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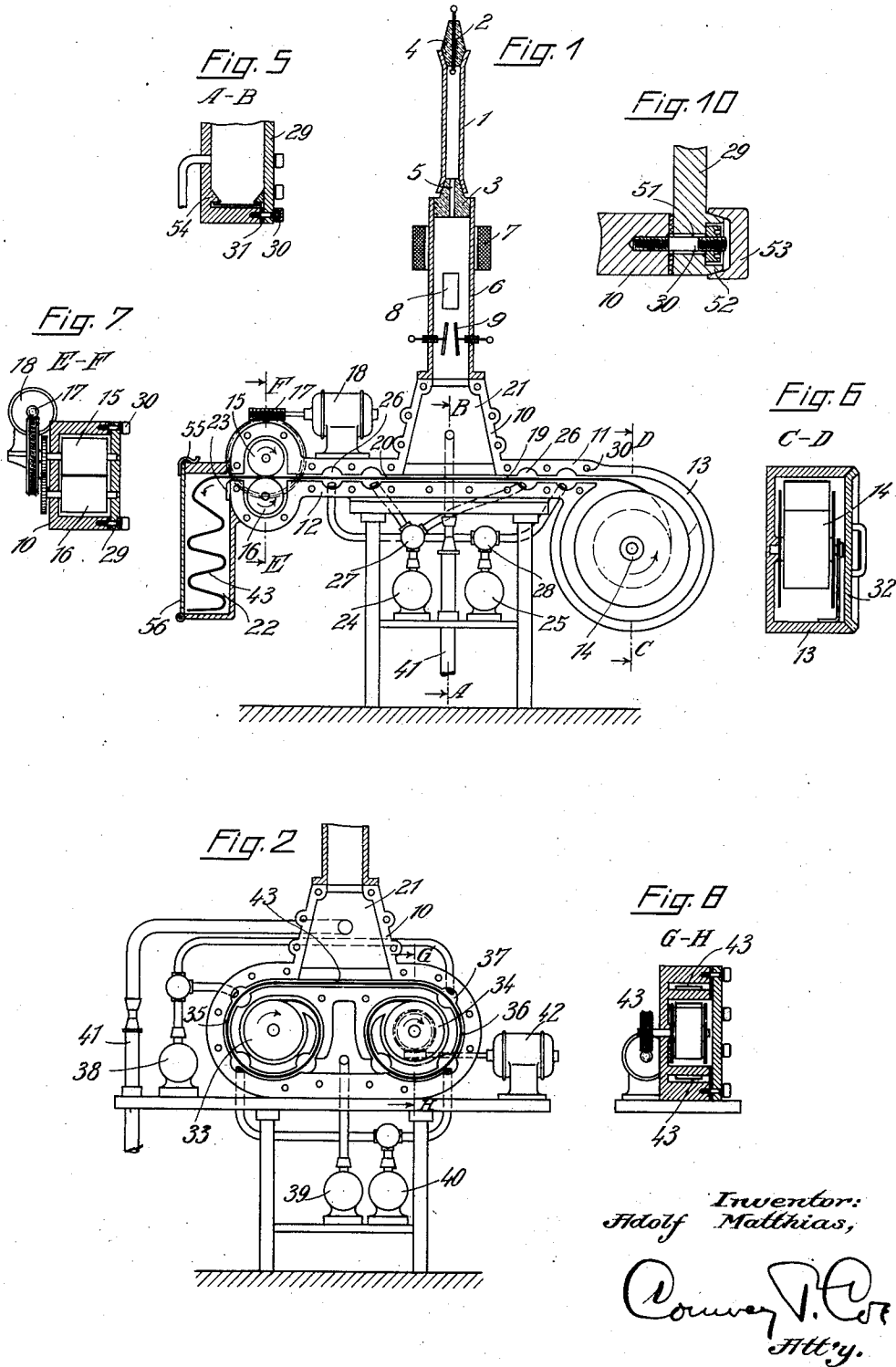
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CATHODE RAY OSCILLOGRAPH

