

March 6, 1934.

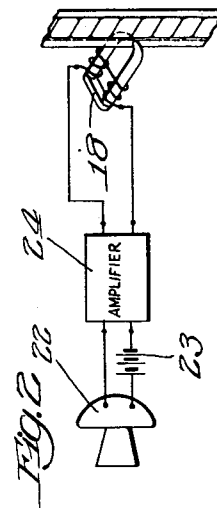
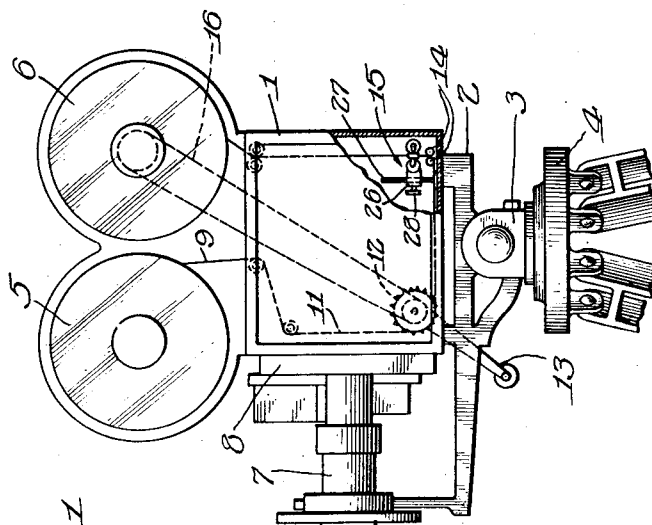
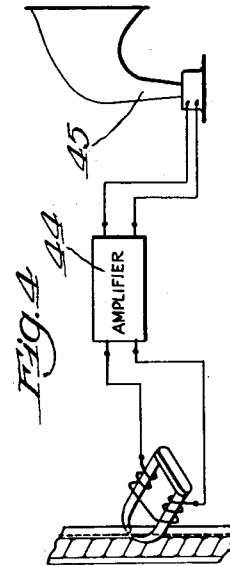
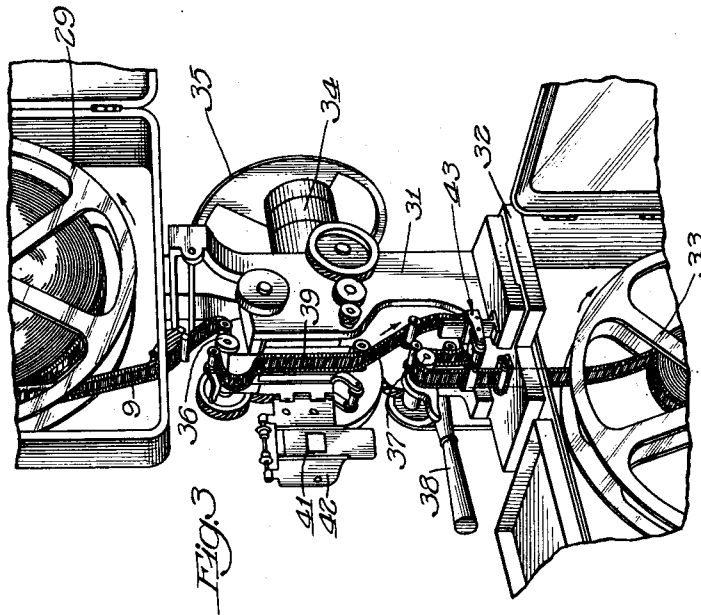
T. COHEN

