

Nov. 3, 1942.

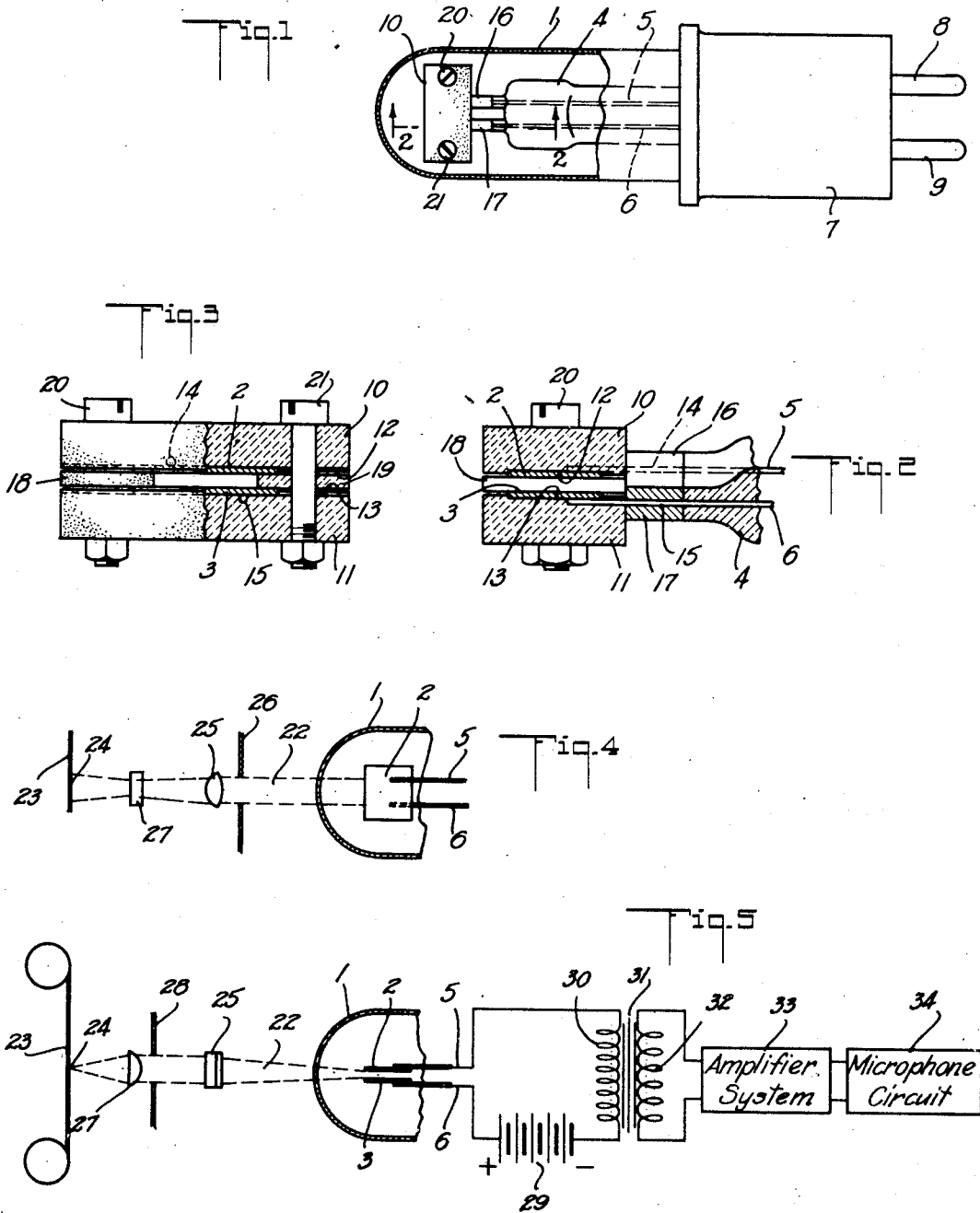
A. E. REEVES

2,300,809

GLOW TUBE

Filed Jan. 16, 1939

2 Sheets-Sheet 1



INVENTOR

Arthur E. Reeves

BY

John Flam

ATTORNEY

Nov. 3, 1942.

