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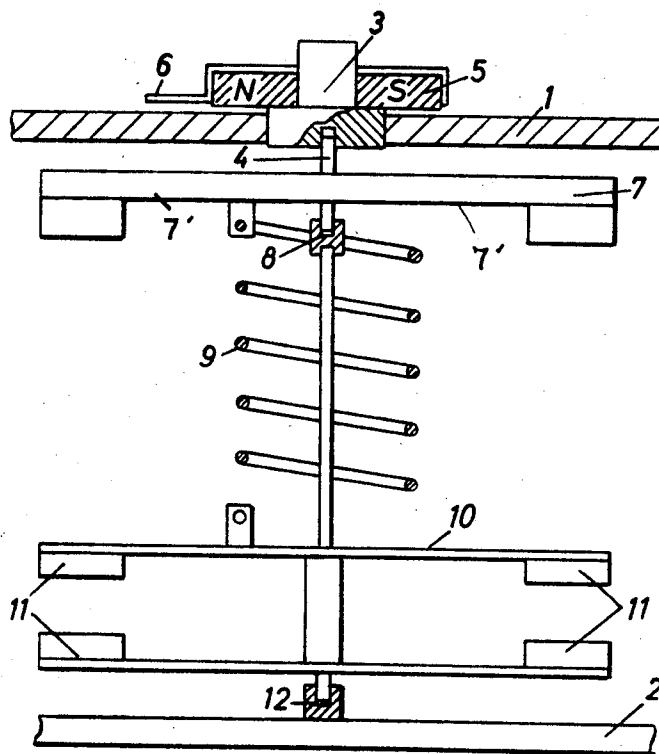
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A,BD, 107-109

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[54] **CLOCK OSCILLATOR REGULATOR**
1 Claim, 4 Drawing Figs.

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ABSTRACT: A device for a timepiece to correct or regulate the running of a turnable mechanical oscillatory partially magnetic system wherein a coaxially turnable permanent magnet is located near the system to influence turning of the latter and reduce thrust on the oscillator bearing.



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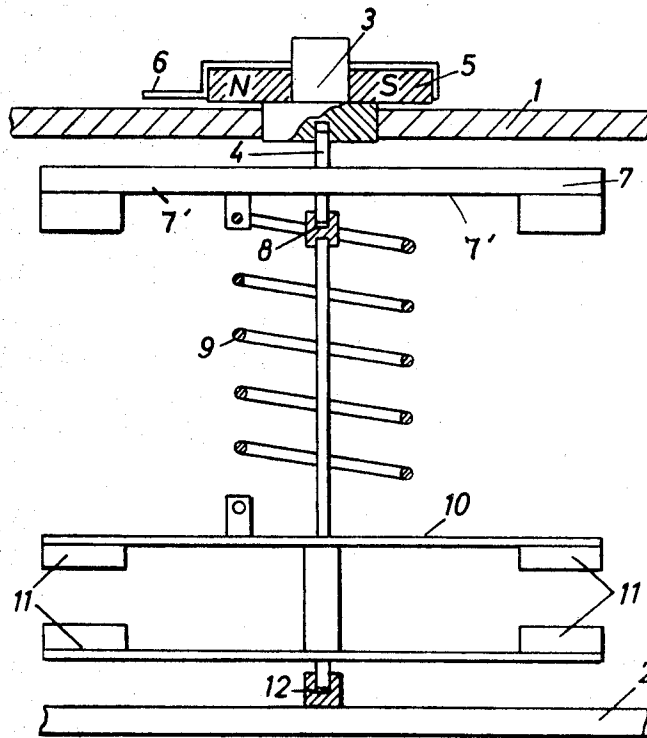


Fig. 1.



Fig. 2a



Fig. 2b.

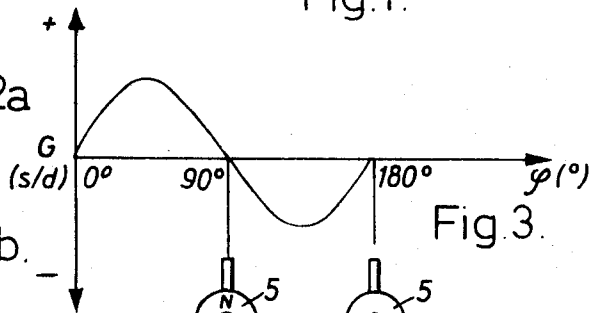


Fig. 3.

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CLOCK OSCILLATOR REGULATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

Magnetically governed mechanical oscillator.

