July 10, 1934. J. I. TAYLOR 1,965,913

SOUND REPRODUCING SYSTEM

Filed Oct. 11, 1933 3 Sheets-Sheet 1

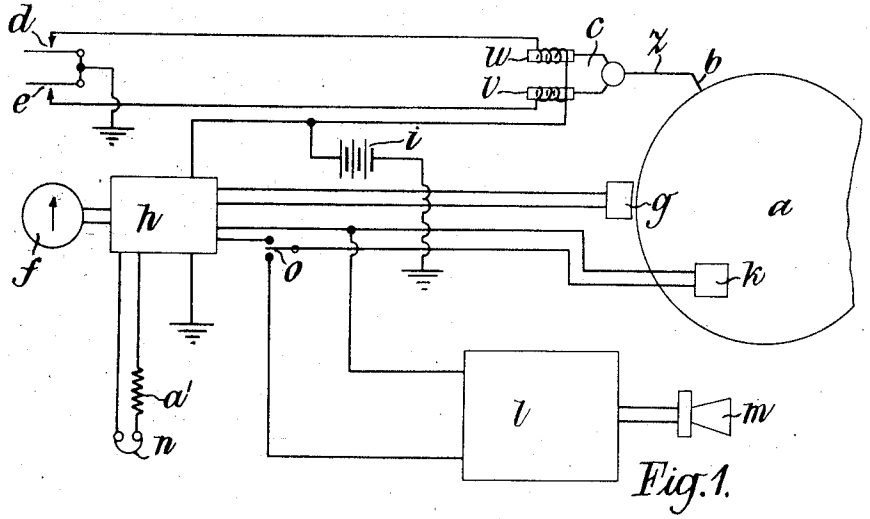


Fig. 1.

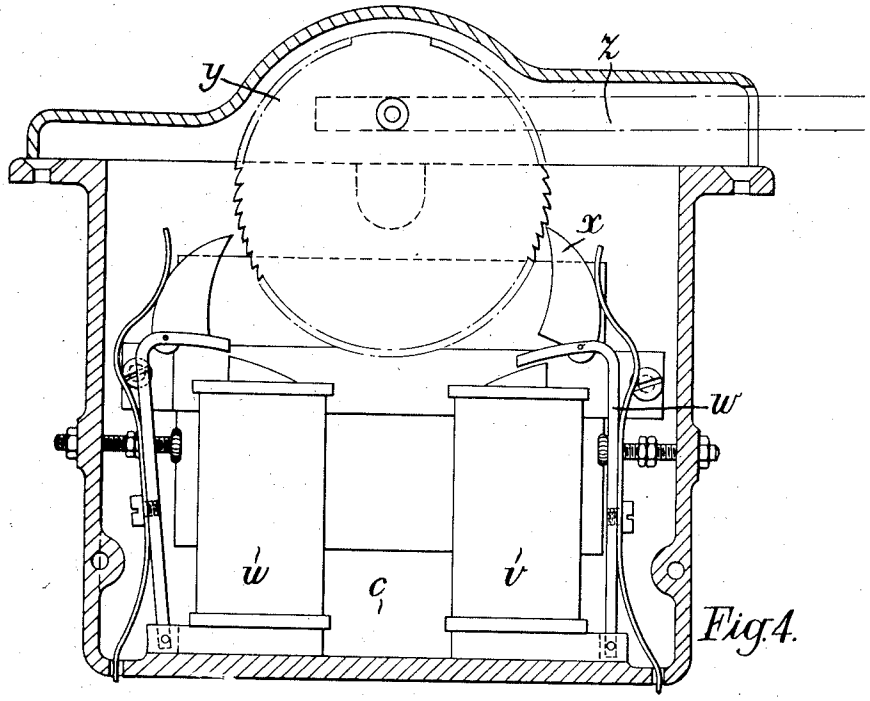


Fig. 4.

