June 26, 1923. 1,460,083

E. THOMSON

RECORDING SIGNAL

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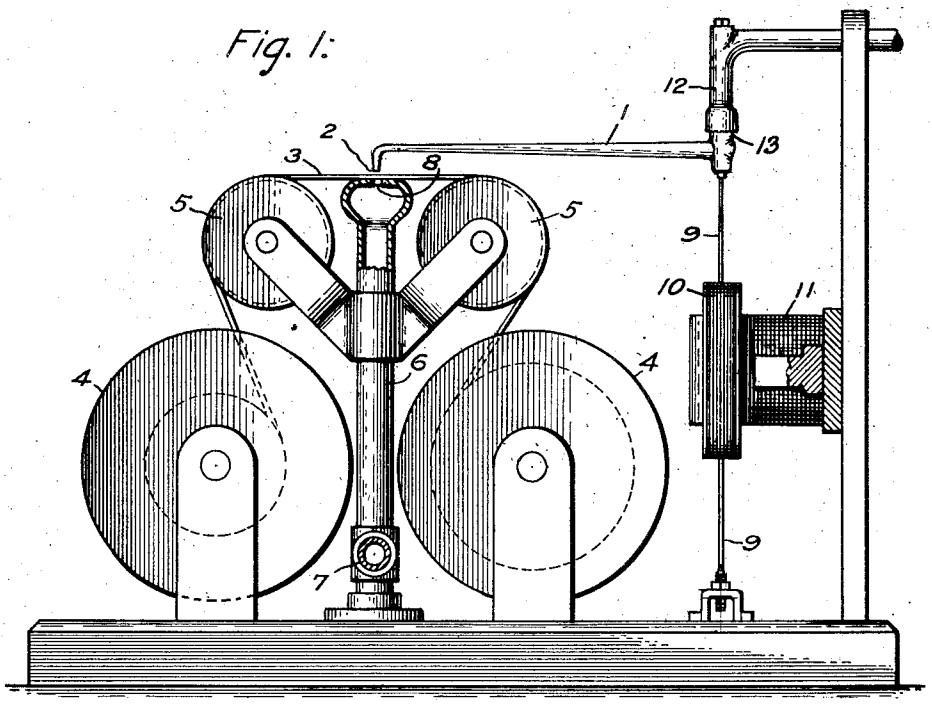
Fig. 1.



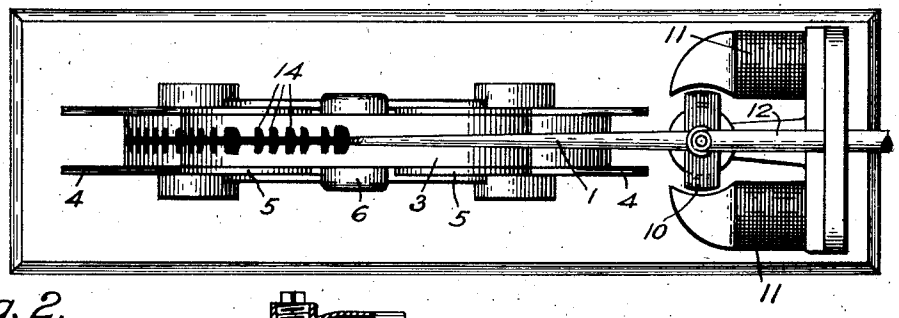


Fig. 2.

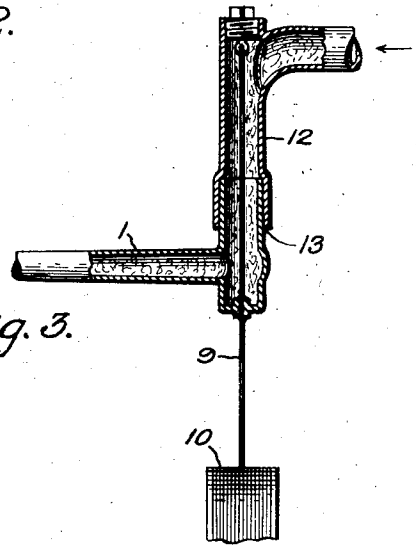
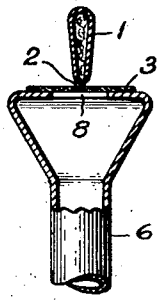


Fig. 3.