1,949,409

SOUND RECORDING AND REPRODUCING APPARATUS

Filed Jan. 11, 1930

4 Sheets-Sheet 1



Inventor:
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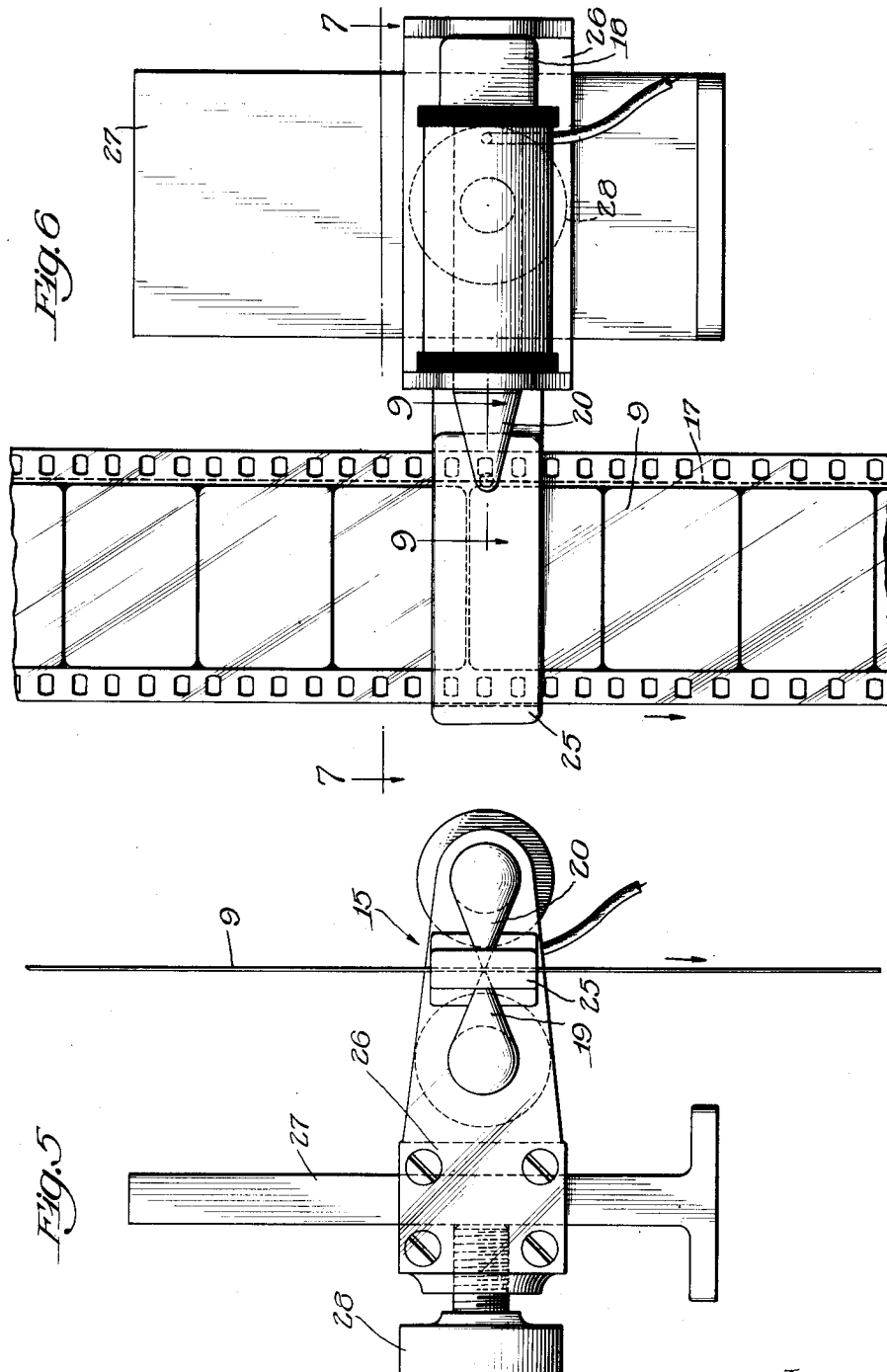
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4 Sheets-Sheet 2



