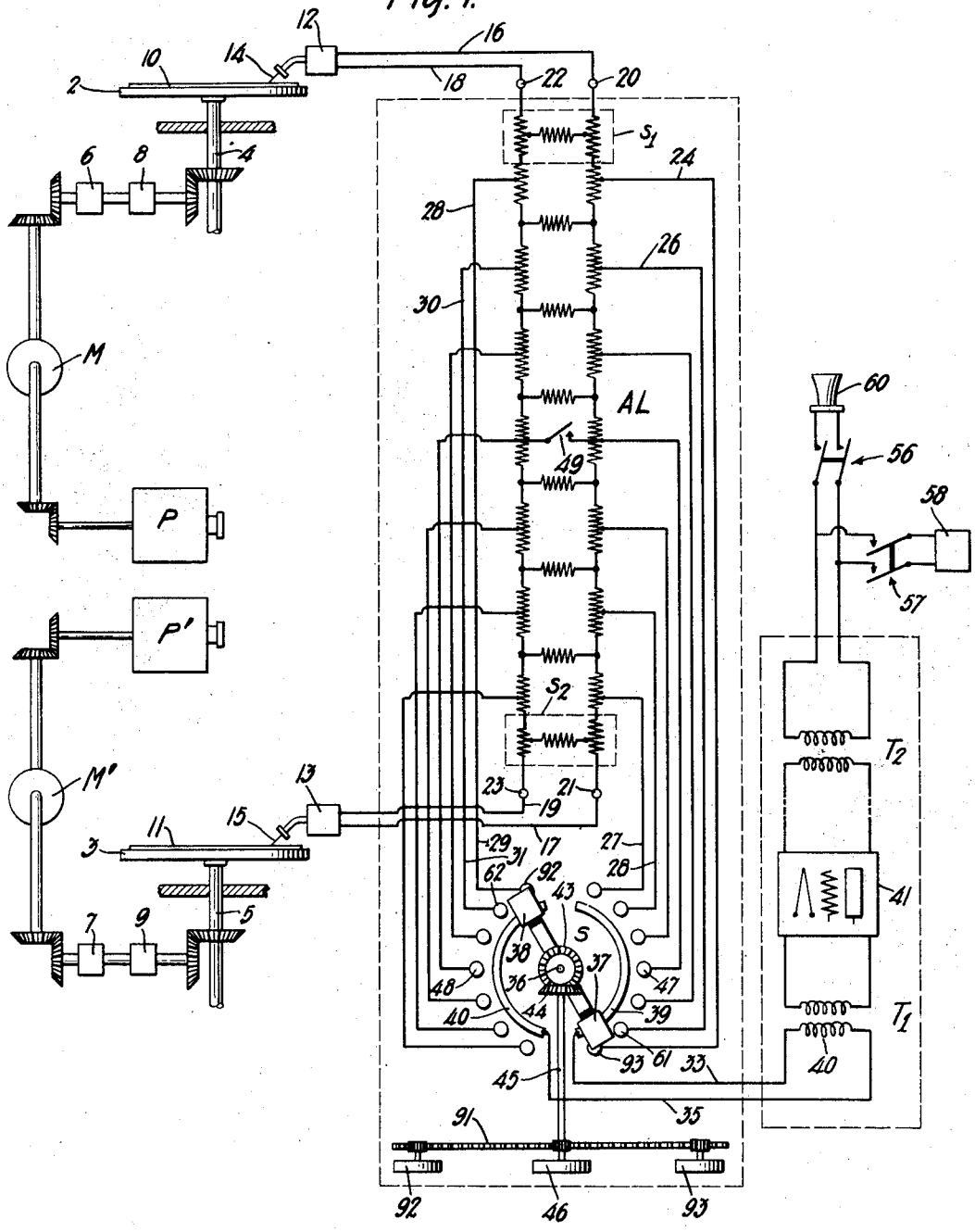
Oct. 17, 1933. J. L. REYNOLDS 1,931,035

SWITCHING APPARATUS FOR SOUND REPRODUCING SYSTEMS

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Fig. 1.



