Dec. 17, 1940. B. F. MIESSNER 2,225,196

ELECTRONIC ORCHESTRA MONITORING SYSTEM

Filed May 2, 1939

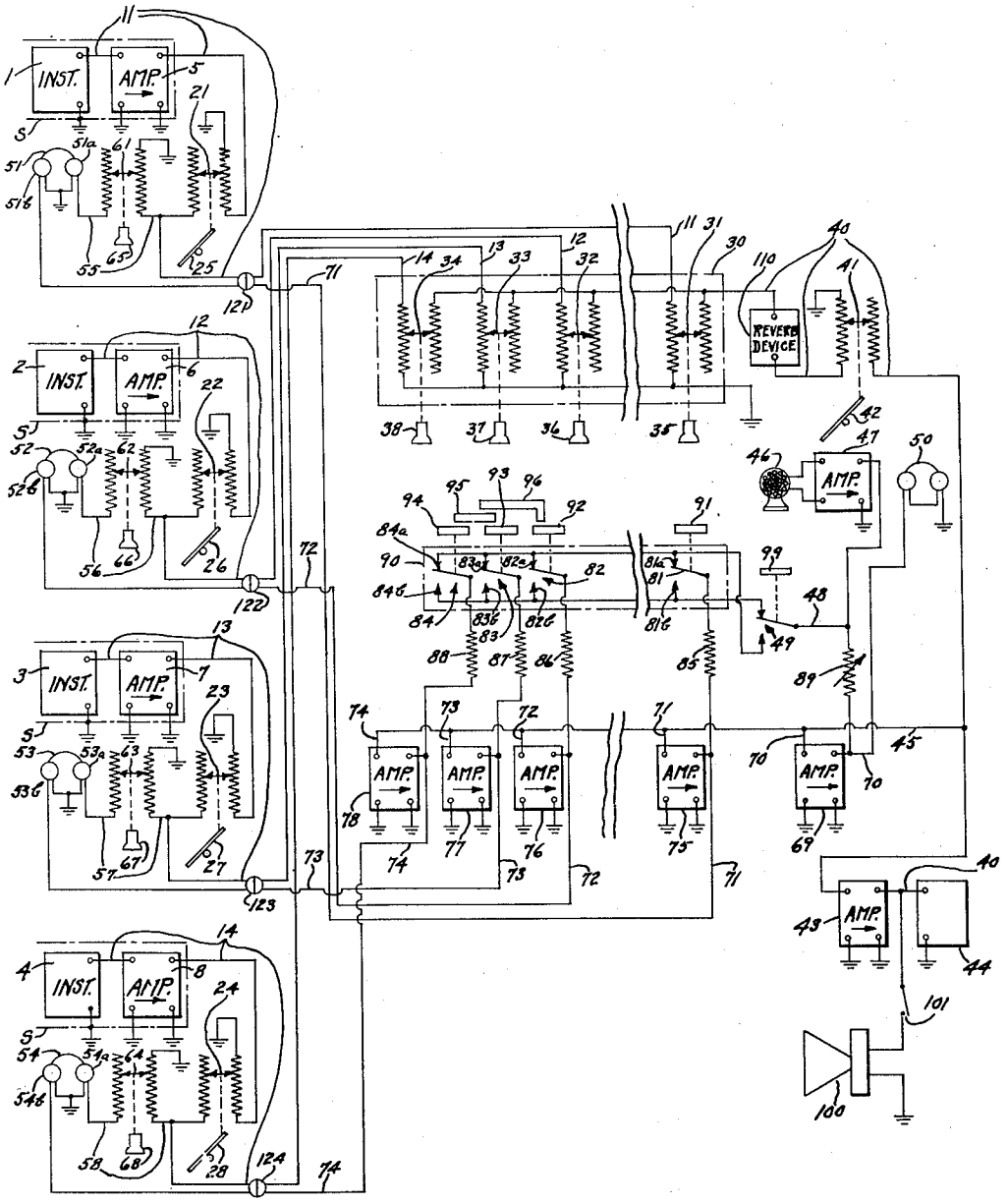


Fig. 1

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Patented Dec. 17, 1940 2,225,196

UNITED STATES PATENT OFFICE

2,225,196

ELECTRONIC ORCHESTRA MONITORING SYSTEM

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Application May 2, 1939, Serial No. 271,299

14 Claims. (Cl. 179—1)

This invention relates to orchestral monitoring, and more particularly to the monitoring of an orchestra comprising a plurality of electronic instruments. By an electronic instrument there is meant a musical instrument on which notes or notes and chords may be selectively played, and from which the utilized musical output is in the form of tone-representing electric oscillations—and preferably from which the direct acoustic output is small or negligible.

