

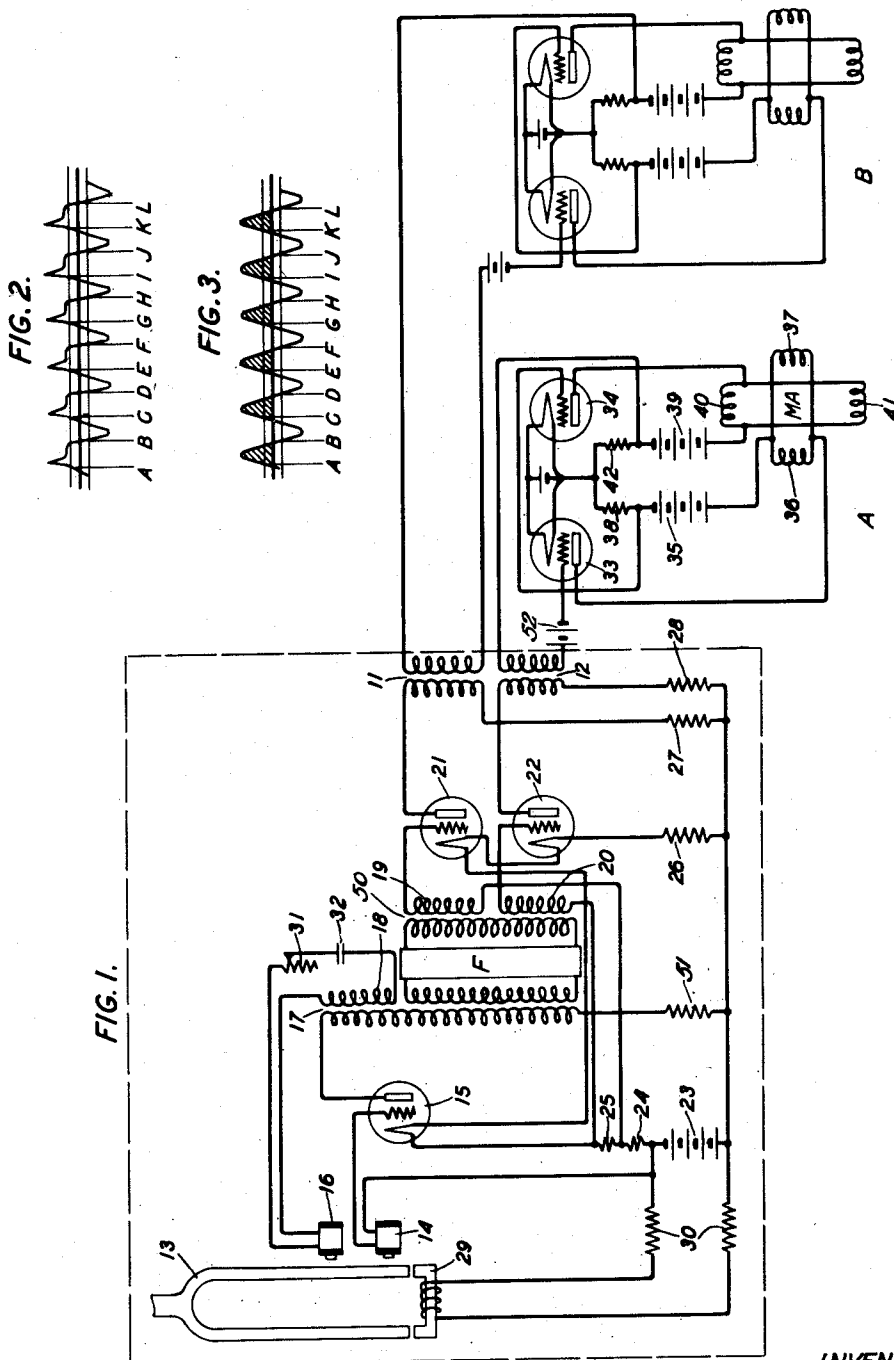
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SYNCHRONOUS SIGNALING SYSTEM

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SYNCHRONOUS SIGNALING SYSTEM

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This invention relates to synchronous impulse transmission systems and more particularly to constant speed driving devices for signaling systems.

- 5 An object of the invention is to increase the reliability and efficiency and reduce the maintenance expense of constant speed devices that are employed in synchronous driving systems.
- 10 In high speed synchronous communication systems vacuum tube regenerative tuning forks are sometimes used as sources of constant frequency waves. These waves are applied to a polar relay through a vacuum tube
- 15 oscillatory circuit which maintains both the tuning fork and the relay armature in constant vibration at the one frequency. The relay armature vibrates in synchronism with the tuning fork and applies at its contacts
- 20 positive and negative current alternately to the primary winding of a transformer, the secondary of which is connected to the armature of a synchronous motor. Considerable difficulty has been encountered in maintaining the relay in proper adjustment at high
- 25 speeds. Furthermore, in normal operation vacuum tube oscillators of the type employed produce a distorted wave due to the presence of even order harmonics and the effect of such
- 30 a distorted wave on the relay is to cause it to remain in one position longer than in the other which results in feeding an unbalanced current to the transformer. This unbalanced current may be resolved into a desired alternating current component and an undesired
- 35 direct current component which reduces the effective permeability of the transformer core material and causes the transformer to draw an excessive magnetizing current from the relay. This heavy current burns the relay
- 40 contacts which as a result require frequent attention.

