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W. H. EDWARDS

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PHONOGRAPH REPRODUCER

Filed May 14, 1929

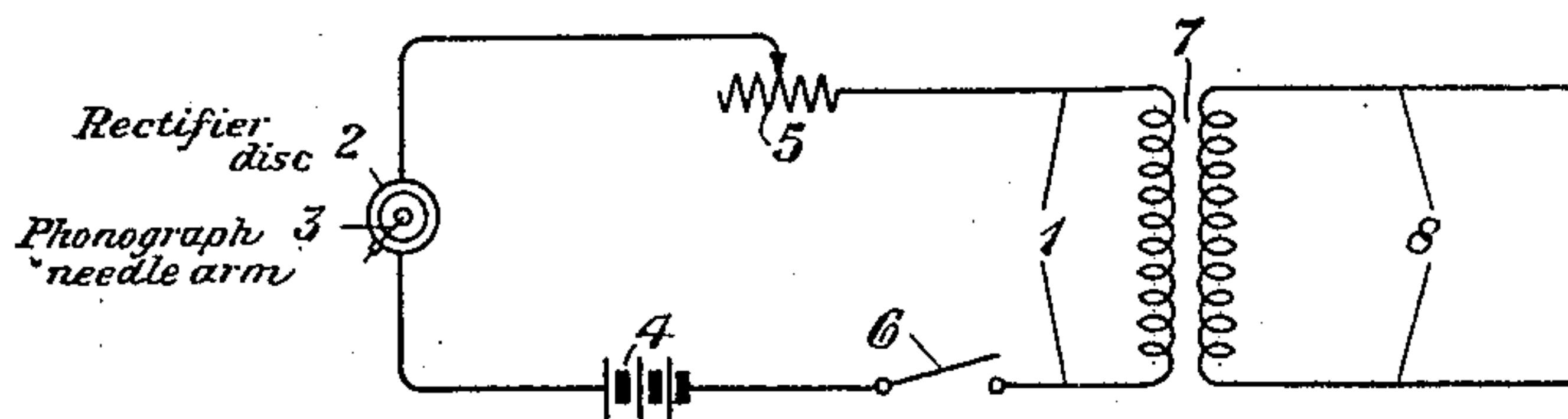


Fig. 1

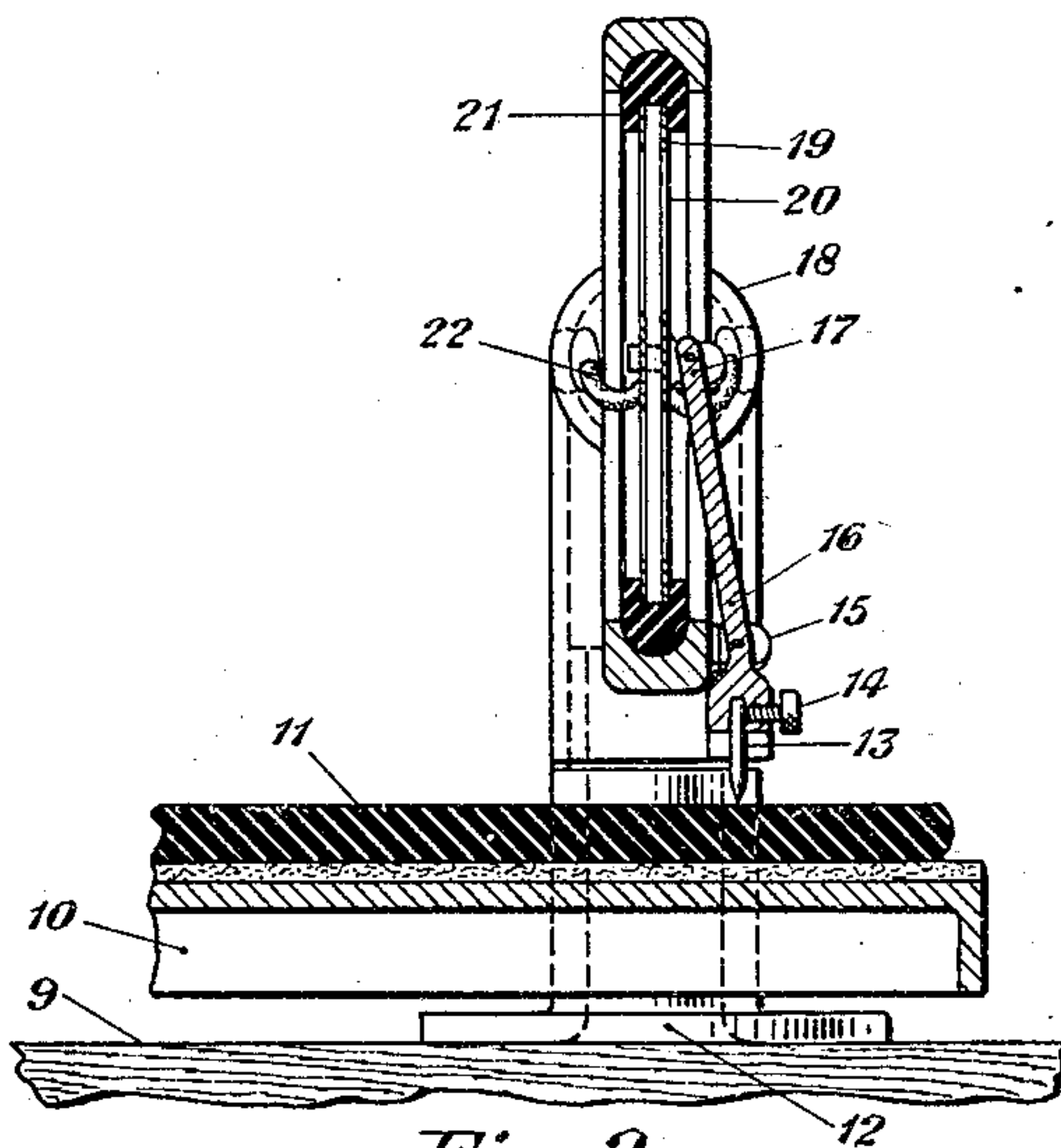


Fig. 2

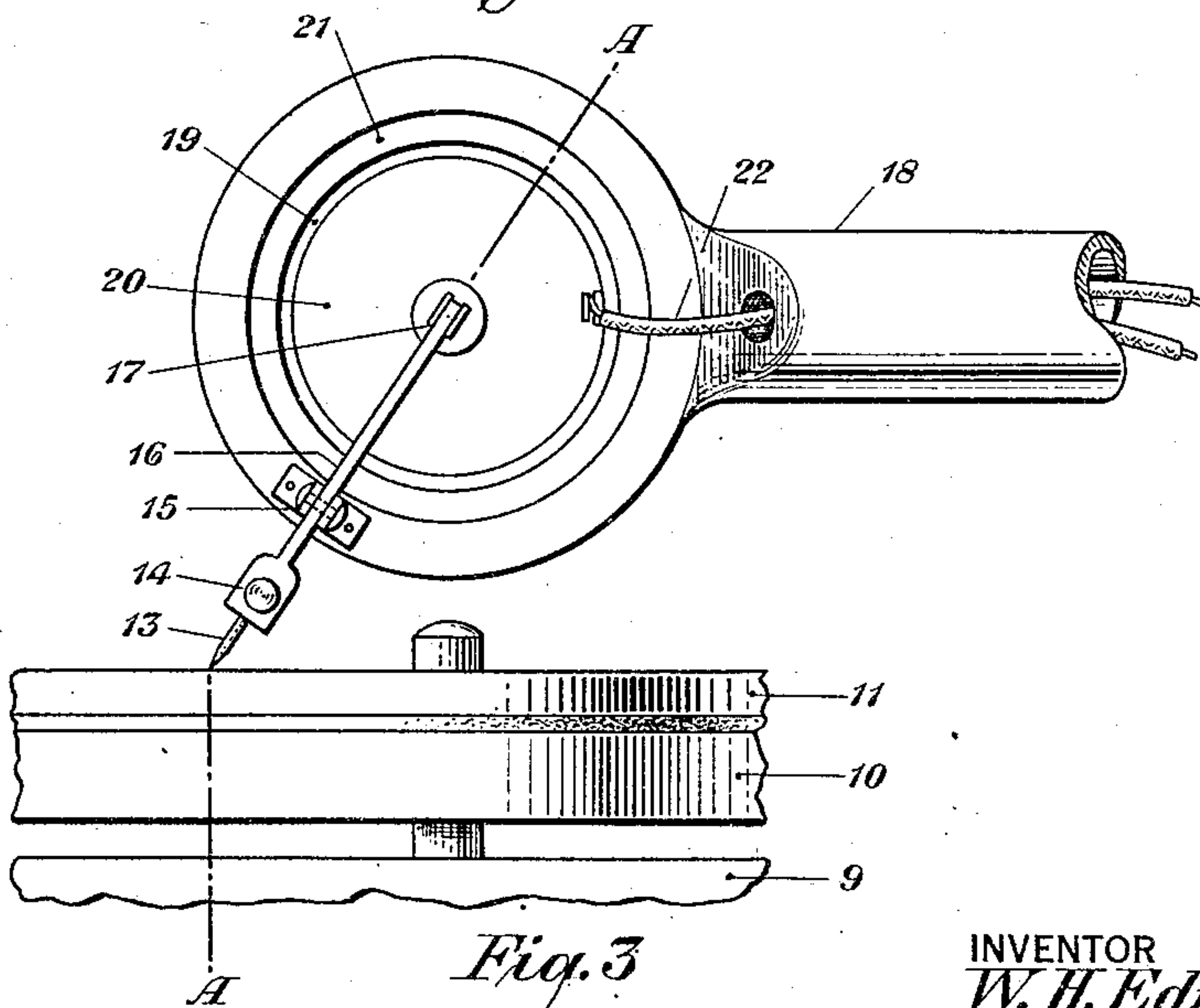


Fig. 3

INVENTOR
W. H. Edwards

BY

g. e. y. o. h.
ATTORNEY

UNITED STATES PATENT OFFICE

WILLIAM H. EDWARDS, OF GREAT NECK, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

PHONOGRAPH REPRODUCER

Application filed May 14, 1929. Serial No. 363,087.

This invention relates to a method of and means for varying the impedance of an element and more particularly to the utilization of such principles and apparatus for the reproduction of sound.

In the operation of the arrangements of the invention a device such as a thin film rectifier, for example, a disk of copper and cuprous oxide, is included in a circuit and is subjected to external stress. It has been found that subjecting a device of this character to stress will vary its impedance in the circuit. In accordance with the arrangements of this invention, the stress to which the device is subjected is caused by the operation of a phonograph needle arm attached thereto. Under such conditions, the arrangements may operate as a reproducer of sounds recorded on a phonograph record. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

