlling and monitoring the position of a valve in an oil well to prevent leakage and spillage of fluids from the well.

## SUMMARY OF INVENTION

The position of a high-low valve on oil wells is remotely controlled and monitored from a distant control station in order to either shut the said valve or other associated valves and controls in case of severe environmental oil pollution/emergency conditions, or to open it during otherwise inaccessible periods or to remote control it at all times in order to conserve manpower. Such cases cover possibilities of oil leakage at a well, and failure of the usually provided shutoff valves at the well head.

The system utilizes secret code for sets of wells to distinguish a set of wells belonging to one owner from those of another owner using similar equipment. Furthermore, each well in a set has an identity-coded signal in order for it to be controlled as opposed to any other well in the same set. The remote-actuated pollution and oil control system (RAPOCS) operates at the particular radio frequency in the HF range of 3–30 megahertz, in general at the lower end of this range when utilized in urban areas as opposed to telemetry and other very-high frequencies (VHF) (30–300 megahertz) or ultra-high frequencies (UHF) (300–3000 megahertz). The RAPOCS is designed to operate at the only control frequency corresponding to range and environmental requirements. Among numerous other uses of RAPOCS are, for example, remote metering applications in the field of public utilities or other such public and commercial services.

## BRIEF DESCRIPTION OF DRAWINGS

The system includes one central platform/station, which may be either mobile or stationary, and one or more satellite well/stations. Block diagrams for each of the two types of stations are shown in the accompanying drawings, wherein:

FIG. 1 is a block diagram of a preferred satellite well/station of the system of the invention; and

FIG. 2 is a block diagram of a preferred central platform/station of the system of the invention.

## DESCRIPTION OF PREFERRED EMBODIMENT

In FIG. 1, a typical satellite well/station (RAPOCS) is shown. An antenna 6, which is designed to be very highly directional in the case of the present pollution and oil control application, receives the signal from a central platform/station shown in FIG. 2. A receiver section of the satellite well/station including an identity coded receiver 7, being set in on the on- or ready- condition, in a manner to be set forth hereinbelow, receives the signal after such signal passes through the transmit-receive switch 5.

A set of wells belonging to a particular owner are identified as comprising one system of wells by a portion of a secret address code, with the remaining portion of the address code being used to identity-code each well in a set and permit such well to be controlled



by a command signal of the code signal, as will be more evident below, without causing operation of other wells in the same set. An end of message code is added at the end of the code signal for reasons to be more evident hereinbelow. The secret address code may be a digital code or a frequency code or other conventional suitable coding techniques may be used if desired.

The identify coded receiver 7 in the satellite well/station receives the code signal from the switch 5 and amplifies it. An identity code check stage of the identity-coded receiver 7 checks the code of the signal and produces an output signal only if the received signal is the correct secret address code which belongs to its system. The signal must also be identity coded for the particular satellite station in a particular system in order that such satellite station can be controlled as opposed to other wells in the same set or system. Unless the proper digital address code for the station and system is received, the output of the receiver 7 is zero and the system does not receive the command signal from the central platform station of FIG. 2, and accordingly does not respond.

An output signal, present at the output terminals of the identity coded receiver 7 in response to the receipt of the proper address coded signal, contains command information of the command signal in coded format, preferably binary, indicative of the command requested by the central platform station of the satellite well station. A decoder 8 decodes this signal to determine the message of the command signal. A command signal converter 9 receives the signal from the decoder 8 and produces an appropriate command signal compatible with the equipment controlled at the particular satellite subsystem. The command signal converter 9 further provides a signal to a timing circuit 13 in response to an end of message signal reception as indicated by the end of message code, for reasons to be more evident hereinbelow.

The command signal from the converter 9 is further furnished to a comparator 10. A second input of the comparator 10 is an off-on position signal formed in a position indicating signal converter 12 and indicating the position of the equipment controlled, in this embodiment a high-low valve 11.

The output of the comparator 10 is zero when the command signal from the converter 9 coincides with the position signal output of the converter 12. The output of the comparator 10 is a positive direct current (dc) level when the output signals from the comparators 10 and 12 do not coincide. The output of the comparator 10, which may be either zero or positive dc in level, as has been set forth hereinabove, is fed into an electrically actuated mechanism to change the position of the high-low valve 11 to that desired by the command signal as well as to correspond to the output of the comparator 10.

