6 volt supply is required, whereas that suggested would require approximately a 300 volt supply and, as the normal method of energizing such a circuit is by means of electrical accumulators, clearly the authors' method represents a considerable saving.

The authors also agree with Mr. Charlton that a more direct method of measuring the strains is an advantage, and have found that for quite a large range of strains the galvanometer reading can be calibrated in terms of strain.

The fact that the drift on each gauge is almost the same cannot be readily explained, but the authors have found that this is purely a phenomenon of the gauges themselves, as standard resistance boxes have been connected into the circuit in place of the gauges without any drift taking place. It was also found that by using this method of compensation in connection with the testing of steel specimens, at low stresses, little or no variation due to drift was found in the measured stress-strain relationship.

Finally the authors have used electrical resistance gauges on steel reinforcement cast in concrete and have found this an invaluable aid for the analysis of reinforced concrete beams.

Shear tests on reinforced concrete beams

Contribution from Mr. A. J. Ashdown,

A.M.I.Struct.E., *of Imperial College, London*

Regarding Dr. A. Sunderland's article* on the strength of reinforced concrete beams in shear I was particularly interested in the attempts to measure the stirrup stresses. In a large beam tested here last year, primarily to study the plastic distribution of concrete stress at ultimate load, a few electrical resistance strain gauges were attached to bars bent up at 45° and at 35° to the horizontal and at the centre of their lengths, immediately above the neutral axis, as measured at the centre of the beam.

The strain gauge on the 45° bar indicated compression increasing with the load, and upon the release of loading a further compression was noted. This compression reduced to its original compression upon the application of the same load, and increased with further loading. Increase of compression was again noted upon release, until at 65 per cent. of the ultimate load the stress quite quickly changed to tension which finally did not exceed 6,750 lb. per square inch.

The 35° bar behaved in the same way. The change over to tension occurred at 80 per cent. of the ultimate load. The maximum tension was 2,550 lb. per square inch.

A strain gauge attached to a stirrup at half its length, and which was inclined at 67½° to the horizontal, indicated compression strain throughout the test reaching a maximum stress of 4,180 lb. per square inch.

It should be noted that the beam failed in compression as intended. The beam was 7·875 inches wide and 16·75 inches effective depth, and 16 feet span, loaded at points of one third. 1 inch diameter bars were bent up in pairs in the condition known as double shear. The failing load was 13·5 tons at each point.

I note also the employment of square twisted loops as stirrups in Dr. Sunderland's tests. When a square twisted bar is tested in air, by calculation it can be shown that the stress is compounded of tension and torsion, the latter amounting to 37 per cent. of the former. In a small beam reinforced with a square twisted bar, and which was tested to destruction, the bar fractured at a stress which was 37 per cent. greater than the air test, showing that the bar was completely restrained by the concrete from twisting.

* *Magazine of Concrete Research*, January 1949, pp. 3-8.