July 12, 1938. W. G. H. FINCH 2,123,721

FACSIMILE RECORDING TUBE

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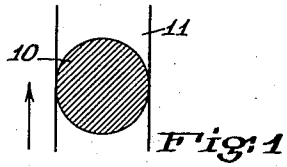

Fig: 1

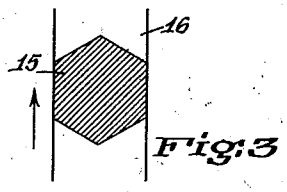

Fig: 3

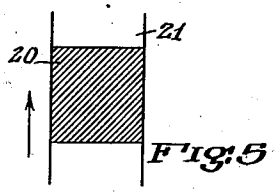

Fig: 5

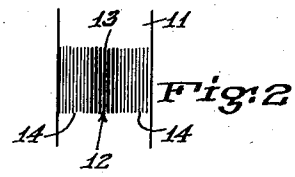

Fig: 2

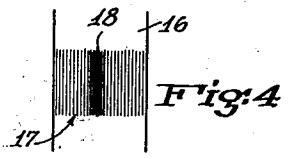

Fig: 4

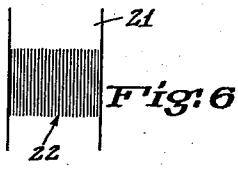

Fig: 6

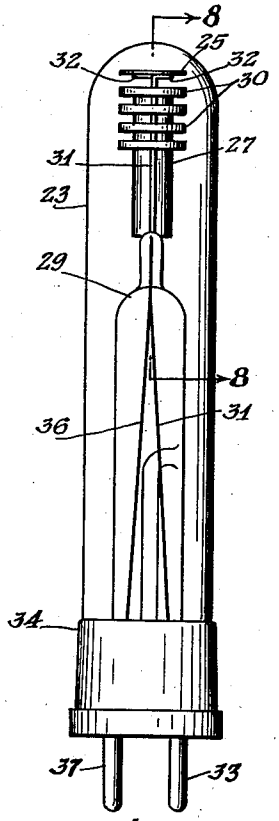

Fig: 7

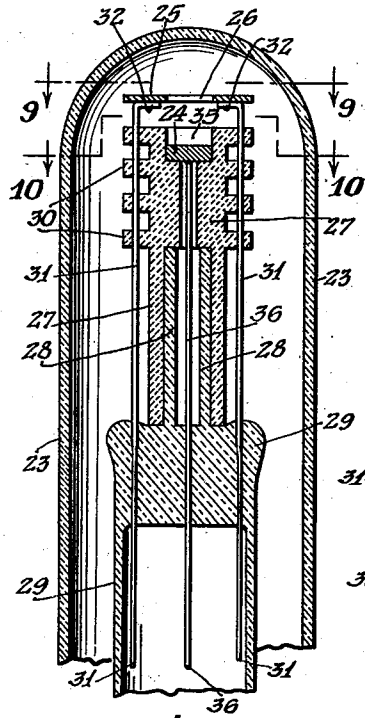

Fig: 8

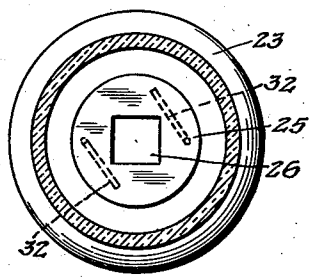

Fig: 9

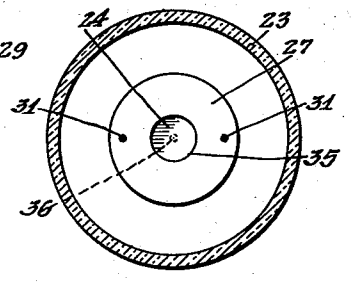

Fig: 10

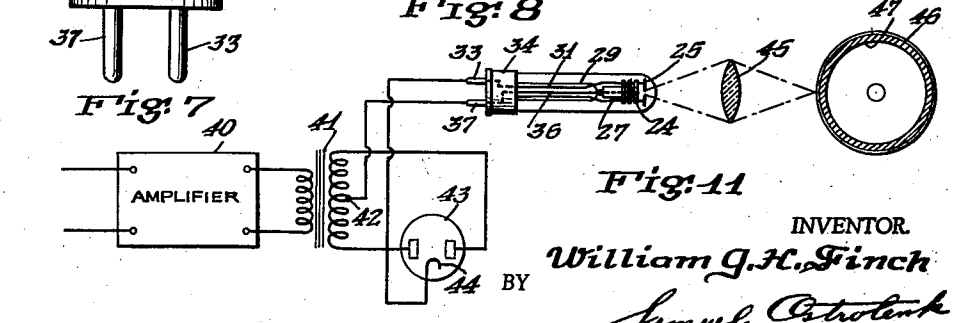

Fig: 11

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UNITED STATES PATENT OFFICE

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FACSIMILE RECORDING TUBE

William G. H. Finch, New York, N. Y.