- According to the present invention, the relay and its output transformer are eliminated
- 45 by inductively connecting to the oscillatory circuit a second vacuum tube circuit wherein two vacuum tubes of considerable power capacity are operated successively in response to a half cycle of current received from the
- 50 oscillatory circuit, each tube having its out-

put circuit connected through the windings of a pair of magnets on an alternating current motor. The grid of the first operated tube is negatively biased so that the tube acts as a rectifier, and therefore while the second tube is operating, the next succeeding impulse which will be of the opposite polarity, blocks the space current in the first tube and no current flows in the output circuits of either tube. In this way the tubes are responsive to alternate half cycles of current which are of one polarity and the successive operation of the tubes energizes the motor magnets successively to maintain the speed of the motor at the frequency of the waves produced by the tuning fork.

Other objects and features will be found in the following description and appended claims when taken in conjunction with the following drawing:

Fig. 1 illustrates a fork controlled vacuum tube oscillator operated into a thermionic rectifying device wherein only alternate half cycles of an alternating current each generate a pair of direct current impulses for maintaining a synchronous motor at a constant speed, and;

Figs. 2 and 3 show curves representing the output wave of the oscillator circuit with and without distortion.

Referring to Fig. 1 the apparatus within the broken line rectangle represents a complete fork controlled vacuum tube oscillator adapted to supply alternating currents of a constant frequency to two independent circuits through two output transformers 11 and 12. Each of the two independent circuits comprise two power vacuum tubes so arranged that they operate successively in response to a half cycle of current received from oscillatory circuits. The successive operation of the tubes serves to successively energize the windings of a LaCour motor.

The oscillator circuit proper comprises a tuning fork 13, pick-up coil 14 feeding into a vacuum tube 15 and driving coil 16, which is coupled to the output circuit of vacuum tube 15 through transformer 17. Part of the energy from vacuum tube 15 is thereby transmitted through the winding 18 of transform-

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er 17. The other part is divided equally through filter F between the windings 19 and 20 of transformer 50 and transmitted to the amplifying tubes 21 and 22 and thence to the
 5 output transformers 11 and 12. The oscillator is adapted to draw energy for both the filament and plate circuits of the vacuum tubes from a single source 23. Resistances 24, 25 and 26 are connected in series with the
 10 filaments of the tubes to reduce the voltage to the proper value. The filaments of all the tubes in the oscillator are connected in series and the proper grid biasing voltage for each tube is obtained by connecting its grid return
 15 lead to such a point in the filament circuit as to utilize the voltage drops in the resistances 24 and 25 and the filaments of some of the other tubes.

The resistances 51, 27 and 28 reduce the
 20 voltage of power source 23 to the proper values for application to the plates of the several tubes of the oscillator and also serve as protection devices to limit the current flow in case of a short circuit.

25 Electromagnet 29 mounted at the end of fork 13 and energized through resistances 30 from source 23, is to compensate for the effect on the fork frequency of variations in the voltage of the power supply. Thus if the
 30 voltage of source 23 should increase, it would increase the space current of tubes 15 and deliver more power to the coil or polarized electromagnet 16, which would tend to increase the magnitude of vibration of the fork.
 35 The increase in voltage of source 23 would, however, also increase the magnetic attraction of electromagnet 29 and the fork tines. This has the effect of increasing the tension in the fork tines and also of increasing the work
 40 done by the tines in cutting through the magnetic field of the electromagnet. Both effects tend to reduce the amplitude of vibration and compensate for the stronger driving impulses from magnet 16.

45 It is to be understood that an increase in the amplitude of vibration reduces the frequency, and vice versa. For this reason variable resistance 31 is inserted in the drive magnet circuit to make fine adjustments in frequency
 50 by varying the amplitude.

In operation, the motion of the steel fork tines changes the flux in the polarized pick-up coil 14, which has a permanent magnet core, and develops an electromotive force corresponding in frequency to the frequency of
 55 vibration of the fork. This electromotive force is applied to the grid of oscillator tube 15 and the amplified energy from the output of the tube is fed back through the secondary winding 18 of transformer 17, condenser 32 and variable resistance 31 to drive magnet 16, which also is permanently polarized by
 60 suitable means. When the spaces between the pick-up and drive magnet, and the fork tines, are adjusted for stable operation, it is found

that the amplitude of vibration is limited by the oscillator tube 15 which overloads and acts to limit the amount of power applied to transformer 17 and the drive magnet 16. The
 70 wave supplied by tube 15, when the tube is overloaded, is badly distorted, due to the presence chiefly of even harmonics, and may have a form like that of the curve in Fig. 2. By inserting filter F in the output circuit of
 75 oscillator tube 15 the distorted wave of Fig. 2 is changed to the undistorted wave form shown in Fig. 3. This feature is described in detail in U. S. Patent 1,809,832 granted to A. M. Curtis on June 16, 1931.