Inventor
J. Lowell Reynolds
by Pennie & Edmonds
his Attorney

Oct. 17, 1933. J. L. REYNOLDS 1,931,035

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Fig. 2

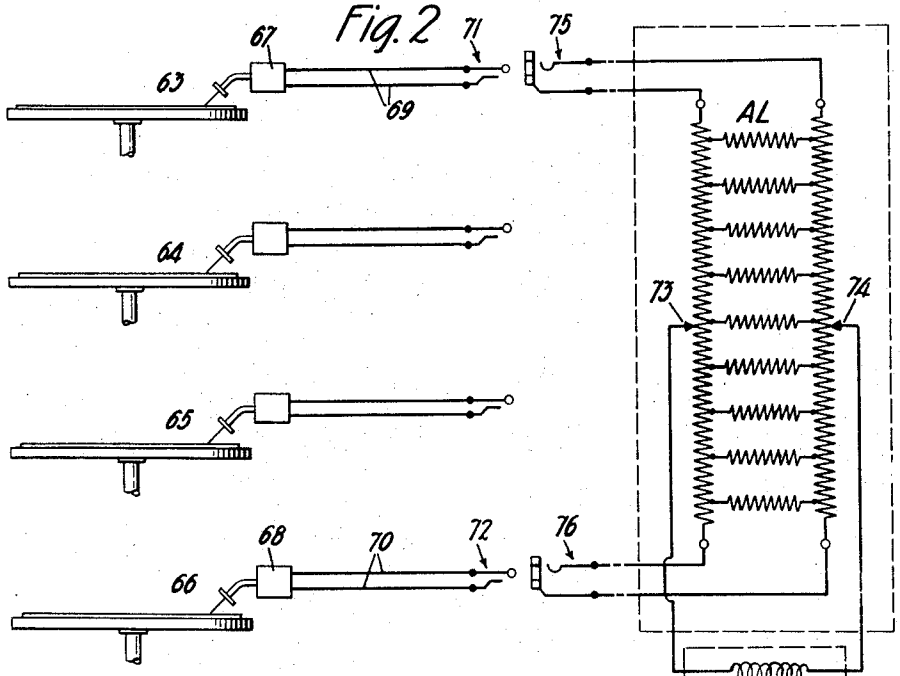


Fig. 3.

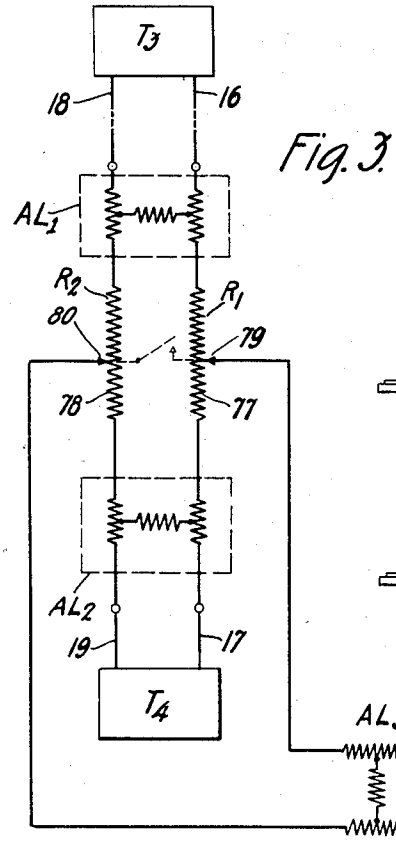
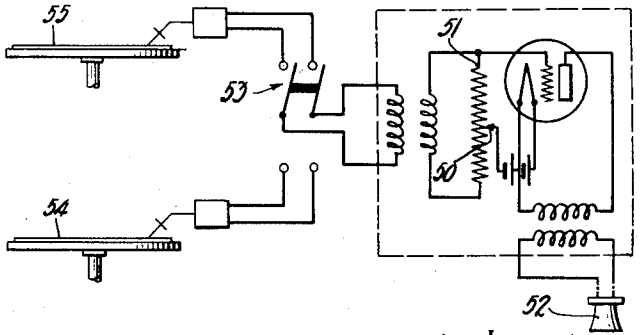


Fig. 4.



Inventor
J. Louis Reynolds
by
Attorney

Oct. 17, 1933. J. L. REYNOLDS 1,931,035

SWITCHING APPARATUS FOR SOUND REPRODUCING SYSTEMS

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Fig. 5.