Application July 2, 1937, Serial No. 151,555

8 Claims. (Cl. 176—122)

This invention relates to a novel source of light particularly useful for picture reproduction systems.

In the production of pictures from received facsimile signals it is desirable to obtain a uniform intensity for the cross-section of the scanning spot of light. A gas-filled tube is a very useful device for translating the variable picture signals into corresponding varying light intensities. However, prior gas-filled tubes were not particularly satisfactory for high quality picture work due to the uneven intensity of the cross-section of the resultant spot of light focussed upon the record sheet. An uneven spot of light naturally results in fringes between the successive scanning lines, causing the line-by-line construction of the picture to be visible to the eye.

It is desirable in picture recording work to employ a square spot of light for scanning the record film upon which the picture is to be reproduced. In order to obtain a square spot of light from a gaseous lamp source, an opaque mass carrying a square aperture has been adopted. However, difficulties were encountered in the proper focussing of the light as a square beam upon the record sheet due to the finite spatial relations between the actual source of light and the aperture. In accordance with my present invention I contemplate a signal lamp producing a source of light having a predetermined cross-sectional shape, preferably square, by incorporating the opaque mass in a novel manner as an electrode used for generating the light.

It is among the objects of my present invention to provide a novel signal lamp useful for recording purposes.

A further object of my invention is to provide a signal lamp for producing a uniform cross-sectional intensity beam of light.

Another object of my invention is to provide a signal lamp for producing a uniform cross-sectional intensity beam of light having a predetermined shape.

It is still a further object of my present invention to provide a gaseous signal lamp of simplified construction, which lamp is relatively inexpensive to construct.

These and further objects of my invention will become apparent in the following description taken in connection with the drawing in which:

Figures 1 to 6 are schematic representations of the scanning spot of light and its effect on the picture reproduction.

Figure 7 is an elevational view of a preferred form for the gaseous lamp of my present invention.

Figure 8 is an enlarged cross-sectional view taken horizontally through the lamp along 8—8 of Figure 7.

Figure 9 is a plan view of the opaque mass used as an electrode and corresponds to the view taken along 9—9 of Figure 7.

Figure 10 is a cross-sectional view taken along 10—10 of the lamp of Figure 7 showing the preferred form of the cathode employed.

Figure 11 is a diagrammatic representation of the signal lamp employed in a picture recording system.

For picture recording work it is desirable to have a beam of light having a uniform cross-sectional intensity across the width of the scanning line. Gas-filled lamps producing a glow discharge between two electrodes maintained at a varying difference in potential create a source of light which varies in intensity in accordance with the voltage between the electrodes. This result creates the varying shading or tonations in the picture reproduction corresponding to the shading of the picture being transmitted. However, unless the light focussed upon the record sheet has a uniform cross-section, accurate correspondence between the reproduction and original cannot be accomplished, but small imperfections will be visibly evident thereon. The glow produced by the gaseous discharge should preferably have a uniform intensity across the section of the beam being focussed on the film. The present invention is directed to producing a gaseous discharge having a definite uniform cross-sectional intensity.

Besides the uniform cross-sectional intensity of the gaseous discharge in the direction toward the record sheet, it is desirable to maintain a square beam for recording of pictures, as will be evident in the following description in connection with Figures 1 to 6.

In Figure 1 I have schematically illustrated in enlarged form a square spot of light 10 acting upon the scanning light region 11 of a record sheet moved past the fixed position of the scanning spot 10 in the direction indicated by the arrow. The effect of the relative movement between the sheet and the spot 10 creates a photographic equivalent upon the scanning light region 11 as illustrated at 12 in Figure 2. The central portion 13 of the reproduction 12 is seen

to be much darker than the edges 14 of the region 12. This effect is due to the greater projected area of the circular spot 10 in the direction of scanning.

In Figure 3 is illustrated a hexagonal spot of light 15 upon the scanning region 16. The resultant recorded area 17 shown in Figure 4 has a very dark central region 18 and gradually tapers toward the edges with lighter intensity.

The result of the recorded areas 12 and 17 in Figures 2 and 4 respectively upon the reproduction is to clearly demark the adjacent scanning line regions due to the lighter fringes of each individual scanning line, as will now be evident. This effect is increased by the non-uniform intensity across the section of the respective beams, as will be evident.

In Figure 5 I have illustrated a square spot of light 20 focussed upon a moving scanning region 21. The square spot of light has a uniform projected effect upon the scanning region 21 as illustrated in Figure 6 at 22. It is obvious that the square spot of light of uniform intensity produced the best results for quality scanning of a picture. The recording lamp of my present invention produces a square spot of light having a substantially uniform cross-sectional area for use in high quality picture recording work.

