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INTERVALOMETER

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fig. 1.

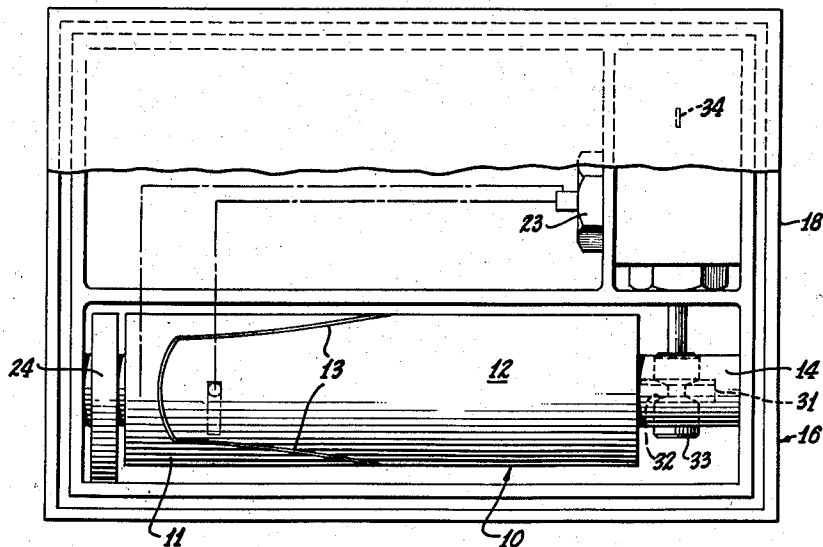


fig. 2.

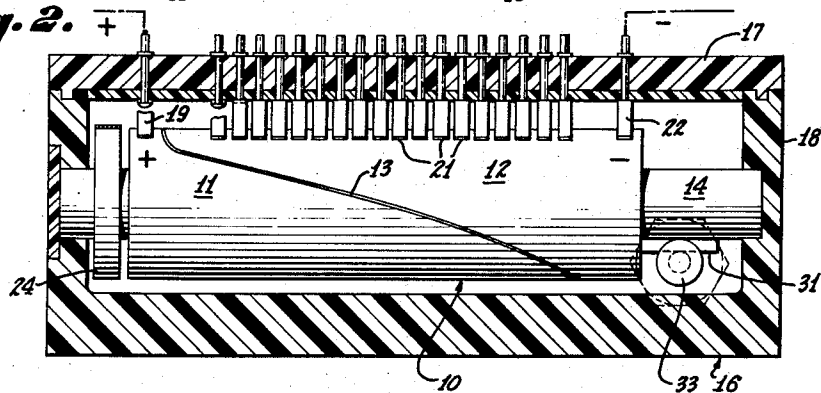
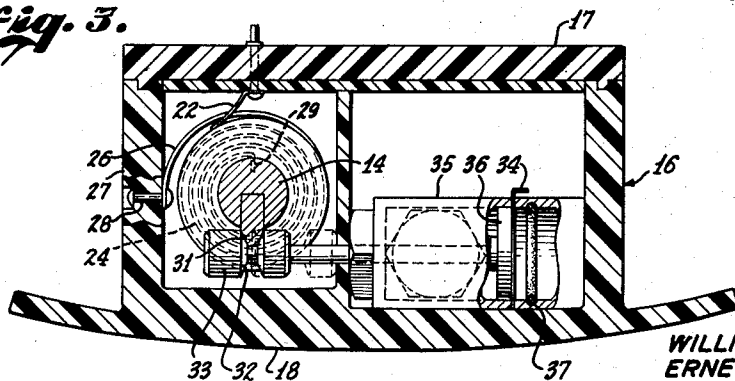


fig. 3.



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INTERVALOMETER

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2 Claims. (Cl. 200—8)

The present invention relates to an intervalometer designed to energize in sequence a series of active electrical contacts at predetermined spaced time intervals over a predetermined total time period, and in particular to such an intervalometer designed to be insensitive to magnetic fields and to reasonable variations to current amperage and voltage.

In some applications for intervalometers, it is required that the intervalometer function basically as a multiple switch making a series of electrical contacts at equal short time intervals over a total short time period. One such application is found in the sequential firing of a series of rockets of the folding fin type. All of the rockets of the series cannot be fired at the same time when the rockets are closely packed in their tubes. If all of the rockets are ejected from their tubes at the same instant their fins will strike each other as they expand into the full guide positions. This will destroy the aim of the rockets. In this application of an intervalometer, it also is desirable that all of the electrical contacts to be made be grounded until just before they are energized. A further desirable feature in an intervalometer used in such applications is that it be non-sensitive to voltage and amperage variations.

Accordingly, it is an important object of the invention to provide an intervalometer based on a mechanical rather than an electrical activating power means.

Another object is to provide an intervalometer designed to make a series of electrical contacts at predetermined short spaced time intervals and over a total predetermined short time period.

A further object is to provide an intervalometer that is insensitive to variations in magnetic fields, current amperage and voltage.

Additional objects will become apparent from the following description.

