Jan. 19, 1932. R. H. RANGER 1,841,452

RECORDING SYSTEM

Filed Feb. 4, 1930

Fig. 1

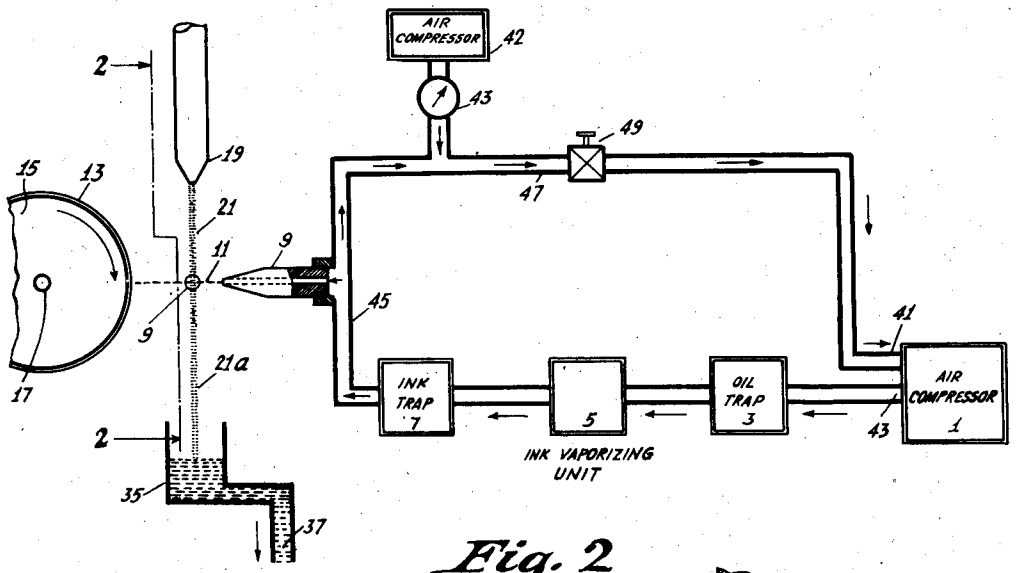


Fig. 2

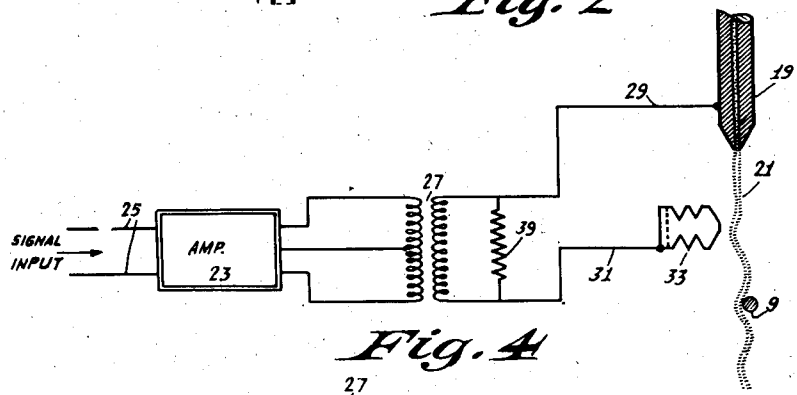


Fig. 4

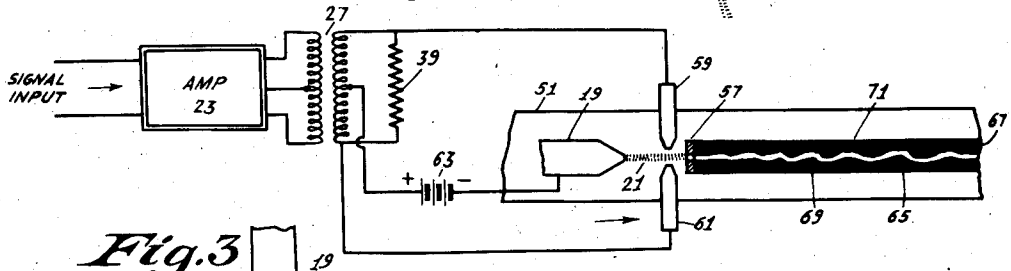
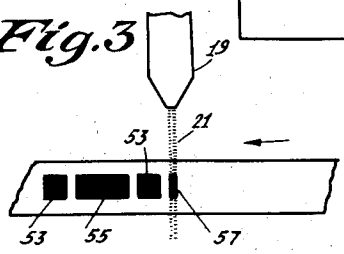


Fig. 3



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RECORDING SYSTEM

Application filed February 4, 1930. Serial No. 425,768.