The final position of the high-low valve 11, as indicated by the position signal indicator 12, is furnished to a multiplexer 1. The multiplexer 1 may receive many other sensor outputs which may be time or frequency multiplexed, as desired. The multiplexed signals are then furnished to a signal conditioner 2 for appropriate signal conditioning and furnished to an encoded 3 for encoding in a signal encoder portion, to encode the position signal indicating the position of the valve 11,

and a satellite identity encoder portion of the encoder 3 which adds an identity-coded signal in order to indicate the particular satellite well/station and the set or system to which the particular satellite well/station belongs. The coded output of the encoder 3 is then transmitted by a transmitter 4 after passing through the transmit-receive switch 5 via the antenna 6.

The timing circuit 13 receives the on-command output from the on-off command signal converter 9, as has been previously set forth, and furnishes an on-command signal to the multiplexer 1, as is evident from FIG. 1, and further activates the receiver 7 after a transmission from the satellite well station is completed in order that the next subsequent signal from a central platform station may be received.

In FIG. 2, a typical central platform station is shown. The central platform station has a clock interval generator 1 which operates in an automatic mode (with provision for a manual override as is evident from the drawings), and generates a timing sequence: for turning on a transmitter section including a command generator 2, an encoder 3, and a sequential transmitter 4; and for turning the transmitter section off after completion of the transmission. After completion of the transmission, the clock interval generator then turns on a receiving portion including an identity coded receiver 7, a decoder 8, a signal conditioner 9, and a demultiplexer 10.

Upon receipt of the turn-on signal from the clock interval generator 1, the command generator 2 generates the necessary digital command signal, either to open the high-low valve, or to shut the high-low valve at the satellite well. Additional commands which might be generated include commands to report the current position of the high-low valve or other sensors at the satellite/well station.

The command signal from the command generator 2 is then encoded and the address of the particular satellite station receiving the signal is identity encoded to identify the particular well in the set to be controlled and distinguished from other wells in the same set in an identity encoding portion of the encoder 3. The command signal is further secret address-coded, using the secret code for the set of wells to which the satellite/well station belongs, in order to permit control of such particular satellite/well.

The secret and identity encoding in the encoder 3 further insures that the transmission from the central platform station is secured in the presence of any other interfering signals for other sets of wells using similar equipment. As has been set forth with respect to the satellite well, an end of message signal is added in the encoder 3 to indicate that the message is completed.

The coded signal from the encoder 3 is now made ready for sequential transmission from the transmitter 4 through the transmit-receive switch 5 in an antenna 6. Each satellite identity coded transmission so formed and transitted is followed by turning off the transmitter section and turning on the receiver section by the clock interval generator 1, as has been previously set forth. Thus, the transmitter-on and receiver-on sequence is repeated for subsequent satellite well/stations until transmission to each desired one of the satellite well/stations within the transmit-receive sequence is completed.

During receiver-on operations in the receiver portion of the central platform station, the secret signal, having the information signal, an identity coded signal for the satellite well/station, and a secret address code for the particular set of wells formed in the manner set forth hereinabove, is received through the antenna 6 and the transmit-receive circuit 5 and passed to the identity coded receiver 7. If the signal is from a satellite station within the set or system, such signal is identity decoded in the receiver 7 and passed to an information decoder 8 which decodes the information signal indicating the position of the valve at the satellite station and furnishes such signal to a signal conditioner 9. The output of the signal conditioner 9 is furnished to a demultiplexer 10 and the output information from the demultiplexer 10 may be displayed on a meter 11, a tape-recorder 12, or remote transmitted to another system 13, as desired.

Each of the blocks set forth in FIGS. 1 and 2 of the drawings is a typical, commercially available off-the-shelf item. Further, each of the transmission and receiving portions thereof may be adapted to the particular frequency of operation desired. The particular codes used in secret coding and identity coding of the set and satellite signals, respectively, are formed for each individual satellite and set in suitable distinctive codes of the type previously set forth.

The following chart lists suitable equipment for use in the preferred embodiment of the invention, although it should be understood that other units may be used.