For purposes of illustration, it will be assumed that the element whose impedance is to be varied by the method of this invention may be a rectifier of the well known copper oxide type. However, other types of thin film or contact rectifiers may be utilized. One of the suitable methods of forming the rectifier element might consist in heating a copper sheet about .005" thick to over 1000° C. until a thin closely adherent layer of cuprous oxide about one or two thousandths of an inch is formed. A heat treatment is then administered at lower temperatures. The outer surface of the oxide may then be reduced to metallic copper by electrolysis. The impedance element in the circuit might be formed of one or more of such units.

At the junction of the bulk of the cuprous oxide and the other copper there is believed to be a transition layer wherein the copper oxide crystals match perfectly the copper crystals which they adjoin. This transition layer is of high resistivity but in formation is made to match on to the copper in such a way (probably with considerable stress in the transition layer) as to reduce to a low value the work function of escape into it of electrons from the copper. However,

it matches on to the adjoining cuprous oxide in such a way as to make a large work function. There is no such effect between the thin metallic copper on the outer surface of the oxide as between the mother copper and the oxide due to the different manner in which it is formed. Based on the theory of a transition layer depending upon initial stresses or on substantially perfectly matched crystals, it is proposed in accordance with the principles of this invention to vary the stresses in this transition layer or the manner in which the crystals are matched and thus vary the work functions. Inasmuch as the oxide and surface coating of copper are very thin, the transition layer is near the surface of the rectifier plate and is subject to approximately the maximum fibre stresses existing in the plate when it is flexed. Furthermore, when a portion of the plate bends in one direction, the transition layer has tension stresses superimposed on the initial stresses, and when bent the other way, has compression stresses added to it. It has been found by experiment that bending a plate so that the oxide is placed in tension instantly increases the resistance in the reverse direction and that when placed in compression, the opposite occurs. It has also been found that variations in pressure cause variations in resistance in the conducting direction. Also, if kept within proper limits, it appears that this flexure can be continued indefinitely without deterioration of the disks.