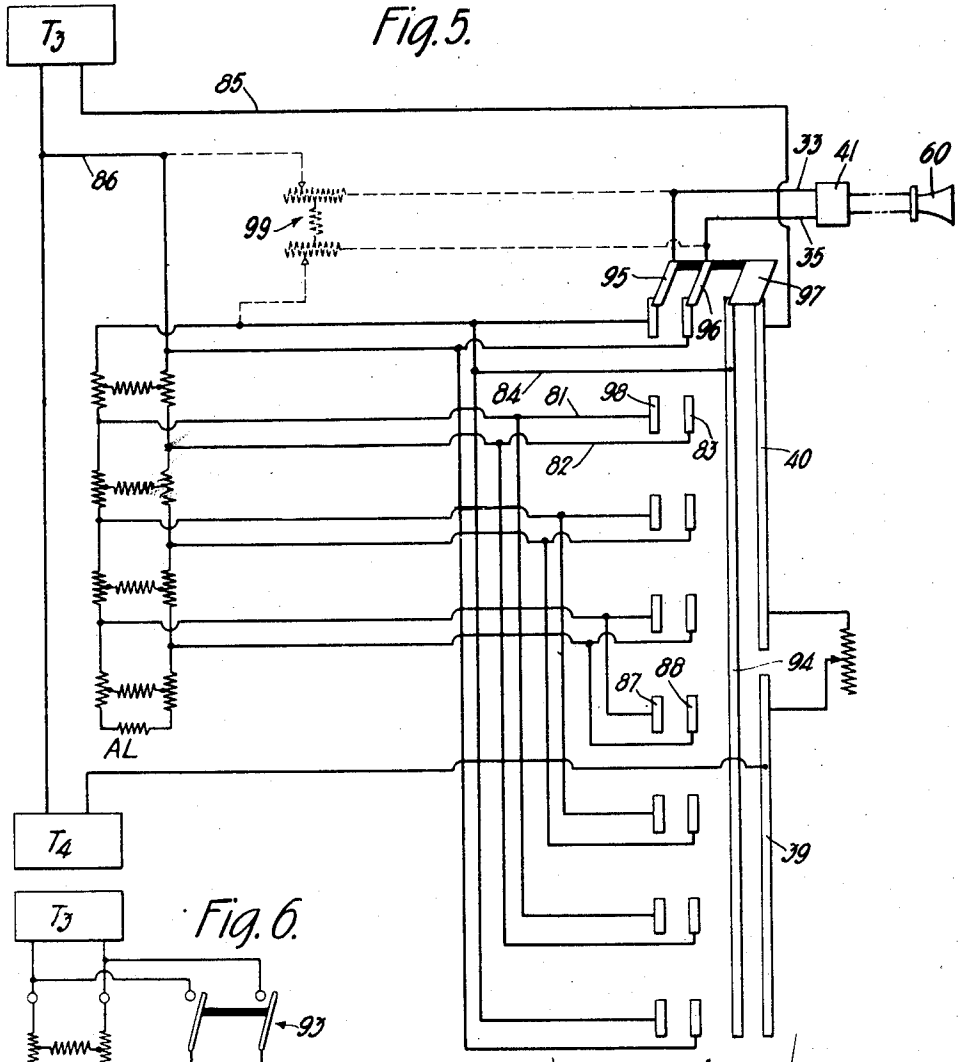


Fig. 6.

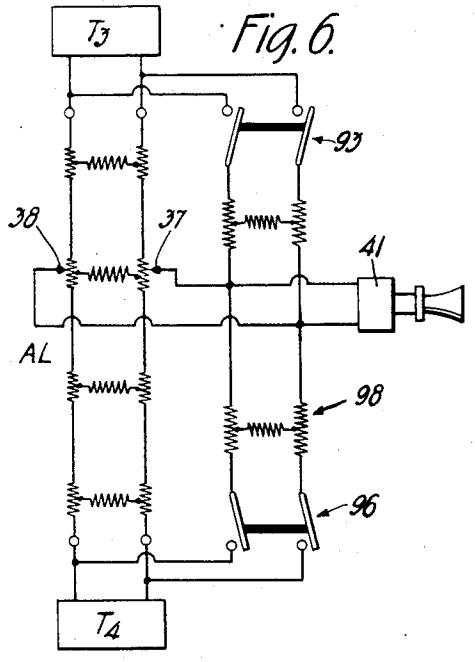
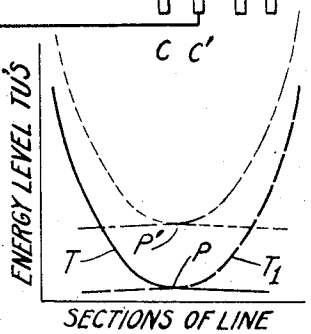


Fig. 7.



Inventor
J. Lowell Reynolds
by
Attorney

Patented Oct. 17, 1933 1,931,035

UNITED STATES PATENT OFFICE

1,931,035

SWITCHING APPARATUS FOR SOUND REPRODUCING SYSTEMS

John Louis Reynolds, Long Island City, N. Y., assignor, by mesne assignments, to Electrical Research Products Inc., a corporation of Delaware

Application April 1, 1927. Serial No. 180,323

15 Claims. (Cl. 179—100.4)

This invention relates to transmitting and reproducing systems, and in particular to those systems wherein vibrations, such as sound or mechanical vibrations, are to be transmitted and reproduced.

In certain types of reproducing systems, for example, those involving the use of an electromagnetically operated sound reproducer, it is highly desirable to be able to rapidly associate said reproducer in succession with a plurality of transmitters without causing any perceptible or disagreeable effects on the ears of an audience because of transition from one transmitter to another.

An object of the invention, therefore, is concerned with methods and apparatus for controlling the effective connection of separate transmitters, each of which may have different characteristics, with a common reproducer without the causing of any deleterious effects on the reproduction, and without rendering the transfer of connections noticeable to an auditor.

For the purpose of illustrating one manner of attaining the above object as well as other objects pointed out herein below, the invention is shown and described in connection with sound recording and reproducing apparatus suitable for use with picture projecting apparatus for the purpose of synchronizing the sound reproduction with the pictures being projected. In synchronized sound and picture systems of this character, the sound and picture records may be operated independently of each other. At certain times it may be necessary to replace one sound record by another sound record without interrupting the continuity of the picture projection or without rendering the change noticeable to an audience.

Accordingly, another object of the invention is to provide a synchronized sound and moving picture system wherein the sound vibrations may be recorded in separate mechanical media and each of said media may be effectively associated with the projected picture without disturbing the continuity and pleasing quality of the sound reproduction.

Another object of the invention relates to the method of combining the effects produced by discrete sound records, so that the effect on the ear of an auditor is the same as if but one continuous record were employed.

A feature of the invention resides in an adjustable electric network or artificial line connected between a plurality of transmitters and a sound reproducer, for causing the effective association of one transmitter with said reproducer and rendering ineffective the association of the other transmitter with the reproducer without disconnecting either of said transmitters from said reproducer during the associating process.

Another feature of the invention pertains to an electrical network and switch means associated with a plurality of transmitters and reproducer, said switch being capable by its operation, of concurrently rendering the effects of one transmitter upon said reproducer inversely as regards the effects of the other transmitter on said reproducer.

Another feature of the invention is characterized by means for "fading" one series of sound modulated electrical impulses into another series of sound modulated electrical impulses.

