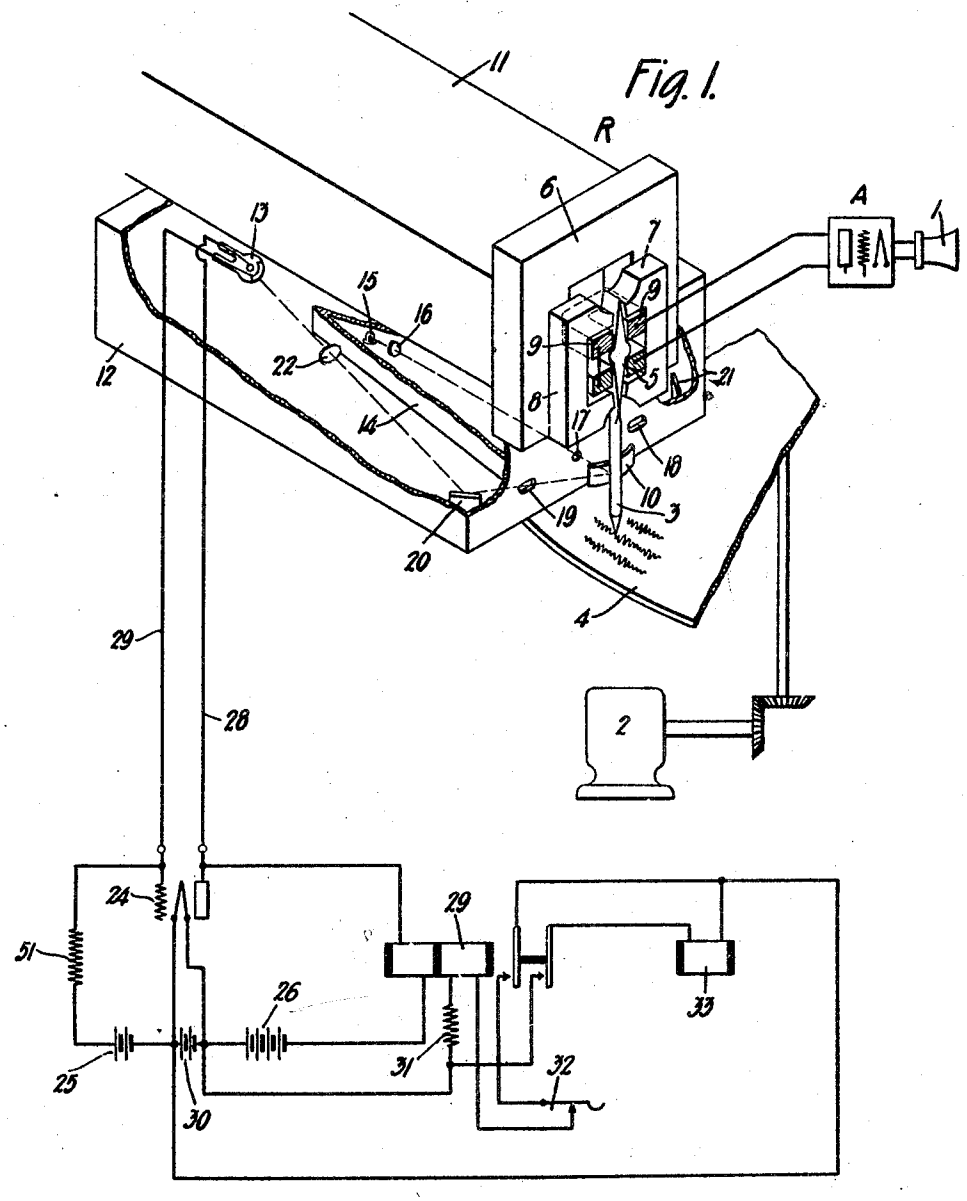
Jan. 10, 1928. 1,655,843

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SIGNAL CONTROLLING APPARATUS

Filed April 1, 1927 2 Sheets-Sheet 1

Fig. 1.



