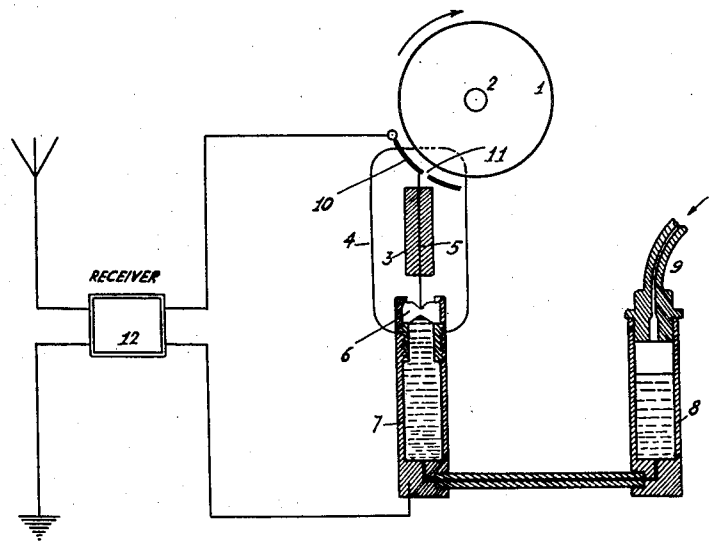
Oct. 11, 1932. F. SCHRÖTER 1,882,043

SIGNAL RECORDING

Filed Sept. 12, 1929



INVENTOR
FRITZ SCHRÖTER
BY H. G. Grover
ATTORNEY

Patented Oct. 11, 1932 1,882,043

UNITED STATES PATENT OFFICE

FRITZ SCHRÖTER, OF BERLIN, GERMANY, ASSIGNOR TO TELEFUNKEN GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE M. B. H., OF BERLIN, GERMANY, A CORPORATION OF GERMANY

SIGNAL RECORDING

Application filed September 12, 1929, Serial No. 391,996, and in Germany October 20, 1928.

The present invention relates to a telegraph or graphic recorder which is particularly adapted to high speed signaling and preferably comprises a movable jet of liquid which is useful in general for all recording purposes. The invention, however, will be particularly described in its application to picture transmission, although it is to be understood that it is capable of recording current waves and the like of all general types for the reception of all types of code messages and the like.

One of the fundamental objects of my invention is to provide for the particular purpose above set forth a system for recording which insures high recording speed by reason of the fact that a nearly non-sluggish or massless tiny jet of liquid is altered or changed in its position with respect to the recording surface by only extremely small amounts. One essential advantage of the invention resides, in addition to the said high speed of recording, in that only extremely small deflective forces are required for the controlling action upon the jet.

The basic idea underlying this invention is that the nearly massless jet of liquid which constitutes a convection current of charged or magnetically responsive particles, is influenced in its position by means of magnetic or electric forces. This controlling action may be effected in various ways and by various means, for instance, in the case of paramagnetic or ferro-magnetic nature of the liquid, solely by the agency of a magnetic field controlled by the recording currents, or, in the case of an electrically insulating liquid jet charged by positive or negative particles or vesicles, may be controlled by the aid of suitably disposed electric fields.

In the case of conducting liquids provided for the jet, recourse may also be had to an electrodynamic action as will be explained in more detail in the following specification by making reference to the accompanying drawing illustrating one embodiment of my invention in a rather conventional manner.

The liquid in the form of a slender jet, as shown by the drawing, is controlled in its position in relation to the recording surface and may consist of an ink serving merely as a "covering means" which causes coloration directly upon the writing or recording surface to contrast with the background, though coloration, meaning either blackening or contrasting, may be produced by the liquid jet also indirectly by providing a type of liquid which when it impinges upon a suitable recording paper impregnated with suitable chemicals may produce a local color reaction or a burning reaction. According to the particular manner of causing the changes in position of the jet, the ink or reactive liquid must possess the requisite electric or magnetic properties. For instance, as para-magnetic or ferro-magnetic liquids, I might provide a concentrated iron salt solution for the marking jet. In this case, the jet would be deflected by the agency of a magnetic field subject to the controlling action of an incoming or recording current, and the same could be made to act directly as an ink either by the incorporation therein of coloring constituents or it could be made to produce upon the prepared or sensitized recording or writing surface a chemical reaction, such as the formation of Prussian blue. This scheme is feasible, for instance, when the jet of liquid contains iron salts and when the recording paper or surface is impregnated with potassium ferricyanide or ferrocyanide.