Fig 4



Inventor,
Elihu Thomson,
by Albert G. Davis
His Attorney.

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Fig. 5.

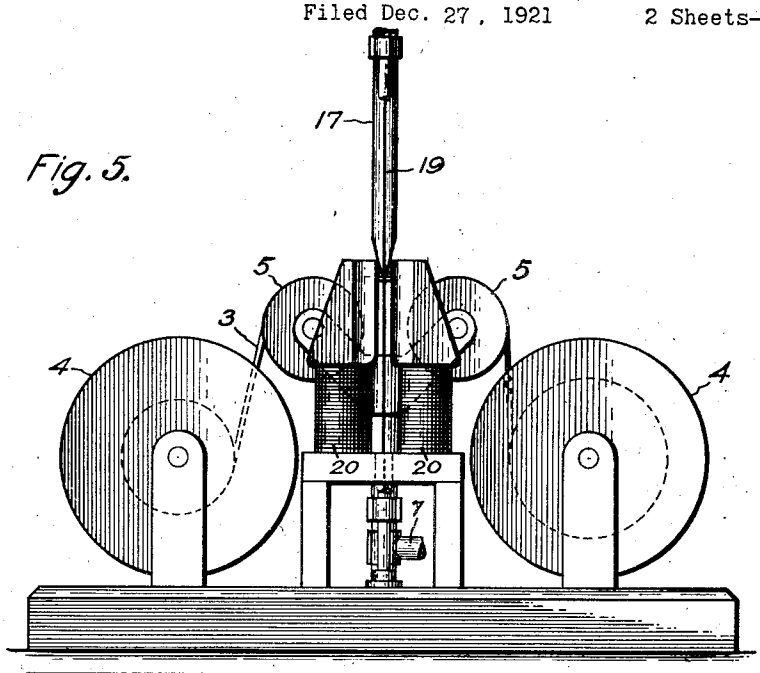


Fig. 6.

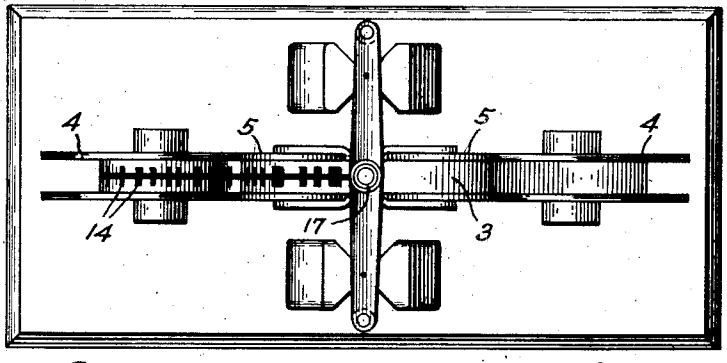


Fig. 7.

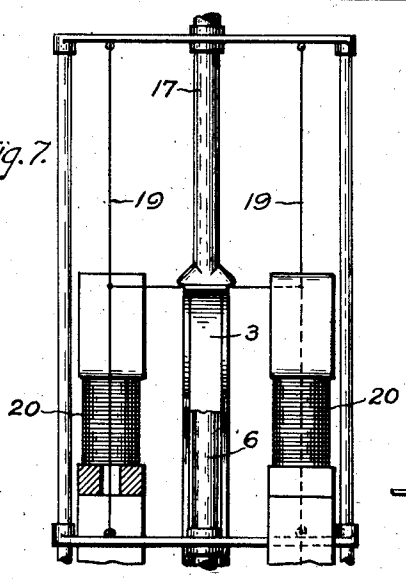


Fig. 8.

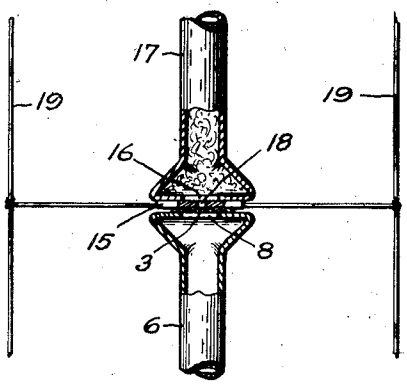
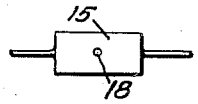


Fig. 9.



Inventor,
Elihu Thomson,
by Albert G. Davis
His Attorney.