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SIGNAL CONTROLLING APPARATUS

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Fig. 2.

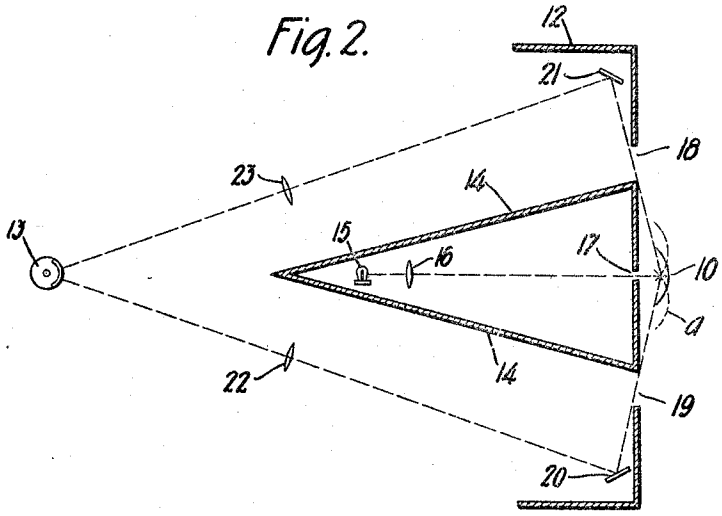


Fig. 3.

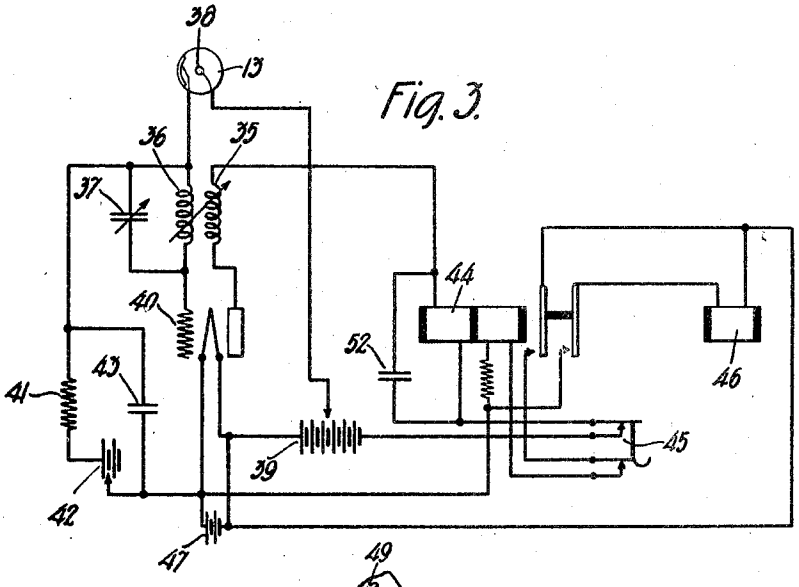
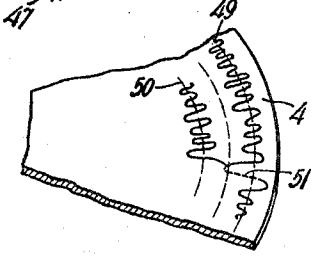


Fig. 4.



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Patented Jan. 10, 1928. 1,655,843

UNITED STATES PATENT OFFICE.

JOHN LOUIS REYNOLDS, OF LONG ISLAND CITY, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO ELECTRICAL RESEARCH PRODUCTS INC., A CORPORATION OF DELAWARE.

SIGNAL-CONTROLLING APPARATUS.

Application filed April 1, 1927. Serial No. 180,325.

This invention relates to signal control apparatus and with particularly to alarms controlling apparatus for use in connection with sound recording mechanism.