When the controlling action for the jet is by means of an electric field, the recording ink most suitably consists of a non-conducting liquid containing dyestuffs, for instance, a solution of anilin black in xylene or xylol, and the most important point is here to use substances of a maximum insulation power. In the case of electrodynamic action, that is, mechanical movement of the jet of liquid

passed by an electric current inside a magnetic field, the liquid must be conducting for electric currents. In other words, it must be substantially an aqueous solution of suitable salts with addition of coloring substances or dyestuffs suitable for the particular recording action.

It may also be conceivable to use, in the case of electrodynamic control and action, the para-magnetic or ferro-magnetic properties of an iron-salt solution in an accessory manner in order that the magnetic field intensity and thus the force actions at the jet may be increased.

The accompanying drawing, which explains and illustrates my invention in a conventional manner as applied to picture transmission systems, indicates a scheme which is applicable to what is known as black and white contrast pictures. In the drawing, the picture drum 1 is revolved in any appropriate and known manner in synchronism with a like drum at a transmitting station upon a spindle or shaft 2, and upon the surface of the drum 1 is arranged the recorder inking surface for the purpose of reproducing marks or images corresponding to those transmitted from the transmitting point. The jet of liquid 5 is projected from the diamond nozzle 6 and is deflected between the polar surfaces 3 of a powerful electromagnet electrodynamically out of its normal position as soon as a current flows therethrough. For this purpose, the same is connected in the output circuit of a receiver 12, and the parts 7 and 10, to which more particular reference will hereinafter be made, represent electrodes through which the current comes in and flows out of the jet of liquid.

To excite the deflector electromagnet, there are used the coils 4 which are fed and energized with a sufficiently strong direct current in any appropriate manner. The conducting jet of ink or liquid issues under pressure from the diamond nozzle 6 whose cross-sectional area is governed by the bore of the die or nozzle 6, and it may be of an order of magnitude of approximately 1/100 mm.

The liquid for the recording action is stored in the communicating tubes 7 and 8, of which the latter has a screw plug 9 in one end thereof in order to produce pressure by connection with a pump or by connection with a compressed air or gas tank (not shown). The circuit of the liquid jet is made by reason of the fact that when the jet is not deflected, it strikes against the conducting surface 10 which screens the liquid at the same time from the picture drum 1. Now, when the controlling current from the receiver 12, connected with either a radio antenna receiving system (as shown), or by wire lines where desired, starts to flow in the jet of liquid 5, then, since the magnetic force lines are at right angles to the plane of the drawing, the jet of liquid 5 will be moved over to the righthand side of the recording surface in the presence of a certain direction of the field or current, and by a very slight deflection it strikes a small slit 11 in the diaphragm 10 through which the jet of ink or other recording fluid will pass. The jet thus reaches, inside a slight instant depending upon its lower inertia, the recording or inking surface where the recording action, blackening or coloration, is produced. An interruption in the deflective action by the slit 11 can be avoided if the recording surface, say, by moistening the same, is given a certain conducting power, and if the drum 2 upon which the recording surface is mounted is connected with the diaphragm 10.

The value or amount of the deflective action in an arrangement as above described depends upon the magnetic field intensity, the strength of the current flowing in the jet of liquid, and the distance or path covered inside the magnetic field. Since the jet of liquid is of very reduced cross-section, as above described, the magnetic air gap can be chosen very small, with the result that an extremely intensive field is produced. The length of the jet can be made sufficiently great without any particular difficulty, and without the resistance in the jet assuming undesirably high values. The high resistance of the thin jet 5, on the contrary, promotes the direct utilization of the energy furnished from the amplifier since it represents an external resistance of the output or power amplifier tube which may be conveniently made of the same order of magnitude as the internal resistance of the tube. Therefore, fundamentally speaking, it is unnecessary to provide any transformation of the amplifier potential, and, owing to the small mass of the jet, its acceleration by dynamic control action becomes very high so that extremely high recording speeds are attainable, and very little or substantially no lag whatever is experienced.

As an alternative scheme, it is also possible to have recourse instead of direct current excitation of the magnetic fields 3 and 4 to radio frequency alternating current energization so that the liquid jet is subjected to a sort of pendular motion. In order that the jet may then be directed upon the recording surface carried by the drum 1 or the passage slit 11 in the diaphragm member 10, only a slight addition in the amplitude of the oscillations by variation of the current strength inside the jet will be needed.