Patented June 26, 1923. 1,460,083

UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

RECORDING SIGNAL.

Application filed December 27, 1921. Serial No. 524,939.

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Recording Signals, of which the following is a specification.

My present invention relates to a method of and apparatus for recording upon a tape telegraphic signals transmitted either by radio or over wire lines.

The object of my invention is to improve the operation of tape recording apparatus and provide a system which involves a minimum amount of friction between the oscillating and other parts of the recording apparatus.

One common form of tape recorder which has been used extensively in the past comprises a moving tape and a jet of colored liquid which is projected toward the recording strip, this jet being caused to oscillate from side to side by an electromagnetic means which is actuated by the received signaling currents. In carrying my invention into effect I substitute for the jet of colored liquid a jet of a reagent, preferably a gas, and cause this jet to react with a substance carried by the recording tape so as to make a discoloration upon the tape wherever the jet strikes the tape. Any sidewise movement of the jet will of course produce a laterally disposed discoloration of the tape and the signals will be represented by these laterally disposed discolorations of the tape. By using a gas as a reagent it will be possible to make the oscillating parts of the apparatus very light and at the same time provide a practically frictionless connection between the oscillating and stationary parts.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, my invention itself, however, will best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 is an elevation, with some portions broken away, of an apparatus for carrying out my invention; Fig. 2 is a plan view of the same; Fig. 3 is a cross-sectional enlarged view illustrating the connection of the oscillating parts of the apparatus to the stationary parts; Fig. 4 is an enlarged cross section showing the relation of the jet producing apparatus to the moving tape; and Figs. 5 to 9, inclusive, are similar views of a modified form of apparatus.

As indicated in Figs. 1 to 4 of the drawing, I provide a horizontal jet tube 1 of light material having a small orifice 2 at its outer end. The outer end of the tube 1 is directed downwardly so that the orifice 2 is located directly over the recording tape 3, which is caused to move longitudinally under the orifice 2 by means of suitable reels 4 and drums 5. The tape 3 in passing from one drum 5 to the other is drawn closely over the top of a hollow pedestal 6 in which a partial vacuum is constantly maintained by connecting the outlet pipe 7 to any suitable exhaust apparatus. The upper end of the pedestal 6 is provided with a slot 8 extending transversely of the tape, this slot being entirely covered by the tape. The slot 8 is directly under the orifice 2 of the tube 1.

The tube 1 may be mounted on any form of apparatus adapted to give it an oscillating motion. In the form of my device shown in Figs. 1 to 4, the tube 1 is attached to a torsion wire 9 on which is mounted a hollow coil 10, which moves in a powerful magnetic field produced by the coils 11. If the signaling current which is to be recorded is supplied to the coil 10 by any suitable connection, the coil 10 and the tube 1 may be caused to oscillate in response to variations in the strength of the signaling current. It will of course be understood that in practice the moving system will be provided with a suitable damping apparatus for preventing sustained oscillations.

The gas which is employed for producing a jet will be supplied to the tube 1 through a feed pipe 12, a loose and substantially frictionless joint being provided at 13, as shown in Fig. 3 between the feed pipe 12 and the tube 1. This joint should be as loose as possible without permitting appreciable leakage.

The recording tape 3 may be of fine porous paper or thin cloth so as to be easily permeated by the gas stream issuing from the orifice 2, which will preferably be of very low pressure. The tape 3 carries a substance which when acted upon by the stream of gas issuing from the orifice 2 will be discolored. This substance may be placed on the tape in any suitable manner. One convenient way

of preparing the tape is to soak it in a solution of a salt, such as acetate of lead with a small amount of glycerine to prevent complete drying. If with a tape prepared in this manner hydrogen sulphide gas is used, a blackening of the tape will take place directly under the jet. When the jet is stationary and the tape is moving a straight black line will be produced along the center of the tape consisting of black sulphide of lead. If while the tape is moving there is a movement of the coil 10 which produces a proportional movement of the jet arm 1 transversely to the length of the tape, a discoloration of the tape will be produced which is displaced from the center line position. This movement of the jet may take the form of lateral oscillations so that the record becomes a sort of broken line with broader portions, as indicated at 14 in Fig. 2.