The invention exhibits its practical utility when employed in sound recording systems wherein the sound record is made in a mechanical medium such as wax or other element having an impressionable surface, the sounds being permanently represented in the form of a continuous wavelike cutting of varying amplitude. When records of this type are being produced, it frequently happens that the recording stylus, the point of which moves in a horizontal plane, is subjected to an excessive amplitude of movement, for example, that occurring in the recording of unusually loud sounds, resulting a socalled "overcutting." In some cases this "overcutting" may result in the breaking of the wall between adjacent grooves rendering the record worthless as a master record. This difficulty is of much pecuniary moment where the works of great artists are being recorded, and where a defect in the forming of the master record may occasion the outlay of large expenditures of money for repetition of the recording process. Unless some continuous check is provided on the functioning of the recording stylus such defects as "overcutting," are not revealed until the complete performance of the artist has been recorded. It has been the practice heretofore to follow visually, by means of microscopes or the like, the action of the cutting stylus. It has been found, however, that this visual check is not in all cases reliable, and necessitates the employment of skilled operators who must continually watch and instantaneously detect "overcutting when it occurs."

The invention has therefore for its principal object the provision of means for continuously following the action of a recording stylus and for automatically giving signals, either visual, audible or both, when the stylus exceeds a maximum predetermined amplitude of movement.

A feature of the invention resides in an electro-optical system which is effective to control an alarm at the instant a recording stylus begins to "over-cut."

Another feature of the invention is concerned with a relay arrangement for insuring the closure or opening of a control circuit in response to very short signal impulses.

A still further feature relates to the combination of a vacuum tube oscillator which is normally just below the point of oscillation but which responds to a single transient impulse and generates sustained current oscillations which may be utilized to permanently control a visual or audible signal.

Other features and advantages of the invention, not specifically set forth at this point, will be revealed by a consideration of the description of one mode of practicing the invention as given hereinafter and as pointed out with particularity in the appended claims.

Referring to the drawing, Fig. 1 shows an electro-magnetic sound recording device with which is associated an electro-optical system for controlling the alarm circuit.

Fig. 2 illustrates schematically the electro-optical system disclosed in Fig. 1.

Fig. 3 shows a novel form of a vacuum tube relay for controlling an electric circuit.

Fig. 4 shows a magnified section of a disc type sound record illustrating one form of sound cutting.

Similar pieces of apparatus disclosed in the several figures of the drawing bear the same reference characters.

For the purposes of illustrating one mode of using the invention, it has been chosen to describe the same in connection with a sound recording system wherein electromechanical devices are employed for the purpose of translating the sound variations into corresponding "cuttings" in a wax record. For this purpose when the microphone 1, has been properly positioned for the reception of the sound waves to be recorded, the motor 2, is started and brought up to speed with the stylus 3 in contact with the recording surface 4. The sound waves impinging upon the microphone 1 cause corresponding

variations in the grid potential of the amplifier A which is preferably of the electron discharge type and which produces in its output circuit voltages which are undistorted in so far as they correspond to the variations in intensity and quality of the sound waves.

Associated with the output circuit of the amplifier A is the electromagnetic translator R which may be of any well-known construction adapted to move the recording stylus point laterally across the record 4. A special form of translator is shown in Fig. 1, but it is understood that the drawing is essentially schematic in this respect. The recorder-translator shown, comprises a magnet 6 to which are attached, in any suitable manner the laminated pole-pieces 7 and 8. The tips of the pole-pieces are preferably so shaped as to conform to the shape of the ends of armature 5 as shown, the armature being supported in any suitable manner for vibration between the pole-pieces. Surrounding the armature, but not interfering with the movement thereof, is a winding 9, which is connected in the output circuit of the amplifier A. Armature 5 will therefore be moved toward and away from the pole-pieces in accordance with the characteristics of the sound waves striking the microphone 1, and in the well-known manner, the point of stylus 3, which is attached in any suitable manner to the armature, will cut a continuous wave-like groove of constant depth in the wax record blank 4, the amplitude of the wave at any particular point corresponding to the amplitude of vibration of the stylus point.