As typical electronic instruments there may be mentioned instruments comprising tuned vibrators and associated mechanico-electric translating, or pick-up, apparatus. With strings as vibrators, the instrument may comprise a piano, violin, guitar, cello, bass or the like, preferably without soundboard or resonator (as disclosed for example in U. S. Patent No. 1,929,027 to me- or with restricted soundboard or resonator (as disclosed for example in U. S. Patent No. 1,929,029 to me). With reeds as the vibrators (as disclosed for example in my co-pending application Serial No. 758,155, filed December 19, 1934) the instrument may comprise an organ, or with bars as the vibrators (as disclosed for example in U. S. Patent No. 1,933,297 to me) the instrument may comprise a set of chimes or the like. With a single vibrator vibratable selectively at a plurality of frequencies the instrument may comprise a woodwind or the like (as disclosed for example in U. S. Patent No. 2,138,500 to me). Again, the instrument may be of any form producing sound waves, with appropriate acoustic-electric translating means contained within an enclosure which restricts general sound production by the instrument (as also disclosed for example in U. S. Patent No. 2,138,500 abovementioned). Still again, the instrument may be of an electrical-generator type, in any of a variety of forms (as disclosed for example in U. S. Patent No. 1,580,112 to Bone, or in my co-pending application Serial No. 133,571, filed March 29, 1937, now Patent No. 2,215,708, or in the co-pending application of C. T. Jacobs, Serial No. 138,562, filed April 23, 1937, now Patent No. 2,165,707). And it will be understood that the mentioned types of electronic instrument are by way of example only, and that by such instrument I intend to refer broadly to any musical instrument as above defined.

It will be appreciated that there are certain peculiar problems in conducting or monitoring occasioned by the failure of instruments of the orchestra to have their conventional large acoustic outputs, and one general object of my invention is the solution of these problems. Many aspects of the invention go much further, however, and solve problems or supply deficiencies which exist in connection with orchestral conducting or monitoring broadly; thus an even more general object of my invention is the provision of a monitoring system, for use with an electronic orchestra, whereby there are made possible conducting or monitoring operations significantly improved over those heretofore possible with any orchestra.

It is an object to unify the orchestral performance to a particularly high degree.

It is an object to increase the range of orchestral expression in a number of respects.

It is an object to place the conductor in materially closer contact with each and all of the players.

It is an object to increase the freedom of direction of the orchestra by the conductor without any impairment of the ultimate sound output of the orchestra.

It is an object to provide for unrestricted vocal communication of the conductor with the orchestra.

It is an object to provide for communication of the conductor at any time with only that player or those players whom he may then wish to address.

It is an object to provide for such improved communications in a particularly simple and economical manner.

It is an object to facilitate a supervisory physical control by the conductor, supplemental to his directory control, over the music produced both by individual players and by the ensemble.

It is an object to improve the relative balance for each player between sound representing his own performance and sound representing the performance of the ensemble.

It is an object to supply these two sounds to the player in an especially favorable and effective manner.

Other and allied objects will more fully appear from the following description and the appended claims.

In the description hereinafter set forth reference is had to the accompanying drawing, in which Figure 1 is a schematic electrical diagram of a monitoring system for an electronic orchestra in accordance with my invention.

In Figure 1 I have illustrated a preferred form of my invention applied to the monitoring of an

orchestra of four electronic instruments, schematically illustrated as 1, 2, 3 and 4, respectively; each instrument may be of any electronic variety, and typically though not limitatively different from the others. It will of course be understood that the number of instruments illustrated has been chosen for purposes of simple illustration and not as indicating any limitation of number whatsoever—the invention indeed having great utility and especial effectiveness with relatively large orchestras. An individual output circuit or channel is shown for each instrument—11, 12, 13 and 14 for the instruments 1, 2, 3 and 4 respectively—leading for example from one of the two output terminals of the respective instrument. These output channels, as well as other circuits in the figure, have each been shown as comprising a single conductor, grounding (i. e., connecting to a single reference potential) of one of each pair of terminals intended for connection in the circuit being relied on for completion of the circuit; it will be understood, however, that this arrangement is purely typical, having been illustrated for reasons of simplicity, and that no limitation thereto is intended. In the several output channels are shown individual pre-amplifiers, designated as 5, 6, 7 and 8 respectively; it will be understood that these may serve to raise the voltage levels in, and if desired to lower the impedances of, the output channels immediately adjacent the respective instruments. Grounded electrostatic shielding may be provided about such portions of each instrument and of its output channel as may require it, such shieldings having been schematically shown about each instrument and its associated pre-amplifier, and designated as S.