The present invention relates to recording systems, and in particular to systems suitable for recording telegraphic messages, such as code, or pictures, or sound records to accompany motion picture films, or the like, in response to incoming signals.

More particularly, the invention is directed to systems by which signals received over wire, radio, or wired radio systems, and corresponding either to telegraphic code messages or transmitted picture messages, by which I intend to include all forms of picture records, newspaper publications, magazines, checks, finger prints, financial statements, blue prints, and the like, as well as motion picture films with or without sound accompaniment, may be recorded. In connection with the motion picture film records, it should be understood that the invention is intended to cover a system by which the sound accompaniment may be produced separate from the picture portion of the record where desired, as will more fully appear from reading the following specification. By my Patent #1,770,493, granted to me on July 15, 1930, I have disclosed a system by which I may project heated air, gas, or other appropriate marking fluid toward a record surface, and, in accordance with the amount of the marking fluid, or gas, which reaches the record surface, it is possible to reproduce a record of the transmitted signals. According to the system disclosed in my above named copending application, the control of the marking has been disclosed as being dependent upon electromagnetic or electrochemical means, and either by the covering or blocking of a gas or fluid in accordance with received signals or by utilizing a second gas or fluid to dissipate the recording gas or fluid.

According to my present invention, I have provided a means by which any type of recording medium, liquid, gas, or the like, may be projected toward a recording surface, and, in the case of a liquid, have provided a system whereby the liquid may be projected in the form of a highly colored vapor. However, in contrast to the schemes previously disclosed, I have provided a means whereby a second fluid, which I have herein termed a "blocking", "screening" or "interrupting" fluid, may be at all times projected transverse to the path of projection of the recording or marking fluid, so as to form a wall or shutter between the source of projection of the marking fluid and the record surface, so as to provide an arrangement such that, under normal conditions, no marking fluid may reach the record surface. In order to permit marking fluid to reach the record surface in response to signals, I have provided a novel means whereby the blocking or screening fluid may be deflected so as to no longer block or screen the recording fluid from the record surface, and, under such conditions, the recording fluid is projected toward the record surface and produces markings thereon.

In order to control the "blocking" fluid, I have herein disclosed my invention as embodying electrostatic means, although it is, of course, apparent that an electromagnetic control, or its equivalent, may be substituted for the electrostatic means where desired.

As a primary object of the present invention, I have sought to provide a system wherein a more faithful and accurate reproduction of a message may be had, while, at the same time, providing a system which permits considerably increased speeds of recording and provides for improved definition of the subject matter of the received record.

As a further object of my invention, I have sought to provide a recording system in which signal controlled moving parts are eliminated, and in which the control of the marking fluid or gas is accomplished substantially without inertia.

Still a further object of my invention is to provide a system wherein it is possible to produce an oscilloscope type of record for use in plotting wave forms or in forming sound records for use in conjunction with talking motion picture films, for example, as well as many other uses which will become apparent.

A further object of the invention is also to provide a system wherein any of the types of motion picture sound records commonly

in use, such as the variable area, variable density, plus and minus, and sinusoidal types, may be produced for use in connection with motion picture films, or other film sound records.

Other objects of my invention are, of course, to provide a recording system which is extremely simple in its nature and set-up, a system in which the recording operation is faithful to the received signals, and a system in which the expense of installation has been reduced to a minimum, while maintaining the usual requirements of rigidity and fool-proof construction.