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SOUND REPRODUCING SYSTEM

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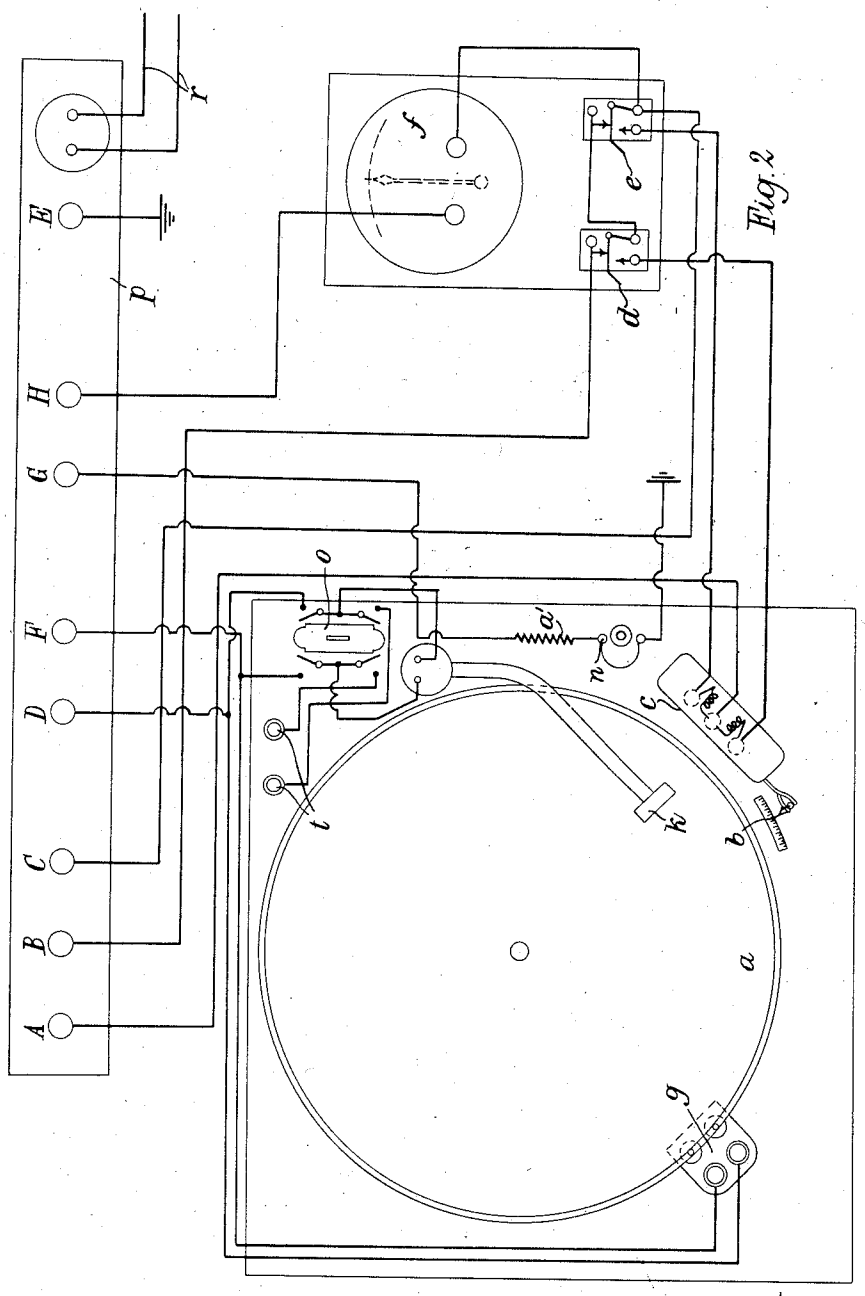