An additional feature of the invention resides in the combination of means for rapidly associating in succession a number of mechanical sound records with a current amplifier, so that the output of said amplifier may be rapidly brought to the same energy level for successively associated records.

The invention further comprises the various combinations of elements and structural details which go to make up an effective synchronized sound and moving picture system, as will be more fully pointed out herein below.

In order that a clear understanding of the invention may be readily attained, attention is hereby directed to the accompanying drawings which illustrates certain modes of using the invention, but it is to be understood that the inventive idea is susceptible of many other uses, as will be apparent to those familiar with the practice of the art to which the invention relates.

Another feature of the invention pertains to a combined picture and sound reproducing system wherein the sound current amplifier may be operated at a substantially fixed gain, and may be located at any desired distance from the picture projector. The output level of the sound from the sound projector may be controlled by an electrical network which may be adjusted from any one of a number of convenient points.

Fig. 1 of the drawings show the invention incorporated in a synchronized sound and moving picture system employing mechanical media sound records, mechanical electric translators, vacuum tube amplifiers, and electromagnetic sound reproducers.

Fig. 2 of the drawings show the invention applied to a system similar to that disclosed in Fig. 1, and by means of which the "fader" network may be rapidly and effectively interconnected with any two of a number of electromechanical sound translators.

Fig. 3 shows an alternative form of the "fader" using a slide wire resistance in place of an artificial line.

Fig. 4 shows schematically a sound reproducing switching system according to the prior art.

Fig. 5 shows a modified form of switching arrangement by which the number of sections in the artificial line may be reduced one-half.

Fig. 6 illustrates a "fader" network modified so that the transition from one record to another may be accomplished without reducing the energy level of the currents to zero.

Fig. 7 shows characteristic curves of the "fader" networks shown in Figs. 1, 2, 3, 5 and 6.

Referring to Fig. 1 of the drawings, which illustrates a preferred embodiment of the invention, there are shown moving picture projecting machines, P and P' and a plurality of transmitting phonographs schematically represented by the turntables 2 and 3, respectively. These turntables may be mounted on respective spindles 4 and 5 which may be operatively associated with their respective driving motors M and M' by means of the diagrammatically represented clutches 6 and 7. Each drawing motor should be sufficiently powerful to simultaneously operate a turntable and its associated projecting machine. Devices 8 and 9, if desired, may be provided between the clutches and the turntables to permit of relative adjustment between the moving picture film and the sound records while the same are in motion. The mechanical records 10 and 11 may be of the well known disc type with the "sound cuttings" in the form of a continuous spiral of varying depth or of varying width, as may be desired. The discs may be of wax or other suitable material. The discs in the recording process may, if desired, be prepared so that there is an overlapping of the records on each disc; that is to say, a portion near the end of the record in disc 10 may be duplicated in disc 11 for purposes herein below pointed out.

For the purpose of translating the disc cuttings into current impulses there are provided respective "pick-up" devices, 12 and 13, with each of which is associated its respective stylus 14, 15. The styli 14, 15 "track" the cuttings in their respective discs. The varying amplitudes of the disc cuttings cause the stylus to be moved accordingly and this movement in turn serves to cause the "pick-up" device to generate voltages whose amplitudes correspond to the extent of movement of the stylus.

Assuming for the present that turntable 2 and projector P are in operation, then the varying sound modulated currents from the device 12 are led by means of conductors 16 and 18 to the terminals 20 and 22 of the network or artificial line AL. This artificial line is made up, as shown of a number of serially and bridge-connected resistances or their electrical equivalents, and constitutes a series of so-called ladder or H type networks. Connections are made from various points of this network by means of conductors 24, 26, 27, etc., to corresponding contact points in the switch S, these contact points being arranged preferably, for rapid connection, in the form of a circle as shown. For the purpose of connecting the primary winding of transformer T_1 with any set of contacts in the switch S, a rotatable brush arm 34 is mounted on the spindle 36. Arm 34 carries at either end brushes 37 and 38 insulated from each other and from the spindle 36. Brushes 37 and 38 are designed to connect the contact points of the switch S with the corresponding continuous segments 39 and 40. The space between the contact points may be such, with regard to the width of the brushes 37 and 38, that each brush in moving makes contact with the one segment before breaking contact with the preceding segment. It is obvious then that when the arm 34 is rotated the primary winding 40 of transformer T_1 is at all times in circuit with the artificial line AL. Various other well known arrangements might be used for insuring the continuity of this circuit while the switch S is being moved. In addition, the degree of fineness of adjustment attainable by switch S may be increased by using a greater number of contact points and a correspondingly greater number of H sections in line AL. It is desirable that the impedances of the end sections S^1 and S^2 be designed so as to match the impedances of the circuits looking toward the respective reproducers 12 and 13, and the other sections of the artificial line may be designed so that the mid-series value of impedance will bear the correct relation to the input of the amplifier, thus providing optimum impedance matching relations.

