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ELECTRONIC TACHOMETER AND STROBOSCOPE

Filed Sept. 4, 1944 2 Sheets-Sheet 1

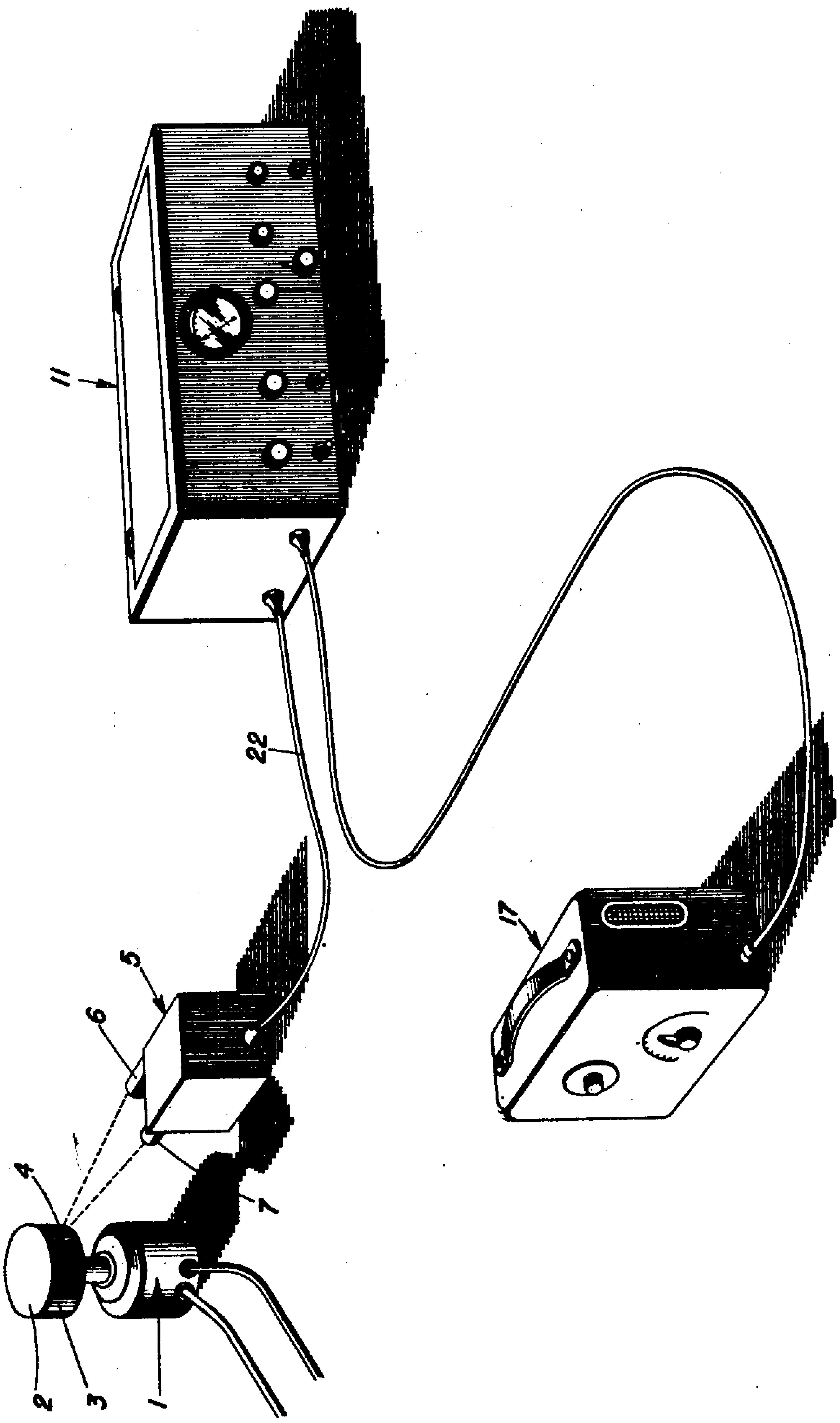

FIG. 1

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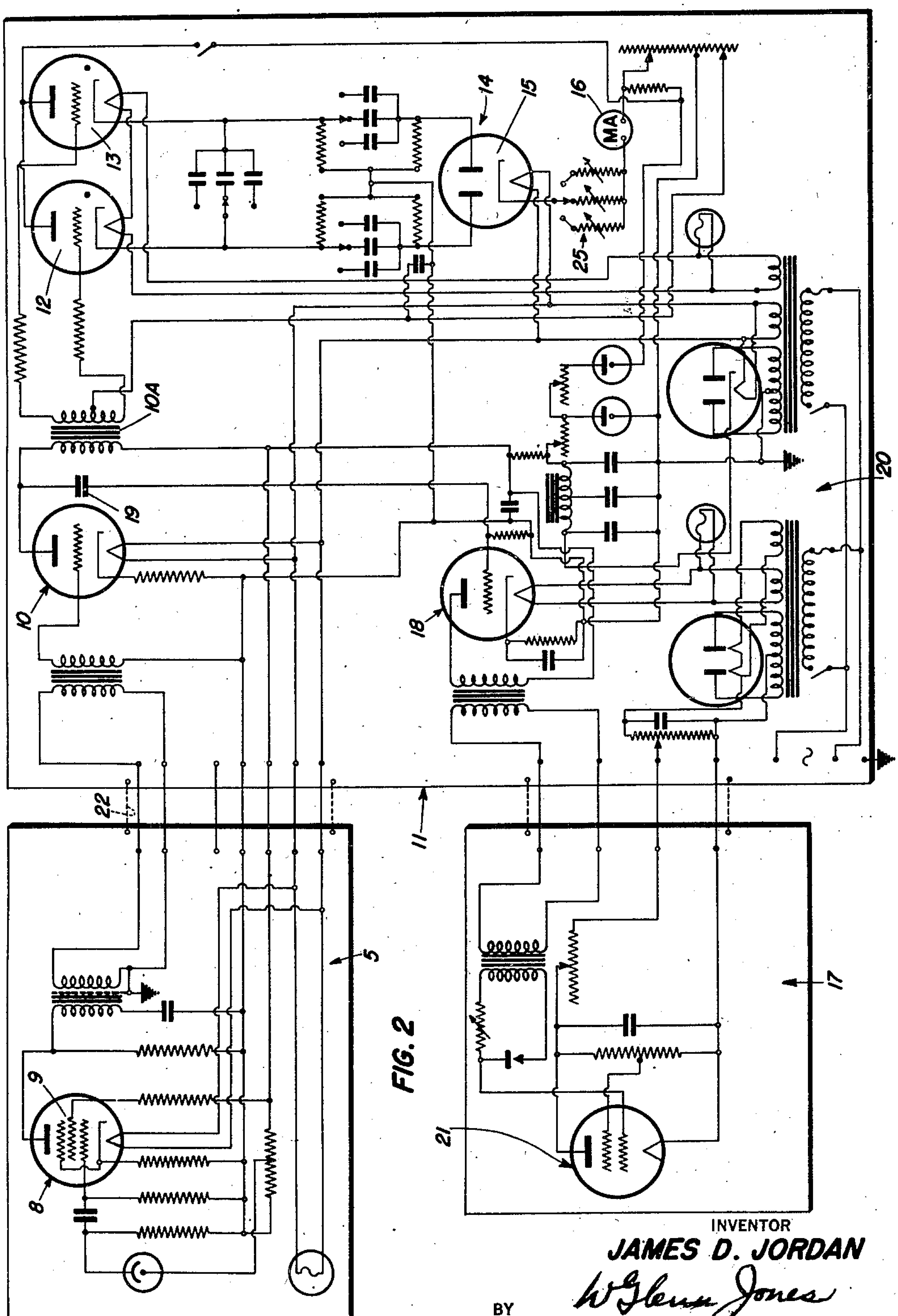

FIG. 2

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ELECTRONIC TACHOMETER AND STROBOSCOPE

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1 Claim. (Cl. 88—14)

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This invention relates generally to electronic tachometers and stroboscopic viewing devices, and more particularly to improved compact and readily portable apparatus of this character.

In the testing of apparatus designed to withstand centrifugal forces of a high order, it is usually desirable to place such apparatus in a centrifuge or some other suitable spinning device. It is, of course, also desirable to learn the speed at which the apparatus is rotating and to observe the apparatus while it is in rotation, so that comparisons can be made of the conduct of apparatus at different speeds. A system now in use for counting the revolutions of a centrifugal rotor includes an electro-magnetically operated pulse generating mechanism which is adapted to cooperate with a cathode ray oscilloscope and an audio frequency oscillator, the procedure being to beat the pulses from the electro-magnetic generating apparatus with a signal from the oscillator to the end that a generally sinusoidal pattern will be present on the screen of the oscilloscope. At this point the oscillator frequency may be checked and the speed of rotation of the centrifuge rotor determined.

It has been found, however, that the electromagnetically operated pulse generating apparatus tends to impose a drag on the centrifuge so that maximum speeds cannot be obtained therefrom. Also, in order to insure that proper locking in of the pulse with the signal will take place, careful manual operation of the frequency control of the oscillator must be effected. In addition, the apparatus above described comprises a number of cumbersome parts and, as a result, is not easily transported.

One of the principal objects of the present invention is to provide an improved portable, combination, self-synchronizing stroboscope and electronic tachometer which is so arranged that drag on the centrifuge rotor is eliminated, with the result that maximum speeds may be obtained.

Another object of the invention is to provide an apparatus of this character which, in view of the self-synchronizing feature, will be automatic in operation.

A further object of the invention is to provide an improved process and apparatus for electronically counting recurrent action, such as the rate of revolution of a centrifuge rotor, or other rapidly moving or rotating object.

Still another object of the invention is to provide a portable, combination, self-synchronizing stroboscope and electronic tachometer which will be relatively simple in arrangement.

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Other objects, not particularly mentioned hereinabove, will be evident upon consideration of this disclosure in its entirety.