If recourse is to be had to the control action of the jet by para-magnetic or ferro-magnetic liquid jets rather than to electrodynamic control as hereinbefore suggested, then the jet, of course, does not constitute a portion of the path of the current flow, and the control action is produced in a similar manner solely by

causing the incoming currents or the currents to be recorded to vary the magnetic field acting upon the jet. In the case of electric action of an electrically charged jet, the incoming currents or the recording currents are either used to control the instantaneous intensity of charge of the jet or to control the intensity of the deflecting electric field, the latter having to be imagined to take the place of the magnetic field in an arrangement as shown in the drawing. However, it is also possible to utilize a combination of both actions so that both the charging of the jet as well as the effective electric field are varied.

Still other objects and modifications of my invention will become apparent and at once suggest themselves to those skilled in the art to which the invention relates, and I, therefore, believe myself to be entitled to make any and all modifications of my invention such as fall fairly within its spirit and scope as hereinafter set forth in the 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 electrical energy which comprises projecting a stream of marking fluid toward a recording surface and influencing the stream directly by electromagnetic force to control the amount of fluid reaching the surface.

2. The method of recording electrical energy which includes projecting a recording fluid along a predetermined path toward a recording surface and in subjecting the fluid to a magnetic field for changing the path of the recording fluid in accordance with received signal energy so as to cause variations in the marking of the recording fluid upon the recording surface.

3. The method of recording signals which includes projecting a jet of recording fluid along a predetermined path toward a signal recording surface, subjecting the fluid to a magnetic field for causing a deflection in the path of the projected jet in accordance with received signal impulses and producing markings on the recording surface at periods of deflection of the recording jet.

4. The method of recording signals on a recording surface in accordance with received signal energy impulses which includes continuously projecting a jet of recording fluid along a predetermined path toward the recording surface, electrically deflecting the path of the recording jet in accordance with received signal energy impulses, producing markings by the recording jet upon the recording surface during periods of deflection, and interrupting the marking action during the absence of electrical effects producing deflections in the jet.

5. The method of producing interrupted recording actions upon a recording surface which includes continuously projecting a jet of recording fluid along a predetermined path relative to the recording surface, electromagnetically altering the path of projection of the recording jet in response to received signal energy, producing markings on the recording surface by the recording jet in its deflected position, and screening the recording surface from the jet action during the absence of electromagnetic effects sufficient to cause deflection thereof.

6. The method of recording signals which includes projecting a jet of marking fluid along a predetermined path relative to a recording surface, continually subjecting the jet to a magnetic field conducting electric currents to be recorded along its jet and thereby altering the position of the jet with respect to the recording surface, and causing the jet to produce marks on the recording surface during periods when the position thereof is altered by currents flowing therethrough.

7. A system for recording electric energy which includes means for projecting a stream of marking fluid along a predetermined path relative to a recording sheet, and means for causing a magnetic field to act upon said fluid for deflecting the path of said projected jet in accordance with received signal energy so as to vary the amount of recording fluid reaching the recording surface.

8. A signal recorder comprising means for projecting a jet of marking fluid along a predetermined path relative to a signal recording surface, means for moving the recording surface, and means for deflecting unsupported portions of the jet of marking fluid in accordance with electric actions produced thereon for causing said jet to produce markings on said recording surface during periods of deflection and means to interrupt the marking periods during periods when the jet remains in an uninfluenced state.

9. A signal recorder for producing a discontinuous signal record which includes means for supporting a record surface, a source of marking fluid for producing marks upon said surface, means for causing a stream of said marking fluid to be projected as a fine jet along a predetermined path relative to said recording surface, and means for interrupting the action of said recording jet upon said recording surface by electro-magnetically deflecting the said jet.

10. A system for producing a discontinuous graphical record of received signal energy impulses which includes a surface for supporting a recording sheet, a jet of fluid marking material normally and continuously projected along a predetermined path relative to said recording surface, a screen interposed between the path of said jet and said recording surface for preventing markings upon said recording surface by said jet when projected in its normal position, and

means for electromagnetically altering the path of said jet for producing markings upon said recording surface upon the influence of received signal energy causing said electromagnetic action.

