H. J. VAN DER BIJL.

PRODUCING CURRENTS OF DESIRED WAVE FORM.

APPLICATION FILED SEPT. 30, 1918.

**1,337,737.** **Patented Apr. 20, 1920.**

Fig. 1.

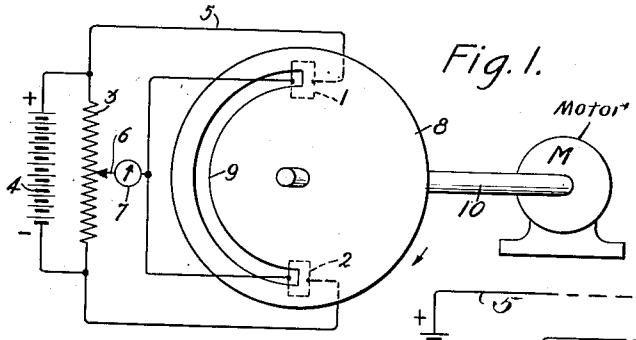



Fig. 3.

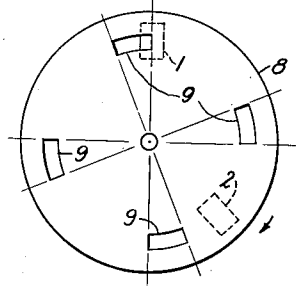
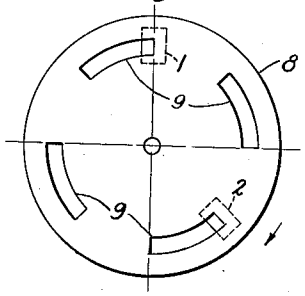



Fig. 2.



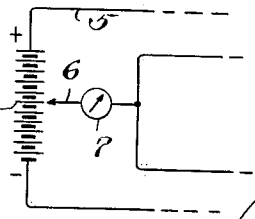




Fig. 1a

Fig. 4.

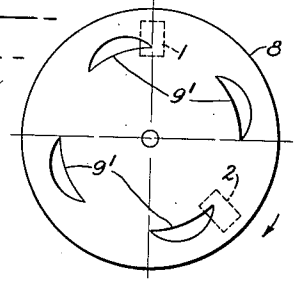



Fig. 5.

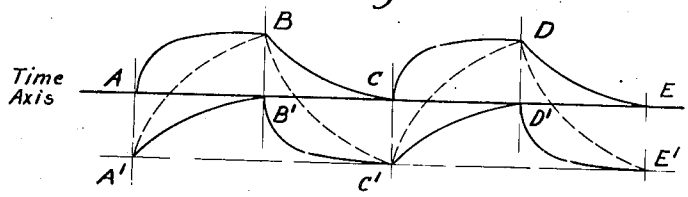



Fig. 6.

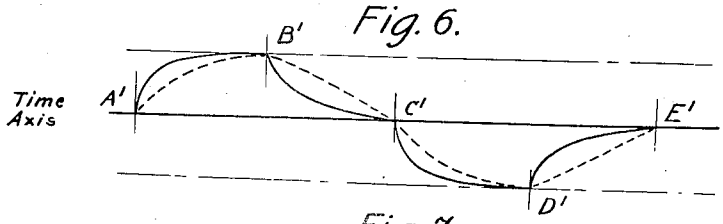
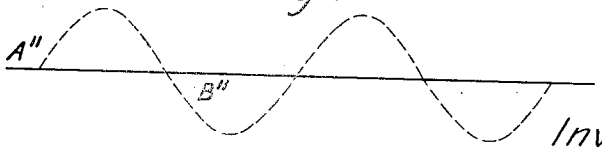



Fig. 7.




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by J. S. Roberts Atty.

# UNITED STATES PATENT OFFICE.

HENDRIK J. VAN DER BIJL, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## PRODUCING CURRENTS OF DESIRED WAVE FORM.

1,337,737. Specification of Letters Patent. Patented Apr. 20, 1920.

Application filed September 30, 1918. Serial No. 256,237.

*To all whom it may concern:*

Be it known that I, HENDRIK J. VAN DER BIJL, a subject of the King of Great Britain, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Producing Currents of Desired Wave Form, of which the following is a full, clear, concise, and exact description.

The invention relates to means and methods for producing alternating or fluctuating currents, and more particularly for producing low frequency currents.