A. E. REEVES

2,300,809

GLOW TUBE

Filed Jan. 16, 1939

2 Sheets-Sheet 2

Fig. 6

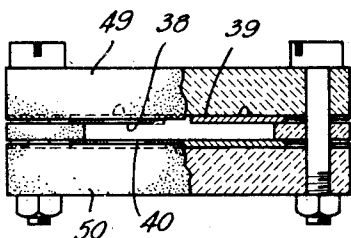
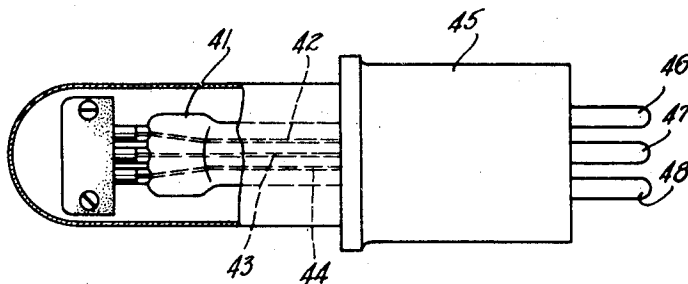


Fig. 7

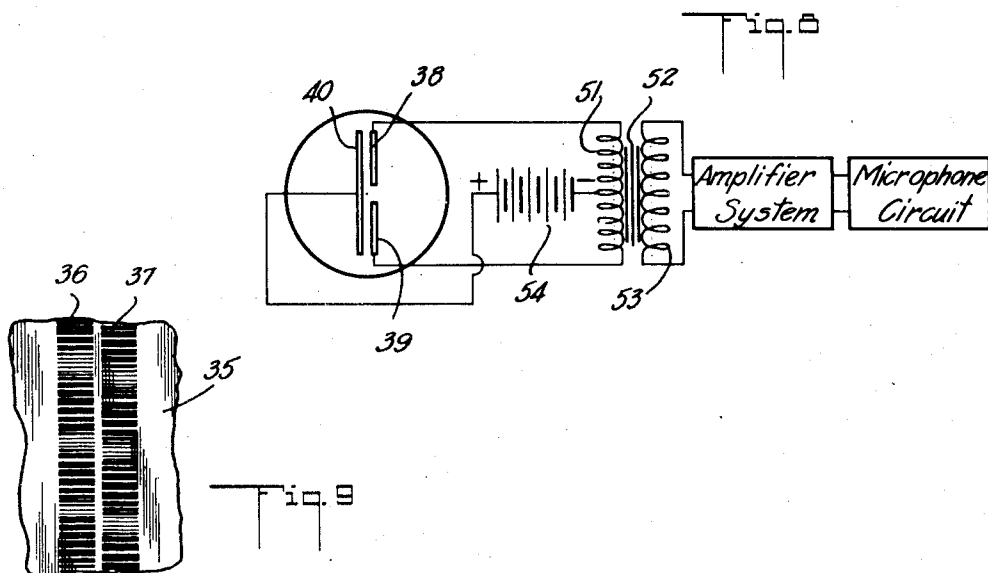


Fig. 8

INVENTOR
Arthur E. Reeves
BY *John Flam*
ATTORNEY

UNITED STATES PATENT OFFICE

2,300,809

GLOW TUBE

Arthur E. Reeves, Los Angeles, Calif.

Application January 16, 1939, Serial No. 251,155

3 Claims. (Cl. 179-100.3)

This invention relates to sound recording; and particularly by photographic means.

Such systems are in general use. The recording is accomplished by varying the intensity of a beam of actinic radiations, which is directed toward a moving medium carrying a photosensitive surface. Motion picture film is usually employed for this medium, especially where the "sound track" or record is to be utilized for talking motion pictures.