In accordance with the arrangements of this invention, the stressed thin film rectifier disk is included in a circuit and is mounted in the reproducing arm of a phonograph. A needle arm will have a phonograph needle at one end thereof and will have its other extremity fastened to the disk. By means of a fulcrum movement, the indentations on a phonograph record will impart a corresponding stress to the disk, thus bending it and subjecting its parts to tension and compression. This will vary its impedance in the circuit in accordance with the indentations on the phonograph record. By connecting the circuit to loud speaker apparatus

tus, the device will operate as a phonograph reproducer.

The invention may be more fully understood from the following description together with the accompanying drawings in the Figures 1, 2 and 3 of which the invention is illustrated. Fig. 1 is a circuit diagram illustrating the invention. Fig. 3 is a side view of the phonograph reproducer apparatus. Fig. 2 is a sectional view of Fig. 3. Similar reference characters have been utilized to denote like parts in all of the figures.

In Fig. 1 is shown a circuit 1 in which is connected the stressed thin film rectifier disk 2. A phonograph needle arm 3 is shown affixed to the central portion of this disk, as will be pointed out hereinafter. The circuit also includes battery 4, a switch 6, a variable resistance 5 for controlling the current flow and the winding of a transformer 7. The other winding of the transformer 7 will be included in a circuit 8 which may lead to loud speaker apparatus.

In Fig. 3 is shown a side view of the device of the invention utilized as a phonograph reproducer. Fig. 2 is a sectional view of the arrangements of Fig. 3 along the lines A—A. Similar reference characters have been utilized to denote like parts in both figures. In these figures there is shown a base member 9, a turn-table 10 and a phonograph record 11 mounted on the turn-table. A swivel support 12 is provided for the reproducer arm 18 of the device. Mounted in the reproducer arm 18 is the rectifier disk 20. This disk will be surrounded at its periphery by the metallic contact rings 19, one on each side of said disk. The disk and contact rings will be held in place by a soft ring 21 of rubber or other suitable material which slips into a depression in the head member of the reproducer arm 18. A phonograph needle 13 will be held by the clamp 14 at one end of the needle arm 16. The needle arm 16 will have its other end affixed through a coupler device 17 to the central portion of the rectifier disk by means of a fulcrum member 15. The movement of the needle caused by the indentations on the record will cause the needle arm to impart to the rectifier disk certain stresses. In other words, the disk will be caused to bend in accordance with the indentations on the record. As has been previously pointed out, this subjecting of the disk to stresses will vary its impedance in a circuit. The disk is connected to a circuit by means of the flexible conductors 22 fastened to each of the contact rings and carried through the reproducer arm to the balance of the circuit, as indicated in Fig. 1. By thus varying the impedance of the rectifier disk by means of the phonograph needle attachment, the arrangements may be utilized as a phonograph reproducer.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. An electrical phonograph reproducer including a disk, a needle holder, and means controlled by said needle holder for subjecting said disk to stresses by bending and thereby varying the impedance of the disk.
2. An electrical phonograph reproducer including a thin film rectifier disk, and means for varying the impedance of said disk by subjecting it to bending stresses in accordance with recorded sound.
3. An electrical phonograph reproducer including a thin film rectifier disk, and means for varying the impedance of said disk by subjecting it to stress by bending, said means comprising a phonograph needle arm associated with said disk.
4. An electrical phonograph reproducer including a thin film rectifier disk, and means for varying the impedance of said disk by subjecting it to stress by bending, said means comprising an arm with fulcrum movement having one extremity connected to said disk and the other extremity under control of a sound record.
5. An electrical phonograph reproducer including a contact rectifier of the electronic variety, a sound record, and means controlled by said sound record for subjecting said rectifier to stresses by bending and thereby varying its impedance.

In testimony whereof, I have signed my name to this specification this 11th day of May, 1929.

WILLIAM H. EDWARDS.