is operative between offices whose instruments are adjusted and inoperative to those whose instruments are not adjusted or otherwise locally affected.

Now, from what has been stated, it is evident that we have here a system calculated to afford the highest possible degree of efficiency and one that utilizes the capacity of the line wire to the fullest extent.

Of 13 circuits theoretically obtainable in a wire 300 miles long, we can count upon at least 9 for signalling purposes; we might do more than that, but recollecting that the number depends upon the length of the surface traversed by the line brush per second, the space equivalent to 4 circuit plates is only a liberal allowance to make for the synchronous circuit plate, the earth plate, and its minor segments and the insulation wedges. All these may be taken together and set down as *mechanical intervention*, and therefore a constant quantity; and in any calculation we make for a given line, we may subtract the equivalent of 4 circuits from the theoretical in order to determine its practical capacity. Thus, in accordance with the law of proportions elsewhere dealt with in this paper, we should obtain on an ordinary line 150 miles long, as + many as ($\frac{300}{150}$ × 13 = 26, — 4 =) 22 signalling circuits. It now only remains to be seen whether this can be realized in practice.

(REFERENCE SHEET 35.)

Note.—It is not stated so, literally, but it is in effect: It is stated on p. 397, that "The rapidity with which successive signals can be transmitted depends essentially upon the time required to charge and discharge the line." This time, it is shown on p. 393, is on a No. 8 iron wire 300 miles long, about ·018 sec., and on an equal length of No. 6 gauge (·20 in diameter), the time required is about ·013 sec.

It is stated on p. 395, that the time required to produce an effect on the No. 8 wire was found to be with a Hughes electro-magnet ·003 sec.: and ·01 sec. is set down for an unpolarized electro-magnet of the ordinary form.

It further appears, on p. 395, that on a given line with one class of apparatus, the time required to produce an effect is "nearly in proportion to the length of the line;" and with the other class of apparatus the time required "increases in a much greater proportion than the length of the line." These statements have reference to lines of 300 miles and over, and it is therefore very safe to assume that for lines under 300 miles the time is at the most directly proportional to the length.

The obvious interpretation of all this is, that the time required to charge a line is the index of its signalling capacity. If we know the rate of charge of any two wires and the signalling capacity of one of them, we can, by a simple sum in proportion, determine the signalling capacity of the other.

According to these figures and statements then the time required to produce an effect on an unpolarized magnet on the 300 mile No. 6 line is ·0072 sec.; the proportion being ·018 : ·013 : : ·01 : ·0072. And the time required on a 100 mile length of the same line is ·0024 sec.; the proportion being ·300 : ·100 : : ·0072 : ·0024.

The result is practically the same as that arrived at by the other calculation. Besides, that interpretation of the text is supported by the statement, *Prescott*, Vol. II, p. 1110, that "the speed (having reference to the synchronous multiplex) is inversely proportional to the length and directly as the size of the conducting wire."