A wide variety of substances may be employed on the tape for producing similar results. If, for example, the tape is impregnated with a moist starch solution and the jet contains a small amount of iodine vapor the line produced will be formed of a blue iodide of starch and the record will consist of lateral displacements of the line, as indicated at 14 in Fig. 2. As the tape may be impregnated with starch and potassium iodide and chlorine, bromine, ozone N_2O_4 or other gases be employed for producing the discoloration. If the tape is impregnated with Hg_2Cl_2, or an acid dye ammonia gas may be employed. SO_2 may also be used with a tape impregnated with a sensitive dye such as litmus. The end of the jet arm 1 should be arranged as closely as possible to the tape without actually touching it in order that there shall be no friction set up at this point. The slight vacuum which is provided in the interior of the pillar 6 is for the purpose of causing the gas to be drawn through the tape. It also has the effect of preventing the spreading out of the gas jet on the upper face of the tape and thus producing blotches in the record. For this reason the tape itself should be of such a nature that the gas may be drawn through the tape readily.

In the form of my invention shown in Figs. 5 to 9, the moving arm 1 is dispensed with and the orifice through which the gas is directed to the tape is provided in a thin sheet 15 of mica, celluoid or the like. This sheet is mounted between the tape 3, which passes over the orifice 8 in the upper end of pillar 6, as in the form shown in Figs. 1 to 4, and the opening 16 in the end of the feed pipe 17. As indicated in Fig. 8, the plate 15 is located as close as possible to the lower end of the feed pipe 17 without making a rubbing contact therewith or with the tape 3. The plate 15 is made large enough to cover the openings 8 and 16 so that all of the gas which is supplied to the tape 3 must flow through the opening 18 in the plate 15. If, therefore, the plate 15 is caused to oscillate laterally with respect to the tape, the record will be made on the tape as in the form of my invention shown in Figs. 1 to 4. In the present case I have indicated as a means for producing lateral oscillations in the plate 15 a pair of wires 19. When these wires 19 are traversed by the signaling current they will both tend to move to the right or left in the strong magnetic fields produced by the coils 20, thereby producing a corresponding displacement of the plate 15 and of the orifice 18.

While I have shown and described the preferred embodiments of my invention it will be apparent that my invention is by no means limited to the particular apparatus or method of operation described and that many modification in the apparatus as well as in the substances and reagents employed may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A signal recording apparatus comprising a porous strip carrying a material which when exposed to the action of a suitable reagent will change in color, means for moving said strip past an orifice, means for producing from said orifice a jet of gas which will produce a change in color of the material on said strip and means for moving the jet in response to a signaling current.

2. A signal recording apparatus comprising a porous strip carrying a material which when exposed to the action of a suitable reagent will change in color, means for moving said strip past an orifice, means for producing from said orifice a jet of gas which will produce a change in color of the material on said strip, means for moving the jet in response to a signaling current, and means for causing the gas issuing from said orifice to pass through said strip.

3. A signal recording apparatus comprising a porous strip impregnated with a material which when exposed to the action of a suitable reagent will change in color, means for moving said strip past an orifice, means for producing from said orifice a jet of gas which will produce a change in color of the material on said strip, and means for moving the jet in response to a signaling current.

4. A signal recording apparatus comprising a porous strip carrying a material which when exposed to the action of a suitable reagent will change in color, means for moving said strip past an orifice, means for producing from said orifice a jet of a reagent which will produce a change in color of the material on said strip, and means for

moving the jet in response to a signaling current.

5. The method of recording signals which consists in impregnating a tape with a material which when exposed to the action of a suitable reagent will change in color, producing a jet of a reagent which will cause the color of the material to change, producing a relative lengthwise movement between the tape and the jet and producing by means of the signals to be recorded a relative lateral movement between the tape and the jet.

6. A signal recording apparatus comprising a porous strip carrying a material which when exposed to the action of a suitable reagent will change in color, means for moving said strip past an orifice, means for producing from said orifice a jet of a reagent which will produce a change in color of the material on said strip, and means for moving the jet in response to a signaling current, and causing the reagent of the jet to pass through the tape.

7. The method of recording signals which consists in impregnating a tape with a material which when exposed to the action of a suitable gas will change in color, producing a jet of a gas which will cause the color of the material to change, producing a relative lengthwise movement between the tape and jet and producing by means of the signals to be recorded a relative lateral movement between the tape and the jet.

In witness whereof, I have hereunto set my hand this 20th day of December, 1921.

ELIHU THOMSON.