When a master record is prepared in accordance with the apparatus shown in Fig. 1 it is desirable for various reasons to fix a definite limit to the amplitude of movement of the stylus. In a manner this amplitude may be controlled by the amplifier A whose gain may be adjusted to give the required amplitude of movement of the stylus when the loudest sound is impressed upon the microphone. Nevertheless at times, because of varying degrees of hardness of the blank 4 at different points a given current from amplifier A will cause stylus 3 to trace a wave of greater amplitude than is required. At times this may result in the stylus cutting across from one groove to the preceding adjacent groove as indicated in Fig. 4 by the dotted portion 51 between grooves 49 and 50. For the purpose of instantaneously detecting this "overcutting" an optical system is provided, comprising the small, concave mirror 10 (Figs. 1 and 2) which is fastened in any suitable manner at a convenient point on the stylus 3. This mirror is preferably of aluminum or other light material in order that it may not affect the constants of the reproducer.

Suitably mounted beneath the reproducer arm 11 and movable therewith is a "dark-box" 12 at one end of which is conveniently mounted the photoelectric cell 13. Between the cell 13 and the mirror 10 is a small lamp 15 giving substantially a point-source of light. The light rays from the source 15 pass thru a small opening 17 in the right-hand end of the "dark-box" and strike the small mirror 10 upon which they are focussed by the lens 16. When the stylus 3 is at rest the rays from the source 15 strike the mirror 10 at its center, as shown in Fig. 2 and are reflected back upon themselves in a straight line. When the stylus is moved away from its rest position the rays from the source 15 are eccentric with respect to the mirror 10 and are reflected to one side or the other as shown.

On either side of the central opening 17 are two other openings 18 and 19 which correspond to the maximum allowable amplitude of movement of the stylus in either direction. When the stylus is in any intermediate position, the rays reflected from the mirror 10 do not enter the "dark-box" and consequently do not affect the cell 13. Should the stylus be moved just beyond the allowable maximum, for example, as a result of "over-cutting," the rays reflected from mirror 10 will pass thru one of the openings 18, 19. The rays from mirror 10 after passing thru opening 19 for example, strike the mirror 20 which is conveniently mounted on the inner lateral wall of the "dark-box" in the proper position to reflect the rays toward the photoelectric cell 13 upon which they are focussed by the lens 22. In a similar manner on the opposite lateral interior wall of the "dark-box," is a mirror 21 for reflecting on to the cell 13 the light rays entering the opening 18. A light baffle 14 is provided in order that the cell 13 may not be affected by the direct rays from the lamp 15.

Referring to Fig. 2 it will be seen that when the mirror 10 is in its central position (indicated in full lines), the rays reflected from the mirror 10 are reflected back through the opening 17. When the mirror 10 is moved to its maximum allowable position in one direction, the rays are reflected through the opening 19 and strike the mirror 21 from which they are reflected and are then focussed by lens 22 upon the cell 13. Similarly when the mirror is moved to its maximum allowable position in the opposite direction the rays are reflected thru the opening 18, strike mirror 20, and are reflected to the cell 13. It is clear then that when the stylus 3 begins to move beyond its maximum allowable distance in either direction, the cell 13 receives a sudden impulse of light and its resistance is changed to correspond. This change in resistance may be utilized to

cause the actuation of a bell, the lighting of a lamp, or any other suitable signal to attract the attention of an attendant to the condition in order that the recording process may be immediately stopped and a new record blank substituted.

