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ELECTRIC SIGNAL RECORDING METHOD

Filed April 8, 1959

Fig. 1

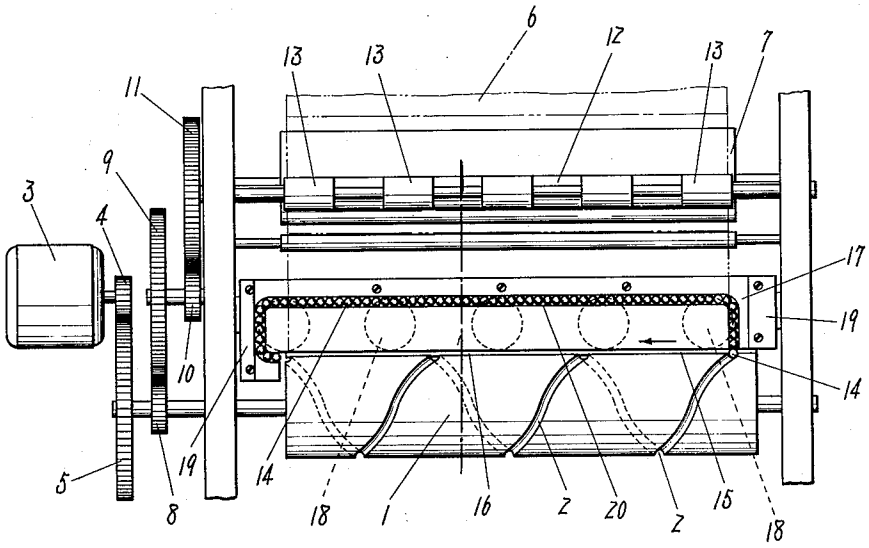
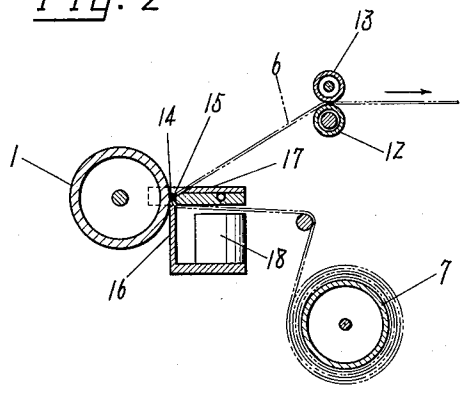


Fig. 2



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ELECTRIC SIGNAL RECORDING METHOD

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This invention relates to an electric signal recording apparatus in which a number of balls and a rotating helically grooved cylinder are used instead of a recording stylus and a belt and the like.

The concept of the present invention is that the steel balls move in a straight path between a guide-gap which is constituted by two magnetic metals facing each other and a groove which is carved helically on the surface of a rotary cylinder, and according to rotation of the said cylinder the recording is made on recording paper which is inserted and moved at a suitable speed between the guide-gap and a steel ball.

An object of this invention is to provide means taking into consideration that the pressure between a steel ball and the recording paper is maintained constant, and that the friction on each steel ball is reduced to the minimum.

Another object of this invention is to provide means eliminating hunting of steel balls during a scanning stroke.

A further object of this invention is to provide means facilitating rapid speed of scanning as in the case of a facsimile recorder.

Another object of this invention is to provide means avoiding any error of phase difference caused by the position of the recording steel ball.

A still further object of this invention is to provide means resulting in the obtainment of recorded figures which are very exact and clear.

Another object of this invention is to provide means aiming at a machine construction for the above purpose which can be made relatively small, and wherein the steel balls can be used substantially continuously and permanently.

The objects, features, and advantages of the invention will be hereinafter explained in conjunction with the accompanying drawings in which:

FIG. 1 is a plan view of the principal part of this invention; and

FIG. 2 is a vertical sectional view taken through the center of FIG. 1.

Referring to the figures, this invention will be explained as follows:

In the figures, the numeral **1** designates a cylinder, the numeral **2** a groove carved helically on the surface of the cylinder **1**. The numeral **3** an electric motor, and the numerals **4** and **5** toothed wheels by which the speed of rotation of the cylinder **1** is to be reduced. The numeral **6** designates a rolled recording paper which is to be put on the stable supporter **7** and is to be pulled out towards the direction of an arrow (FIG. 2) by the roller **12** and the roller **13** which rotate at reduced speed by the reduction gear **8**, **9**, **10** and **11**. The numeral **14** designates steel balls which move in a straight line between the guide-gap **15** and the helical groove **2** on the surface of the cylinder **1** according to the rotation of cylinder. The guide-gap **15** is composed of two parallel magnetic metals **16** and **17** facing each other. The magnetic metal **16** is shaped as an angle-iron, and is provided with a plurality of permanent magnets **18** on one side while its other side constitutes one rail of the guide-gap **15**. The other magnetic metal **17** which is facing the permanent magnet **18** and its knife-edge shaped end facing the pointed end of the magnetic metal **16** form the other rail of the guide-gap **15** leaving a gap through which a recording paper **6** is passable.

