APPLICATION OF AN OLD PRINCIPLE IN THE CONTROL OF SUGAR CONTAMINATED CONDENSATES

By W. E. O. DOUGLAS

It is a well known fact that the electrical conductivity of solutions of salts varies according to the amount of salt present.

Indicators based on this principle have been used on shipboard for many years, to detect the entry of seawater into the condensate via leaking condensor tubes.

It was decided to see if a similar device could be constructed for use in a sugar factory for the control of sugar contaminated condensates. After a number of experiments a satisfactory instrument was evolved and has been in operation during the 1961 crushing season.

Referring to the diagram and starting at the transformer, the primary circuit wire "A" is led to the coils of the relay and hence via junction box "C" to the right hand electrode of the probe. The circuit continues from the left hand electrode through the milliammeter and back to junction box "C". Here the adjustable resistance "D", which is controlled by a pair of the normally closed relay contacts, is looped into the circuit. Point "C¹" is then connected to the rheostat "E" which is in turn wired to contact "B" on the transformer.

The secondary side is arranged so that one pair of normally closed relay contacts supplies power to the white pilot light. When the armature of the relay "pulls in", these contacts open and another pair close, the latter supplying power to the red warning light and the coils of the solenoid air valve. Air is then admitted to the air relay valve and the main valve is opened for rejection of the condensate.

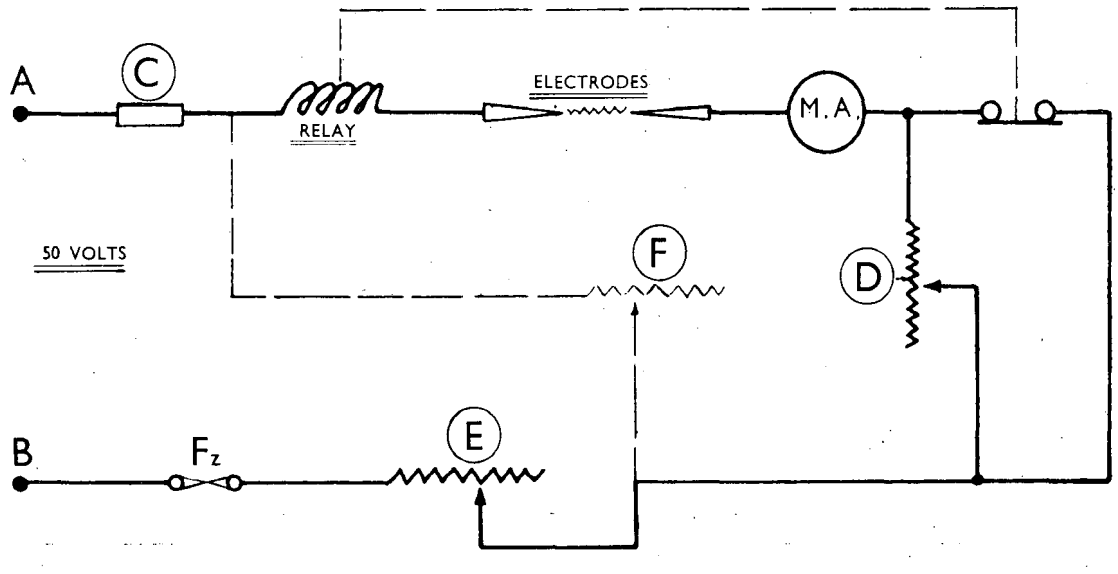
The rheostat "E" is used to control the flow of current in the whole primary circuit and is used for setting and calibrating the instrument.