As hereinabove pointed out the cell 13 may receive only a momentary light impulse which might not be of sufficient duration or intensity to cause the permanent operation of a signal. Accordingly, as shown in Fig. 1, the cell 13 is connected across the grid and plate electrodes of the three-electrode amplifier A^1. Normally the grid 24 may be so polarized by battery 25 and resistance 51 that the space current is insufficient to operate the relay 29. When, however, cell 13 receives a momentary impulse of light, the resistance of the cell is reduced and current flows from the positive pole of battery 26, lefthand winding of relay 27, conductor 28, anode of the cell 13, conductor 29, resistance 51, to the negative pole of battery 26. The flow of current as traced is in such a direction as to decrease the negative potential of grid 24. The left winding of relay 29 is preferably of a comparatively high resistance and a great number of turns in order that relay 27 may attract its armatures in response to a momentary current impulse. As soon as relay 29 operates in the manner described, a locking is established from positive pole of battery 30, resistance 31, right-hand low resistance winding of relay 29, contacts of key 32, inner contacts of relay 29, to the negative pole of battery 30. This last traced circuit also extends in parallel through the outer contacts of relay 29 and thence through the signal device 33. Signal 33 therefore remains operated until the locking circuit of relay 27 is broken by the attendant manipulating key 32.

In the event that the impulse of light is of insufficient duration to effect the operation of relay 27, a novel form of "trigger" circuit such as shown in Fig. 3 may be employed. This "trigger" circuit comprises a three-electrode regenerative vacuum tube amplifier which is normally maintained just below the point of oscillation. The oscillating circuit of the amplifier shown in Fig. 3, comprises the inductances 35, 36 and the variable condenser 37. The photoelectric cell 13 is connected in a "leak" circuit across the grid and plate of the amplifier, and has its anode supplied with potential from the same source as supplies the plate potential for the amplifier, namely, battery 39. The potential of the grid 40 is a function of the potential drop in resistance 41, and a function of the potential of battery 42. With the cell 13 completely dark, the inductances 35 and 36, condenser 37 and battery 42 are so adjusted that the amplifier is just on the verge of generating oscillations, and in response to a slight change in good potentials will sustain these oscillations or "spill-over" as is well known in the art. The resistance 41 and the condenser 43 are of such proportions with regard to the average working resistance of the cell 13 that any potentials impressed upon the grid due to the excitation of cell 13 will leak off comparatively slowly. The resistance 41 and condenser 43 may also be proportioned to facilitate the generation of oscillations.

When the cell 13 is excited by a momentary impulse of light, for example that due to an excessive movement of mirror 10 as hereinabove described, the current flowing through the cell from the battery 39 and through resistance 41 will be in such a direction as to make grid 40 less negative with respect to the filament, causing the amplifier to "spill-over" and the resulting oscillations will be sustained in a well-known manner even though the cell 13 becomes dark. The increased current resulting from the sustained oscillations flows through the left-hand winding of relay 44 which is similar to relay 27 of Fig. 1. Relay 44 is also provided with a right-hand low resistance holding winding which is controlled by key 45. When key 45 is operated by the attendant the upper contacts thereof open the circuit through the left winding of relay 44, thus curtailing the generation of oscillations, while the lower contacts open the locking circuit of relay 44 which may thereupon release and disconnect the signal 46 from battery 47. If desired, the condenser shunting the operating winding of relay 44 may be used for tuning to the oscillation frequency or for "by-passing" the oscillatory currents.

It is understood that the scope of the invention is not to be confined to the precise elements shown in the drawing, as various modifications may be made therein without departing from the spirit and purpose of the inventive idea.

What is claimed is:

1. In combination, an element having an impressionable surface, a movable device adapted by its movement to translate sound variations into impressions on said element and a signal automatically responsive to an excessive amplitude of movement of said device.

2. In combination, an element having a sound recording surface, a stylus for translating sound waves into impressions on said surface, a relay responsive to excessive movements of said stylus, and an alarm operated by said relay.

3. In combination, a recording surface, a source of electrical variations, an element adapted to move in response to said variations to cause a mechanical record thereof to

be made in said surface, an electro-optical system, controlled by said element, and a signal to be actuated under control of said electro-optical system.

4. Means for detecting "overcutting" in a master sound record comprising a light sensitive device actuated by the recording stylus and an alarm automatically actuated by said light sensitive device.

5. In combination, a recording stylus, a light beam controlled by the movement of said stylus, a light sensitive cell excited only when said stylus has a predetermined amplitude of movement, and a signal operated under control of said cell.