2. Description of the Prior Art

There are conventional oscillator constructions for example, one wherein a leaf spring carries a permanent magnet and a regulating magnet is disposed near the magnet on the spring. In that construction the two magnets have north and south polarity and the regulating magnet can be turned about its axis in such a way that the north pole of the permanent magnet on the leaf spring stands opposite either a north or south pole of the regulator magnet. The regulator magnet functions as a sort of buffer to limit amplitude. Accordingly, depending on whether north pole or south pole acts on the magnet of the leaf spring, a speeding up or slowing down of the time beat of the leaf spring is obtained. This type of construction has the drawback that its maximum action occurs at the point of reversal of vibration of the leaf spring, with the result that the isochronism of the vibratory system is adversely affected.

In another known construction a pendulum with a bar-shaped permanent magnet has a radially polarized regulating magnet underneath the pendulum or magnet. The lines of force of this regulating magnet run either in the same direction as those of the magnet on the pendulum, or oppositely if the regulating magnet is turned through 180°. This kind of construction minimizes some of the disadvantage of the previously mentioned arrangement in that the magnetic force acts over the whole range of pendulum movement but it does not lend itself to use with balance wheels.

SUMMARY OF THE INVENTION

The present invention provides a magnetic regulator for the oscillator of the balance wheel type and which has a very low effect on the isochronism of a timepiece controlled by it. The "wheel" is in fact two radially extending arms of feebly magnetic material (such as soft iron in comparison with alloy magnets) for swinging in a substantially horizontal plane. Above the arms is the turnable regulator magnet, diametrically polarized to influence the swinging of the arms and which also relieves thrust on the oscillator bearings.

DRAWING

FIG. 1 shows a substantially diametric cross section of the oscillator.

FIGS. 2a and 2b show respective forms of the regulator magnet, while

FIG. 3 indicates the alteration of the running of the timepiece by turning of the regulator magnet.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a portion of a clockwork having, for example, brass work plates 1 and 2, between which is mounted a double or split oscillator or balance made up of two counter phase horizontal swingable masses 7 and 10. These two masses are connected by means of a helical spring 9 which is fastened or

attached at its midportion to the frame of the clockwork at a point not shown. The mass 7 is bearingly mounted by its vertical arbor 4 in a fixed top bearing 3 in work plate 1 and in a connector bearing 8. The other half of the oscillator has its bearings at 8 and 12, the latter being in the bottom plate 2.

In the shown arrangement the mass 10 is provided very largely by permanent magnets 11 which cooperate in a well-known manner with periodically energized drive coils (not shown) and thus form an electrodynamic driven turning oscillator or balance for the clockwork.

The mass 7 is driven in counterphase entirely by means of the coupling through the spring 9 and hence swings free. It may be considered that mass 10 is for the primary oscillator half while mass 7 is for the secondary oscillator half. A radially magnetized permanent magnet 5 is disposed for turning on and about the top bearing 3 exterior of plate 1. Magnet 5 is a regulator magnet and acts on the diametrically extending soft iron arms 7' making up part of mass 7. In practice the mass 7 is preferably an iron strip having weights affixed at its respective ends.

By turning the regulator magnet 5, alterations in running rate are obtained as are shown in FIG. 3. When the position of the regulator magnet 5 is such that the lines of force of magnet 5 are either nearly parallel with, or perpendicular to, the axial plane of the arms 7' in null position, nearly linear regulation zones are obtained. The accuracy G in, say, seconds per degree of turn can be either positive or negative of course as shown in FIG. 3.

As is clearly shown by the construction in FIG. 1, the regulating device operates on the secondary or nondriven half of the oscillator. In this construction the regulator magnet is mounted on the upper bearing and so provides the additional function of relieving the gravity thrust on the bearing 8, and consequently, to some extent at least, on bearing 12. By having the second half essentially floating, it attains its normal speed very quickly even though it is driven through a spring coupling.

Preferably the amplitude of oscillation of the system should be held below 90°. Under this condition the influence of the regulator magnet on the isochronism becomes negligibly small.

Preferably the regulator magnet is provided with a pointer 6. The null position of the regulator zone should be so predetermined that the field lines of force of regulating magnet run in the direction of the arms of the mass 7 as is illustrated in FIG. 3 at the 90° position when the mass is at null position.

We claim:

1. In a clockwork, a mechanical turnable oscillator made up of spring coupled upper and lower counterphase sections turnable about a vertical axis, the lower section being a directly driven section and the upper section being free swinging and having radially extending mass carrying arms of low remanence magnetic material for turning about said axis, an axially vertical arbor carrying the oscillator, upper and lower bearings for the arbor, and a radially polarized regulating magnet mounted on the upper bearing above the arbor for turning coaxially therewith and sufficiently near the path of the arms to influence the turning of the arms and reduce thrust of the arbor on the lower bearing.