The source of variable illumination may be any of several types; but this invention deals with glow tubes that have been commonly employed for this purpose. Such glow tubes employ a pair of spaced electrodes in a sealed transparent vessel; the potential difference across the electrodes is such as to produce a glow discharge. The intensity is varied by superimposing variations upon the potential difference in accordance with the impulse to be recorded, and the attendant variations in glow intensity affect the density of the ultimate photographic image.

While glow tubes of this character have been satisfactorily employed, there is difficulty in securing sufficient luminosity; and often the glow variations do not accurately follow the impulses. This lack of fidelity is often due to overloading of the tube, in an effort to secure adequate illumination.

It is one of the objects of this invention to make it possible to overcome these difficulties.

In using glow tubes, the current glowing between the electrodes produces heating. It is another object of this invention to make it possible in a simple manner to dissipate the heat.

It is still another object of this invention to arrange the electrodes in such manner as to secure a more intense illumination. In this connection, there is provided a lens system to produce an image of the glow focused upon the recording surface; this image is of the desired size to obviate the necessity of a mechanical slit, and the reduction in size also produces a greater intensity of illumination.

It is still another object of this invention to make it possible in a simple manner to record a double sound track simultaneously.

This invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of several embodiments of the invention. For this purpose there are shown a few forms in the drawings accompanying and forming part of the present specification. These forms, which illustrate the general principles of the invention, will now be

described in detail; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a side elevation, partly in section, of a glow tube embodying the invention;

Fig. 2 is an enlarged sectional view, taken along plane 2-2 of Fig. 1;

Fig. 3 is a view, partly in section, taken from the left of Fig. 2;

Fig. 4 is a diagrammatic plan view of a recording system utilizing the invention;

Fig. 5 is a diagrammatic elevation of the system shown in Fig. 4;

Fig. 6 is a view similar to Fig. 1, but of a modified form of the invention;

Fig. 7 is an enlarged fragmentary end view, partly in section, of the glow tube elements of Fig. 6;

Fig. 8 is a schematic wiring diagram illustrating the manner in which the glow tube of Fig. 6 may be utilized; and

Fig. 9 is a fragmentary view of a sound record made by the aid of the system illustrated in Fig. 8.

The glow tube illustrated in Figs. 1, 2 and 3 includes a sealed transparent envelope 1. This envelope may be made from such material as glass or Pyrex, capable of passing substantially all wave lengths in the visible spectrum. The glow is intended to be produced over an extensive surface of one of a pair of electrodes 2 and 3, which are shown as closely spaced in this instance. These electrodes are made from suitable sheet metal, having similar opposed surfaces. In the present instance these surfaces are parallel planes. The spacing between the surfaces is such that the usual potential differences of several hundred volts across the electrodes may cause the creation of a glow between the electrodes or over one of the electrode surfaces. A suitable combination of ionizable rare gases at the usual pressures, may be employed in the envelope.

These electrodes are supported within the tube or envelope 1 in any suitable manner. For example, a glass press 4 may be provided extending longitudinally of the tube 1. In this press are sealed the lead-in conductors 5 and 6 for the electrodes 2 and 3 respectively. A base 7 of insulation material, with suitable prongs 8 and 9, is affixed to the right hand end of the envelope 1. The lead-in wires 5 and 6 are attached to the respective electrodes in a manner to be hereinafter described.

The electrodes are so arranged that a beam of actinic rays emerges from the left hand end of the envelope 1, in a thin, flat form, and edge-wise from between the active electrode surfaces. Thus the glow from the whole space between these electrodes is rendered effective to add to the beam intensity. Provisions are made to limit the glow to the space between the electrodes, as by covering the reverse sides of the electrodes by a layer of insulation.

