

XIV. SENSORY REPLACEMENT

Dr. C. M. Witcher
L. Washington, Jr.

A. OPTICAL PROBE

The optical probe, described in the Quarterly Progress Reports of July 15, 1953, and July 15, 1955, has been further improved by the substitution of a transistorized multivibrator circuit for the neon lamp relaxation oscillator previously used. The circuit was developed by Carl R. Hurtig, of this Laboratory. Its description, together with some additional information concerning the new probe, is given in Section X. Note that substantial reduction in size was achieved and that the three 30-volt hearing aid B-batteries were replaced by a single 1.5-volt pen-light cell.

The American Foundation for the Blind, New York, N. Y., has appropriated funds for the production of 50 models of the probe for distribution to interested blind people on a loan basis. These units are being produced by Dunn Engineering Associates, Cambridge, Massachusetts.

B. TRAVEL AID OPTICAL SYSTEM

The calculations carried out by the optics design group at Boston University (Quarterly Progress Report of Jan. 15, 1956) did not lead to a system capable of meeting the requirements previously given. A new attempt to design a suitable system is now under way at the American Optical Company, Southbridge, Massachusetts.

C. VOCATAC

The device for converting speech sounds into tactile patterns, the Vocatac, was described in the Quarterly Progress Report of Jan. 15, 1956. On completion of the instrument, it was found that the tactile patterns produced were unsatisfactory in two respects: they were not at all consistent – being strongly dependent on voice level at the microphone; and they often failed to provide any indication of consonant sounds or of the shorter transition elements of speech.

In order to obtain complete consistency, we would apparently need an automatic volume control (avc) circuit whose performance was "ideal," in the sense that it would provide a perfectly constant output level for a wide range of input levels while operating with absolutely no time delay. This being impossible, an alternative procedure had to be found. J. C. R. Licklider and I. Pollack have shown (1) that infinite clipping of speech has very little effect on its intelligibility. It therefore appeared that a satisfactory substitute for the "ideal" avc circuit might be the subjection of speech to a considerable amount of clipping. Accordingly, the input section of the instrument was completely redesigned; its circuit schematic is shown in Fig. XIV-1. Note the two sets of diodes used to provide clipping, one at the output of the microphone transformer and

*This work was supported in part by Purchase Order DDL-B158. (See the Introduction.)

