Sept. 8, 1936. G. BEDESCHI ET AL 2,053,760

PROCESS AND APPARATUS FOR REGISTERING AND REPRODUCING SOUNDS

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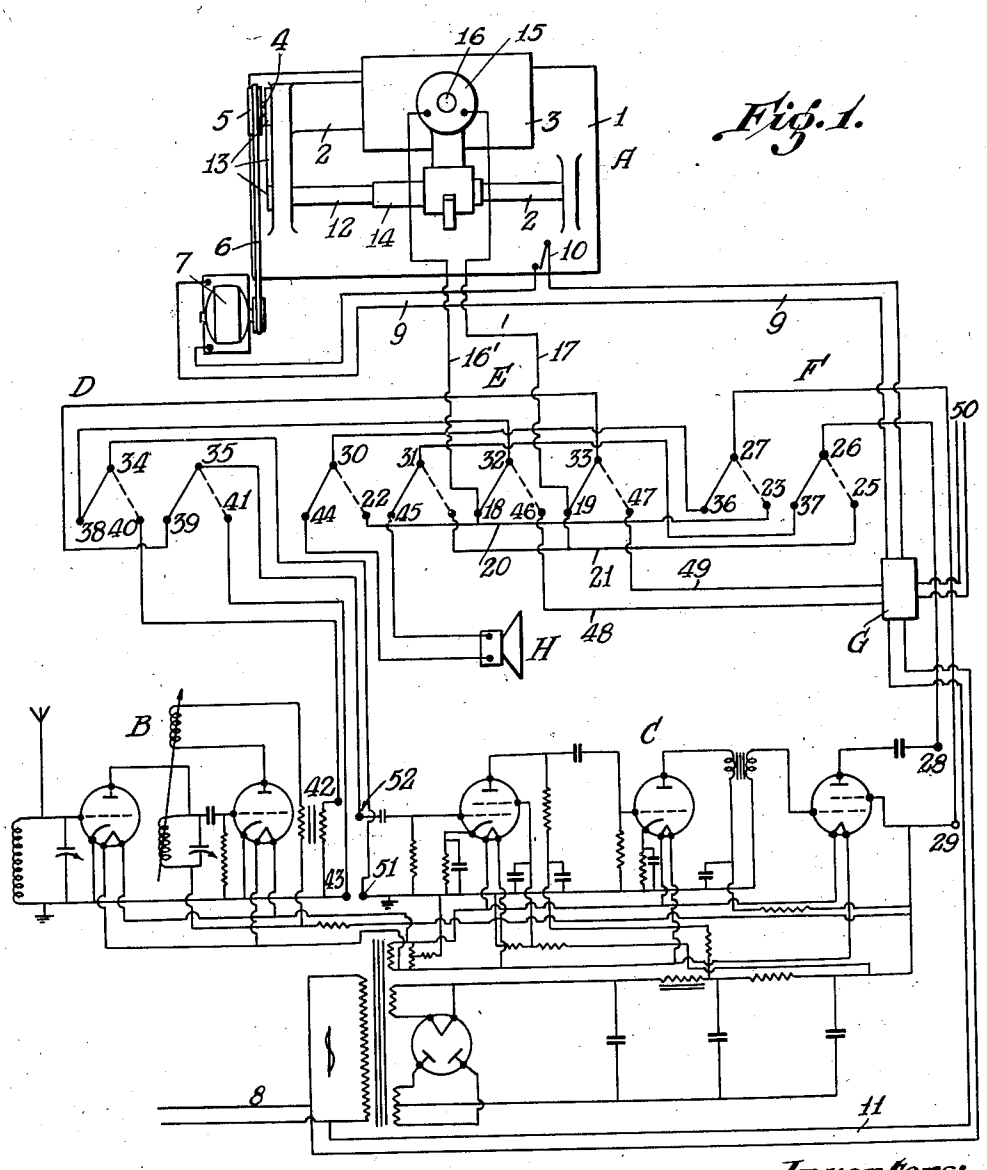

Fig. 1.