The energy of the undistorted wave is divided equally between the windings 19 and 20 wherein one half of the energy is impressed
 80 on amplifier tube 21 and the other half is impressed on amplifier tube 22 to operate through the transformers 11 and 12 respectively two independent devices A and B. It is understood, of course, that more than two such devices may be employed by providing
 85 additional windings in the output circuit of filter F.

The undistorted wave received in transformer 12 is impressed on the grid of tube
 90 33 of a pair of power vacuum tubes 33 and 34 of device A. The grid of tube 33 is negatively biased by battery 52 so that the normal space current in the tube is reduced to a negligible
 95 value and the tube when subjected to an input of alternating current voltage, acts as a rectifier wherein the negative half cycles of input voltage are blocked. In this manner tube
 100 33 is made responsive to the positive half cycles only of the wave shown in Fig. 3. The plate current produced in tube 33 in response to the positive half cycles of the input voltage, flows from the positive pole of battery
 105 35, through the windings 36 and 37, in parallel, of LaCour motor M_A , the plate and filament of tube 33, resistance 38, and back to the negative pole of battery 35. The plate current of tube 33 produces across resistance
 110 38 a voltage drop which causes the filament of tube 34 to become positive with respect to the grid of tube 34 so that the normal space current in tube 34 is blocked during the time
 115 that current produced by the positive half cycles of the undistorted wave, is flowing in the plate circuit of tube 33. The plate circuit of tube 34 extends from the positive pole of battery 39, through the windings 40 and 41,
 120 in parallel, of the LaCour motor M_A , the plate and filament of tube 34, resistance 42, and back to the negative pole of battery 39. Therefore in the interval when the plate current of tube 33 is flowing through windings
 125 36 and 37, no current is flowing through windings 40 and 41.

When a negative half cycle of the undistorted wave is impressed on the grid of tube
 130 33, the grid becomes more negative with respect to its filament and the input voltage of

the negative half cycle is blocked so that the plate current in tube 33, caused by the previous half cycle, ceases to flow through the windings 36 and 37 and the filament of tube 34 is restored to its normal condition. When the filament of tube 34 is in its normal condition the normal space current in the tube causes plate current to flow through the windings 40 and 41. The sudden rush of plate current in tube 34 produces across resistance 42 a voltage drop which causes the filament of tube 33 to become more positive with respect to the grid of tube 33 so that this voltage drop aids in blocking the negative half cycles of the undistorted wave. In this manner the positive half cycles only of the undistorted wave are each effective to generate, first, an impulse in the windings 36 and 37, and then, an impulse in the windings 40 and 41, due to the blocking of the normal space currents in the tubes 33 and 34 alternately. Therefore the alternate energization of the two pairs of windings on LaCour motor M_1 by impulses of equal energy provide a driving device of constant speed.

Device B and any additional devices may be operated at constant speed in the same manner.

What is claimed is:

1. A synchronous driving system comprising a source of alternating current waves of a definite frequency and a rotatable magnetic device characterized in this that a plurality of uni-directionally conducting devices interconnect said source and said magnetic device and are respectively arranged to energize a plurality of magnetic fields in said magnetic device to maintain said rotatable device in synchronism with the frequency of said alternating current waves.

2. A synchronous driving system comprising a source of alternating current waves of a certain frequency, a motor and a pair of uni-directionally conducting devices interconnecting said source and said motor, characterized in this that a plurality of magnetic fields of said motor are successively energized by the output of said devices respectively to drive said motor.

3. A synchronous driving system comprising a source of alternating current waves, a circuit connected to said source, a pair of uni-directionally conducting devices in said circuit arranged to operate successively in response to a half cycle of said waves, and a motor responsive to the successive operations of each of said devices.

4. A synchronous driving system, in accordance with claim 3, wherein only one of said uni-directional current devices is a rectifier.

5. A synchronous driving system, in accordance with claim 3, wherein the uni-directionally conducting devices are thermionic discharge tubes.

6. A synchronous driving system, in accordance with claim 3, wherein the source of alternating current waves is a self-sustaining vibrating tuning fork.

7. A synchronous driving system, in accordance with claim 3, further comprising two or more motors respectively responsive to two or more pairs of thermionic discharge devices, said source of alternating current waves being common to the pairs of thermionic discharge devices employed.

8. A synchronous driving system, in accordance with claim 3, wherein the uni-directional conducting devices are connected in a cascade arrangement with a feed-back circuit joining the last with the first device, adapted to utilize the half cycles of positive polarity only of the alternating current waves to maintain the motor in synchronism with the frequency of said waves.

In witness whereof, I hereunto subscribe my name this 19th day of September, 1930.

GEORGE A. LOCKE.