The general object of the invention is to provide a useful means for producing fluctuating currents.

A further object is to produce low frequency alternating currents of desired wave forms such as a sine wave or an irregular wave.

Another object is to make use of a plurality of radiant energy sensitive devices or crystals, such as selenium, to produce currents of desired frequency and wave form.

In carrying out the invention, radiant energy of any suitable wave length is caused to fall intermittently upon a plurality of radiant energy sensitive devices so as to generate a fluctuating current in a suitable circuit. While light may be used, the use of radiant energy of any form and of any wave length or combination of wave lengths which will accomplish the desired result is contemplated, and where the word "light" itself is used, it is not intended to limit the meaning thereof to the exact range of wave lengths to which the retina of the human eye is sensitive.

The invention is exemplified by apparatus which will be explained in connection with the accompanying drawings, wherein Figure 1 is a diagram of a circuit containing selenium cells with a rotary disk having transparent slots associated therewith; Fig. 1[a] is a slightly modified form of circuit; Figs. 2, 3 and 4 are views of other varieties of disks; and Figs. 5, 6 and 7 are curves which will be herein referred to in elucidating the invention.

Selenium cells or resistances or equivalent radiant energy sensitive devices 1 and 2 are in series with a resistance 3 which is in circuit with a source of electromotive force 4. The conductor 6, which may be designated an output line, is extended from circuit 5 between the cells 1 and 2 to an intermediate point of resistance 3. Branch 6 may contain or have associated therewith any suitable device 7, which is to be acted upon by the output current. Branch 6 also forms a common return portion for each side of the circuit 5. Disk 8 consists of any suitable material opaque to radiant energy of the wave length to be utilized and contains the slot or transparent portion 9. To the disk 8 is attached motor M, by a shaft 10, which represents any suitable means for producing uniform rotation. If a source of light or other radiant energy is so applied as to fall through slot 9 on the resistances 1 and 2, and the disk 10 is set into revolution, the cells will be alternately illuminated and darkened. To produce a symmetrical wave branch 6 should be so adjusted upon the resistance 3 that when both devices 1 and 2 are darkened, no current flows through the device 7. If desired, however, the optional arrangement of Fig. 1[a] may be used wherein the resistance 3 is omitted and the circuit 5 applied directly to the terminals of the source 4 and the branch 6 tapped directly into the midportion thereof, but more convenient adjustment is possible with the arrangement shown in Fig. 1.

Now, let the ordinates (Fig. 5) above the time axis represent current through the device 7 in one direction, and ordinates below the time axis represent current in the opposite direction, then as disk 8 is revolved, the curve A B C D will represent current through branch 6, due to variations of resistance of device 1, and curve A′ B′ C′ D′ will represent current due to variations of resistance of device 2. The rise in current is much more rapid than the recovery. The resultant of the two currents will be represented by curve A′ B C′ D, which is seen to be non-sinusoidal and represents the alternating current through device 7.

It is not necessary that the disk 8 contain a single slot only, as a plurality of slots 9 may be used (Fig. 2), and, provided the slots 9 are suitably placed with respect to devices 1 and 2, a curve similar to that of Fig. 5 will be obtained. The means described for alternately applying radiant energy to cells 1 and 2 are illustrative only and many modifications may be devised which

may consist of one device or a plurality of devices suitably synchronized.

Referring to Fig. 3, if the disk 8 is uniformly rotated the slots 9 are of such length and resistances 1 and 2 are so placed that each resistance is illuminated for a period and darkened for an equal period, and then continues to remain dark while the other resistance goes through a similar cycle of illumination. This will produce a current through device 7 as represented by the full line of Fig. 6. Current through device 7, due to resistance 1, will be represented by the full line portion A′ B′ C′, while that due to resistance 2 will be represented by full line curve C′ D′ E′. The total resultant current through the device 7 will be represented by the full line curve A′ B′ C′ D′ E′.

Referring to Fig. 4, it will be seen that by varying the width of the openings 9′ so as to apply light or radiant energy to the cells 1 and 2, gradually increasing it to a maximum and decreasing gradually to a minimum, the result will be to make the full line curve A′ B′ C′ D′ E′ approach closely to the dotted curve A′ B′ C′ D′ E′ which is an approximate sine curve. If the slots shown do not produce a sufficiently accurate sinusoidal current, the curve may be made to approach very closely to the exact sine curve A″ B″ of Fig. 7 by narrowing openings 9′ where the illumination is too great and widening them where it is too small.