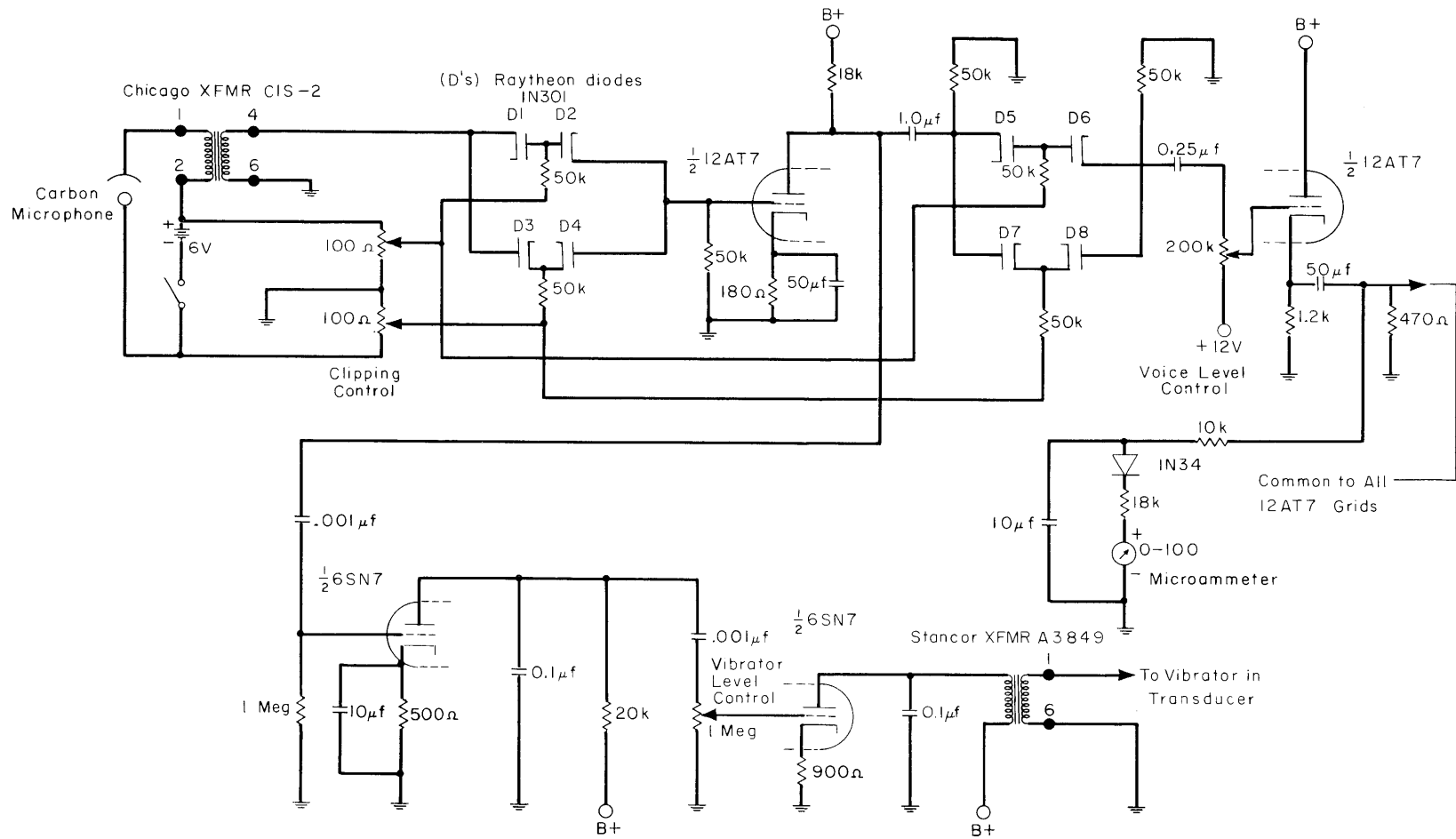


Fig. XIV-1. Redesigned input section of the Vocatac.

(XIV. SENSORY REPLACEMENT)

the other between the amplifier section and the cathode follower section of the 12AT7. These diode arrangements are similar to those employed by Licklider and Pollack (1). The total amount of clipping thus obtained is 43-55 db, depending on input voice level. It would seem that not much more clipping than this could be tolerated, since the consequent required increase in gain would bring the noise up to the point at which it might begin to actuate the output transducer. (Note that for the clipping figures just given, the ganged potentiometers r_2 and r_3 constituting the clipping control are set to give a reading of 0.5 volt rms at the output sides of the diode clippers.) This circuit has provided some improvement in pattern consistency, but much more is to be desired.

One cause of the second defect in the tactile patterns is the insufficient speed of operation of the transducer. Another may be the charging time of the output filters. In the present transducer each solenoid plunger, together with its associated push rod and coupling rod, represents a relatively large mass. Therefore, a new transducer is being constructed in which the solenoids are replaced by small relays with much less massive armatures. The tactile patterns are produced by steel balls, $3/32$ inch in diameter, that are brought up against the finger tip by pressure of the relay armatures. The output circuits are being replaced by Schmidt trigger circuits (2). This type of trigger circuit would seem to be ideal for the present application, since it can be turned on and off by a very small variation in the dc potential applied to the grid of one of the triodes. The use of these circuits should also yield a further improvement in pattern consistency.

References

1. J. C. R. Licklider and I. Pollack, J. Acoust. Soc. Am. 20, 42-51 (Jan. 1948).
2. O. S. Puckle, Time Bases (John Wiley and Sons, Inc., New York, 1951), pp. 81-83.