Broadly stated, the intervalometer of the invention comprises a generally cylindrical rotor. The rotor can be made of conducting material or the cylindrical surface can be made electrically conducting. In the former case, the rotor is divided into two portions along a surface generally at an acute angle to the axis of the rotor. In the latter case, the electrical conducting surface of the rotor is divided into two portions along a line generally at an acute angle to the axis of the rotor. In either case, the two resulting electrically conducting cylindrical portions (or cylindrical surface portions) are electrically insulated from each other by suitable electrical insulating material. The rotor surface dividing line between the two portions of the rotor (or rotor surface) preferably is in the form of an acceleration curve at an acute angle to the axis of the rotor or to a perpendicular drawn axially on the surface of the rotor. The intervalometer also preferably contains a series of resilient electrical contacts frictionally engaging the surface of the rotor and spaced with respect to each other axially along the surface of the rotor. A rotary power means is connected to the rotor for rotating the same and a releasable cocking means is associated with the rotor and the power means. In addition, an initiating means for releasing the cocking means and freeing the rotor for rotation by the rotor power means is included.

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A more detailed description of a specific embodiment of the invention as applied to the sequential firing of a series of rockets is given with reference to the drawings, wherein:

Figure 1 is a front elevational view showing the intervalometer mounted in a sealed case;

Figure 2 is a bottom view showing the resilient electrical contacts and the dividing line of the two portions of the rotor; and

Figure 3 is an end view showing the initiating and power means and the cocking and release mechanism.

In the embodiment shown in the drawings, the rotor 10 can be made to have any convenient dimensions. For example, the rotor 10 can be made about three-quarter inch in diameter and about three inches long. Any desirable method of making the rotor 10 can be employed. For example, the portions 11 and 12 of the rotor can be die cast of conducting material such as aluminum or zinc.

The two portions 11 and 12 are electrically insulated from each other by any suitable insulating material such as varnish, cardboard, or other types of paper. It is preferable that the juncture surface between the two overlapping portions 11 and 12, form a surface dividing line 13 at a generally acute angle with the axis of the rotor 10 or with a normal drawn axially on the surface of the rotor. Also, the surface dividing line 13 preferably should be in the general form of an acceleration curve.

The assembled rotor 10 is mounted on an axle 14 which can be cast in the portions 11 and 12 of the rotor before assembly thereof. The opposite ends of the axle 14 are journaled in the sides of a case 16 which preferably is a sealing case made of non-conducting materials such as plastics, resins, wood or other similar materials. The case 16 preferably is designed to be hermetically sealable such as by a tightly fitting back 17 sealed into a prefabricated unit 18 consisting of a front, top, bottom and sides.

Resilient electrical contacts, preferably made of spring wire, 19, 21 and 22 are sealed in the back 17 of the case 16 and project through the wall of the back. These contacts make frictional electrical contact with the surface of the rotor 10, as best shown in Figure 2. The one end contact 19 touches the rotor portion 11, whereas the other end contact 22 and the remaining contacts 21 touch the rotor portion 12. The contacts 19, 21 and 22 are spaced axially with respect to the surface of rotor 10, and are spaced a predetermined distance from each other.

The one end contact 19 is an initiating or firing lead and is connected to an initiator squib 23. The end lead 19 and the line connecting the lead 19 with the squib 23 are marked plus. The other end lead 22, opposite lead 19, is grounded and is marked minus. Rotor portion 12 is, therefore, also grounded and contacts 21 touching rotor portion 12 also are grounded.

Thus, rotor 10 is made of two insulated conducting portions 11 and 12, which are electrically insulated from each other by a dividing strip defining surface lines 13 and is composed of a rotor portion 11 always connected with a firing or initiating circuit through end contact 19 marked plus, and a second rotor portion 12 always grounded through a contact 22 marked minus. Contacts 21 touching rotor portion 12 also are grounded.

A clock or spiral power spring 24 is mounted on one end of the axle 14 adjacent rotor portion 11. The outer end 26 of the spring 24 is fixed to the bottom wall 27 of case 16 by any suitable means such as screw 28. The inner end (not shown) of the spring 24 is fixed to the axle 14 as at 29 by any suitable means. Thus, the spring 24 can be wound up by turning the rotor 10 until a desired amount of potential energy is stored in the spring for future rapid rotation of rotor 10.

The rotor 10 is held in a cocked position against the tension of wound spring 24 by means of a tooth 31 pro-

jecting radially from the end of axle 14 and held engaged in an annular groove cut with inclined sides in release and accelerating plunger 32, as best shown in Figure 3.

The plunger 33 is held in the cocked position against movement by a shear wire 34 passing through the walls of the initiator assembly case 35. It will be observed that in the cocked position at which the intervalometer rotor 10 is set, the rotor portion 12, which is contacted by all of the resilient contacts 21 and 22, except 19, is grounded through end contact 22. The other end contact 19 contacts the rotor portion 11 through a positive lead connecting squib 23 which, in turn, is connected to a positive, initiating or firing lead.