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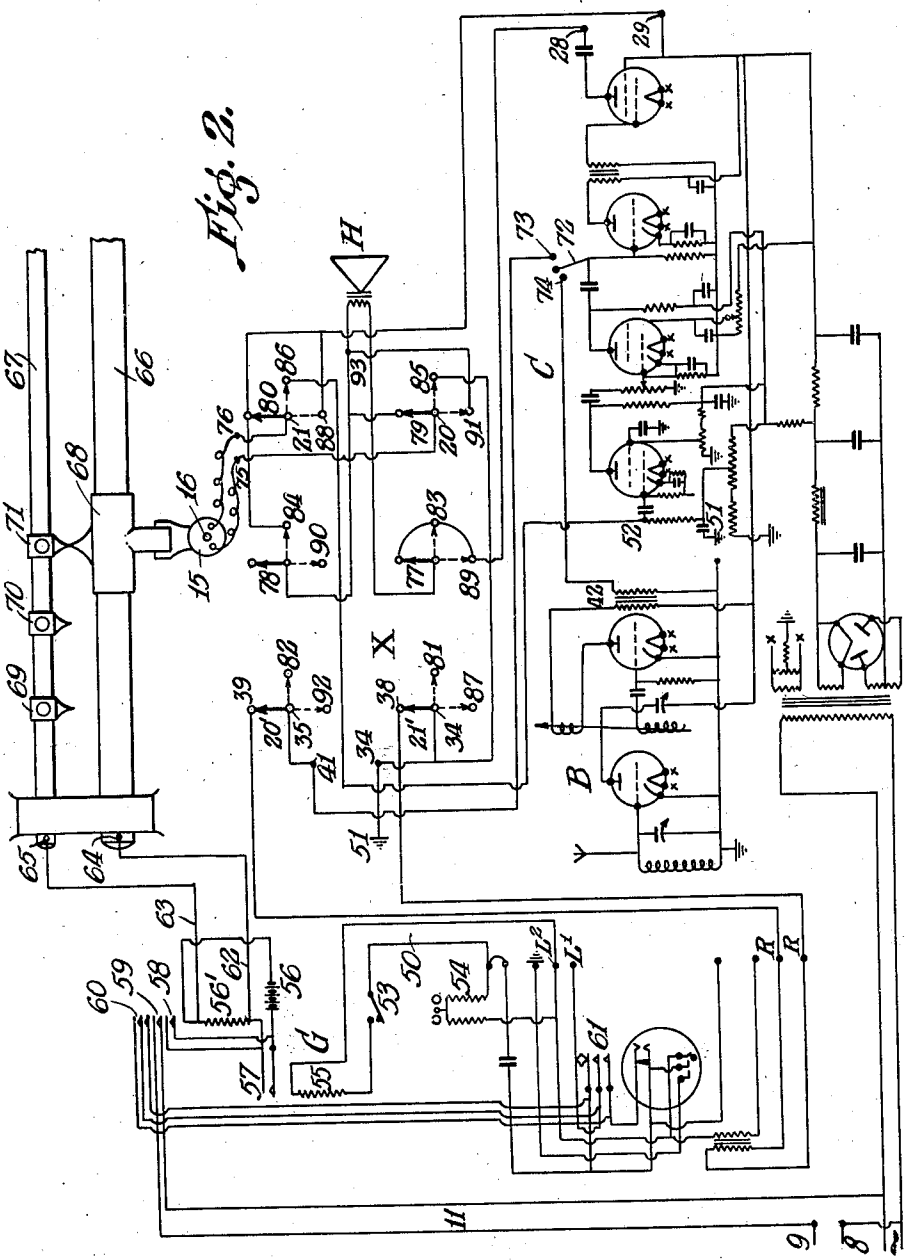
Fig. 2.



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Patented Sept. 8, 1936

2,053,760

UNITED STATES PATENT OFFICE

2,053,760

PROCESS AND APPARATUS FOR REGISTERING AND REPRODUCING SOUNDS

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Application July 31, 1934, Serial No. 737,718
In Italy August 7, 1933

4 Claims. (Cl. 179—100.2)

A process is already known for recording sounds on a steel wire by means of electromagnetic impressions produced by the pulsating currents of a microtelephone, in which two electromagnets are used, the unlike poles of the magnet cores facing each other and the steel wire to be impressed being caused to run between the said poles.

