ONTARIO HYDRO
RESEARCH DIVISION REPORT

To Mr. F.J. Simpson
Director of Research

DEMAGNETIZING TRANSFORMERS WITH DIRECT CURRENT

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Equipment that automatically demagnetizes transformers by applying a reversible dc voltage to the winding is described. The equipment, although especially designed for demagnetizing current transformers, with modifications can be used for demagnetizing voltage and power transformers.

Current transformers can become magnetized by fault currents containing a transient component or by direct current applied during continuity or resistance measurement of the winding. Because CTs operate at low flux densitities, they will remain magnetized until another application of fault current. Since magnetized current transformers may cause a delay or incorrect operation of protective relays due to premature saturation, they should be demagnetized after severe fault conditions or after continuity tests.

Voltage or power transformers become magnetized by direct current applied to the windings during resistance measurement. Magnetized power transformers may easily saturate and draw an extra large inrush current upon energization. Since the forces on the windings due to inrush current may be large enough to shift the windings, it is desirable to avoid these currents. Demagnetizing transformers will reduce the chances of a large inrush current upon energization.

DEMAGNETIZING OF TRANSFORMERS

Transformers may be demagnetized by means of ac which is gradually increased until the knee-point of the iron is reached or exceeded, and then reducing the voltage slowly to zero. An alternative is to use direct current and a fluxmeter. In this method, the direct current is applied for a long enough period that resets the flux to zero according to the reading of the fluxmeter.

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Another method which is employed in the demagnetizer to be described, uses a square wave voltage that is generated by means of a reversible dc supply. This method is similar to the ac method. This square wave output, however, is not reduced in amplitude, but increased in frequency. The result is that the flux in the core is reduced every cycle, until zero flux is reached.

The advantage of the reversible dc supply demagnetizer is that it requires relatively little power as compared to the ac method, and that the voltages used are low and therefore safe. The demagnetizing process is automatic and does not require operator's attention. The disadvantage of the method is that it may require a longer time to complete, especially when demagnetizing transformers that have a high-voltage rating. It takes approximately one minute to demagnetize a CT rated at 2.5 L 800.

CIRCUIT DESCRIPTION

The diagram of the demagnetizer is shown in the attached schematic drawing. It functions in the following manner.

At the start C1 is charged through S1 to a voltage approximately +0.7 V. This voltage resets the contact of the latching relay A to the open position by means of amplifier Q4, thus unshorting the output of amplifier Q3. The same voltage is also inverted and appears as -0.7 V at the output of Q2. Since the gate of Q9 is biased to the positive supply it is first to conduct resulting in a positive output.

The output remains positive until sufficient current flows in the output so that a voltage larger than +0.7 V appears across diode D1. At this point, output of Q3 switches from (+) to (-) turning off Q9 and turning on Q10. Now the negative output persists until a current large enough to cause a -0.7 V to appear across D2 is reached. The output is again reversed.

As the reversing process continues, C1 is slowly discharged through C2, thereby reducing the amplitude of the switching current. This process continues until the voltage across C1 is reduced to approximately 0.5 V, which indicates an output current less than 100 μA. At this level, the output of Q4 closes the latching relay, A, and shorts out the output.

During the demagnetizing process, a "Running" indicator is illuminated, as well as an appropriate "Direct" or "Reverse" output indicator. When the demagnetizing process has been completed, a "Finish" light comes on.

DISCUSSION

The prototype transformer demagnetizer described in this report has been found useful for demagnetizing current transformers of ratios from 5-to-5 to 32 000-to-5 A, as well as potential transformers up to 27.6 kV. The output of the prototype is limited to a current of about 0.2 A. This current level is adequate for demagnetizing CTs and small potential transformers. To adequately demagnetize large potential and power transformers, the output current capability would have to be increased to 5 or 10 A by using a larger power supply and larger output switching transistors.

CONCLUSIONS

The prototype demagnetizer is useful for demagnetizing CTs and small transformers. To demagnetize large transformers, the power capability of the demagnetizer has to be increased.