It will be understood that a selenium cell or resistance is described merely for purposes of illustration, and that other equivalent radiant energy sensitive means may be used in carrying out the purposes of the invention. Equivalent means may also be devised for other parts of the apparatus described herein. The novel features of the invention are defined both broadly and specifically in the appended claims.

What is claimed is:

1. In combination, a pair of electric circuits each containing a source of electromotive force, a radiant energy sensitive device controlling each circuit, said circuits having a common return branch to their respective sources of electromotive force, said sources having opposing terminals connected to said return branch, and means for periodically varying the light energy affecting said devices.

2. In combination, a pair of electric circuits each containing a source of electromotive force, a radiant energy sensitive device in each circuit, said circuits having a common return branch to their respective sources of electromotive force, and means for uniformly alternately applying radiant energy to said devices.

3. Means for producing fluctuating current including a plurality of circuits one of which has associated therewith a source of electromotive force and a radiant energy sensitive device, said circuits having a common branch where the desired fluctuating currents are produced, combined with means for varying in a cyclical manner the amount of radiant energy impinging upon said sensitive device.

4. In a means for producing fluctuating current, an output line having two branches, a radiant energy sensitive device controlling each of said branches, and means for varying the radiant energy acting upon said devices in such a manner that a current flows through said output line consisting of similar and opposite currents alternately supplied through said branches.

5. Means for producing low frequency varying currents including a branched circuit having a common portion and individual portions, and means for periodically changing the electrical impedance of said individual portions so as to cause a cyclically varying current in said common portion.

6. Means for producing fluctuating currents including a circuit having two branches and a common portion, a selenium resistance controlling the impedance of each branch, means for alternately increasing and decreasing the amount of radiant energy impinging upon each of said resistances, said means including a movable opaque member having a transparent portion which passes before said resistance and through which radiant energy may impinge thereon.

7. Means for producing fluctuating currents including a plurality of radiant energy sensitive devices, opaque means having at least one portion which is transparent to radiant energy of the kind to which said devices are sensitive, and means to cause said transparent portion to admit radiant energy to said sensitive devices successively.

8. Means for producing fluctuating currents including a plurality of radiant energy sensitive devices, an opaque means having a portion of varying width which is transparent to radiant energy of the kind to which said devices are sensitive, and means to cause said transparent portion to admit radiant energy to said sensitive devices successively.

9. Means for producing fluctuating currents including a plurality of devices, the resistance of each of which changes non-uniformly under the influence of radiant energy and is subject to a time lag, an opaque means having portions which are transparent to radiant energy of the kind to which such devices are sensitive, said portions being shaped to compensate for the non-uniformity of resistance and the time lag of said devices, and means to produce relative motion between said portions and

said devices so that radiant energy may pass through said portions to said devices successively.

10. Means for producing alternating currents including a plurality of radiant energy sensitive devices, and means for gradually alternately increasing to a maximum and then decreasing to a minimum the radiant energy affecting each of said devices respectively.

11. Means for producing fluctuating currents including a plurality of radiant energy sensitive devices, a disk, and a means to rotate said disk before said devices, said disk having a part therein through which radiant energy may pass to said devices successively.

12. Means for producing fluctuating currents including a plurality of radiant energy sensitive devices, a disk, and means to rotate said disk before said devices, said disk having a portion therein of varying width through which radiant energy may pass to said devices successively.

13. In combination a source of electromotive force, circuits connected thereto at each terminal thereof, each of said circuits having a selenium resistance device therein, a common return branch for said circuits to a point in said source between said terminals, a disk having a plurality of portions transparent to light rays, means to rotate said disk so that said portions will pass successively before said devices, said portions being so shaped as to cause a substantially sinusoidal current in said common return branch.

14. The method of producing an alternating current wave in a path which consists in supplying from one source positive portions of said wave and from another source negative portions of said wave while maintaining both of the sources constantly conductively connected in a closed circuit with said path.

15. In combination, a circuit including a source of unidirectional current and a resistance element sensitive to light, means for periodically illuminating said element to vary the value of the current in said circuit, and an output circuit connected to two points in said first named circuit between which the potential difference varies for deriving alternating current energy therefrom.

In witness whereof I hereunto subscribe my name this 25th day of September A. D. 1918.

HENDRIK J. VAN DER BIJL.