Figure 7 is an elevational view of a preferred form of the gaseous picture recording lamp of my invention. The glass envelope 23 containing the elements of the lamp and the gas at low pressure is of an elongated cylindrical shape to assist in the circulation of the gas to maintain the tube in a cool operating condition. Figure 8 is an enlarged cross-sectional view taken horizontally along Figure 7 at 8—8.

The electrodes of the tube consist of the cylindrical cathode 24 and the flat plate anode 25 containing the square aperture 26 located directly above the cathode 24. The cathode 24 is set into the supporting insulation material 27 which is mounted upon the extension tube 28 from the glass stem 29. The insulation material may be ceramic, lava or other suitable material well known in the art. The insulation member 27 contains the projecting fins 30 about the region of the cathode 24 and the discharge to assist in the cooling of the electrode 24.

The plate electrode 25 is mounted in position above the cathode 24 by means of two wires 31 projecting from the glass stem 29 and supported in holes in fins 30. The electrode 25 is welded or otherwise suitably mechanically and electrically secured to the end portions 32 of the wires 31. The supporting wires 31 for the electrode 25 also serve as conducting wires therefor to the suitable prong 33 in the base 34 of the tube. This construction of the tube is relatively inexpensive as to material and assembly costs and provides a sturdy and rigid structure which cannot be dislodged in normal use.

Figure 9 shows the anode electrode 25 and the square aperture 26 centrally located therein. The end portions 32 of the supporting and conducting leads 31 are shown in dotted lines beneath the electrode 25.

Figure 10 is a plan view showing the central position of the cathode electrode 24 set into the ceramic or insulation member 27. The diameter of the cathode 24 is preferably substantially equal to the width of the aperture 26 in the electrode 25 located above it in order that the glow discharge may project uniformly therefrom to the electrode 25. As shown in Figure 2, the cylindrical cathode electrode 24 is set into the insulation member 27 so that the cavity 35 remains between the top surface of the electrode 24 and the top of the member 27. This cavity serves the useful function of preventing the glow discharge from spreading beyond the edges of the electrode 24 and also to concentrate the discharge toward the electrode 25. A conducting wire 36 connects the cathode 24 to the prong 37 of the base 34.

I have found that argon is the most suitable gas for use with the tube for picture recording, since the actinic value of the bluish-white light produced by the glow discharge is a maximum with argon. However, it is to be understood that helium, neon and other well-known inert gases may be used for the tube. It is to be further understood that my invention is not limited to the particular shape of the electrodes but rather to the co-relation thereof in producing a uniform cross-sectional intensity beam, and the relatively simple structure of the tube to accomplish this result.

In a preferred embodiment for this tube for facsimile work I have very successfully used a square aperture having a width of about 1/8 of an inch, the corresponding cathode electrode having the same diameter. The electrodes 24 and 25 are preferably formed of tungsten for durability and longest life. However, other materials may be used, such as nickel and the like.

The high voltage applied between the electrodes 24 and 25 causes a glow extending from the center of the cylindrical cathode upwardly toward the aperture and is concentrated across the opening forming the aperture. The intense heat developed by the glow discharge is readily dissipated by the novel construction of the tube illustrated and described.

Figure 11 is a schematic electrical diagram of the use of the recording tube for a facsimile recording system. The facsimile signals are received in a well-known manner and amplified at 40, the output of which is connected to a transformer 41 having a secondary winding with a center tap 42. Although the discharge tube may be directly connected to the output of the amplifier, the picture signals, which are usually in the form of a modulated carrier wave, are preferably rectified so that the actual light variations of the glow discharge will correspond to the elemental shading of the transmitted picture.

I prefer to rectify the signals in the manner shown by means of the double anode rectifier tube 43, the anodes of which are connected to the outer terminals of the secondary of the transformer 41. The glow discharge tube is connected in series between the cathode 44 and the center tap 42 of the transformer. In order to concentrate the glow at the aperture of the electrode 25, I connect the electrode to the positive potential to serve as the anode for the discharge. The electrode 25 is shown connected through the base prong 33 to the cathode 44 which is positive with respect to the center tap 42 connection. The cathode 24 is connected to the center tap 42 with the prong 37 of the tube.

In a preferred embodiment for a recording system I amplify the picture signals so that about 1600 volts effective value exists across the outer terminals of the secondary of the transformer 41, 800 volts existing between the center tap 42 and the outer terminals thereof. This voltage has been found satisfactory to produce quality recording without requiring any starting biasing

potentials for the tube but rather by its direct connections in the output circuit as shown.

