

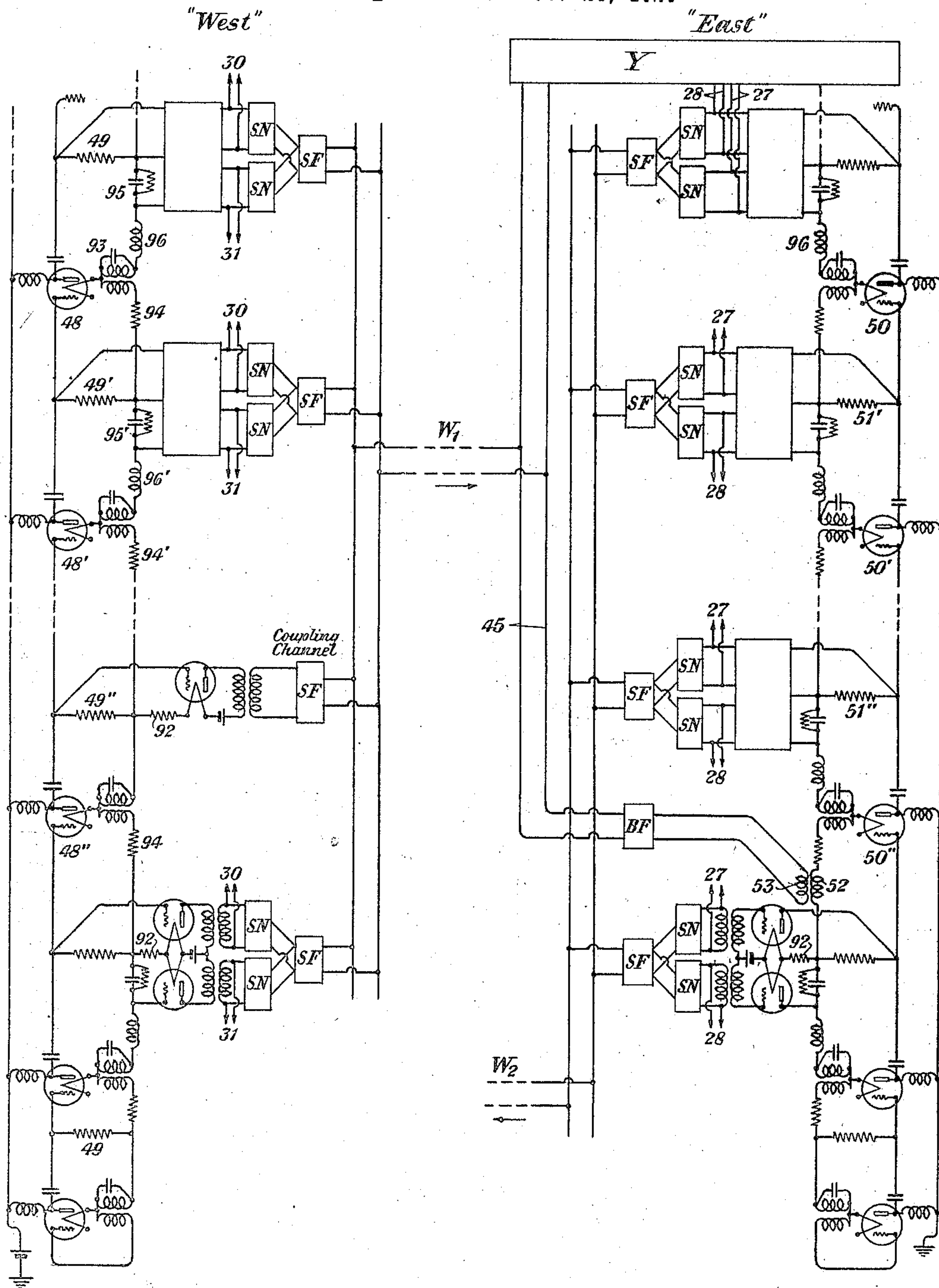
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SYSTEM OF SYNCHRONIZING SIGNALING APPARATUS

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SYSTEM OF SYNCHRONIZING SIGNALING APPARATUS.

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An object of my invention is to provide a new and improved system of synchronizing apparatus at points between which an electrical transmission is effected. Another object of my invention is to provide for proper synchronous relation of the currents in the various parts of an electric signaling system. Another object is to provide for synchronizing by currents of suitable frequency, more particularly to synchronize relatively low frequency apparatus by transmission of higher frequency currents. Still another object is to govern the frequency of a vacuum tube oscillator by impressing a current of harmonic frequency thereon. These and various other objects of my invention will become apparent on consideration of an embodiment of the invention which I have chosen for illustration and which I now present by way of example in the following specification taken with the accompanying drawing. It will be understood that the invention is defined in the appended claims and that the following description relates more particularly to the example shown in the drawing.

