Jan. 18, 1955 T. C. BURNETTE, JR 2,699,829

TIMING DEVICE

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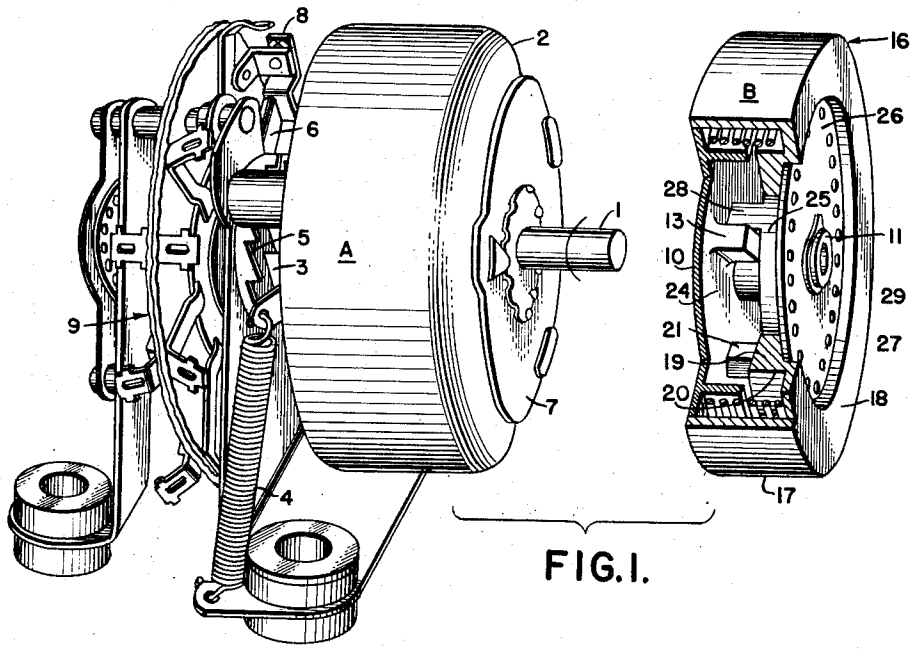


FIG. 1.

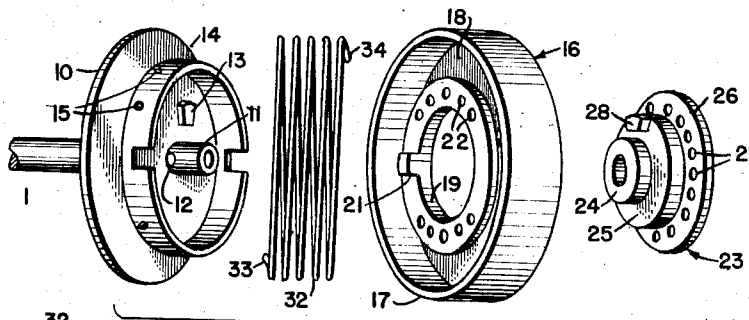


FIG. 2.

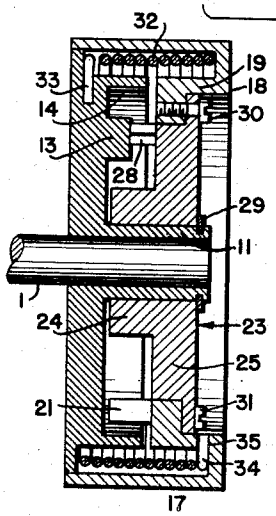


FIG. 3.

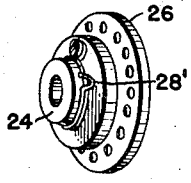


FIG. 4.

INVENTOR.
Thaddeus C. Burnette, Jr.

BY
Stone, Boyden & Mack,

ATTORNEYS

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TIMING DEVICE

Thaddeus C. Burnette, Jr., Swannanoa, N. C., assignor to Oerlikon Tool & Arms Corporation, Buncombe County, N. C., a corporation of Delaware

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7 Claims. (Cl. 161—1)

This invention relates to devices for effecting accurately timed actuations, and more particularly to an improved timing device for switch actuating mechanisms and the like.