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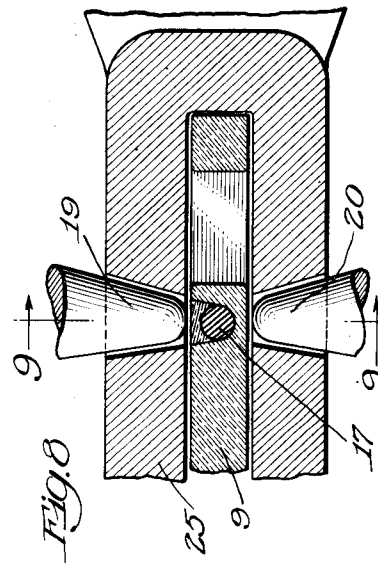
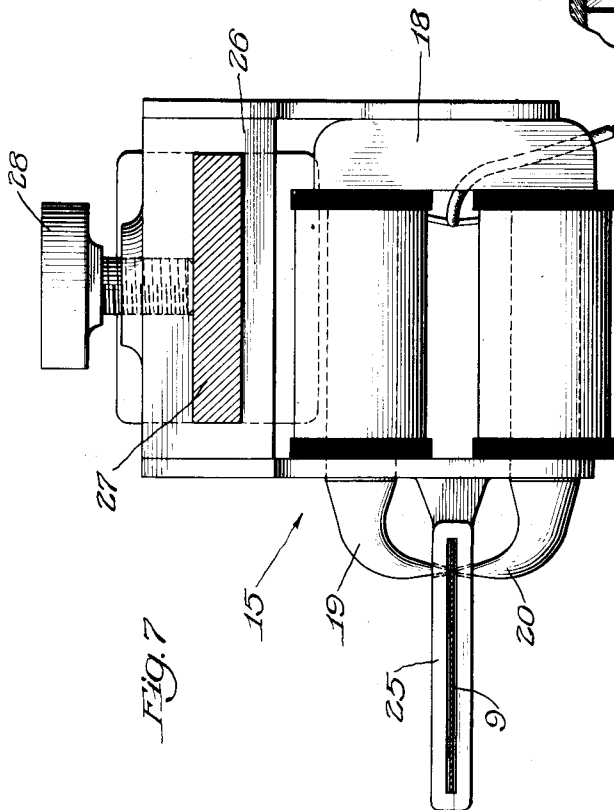
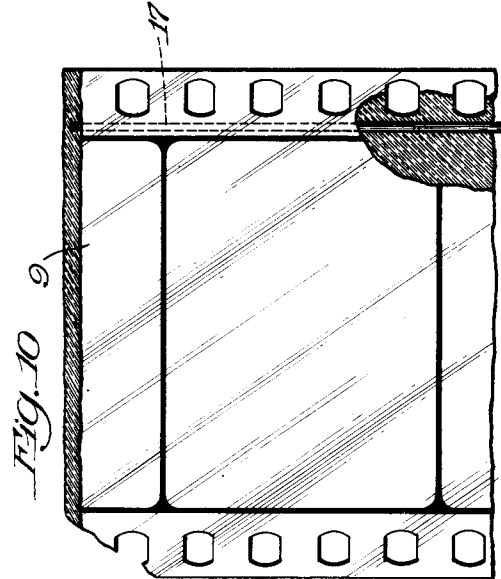
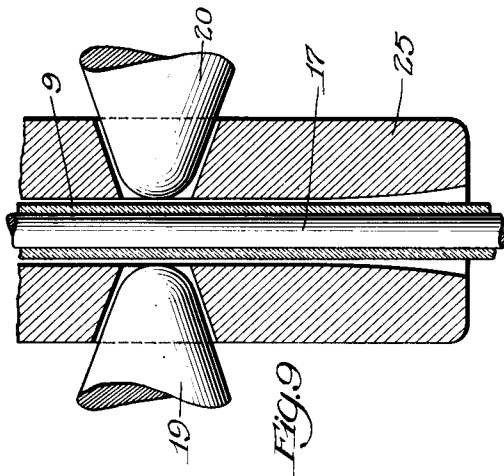
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1,949,409