Filed April 10, 1928

2 Sheets-Sheet 1



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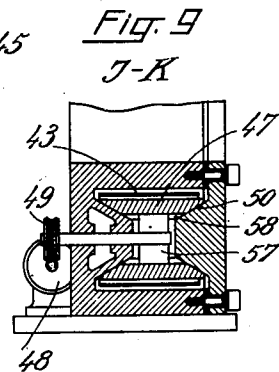
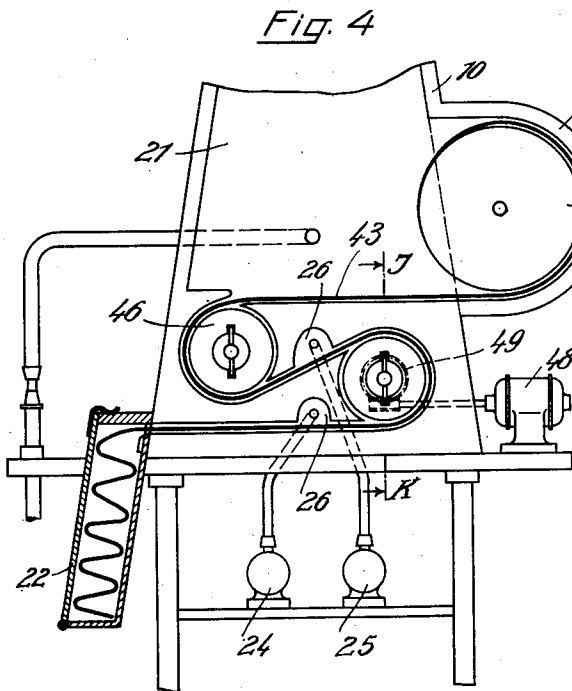
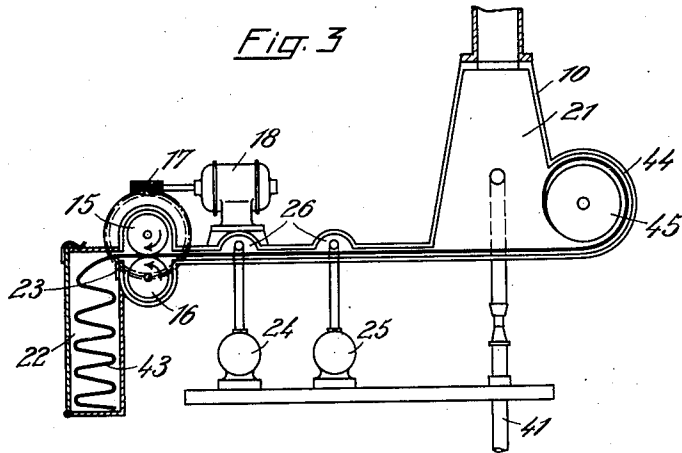
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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CATHODE-RAY OSCILLOGRAPH

Application filed April 10, 1928, Serial No. 268,994, and in Germany April 13, 1927.

My invention is related to cathode ray oscillographs for recording transient electrical phenomena.

One object of my invention is to provide a cathode ray oscillograph, in which the exchanging, inserting or removing of the photographic plates or films can be accomplished without spoiling the vacuum in the cathode tube.

Another object of my invention is to provide a cathode ray oscillograph of the above described kind, in which the film can be moved on continuously, so as to take a large number of photographs, and the exposed parts of the film can be extracted without the necessity of opening the apparatus.

Other objects and advantages will appear in the following specification and the novel features of the invention will be particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawings, forming part of this application, in which

Fig. 1 is a vertical section through the cathode ray oscillograph.

Fig. 2 is a plain view of the base of another form containing the recording apparatus, the cover being removed.

Fig. 3 is a schematic diagram of another form of base.

Fig. 4 is yet another design of the base.

Fig. 5 is a section on the line A—B in Fig. 1.

Fig. 6 is a section on the line C—D in Fig. 1.

Fig. 7 is a section on the line E—F in Fig. 1.

Fig. 8 is a section on the line G—H in Fig. 2.