This arrangement, which is theoretically logical, yet in actual practice involves difficulties which impair its efficiency. It is namely impossible to maintain the two cores accurately opposite one another and mathematically on the same axis and, if even the slightest displacement occurs, the magnetic tension fluctuations transmitted by the cores to the wire tend to be levelled. This trouble is completely done away with by the process forming the subject matter of the present invention. In the novel process a single electromagnet is employed, having a single pole arranged and maintained in sliding contact with the metal surface on which the impression is to be made. One and the same electromagnet serves for recording and for reproducing the sounds.

The cancelling or, better said, the levelling of the various magnetic intensities impressed and retained, by coercitive force, by the steel wire or ribbon, was heretofore obtained by causing a direct current to flow through the turns of the electromagnet while the wire was made to run in front of the cores, but the cancellation thus obtained never is a perfect one owing to the self-inductions.

The cancelling process contemplated by the invention consists in letting a pole of a permanent magnet slide on the magnetic impressions of the wire, ribbon, drum or disc, thus determining the magnetic levelling which is a perfect one, since in this case all self-induction phenomena are absent.

On this principle of the electromagnetic recording of sounds has been thought out the process for making records on cylinders and discs, which constitutes the subject matter of the invention. The process essentially consists: For the registration of sounds; in letting the magnetic point of an electromagnet electrically connected (across a radiophonic amplifier) to a microphone or to a telephonic transmitter of the sounds to be recorded, pass in a straight helicoidal or spiral line on a single surface of a cylinder or disc made of steel or other magnetic material, in such a manner that the magnetic point shall determine along the said straight, helicoidal or spiral line magnetic-intensity variations corresponding to the harmonic of the sounds; whereas the reproduction of the said sounds is obtained by causing (with suitable mechanical means) the resulting magnetic spiral to pass in front of the point of the same electromagnet that has been employed for the registration.

In this manner the variations in the magnetic intensities of the magnetic spiral will determine, by induction, corresponding variations of rectified electromagnetic tensions which (across a low frequency radiophonic amplifier) can be reproduced in a loud-speaker or in a headphone.

Such a system may be utilized in the preparation and corresponding reproduction of magnetophonic discs and cylinders (which in the case of cylinders may carry a long registration), as well as for the registration and transmission of eventual telephone communications from any telephone of a town network, which can be obtained with suitable arrangements that will be explained by way of example further below. The system may also be utilized for intercepting conversations or for registering sounds of any kind by means of a suitable microphone.

Besides, by means of special microphones, the internal sounds of several organs of the human body can be registered.

For a better understanding of the system at issue, to the present description are attached two diagrams (Figures 1 and 2) of an embodiment in which, only by way of example, the case of registration of sounds on a steel cylinder is considered; the system however is applicable, with convenient mechanical adaptations, also to discs and the like. The diagram refers more precisely to an apparatus for the registration of microphonic or radiophonic sounds and for their reproductions in a loud-speaker, the apparatus essentially comprising:

(I) A mechanical device A consisting of the sound registering electromagnet and the registering cylinder driven by an electric motor;

(II) A radiophonic set comprising an oscillating set B separate from the low frequency amplifier C;

(III) A set of change-over switches D—E—F adapted to establish the various connections between the radiophonic portion and the electromagnet of the mechanical device A;

(IV) A relay G which serves to establish the connection of the apparatus with the telephone line or with a determined microphone receiver of the sounds to be registered.

The apparatus is connected to a loud-speaker H or to a headphone.

The mechanical apparatus A comprises a preferably cast iron base 1 having a support 2 on which is mounted a steel cylinder 3 adapted to revolve about its axis, the shaft 4 of the cylinder being connected by pulley 5 and shaft 6 to an electric motor 7 mounted in the apparatus itself and fed, for instance, from the lighting line 8.