Other objects and advantages will suggest themselves and become apparent to those skilled in the art to which my invention relates by reading the following specification and claims in connection with the accompanying drawings, wherein:

Fig. 1 illustrates in schematic form a diagram of one form of recording apparatus falling within the scope of my invention;

Fig. 2 illustrates conventionally a side view of the apparatus shown by Fig. 1, looking in the direction of the arrow 2—2 of Fig. 1, and also illustrates a portion of the output connection of the amplifier for supplying signals to the control means;

Fig. 3 shows an embodiment by which the vapor jet may be of a flat wedge-shape type so as to produce a record which, if applied to code signals, may provide enlarged size dots and dashes; and,

Fig. 4 illustrates a further modification of the scheme, especially suited and adapted to the production of an oscilloscope type of record on a record strip.

According to the accompanying drawings, I have shown an air compressor 1 for forcing air or vapor under pressure through an oil trap 3 of the usual type through to an ink vaporizing unit 5 and then through an ink trap 7 to a nozzle 9 from which the ink vapor is projected under pressure from the air compressor for recording the received signals. Ink of any appropriate high color is contained within the ink vaporizing unit, and due to the action of the compressor forcing air through the vaporizer 5 (which may be of any well known type, such as that known in the art as the De Vilbiss), the ink may be converted into a vapor state. Excessive amounts of ink contained in the ink vapor are removed in the settling trap 7. Due to the pressure in the system, as derived from the air compressor, the ink vapor may be projected from the nozzle 9 with considerable velocity, so that as it leaves the nozzle along a path conventionally indicated as 11, it strikes against a recording surface 13 carried upon a record drum 15, adapted to rotate in the direction of the arrow. Thus, the recording fluid or jet is adapted to produce a mark upon the record surface 13 corresponding in color to the color of the ink used in the vaporizing unit 5.

If the record drum 15 is continuously rotated and then advanced longitudinally of a support shaft 17, as the latter rotates, the ink will trace a path upon a record strip or surface 13 corresponding to the path of a helix traced about the drum, or, where desired, in order to produce a parallel line for line record of received signal impulses, the jet assemblage 9 or drum 15 may be moved longitudinally relative to each other, and the drum 15 may be rotated in step fashion at the end of each longitudinal movement, so that each line is recorded parallel to each other line in well known manner.

For recording either pictures or telegraphic code signals, it is, of course, both necessary and desirable to break the continuity of the continuous line of reproduction, as would be formed by projecting the vapor continuously from the jet or nozzle 9 toward the record surface 13, in accordance with received signals. Where the received signals correspond to the intensities of light and shadow representing elemental areas of a picture subject being transmitted, it is, of course, desirable to interrupt the recording fluid projected from the jet 9 in a manner such that there is an amount of fluid reaching the surface 13 which corresponds to the intensity of light and shadow of the particular elemental areas.

According to the teachings of C. W. Hansell, as disclosed in his pending United States patent application No. 333,617, filed January 19, 1929, it has been proposed to electrostatically control a jet of projected fluid, such as water, ink, or the like, by way of example, in accordance with electric potentials, so that the jet may be deflected from its normal position of flow so long as these electric potentials are maintained, and also to provide a means by which the jet assumes its normal position upon the removal of electric potentials. Thus by alternately applying and removing potentials very rapidly, it was observed that the fluid jet adopted a wave form corresponding to the alternation of potentials.

Therefore, in accordance with the teachings in the above named Hansell disclosure, I have found that by projecting a second jet of water or other appropriate fluid, or even gas, at a relatively high velocity from the nozzle or jet 19 along a path 21, it is possible to control the amount of recording fluid, projected along the path 11 from the nozzle 9, which reaches the surface 13. In accordance with the showing of Fig. 2, where the "blocking" or "screening" fluid, which may be herein assumed to be water, by way of example, is projected along the path 21 from the nozzle 19, if signals are supplied to an appropriate amplifying system 23 through signal input lines 25, and amplified and then transferred

through a step-up transformer 27, so as to be applied from one end of the secondary of the transformer 27 to the nozzle or jet 19 through conductor 29, and applied from the other end of the transformer windings through conductor 31 to the threaded pole piece 33, it is possible to alter the path 21 so as to make it conform to the wave corresponding to the A. C. output of the transformer 27, and, thus, uncover the end of the jet 9 and permit fluid projected therefrom along a path 11 to reach the record surface 13. In order to produce deflections of satisfactory amounts, the potentials of the order of 4,000 to 7,000 volts should be produced across the secondary terminals of the transformer.