Fig. 9 is a section on the line I—K in Fig. 4.

Fig. 10 is a detailed sketch of the packing at the fastening screws for the base.

As regards Fig. 1, the apparatus illustrated consists of the cathode tube 1, in the top of which the cathode 2 is arranged and in the bottom the anode 3. The cathode 2 is connected with the h. t. side of a transformer via the bushing 4. The bottom of the cathode tube is joined to the metal tube 6, the top

part of which is surrounded by a coil 7 serving to concentrate the cathode rays entering the cathode through the opening 5. Pairs of diverting plates 8 and 9 are provided in the metal tube 6. The diversion of the cathode rays is dependent on the alteration in the voltage and on time. The base 10 joins on the metal tube and contains the device for recording the alterations in the electrical phenomena indicated by the movement of the stream of the cathode rays.

The base 10 has extensions 11 and 12 on both sides. At the end of extension 11 is supported a drum 13, in which a spool 14 is provided. Two spools 15 and 16 are arranged in the extension 12 and are driven by an electric motor 18 over a worm gearing 17. The extensions are provided with narrow slits 19 and 20 running parallel to the front side of the base. These slits terminate on the one side in the recording chamber 21 and on the other side lead into the drum 13 or between the spools 15 and 16. The film 43 to be exposed to the cathode rays is wound on the spool 14 and conveyed through the slits 19 and 20 to the spools 15 and 16. These motor-driven spools draw the film off spool 14 through the recording chamber 21, in which the film is exposed to the cathode rays. Behind the spools 15 and 16, the film passes into the film box 22 being provided with a door 56 which can be locked by a spring 55. Between the spools 15 and 16 and the film box an externally operated knife 23 is arranged.

The cathode tube 1 the metal tube 6 and the hollow space 21 in the base 10 are highly evacuated. The vacuum is produced and maintained by the high vacuum pump 41 and the vacuum pumps 24 and 25. The narrow slits 19 and 20 are practically completely filled by the film, so that practically no air can find its way through these slits into the evacuated apparatus. In order to increase the air-tightness of the slits, their sides can be fitted with flexible lugs, which press against the edge of the film and thereby render the passage of air more difficult. The longer the slits are, the better is of course, the packing.

In order to limit the output of the pumps for maintaining the vacuums, the drop of pressure between the outer air and recording space may be distributed by providing extensions 26 in the slits, being either connected to prevacuum stages of the high vacuum pump, or, as shown in the drawing, to special prevacuum pumps 24 and 25 via the pressure equalizing spaces 27 and 28.

In general it will be easily possible to shove the beginning of the film out of the drum 13 into the slit 19 and on through the recording chamber 21 into the slit 20. Lugs 54 are provided to facilitate guiding of the film. In view of the fact that in spite of all precautions sticking may occur, it is best to make the side wall 29 of the base piece, which closes the slit on the side, detachable, in order to be able to readily guide the film into the slits and between the rollers on removing the side wall. The side wall is fastened to the base piece by means of screws 30 and either it can be ground into position or a packing 31 of rubber can be inserted between the wall and base piece.

The slits 19 and 20, made according to the invention, are capable of maintaining the vacuum in the recording chamber, even if, as illustrated in Fig. 1, the entrance and exit positions for the film are in connection with the external air, however it is advantageous to provide the cover 32 of the drum 13 with a ground conical edge. By this means an excessive ingress of air is avoided and it is possible to stop the pumps for a time even during service.

In Fig. 2 a design incorporating the invention is shown, in which the film 43 is unwound from a spool 33 and wound on a spool 34. Both spools are arranged in the base 10 and the film passes through the narrow curved slits 35 and 36 between them. The slits are as in Fig. 1 provided with extensions 37, which are in connection with the vacuum pumps 38, 39, 40 and serve to distribute the pressure drop between the outer air and the recording chamber. The recording chamber 21 is evacuated by means of a high vacuum pump via the tube 41. The film is moved by means of the spool 34, driven by the motor 42 over the worm gearing 43.