The connection of the motor 7 with the said line is through: leads 9, switch 10, relay G and leads 11.

On the base 1 is also arranged a screw-threaded rod 12 revolvable about its axis and kinematically connected through gear wheels 13 to the shaft 4 of the cylinder 3 in such a manner that said rod can revolve only in synchronism with the said cylinder. On the screw-threaded rod 12, a support 14 is screwed, this support carrying the electromagnet 15, so that the rotation of the rod 12 will determine a longitudinal travelling motion of the said electromagnet.

The electromagnet core 16 ends with a point in sliding contact with the cylinder 3.

The electromagnet 15 is electrically connected by leads 17 and 17' to the contacts 18 and 19 of the switch E, said contacts being connected to the leads 20 and 21; the lead 20 is connected to the contact 22 of the change-over switch E and to the contact 23 of the change-over switch F, while the lead 21 connects the contact 24 of the change-over switch E to the contact 25 of the change-over switch F. The two movable contacts 26 and 27 of switch F are connected to the two outlet terminals 28 and 29 of the amplifier C.

30, 31, 32, 33 are the movable contacts of the change-over switch E; 34 and 35 are the movable contacts of the change-over switch D. The contacts 30 and 31 are connected by leads to the stationary contacts 36 and 37 of the change-over switch F, while the contacts 32 and 33 are connected to the stationary contacts 38 and 39 of the change-over switch D.

The contacts 40 and 41 of switch D are connected to the terminals 42 and 43 of the oscillating set B.

The contacts 44 and 45 of the switch E are connected to the loud-speaker H.

The contacts 46 and 47 of the same switch E are connected through lead 48, lead 49 and relay G to the telephone line 50 or to any microphone.

51 and 52 are the inlet terminals of the amplifier, these terminals being connected to the movable contacts of the switch D.

Let us suppose the apparatus to have to serve for the reception of communications from the town telephone network and to be therefore connected up to the telephone line 50.

When a telephone call takes place, the call trips the relay G, which will connect the motor 7 to the lighting line 8; the call will simultaneously connect the telephone line 50 to the conductors 48 and 49 leading to the contacts 46 and 47 of switch E, the movable contacts of which will have been previously moved into the position shown by dots in the diagram. The movable contacts of the switches D and F on the contrary will have been moved into the position shown by full lines.

With the said position, the secondary of the microtelephone is connected (through the contacts 32 and 33 of switch E and through switch D) to the inlet terminals 51 and 52 of the amplifier, while the outlet terminals of this amplifier are connected to the electromagnet 15 by two lines, namely line 28, 26, 25, 21, 19, 17 and line 29, 27, 23, 20, 18, 16.

The motor 7 fed from the lighting line determines the revolution of the steel cylinder 3 and of the screw 12; in its turn the screw 12 determines the longitudinal travelling motion of the electromagnet 15, the movable magnetic point of which, in combination with the rotation of the cylinder, will slide on the cylinder and describe an helicoidal line the pitch of which will be determined by the ratio of the wheelgear 13 and by the pitch of the screw 12.

The intensity variations in the electromagnet 15 determined by the electromagnetic variations in the microtelephone during the telephonic transmission, will be transformed into pulsating variations of the magnetic intensities of the core 16; these last variations will be registered on the cylinder 3 and will be retained by coercitive force. On cessation of the telephonic communication, the man who was speaking hangs up the microtelephone to the hook of his apparatus and by so doing, owing to the cessation of the current, determines the working of the relay G which interrupts the lighting circuit and consequently also the circuit of the motor 7, thus automatically bringing to a stop the working of the apparatus.

If afterwards it is desired to hear the communication registered on the cylinder and, therefore, to re-transmit the said communication in the loud-speaker H, it will suffice to move the electromagnet 15 into its starting or initial position (this can be done accurately by means of a suitable initial stop) and to start the motor 7, thus causing the core 16 to slide along the magnetic spiral registered on the cylinder 3.

For the repetition, all change-over switches must find themselves in the position shown in full lines, in which case the switch D disconnects the oscillating circuit B, and the switch F connects the loud-speaker to the amplifier.