It is frequently necessary to provide for repeated actuation of a device, such as an electric switch, for example, with each actuation being accurately timed. For instance, in the operation of aircraft and like machine guns, it is necessary to accurately control the amount of compressed air supplied to the gun charger for each operation thereof. Such control may be effected by an electrically operated valve dominated by a control switch, and timed operation of the gun charger may thus be accomplished by either closing or opening the switch, as the case may be, for a predetermined time period for each cycle of operation. A similar problem exists in the electric welding art, where it is necessary to supply pulses of welding current of predetermined duration, this usually being accomplished by means of a control switch dominated by a timing device.

In the past, numerous mechanical and electrical devices have been proposed for accomplishing such timed actuations, but none of these devices has proved entirely satisfactory. Many electrical and electromagnetic timing devices, for example, are unduly frail and are adversely affected by changes in supply voltage and ambient temperature. Similarly, mechanical timing devices of the prior art tend to be adversely affected by ambient temperature and pressure and also by age. Thus, such prior art devices often can not be successfully used in any application wherein the timing device is subjected to a wide variation in ambient conditions.

One object of the present invention is to provide an improved timing device for effecting accurately timed actuations of relatively short duration, which device will accurately reproduce its timing cycle despite wide variation in ambient pressure and temperature and the accuracy of which is substantially unaffected by age.

Another object is to provide an improved fly mass type of timing device which is unusually simple in construction, relatively inexpensive to manufacture, and especially rugged in design.

A further object is to provide an improved electromechanical timing switch which is unusually simple in construction, relatively inexpensive to manufacture, and especially rugged in design.

A further object is to provide an improved electromechanical timing switch which is substantially insensitive to supply voltage variations over relatively a wide range.

In order that these and other objects may be understood in detail, reference is had to the accompanying drawings which form a part of this specification and wherein:

Fig. 1 is a perspective view of an electro-mechanical timing switch constructed in accordance with the invention, showing the timing mechanism separated from the switch operating means;

Fig. 2 is an exploded elevational view of the timing mechanism of Fig. 1;

Fig. 3 is a vertical sectional view taken longitudinally through the timing mechanism of Fig. 1, and

Fig. 4 is a perspective view of a modified form of an adjustment member employed in the device of Fig. 1.

Referring now to the drawings in detail, and first to Fig. 1 thereof, it will be seen that the embodiment of the invention here disclosed includes a rotary solenoid operated switch A of the type described in United States

Patents 2,475,598; 2,496,880, 2,501,950 and 2,539,090 to Leland, and an inertia time period controlling means B combined with such device. The mechanism A includes an oscillatable shaft 1 operated by conventional rotary solenoid means 2 against the restraining influence of a tension spring 4. Upon energization of the solenoid, the ratchet 3 is rotated in a clockwise direction, as seen in the drawings, and engages a cooperating ratchet member 5 to effect rotation of the shaft 1 and a cam 6 carried thereby, the extent of rotation being determined by stop means of any suitable conventional construction. As disclosed in the aforementioned patents to Leland, the stop action limiting rotation of shaft 1 may result from the ball race plate 7 coming into contact with the end plate of the casing of solenoid means 2. During such rotation, the switch 8 is connected in series in the solenoid supply, so that when the switch is opened the solenoid is deenergized. When that occurs, spring 4 serves to return the mechanism to its initial start position.

The device will normally be controlled by a normally open, manually operated switch, not shown, connected in series with the switch 8 and solenoid mechanism 2. The switch 8 operates in conjunction with a conventional commutator switch 9 to control the apparatus being timed, such as a gun charger.