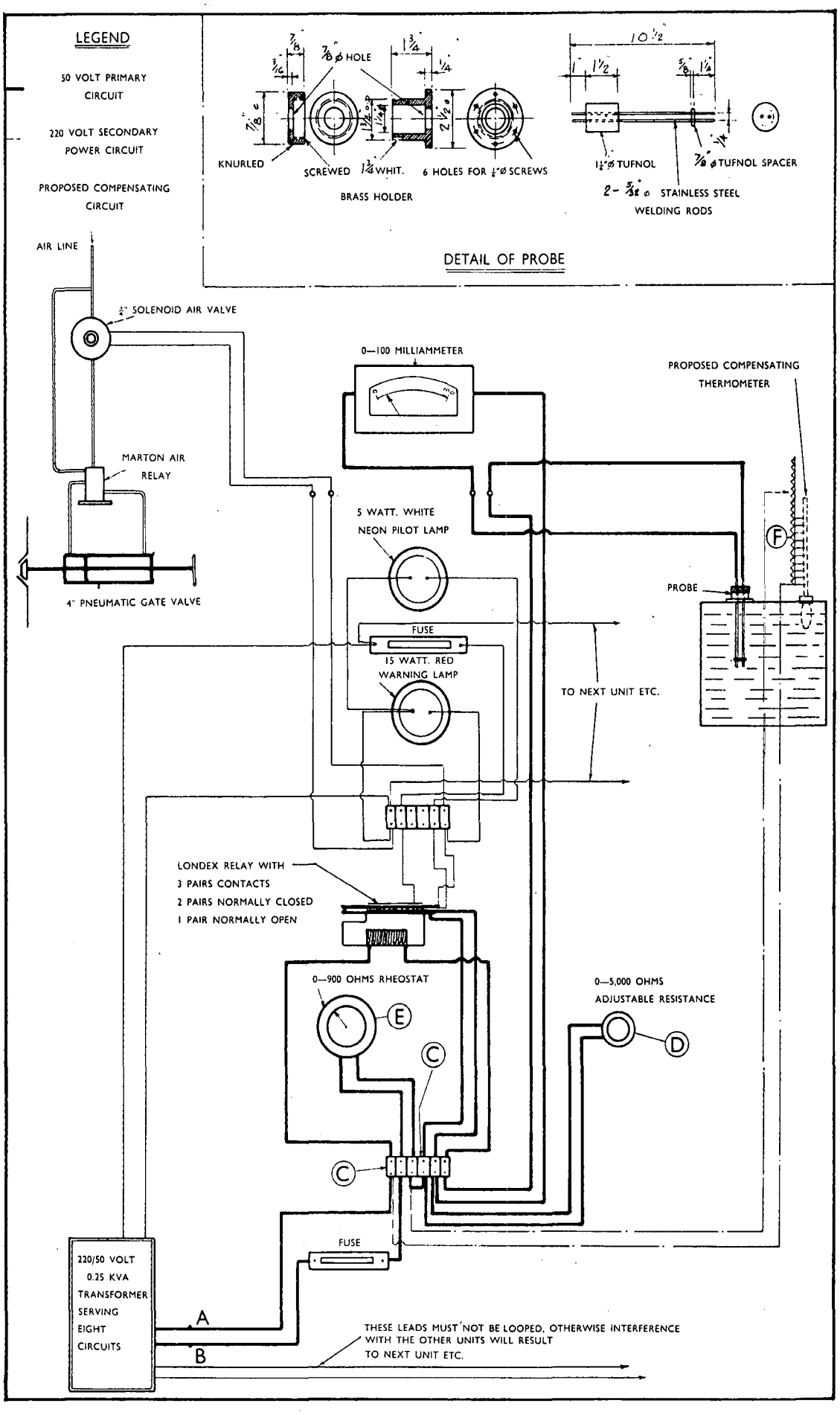
The adjustable resistance "D" comes into operation when the armature "pulls in". Its function is to weaken the magnetic field of the relay to such an extent, that a drop of say one milliampere in the primary circuit will cause the relay to "let go" again.

With regard to temperature correction, it was established that the conductivity of the water increased by about 1¼ per cent per degree Fah. rise in temperature. The proposed circuit has not yet been fitted because of difficulty in obtaining the special thermometer, but the idea is, that the compensating circuit is connected in parallel with the primary circuit and sections of the shunt "F" will be progressively shorted out as the mercury rises up the thermometer stem. In this way the extra current flowing, due to the increase in conductivity with rise in temperature, will flow in the compensating circuit and will not disturb the primary circuit.

In practice, however, and until special thermometers can be obtained, it has been found that the temperature of our condensate returns do not vary much once the factory has started up and with each instrument set to suit the highest temperature of the circuit it is controlling, good operation is obtained.