## SPECIFIC EQUIPMENT FOR FIGS. 1 & 2

### Remote Actuated Pollution and Oil Control System

| Block Number FIG. 1 | Block Number FIG. 2 | Description |
|---|---|---|
| 2,3 | 1,2,3 | Motorola No. AR-81-MAR-Y--Multi Input Encoder (6 sensors/unit) |
| 4 | 4 | Johnston Transmitter Viking-2(for AM and continuous wave)—Hewlett Packard No. 606A, 8403, 8730 (for CW, AM, or FM) |
| 5 | 5 | *Reference Data for Radio Engineers*, Fourth Edition, 1956, page 427 |
| 6 | 6 | Vertical Monopole with Matching Coil for Appropriate Frequency—25 ft. |
| 7,8,9 | 7,8,9 | a. Collins Receiver Model 51 S-1 (CW or AM) |
| 10,11 | | b. Motorola C-1010—Digital Decoder and Printer |
| 12,13 | 10 | Multiple Contact Relay—Potter and Brumfield No. MH6PDT |
| | 11 | Solenoid Operated Valve ASCO No. 8223A4 |
| | 12 | Position Controlled Contact—Potter and Brumfield No. MG11D |
| 1 | 13 | Data Pulse No. 106A |

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, materials, components, circuit elements, wiring connections and contacts as well as in the details of the illustrated circuitry and construction may be made without departing from the spirit of the invention.

What is claimed is:

1. A system for monitoring and controlling the position of a valve in an oil well to prevent leakage and spillage of fluids from the well, comprising:

a. a central station for controlling and motoring conditions at a remote station, comprising:
1. transmitter means for sending command signals to the remote station to control and determine the position of the valve, said central station transmitter means comprising:
i. means for generating a command signal to determine the position of a valve in the well;
ii. means for encoding the command signal to maintain the signal secure from interference;
iii. means for transmitting the encoded signal; and
iv. means for activating a receiver section at the central station subsequent to transmission of the encoded command signal; and
2. receiver section means at the central station for receiving and monitoring signals indicating the position of the valve from the remote station, said central station receiver section means for receiving comprising:
i. means for decoding an incoming received signal to determine the identity of the sending station of such signal;
ii. means for decoding the incoming received signal to determine the message in such signal; and
iii. means for displaying the message of the incoming signal; and
b. at least one remote station having an oil well associated therewith, comprising:
1. a valve with the oil well having open and closed positions;
2. means for receiving the command signals from said central station, said means for receiving changing the position of said valve in accordance with the command signals, said remote station means for receiving comprising:
i. means for receiving an incoming command signal;
ii. means for checking the incoming command signal to determine if such signal is from the proper central station, said means for checking providing an output signal in response to a signal from the proper central station;
iii. means for decoding the received command signal to determine the message of such command signal;
iv. means responsive to the decoded signal for providing a command signal to operate said valve;
v. means for generating a signal indicative of the position of said valve; and
vi. means for comparing the signal indicative of the position of said valve with the command signal, said means for comparing forming an output signal indicative of the coincidence of the compared signals and of the position of said valve; and
3. means for transmitting signals indicating the position of said valve to said central station, comprising:
i. means for encoding the signal indicative of the position of said valve; and
ii. means for transmitting the encoded signal.

2. The structure of claim 1, wherein said remote station receiver section comprises:
electrically actuated means for changing the position of the said valve to correspond to the position indicated by the output signal of said means for comparing.

3. The structure of claim 1, wherein said control station receiver section comprises:
means for recording the message of the incoming signal.

4. The structure of claim 1, further including:
timing circuit means for activating said remote station means for receiving after transmission of the output signal by said remote station transmitter section.

5. A method of monitoring and controlling the position of a valve in an oil well to prevent leakage an spillage of fluids from the well, comprising the steps of:
a. encoding a command signal;
b. sending the command signal in the frequency range of from 5 to 20 megahertz from a central station to a remote station having an oil well associated therewith;
c. receiving the command signal from the central station at the remote station;
d. decoding the received command signal to determine the identity of the sending central station;
e. changing the position of the valve in accordance with the command signal;
f. forming a signal indicative of the position of the valve;
g. comparing the signal indicative of the position of the valve with the received command signal;
h. forming a command signal when the signals compared during said step of comparing do not coincide;
i. changing the position of the valve to correspond to the position dictated by the command signal;
j. transmitting the position signal from the remote station indicating the position of the valve;
k. receiving at the central station the position signal transmitted from the remote station; and
l. monitoring the position signal received at the central station.

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