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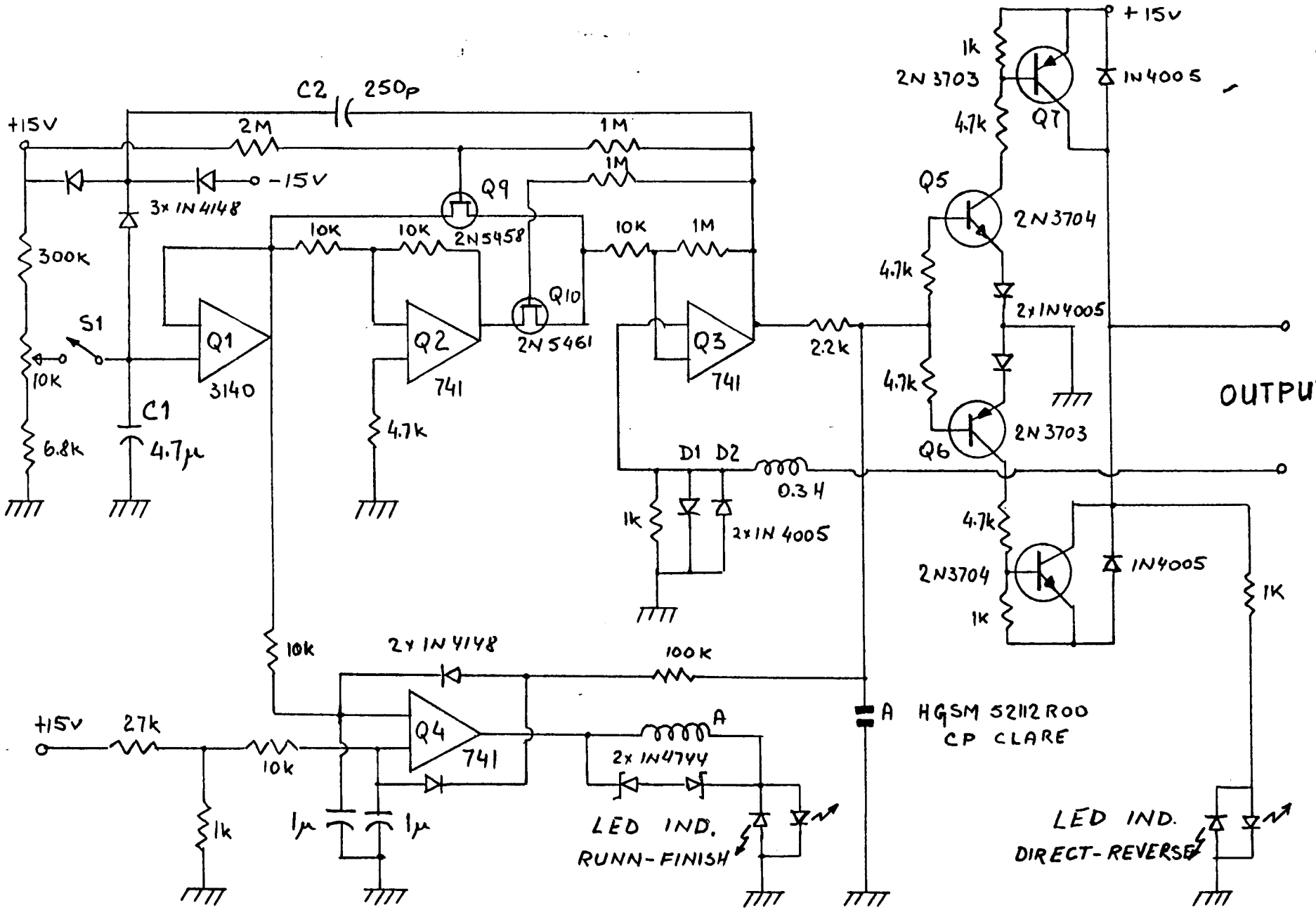

TRANSFORMER DEMAGNETIZER

Schematic Diagram