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STROBOSCOPE

Filed May 19, 1927

Fig. 1

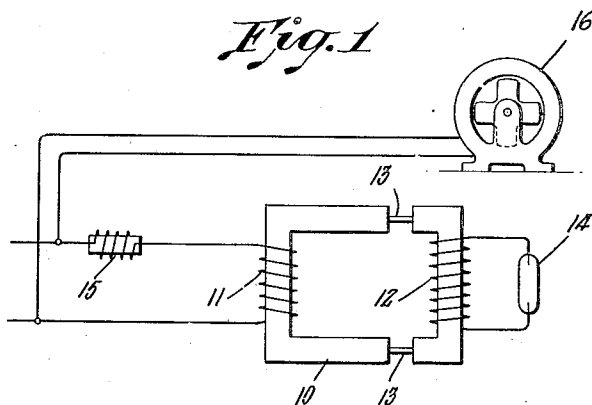
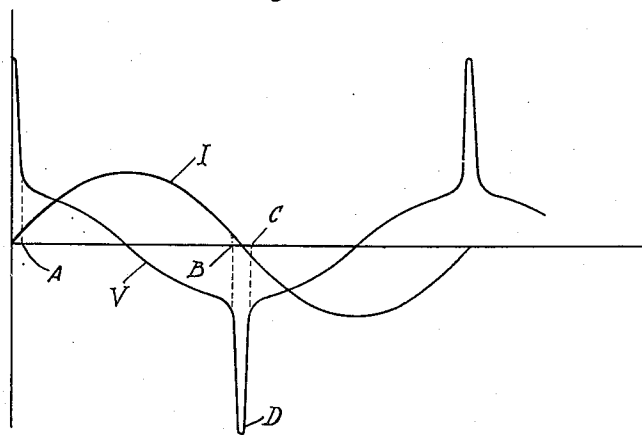


Fig. 2



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UNITED STATES PATENT OFFICE.

CLIFFORD A. NICKLE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

STROBOSCOPE.

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My invention relates to electrical apparatus and its principal object is to provide electrical stroboscopic apparatus which has no moving parts except the object under stroboscopic observation. A further object of the invention is to provide an electric stroboscopic light producing means which gives exceptionally short but bright stroboscopic illumination which enables its use for observing exceptionally high speed phenomena.

In the preferred embodiment of my invention I provide an alternating current transformer. The transformer core is designed to permit saturation over a substantial portion of the flux wave therein. The transformer carries a primary energizing winding and a secondary winding for energizing a stroboscopic lamp. The action is such as to produce intermittent sharp current impulses in the secondary circuit and correspondingly intermittent sharp illuminations of the lamp.

The features of my invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. For a better understanding of the invention reference is made in the following description to the accompanying drawing in which Fig. 1 represents the physical embodiment of the invention and one of its uses, and Fig. 2 represents approximate wave shapes of primary current and secondary voltage of the transformer.

Referring to the drawing, 10 represents the core of a transformer, 11 its primary winding, and 12 its secondary winding. The transformer core has a reduced portion or portions 13 which are designed to become saturated at a low percentage of the normal transformer flux. Connected in the secondary circuit is one or more stroboscopic lamp devices. For this purpose I prefer to employ neon tubes or lamps one of which is shown at 14. A protective reactance 15 is preferably included in the primary circuit of the transformer for reducing the primary current. This is desirable because the transformer itself will have low reactance over the greater portion of a current cycle because of its core. When this apparatus is energized with an alternating current of approximately a sine wave voltage, we may represent the primary current by curve I, Fig. 2. This curve will usually be distorted somewhat from that of a true sine wave shape in the region where the transformer core becomes saturated because of the varying reactance in the primary circuit but so far as the invention is concerned such distortion is immaterial. When the portions 13 are saturated, as from point A to point B of the primary current wave, the reactance of winding 11 will be low and practically all of the primary voltage will appear across 15. When the portions 13 are below saturation as from points B to C of the current wave the full reactance of the transformer appears and the primary voltage is divided across 15 and coil 11, and the voltage across the primary coil will have some certain ratio to the line voltage. By transformer action, a proportional voltage is induced in the secondary winding 12. Thus, from points B to C of the primary current wave the action of the transformer is like that of an ordinary transformer and from points A to B the series reactance 15 keeps the primary current from increasing to undesirable values. We may represent the secondary voltage which appears across the secondary winding 12 and lamp 14 by the curve V. From A to B when the reduced sections of the core are saturated, the leakage flux of the transformer is excessive and the rate of change of the transformer flux is the least. Consequently the rate of change of flux threading the secondary winding D is very low and the secondary voltage is correspondingly low. As the primary current passes through zero the rate of change of the transformer flux is a maximum and the sections 13 are unsaturated at this time so that from B to C the flux threading the secondary winding has a very greatly magnified rate of change and as a result the secondary voltage rises in a sharp peak of very short duration as represented at D. This peak occurs at every half cycle and is the voltage utilized to illuminate the lamp 14 stroboscopically.

cally. The lamp 14 is selected with the design of the apparatus so that for voltages such as are present from points A to B no illumination is produced, but for voltages occurring over the short range from B to C, intensive illumination is produced. The neon lamp is especially suited for this purpose since its characteristics are somewhat like that of a condenser and the effective illumination seems to be dependent more on the rate of change of voltage than on the magnitude. For a 110 volt primary source of supply the transformer is preferably designed to step up the voltage and has many more turns in the secondary than in the primary. Best results, with a neon tube, are obtained with a relative high peak voltage at D. For example, this may be as high as 5000 volts. As a result of such an arrangement, sharp intensive flashes of light are produced, the periodicity of which depend upon the frequency of supply, which of course may be varied to suit the rate of movement of the object under stroboscopic observation.

Very rapidly moving objects may be clearly observed by the use of this apparatus because of the extreme sharpness of the light flashes. The use of this device is very simple and effective as it has no moving parts. In Fig. 1 I have represented a synchronous motor 16 connected in multiple with the supply leads of the stroboscope device. By simply illuminating the rotating part of the machine 16 by the lamp 14 in a relatively darkened room the rotating member will appear stationary as it will rotate one pole space between flashes of the lamp.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown and described is only illustrative and that the invention may be carried out by other means.

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

1. Stroboscopic apparatus comprising a neon lamp, an alternating current source of supply, and means connected between said source and lamp for changing a substantially sine wave voltage to sharp intermittent peak voltage impulses.

2. Stroboscopic apparatus comprising a neon lamp, an alternating current source, a step-up transformer connected between said source and lamp, said transformer having a core designed to become saturated over substantial portions of the flux wave of said transformer.

3. In combination a neon lamp, a transformer for energizing said lamp having

primary and secondary windings wound on a core member having a reduced section between said windings designed to operate above and below saturation over different portions of the flux wave of said transformer, and a means connected in series with the primary winding of said transformer to limit the current therein.

4. Stroboscopic apparatus comprising a neon lamp, an alternating current source, a transformer connected between said source and lamp, said transformer having a core designed to become saturated over a substantial portion of the flux wave of said transformer, and a reactance connected in series on the primary side of said transformer for limiting the supply current thereto.

5. Stroboscopic apparatus comprising an alternating current transformer having a core and primary and secondary windings thereon, said core having a reduced cross-section so as to operate above saturation for all but a short portion of the alternating flux wave therein, and an electric lamp energized by the secondary winding of said transformer, said lamp being effectively energized only by the secondary voltages of said transformer produced during the time the reduced portion of said core is unsaturated.

In witness whereof, I have hereunto set my hand this 18th day of May, 1927.

CLIFFORD A. NICKLE.