Fig. 2

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SOUND REPRODUCING SYSTEM

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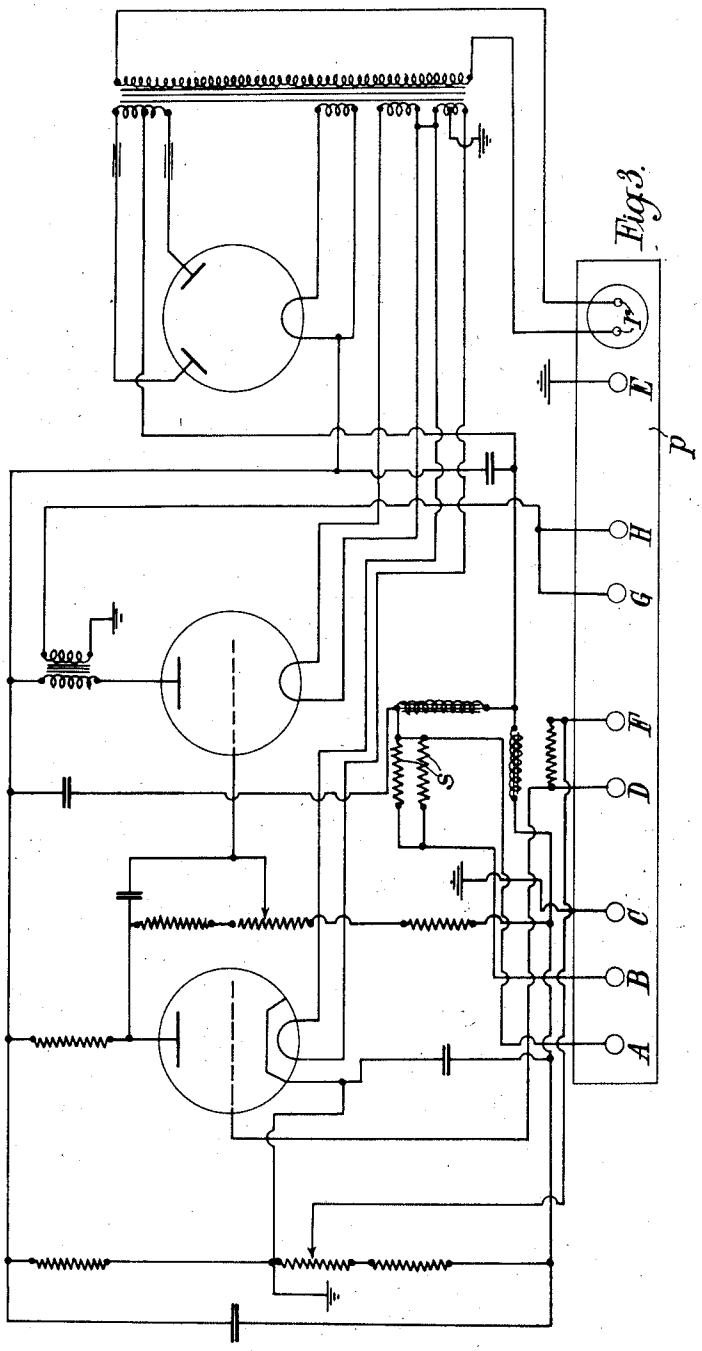


Fig 3.

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Patented July 10, 1934 1,965,913

UNITED STATES PATENT OFFICE

1,965,913

SOUND REPRODUCING SYSTEM

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Application October 11, 1933, Serial No. 693,198
In Great Britain September 22, 1932

8 Claims. (Cl. 179—100.4)

This invention relates to systems for the reproduction of sound and is concerned with the control of apparatus employed for that purpose.

In cinemas and similar places of entertainment it is common practice for the organist to accompany on the organ a song or other music reproduced from a sound record and in these cases it is of course necessary to adjust the speed of reproduction so that the music is in tune with the organ. As normally arranged the sound reproducing unit (e. g. a gramophone turntable) is placed at a position remote from the organ console and also remote from the position of other officials, e. g. an orchestral conductor, who might desire to effect this adjustment, and in these circumstances immediate speed adjustment, when desired, is not possible, and the prior adjustment has to be effected or a system has to be installed whereby signals may be transmitted from the organist to an operator who adjusts the speed manually as directed. Similar difficulties arise in any other system in which it is desired to adjust the speed of sound reproducing device from a distance.

Furthermore in existing systems it is necessary for the organist or other person who has to determine whether or not the speed of the sound reproducing apparatus is correct, to await reproduction of sound from the record before he can decide whether adjustment is or is not necessary. This in many cases results in the opening bars of reproduction being out of tune and mars the effect intended to be produced by the reproduction.

With the object of overcoming these difficulties the invention consists in a sound reproducing system comprising in combination an indicator at a point remote from the sound reproducing apparatus for indicating the rate of rotation or other movement thereof, and means for effecting, from said remote point, control or variation of the rate of rotation or other movement of the sound reproducing apparatus.

The invention further consists in a sound reproducing system as set forth above wherein the indicator obtains its main power supply from a source independent of, but controlled by, the sound reproducing apparatus.

The invention also consists in a sound reproducing system as set forth above comprising means for picking up from said sound reproducing apparatus impulses indicative of the rate of rotation or other movement thereof, and an amplifier adapted to magnify said impulses and feed them to the indicator.

The invention further consists in a sound reproducing system as set forth above wherein the amplifier and the means for controlling the rate of rotation or other movement of the sound reproducing device receive power from a common source.