Heretofore, in controlling the volume of sound from the reproducer, it has been customary to use an amplifier whose gain was controlled by a potentiometer which, in most cases is of very high impedance. In as much as such a potentiometer and the intimately associated connecting circuits are very susceptible to electromagnetic pickup it was necessary to locate them very close to the amplifier proper. In certain cases it is not practical to have the amplifier and control potentiometer in the same room as the picture projecting apparatus, which fact would necessitate the operator's leaving his machine whenever the volume required changing. In accordance with the present invention the line AL may be a relatively low impedance device which renders it capable of being located at a considerable distance from the amplifier without its being affected appreciably by the electrostatic capacity of the connecting wires, and also is less susceptible to any other form of parasitic interference. As a result the line AL may be placed at the location which is most convenient for the picture operator. For this purpose the spindle 36 of switch S has rigidly mounted thereon the gear 43 which cooperates with gear 44. This latter gear is fixed in any suitable manner to the shaft 45, at the end of which is fixed the adjusting hand wheel 46. Shaft 45 may also be mechanically connected by a suitable pinion to the rack 91 which in turn is adapted to be moved by the handwheels 92, 93 located at other convenient points in the operating room.

From the foregoing description, it is seen that the function of switch S is to "cut-in" a greater or less number of sections of the line AL in circuit with the amplifier 41 and a given one of the devices 12, 13. Amplifier 41 is preferably of the three-electrode space discharge type, which is preferably designed that during reproduction it has a fixed gain relation between the input and output voltages.

Referring to Fig. 7, there are shown character-

istic curves for the artificial line AL, the ordinates representing energy levels in transmission units at the input circuit of the amplifier 41 and the abscissæ representing the number of sections of line in circuit. Curve T illustrates the manner in which the power level of the currents from device 12 varies as brushes 37 and 38 are moved in a counterclockwise direction from the contacts 93 and 92 respectively. Curve T_1 shows the manner in which the energy level of the power device 13 is simultaneously varied. The point P at which curves T and T_1 cross each other corresponds to the electrical midpoint of the line AL, the energy level of the point P is dependent upon the characteristics of each half section of the artificial line AL. For example as shown in Fig. 7 the energy level of the point P is substantially zero. If desired the artificial line may be so proportioned that when the brushes 37 and 38 are on the middle set of contacts 47, 48, the energy level may have any other minimum value, for example, that indicated by the point P' in Fig. 7, in which case the rest of the system including the amplifier 41 may be adjusted so that these currents have no appreciable effect on the reproducer 60. In other words, the artificial line may be so proportioned that the energy level of the currents applied to the amplifier 41 may have any desired minimum value. Another arrangement for controlling the minimum energy level is shown in Fig. 6 wherein the rectangles T_3 and T_4 represent schematically transmitting devices which may be similar to the devices 12, 13 and the associated apparatus (Fig. 1). The artificial line AL may be similar to the line AL of Fig. 1 and may be so proportioned that with brushes 37 and 38 making contact with the midsection of the line, the energy level of the currents reaching the amplifier 41 from the devices 12, 13 is substantially zero in which case the attenuation characteristics of the currents from the respective transmitters can be represented by curves similar to curves T and T_1 of Fig. 7. Should it be desired to raise the minimum energy level to any other point above zero, for example to the point P' of Fig. 7, switches 95 and 96 may be operated to connect the sections 97 and 98 directly from the respective transmitters 12, 13 to the input circuit of the amplifier 41 thus providing a "by-path" for the sound modulated currents which is independent of the position of the brushes 37 and 38. If desired, the sections 97 and 98 may consist of variable artificial lines similar to line A^1, in which case the minimum energy level may be given any desired value.

Considering for the moment the currents generated by the device 12, (Fig. 1), these currents after being led to the terminals 20 and 22 of the artificial line AL thence passing thru contacts of switch S to transformer T_1 are attenuated to a greater or less degree in accordance with the position of the brushes of switch S. In the particular position shown in the drawings only the end section S_1 of the line AL is connected in circuit with the device 12 and the transformer T_1, accordingly these currents will undergo minimum attenuation when they reach the transformer T_1. On the other hand, should the device 13 be also operating at this time, the currents generated thereby and reaching transformer T_1 undergo maximum attenuation. Under this condition, with both devices 12 and 13 operating simultaneously, the currents in the transformer T_1 will be substantially those generated by device 12. By moving the brushes 37 and 38 in a counterclockwise direction the currents from device 12 are gradually attenuated and, in the inverse sense, the currents from device 13 undergo decreasing attenuations. When brushes 37 and 38 pass beyond the middle points 47 and 48, the device 12 begins to take control. Thus by means of the switch S the energy level of the currents reaching transformer T_1 from device 13 are gradually increased and the energy level of the currents reaching this transformer from device 12 are gradually decreased, these two currents gradually and imperceptibly blending with each other in the primary winding of transformer T_1 and transition between the records 10 and 11 is smoothly, gradually and continuously effected.

Under certain circumstances it may be desirable not to have the currents from the devices 12 and 13 blend or "fade" into each other as above described, in which case the switch 49 is closed and places a short circuit across the electrical center of the artificial line AL. Hence, with the switch S in the position shown in the drawings, the currents from device 13 are entirely shunted from the transformer T_1 which is energized solely under control of the device 12. The converse is true when switch S is rotated past the middle points 47 and 48.

