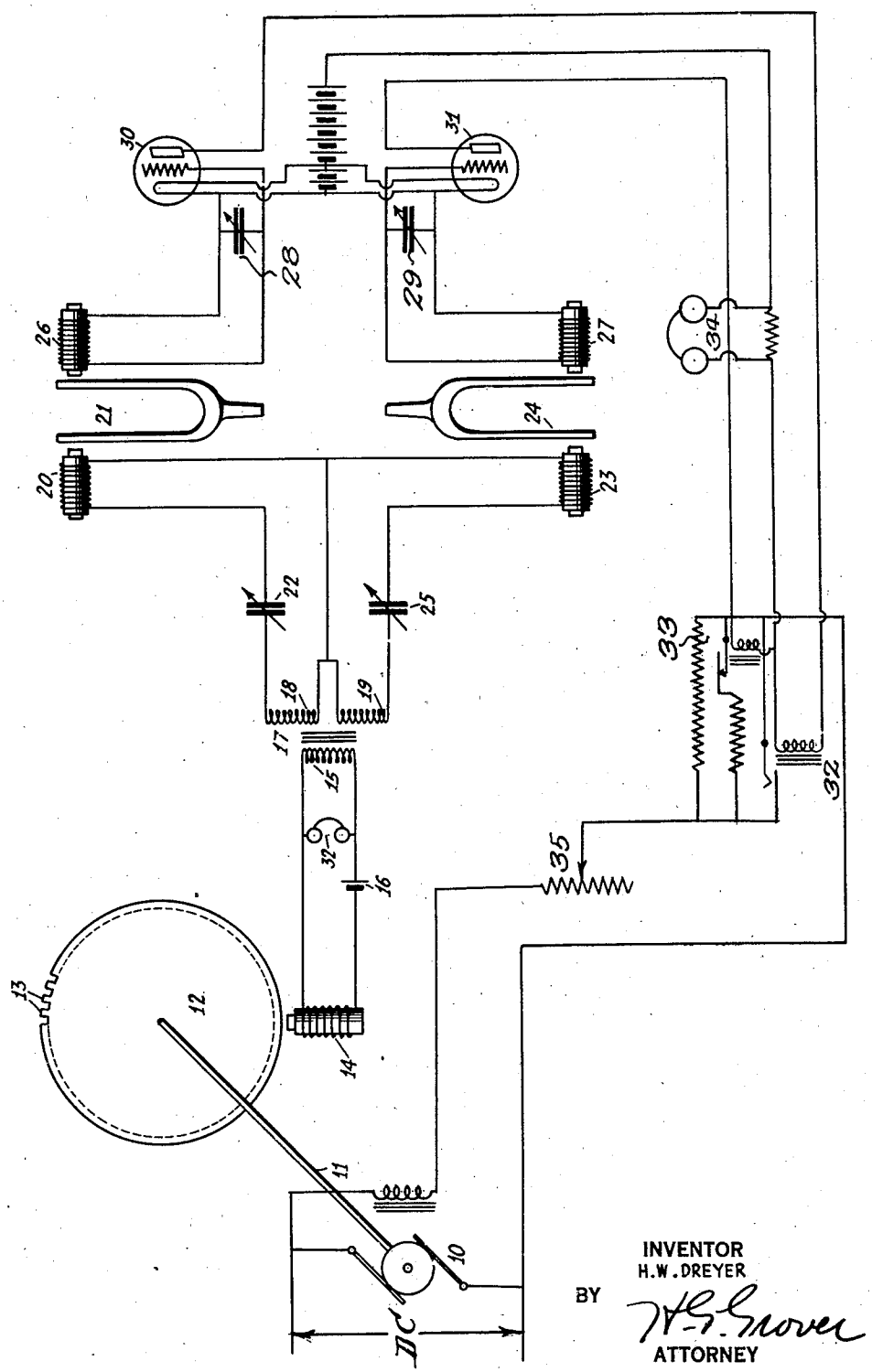
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APPARATUS FOR SPEED CONTROL

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INVENTOR
H.W. DREYER
BY H. W. Grover
ATTORNEY

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HARRY W. DREYER, OF BROOKLYN, NEW YORK, ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE

APPARATUS FOR SPEED CONTROL

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In the recording of sound for use in connection with talking movies, it is necessary that the speed of the recording device be maintained at all times as near as possible to constant speed. Variations in the speed of recording will result in what are termed "wow-wows" or variations in the frequency of a constant tone in the reproduction of the film thus recorded.

It is an object of this invention to control the speed of the recording device.

It is a further object of this invention to prevent the formation of imperfections in the recorded film due to speed variations.

It is a still further object of this invention to automatically control the speed of the motor used in driving a recording device.