According to normal conditions, the fluid or water projected from the jet 19 flows transversely to the nozzle 9 and substantially tangentially to the drum 15, so as to cross the path 11. In this manner, and in the absence of signals, all fluid or vapor projected from the nozzle 9 flows along a path designated as 21*a*, forming a continuation of path 21, into a waste receptacle 35 from which it may flow away through the pipe 37.

If signals are brought over the lines 25 to act upon the amplifier 23, and if the resistor 39 connected across the secondary winding of the transformer 27 is made to match substantially the secondary so far as the impedance thereof is concerned, it is observed that the incoming signal potentials as applied across the secondary windings of the transformer, and which should be of the order of 4,000 to 7,000 volts, cause the jet 21 to be altered in its path in such manner that incoming signals control the marking on the record surface 15. Thus, if the drum 15 is continuously rotating and signals are being received, there may be recorded upon the record surface 13 signals corresponding to those transmitted from some distant point, so as to represent either code, picture or similar types of messages. Upon the interruption of signals corresponding to spacings or the like, the potentials are removed from the secondary of the transformer 27, and, thus, the jet of water being projected from the nozzle 19 resumes its normal path 21 and causes the vapor projected from the nozzle 9 to be deflected along the path 21*a*, so as to prevent any marks from being recorded upon the record surface 13.

In the vapor generation system above described, the air compressor 1 is provided with an intake opening 41 and an outlet opening 43. Through the intake opening 41 the air and vapor which has been circulated through the closed system including the oil trap 3, vaporizing unit 5, the ink trap 7, and the tubing connecting the same, flows into the compressor, and with this circulated air and vapor additional air is taken into the system through the intake valve 43. The valve 43 is so constructed that air may be taken in from the atmosphere without any appreciable escape of the colored vapor therefrom. In order to maintain an even pressure on the nozzle 9 and also to remove completely all vapor from the system, so that it does not block or clog any part or parts of the apparatus, I have provided an additional compressor unit 42 for pumping in additional air to the system. The valve 43 may, as shown, be supplied with a pressure indicator, so that even pressures are easily maintained.

As the air and vapor circulates through the system, the oil trap serves to catch any oil which may be mixed with the air delivered from the compressor. The vaporizing unit, as above explained, is filled with a highly colored and readily vaporizable liquid ink which is converted into a vapor state to be passed through the ink trap 7 which catches the heavier ink particles delivered from the vaporizing unit. The vapor is then conducted through a conduit 45 to the nozzle 9 from which it flows. That portion of the ink vapor which cannot pass out through the nozzle 9 then flows through the tubing 47, through an adjustable needle check-valve 49, and thence back to the compressor unit 1. Thus, it will be apparent that when the apparatus is running, there exists a continuously circulating mixture of air and colored ink vapor, with a small part of this mixture issuing from the vapor nozzle and being projected either against the record surface 13 or against the jet 21 and into the receptacle 35.

For normal picture or code recording, it is obvious that the recorded dot would be normally a small round circle to be elongated to dashes by the movement of the recording surface with respect to the normal path of the vapor stream. It is equally obvious that instead of being a small circular dot, the recording stream may be changed to the form of an elongated slit by making the nozzle 9 of the appropriate form to give a sheet of issuing vapor instead of the round stream. This would make it possible in code recording on a tape such as shown by numeral 51, for example, to have rather high dots 53 and dashes 55 created which would be more legible to the receiving operator. In this case, as more particularly illustrated by Fig. 3, the water stream would operate vertically downward to cut the entire vapor stream on or off. This type of arrangement may, where desired, produce the so-called "variable density" sound record.

In distinction to this, the device may also be used as an oscilloscope recorder. In this case, the water stream would be made to operate say horizontally with respect to the vertically upright narrow wedge of vapor 57. By such an arrangement, the water

stream 21 would act to prevent only a small portion of the vapor from hitting the paper at any given time. The water jet 21 could be set, for example, in the center of the height of the vapor stream 57. Then, as the water is deflected up or down from this position, a record on the record strip 51, moving in the direction of the arrow, will be obtained of the actual wave shape of the potentials applied to the water stream with respect to the time axis of the recording paper moving horizontally.