SOUND RECORDING AND REPRODUCING APPARATUS

Filed Jan. 11, 1930

4 Sheets-Sheet 3



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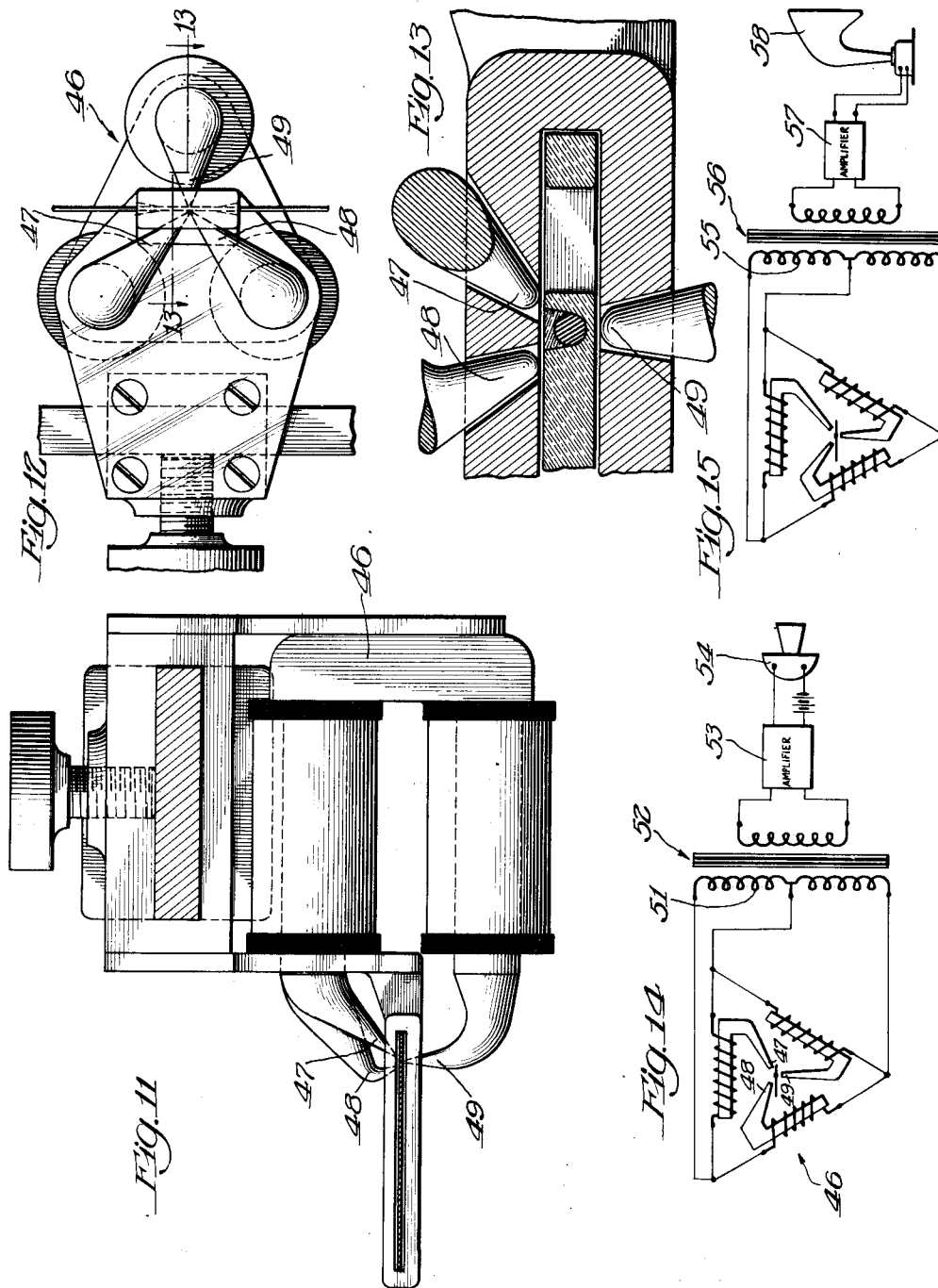
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SOUND RECORDING AND REPRODUCING APPARATUS

Filed Jan. 11, 1930

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

1,949,409

SOUND RECORDING AND REPRODUCING
APPARATUSTheodore Cohen, Chicago, Ill., assignor to Scien-
tific Research Trust, Chicago, Ill.

Application January 11, 1930, Serial No. 420,093

14 Claims. (Cl. 179—100.2)

This invention relates to sound recording and reproducing apparatus in general and more particularly to such apparatus as is adapted for use in conjunction with motion pictures.

8 Sound recording reproducing apparatus such as has been used in the past usually involves some outward physical change on the recording medium such as variations in the surface there-
10 of or variations in the opaqueness thereof, which variations may be transmitted through the inter-
mediary of a phonograph needle or a photo-
electric cell to reproduce the sound. I have found
15 that the internal molecular structure of metal may be affected magnetically to vary such internal
structure in accordance with sound, and the
20 structure as thus varied may be retained and caused to reproduce the sound which caused the change.

The primary object of this invention is, accord-
20 ingly, to provide an apparatus whereby sound may be recorded magnetically and reproduced magnetically.