In the several output channels, preferably in close physical association with the several instruments, are provided respective player's volume controls designated as 21, 22, 23 and 24; each may for example be operated by a respective pivoted "swell" pedal, such pedals being shown as 25, 26, 27 and 28 respectively. It will of course be understood that each player, by his respective one of these volume controls, is given full control over the output from his instrument, over and above such control as he may exert over individual tones through the touch, bowing, blowing or other playing technique peculiar to his particular instrument. While these volume controls may be of any suitable electrical form, they have by way of example been shown as of a relatively simple dual type—comprising shunt potentiometer and series resistance variable in predetermined relationship to the adjustment of the potentiometer—adapted to maintain at least fairly constant impedance conditions. A similar type of control structure has been shown for other volume controls comprised in the system and hereinafter mentioned, for the sake of uniform illustration but without any limiting intention.

The several output channels lead to a conductor's monitoring unit 30. In this unit they may be connected to respective volume controls 31, 32, 33 and 34 individually controllable by the conductor, as through the manipulation of respective control knobs 35, 36, 37 and 38 appropriately associated therewith. After control by these individual conductor's monitoring controls, the oscillations from the several output channels are combined in a common output circuit 40 connected to all the controls 31, 32 &c. In this output circuit 40 there is provided a conductor's master volume or monitoring control 41, operated as by conductor's "swell" pedal 42. In the output circuit 40 there may further be connected as amplifier 43. The output circuit 40 may lead to or terminate in a utilization circuit 44; this may be a radio broadcasting equipment, a recording equipment, or other device or equipment appropriate to the utilization for which the ouput of the orchestra is intended.

It will be understood that by the conductor's monitoring controls 31 through 34, the conductor may regulate the relative contributions of the several instruments to the general output, thereby "balancing" the orchestra, at his will. By his master monitoring control 41 he may impose his own overall expression on the general output, as well as exercising a supervisory control over that output; the latter the conductor, by reason both of his general skill and of his immediate familiarity and contact with the music being played, is usually much better qualified to do than is the gain-control operator usually assigned to perform this function.

In a conventional, purely acoustic-instrument orchestra each individual player is able to hear the music produced by the entire orchestra, together with that produced by his own instrument—the latter usually at a somewhat higher level than the former in view of his greater proximity to his own instrument. This is a desirable condition, since it acquaints the player both with the musical effect he is himself producing and with the effect of the ensemble. One deficiency in this condition, however, lies in the fact that the ensemble effect as heard by each player (considered without the abovementioned desirable accentuation of his own instrument) is different, and distorted from that heard by the immediate or ultimate audience, because of each player's varying proximity to the instruments of other players. Another deficiency lies in the inability of each player to adjust the degree of accentuation with which he hears the music produced by his own instrument over that produced by the ensemble—that is, the inability to adjust this characteristic without disturbing the balance, of his with other instruments, proper for the intended ensemble effect.

In the preferred form of my electronic orchestra monitoring system I not only arrange for each player to hear both the music of his own instrument and that of the ensemble, but in so doing I also cure both of the deficiencies just mentioned. Still further, I may discretely and predeterminedly localize the sound sources from which each individual player hears his own music and the ensemble music, respectively—thus increasing, over that which is usually available, the physiological perceptibility of the distinction between the two. To do this I may provide each player with a pair of electro-acoustic translating devices each positioned in effective relationship to a respective one of his two ears; to one of these translating devices I may supply oscillations from the common output circuit 40; to the other of these devices I may supply oscillations from the player's individual output channel; and I may make the amplitude of at least one of these oscillation supplies variable at the will of the player.