For various reasons the records 10 and 11 may not be always cut to the same average amplitude, which, if certain precautions are not taken may result in a different energy level of the currents reaching transformer T_1, when switching is effected between one record and the next. For this purpose, according to the prior art amplifiers with variable gain were required. A system of this type is shown schematically in Fig. 4 of the drawings. In such a system, should it be desired to switch from the upper record 55 to the lower record 54, it would be necessary in order not to produce any objectionable sounds in the loud speaker 52 and in order not to suddenly take off the load from the amplifier, to move the contact 50 relatively slowly to the point 51, at which time the switch 53 may be manipulated to "cut-in" the lower reproducer, after which the contact 50 must be moved back to the desired point. If the record 54 happened to be cut to the same average degree of amplitude as record 55, the contact 50 might be moved to its original position. Should these two records, however, differ in the degree of cutting, it would be necessary to further adjust contact 50 in order to produce the same volume in the loud speaker 52 as was produced when record 55 was functioning. Thus with records of different degrees of cutting, in order to maintain the same volume of sound from the device 52, three distinct operations were necessary in order to switch from one record to another. With a "fading" device such as hereinabove described these three operations are accomplished by a single manipulation of switch S and it has been found that the transition from one record to another, as regards the effect on the ear of an auditor, is smooth, and substantially unnoticeable.

When it is desired to produce synchronized sound and moving pictures, the positive film to be projected is inserted in the projecting machine (Fig. 1), and the turntable 2 together with the projecting machine are started. Switch 57 may then be operated and switch S

adjusted until the desired output is obtained from amplifier 41, as indicated by a device 58 which may take the form of a "monitoring" loud speaker. Switch 56 may then be operated to connect the loud speaker 60 in circuit. For the purpose of description, it will be assumed that the switch S has thus been adjusted to close the circuit through contacts 61 and 62.

Assuming it is desired to blend the effects of record 10 into those of record 11 when the end of the cuttings on disc 10 is nearly reached, the turntable 3 and projector P are started in operation, the switch 49 being open as hereinabove described. Switch S is now rotated to increase the number of sections of line AL in circuit with device 12 and amplifier 41, at the same time decreasing the attenuation of the currents from device 13. Switch S is rotated in this manner until device 58 indicates the same output from amplifier 41 as was obtained when record 10 was functioning.

Should the records 10 and 11 be such that it is not desirable to blend the effects of one into those of the other the switch 49 is closed prior to the beginning of the operations. Accordingly, when it is desired to switch from record 10 to record 11, the procedure is similar to that already described. In this case, however, movement of brushes 37 and 38 from contacts 61 and 62 in a counter clockwise direction, reduces the current from device 12 gradually until contacts 47 and 48 are reached when this current is zero. Further movement of switch S increases the current from device 13, which thereupon takes control of the loud speaker 60, thus at no time is there a feeding of current from device 12 to device 13 or vice versa.

When the discs are so prepared that the end portion of the cutting in disc 10 is repeated at the beginning of the cutting in disc 11, the element of the artificial line AL are so proportioned that the movement of switch S has no effect upon the volume of sound produced in the loud speaker 60, but simply transfers the control of said speaker to one or the other of the records. Consequently, advantage may be taken of the overlapping of the records to perform the switching over process.

Referring to Fig. 2 of the drawings, there is disclosed a system of the general type disclosed in Fig. 1, but with more than two "pick-up" devices. The devices indicated generally by the numerals 63, 64, 65, etc., may be similar to corresponding devices in Fig. 1, comprising a turntable and an associated electromechanical pick-up translator. Each of the spindles on which the turntables are mounted may be mechanically connected through suitable gearing to the same motor that drives the associated picture projector, or they may be driven by separate motors which are synchronized by any well-known means. Each of the sets of conductors 69 and 70 leading from the respective devices 67, 68, etc., terminates in corresponding plugs 71, 72, etc. The apparatus shown within the dotted rectangle is a "fader" similar to that described in connection with Fig. 1 and comprises an artificial line AL and a progressively movable switch represented schematically by the contacts 73 and 74. The end sections of this artificial line are connected to respective jacks 75 and 76 by means of which any two of the pick-up translator devices 63, 64, etc., may be associated with the "fader". Thus the "fader" may be connected to any one or more of the "pick-up" devices as conditions demand, thus forming a very flexible system of interconnection and transfer. The rest of the apparatus disclosed in this figure, namely, the coupling transformers, vacuum tube amplifier and loud speaker, may be similar to those described in connection with Fig. 1. The switch contacts 73 and 74 may be moved in an equivalent manner to that disclosed in Fig. 1 and the procedure, in changing from record to record, is the same as already described. It is believed, therefore, that further description of this figure is unnecessary.

Fig. 3 shows an alternative form of "fader" in which slide-wire resistances are employed to vary the input to the amplifier. In this modification the conductors 16, 18 and 17, 19 leading from the transmitting devices T_3 and T_4, respectively, terminate in corresponding artificial line sections AL_1 and AL_2. Line sections AL_1 and AL_2 are connected by the high-resistance slide-wires 77 and 78. In addition, an artificial line section AL_3 is inserted in the conductors 33 and 35 leading to an input transformer, such as T_1 (Fig. 1). These artificial line sections are so designed that for varying positions of the sliding contacts 79 and 80, the impedances of the circuits looking from the respective devices T_3 and T_4 are substantially constant. In a similar manner, the artificial line sections AL_3 is so designed as to maintain the input impedance of the amplifier substantially independent of the positions of the sliding contacts 79 and 80. The operation of this form of "fader" is similar to that disclosed in Figs. 1 and 2. When the contacts 79 and 80 are at the upper end of the respective slide wires, the resistance in series with device T_3 and the primary of the input transformer is zero, while the resistance in series with device T_4 on the loud speaker is substantially negligible. As the contacts 79 and 80 are moved downward, the resistance in series with device T_4 decreases, causing the currents from these devices to "blend" into each other in a similar manner to that described in connection with Fig. 1. If this "blending" is not required, a short circuit may be placed across the electrical midpoints of the slide-wires 77 and 78, as described hereinabove in connection with switch 49.