The induced currents across the circuit formed by the connections 16, 18, 32, 38, 34, 51 and by the connections 17, 19, 33, 39, 35, 52, reach the inlet of the amplifier C, the outlet of which is connected as above stated to the loud-speaker which will transmit in a perfect manner the registered communication.

Obviously, if instead of the town telephone line, a microphone is assumed, the reception will be the same. Also in this case, words and sounds may be registered on the cylinder in order to be re-transmitted either with the same apparatus or with other apparatus fitted with the mechanical device.

It will also be understood that the magnetic registration above described may be carried out as well on steel discs or the like as is done for gramophone discs, with the mere variation of the mechanical device A which must be fit to rotate the disc instead of the cylinder; the transmission of the disc may be carried out with the registering apparatus itself.

It is practicable to make registrations on radio reception cylinders and discs; it suffices to set the apparatus switches F and D in the dotted position, and the switch E in the repetition position, viz. in the position shown in full lines.

The apparatus may also be used for radiophonic receptions alone; to this effect it suffices to set the switch D in the dotted position and to leave the other two switches in the position indicated on the drawings, which corresponds to the full line position.

In diagram of the Figure 2, the relay G is so designed as to possess the features of a great simplicity in construction and working as, for instance, will be described below. In the description hereunder is described also a modified form of the connection of the various stages of the radio to the sound-registering and repeating bobbin; the said modified connection permits of carrying out the registration with only two low frequency stages, and the repetition with four stages, this securing a strong and clear loud-speaker transmission.

In the said diagram the change-over switches controlling the apparatus are so arranged as to form a single change-over switch of multiple type.

Diagram of the Figure 2 represents the apparatus in sound-registering conditions. 53 is the switch connecting the telephone and the registering bobbin; L^1—L^2 are the terminals to which the telephone line is led; R—R are the two terminals of the telephonic apparatus connected in parallel to the multiple change-over switch X; 57 is a contact controlled by the relay 55; 56 is a battery connected to the contacts 57—58—59 through the relay 56'; 60 is a contact likewise controlled by the relay 56' and connected to the contacts of the telephone hook. To the relay 56' are led the two lines 62 and 63 which, at 64 65, are connected to the screw-threaded spindle 66 and to the stationary rod 67. On said spindle 66 is screwed the support 68 of the bobbin 15, while on the rod 67 the movable contacts 69—70—71 are mounted. The bobbin 15 is connected to the switches 20 and 21.

As already said, the telephone line is led to the telephone terminals L^1—L^2. The switch 53 being maintained open, as soon as a call is made the current that causes the bell to ring attracts the armature of the relay 55 which operates the closure of the contact 57.

Contact 57 closes the circuit of the battery 56 through the relay 56' which in its turn closes the contacts 58—59—60.

Contact 58 locks the armature of relay 56'; contact 59 closes the lighting line circuit in order to actuate the motor driving the sound-registering apparatus; contact 60 closes the contacts of the telephone hook.

The two lines 62 and 63 starting from the end of the winding of relay 56' lead up to the automatic switch (at 64 and 65) fitted to the registering apparatus.

The automatic switch works in the following manner:

Parallel to the screw 66 (which imparts the travelling motion to the bobbin-carrier 68), a metal rod 67 is provided on and electrically insulated from the support of the screw 66, this support carrying a certain number of movable contacts, for instance 69—70—71, adapted to be moved away from each other in such a manner as to determine a given time-period taken by the bobbin-carrier 14 to enter in touch with a movable contact and with the next one. Any time the bobbin-carrier comes in touch with one of these movable contacts the circuit of the battery 56 is closed and the relay 56' is disconnected; the relay, being no longer traversed by the current, releases its own armature, whereby also the contacts 57—58—59—60 are released and all parts are restored into their starting position, so that the apparatus is ready for the reception of further telephone communications.

The telephonic communication reaches the receiver at R—R. The receiver is connected in parallel to the multiple switch X at the contacts 38 and 39 which, through the movable contacts 20' and 21', become connected: through 20' with the grid of the last but one amplifier valve the switch 72 being closed at 73, and through 21' with the earth 51.