For the purpose of the oscillograph record, it may be more useful to have two electrodes 59 and 61, as disclosed by the copending Hansell application above named, rather than the single electrode 33 normally used for picture recording. For this purpose, Fig. 4 illustrates the two electrodes 59 and 61 vertically disposed above and below the water stream 21. These electrodes are connected respectively to the two ends of the secondary of the signal transformer 27. The water vapor jet 19 is then connected to the center of the secondary of this transformer. A polarizing voltage, illustrated as being supplied from a battery 63, although in actual operation it would preferably be supplied from the regular rectifier output of the power units associated with the amplifier, is inserted between the water jet 19 and the mid-point of the secondary of the transformer 27. The purpose of this additional voltage is to polarize the action of the water stream so that, for example, when the upper electrode is made positive and the bottom electrode negative, the water stream will be deflected upwards because the negative voltage of the water jet is attracted to the upper positive electrode and repelled from the lower negative electrode. For purpose of illustration, the transformer 27 has been included, but it is obvious that if only low frequencies are being investigated or used, the transformer, which is essentially an alternating current device, might be replaced by direct current amplifiers to accomplish the definite positioning of the water stream to indicate the voltages derived from such a direct current amplifier.

With an arrangement of this type, the record of the signals will assume the white color shown by the wavy line 65, whereas the record strip itself will be dark colored, or of the color of the vapor jet, as indicated by the portion 67 of the record strip 51.

From a consideration of the record formed on the end of the record strip 51 of Fig. 4, it is quite obvious that this record substantially corresponds to the oscillograph type of recording frequently used in connection with the reproduction of sound in conjunction with motion picture films and the like, and my invention is, therefore, applicable to such reproduction of sound where there is a sound input or a sound modulated input to the amplifying system 23.

Also, in order to produce the well known and so-called variable area type of sound record for talking motion picture films, I may, where desired, use an arrangement similar to that shown by Fig. 4, where the vapor stream has appreciable height and extremely narrow width, by similarly projecting a water or screening jet from the nozzle 19, so that this jet also has appreciable height but extremely narrow width. Thus, it is apparent that, under normal conditions, the screening or water jet issuing along the path 21 will normally block all of the vapor stream projected from nozzle 9 so as to reach the record strip under normal conditions over an area designated by 57 on Fig. 4. However, upon the receipt of signals, the water or screening jet may then be moved in one direction so as to provide for a variable area record being produced from the vapor jet projected toward the record strip. Thus, the water or screening jet might serve as a means for controlling the height of the area covered by the vapor on the record strip 51, which may be measured from the edge 69, and, in this case, the record will consist of dark portions extending from the edge 69 upwardly to the white colored wavy line 65 and the upper portion of the record will be entirely missing, or, where desired, the record may be measured from the edge 71 down to the wavy line 65. Of course, it is obvious that any well known method may be resorted to for transferring this record on to the sound track of the well known motion picture film, or the strip 51, itself, may be used for reproducing the sound record.

It will also be apparent that while I have herein described my invention as being applicable to marking by vapor or the like, it is also possible to continuously circulate heated air or heated fluids or waters, or gases, through the closed system, and to then project these heated fluids from the nozzle 9 toward the record surface 13. In such a case, the record surface 13 should preferably be of the type which I have disclosed by my copending application, Serial No. 303,108, filed August 30, 1928, jointly with R. S. Bicknell, disclosing a heat sensitive recording surface. My above named copending application, Serial No. 128,720, as above stated, discloses the features of projecting a heated recording medium from a nozzle. Under such conditions, of course, the "blocking" or "screening" fluid or the like would be projected from the nozzle 19, as disclosed, and would constitute a wall or blocking medium for preventing the heated marking fluids from reaching the record surface in the same manner as is disclosed in the present case.