In order to avoid the difficulties encountered in maintaining the recording chamber airtight, one slit can be done away with and the film spool arranged directly in the recording chamber, as shown in Fig. 3. The base 10 is convex at one side of the recording chamber, 21 and in the bulge 44 a film spool 45 is arranged. In an extension 46 on the opposite side of the base, the slit 20, its extension 26 connected with the vacuum pumps 24 and 25, as well as the spools 15 and 16, are provided. The spools driven by the motor 18 draw the film from the drum 45 and convey it into the film box 22, out of which the exposed

part of the film can be taken, after it has been separated from the remaining part by the knife 23.

Fig. 4 shows a somewhat altered design, in which the slit 20 does not follow a straight path but is curved shaped for the purpose of increasing the resistance to the passage of air. Although it is also possible to construct the slit with stationary walls, it is advantageous to replace one side of the curved parts by the spools 46 and 47, so that the film may slide more easily. One or both spools can be driven by the motor 48 over the worm gearing 49. The shaft of the toothed wheel 49 is provided at its end with lugs 57, which engage in slots 58 in the spool. Since the front side of the spools must be air-tight so as to prevent air entering the slit, the spools are appropriately supported in conical bearings as shown in Fig. 9. The conical bearing surfaces 50 can be easily made air-tight by means of grease.

As it is possible for the screws with which the detachable side wall is fastened to leak in the course of time, it is advisable to provide them with an additional packing as in Fig. 10. The detachable side wall 29 is thus designed so that each screw hole 51 is surrounded with a circular shaped collar 52 having a ground outer surface. The ingress of air to the screw is prevented by a cap 53 mounted on the collar, the inner conical surface of the cap being ground.

From the above description it is clear that, with a cathode ray oscillograph embodying my invention any number of photographs can be taken successively without opening the recording chamber and thereby disturbing the vacuum. This advantage is of great importance especially in the study of atmospheric disturbances in h. t. conductors, since the cathode ray oscillograph is thus always ready for service and can also record a large number of disturbing waves occurring at short intervals. Apart from this, it is naturally also important for laboratory measurements that by using a cathode ray oscillograph according to my invention the time at disposal can be fully utilized, as the preliminary work merely consists in inserting the film roll and evacuating the cathode tube only once for a large number of records.

Although I have described some embodiments of my invention, it will be obvious to those skilled in the art that various modifications may be made in the details of construction and in design and proportion of the several parts without departing from the principles herein set forth.

I claim as my invention:

1. In a cathode ray oscillograph, in combination, a cathode tube, means for diverting the cathode rays, means for the evacuation of the tube, a base piece on the end of the tube and openings in said base piece adapted

for the insertion and extraction of a body covered with a layer which is sensitive to light.

2. In a cathode ray oscillograph, in combination, a cathode tube, means for the evacuation of the tube, a base piece provided with openings adapted for the insertion and extraction of a body covered with a layer which is sensitive to light, and means for the evacuation of said base piece.

3. In a cathode ray oscillograph, in combination, a cathode tube, vacuum pumps connected with said cathode tube, a base piece provided with openings adapted for the insertion and extraction of a body covered with a layer which is sensitive to light, and a sucking tube connecting said base piece with said vacuum pumps.

4. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube, means for the evacuation of said tube and said base piece, and narrow slits provided in opposite side walls of said base piece.

5. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube, means for the evacuation of said tube and said base piece, and narrow slits running parallel to the front wall of the base piece, provided in opposite side walls of said base piece.

6. In a cathode ray oscillograph, in combination, a cathode tube, a base piece at the end of the tube, means for the evacuation of said tube and said base piece, narrow slits running parallel to the front wall of the said base piece, provided in opposite side walls of said base piece, said slits being continued over extensions on both sides of the base piece, thus forming long narrow canals in them.

7. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube, means for the evacuation of said tube and said base piece, narrow slits running parallel to the front wall of the base piece, provided in opposite side walls of said base piece, said slits being continued over extensions on both sides of the base piece, thus forming long narrow canals in them, one of the side walls of the base piece being adapted to be removed.

8. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube, means for the evacuation of said tube and said base piece, narrow slits running parallel to the front wall of the base piece provided in opposite side walls of said base piece, said slits being continued over extensions on both sides of the base piece, thus forming long narrow canals in them and extensions in said canals with means for the evacuation of these extensions.

9. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the

end of the tube, long narrow canals provided with enlargements, extending over extensions of said base piece on both sides of the base piece, vacuum pumps connected to the record chamber in said base piece and to the tube, said pumps having pressure equalizing spaces which are connected to said enlargements by sucking tubes.

10. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube forming a record chamber, long narrow canals provided with enlargements, extending over extensions of said base piece on both sides of the base piece, means for evacuating the cathode tube, the record chamber and the enlargements of the canals, one canal leading to a drum which contains a spool adapted to admit a film, the other canal leading between two spools adapted to be rotated.

11. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube forming a record chamber, narrow slits running parallel to the front wall of the record chamber provided in opposite side walls of said record chamber, said slits being continued in the base piece thus forming narrow curved canals each of them leading to a spool being provided in the base piece, said spools being adapted to be rotated.

12. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube forming a record chamber, vacuum pumps connected to the tube and the record chamber, narrow canals leading from the record chamber to spools provided in the base piece, said canals having enlargements which are connected via pressure equalizing spaces to said vacuum pumps.

13. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube forming a record chamber, means for the evacuation of the tube and the record chamber, a spool in the record chamber being adapted to admit a film, a narrow slit provided in the side wall of the record chamber, said slit being continued through an extension of the base piece, thus forming a long narrow canal which leads between two spools at the end of said extension, the spools being adapted to be rotated.

14. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube forming a record chamber, vacuum pumps connected to the tube and the record chamber, a spool in the record chamber being adapted to admit a film, a long narrow canal leading from the record chamber through an extension of the base piece to two spools at the end of said extension, said canal having enlargements which are connected via pressure equalizing spaces to said vacuum pumps.

15. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the

end of the tube forming a record chamber, means for the evacuation of the tube and the record chamber, a spool in the record chamber being adapted to admit a film, a narrow curved canal leading from the record chamber through the base piece to the external air and lugs in the record chamber walls, adapted to guide the film from said spool to the entrance of said canal.

- 10 16. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube forming a record chamber, vacuum pumps connected to the tube and the record chamber, a spool in the record
15 chamber being adapted to admit a film, a narrow curved canal leading from the record chamber through the base piece to the external air and enlargements in said canal being connected via pressure equalizing spaces
20 to said vacuum pumps.

17. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube forming a record chamber, vacuum pumps connected to the tube and
25 the record chamber, a spool in the record chamber being adapted to admit a film, a narrow curved canal leading from the record chamber through the base piece to the external air, enlargements in said canal being
30 connected via pressure equalizing spaces to said vacuum pumps, one side of the curved parts of the canal being replaced by rolls which are adapted to be rotated.

18. In a cathode ray oscillograph, in combination, a cathode ray tube, a base piece on the end of the tube forming a record chamber, means for the evacuation of the tube and the record chamber, a spool in the record chamber being adapted to admit a film, a
40 narrow curved canal leading from the record chamber through the base piece to the external air, one side of the curved parts of the canal being replaced by rolls which are adapted to be rotated and have conical bearing
45 surfaces.

19. In a cathode ray oscillograph, in combination, a cathode tube, a base piece on the end of the tube forming a record chamber, vacuum pumps connected to the tube and the
50 record chamber, a spool in the record chamber being adapted to admit a film, a narrow curved canal leading from the record chamber through the base piece to the external air, enlargements in said canal being connected
55 via pressure equalizing spaces to said vacuum pumps, one side of the curved parts of the canals being replaced by rolls which are adapted to be rotated and have conical bearing surfaces, one of the side walls of the
60 base piece, covering the record chamber, the spool for the film and the canal, being adapted to be removed.

In testimony whereof I affix my signature.