Another object of this invention is to provide
25 an apparatus which may be used in conjunction with motion pictures for recording sound cor-
responding to the pictures being taken and for reproducing the same sound in conjunction with
the projection of the pictures.

Other and further objects of this invention
30 will be apparent as the same becomes better understood from an examination of the specifica-
tion and claims in conjunction with the accom-
panying drawings, wherein:

Fig. 1 represents a side elevation of the upper
35 portion of a motion-picture camera embodying this invention;

Fig. 2 is a diagrammatic sketch of the elec-
trical circuit embodied in the apparatus shown
in Fig. 1;

40 Fig. 3 is a fragmentary perspective view of a portion of a motion-picture projection machine
embodying this invention;

Fig. 4 is a diagrammatic sketch of the elec-
trical circuit of my invention embodied in the
45 apparatus shown in Fig. 3;

Fig. 5 is an enlarged fragmentary elevation of
a detail of the device embodying my invention;

Fig. 6 is a similar view taken from the right of
the detail shown in Fig. 5;

50 Fig. 7 is a section taken at the line 7—7 of
Fig. 6;

Fig. 8 is an enlarged section taken at the line
8—8 of Fig. 6;

55 Fig. 9 is a section taken at the line 9—9 of
Fig. 8;

Fig. 10 is a fragmentary elevational view,
partly in section, of a motion-picture film em-
bodying this invention;

Fig. 11 is a view corresponding to that shown in
Fig. 7, but illustrating a modified form of device
60 embodying this invention;

Fig. 12 is a view taken from the left of Fig. 11;
Fig. 13 is an enlarged fragmentary section
taken at the line 13—13 of Fig. 12;

Fig. 14 is a diagrammatic sketch of an electrical
65 circuit used in the modified form for recording;
and

Fig. 15 is a diagrammatic sketch of an electrical
circuit used in the modified form of this invention
70 for reproducing.

Referring to the drawings more particularly,
Fig. 1 represents more or less schematically a
standard motion-picture camera including a
housing 1 attached to a bracket 2 which is pivotal-
ly mounted upon a swivel 3 on a tripod 4. This
75 camera includes a part 5 for supporting a reel of
motion-picture film, and a part 6 for supporting
a reel on which the exposed film is adapted to be
wound. At the front of the housing 1 is supported
an optical device 7 and shutter mechanism 8 for
80 automatically exposing the various frames on
the film when they are in register with the optical
device.

The film strip 9 is brought from the reel in the
part 5 over idler rollers and passes vertically ad-
85 jacent the exposure point 11. The film, after
passing the exposure point 11, passes over a
sprocket wheel 12 which is manually driven by a
crank 13, and thereafter passes between a pair
of idler rollers 14, whence it passes through the
90 magnetic field of my improved magnetic record-
ing device, generally designated 15, and is deliv-
ered upwardly to the wind-up reel in the part 6.
The film is driven by the crank 13, which also
acts through the intermediary of a chain 16 con-
95 nected to sprocket wheels on the crank shaft and
wind-up-reel shaft for winding up the film on the
wind-up reel. The shutter mechanism 8 is so
geared, by means not shown, to the sprocket wheel
12 as to provide for automatically exposing the
100 frames on the film when they come in register
with the optical device 7. With the exception of
my device 15 and its relation to the aforemen-
tioned parts and certain characteristics of the
film about to be hereinafter described, these parts
105 are old and well known, and are therefore not
more particularly described.

The film strip 9 has embedded therein at one
side thereof a sound strip in the form of a very
small wire 17. This wire I have found to be prefer-
110

ably of ninety per cent. ordinary music-wire content, five percent nickel to increase the permeability of the wire, and five per cent. of cobalt to increase the retentivity of the wire. The film strip 9, as it passes the exposure point 11 in Fig. 1 and the device 15 at a predetermined distance therefrom, has recorded on it the motion picture being taken and the corresponding sound, the optical device 7 acting to record the picture, and the device 15, as will be hereinafter pointed out, acting to record the sound.