11. A system for recording signals as discontinuous records which includes a support surface adapted to carry a signal recording medium, means for projecting and electrically conducting the jet of marking fluid along a predetermined path relative to said recording surface, means for continually subjecting said jet to a constant magnetic field, means for causing electric energy pulses to periodically traverse said jet during periods when signals are to be recorded for producing a deflection of said jet, means provided by said jet in its deflected state for producing markings upon the recording surface, and means for preventing markings of said liquid jet upon said recording surface during periods when said jet is uninfluenced by electric signal energy flowing therethrough.

12. The method of recording signals on a recording surface which includes projecting a jet of marking fluid through a magnetic field toward the recording surface, and passing current proportional to received signals through the jet for controlling the position thereof so as to produce signal indications on the recording surface.

13. The method of recording electrical energy which includes projecting a stream of marking fluid toward a record sheet and subjecting the stream to an electromagnetic field varying in intensity in accordance with the energy to be recorded so as to proportionately deflect said stream.

14. The method of recording signals which includes projecting a stream of marking fluid toward a moving record sheet, and deflecting an unsupported portion of the stream by the action of an electro-magnetic field exerted directly on the unsupported stream in accordance with the signal to be recorded.

15. The method of producing a discontinuous signal record which includes causing a stream of marking fluid to flow continuously toward a record sheet and producing fluid markings on the record sheet by directly subjecting the marking fluid to a varying strength magnetic field so as to deflect the stream in accordance with the signal to be recorded.

16. The method of producing a discontinuous signal record which includes causing a continuous stream of marking fluid to flow toward a record sheet, deflecting the stream by electromagnetic force exerted thereon in accordance with the signal to be recorded, and permitting the stream to reach the record when flowing along one path and preventing the stream from reaching the record when flowing along another path.

17. In the operation of a recorder comprising a record sheet, a source of marking fluid, and means including a fine bore nozzle for projecting the stream of marking fluid toward the record sheet, the method of preventing clogging of the nozzles due to the drying of the marking fluid thereon during the absence of signal recordings which includes causing a continuous flow of the marking fluid through the nozzle and preventing contact of the marking fluid with the record sheet by baffling the stream outside of the nozzle without stopping the flow through the nozzle for preventing recordings during the absence of signals, and subjecting the fluid to an electromagnetic deflecting field during signalling periods for causing signals to reach the recording surface.

18. An electrical energy recorder comprising means to project an unsupported stream of marking fluid toward a record sheet, and means to control the steam by electromagnetic force exerted directly on the marking fluid in accordance with energy to be recorded so as to produce recordings on the record sheet.

19. An oscillograph for recording electrical energy comprising means to project a stream of marking fluid on a record, and means to deflect the stream by electromagnetic force exerted thereon in accordance with the energy to be recorded.

20. A signal recorder for producing a discontinuous signal record comprising means to support a record sheet, a source of marking fluid, a baffle arrangement adjacent the record sheet, means to cause a continuous stream of marking fluid to flow toward said baffle, said baffle normally preventing the fluid stream from reaching the record sheet, and means to deflect the fluid stream by electromagnetic force exerted thereon in accordance with the signal to be recorded, so that the fluid stream for permitting the stream passes to one side of the baffle to produce marking representations upon the record sheet.

21. A recorder comprising means to support a record sheet, means to move the record sheet, a source of marking fluid, means for projecting a stream of marking fluid toward the record sheet, a baffle means for normally interrupting the flow of marking fluid toward the record sheet and collecting the marking fluid without stopping the flow thereof, and means for electromagnetically attracting the stream of marking fluid upon receipt of incoming signals for automatically moving the stream away from the baffle so as to produce recordings upon the record sheet.

22. In a signal system, means for producing an unsupported recording stream, and means for subjecting the stream to varying strength magnetic fields in proportion to the strength of desired signals, whereby the stream is deflected in accordance with the variations in the magnetic field.

23. The method of producing visible indi-

cations of electrical energy which includes projecting a registering stream toward a viewing surface so as to produce thereon visible indications, and subjecting the stream to the direct influence of a controlling magnetic field produced from the electrical energy of which visible indications are to be produced so as to modify with the magnetic field strength acting upon the projected stream.

FRITZ SCHRÖTER.

CERTIFICATE OF CORRECTION.

Patent No. 1,882,043. October 11, 1932.

FRITZ SCHRÖTER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 107, claim 20, strike out the words "for permitting the stream"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of February, A. D. 1933.

(Seal) M. J. Moore, Acting Commissioner of Patents.