The pair of electro-acoustic translating devices for each player I prefer to provide in the form of a pair of ear-phones (or head-phones, as they are frequently termed). Such pairs of ear-phones for the players of the several instruments

I have shown as 51, 52, 53 and 54, respectively, the righthand one of each pair being designated by the number of the pair together with the letter *a* and the lefthand one of each pair being designated by the number of the pair together with the letter *b*. One terminal of each ear-phone of each pair has been illustrated as grounded, so that each circuit leading to an ear-phone is terminated therein.

The righthand ear-phone of the pair for each individual player may be supplied with oscillations from his respective output channel, and this supply may be made variable in amplitude at the will of the player. Thus ear-phone 51*a* may be supplied with oscillations from output channel 11 through a "listening" circuit or channel 55, the channel 55 preferably being branched from the channel 11 at a point in the latter between player's volume control 21 and conductor's monitoring control 31. In the channel 55 may be provided the "listening" volume control 61, adjustable by the respective player as by means of a knob 65 appropriately associated therewith. In entirely corresponding fashion ear-phones 52*a*, 53*a* and 54*a* may be supplied with oscillations from output channels 12, 13 and 14 respectively, through respective listening channels 56, 57 and 58, in which are provided respective listening volume controls 62, 63 and 64 adjustable by the respective players by means of respective knobs 66, 67 and 68.

The lefthand ear-phone of the pair for each individual player may be supplied with oscillations from the common output circuit 40 through a return circuit system comprising a plurality of return circuits 71, 72, 73 and 74 leading to the respective ear-phones 51*b*, 52*b*, 53*b* and 54*b*. These circuits may carry output oscillations from a point in the output circuit 40 between the master monitoring control 41 and the utilization circuit 44. Accordingly a common conductor 45 is shown branched from the output circuit at such a point, and the individual return circuits 71, 72, 73 and 74 are branched from this common conductor. It may be noted that, for reasons hereinafter apparent, I prefer to include in each of these return circuits an individual one-way electrical device. Each such device may be a respective thermionic amplifier, for example, and amplifiers 75, 76, 77 and 78 have accordingly been shown respectively included in the return circuits 71, 72, 73 and 74.

It will be seen that by the described arrangement all players hear the ensemble music (e. g., each through his lefthand ear-phone) uniformly; that each player also hears the music of his own instrument (e. g., through his righthand ear-phone); that each player may adjust the accentuation of his own music over the ensemble music as he may desire (e. g., by his listening volume control), but without effect on the ensemble music; and that each player hears his own and the ensemble music from discrete and predeterminedly positioned sources (e. g., his two ear-phones).

The return circuit system may further include a return circuit 70 for the conductor, leading from the common output circuit 40 (e. g., through common conductor 45) to a pair of conductor's ear-phones 50. Both the ear-phones of this pair, instead of only one ear-phone as in the case of each individual player, may be energized by the return circuit oscillations; the pair 50 has therefore been shown with its two ear-phones connected in series and with one extremity of the series grounded, so that it is the pair which terminates the return circuit 70. The ear-phones 50 furnish to the conductor the music of the ensemble precisely (except, of course, for the appropriate difference in volume level) as it is being supplied to and utilized by the utilization circuit 44. It may be noted that a one-way device, for example amplifier 69, has been shown included in the conductor's return circuit 70, analagously to the inclusion of respective amplifiers in the players' return circuits as above-mentioned.

It is of course essential that the conductor of the orchestra be able to communicate with the players. One manner of communication widely employed with conventional orchestras, and equally employable with electronic orchestras, is visual communication. This, however, leaves much to be desired, and with conventional orchestras it is supplemented to some extent, particularly in rehearsals, by vocal directions spoken by the conductor. In utilized performances, however, vocal directions must be subdued if employed at all, and in any event their efficacy is normally sharply limited by the sound level of the music, particularly of course when the orchestra is large and that level high. Furthermore ordinarily the vocal directions of the conductor intended for only one player or a small number of players must be heard by the entire orchestra, and this tends to needless distraction of most of the players.

According to my invention I arrange for vocal communication by the conductor to the players which may be employed freely without danger of the voice sounds being transmitted along with the music; which, without effort on the part of the conductor, will reach the player or players at ample level to be heard above the player's own and the ensemble music; and which, at the ready control of the conductor, is general to the entire orchestra or selective to any player or group of players, so that no needless distraction is suffered by players for whom any particular spoken directions are not intended. With these vast improvements in the vocal communication, it is possible greatly to reduce the difficult reliance on hand motions, signs and other confusing visual communications, while actually increasing to a marked degree the closeness of contact of the conductor with the players.