The device 15 includes a double-pole magnet 18. The pole pieces 19 and 20 of this magnet are tapered to very fine points, as shown more clearly in Figs. 8 and 9, and are supported on opposite sides of the film 9 in close proximity to the wire 17, so that substantially all of the flux flowing between these pieces will pass through the wire. This magnet 18 is an electrical magnet and is in circuit with a source of audio-frequency current which consists of a microphone 22, battery 23 and amplifier 24 for amplifying the current frequency produced by the microphone prior to delivery of these frequencies to the magnet 18. The fluctuations of current in the coils of the magnet 18 cause a fluctuation of the magnetic field between the pole pieces 19 and 20. This magnetic field, on account of the permeability of the wire 17, causes a change in the internal molecular structure of the wire. This change is retained on account of the retentivity of the wire, so that when the film is used in the motion-picture projector, as will be hereinafter described, it will cause reacting and corresponding variations in the magnetic field which will cause the reproduction of the original sound recorded on the wire.

The device 15 more particularly includes an annular guide member 25 for supporting the film 9 and wire 17 in desired relative position with respect to the pole pieces 19 and 20 as the film passes in its travel. This guide member 25 is supported on a bracket 26 vertically slidable on a standard 27. A thumb nut 28 threaded in the bracket 26 is adapted to engage the standard 27 to secure the bracket thereto at any desired position so as to adjustably support the guide 25. The magnet 18 is also supported by the bracket 26, as shown in Fig. 7, and the guide 25 is provided with apertures for the pole pieces 19 and 20. The standard 27 is provided with a suitable base for holding the standard in a vertical position for attaching the same by means of screws to the bottom of the housing 1 at one side of the path of the film strip.

In Fig. 7 there is shown a standard motor-driven motion-picture projection machine, including a stack reel 29, means for supporting the same, a housing 31 and a base 32 containing a wind-up reel 33 and means for mounting the same. The projection machine also includes an optical device 34, a shutter 35, a motor not shown, for advancing the film, and sprocket rollers 36 and 37 drivingly connected to the motor through the intermediary of a clutch which is operable by a lever 38. The film strip is advanced over suitable idler rollers, over a position 39 in the housing 31 by means of the sprocket rollers 37 and 36. This position 39 is adapted to register with an opening 41 in a gate 42 for the housing 31, said gate containing a source of light adapted to be emitted through said opening for projecting the film through the optical device 34. The rollers 36 are operable in synchronism with the shutter 35 by suitable means (not shown), so that the optical device 34 will

project the film at the instant that each frame is in register with the opening 41 when the gate 42 is closed. The parts of this motion-picture projection machine described, including the mechanism for advancing the film 9 and the shutter in synchronism therewith, are old and well known, and are therefore not more particularly described.

In addition to the parts of the motion-picture projection machine just described, I provide a device 43 which is identical in all respects with the device 15 and is adapted to have the film strip 9 pass through it in exactly the same manner as the film strip 9 passed through the device 15. The wire 17 with the sound recorded thereon in this instance passes between the pole pieces of the magnet on the device 43 exactly as it passed between the pole pieces of the magnet on the device 15. This device 43 is mounted on the motion-picture projector machine structure in such a manner that the distance between the point where the wire passes between the pole pieces and the point 39 is exactly the same as the distance between the point 11 and the point where it passed between the pole pieces of the device 15 when the sound was recorded, so that the sound which is taken off of the wire by the device 43 will correspond exactly to the same frame of the strip 9 that was filmed when this sound was recorded.

The magnet on the device 43 is connected electrically as shown in Fig. 4, wherein it is shown that the coils of the two poles of this magnet are connected to the input of an amplifier 44, the output of which is in turn connected to a reproducer 45. As the wire 17 passes between the pole pieces of the magnet of the device 43, the molecular changes in the internal structure of the wire which were produced by the pole pieces of the magnet of the device 15 cause corresponding impedances to the flow of magnetic flux, and this sets up corresponding fluctuations in the input of the amplifier 44, whereby corresponding amplified fluctuations are delivered to the reproducer 45.