It is another object of this invention to provide means for determining when the speed of the recording apparatus is constant.

These and further objects will become apparent from the following specification taken in connection with the appended drawing.

In accomplishing this invention a notched tone wheel of electromagnetic material is attached to the shaft of the recorder the speed of which it is desired to control. An electromagnet placed adjacent to the tone wheel has its electromagnetic path varied at a rate corresponding to the number of notches passing it per second. This produces a current in the winding of the magnet which current is supplied to the driving magnets of two tuning forks one tuned to a frequency slightly above that which is proper to determine the frequency of the recording device and one of which is below the same frequency. The tuning forks upon vibration generate currents of their natural frequencies in an output circuit and the currents thus generated are utilized to increase or decrease the speed of the driving motor in order to correct for the variation in its speed which caused the correcting pulse to be thus generated.

Having thus briefly described my invention, attention is now invited to the drawing in which:

The single figure represents a general layout of the apparatus necessary for accomplishing the objects of my invention.

Referring now more particularly to the drawing, 10 represents a D. C. motor adapted to drive the shaft 11 which is that driving the recording device and also the toothed tone wheel 12 which, in this instance, is shown attached thereto. The tone wheel is notched throughout its periphery having the teeth 13 regularly disposed and so proportioned that at the proper speed of the driving motor, a given number of teeth, say 500, will pass a given point per second. For the production of an alternating current of the 500 cycle frequency, the electromagnet 14 is placed close to the periphery of the tone wheel 12. The electromagnet 14 is connected to the primary 15 of the transformer 17, its circuit including the battery 16. The transformer 17 has the split secondary 18–19, the former section of which is adapted to supply the electromagnet 20 and the latter section of which is adapted to supply the electromagnet 23 with the frequency produced by the electromagnet 14. The circuit of the electromagnet 20 is adapted to be tuned to be resonant to a frequency of, say, 505 cycles by means of the condenser 22. The circuit including the electromagnet 23 is adapted to be tuned to be resonant to a frequency of, say, 495 cycles by means of the condenser 25.

The electromagnet 20 is adapted to drive the tuning fork 21 which is also tuned to vibrate at a frequency of 505 cycles, and upon vibration to excite the electromagnet 26 in the usual and well known manner, at a frequency of 505 cycles. The output of the electromagnet 26 is connected to the grid of the amplifier 30 and is tuned to be resonant to a frequency of 505 cycles by the condenser 28.

Similarly, the tuning fork 24 which is adapted to be actuated by the electromagnet 23 is naturally resonant to a frequency of, say, 495 cycles and upon vibration is adapted to generate a current of that frequency in the winding of electromagnet 27. The electromagnet 27 supplies the amplifier device with the frequency of 495 cycles, the circuit of said electromagnet being tuned to the

proper frequency by means of the condenser 29. The output of the vacuum tube 30 is connected by means of appropriate relay 32, so that upon a flow of plate current the speed of the driving motor 10 will be decreased. Similarly, the output of vacuum tube amplifier 31 is connected to relay 33 so that when a current flows in its output the speed of the motor 10 will be increased. These connections are made in any well known and appropriate manner and they may be arranged as shown to vary the resistance in the shunt field of the motor 10, or to vary a series resistance, or to otherwise control the motor speed by any appropriate means, which specific means comprises no part of the present invention.

For determining when the speed of the recording apparatus is constant, the telephone receivers 32 or other indicating apparatus may be inserted in the circuit of the electromagnet 14, as shown.

Having thus described my invention, I will now describe its operation. The motor 10 drives the recording apparatus and the tone wheel 12 which latter produces an alternating current of a frequency depending upon the motor speed. The frequency thus produced acts upon the tuning forks 21 and 24. Due to the tuning of the input circuits of the tuning forks and to their own natural periodicity, if the frequency generated by the tone wheel 12 is 500 cycles per second, the vibration of these forks will be slight. The two tuning forks will then generate in the circuits of the inductances 26 and 27 a current which is approximately of the same value and thus the amplifier devices 30 and 31 will supply to the relays for varying the speed of the motor an equal current so that the speed of the motor will be neither increased nor decreased. If, however, the speed of the motor drops below that which is required to produce a tone frequency of 500 cycles, the circuit of the tuning fork 24 will be excited by a current of more nearly the proper resonance frequency and the tuning forks will be vibrated by an amount proportional to the amount of the speed variation in the motor 10. This will cause a decrease in the current in the output of the vacuum tube 30 and an increase in the output of the vacuum tube 31 and will serve to supply the proper pulse to increase the speed of the motor 10, thus overcoming its original decrease in speed, which was due to some extraneous cause.