Figure 5 shows a switching arrangement whereby the artificial line may be reduced to one half of the length of the line shown in either Figs. 1, 2 or 3. In this figure, T_3 and T^4 schematically represent transmitting devices similar to those shown in the lefthand portion of Fig. 1. The artificial line AL may consist of electrical impedance elements similar to the sections of line AL of Fig. 1. It will be noted however that each of the devices T_3, T_4 feeds into the same end of line AL, the number of effective sections of line AL in series with each device being dependent upon the position of the brushes of switch S. Switch S in the construction shown in Fig. 5 has series of separated contact points C, C^1 similar to contact points 47, 48, etc. of Fig. 1, and two long segments 39, 50, in addition a continuous segment 94. Conductors 33, 35 leading from the amplifier 41 are connected respectively to the brushes 95, 96 which are insulated from each other and are adapted to contact with the associated segments C, C^1. Also mounted on the shaft carrying brushes, 95, 96 is a brush 97 which bridges the segments 39, 40 with the continuous segment 94. Assuming that brushes 95, 96, 97 are moved to contact with

contacts 98, 83, 94, 40, the loud speaker 60 is connected in circuit with only the first section of the artificial line AL. This circuit may be traced from the conductor 33, brush 95, segment 98, conductor 81, first section of the line AL, conductor 84, brush 97, through device T_3, conductor 86, conductor 82, brush 96, to conductor 35. As brushes 95, 96, 97 are moved downward a corresponding greater number of sections of line AL are included in circuit with device T_3 and loudspeaker 60. When it is desired to switch to the transmitter T_4, brushes 95, 96 and 97 are moved to engage segments 87, 88 and 39 in which position the transmitter T_3 is out of the circuit, and transmitter T_4 is in circuit with all the sections of line AL. As brushes 95, 96, 97 are moved further downward the number of sections of line AL in circuit with the transmitter T_4 is reduced causing a gradual increase in the volume of sound from the loudspeaker 60. As hereinbefore described in connection with Figs. 1 and 6, the line AL may be proportioned so that when all the sections are in circuit with a transmitter the energy level of the currents applied to the amplifier 41 may be substantially zero, or the line may be such that this minimum energy level has any other desired value. Similarly a direct "by-path" represented by the dotted lines of Fig. 5 may be provided by which the minimum energy level may be varied from zero to any value required.

From a consideration of the foregoing description it is clear that many modifications may be made in the apparatus disclosed without departing materially from the spirit and scope of the invention. For example, the pick-up device T_3 and T_4 may take any of the well-known forms such, for example, as telephone transmitters or the like. Similarly, switch S may be replaced by any other well-known form of switch for progressively varying the connections between the input transformer T_1 and the pickup devices. While the artificial lines are shown as comprised of resistances it is clear that any form of impedance device whether inductive, condensive, or a combination of both, may be employed, it being understood that the showing of Fig. 1 is meant to be essentially schematic in this respect.

In addition, while a separate picture projector has been shown associated with each turntable, the invention includes within its compass the use of a single projector which may be used in common with a number of turntables. For example, the motor for driving the projector P may also serve to drive both the turntables 2 and 3 which may be associated in succession with the projector in the manner hereinbefore described.

Finally, while the invention for the purposes of illustration merely, has been shown in connection with a sound reproducing system, it is understood that the compass of the invention is not to be limited to such use, nor to the specific combination of elements disclosed, but its scope is to be determined by the claims which are hereinbelow set forth.

What I claim is:

1. In combination, a plurality of transmitters, a reproducer common to said transmitters, an electrical impedance interconnecting said transmitters and said reproducer said network having a series of sections, a switch having two groups of contact sets corresponding sets in each group being multipled electrically, means connecting each set in one of said groups with corresponding sections of said network, wipers for said contact sets, means for moving said wipers progressively over one of said groups of contacts sets to gradually increase the number of sections of said network in circuit with one of said transmitters, and for moving said wipers over the other group of said contact sets to gradually decrease the number of sections of said network in circuit with another one of said transmitters.

2. In combination two transmitters, a reproducer to be operated under control of said transmitters, an artificial line interconnecting said transmitters and said reproducer, said line having a series of sections, a switch having two groups of contact sets each group having as many sets as said line has sections and corresponding sets in each group being electrically multipled, wipers for said sets, and means for moving said wipers over said sets so that during one half of their movement the number of sections of said line in circuit with one of said transmitters is gradually increased and during the other half of their movement the number of sections in circuit with the other transmitter is gradually decreased.

3. In a sound reproducing system, a plurality of sound transmitters each connected to an incoming circuit, a sound reproducing device connected to an outgoing circuit common to said incoming circuits, a progressively operable impedance adjusting device interconnecting said circuits, and means to variably operate said impedance adjusting device to successively and at will effectively associate said transmitters with said sound reproducing device, said impedance adjusting device being designed to substantially maintain the impedance matching of said apparatus at all times.