SCHEMATIC DIAGRAM OF CONTROL CIRCUIT




LEGEND
50 VOLT PRIMARY CIRCUIT
220 VOLT SECONDARY POWER CIRCUIT
PROPOSED COMPENSATING CIRCUIT
DETAIL OF PROBE
KNURLED
SCREWED
BRASS HOLDER
6 HOLES FOR SCREWS
TUFNOL
TUFNOL SPACER
STAINLESS STEEL WELDING RODS
AIR LINE
SOLENOID AIR VALVE
MARTON AIR RELAY
4" PNEUMATIC GATE VALVE
0—100 MILLIAMMETER
PROPOSED COMPENSATING THERMOMETER
5 WATT. WHITE NEON PILOT LAMP
PROBE
FUSE
15 WATT. RED WARNING LAMP
TO NEXT UNIT ETC.
LONDEX RELAY WITH
3 PAIRS CONTACTS
2 PAIRS NORMALLY CLOSED
1 PAIR NORMALLY OPEN
0—900 OHMS RHEOSTAT
0—5,000 OHMS ADJUSTABLE RESISTANCE
FUSE
220/50 VOLT 0.25 KVA TRANSFORMER SERVING EIGHT CIRCUITS
A
B
THESE LEADS MUST NOT BE LOOPED, OTHERWISE INTERFERENCE WITH THE OTHER UNITS WILL RESULT
TO NEXT UNIT ETC.

Dr. Douwes Dekker, in the chair, said the three papers all dealt with the problem of how to avoid contamination of the factory condensates which would otherwise condemn them for use as boiler feed waters. The use of cold make-up water in this country has always been rather excessive, mainly due to the fear of the engineers that sugar would be present in the condensates especially those from vapour and that the pH would be low. The cold make-up water required a considerable amount of heating and if it was not properly conditioned might cause scaling, while the oxygen content was also an objection.

There was a lot to be said for the discontinuing of the use of the cold make-up water and trying to use the pure hot water we had available in the factories. Making sure that these condensates contained no sucrose could be done in various ways. Automatic control was obviously much better than relying on the periodic testing of catch samples. We could, for this purpose, use either an instrument which tested for sucrose or we could use the type which measures the conductivity caused by the ash which usually accompanied sucrose in a raw sugar factory.

Mr. Cargill had stated that when the condensate from the refinery vacuum pans was used it sometimes showed conductivity but no sucrose. In spite of shortcomings of this nature, conductivity testing often was being used with good results.

The chemical method was used by the British Sugar Corporation and also in refineries in America. A rather severe draw-back of the chemical method was that it was slower than the conductivity method, and in the S.M.R.I. apparatus, one obtained a reading only every quarter of an hour, whereas Mr. Cargill got a reading with the conductivity method every four seconds.

Mr. Ashe related that at Umfolosi the "Pass Auf" apparatus, which was a chemical one, was used. This gave a reading about every 2½ minutes. The cost was about R960. The drawback he found was that the chemical injected into the sample had to be washed out by the succeeding sample, so that if there was no sample coming forward from a particular point because the plant was not in use, the cycle still went on. The chemical was thus injected into the old sample and this became very sticky and led to the apparatus discontinuing working after a certain period. This disadvantage was overcome by introducing an external source of water to take the place of the sample which was not being delivered, and the apparatus was now working satisfactorily. Umfolosi was now using the condensate from the second vessel of the evaporator and was using only 10 per cent of cold make-up water.

Mr. J. B. Alexander asked with reference to the chemical method used in America, if this was not applied mainly to the detection of sugar in the condenser water the conductivity of which was too high to allow of the conductivity method.

He asked Mr. Cargill if he had found the reason for the exception to the good operation of his apparatus in its application to condensate from the refinery pans, when they were using vapour.

Dr. Douwes Dekker replying to Mr. Alexander said he thought Mr. Alexander was correct, and that the method was used in detecting sugar in the condenser water in America.

He said that he understood that conductivity had been found when vapour was used in pans but not when it was used in evaporators.

Mr. Cargill stated that no sugar was found in the condensate from either the pans or the evaporator, and although many tests were made no reason for the malfunctioning of the apparatus on refinery condensate could be found.

Mr. Perk referred to the experience with the conductivity system for condensates at Mhlume mill. Here, the red lamp referring to the condensate of the first vessel was consistently burning. Since there could not be any sugar (juice) in this condensate when the evaporator was operating, the only explanation could be that boiler feedwater chemicals had come over with the steam, resulting in a conductivity of the process steam condensate higher than the set limit.

Mr. Cargill said that most of the major heating was done by exhaust steam at Mount Edgecombe, but no conductivity was found in the condensate from this exhaust steam.

Mr. Grant stated that at Felixton no make-up water was used although they had no instrument to detect contamination. Only the usual periodical check was made in the laboratory. In the use of vapours it would appear that the chemical method was preferable.

Dr. Douwes Dekker said he did not aver that the conductivity method was not valuable. It had been used successfully and although he preferred the chemical method, the conductivity method was better than no method at all.

Fuel consumption in this country he felt was excessive, and suitable adequate means of checking for sucrose in condensates, allowing them to be used as boiler feed waters, was a means of reducing high additional fuel costs.