The exit terminals of the amplifier 28 and 29 are connected (through the switch and by means of the contacts 75 and 76) to the feed of the bobbin 15 and loud-speaker H, the bobbin and the loud-speaker being connected with one another in series. The change-over switch 72, in order to connect the telephone to the amplifier, must close the circuit at 73.

In order to reproduce the registered communication, the movable contacts 21'—20'—77—78—79—80 must be carried into touch with the contacts 82—81—83—84—85—86 respectively. The terminal 76 of the bobbin will then be connected up (through contact 86) to the grid of the first pre-amplifying valve of the amplifier, and the terminal 75 will be connected to the earth 51 across the contact 85.

The exit terminal 28 of the amplifier is connected, through contact 83, to the terminal 77 of the loud-speaker; the exit terminal 29 of the amplifier is connected, through contact 84, to the other terminal 78 of the loud-speaker.

In order to simultaneously register and hear the radiophonic communications, the change-over switch 72 should be moved into touch with 74, and the movable contacts of said switch should be moved into the positions 87—88—89—90—91—92. The exit terminal 28 will then result to be connected, through the exit contact 89, to the terminal 77 of the loud-speaker which is connected in series to the bobbin 15. The exit terminal 29 of the amplifier is connected, through contact 88, to the bobbin terminal 76; the bobbin terminal 75 is connected to the loud-speaker at 93. In order to obtain the repetition of the registered sounds, the change-over switch should be moved into its second position.

As will be gathered from the diagram herewith attached, the registration of the sounds is accomplished with only two low frequency stages, whereas the repetition is carried out with four stages.

With the apparatus set according to the diagram herewith attached, when the apparatus is called up by a telephonic apparatus, the motor at once starts the rotation of the screw 66, and the bobbin begins to travel till it encounters the contact 70 which then, across the contact 57, short-circuits the relay 57', thus interrupting the communication and determining the stoppage of the bobbin 15.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Apparatus for electromagnetically recording sound upon steel objects such as steel cylinders, disks, bands and the like and for repeating the recorded sounds, comprising the combination, of a microphone, a recording electromagnet, a loud-speaker having a coil, a low frequency amplifier interposed between said microphone and said electromagnet for recording, said amplifier including two low frequency stages in cascade, and at least one pre-amplifying stage interposed before said two cascade stages, there being a multiple changeover switch for inserting solely the two cascade stages for recording, and for insert-

ing all three stages in series for reproducing or repeating.

2. Apparatus for electromagnetically recording sound upon steel objects such as steel cylinders, disks, bands and the like and for repeating the recorded sounds, comprising the combination, of a microphone, a recording electromagnet, a loudspeaker having a coil, a low frequency amplifier interposed between said microphone and said electromagnet for recording, said amplifier including two low frequency stages in cascade, and two pre-amplifying stages interposed before said two cascade stages, there being a multiple changeover switch for inserting solely the two cascade stages for recording and for inserting all the four stages in series for reproducing or repeating.

3. Apparatus according to claim 1, including a relay and a battery for operating the same, there being driving means for the cylinder, disk, band or other steel object, which relay is capable of connecting the driving means with a current source and causing the recording electromagnet to be energized by connecting the same with a separate current source upon actuation of said relay by an incoming telephone call and simultaneously connecting the recording electromagnet in shunt through the two low frequency cascade stages.

4. Apparatus according to claim 1, including a relay and a battery for operating the same, there being driving means for the cylinder, disk, band or other steel object, which relay is capable of connecting the driving means with a current source and causing the recording electromagnet to be energized by connecting the same with a separate current source upon actuation of said relay by an incoming telephone call and simultaneously connecting the recording electromagnet in shunt through the two low frequency cascade stages, a contact bearing rod having a plurality of contacts fixed thereon at predetermined distances capable of making contact with the recording electromagnet and effecting a short-circuiting of the relay upon cessation of the telephone call and effecting interruption of the connection with the current source and disengagement of the telephone apparatus.

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