As seen in Figs. 1–3, the inertia time period controlling means comprises a driven member 10 in the nature of a plate having a central hub 11. The plate is fixed to the shaft 1 by means of a key 12. At a point radially removed from the shaft 1, the plate is provided with a fixed stop member 13. Surrounding the hub 11 and the stop member 13 is a cylindrical flange 14 provided with a series of spaced openings 15.

Positioned coaxially with the shaft 1 and the hub 11 is generally cylindrical inertia member 16 including a rim 17, an inturned flange 18, and an extended flange portion 19 connected to the flange 18 by means of an offset 20. A first abutment 21 is fixed to the flange 19 of the inertia member 16, and is circumferentially aligned with the stop 13 of the driven plate 10. The flange 19 is provided with a series of circumferentially spaced threaded apertures 22.

The inertia member or fly mass 16 is supported on the shaft 1 by means of an adjustment member indicated generally at 23. The member 23 comprises a central bushing 24 journalled on the hub 11, an intermediate hub 25, and an exterior flange 26. The flange 26 is so arranged as to overlie the outer face of the flange 19 of the fly mass 16, and is provided with a series of apertures 27 which may be brought into alignment with the apertures 22. Fixed to the hub 25 is a second abutment 28 which, as will be seen in Figs. 1 and 3, is circumferentially aligned with the stop member 13 of the driven plate 10. As best seen in Fig. 3, the hub 24 embraces the hub 11 of the driven member 10, so that the entire inertia time period controlling assembly is rotatable upon the shaft 1, the adjustment member 23 being in turn rotatable upon the hub 11.

The adjustment member 23 is held in place by means of a suitable key 29 engaged in annular slot in the hub 11. The adjustment member and the fly mass 16 are connected by means of a pair of diametrically opposed screws 30 and 31 engaged in diametrically aligned ones of the apertures 22 and 27.

Driven member 10 and the fly mass 16 are interconnected by a torsion spring 32 which is stronger (that is, has a greater spring stiffness) than tension spring 4. The spring 32 is provided with inturned end portions 33 and 34, the end portion 33 being engaged in one of the apertures 15 in flange 14 of the driven member, and the inturned portion 34 being engaged in a radial opening 35 in portion 19 of the member 16. The parts 10, 16 and 23 may be so assembled as to be maintained by the spring 32, when the spring is relaxed, in a relation such that the first and second abutments 21 and 28 normally held in engagement with stop 13 by action of the spring 32.

Operation of the device is as follows: The solenoid mechanism 2 is energised by closing the manual control switch, not shown, with the result that the shaft 1 is rotated in a clockwise direction through a portion of one rotation determined by the stop means of the rotary

solenoid mechanism **2**. At this point, the tension spring **4** is extended, and the switch **8** is opened by cam **6** so that the solenoid is deenergised. The plate **10**, being fixed to the shaft **1**, rotates therewith. Such rotation imparts a similar rotation to the fly mass **16**, since that member is connected to the plate **10** through spring **32**, until abutment **21** engages stop **13**. During such travel of the fly mass, the shaft **1** is held against its stop means, since there is a direct mechanical connection between the fly mass and the shaft **1** through the spring **32** and since the tension of spring **32** is greater than that of spring **4**. When motion of the fly mass **16** is stopped, by reason of abutment **21** striking stop **13**, springs **4** and **32** relax, returning the shaft **1** to its start position and the fly mass **16** to an initial position determined by contact of the second abutment **28** with the stop **13**. There is thus obtained a timed actuation of the switch **8**, the duration of such actuation depending upon the inertia of the fly mass **16**, the strength and initial tension of the spring **32**, and the angular spacing between stop **13** and the first abutment **21** when the mechanism is in its initial postion. The time period of operation will be accurately repeated for periods in excess of one hundred thousand cycles of use. The various components making up the inertia time period controlling means are not affected by ambient temperature, pressure, or the like. Also, within practical limits, age of the device is not a material factor in accuracy of the timing operation. Further, the operation of the inertia time period controlling means is substantially independent of any normal variation in supply voltage energising the solenoid means **2**.