The glow discharge is formed substantially across the aperture of the anode 25 with substantially uniform cross-sectional intensity, as already described. The resultant light, varying in intensity in accordance with the picture signals, is sharply focussed by lens system indicated by 45 upon the film 46 mounted upon the drum 47 of a facsimile unit. The drum 47 naturally is maintained in synchronous rotation and phase relation with the corresponding transmitter drum, not shown. The size of the spot of light focussed upon the film 46 is in a preferred embodiment .01 inch square. The facsimile system schematically indicated here may well be one disclosed in my Patent No. 2,047,863, which issued on July 14, 1936, entitled "Telecommunications system", although it is not restricted thereto.

An important advantage of the tube producing this uniform glow across the square aperture is that the lens system may be focussed directly upon the aperture so that the image of the light is directly produced upon the film. No problems of relative focusing of a mask or a spot of light or some region there in between are had. It is to be understood that the orientation of the square aperture is such that the spot of light produced upon the record film 46 corresponds to the position of the spot 20 shown in Figure 5 with respect to the scanning direction indicated by the arrow.

Although I have described a preferred form for carrying out my present invention, it is to be understood that variations and modifications therein may be practised by those skilled in the art and that the tube is equally useful for sound recording, television, and other uses requiring a modulated resultant light beam of uniform cross-sectional intensity, and, accordingly, I do not intend to be limited, except as set forth in the following claims.

I claim:

1. A gaseous discharge tube comprising a sealed vessel containing a cathode electrode, an insulation member for supporting said cathode, said cathode being juxtaposed against said member, cooling fins integral with and projecting from said member for reducing the temperature of said cathode during operating condition.

2. A gaseous discharge tube comprising a sealed vessel containing a cathode electrode, a member having a cavity for supporting said cathode in said cavity and containing the discharge therein, cooling fins integral with and projecting from said member for reducing the temperature of said cathode and discharge during operating condition.

3. A gaseous discharge tube comprising a sealed vessel containing a cathode electrode, an insulator member having a cavity for supporting said cathode in said cavity and containing the discharge therein, cooling fins integral with and projecting from said member for reducing the temperature of said cathode and discharge during operating condition, said fins being annular and spaced from each other.

4. A gaseous discharge tube comprising a sealed vessel containing a solid cathode electrode, an insulator member having a cavity for supporting said cathode in said cavity and containing the discharge therein, cooling fins integral with and projecting from said member for reducing the temperature of said cathode and discharge during operating condition, said fins being annular and spaced from each other, and a stem projecting into said vessel, said member having a tubular recess for fitting over said stem.

5. A gaseous discharge tube comprising a sealed vessel containing a cathode electrode, a member for supporting said cathode, said cathode being juxtaposed against said member, cooling fins projecting from said member for reducing the temperature of said cathode during operating condition, and a stem projecting into said vessel, said member having a tubular recess for fitting over said stem, and a lead secured to said cathode and passing through said member and stem for securing said member and cathode in fixed relation with respect to said stem.

6. A gaseous discharge tube comprising a sealed vessel containing a solid cathode electrode having a flat surface, an insulation member having a cavity for supporting said cathode in said cavity and containing the discharge therein, said cathode being juxtaposed against said member, cooling fins projecting from said member for reducing the temperature of said cathode and discharge during operating condition, a stem projecting into said vessel, said member having a tubular recess for fitting over said stem, and a lead secured to said cathode and passing through said member and stem for securing said member and cathode in fixed relation with respect to said stem.

7. A gaseous discharge tube comprising a sealed vessel containing a solid cathode electrode having a flat surface, an insulation member having a cavity for supporting said cathode in said cavity and containing the discharge therein, said cathode being juxtaposed against said member, cooling fins projecting from said member for reducing the temperature of said cathode and discharge during operating condition, said fins being annular and spaced from each other, a stem projecting into said vessel, said member having a tubular recess for fitting over said stem, a lead secured to said cathode and passing through said member and stem for securing said member and cathode in fixed relation with respect to said stem, an anode electrode, and wires for carrying said anode in a fixed relation with said cathode, passing through said fins.

8. A gaseous discharge tube comprising a sealed vessel containing a solid cathode electrode having a flat surface, an insulation member having a cavity for supporting said cathode in said cavity and containing the discharge therein, said cathode being juxtaposed against said member, cooling fins projecting from said member for reducing the temperature of said cathode and discharge during operating conditions, said fins being annular and spaced from each other, a stem projecting into said vessel, said member having a tubular recess for fitting over said stem, a lead secured to said cathode and passing through said member and stem for securing said member and cathode in fixed relation with respect to said stem, an anode electrode, and wires for carrying said anode in a fixed relation with said cathode, passing through openings in said fins.

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