4. In a sound reproducing system, a plurality of sound transmitters each connected to an incoming circuit, a sound reproducing device connected to an outgoing circuit common to said incoming circuits, a progressively operable impedance adjusting device interconnecting said circuits, and means to variably operate said adjusting device to effectively associate either one or both of said transmitters with said sound reproducing device, said impedance adjusting device being designed to substantially maintain the impedance matching of said apparatus at all times.

5. In a sound reproducing system, a plurality of sound transmitters each connected to an incoming circuit, a sound reproducing device connected to an outgoing circuit common to said incoming circuits, a progressively operable impedance adjusting device interconnecting said circuits, and means to change said sound reproducer from effective association with one transmitter to effective association with the other and at the same time control the energy level of the currents applied to the reproducer, said impedance adjusting device being designed to substantially maintain impedance matching of said apparatus at all times.

6. In a sound reproducing system, a plurality of sound transmitters each connected to an incoming circuit, a sound reproducing device connected to an outgoing circuit common to said incoming circuit, a progressively operable impedance adjusting device interconnecting said circuits, and means to variably operate said impedance adjusting device to change said sound reproducer from effective association with one transmitter to effective association with the other by progressively attenuating the currents from one transmitter and at the same time progres-

sively increasing the energy level of the currents from the other transmitter, said impedance adjusting device being designed to substantially maintain the impedance matching of said apparatus at all times.

7. In a sound reproducing system, a progressively operable switching device, fixed and movable contacts for said switch, a sound reproducing device connected to the movable contacts of said switching device, an electrical network comprising a plurality of pads or sections connected to the fixed contacts of said switching device, transmitters connected to opposite ends of said electrical network, and means to progressively operate said switching device to effectively associate said sound reproducing device with a desired one of said transmitters, said network being so designed that impedance matching for said sound reproducing device and said transmitters is substantially maintained in all positions of said switching device.

8. In a sound reproducing system, two transmitters, a sound reproducer, a switching and controlling device acting on the potentiometer principle, said device consisting of a series of electrical network pads and means including suitable electrical connections between said transmitters, sound reproducer and switching device to operate said device to effectually associate said sound reproducer with a desired one of said transmitters, the design of said network being such that mid-series impedance matching is substantially maintained with respect to said transmitters and reproducer.

9. A music synchronizing attachment for phonographs with two record tables, corresponding tone arms, electric pick-ups, and electric motors rotating said tables; said attachment comprising a manually operated synchronizing control embodying a resistance coil in circuit with both pick-ups and a control lever arranged in circuit with said resistance coil to gradually increase current to one of said pick-ups and simultaneously decrease current to the other pick-up to respectively increase the volume of sound produced by the first pick-up from the record it is in contact with, and to decrease the volume of sound produced by the other pick-up from its record, and a control for volume of sound arranged in circuit between said synchronizing control means and the tone chamber of the phonograph.

10. An electric reproducer for sound accompaniment to motion picture films including, a plurality of records of sounds, a plurality of electric current pick-up means, a loud speaker means, and a single fader means associated with said pick-up means adapted to selectively switch over from one of said pick-up means to another of said pick-up means to translate sound selectively from any of said records to the other without audible break between the selections.

11. In an electric reproducer for sound accompaniment to theatrical productions, including, a plurality of record means, a plurality of electric current modulating devices for translating the recorded sound variations from said record means into corresponding electric current variations, amplifier means, reproducer means, and a single fader means associated with said electric current modulating devices and said reproducer means to switch over and blend selectively from said record means.

12. In an electric reproducer for sound accompaniment to motion picture films including recorded sound vibrations, a multiple of electric pick-ups, a common circuit for said pick-ups, and switching means associated with said common circuits adapted to selectively switch over from one pick-up to another to reproduce the recorded sound variations without audible break between sections of said recordings.

13. The combination with a pair of pick-up devices for translating records of sound variations into corresponding electrical variations, a sound radiating device responsive to audio-frequency electrical variations, electrical circuits connecting said pick-up devices and said sound radiating device, and an electrical switch for transferring the effective connection to the input of the sound radiating device from the output from one pick-up device to the output of the other pick-up device, of means under the control of said switch for effecting, during the switching operation, a continuous change in the circuit impedance between each of the pick-up devices and the sound radiating devices.

14. The combination with a pair of pick-up devices for translating records of sound variations into corresponding electrical variations, a sound radiating device responsive to audio-frequency electrical variations, electrical circuits connecting said pick-up devices and said sound radiating device, and an electrical switch for transferring the effective connection to the input of the sound radiating device from the output from one pick-up device to the output of the other pick-up device, of means under the control of said switch for effecting, in the course of the switching operation, gradual overlapping and complementary changes in the circuit impedance between each of said pick-up devices and the sound radiating device.

15. The combination with a pair of pick-up devices for delivering audio-frequency electrical variations, a receiver responsive to audio-frequency electrical variations, output circuits for the pick-up devices and an input circuit for the receiver, of adjusting means common to said pick-up devices and connecting said output circuits to said input circuit for gradually, oppositely, and simultaneously varying the effect of the respective pick-up devices on the receiver.

JOHN LOUIS REYNOLDS.