In arranging for this vocal communication I provide for the conductor a microphone 46, typically of the lapel type, into which he may speak as desired; an amplifier 47 for the output of the microphone; a plurality of circuits to and electro-acoustic translating devices for the several players; and a selective control or switching system 90, operated by the conductor, for connecting the output of the microphone amplifier 47 selectively with the several circuits to the respective players. Conveniently, and economically of both cost and complexity, the circuits and translating devices just mentioned may be the return circuits 71, 72, 73 and 74, and the ear-phones 51*b*, 52*b*, 53*b* and 54*b*, all above described.

Thus the output of the amplifier 47 (i. e., its ungrounded terminal) may be connected through the conductor 48 and switch 49 (hereinafter mentioned) to a conductor 80 within the switching system 90. To the conductor 80 are connected the lower throw-contacts 81*b*, 82*b*, 83*b* and 84*b* of respective single-pole double-throw switches 81, 82, 83 and 84, the poles of which are biased toward the respective upper throw-contacts 81*a*,

82a, 83a and 84a. The poles are connected—for example through respective resistances 85, 86, 87 and 88—to the respective return circuits 71, 72, 73 and 74 on the output sides of the respective one-way devices or amplifiers 75, 76, 77 and 78 n those circuits. The poles of the several switches 81, 82 etc. are throwable downwardly by the conductor, to touch the respective lower throw-contacts, through respective tablets 91, 92, 93 and 94 appropriately connected therewith and conveniently available to the conductor. It will be understood that when the pole or poles of any one or more of the switches is or are so thrown, the amplified output of the microphone 46 will be impressed (through that or those switches, through the respective one or more of the resistances 85, 86 etc., and through the respective return circuit or circuits) on the respective one or more of the lefthand ear-phones 51b, 52b etc., along with the ensemble music.

Thus when the conductor holds down the tablet or tablets (of the group 91 through 94) corresponding to one or more of the players, all vocal directions which he gives will be plainly audible to that player or those players; at the same time the open condition of the switches whose tablets are not depressed, together with the impossibility of backward transmission through the one-way devices or amplifiers 76, 76 etc., renders those directions inaudible to the other players. Accordingly the conductor, through the switching system 90, has full control over the selective transmission of his vocal directions to the several players.

If desired, one or more auxiliary tablets may be arranged so that when each is depressed it will throw a predetermined plurality of the switches 81, 82 etc., so that a plurality of players—for example, a whole string section, or a whole string section together with a whole wood-wind section—may be communicated with during depression of a single tablet. This has been schematically illustrated by the showing of tablet 95 above tablets 93 and 94, and straddling the same to depress them both upon its depression; and by the showing of tablet 96 above tablets 95 and 92, and straddling the same to depress the three tablets 92, 93 and 94 upon its depression.

While the switching system as so described, and without the use of the upper throw-contacts 81a, 82a etc., is an entirely complete one, I have shown it elaborated for additional or alternative operation. Thus the conductor 48, carrying the amplified microphone output, may be transferred by switch 49 from the conductor 80 to a conductor 79, which latter conductor is connected to all the upper throw-contacts 81a, 82a etc. abovementioned and against which the respective switch poles are biased. The switch 49 may be thrown, to substitute conductor 79 for conductor 80, as by depression of a "master" tablet 99 available to the conductor and appropriately connected with the switch 49. It will be seen that upon such throwing, so long as none of the earlier-mentioned tablets are depressed, the microphone output will be supplied to all the return circuits and will be audible to all the players; this provides a very simple arrangement useful for general directions to the entire orchestra. Furthermore it will be seen that while this master tablet 99 is depressed, the depression of any one or more of the earlier-mentioned tablets (corresponding to one or more of the individual players) will perform the operation—reverse of that above described—of eliminating the transmission of the microphone output to that player or those players; this provides an alternative manner of selection for the use of the conductor when large portions of the orchestra are to be communicated with, and in any case when the conductor may prefer it.

Since the conductor's ears are very largely shielded from the surrounding air by his ear-phones 50, it is usually desirable that he be able to hear his own voice through his ear-phones. This is readily arranged, for example by connecting a resistance 89 between the conductor 48 and the conductor's return circuit 70 on the output side of the amplifier 69 in that circuit. This resistance 89 may be variable so that the conductor may adjust the volume of his own voice as he hears it to such level as pleases him.