It will be noted that the time period of control is dependent upon the initial angular spacing between the stop **13** and the first abutment **21**. Since the second abutment **28** is normally held in engagement with the stop **13** by spring **32**, it will be obvious that the initial spacing between the first abutment **21** and stop **13** will be determined by the angular spacing between the two abutments. Such angular spacing is adjustable merely by removing the two screws **30** and **31**, rotating the adjustment member **23** with respect to the fly mass, and replacing the screws in the new ones of the apertures **22**. Such adjustment makes possible, for example, selection of time periods of control in the range of from about .03 second to about 1.1 seconds, in a typical embodiment. When necessary, the initial tension on spring **32** may be adjusted by inserting the end **33** thereof in different ones of the apertures **15**.

It will be noted from Fig. 3 that the rim **17** of the fly mass **16** embraces the periphery of the disc **10**. Thus, the torsion **32** is completely enclosed within a space determined by the rim **17**, the outer portion of disc **10**, flange **14**, offset portion **20**, and flange **18**.

Members **10** and **23** may be machined from aluminum alloy or other light metal, and the fly mass **16** may be of steel or other suitable heavy material to provide the desired relatively great inertia. Abutment **21** has been described as the trailing abutment, and abutment **28** as the advance abutment, the latter being normally in contact with stop **13**. It will be understood that, as the device is assembled, the positions of the abutments **21** and **28** may be reversed, so that abutment **21** is held against stop **13** when the device is at rest, and abutment **28** is the trailing abutment which limits the travel of the fly mass. When the abutments are arranged in this manner, adjustment of member **23** to change the spacing between the abutments will not change the tension of spring **32**.

While the trailing abutment may be dispensed with, relying upon spring **32** to halt the fly mass, I prefer to employ both abutments. Further, as seen in Fig. 4, I may make the trailing abutment in the form of a spring **28'** having one end attached rigidly to the adjustment member **23** and the other end free to engage stop **13**. Thus making the trailing abutment elastic improves the stability of the timed interval when the driving voltage is subject to wide fluctuation.

I claim:

1. In a device for effecting timed actuations, the combination of operating means including an oscillatable shaft, actuating means operatively associated with said shaft to actuate the same in one direction, return means connected to said shaft and opposing said actuating means to urge the shaft to a given start position, and stop means for determining the extent of oscillation imparted to said shaft by said operating means, and an inertia time period controlling means including a driven member fixed to said shaft for oscillation therewith, a stop member carried by said driven member, an annular member constituting a fly mass positioned coaxially with said shaft and provided with a first abutment circumferentially aligned with said stop member, a torsion spring interconnecting said driven and annular members, a second abutment circumferentially aligned with said stop member on the side of said stop member opposite said first abutment, and adjustable means interconnecting said second abutment and said annular member whereby the angular spacing between said first and second abutment may be predetermined.

2. In a device for effecting timed actuations, the combination of operating means including an oscillatable shaft, actuating means operatively associated with said shaft to actuate the same in one direction, return means connected to said shaft and opposing said actuating means to urge the shaft to a given start position, and stop means for determining the extent of oscillation imparted to said shaft by said operating means, and an inertia time period controlling means including a driven member fixed to said shaft for oscillation therewith, a stop member carried by said driven member, an annular member constituting a fly mass positioned coaxially with said shaft and provided with a first abutment circumferentially aligned with said stop member, a torsion spring interconnecting said driven and annular members, a bushing freely rotatable about said shaft and provided with a second abutment circumferentially aligned with said stop member, said stop member being positioned between said first and second abutment, and adjustable means rigidly interconnecting said bushing and said annular member whereby the angular spacing between said abutments may be predetermined.