The various features of the invention will become apparent from the following description of one form which it may assume but it must be understood that this description is given merely by way of example. This description will be more readily understood by reference to the accompanying drawings wherein:—

Figure 1 represents a general schematic arrangement of a sound reproducing system according to the invention;

Figures 2 and 3 represent in the usual symbols more detailed circuit arrangements of parts of the system shown in Figure 1, and

Figure 4 represents an electrically operated control device employed in the invention.

In carrying the invention into effect in one convenient manner and referring more especially to Figure 1, the speed of operation of the sound reproducing device (here represented as a gramophone turntable *a*, the motor of which is provided with a speed adjusting lever *b*) may be adjusted by an electromagnetic device *c* (described more fully below) which is mechanically connected to the lever *b* and is operated, to move the lever in one direction or the other, as desired, by a single two-pole switch or, preferably, as shown, by two switches, *d* and *e*, disposed at the desired control point, such as an organ console, remote from the turntable. In order that the operator may ascertain the speed at which the turntable is running there is also provided at the remote control point, adjacent to the control switches *d* and *e*, a speed indicator *f* of any suitable kind, the operation of which is controlled by impulses generated by teeth or corrugations or by suitable markings on the turntable respectively in an electromagnetic pick-up, or a photo-sensitive pick-up *g*, said impulses being amplified to a value necessary for operation of the indicator *f* by a suitable amplifier *h*. As a matter of simplicity and convenience the power to the amplifier *h* and to the speed adjusting device *c* is preferably provided from a common source *i* which may conveniently be the ordinary mains supply, rectified to direct current or smoothed, if necessary, by suitable means. It will be seen that by employing an amplifier such as *h* fed with its main power supply from an external source independent of the turntable, substantially

no load liable to interfere with the steady running of the turntable is imposed by the pick-up upon the turntable motor.

The sound circuit of the above described sound reproducing system in normal operation comprises a pick-up *k* of any convenient form connected through a main amplifier *l* to one or more loud speakers *m* in the usual manner. In such a sound system, when, for example, operating in association with an organ or other accompaniment, it is frequently desirable to commence reproduction in the loud speakers at a prearranged point of the record not necessarily at the beginning. In order to facilitate this, and in order also to allow the speed of the turntable to be adjusted by aural observation upon the pitch of the reproduced sound (instead of, or in addition to, visual observation on the indicator *f*) during the time sound is not being emitted by the loud speakers, there may be incorporated in the circuit, in accordance with the invention, a monitoring telephone *n*, which may, for example, comprise a single receiver fitted to a headpiece for support upon the organist's or operator's head. A two-way switch *o* may be provided in the sound pick-up leads to allow it to be connected either to the main amplifier and loud speakers or to the monitoring telephone *n*, at the will of the operator or organist. Thus by using the telephone an organist can ascertain when a desired point on the record has been reached and immediately switch over to the main sound system and loud speakers. To amplify the impulses from the sound pick-up passed to the telephone *n* an amplifier, preferably separate from the main amplifier *l*, is employed, and it is convenient for this purpose to use the same amplifier *h* as is used to amplify the impulses passed to the speed indicator *f*. In this arrangement, in order to prevent or reduce interference of the reproduced sounds in the telephone by frequencies produced therein by speed impulses generated in the speed pick-up *g*, there may be included in the telephone circuit a filter network or networks or like arrangement of electrical elements adapted to block the passage to the telephones of low frequencies of the same order as those generated in the speed pick-up *g*, but to pass higher frequencies reproduced from the record. This arrangement may comprise merely a high ohmic resistance *a'* of, say, 400,000 ohms, in series with the telephone.

Details of arrangements according to the invention are shown in Figures 2, 3 and 4. Figure 2 represents the circuit arrangements of the pick-up devices, the control device and indicator, and the telephones, the leads from all of which are connected to plugs A—H which are plugged respectively into sockets represented by the same letters in a contact board *p*, also shown in Figure 3 which represents the circuit of the amplifier *h*. The various elements of the circuits are represented by the usual symbols, and the arrangement will be clear from these figures which are substantially self-explanatory after consideration of the above general description. A point to be noted however is that the control device *c* obtains current from the same supply as the amplifier (which supply is here shown as a rectifier of usual form arranged to rectify current from A. C. mains *r*), and when in operation the coils of the control device *c* replace resistances *s* in the amplifier H. T. circuit. The main amplifier and sound system is connected to terminals *t* (Figure 2) adapted to be connected by switch *o* to the sound pick-up *k*.