In this construction, as the magnetic flux induced by the permanent magnet **18** closes the magnetic circuit extending from the magnetic metal **16** passing through the guide-gap **15** and magnetic metal **17**, the guide-gap **15** becomes a magnetic field and attracts steel balls **14** strongly towards the both rails. Therefore, steel balls **14** move along the gap between the two parallel rails i.e. guide-gap **15**, and do not deviate from this gap. When steel balls **14** are inserted on the guide-gap **15**, the balls will move naturally along the guide-gap **15** by the help of rotating helical groove **2** on the cylinder **1**. Then the speed of scanning as in the case of a facsimile recorder can be attained. And now the recording paper **6** is pulled out in the direction of an arrow from the gap on the top of the permanent magnet **18** passing through the guide-gap **15** as shown in FIG. 2, so a steel ball **14** will move along the guide-gap **15** keeping contact with the surface of the recording paper **6**. That is, when the signal impulse potential is supplied to the positive pole of the magnetic metal **16**, the current will flow to the steel ball **14** and will reach the negative pole of the magnetic metal **17** through the surface of paper **6**; and thus, the signal will be recorded on the recording paper **6**. Supporter **19** of the rails of the guide-gap **15** made of insulating material, insulates positive rails from earth-end and furnished in parallel to the surface of the cylinder **1**. The numeral **20** in FIG. 1 designates the storing tube or channel for the steel balls **14**, the inside of which is filled with the steel balls **14**. When the steel balls **14** which started the scanning line movement in the direction of the arrow (FIG. 1) arrive at the left end of the helically grooved cylinder **1**, they are to be pushed in the storing tube **20** at the end of the helical groove **2**. As the inside of the storing tube **20** is being filled with steel balls **14**, when a ball is pushed in the storing tube **20**, the other one will naturally come out from the right end of the storing tube **20** and enter into the helical groove **2** provided in the same phase and produce the scanning line movement together with the rotation of the cylinder **1**. Thus, through the repetition of this operation, the recording is done exactly and clearly on the paper **6** which is continuously to be pulled out.

Although there are many other mechanical methods of inserting a steel ball into the guide-gap **15** at every scanning line movement, only one example has been explained.

The machine is constructed in this way, the recording on the paper **6** is to be done by the signal impulse current through the steel balls **14** and its object can be achieved. In the invention, as the scanning line movement of the steel balls **14** is conducted between such a straight guide-gap **15** and the helical groove **2**, there will be no hunting caused by the error of position of recording balls **14** and also as the steel balls **14** themselves are always adhering closely to the surface of paper **6** by the strength of magnets attracting these balls, the recording can be done under a constant pressure. Further, as the light steel balls are to be used in place of the recording stylus, the friction is little, and also as many steel balls are used, they can be used semi-permanently. Furthermore, as a scanning line movement of the steel balls **14** can be conducted at proper intervals by pushing the balls **14** in the guide-gap **15**, regardless of the number of threads of helixes, the helixes of many threads can be used in a scanning line movement. Therefore, the diameter of cylinder **1** can be reduced, and the size of machine can naturally be made small.

Moreover, the invention can be applied to the method of electric discharge or electro-chemical recording method.

Having thus described my invention, I claim:

1. An electric signal recording apparatus comprising a rotary cylinder having a peripheral helical groove extending along the surface thereof, means to rotate said cylinder, a first plate member having an edge disposed along the length of said cylinder, a second plate member including a portion extending upwardly adjacent said first plate and with an edge defining with said first plate a guide gap adjacent said cylinder, said first and second plate members being of magnetic material, a steel ball of a size to be received in the helical groove of said cylinder and disposed in said guide gap and within said groove, a recording paper stretched through said gap over said first plate member and under said steel ball, one of said first and second magnetic plates having a permanent magnet for urging the ball under constant pressure against said recording paper, and means for applying an electric signal voltage between said magnetic metals.

2. An electric signal recording apparatus as set forth in claim 1, wherein the other magnetic metal facing said

plurality of permanent magnets is provided with a knife-edge.

3. An electric signal recording apparatus as set forth in claim 1, wherein said one magnetic metal is angle shaped.

4. An electric signal recording apparatus as set forth in claim 1, including a steel ball storing tube having a plurality of steel balls therein, said tube being arranged adjacent said helical groove for feeding steel balls one by one to said helical groove.

References Cited in the file of this patent

UNITED STATES PATENTS

2,188,650	Clark	Jan. 30, 1940
2,760,840	Gordon	Aug. 28, 1956
2,785,039	Artzt	Mar. 12, 1957
2,887,353	Barstrom et al.	May 19, 1959

FOREIGN PATENTS

18,346	Great Britain	1901