3. In a device for effecting timed actuations, the combination of operating means including an oscillatable shaft, actuating means arranged to drive said shaft in one direction, return means connected to said shaft in opposition to said actuating means to bias said shaft to a start position, and stop means for determining the extent of oscillation imparted to said shaft by said operating means, and an inertia time period controlling means including a driven member fixed to said shaft for oscillation therewith, a stop member carried by said driven member, an annular fly mass positioned coaxially with said shaft and provided with a first abutment circumferentially aligned with said stop member for engagement therewith upon relative rotation between said driven member and said fly mass, a torsion spring interconnecting said driven member and fly mass and disposed coaxially with said shaft, an adjustment member journalled about said shaft and provided with a second abutment circumferentially aligned with said stop member on the side thereof opposite said first abutment, and means for interconnecting said adjustment member and said fly mass in any of a plurality of angular relationships to select the angular spacing between said first and second abutments and thereby determine the extent of angular travel of said fly mass.

4. In a device for effecting timed actuations, the combination of operating means including an oscillatable shaft, actuating means operatively associated with said shaft to actuate the same in one direction, return means connected to said shaft and opposing said actuating means to urge the shaft to a given start position, and stop means for determining the extent of oscillation imparted to said shaft by said operating means, and an inertia time period controlling means including a driven member fixed to said shaft for oscillation therewith, a stop member carried by said driven member, an annular member constituting a fly mass positioned coaxially with said shaft and provided with a first abutment circumferentially aligned with said stop member, said annular member including a face lying transversely of said shaft and provided with a plurality of circumferentially spaced apertures, a torsion spring interconnecting said driven and annular members, a bushing freely rotatable about said shaft and provided with a second abutment circumferentially aligned with said stop member on the side thereof opposite said first abutment, said bushing having an outwardly extending flange overlying said face and provided with an opening aligned with one of said apertures, and fastening means engaged in said opening and

one aperture to interconnect said bushing and fly mass to determine the angular spacing between said abutments.

5. In combination in an inertia time period controlling device, a driven plate having a central hub and a stop member radially spaced therefrom, an annular fly mass including an annular flange spaced from but parallel to said driven plate and a rim portion freely embracing the periphery of said driven plate, an adjustment member including a bushing journalled on said hub and an annular flange overlying the annular flange of said fly mass, a torsion spring arranged coaxially of said hub and interconnecting said fly mass and driven plate, a first abutment fixed to said fly mass and positioned on one side of said stop member in circumferential alignment therewith, a second abutment fixed to said adjustment member in circumferential alignment with said stop member on the side thereof opposite said first abutment, and means for rigidly interconnecting said two flanges to determine the angular spacing between said abutments.

6. In combination in an inertia time period controlling device, a driven plate having a central hub, a stop member radially spaced therefrom and an annular flange coaxial with said hub and surrounding said stop member; an annular member constituting a fly mass and including a flange spaced from, but parallel to, said driven plate and a rim portion freely embracing the periphery of said driven plate and spaced outwardly from said annular flange; a torsion spring positioned coaxially with said hub and situated between said rim portion and said annular flange, one end of said spring being attached to said driven plate and the other to said fly mass; an adjustment member including a bushing journalled on said hub and an annular flange overlying the annular flange of said fly mass; a first abutment fixed to said fly mass and circumferentially aligned with said stop member, a second abutment fixed to said adjustment member in circumferential alignment with said stop member on the side thereof opposite said first abutment, and means rigidly interconnecting said flange of said fly mass and said flange of said adjustment member in any of a plurality of relative rotational positions to determine the angular spacing between said abutments.

7. A device constructed in accordance with claim 6 and wherein the annular flange of said driven plate is provided with a plurality of circumferentially spaced apertures and said one end of said spring is offset and engaged in one of said apertures.

References Cited in the file of this patent

UNITED STATES PATENTS

1,019,425	Cubitt	Mar. 5, 1912
1,665,318	Mead	Apr. 10, 1928
1,774,966	Eaton	Sept. 2, 1930
2,423,990	McCrory	July 15, 1947
2,514,836	Buntzman	July 11, 1950
2,610,995	Orsatti et al.	Sept. 16, 1952

FOREIGN PATENTS

384,194	Great Britain	Dec. 1, 1932