A preferred form of speed control device *c* is shown in Figure 4 and comprises two electromagnetics *u*, *v*, each energized by one of the switches *d* and *e*, and adapted to attract a spring controlled armature, such as *w*, on which is pivoted a pawl *x*. Upon operation of a magnet the pawl engages teeth of a pivoted pinion *y*, causing it to rotate through a small angle and thereby to move the lever *z* eccentrically pivoted to it. This lever *z* is attached to and operates the speed adjusting lever *b* of the turntable motor, and the amount of adjustment depends upon the number of times the electromagnet is energized by pressing and releasing the appropriate switch *d* or *e*.

The invention is not however limited to this kind of adjusting device and in another convenient form which may be employed there is attached to the speed control arm of the turntable motor a rod which is free to slide in bearings and is provided with a rack or teeth. In mesh with these teeth is provided a small gear wheel fixed to a shaft supported in bearings. Also fixed to this shaft is a two-pole electromagnet adapted to revolve inside a stator or ring which supports the bearings of the shaft and the rod attached to the speed control arm. The stator is provided with slots on the inside diameter and each half is wound with a continuous winding similar to a "gramme" ring armature. The windings on the stator are arranged to be energized from a battery or other suitable source by means of two switches such as *d* and *e*, and the electromagnet is also energized from a battery or other suitable source.

On energizing one half of the stator winding the electromagnet will revolve 180° in a clockwise direction thereby operating the speed control arm by means of the rod and gearing and causing the motor to increase or decrease in speed. The opposite effect to obtain a decrease or increase of speed respectively is brought about by energizing the other half of the stator winding, and opening the circuit of the former half of the stator winding. The normal position of playing is with the electromagnet position between those two extreme positions.

In order that the operation of the speed control arm shall be smooth and continuous the operating rod in either of the above-described control devices may be provided with an air or oil damped dash pot.

For the purpose of indicating the speed of rotation of the turntable one convenient arrangement comprises the provision on or below the circumference of the turntable of a number of teeth or serrations, e. g. 60, preferably of sine wave form. Mounted close to these teeth but not touching them, may be a small electromagnet (referred to above as the speed pick-up) attached to one pole of a horseshoe magnet, the other pole of which projects underneath the turntable. The turntable may be made of iron or the teeth be cut in an iron ring fixed to the turntable, so that on revolving the turntable a fluctuating or alternating current of extremely small power will be produced in the electromagnetic pick-up having a frequency of 60 cycles for every revolution of the turntable. The normal speed of the turntable is 78 revolutions per minute. The pick-up coil may be connected by plugs D and F to the grid and cathode of the amplifier *h*, the output of which is connected to the frequency meter *f*. This meter may be of any convenient form, e. g. the

vibrating reed type, or the deflectional pointer type, the former taking less power to operate.

Instead of such an electromagnetic pick-up there may be provided upon the edge of the turntable suitable markings such as 60 black and 60 white sections. By means of a lens a narrow beam of light may be projected on to the turntable edge so that it is reflected back on to a photo-electric or selenium cell which is connected to the amplifier in place of the pick-up coil. The black and white sections modify the light to the photo cell as the turntable rotates and cause an alternating potential generated therein to be applied to the amplifier of a frequency 60 times the rate of rotation of the turntable.

It will be clear that since the monitoring telephone *n* operates from the same amplifier as is employed for the speed indicator it is liable to receive low frequencies from the speed pick-up which would interfere with reception of reproduced sound from the record. To avoid this there may be provided any suitable filter circuit or arrangement of electrical elements in the telephone circuit suitable for eliminating or reducing this undesired effect. High quality reproduction in the telephones is not essential, and it is therefore possible to employ simple and inexpensive arrangements. In one convenient arrangement there is connected in series with the earphones a resistance of high value compared with that of the speed indicator, one satisfactory value for ordinary purposes being about 400,000 ohms. It will be clear that this arrangement ensures that the low frequency oscillations from the speed meter have negligible effect upon the earphones which, however, readily detect the high frequency speech and music from the pick-up: while since the earphones and series resistance are of high resistance compared with the indicator the low frequency oscillations operate the indicator without appreciable loss.