In the drawings:

Fig. 1 is a perspective view showing a preferred arrangement of apparatus incorporating the principles of the present invention; and

Fig. 2 is a schematic view showing the wiring diagram employed.

Generally considered, the invention comprises an electronic counter which operates as a tachometer whose signal voltage is supplied by a photo-cell pick-up which sets up a pulsating current by repetitive reflection of a light beam, as from a rotating object, illustrated as a centrifuge rotor. A stroboscope has its trip circuit controlled and operated by the resultant frequency supplied to the electronic tachometer. The pick-up unit and stroboscope are individually housed in small separate casings for portability, while the electronic tachometer and other components including amplifier and power supply means may be contained in a single larger case. The electronic tachometer incorporates two gas discharge triodes, the pulsating output of the pick-up unit being impresssed on their grids. The output is then fed through a suitable circuit and the frequency indicated visually on a direct current meter calibrated in cycles per second. In order to improve the accuracy of readings, three ranges are provided and these may be selected by a multiplier switch.

Referring now more particularly to the drawings, the numeral 1 indicates generally a centrifuge, which may be of any design or construction, and the details of which, since they form no part of the present invention, need not be considered. The centrifuge 1 may be of the compressed air driven type and includes a cylindrical rotor 2 the side wall 3 of which is coated with a black masking paint throughout its periphery, except for a vertically disposed rectangular portion 4 which may be simply a cleared area, or may be formed of white paint. In either event it constitutes a bright area. The light source 6 and photo-electric cell 7 are preferably mounted in a metal case 5 of suitable design, which also contains (Fig. 2) an amplifier 8 including a vacuum tube 9 and other conventional components.

The output of the amplifier 8 is connected by means of leads which are incorporated in a flexible cable 22, to the input of an amplifier 10 which is mounted in the main case, said case being shown generally at 11. The output of the amplifier 10 is connected to the primary winding of the coupling transformer 10—A, the secondary winding of said transformer being center tapped and having its end terminals connected respectively, through suitable resistors, to the grids of gas discharge tubes 12 and 13. The output circuit of the gas discharge tubes is connected to the input of an electronic frequency meter which is shown at 14. The frequency meter, which will be recognized as of a type known and commercially available, includes a double diode 15 and other conventional components. The range of the meter is adjustable by selection of any one of the resistors incorporated in the bank generally designated 25. A milliammeter 16 incorporated in the output circuit of the frequency meter is calibrated in revolutions per second.

At 17 is shown a stroboscope which is generally of conventional design but which is tripped by the output of amplifier 10, which is fed to strobotron 21 through an implifier 18, mounted in the main case 11. The input of amplifier 18 is connected to the output of amplifier 10 through a coupling condenser 19. The operation of the stroboscope is thus automatically keyed to the rate of rotation of the centrifuge or other device under observation, which rate is represented by the pulsation frequency present in the controlling output of amplifier 10, and the stroboscope therefore requires no manual adjustment, affording perfectly timed stroboscopic illumination of the work at all times or whenever desired.

In order to supply the necessary voltages for the amplifiers and for the stroboscope I provide a dual power supply system 20 which is mounted in the case 11. The power supply 20, which will also be seen to be of conventional construction, is thought to require no detailed description.

It is believed that the operation of the invention will be evident from the foregoing. It may be summarized briefly, however, as follows: Let it be assumed that the centrifuge rotor is rotating at a high speed and it is desired to observe the same and to determine its speed. It will be understood that in the stroboscopic examination the purpose may be to watch the action of parts or materials in the centrifuge. The photo-cell pick-up unit 5 is mounted at a given distance from the orbit of portion 4 on the wall 3 of the rotor 2. The pulses set up by the portion 4 of the spinning rotor will control the frequency of variation of the plate current of amplifier 10 and thus the triggering frequency of the stroboscopic system as well as the frequency of the output of the gas discharge tubes.

The combined output of tubes 12 and 13 will be impressed upon the electronic frequency meter and rectified in the known manner indicated in Fig. 2, whereby it appears as a direct current (which is a measure of the plate current of the tubes 12, 13) passing through the milliammeter 16. The total plate current is a direct function of the frequency. Inasmuch as the millammeter is calibrated in revolutions per second, it is possible to read the speed of rotation of the rotor directly from the scale of meter 16.

In order to insure that the calibration is maintained constant, suitable voltage regulating devices are disposed in the various circuits. Suitable switches are also provided to keep voltage off of the gas tubes 12 and 13 except when a signal voltage is present at the primary of the transformer 10—A.

By the use of my improved system, it is possible to measure speeds of rapidly rotating objects without imposing a drag thereon.

What is claimed is:

The process of determining the rate of recurrence of action of a body in cyclic motion, which consists in providing a substantially weightless marker by modifying the albedo of a portion of the visible surface of the body, directing radiant energy of substantially uniform intensity upon the said surface, converting some of said energy, after reflection from said surface, into photoelectric pulses which thus occur at a frequency which is a function of the periodicity of the motion of the body, measuring and continuously indicating said frequency and thereby indicating the desired rate of recurrence of the action.

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