The drawing is a diagram of a two-way signaling system in which my invention may be practiced advantageously. For convenience the apparatus at the two ends of this system are designated, respectively, as "west" and "east".

At station "west" a plurality of vacuum tube oscillators such as 48, 48' and 48'' are coupled successively through the resistances such as 49' and 49''. These oscillators are adjusted as nearly as practicable so that the natural frequency of one of them is a certain comparatively low frequency fundamental, and the others are harmonics thereof. By virtue of the couplings through the resistances such as 49' and 49'' the battery of oscillators are forced so that they operate precisely at the harmonic frequencies just mentioned and which would be realized only approximately if the oscillators had no connection with one another.

The various voltages from the various oscillators are taken off across the resistances such as 49, 49' and 49'' and the condensers 95, etc. These are respectively in quarter phase relation, and each pair of quarter phase voltages are impressed upon the grids of two push-pull vacuum tubes which, pre-

senting a substantially infinite impedance to these voltages, draw no current and, therefore, do not disturb the phase relation. The output currents of these respective phases are led to sending networks through separate independent transformers where they are modulated in the manner described earlier, and then transmitted through sending filters which are common to both phases and thence superposed in the common line W_1 . The output currents in quarter phase relation are also available over branch circuits 30 and 31 as a supply for reception of the incoming signals received over line W_2 . Inductances 96, etc., each in series with a resistance and a condenser 95 above referred to, are adjusted to neutralize the negative reactance of the plate filament circuit. The resistances such as 92, 94 are very large. They serve to maintain a high voltage across the oscillating circuits such as 93.

One harmonic voltage, as from the oscillator 48'', is taken off across the resistance 49'', and after passing through the filter SF is put on the line without having any message signals impressed thereon.

At the station "east" this last mentioned particular harmonic frequency goes over the conductor pair 45 through an appropriate band filter BF to the transformer primary 53.

The battery of oscillators such as 50, 50' and 50'' are adjusted as nearly as practicable to have the same natural frequencies as the respective oscillators at the station "west" such as 48, 48' and 48''. One of these oscillators 50'' is adjusted to have as nearly as practicable the same frequency as the oscillator 48'' from which the pilot frequency for synchronizing purposes was drawn. The input circuit of the oscillator 50'' comprises a coil 52 which is made the secondary to the primary winding 53 already mentioned. Thus the synchronizing frequency transmitted over the line W_1 is applied to the oscillator 50'' and forces it to operate precisely at that frequency. Then by virtue of the resistance couplings between successive oscillators such as 51' and 51'' the whole battery of oscillators at station "east" is forced to operate at the same respective frequencies as for the oscillators at station "west".

The output circuits from the respective oscillators 50, 50', etc., go through filters and

sending networks for transmitting over the line W_2 , and also by branch circuits such as 27 and 28 these frequencies go to the apparatus Y where they are employed for reception.

This application is a division of my application Serial No. 11,801, filed February 26, 1925, and renewed on or shortly before the date of filing the present application.

I claim:

1. The method of producing a plurality of alternating currents in harmonic relation to one another, which consists in generating them respectively in vacuum tube oscillators adjusted approximately to the respective harmonic frequencies and coupling these oscillators together whereby they are forced to operate at the precise harmonic relations.

2. In combination, a plurality of vacuum tube oscillators adjusted approximately to respective frequencies harmonic to a certain fundamental, and means coupling these oscillators whereby they are forced to operate at precisely the harmonic frequencies to which they are approximately adjusted.

3. The method of signaling which comprises generating at the sending end a plurality of harmonically related currents in oscillators coupled so as to force them to operate in exact harmonic relation, signaling on these respective currents and transmitting

them to the receiving end, applying one of the received harmonic currents to a corresponding oscillator of a system of oscillators corresponding to those at the sending end and thereby generating at the receiving end a set of corresponding currents to be utilized for detecting the received signals.

4. In a signaling system, a plurality of vacuum tube oscillators at the sending end tuned approximately to frequencies in harmonic relation, a similar set of oscillators at the receiving end, means coupling the oscillators at each end to force them to operate in precise harmonic relation, and means to transmit the current of one oscillator from the sending end and apply it to the corresponding oscillator at the receiving end whereby these oscillators will operate in exact synchronism and all the others will be brought in synchronism, each to each, at the receiving and sending ends.

5. The method of forcing a plurality of vacuum tube oscillators to operate in precise harmonic relation to a certain fundamental, which consists in tuning them approximately to that relation and coupling them so as to force them into that relation.

In testimony whereof, I have signed my name to this specification this 19th day of May, 1927.

ANDREW L. MATTE.