Any desired means of connecting the telephones to the sound circuit may be employed and as shown in Figure 2 these comprise a double-pole two-way switch in place of the single-pole two-way switch represented in Figure 1. Alternatively the telephone may be permanently in circuit with the pick-up, but the impulses are transmitted to the main amplifier and loud speaker by a potentiometer connection on which a sliding contact enables complete volume control from zero up to a maximum value on the loud speaker to be effected.

It will be seen that with either of the arrangements described the operator can listen to sound being reproduced from a record and when the desired point on the record is reached switch on the loud speakers (either instantaneously by the first-described arrangement, or with smooth and continuous increase of volume by the second-described arrangement).

In combination with the above-described apparatus there may, if desired, be incorporated any convenient or well known record starting and stopping and/or changing or repeating devices, providing remotely disposed switches (e. g. on the organ console) for operating same, thus enabling the organist to start, stop and change the records in addition to controlling the speed, and in these devices it is desirable that the minimum of power or braking force be applied to the turntable.

It must be moreover understood that the invention is not limited to the constructional details of the forms of the invention described above. Other electro-magnetic or electrostatic devices may be employed for the indicator pick-up and/or other forms of electro-magnetic apparatus for operating the speed regulator, and in general any modifications necessary or desirable to carry the invention into effect under different conditions and requirements which have to be fulfilled may be introduced without in any way departing from the scope of the invention.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. A sound reproducing system comprising in combination sound reproducing apparatus, an indicator at a point remote from said sound reproducing apparatus for indicating the rate of operation thereof, means for picking up from said sound reproducing apparatus impulses indicative of the rate of operation thereof, an amplifier adapted to magnify said impulses and feed them to said indicator, and means for effecting from said remote point adjustment of the rate of operation of said sound reproducing device.

2. A sound reproducing system comprising in combination sound reproducing apparatus, an indicator at a point remote from said sound reproducing apparatus for indicating the rate of operation thereof, means for picking up from said sound reproducing apparatus impulses indicative of the rate of operation thereof, an amplifier adapted to magnify said impulses and feed them to said indicator, means for effecting from said remote point adjustment of the rate of operation of said sound reproducing device, and a source of power common to said amplifier and said adjusting means.

3. A sound reproducing system comprising in combination sound reproducing apparatus, a pick-up sensitive to electromagnetic vibrations, positioned adjacent to a moving part of said sound reproducing apparatus and adapted to receive impulses from irregularities on the surface of said moving part, an indicator for displaying at a remote point the speed of operation of said sound reproducing apparatus, an amplifier adapted to magnify said impulses and feed them to said indicator, and means for effecting from said remote point adjustment of the rate of operation of said sound reproducing device.

4. A sound reproducing system comprising in combination sound reproducing apparatus, an indicator at a point remote from said sound reproducing apparatus for indicating the rate of operation thereof, and means for effecting from said remote point adjustment of the rate of operation of said sound reproducing device, said adjusting means comprising a plurality of electric windings adapted to be energized by manually operated switches, a plurality of armatures operated by said windings, and gearing connecting said armatures to a speed adjusting lever of the said sound reproducing device.

5. A sound reproducing system according to claim 1 comprising a sound pick-up in said sound reproducing apparatus, a monitoring telephone circuit adapted to be connected to said sound pick-up, said monitoring circuit being connected to the amplifier of the speed indicator impulses, whereby the sound pick-up impulses in the monitoring circuit are also amplified.

6. A sound reproducing system according to claim 1 comprising a sound pick-up in said sound reproducing apparatus, a monitoring telephone circuit adapted to be connected to said sound

pick-up, said monitoring circuit being connected to the amplifier of the speed indicator impulses, whereby the sound pick-up impulses in the monitoring circuit are also amplified, and a frequency selective arrangement of electric elements in the monitoring telephone circuit.

7. A sound reproducing system according to claim 1 comprising a sound pick-up in said sound reproducing apparatus, a monitoring telephone circuit adapted to be connected to said sound pick-up, said monitoring circuit being connected to the amplifier of the speed indicator impulses, whereby the sound pick-up impulses in the monitoring circuit are also amplified, and a high resistance in series with the telephone in the monitoring circuit.

8. A sound reproducing system according to claim 1 having a power supply providing the main power for said amplifier, said power supply being independent of but controlled by said sound reproducing apparatus.

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