In the modification shown in Figs. 11 to 15, the apparatus is substantially the same as that just described with the exception that, in place of the two-pole magnet 18, a three-pole magnet 46 is used having pole pieces 47, 48 and 49, respectively, and the pole pieces of this magnet are electrically connected somewhat differently, as shown in Fig. 14, for the recording apparatus, and, as shown in Fig. 15, for the reproducing apparatus. As shown in Fig. 14, the coils of the poles of the magnet are connected together in delta fashion to the secondary 51 of output transformer 52 for the amplifier 53, the latter having its input connected to a microphone 54. As shown in Fig. 15 for the reproducer circuit, the magnet itself is substantially the same as the magnet 46 shown in Fig. 14, and the three poles of the magnet are connected in delta fashion to the primary 55 of input transformer 56. The secondary of transformer 56 is connected to the input of an amplifier 57, the output of which is connected to a reproducer 58.

In this modification employing the magnet having three pole pieces for recording and reproducing, the pole pieces are, as before, tapered (see Fig. 14), so as to require substantially all of the magnetic flux to flow through the wire forming the sound track. The ends of the pole pieces are arranged in triangular relation with respect to each other, the wire being substan-

tially in the center, whereby the molecular change in the wire brought about in the recording process and which is effective to cause the reproduction is most efficient.

5 By the use of the bracket 26 slidably supported on the standard 27 the magnet carried by said bracket may be adjusted longitudinally of the film and sound track to accommodate any variations in distances between the pictures and corresponding sound.

10 Other advantages and the operation of the aforescribed apparatus will be apparent without further description.

I am aware that many changes may be made without departing from the principles of this invention, and I therefore do not wish to be limited to the details shown or described.

I claim:

1. In an apparatus of the character described, an alloy containing nickel and cobalt and adapted to have sound magnetically recorded thereon.

2. In an apparatus of the character described, the combination of a movable metallic member having permeability and retentivity and relatively stationary magnetic means having at least three poles adapted to create a predetermined fluctuating magnetic field for correspondingly altering the molecular structure of said member over a predetermined path thereon.

3. In an apparatus of the character described, the combination of a movable metallic member having permeability and retentivity and relatively stationary magnetic means having at least three poles adapted to create a predetermined fluctuating magnetic field for correspondingly altering the internal molecular structure of said member over a predetermined path thereon and magnetic means adapted to be proportionally effected by said alterations as said member is actuated to move said path through the field of the latter magnetic means for controlling an electric circuit in proportion to the predetermined fluctuations of the first magnetic field.

4. In an apparatus of the character described, the combination of a motion-picture film, a sound strip co-operable therewith and means including a plurality of pole pieces cooperating together magnetically and adjustably mounted for recording sound on said strip at a plurality of points thereon corresponding to a given point on the film.

5. In an apparatus of the character described, a metallic sound strip having a substantial content of a metal adapted to increase the permea-

bility of the strip and a substantial content of a metal adapted to increase the retentivity of the strip.

6. In an apparatus of the character described, an alloy containing approximately five per cent nickel and approximately five per cent cobalt and adapted to have sound magnetically recorded thereon.

7. In an apparatus of the character described, a metallic member movable in a predetermined path and magnetic means having more than two poles for creating an angular magnetic field for correspondingly altering the molecular structure of said member transverse to the path thereof.

8. In an apparatus of the character described, a metallic member movable in a predetermined path and split-phase magnetic means for creating an angular magnetic field for correspondingly altering the molecular structure of said member transverse to the path thereof.

9. In an apparatus of the character described, an alloy containing approximately five per cent nickel and adapted to have sound magnetically recorded thereon.

10. In an apparatus of the character described, an alloy containing approximately five per cent cobalt and adapted to have sound magnetically recorded thereon.

11. In an apparatus of the character described, an alloy containing a substantial content of nickel to increase the permeability of the alloy, said alloy being adapted to have sound magnetically recorded thereon.

12. In an apparatus of the character described, an alloy containing a substantial content of cobalt to increase the retentivity of the alloy, said alloy being adapted to have sound magnetically recorded thereon.

13. In an apparatus of the character described, the combination of a sound strip, a carriage member mounted for adjustment longitudinally of the strip and a plurality of pole pieces carried by said member and co-operating together magnetically for reproducing sound from said strip.

14. In an apparatus of the character described, the combination of a motion picture film, a sound strip co-operable therewith, a carriage member mounted for adjustment longitudinally of said strip and film and provided with a guide opening therefor; and a plurality of pole pieces carried by said member co-operating together for reproducing sound from said strip.

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