Similarly, if for some reason the speed of the motor 10 is increased, the frequency generated in the circuit of the electromagnet 14 will be increased and the tuning fork 21 will be excited by a greater amount than tuning fork 24, causing an increase in the output of the vacuum tube 30 and a decrease in the output of the vacuum tube 31. This will act to control the speed of the motor to decrease its speed and thus correct for the speed variation which was due to some extraneous cause.

With properly balanced circuits, the speed of the motor may be very accurately controlled and the motion of the film upon which the sound is being recorded can thus be kept very uniform.

It is obvious that the person operating the recording device may be equipped with head-phones 34 or other indicating devices, responsive to the frequency generated in the outputs of the amplifiers 30 and 31, which will, by a preponderance of the high or low frequencies, indicate to him a fluctuation in the motor speed. A manual control 35 may be supplied in addition to the automatic control above outlined. The operator would thus be able to apply large corrective changes, in the case the change in circuits, due to the operation of the relays, were not sufficient to correct for the rise or fall in the line voltage causing the fluctuation in speed.

Similarly, head-phones or other suitable indicating devices may be inserted, as shown, directly in the circuit of the electromagnet 14 which will directly indicate to an operator the constancy of the speed of the motor. This is of particular value in determining when the speed has become steady enough to commence recording.

Having thus described my invention, it is to be understood that I am not to be limited to the specific embodiment shown and described for the purpose of illustration only, but rather by the scope of my invention as set forth in the appended claims.

I claim:

1. Apparatus for controlling the speed of sound recording which comprises, a driving motor for the recording apparatus, a tone wheel adapted to be rotated by said driving motor at a speed proportional to the speed of said recording apparatus, a circuit resonant to a frequency slightly above the normal frequency produced by said last mentioned means, a second circuit resonant to a frequency slightly below the normal frequency produced by said means, a tuning fork tuned to the same frequency as the natural frequency of said first mentioned circuit, means in said first mentioned circuit for driving said tuning fork, a second tuning fork tuned to the same frequency as the natural frequency of said second mentioned circuit, means in said second circuit for driving the second tuning fork, means for producing currents by the vibration of the said tuning forks of the same frequencies as the natural frequencies respectively, amplifier means for amplifying the energies thus produced, and means whereby the current in said amplifiers will serve to control the speed of the driving motor.

2. Apparatus for controlling the speed of sound recording which comprises a driving motor for the recording apparatus, a tone wheel adapted to be rotated by said driving motor at a speed proportional to the speed of the recording apparatus, a tuning fork tuned to a frequency above the normal frequency produced by said tone wheel and adapted to be excited thereby, a second tuning fork tuned to a frequency below the normal frequency produced by said tone wheel and also adapted to be excited thereby, means operated by each of the said tuning forks for producing currents varying in intensity as the amplitude of the vibration of the respective tuning forks, and means whereby the current thus produced will serve to control the speed of the driving motor.

3. Apparatus for controlling the speed of the sound recording which comprises, means for generating a pulsating current the frequency of which is proportional to the frequency of said recording, two tuning forks tuned respectively to a frequency slightly above and slightly below the normal frequency produced by said last mentioned means, and adapted to be operated by the current thus produced, and means whereby the intensity of vibrations of said tuning forks will operate differentially to control the speed of said recording apparatus.

4. Apparatus for controlling the speed of the sound recording which comprises, a tone wheel adapted to be rotated by the recording apparatus at a speed proportional to the speed of said apparatus whereby a frequency proportional to the speed of the said apparatus is produced, mechanical means resonant respectively to frequencies above and below the normal frequency produced by said tone wheel, and means whereby the speed of said recording apparatus is adapted to be controlled in accordance with the intensity of the vibrations of the respective mechanical means, said last mentioned means including two resonant circuits tuned respectively to the frequencies of said mechanical means, and means for causing the current existing in said circuits to differentially control the speed of said motor.

5. The combination of an electrical device, means for generating a pulsating current the frequency of which is proportional to the speed of said device, vibratable means responsive to said generating means and tuned respectively to frequencies slightly above and slightly below the normal value of said frequency, and means for controlling said speed differentially in accordance with said high and low frequencies.

6. The combination of a sound recorder shaft, means for driving said shaft, means including a toothed tone wheel for generating current of a frequency dependent on the speed of said shaft, means controlled by said generating means for producing currents dependent upon departure of said speed from its normal value, and means including separate circuits responsive to said currents for regulating said speed.

7. The combination of an electrical device, means including a tone wheel for generating a pulsating current the frequency of which is proportional to the speed of said device, means responsive to said current and tuned respectively to frequencies slightly above and slightly below the normal value of said frequency, and means for controlling said speed differentially in accordance with said high and low frequencies.

HARRY W. DREYER.