The resistances 85, 86 etc. are preferably of high enough values to cause the level of the amplified microphone output in conductor 48 to remain substantially constant whether none, some or all of the switches 81, 82 etc. are closed. In general these resistances, and the gains of the microphone amplifier 47 and of the return circuit amplifiers 69 and 75, 76 etc., will be adjusted to values providing an operation of the entire system satisfactory to the orchestra, but need not ordinarily be variable from time to time in use.

Since the music is transmitted from the several instruments wholly in electrical form, there will be absent not only disturbing extraneous noises of one character and another, including excessive studio reverberation, but also all reverberation whatsoever. When such a condition is considered objectionable and it is desired to introduce some reverberatory effect, this may be done electrically by some suitable reverberation device—of which the function is to generate reverberation-representing oscillations in accordance with, and to add them to, the main oscillations being transmitted, and of which various forms are in themselves known. Such a device may be inserted for example in the common output circuit 40, preferably ahead of the point of branching therefrom of the return circuit conductor 45, as has been schematically indicated by the device 110.

While I prefer to employ the return circuit arrangement above described for its several advantages already made apparent, it will be understood that many aspects of the monitoring system above set forth are of value without the return circuits. Thus there may if desired be omitted, or left unused, the lefthand player's ear-phones 51b, 52b etc.; the return circuits 70 and 71, 72 etc., with their amplifiers 69 and 75, 76 etc.; the conductor's ear-phones 50 and his microphone 46 with its amplifier 47; and the entire switching system 90, together with its associated resistances and with the switch 49 and its associated resistance 89. As a sound source of the ensemble music for the conductor and each and every one of the players there may be provided a common loudspeaker 100, one terminal of which may be grounded and the other terminal of which may be connected, as by closure of switch 101 heretofore assumed open, with the common output circuit on the output side of amplifier 43.

It will be understood that while there is lost the feature of selectivity of vocal communication of the conductor with the several players, general vocal communication to the players may still be freely indulged in by the conductor without danger of the voice sounds being transmitted to the utilization circuit along with the music.

Though there is lost the substantial shielding of each player's hearing from distracting noises such as falling music racks, squeaking chairs, coughing, etc., these disturbing extraneous noises are still effectively kept out of the transmitted music. There is still retained the complete electrical control by the conductor over the instruments of the orchestra, collectively and individually, through the monitoring unit 30 and the master monitoring control 41—through the former of which the conductor may still accentuate or suppress any instrument or group of instruments above or below the level at which it is or they are being operated by the respective player or players, and through the latter of which he may still control the dynamics of the whole orchestra from faint pianissimo to strong fortissimo. The several improvements in the hearing by each player of the music of his own instrument relative to the ensemble music, and various other of the advantages of the system detailed above, are also still retained.

When there is contemplated the entertainment of "studio audiences" as an adjunct to the main utilization of the output of the orchestra, the propagation of the orchestral music to such an audience may be a part of the function of the utilization circuit 44, and that audience may accordingly be situated in sound-insulated relationship to the conductor and players of the orchestra. But optionally, when the loudspeaker 100 is employed as above disclosed in effective relationship to the conductor and players, the studio audience may be placed in sound-communicating relationship with them, hearing the music from the same loudspeaker; in this way that audience is enabled to hear the vocal communications of the conductor and other audible incidents of the orchestra's performance, and thus better to sense the "atmosphere" of the studio which is presumably the purpose of the audience in attending. In any event, noises made by the audience are not mingled with the transmitted music, as will be understood.

It may be noted that if desired the studio may be permanently wired with the entire righthand portion of the monitoring system as illustrated in Figure 1, with a plurality of plug devices to which the respective equipments employed by the individual players (and illustrated in the lefthand portion of Figure 1) may be removably connected. This has been indicated in Figure 1 by the plug devices 121, 122, 123 and 124, respectively interposed in the circuits 11—71, 12—72, 13—73 and 14—74.

While I have disclosed my invention in terms of a particular embodiment thereof, I do not intend that all its aspects be limited by the details of this embodiment, since they may obviously be varied within wide limits without departure from the true spirit or scope of the invention. In many of the appended claims I undertake to express that scope broadly, subject however to such proper limitations as the state of the art may impose.

I claim:

1. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players: the combination of a plurality of output channels for oscillations from said instruments respectively; a common output circuit in which the oscillations from the several said channels are combined; means rendering audible to all players sound corresponding to the combined oscillations; a plurality of electro-acoustic translating devices each for a respective player; and individual listening channels connected between the several said output channels and the several said translating devices, respectively.