While I have herein described my invention in such manner that incoming signals

cause the interrupting, blocking, or screening fluid to be so deflected that the marking fluid reaches the record surface, it should be borne in mind that the reverse may be true, and especially where "negatives" are transmitted, the absence of signals may provide the means by which the marking fluid is permitted to reach the record surface.

Of course, other modifications and changes may suggest themselves and at once become apparent to those skilled in the art to which the invention relates, and I, therefore, believe myself to be entitled to make and use any and all of such modifications as fall fairly within the spirit and scope of the present invention as set forth in the hereinafter appended claims.

Having now described my invention, what I claim and desire to secure by Letters Patent is the following:

1. The method of recording signals which comprises continuously projecting a recording fluid toward a record surface, projecting a second fluid at an angle to said first named fluid for normally blocking the said first named fluid from the record surface, and altering the path of the second fluid so as to permit varying amounts of the first fluid to reach the record surface in accordance with desired received signals.

2. The method of recording signals which comprises continuously projecting a recording fluid toward a record surface for producing visible markings thereon, projecting a second fluid at an angle to said first named fluid for normally blocking the said first named fluid from the record surface, and electrostatically controlling the second fluid so as to permit the first fluid to reach the record surface in accordance with desired received signals.

3. The method of reproducing signals which comprises projecting a recording fluid in a normal direction toward a recording surface, projecting a second interrupting fluid transverse to the path of the recording fluid for normally preventing the recording fluid being projected beyond the plane of the interrupting fluid, and displacing the interrupting fluid during receipt of signals for permitting the marking fluid to reach the recording surface.

4. The method of reproducing signals which comprises projecting a fluid toward a recording surface for producing visible markings thereon, projecting a second screening fluid transverse to the path of the marking fluid so as to normally prevent the marking fluid from being projected beyond the plane of the screening fluid, and electrostatically displacing the screening fluid during receipt of signals for permitting the marking fluid to reach the recording surface.

5. The method of recording signals which comprises continuously projecting a recording fluid toward a record surface, projecting a second fluid transverse to the path of said first named fluid for normally screening the said first named fluid from the record surface, and controlling the second fluid so as to permit varying portions of the said first named fluid from reaching the record surface in accordance with received signals.

6. The method of recording signals which comprises continuously projecting a wide band of vaporized recording fluid toward a record surface, projecting a second fluid transverse to said first named fluid for blocking a portion of the said first named fluid from the record surface, and controlling the said second fluid in accordance with received signals so as to cause the said first named fluid to trace paths of different width across the record surface.

7. In a system for recording signals, means for projecting a recording fluid toward a recording surface, means for projecting a second fluid at an angle with respect to the direction of projecting said recording fluid so as to prevent said recording fluid from reaching the record surface, and means for varying the path of the second fluid in accordance with received signals for permitting the recording fluid to reach the recording surface.

8. In a system for recording signals, means for projecting a marking fluid toward a recording surface, means for projecting a second fluid at an angle with respect to the direction of projecting said marking fluid so as to normally prevent said marking fluid from reaching the record surface, and electrostatic means for altering the path of the second fluid in accordance with received signals for permitting the recording fluid to reach the recording surface.

9. In a system for recording signals, means for projecting a recording fluid in a normal direction toward a record surface, means for projecting a second fluid transverse to the path of said recording fluid for normally screening the recording fluid from the record surface, and electrostatic means responsive to signals for altering the path of the blocking fluid and permitting marking fluid to reach the record surface.

10. In a system for recording signals, means for projecting a marking vapor toward a record surface, means for projecting a fluid transverse to the path of said marking vapor so as to normally prevent the vapor from marking the record surface, and electrostatic means responsive to signals for altering the path of the vapor controlling fluid so as to permit vapor produced markings on the record surface.

11. In a system for recording signals, means for projecting a wide band of vaporized recording fluid toward a record surface, means for projecting a second recording

fluid across the path of said vaporized recording fluid, and means responsive to received signals for altering the path traced by the recording fluid.

12. In a system for recording signals, means for projecting a wide band of vaporized recording fluid toward a record surface, means for projecting a second recording fluid across the path of said vaporized recording fluid, and means responsive to received signals for varying the area of marking by the recording fluid.

