A LOW COST, LOW POWER TELEMETRY SYSTEM

By W. TALJAARD

The installation of Radio Telemetering Equipment has always been expensive and the allocation of a frequency by the Postmaster-General just about impossible, especially when a small system has to be installed.

A low cost, low power system, which is working satisfactorily was recently installed between the local waterworks and the Town Board Reservoir which is about $1\frac{1}{2}$ miles away.

The complete equipment, comprising of Transmitter, Receiver and Recorder was designed and built locally with the following objectives in mind:

(*a*) Low initial cost

(*b*) Low operating cost

(*c*) Reliability and stability

(*d*) Minimum of maintenance

(*e*) Easy to read chart

The Transmitter

As there is no 220v mains available at the reservoir, the transmitter operates off a 6v car battery. The battery drain is kept to a minimum by using a low power transmitter and a high gain directional antenna. The signal received at the Receiver is about three times the minimum required for dependable operation of the recorder unit. Any signal larger than this would be wasted and any signal smaller would affect the reliability due to signal variations from decreasing battery voltage and atmospheric conditions.

The 13-plate car battery lasts from four to six weeks before recharging is necessary. The current drawn by the Transmitter is about 2.5 amps.

The transmitter emits a signal every hour. A small battery operated clock is used, the minute hand operating a microswitch which in turn switches on the transmitter and transistorized timer unit. This timer switches the transmitter off after the elapsed period. The "on" period is dependent on the water level in the reservoir; the higher the level the longer the transmitter stays on. An empty reservoir gives a "on" period of 4 seconds and a full reservoir (6 ft.) a period of 70 seconds. The timer is linear and therefore the recorder chart reading is also linear.

The transmitter proper consists of a dual tetrode radio valve with instant heating filaments. The first section operates as a overtone oscillator providing a 27 Mc/s. output from a 9 Mc/s. Quartz crystal. The second section operates as a straight amplifier and feeds the directional antenna via a 52 ohms low loss co-axial cable. The transmitter output into the antenna is about $\frac{1}{2}$ watt. The gain of the three-element antenna is about five giving an effective radiated power of 2.5 watts. The antenna is seven foot higher than the reservoir.

The Receiver

The receiver is mains operated and employs six miniature valves. A Radio Frequency stage is used to increase the signal to noise ratio. This is followed by a mixer stage with separate crystal controlled oscillator. The Intermediate Frequency Amplifier consists of two valves and ten tuned circuits. As no modulation is used on the transmitter, the last I.F. stage also operates as a limiter for noise pulses. The high selectivity reduces the bandwidth and also unnecessary noise. As both transmitter and receiver are crystal controlled the narrow bandwidth presents no stability problems. A diode rectifier feeds a dual triode D.C. amplifier which operates a D.P.D.T. high resistance relay.

A signal of 1.0μV at the antenna terminal is sufficient to operate the relay dependably. Attempts to increase the sensitivity any further only increased valve and exterior noises sufficiently to operate the relay.

To increase reliability the high tension supply on the receiver is only 100 v. Dependable components with adequate ratings were used.

A Signal Strength Meter is also installed on the receiver so that a drop in battery power at the transmitter can be detected. It also provides a check on the performance of the equipment.

The antenna for the receiver is a half wave dipole. No directional antenna was installed as another transmitter, in the opposite direction to the first, is soon to be installed.

The limiter stage prevents noise pulses from closing the relay and operating the recorder. Even during violent electrical storms only small marks are recorded on the chart. These marks are on the pen-rest line and do not reach the zero water level line. Storms do not affect the operation of the equipment.

The Recorder

The Recorder employs 24 hr. circular charts. These are standard charts and easily obtainable. The pen drive unit consists of two small 1 r.p.m. motors (5w. 220v. A.C.).

As small A.C. synchronous motors are not reversible, two motors were mounted back-to-back and coupled by a light cork arrangement. One clock drives the pen across the chart from right to left. This happens when a signal is received and the relay operates. The distance the pen moves is determined by the length of the signal. On the removal of the signal the relay drops out and connects power to the second motor via a limit switch. This motor returns the pen to its normal resting place which is about $\frac{1}{4}$ in. below the zero line of the recorder. When the pen reaches its normal resting place the limit switch operates and breaks the circuit to the motor. The recorder is now ready for the next cycle.

The recordings are very clean and easy to read.

Conclusion

No licence is required to operate the equipment in the allocated band. The transmitter power may not exceed 3 (three) watts and one-way communication only may be used.

The equipment with minor changes could be used for a variety of remote control and emergency purposes.

Transistors could have been used at the reservoir but a more elaborate set-up would evolve and it would be more expensive.

Mr. Bentley said this was a very useful application which could be used to greater extent in the Industry. He knew that the author was contemplating installing a small generator to keep the battery charged.

Mr. Taljaard said that when the reservoir was full a considerable pressure was built up behind the ball-valve and this could be used to drive a small water turbine which could keep a small generator going to trickle-charge the battery. Only one amp was required intermittently for this purpose.

Dr. Douwes Dekker (in the Chair) asked if the author had in mind the application of the system to electric instruments in the factory.

Mr. Taljaard said that often one wanted warning lights to register in the laboratory or office or to give instrument readings in these places. Instead of using electric cables or copper tubing for this purpose the system could be installed. Up to 12 or 14 readings could simultaneously be transmitted by the system using only one lead, or even by earthing the radiater.

Mr. J. B. Alexander asked what the cost of the equipment would be.

Mr. Taljaard said the cost was about R80.00, not including the recorder.

Mr. Grant asked what was the maximum distance over which the system could be used.

Mr. Taljaard replied that the signal over $1\frac{1}{2}$ miles was saturated. On open land using the maximum of 3 watts the range would be about 10 miles.

A directional aerial and receiver would boost up the signal some five times but he could not use these for the present installation as signals were being obtained from two different directions.