2. The combination according to claim 1, further including a plurality of listening volume controls respectively connected in the several said listening channels and each available for control by the respective player.

3. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players under the direction of a conductor: the combination of a plurality of output channels for oscillations from said instruments respectively; a plurality of player's volume controls respectively connected in said output channels; a common output circuit; and means under the control of the conductor, including a plurality of monitoring volume controls respectively connected in the several said output channels, for impressing on said common output circuit regulable amplitudes of oscillations from the several said channels.

4. The combination according to claim 3, further including a plurality of means each rendering audible to a respective player the oscillations in his respective output channel free of control by the respective said monitoring control.

5. The combination according to claim 3, further including a conductor's master monitoring volume control connected in said common output circuit.

6. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players under the direction of a conductor: the combination of a plurality of output channels for oscillations from said instruments respectively; a common output circuit in which oscillations from the several said channels are combined; a plurality of player's volume controls and a plurality of conductor's volume controls connected at successive points in the several output channels respectively; and a plurality of player's ear-phones respectively connected to the several output channels between the respective player's volume control and the respective conductor's volume control, whereby to render audible to each player sound corresponding to the oscillations in his respective output channel subject to control by his respective volume control but free of control by the respective conductor's volume control.

7. The combination according to claim 6, further including a plurality of means, each available to a respective player, each for adjusting the volume of sound in the respective said ear-phone.

8. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players: the combination of a plurality of output channels for oscillations from said instruments respectively; a common output circuit in which the oscillations from the several said channels are combined; and a plurality of means each including a connection with said output circuit and a connection with a respective one of said output channels and adjustable means in at least one of said connections, each for rendering audible to the respective player, at regulable relative amplitudes, sound corresponding to the combined

oscillations and sound corresponding to the oscillations in his respective output channel.

9. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players: the combination of a plurality of output channels for oscillations from said instruments respectively; a common output circuit in which the oscillations from the several said channels are combined; and a plurality of pairs, each for a respective player, of ear-phones, one ear-phone of each said pair being connected with the respective said output channel and the other ear-phone of each said pair being connected with said output circuit.

10. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players under the direction of a conductor: the combination of a plurality of output channels for said instruments respectively; a common output circuit in which the oscillations from the several said channels are combined; a plurality of pairs, each for a respective player, of ear-phones, one ear-phone of each said pair being connected with the respective said output channel and the other ear-phone of each said pair being connected with said output circuit; a conductor's microphone; and means for impressing the output of said microphone on one of the ear-phones of each said pair.

11. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players under the direction of a conductor: the combination of a plurality of output channels for said instruments respectively; a common output circuit in which the oscillations from the several said channels are combined; a conductor's microphone; a plurality of circuits arranged for energization by said microphone and leading to the several players respectively; and a plurality of pairs, each for a respective player, of ear-phones one ear-phone of each said pair being connected with the respective said output channel and the other ear-phone of each said pair being connected with a respective one of said plurality of circuits.

12. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players under the direction of a conductor: the combination of a plurality of output channels for said instruments respectively; a common output circuit in which the oscillations from the several said channels are combined; a plurality of electro-acoustic translating devices each for a respective player; a one-way return circuit system, comprising a plurality of return circuits from said output circuit to the several said translating devices respectively; and a conductor's microphone connected with said return circuit system.

13. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players under the direction of a conductor: the combination of a plurality of output channels for said instruments respectively; a common output circuit in which the oscillations from the several said channels are combined; a plurality of electro-acoustic translating devices each for a respective player; a one-way return circuit system, comprising a plurality of return circuits from said output circuit to the several said translating devices respectively; a conductor's microphone; and switching means selectively operable by the conductor to connect said microphone selectively with the several said return circuits.

14. In a monitoring system for an orchestra comprising a plurality of electronic instruments respectively played by a plurality of players under the direction of a conductor: the combination of a plurality of output channels for said instruments respectively; a common output circuit in which the oscillations from the several channels are combined; a conductor's microphone; electro-acoustic translating means for rendering audible to the players sound corresponding to the combined oscillations and vocal directions spoken by the conductor into said microphone; and a switching system connected with said microphone and controlling the operation of said translating means as to said vocal directions selectively with respect to the several players.

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