Preferably in the present instance, these electrode surfaces are covered by the comparatively massive blocks 10 and 11, made of a refractory insulation material, such as lavite. The opposed faces of these blocks are recessed as indicated at 12, 13, for the reception of the electrodes. The connections 14, 15, forming extensions of the lead-in wires 5 and 6, are accommodated in appropriate grooves in these blocks. Beads 16, 17 may respectively be placed over the connections 14, 15, and between the edge of the corresponding block 10, 11 and the end of the press 4. In order to lend further rigidity to the electrode structure, as well as to maintain the active electrode surfaces at the desired separation, spacers 18 and 19 may be provided adjacent the lateral edges of the blocks 10, 11. Bolts 20, 21 may be used to fasten the assembly together.

The areas of the spaced active electrode surfaces are made quite substantial. The current density of the electrode surface is therefore low during glow periods, even when a relatively heavy modulating current passes between the surfaces. Accordingly, the variations in glow intensity follow very faithfully the impulses to be recorded, irrespective of the intensity of the impulses.

The passage of the glow current between the electrodes 2 and 3 produces a considerable amount of heat. The massive blocks 10 and 11, being in good heat receiving relation with respect to the electrodes, serve to receive the generated heat and to dissipate it effectively.

As stated hereinbefore, the glow between the electrodes 2 and 3 is in the form of a thin flat sheet. As shown most clearly in Figs. 4 and 5, the glow produces a narrow beam of illumination 22; it is caused to affect a photosensitive surface on a moving film 23 to produce a variable density record. An optical system is provided through which the beam 22 is so refracted as to produce a reduced brilliant image of the glow upon the film 23 at the place 24. This system is so arranged that the thickness of the image in the direction of travel of film 23 is sufficiently small, considering the speed of film travel as to make it possible to record the highest desired frequencies. In the usual systems, this thickness is of the order of one or two thousandths of an inch. The width of the beam is restricted to agree with the desired width of the sound track.

To effect these results, the optical system includes a cylindrical lens 25 having opposite cylindrical surfaces. This lens acts to reduce the width of the beam 22. If desired a slot forming plate 26 may be interposed in the path of the beam to ensure against transmission of light beyond the edges of the lens 25. The thickness of the glow image is reduced to the desired value by the aid of another cylindrical lens 27, the axis of which is parallel to the width of the beam 22. This lens acts to focus the reduced image onto the film 23. If desired, a slot forming plate 28 may be interposed between lenses 25 and 27 to ensure against any undesired light transmission.

A very brilliant effect is obtained, with attend-

ant well-defined record lines even for low intensity signals. This effect is due to the cooperation of several features incorporated in the apparatus. One is that the glow between the electrodes 2 and 3, forming a glow discharge which may be a positive column or a negative glow, is distributed over a considerable area, and this glow is presented edgewise toward the recording medium 23. Accordingly the full depth of the glow is effective. Another element entering into the creation of a satisfactorily luminous recording beam is the provision of the cylindrical lenses that reduce the glow image to the prescribed dimensions needed. Furthermore, such a lens system obviates any mechanical slits or their equivalents.

In Fig. 5, there are indicated simplified electrical connections for a recording system utilizing the glow tube. For example, the electrodes 5 and 6 can be connected to opposite sides of a source 29 of direct current of the order of several hundred volts. In series with this source is the secondary coil 30 of a transformer 31. The primary coil 32 is shown as fed from an amplifier 33, the input side of which may be connected to an appropriate source of impulses to be recorded, such as the microphone circuit 34. With the microphone circuit 34 inactive, the potential of source 29 is sufficient to produce a glow of intermediate intensity between the electrodes 2, 3. As the transformer 31 however transmits impulses to the electrode circuit, these impulses modulate the electromotive force across the electrodes, and consequently the intensity of the glow.