6. In combination, a movable recording arm, an electromagnetic translating device, a member to be oscillated by said device, an electro-optical system comprising a light sensitive cell, and means for exciting said cell only in response to a predetermined movement of said member.

7. In combination, an electromagnetic reproducer, a stylus to be operated by said reproducer, a "dark-box" containing a light sensitive element and an optical system, means for actuating said reproducer by sound modulated currents to vibrate said stylus, means carried by said stylus for controlling the excitation of said light sensitive element only when said stylus reaches a predetermined amplitude of movement, and a movable recording arm upon which said reproducer and said dark-box are mounted.

8. In combination, a vibrating recording stylus, an electro-optical system comprising a photo-electric cell, a signalling device, a relay for controlling said device, an electron discharge amplifier between said cell and said relay, means associated with said stylus and effective only upon a predetermined amplitude of movement of said stylus to control the excitation of said cell, said relay being responsive to such excitation to cause said signal to be operated.

9. Means for signalling when a recording stylus is "overcutting" which comprises a mirror fastened to said stylus, a photoelectric cell excited when said mirror assumes a predetermined position, an electron discharge amplifier associated with said cell, a relay connected in the output circuit of said amplifier, said relay being inert when said cell is not excited and adapted to be operated in response to a single momentary excitation of said cell, and means for maintaining said relay operated after discontinuance of excitation of said cell.

10. In combination, a recording stylus, a light beam controlled by the movement of said stylus, a photoelectric cell excited when said stylus has a predetermined amplitude of movement, and a signal operated under control of said cell.

11. In combination, a source of light, a light sensitive cell, a device, for generating current oscillations, means for maintaining said device just below the threshold of oscillation when said cell is not excited, means for exciting said cell by a momentary flash of light from said source to cause said device to start generating current oscillations, and means for causing said device to continue generating current oscillations independently of the excitation of said cell.

12. In combination, an oscillatory circuit comprising a light sensitive cell and a regenerative vacuum tube amplifier, and means for maintaining said circuit just below the threshold of oscillation when said cell is not excited and for causing said circuit to pass the threshold of oscillation and to continue oscillating when said cell is momentarily excited.

13. In combination, a regenerative vacuum tube amplifier adapted to produce current oscillations, a light sensitive device connected to the grid of said amplifier, a combination of elements for maintaining said amplifier on the verge of oscillation when said device is not excited, means for exciting said device by a momentary flash of light to cause said amplifier to produce current oscillations, said combination of elements serving to maintain said amplifier producing current oscillations independently of the excitation of said device.

14. In combination a recording stylus, a beam of light controlled by the movement of said stylus, a light sensitive cell, means for exposing said cell momentarily to said beam of light when said stylus exceeds a predetermined amplitude of movement, a regenerative electron discharge amplifier, adjustable means associated with said amplifier for maintainnig said amplifier just below the state of producing current oscillations, a circuit controlling device in the output circuit of said amplifier normally unresponsive to momentary current impulses, and means associating said cell with said amplifier effective upon momentary excitation of said cell to cause said amplifier to produce sustained current oscillations for operating said relay and for maintaining said relay operated independently of the excitation of said cell.

15. In combination, a regenerative vacuum tube amplifier, a resistance connected in the grid circuit of said amplifier, a light sensitive cell connected in a leak circuit to the grid of said amplifier, a grid polarizing battery, said battery and resistance being so proportioned that the potential applied to the grid through said resistance is sufficient to hold said amplifier just below the point of producing current oscillations when said cell is not excited but is insufficient to hold

said amplifier below the point of producing current oscillations when said cell is momentarily excited.

16. An electrical trigger circuit comprising a regenerative vacuum tube amplifier normally just below the point of generating sustained oscillations, and a light sensitive device associated with said amplifier to cause said amplifier to pass the threshold of oscillation in response to a momentary excitation of said cell.

In testimony whereof, I have signed my name to this specification, this 18th day of March, 1927.

J. LOUIS REYNOLDS.