The intervalometer is initiated or fired through this positive lead which fires the squib 23. Upon detonation of squib 23 a piston 36 connected to plunger 33 is driven upward by the explosive charge and shear wire 34 is broken by the upward movement of piston 36 in the initiator assembly case 35. As piston 36 passes upward in initiator assembly case 35, it is forced beyond an O ring 37. The O ring 37 then retains the piston 36 and plunger 33 in an upward position in the initiator assembly case 35.

The rapid upward movement of plunger 33 causes tooth 31 to be disengaged from groove 32 so that axle 14 and thus rotor 10 are initially impelled and then released. The upward movement of plunger 33 under the explosive force of squib 23 imparts an initial accelerating force to rotor 10. The rotor is, of course, under tension of the wound power spring 24 and is rotated by the potential energy stored in the coiled power spring.

As rotor 10 is turned in the direction of the arrow, the resilient contacts 21 pass sequentially over the surface dividing line 13 from the rotor portion 12 electrically grounded through contact 22, to the rotor portion 11, connected to the positive firing lead through contact 19. As each one of the contacts 21 crosses over the dividing line 13 from rotor portion 12 to rotor portion 11, they are in turn electrically connected to the firing contact 19 through positively connected rotor portion 11 and thus close the firing lead circuit through an electrical connection (not shown) to each of the contacts 21. Thus each active contact progressively has its connection to the ground broken and is switched into a firing circuit leading to a rocket initiating assembly (not shown).

It will be observed that the specific embodiment of the intervalometer described above will energize in sequence a number of active contacts at predetermined time intervals of a fraction of a second apart, say about 0.01 second and over a total time period of a fraction of a second, say about 0.20 second. It will also be observed that the embodiment described is insensitive to magnetic fields and is insensitive to reasonable variations in current amperage and voltage in the electrical portion of the intervalometer by virtue of the fact that the rotor 10 is not driven by electrical means, but instead is driven by a mechanical device—that is, the coiled power spring 24. Furthermore, it will be observed that all of the contacts of the intervalometer described are grounded until just before the intervalometer is initiated by firing of the squib 23.

The rotor 10, instead of being inside of two separate portions of metal, can be cast as a single rotor unit of non-conducting material, such as a plastic or a resin, or it can be formed as a single unit of a material such as wood, hard rubber or other composition material of suitable electrical insulating properties. The surface of the resulting rotor can then be covered with a sheet of electrical conducting material, such as a sheet of metal, by securely cementing the sheet material to the cylindrical surface of the rotor. The applied sheet of conductor can then be separated into two portions corresponding to rotor portions 11 and 12 by cutting an electrical insulating separation line of desired shape, corresponding to surface line 13, through the conducting sheet to the rotor

surface. The two portions of electrically insulated conducting sheet can then be used in the intervalometer assembly in the manner described above with regard to the two rotor portions 11 and 12.

The firing time intervals can be made of equal time increments by the use of a dividing insulating curve 13 approaching an acceleration curve. They can be made of unequal increments, if desired, by changing the shape of the curve and/or the spacing of the active contacts. The total time interval for all contacts is varied by the inertia of the rotor and power of the motor spring.

Other variations in the structure and design of the intervalometer described above can be made. A different type of case can be used for the intervalometer and printed circuit boards can be employed in the back wall 17 of the case, if desired. A connector plug can be used in conjunction with the resilient contacts 19, 21 and 22 and any suitable type resilient contact can be used, such as active spring contacts, for example. Instead of a tooth engaged in a groove, other cocking means can be used, as will occur to one skilled in the art.

The foregoing description is primarily for explanatory purposes and is given to illustrate a specific embodiment of the invention. It is understood that many variations in the structure, design and details of the intervalometer described above will occur to one skilled in the art. Accordingly, it is understood that such changes and modifications in the structure, design and details of the specific embodiment of the invention illustrated and described above may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. An intervalometer comprising a generally cylindrical rotor, the surface of said rotor being divided into two adjacent electrically-conductive areas insulated from each other, a boundary portion between said areas extending helically of said rotor, a plurality of fixed contactors engaging said rotor in position to pass sequentially over said helical boundary as said rotor rotates, spring means urging said rotor to rotate, latch means having a plunger engaging an element fixed to said rotor, a cylinder, a piston in said cylinder and connected to said plunger and a shear pin holding said piston in one position, and means for applying gas pressure to said piston to shear said pin and move said plunger to apply an accelerating torque to said rotor, then disengage itself from said element and release said rotor to the action of said spring means.

2. An intervalometer comprising a generally cylindrical rotor, the surface of said rotor being divided into two adjacent electrically-conductive areas insulated from each other, a boundary portion between said areas extending helically of said rotor, a plurality of fixed contactors engaging said rotor in position to pass sequentially over said helical boundary as said rotor rotates, yieldable non-electric means applying a substantially constant torque to said rotor, latch means holding said rotor stationary against the action of said yieldable means, releasing means for releasing said latch, said releasing means including an explosive device, and electrical means for detonating said explosive device.

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