In the form of the glow tube illustrated in Figs. 6, 7 and 8, one of the electrodes is made in two parts so as to form a double sound track record. Such a record is illustrated in Fig. 9. Here the film record carrier 35 is shown as carrying the variable density tracks 36 and 37, offset in phase. There are inherent and distinct advantages that are now well recognized, of such double track records. It is relatively simple to obtain such a double track by the aid of this invention. Thus the double track record can be obtained by providing a split cathode with the electrically separated parts 38, 39. The anode 40 has a surface cooperating with both parts 38, 39. The structure of the glow tube is quite similar to that already described. However, since one electrode is split, the supporting press 41 serves as a seal for three lead-in wires 42, 43, 44, which connect respectively to the electrode elements 38, 39, 40. Likewise the tube base 45 is provided with three connecting prongs 46, 47, 48. The lavite blocks 49, 50 serve the same purpose as the blocks 10 and 11 of the first form described.

The wiring diagram, Fig. 8, illustrates how the double record may be secured. The parts 38, 39 of the cathode are connected to opposite terminals of the secondary coil 51 of the transformer 52. The primary coil 53 is connected to the source of impulses in the same manner as primary 32 in the system of Fig. 5. The anode 40 is connected to the positive terminal of the source of direct current 54. The negative terminal thereof connects to the midpoint of secondary coil 51. Assuming that there is no signaling impulse flowing in the microphone circuit, there is a glow of intermediate intensity between each of the members 38, 39, and the anode 40. Now when a signaling impulse is transmitted, an electromotive force is induced in coil 51; if we assume that the impulse is in such direction as to make the upper terminal of coil 51 positive, then the

potential of member 38 is augmented, and the potential of the other member 39 is reduced. The glow between member 38 and the anode 40 is accordingly reduced, because the potential difference between these electrodes is reduced. At the same time, the glow between member 39 and anode 40 is increased. Upon a change in sign of the impulse, the glow increases between member 38 and the anode 40; and the glow is reduced between member 39 and anode 40. Since the impulses to be recorded are passed to the glow tube circuit through a transformer such as 52, the potentials across the coil 51 change in sign as the impulses vary in the microphone circuit. The action of the glow tube is analogous to that of a push-pull audion circuit.

The resultant double track record 36, 37 (Fig. 9) accordingly is such that the light and heavy lines in one track are displaced along the film 35 with respect to the corresponding light and heavy lines in the other track. By appropriate well-known sound reproducing systems, this type of double track can be readily reproduced.

What is claimed is:

1. An apparatus for the production of a phonofilm having a glow discharge tube as the source of light and electrical means for modulating the glow in correspondence with sound variations; characterized in that the glow tube comprises a pair of electrodes having opposed closely spaced surfaces between which the sound modulated glow is produced, the film being disposed in a plane substantially perpendicular to said electrode surfaces and receiving the edgewise glow of the tube, and a pair of cylindrical lenses interposed between the tube and the film, said lenses subtending the entire sectional area of the glow and serving to focus substantially the total glow of the said edge upon the film and to condense

the same to suitable dimensions for sound records thereby eliminating the use of slits and the like.

2. An apparatus for the production of a phonofilm having a glow discharge tube as the source of light and electrical means for modulating the glow in correspondence with sound variations; characterized in that the glow tube comprises a pair of electrodes having opposed closely spaced similar surfaces between which the sound modulated glow is produced in the form of a luminescent sheet, the film being disposed in a plane substantially perpendicular to the said electrode surfaces and receiving the edgewise glow of the said sheet, and a pair of cylindrical lenses interposed between the tube and the film, said lenses subtending the entire sectional area of the glow and serving to focus substantially the total glow of the said edge upon the film and to condense the same to suitable dimensions for sound records thereby eliminating the use of slits and the like.

3. An apparatus for the production of a phonofilm having a glow discharge tube as the source of light and electrical means for modulating the glow in correspondence with sound variations; characterized in that the glow tube comprises a pair of electrodes having opposed closely spaced surfaces between which the sound modulated glow is produced, the film being disposed in a plane substantially perpendicular to said electrode surfaces and receiving the edgewise glow of the tube, and a lens system interposed between the tube and the film subtending the entire sectional area of the glow and serving to focus substantially the total glow of the said edge upon the film and to condense the same to suitable dimensions for sound records thereby eliminating the use of slits and the like.

ARTHUR E. REEVES.