13. In a system for recording signals, means for projecting a wide band of vaporized recording fluid toward a record surface, means for projecting a second recording fluid across the path of said vaporized recording fluid, and means responsive to received signals for varying the density of marking by the recording fluid.

14. In a signal reproducing system, means for vaporizing a highly colored marking fluid, means for projecting the vaporized fluid in a normal direction toward a record surface, means for projecting a second non-recording fluid transverse to the path of projection of said vaporized recording fluid for normally preventing the recording fluid from being projected beyond the plane of the non-recording blocking fluid, and electrostatic means responsive to received signals for altering the position of the blocking fluid with respect to the marking vaporized fluid for permitting the recording fluid to reach and mark the record surface for periods corresponding to received signal periods.

15. In a signal reproducing system, means for vaporizing a highly colored marking fluid, means for projecting the vaporized fluid in a normal direction toward a record surface, means for projecting a second non-recording fluid transverse to the path of projection of said vaporized recording fluid for normally preventing the said recording fluid from being projected beyond the plane of the blocking fluid, means for receiving signals, transformer means for converting said received signals into corresponding high potential signals, and electrostatic means responsive to said high potential signals for altering the position of said non-recording fluid and permitting the recording fluid to reach the record surface for periods corresponding to the duration of the said received signals.

16. In a system for recording signals, means for projecting a vaporized jet of marking fluid toward a record surface, means for projecting a jet of liquid between said vapor jet and said recording surface for screening the recording surface from said vapor under normal conditions, a pair of electrodes adjacent the said screening jet, means for applying polarizing potentials to said screening jet, and means for applying incoming signal potentials to said electrodes for varying the position of said screening jet and thereby controlling the marking of said vaporized projected fluid on the said record strip.

17. In a system for recording signals, means for projecting a vaporized jet of marking fluid toward a record surface, means for projecting a jet of liquid between said vapor jet and said recording surface for screening the recording surface from said vapor under normal conditions, a pair of electrodes adjacent the said screening jet, means for applying polarizing potentials to said screening jet, and means for applying incoming signal potentials to said electrodes for varying the position of said screening jet and thereby controlling the area of marking of said vaporized projected fluid on the said record strip.

18. The method of recording signals which comprises continuously projecting a recording fluid toward a record surface for producing visible markings thereon, projecting a second fluid at an angle to said first named fluid for normally blocking the said first named fluid from the record surface, and electrically controlling the second fluid so as to permit the first fluid to reach the record surface in accordance with desired received signals.

19. The method of reproducing signals which comprises projecting a recording fluid in a normal direction toward a recording surface, projecting a second interrupting fluid transverse to the path of the recording fluid for normally preventing the recording fluid being projected beyond the plane of the interrupting fluid, and electrically displacing the interrupting fluid during receipt of signals for permitting the marking fluid to reach the recording surface.

20. The method of reproducing signals which comprises projecting a recording fluid in a normal direction toward a recording surface, projecting a second interrupting fluid transverse to the path of the recording fluid for normally preventing the recording fluid being projected beyond the plane of the interrupting fluid, and displacing the interrupting fluid during receipt of signals by amounts proportional to the signal strength for permitting the marking fluid to reach the recording surface.

21. In a system for recording signals, means for projecting a marking vapor toward a record surface, means for projecting a fluid transverse to the path of said marking vapor so as to normally prevent the vapor from marking the record surface, and electrical means responsive to signals for altering the path of the vapor controlling fluid so as to permit vapor produced markings on the record surface.

22. In a signal reproducing system, means

for vaporizing a highly colored marking fluid, means for projecting the vaporized fluid in a normal direction toward a record surface, means for projecting a second non-recording fluid transverse to the path of projection of said vaporized recording fluid for normally preventing the recording fluid from being projected beyond the plane of the non-recording blocking fluid, and electrical means responsive to received signals for altering the position of the blocking fluid with respect to the marking vaporized fluid for permitting the recording fluid to reach and mark the record surface for periods corresponding to received signal periods.

23. In a signal recording system, a plurality of jets each projecting fluid in undiminished quantities in predetermined directions, and means for altering the direction of one of said fluids for controlling the effective action of the other of said fluids.

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