Nov. 15, 1955 D. B. SEVIN 2,724,025

DIFFERENTIAL COMMUTATOR

Filed Jan. 2, 1951 2 Sheets-Sheet 1

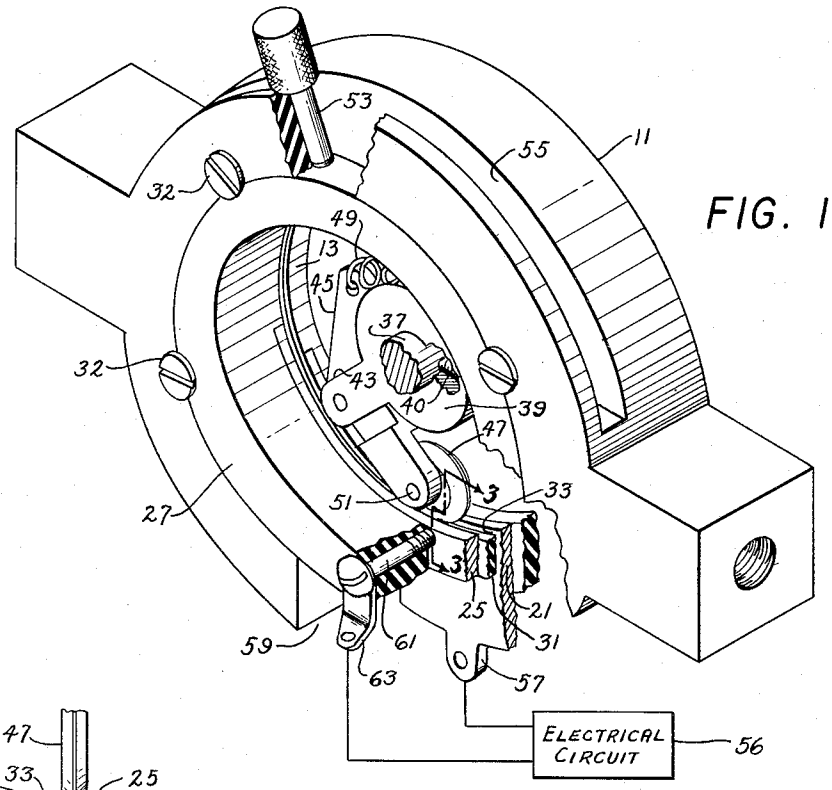


FIG. 1

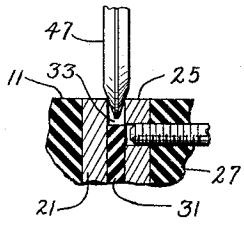


FIG. 3

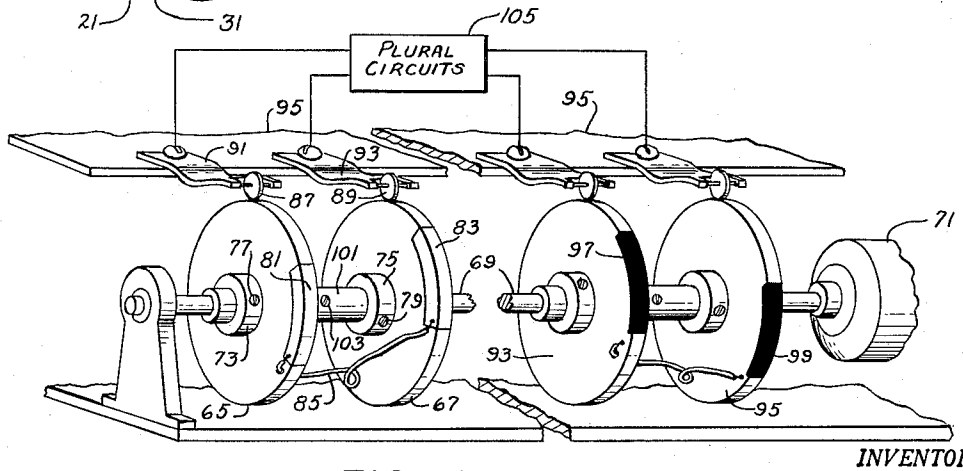


FIG. 4

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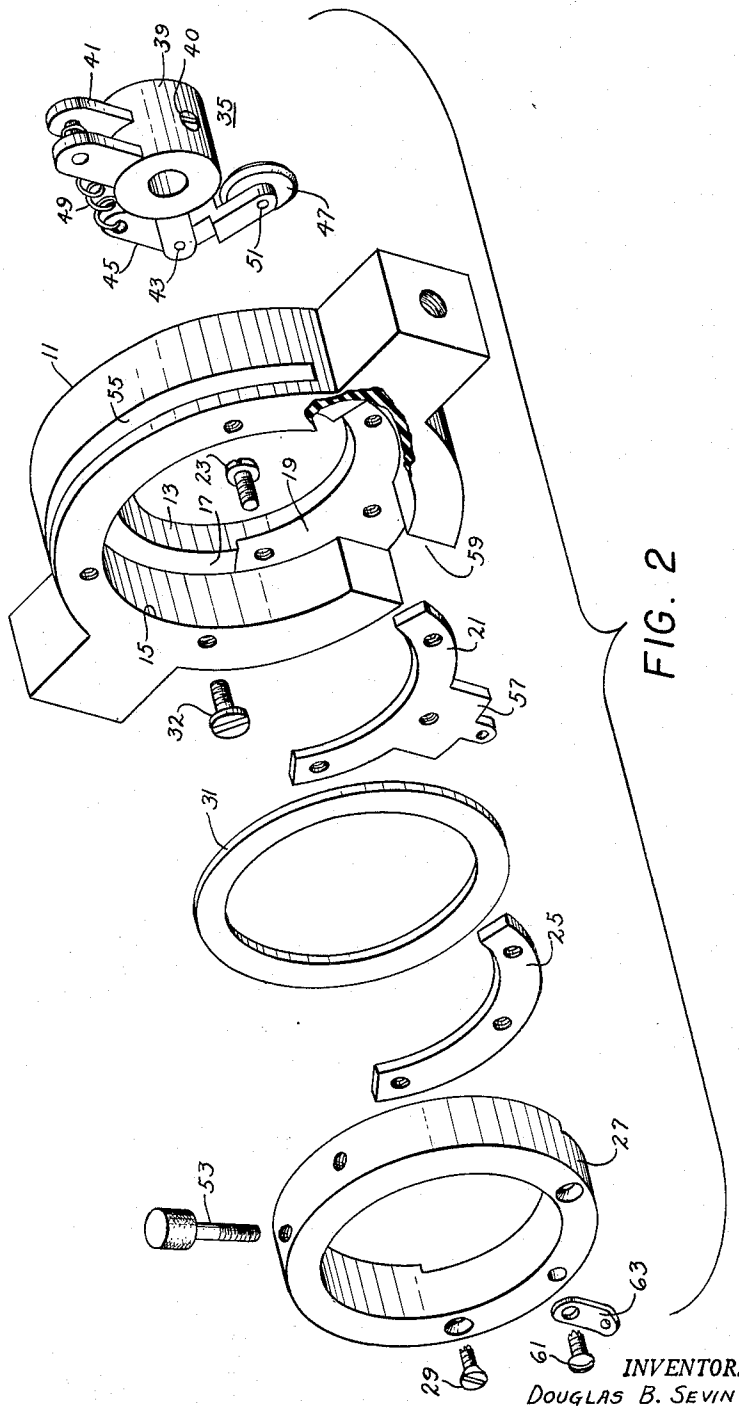


FIG. 2

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DIFFERENTIAL COMMUTATOR

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5 Claims. (Cl. 200—25)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to the art including time-interval controllers, and more particularly, it relates to mechanical arrangements for controlling the on and off periods of electric signals.

A principal object of the invention is to provide an interval controller that is operable at high speeds to define exceedingly small periods.

Another object is to provide such a controller that is readily adjustable over relatively wide ranges of time-interval values.

Still another object is to provide such a controller that is adapted for smooth operation, evidencing substantially no discontinuities during relatively high-speed opening and closing of electric circuits.

Yet another object is to provide a mechanical interval timer that is simple in construction, dependable of operation and easily adjustable over a wide range of operating conditions.

A feature of this invention resides in the provision of an apparatus for controlling intervals of circuit continuity, which comprises a pair of spaced conductive elements movably mounted with respect to contactor means adapted to effect closed circuit condition therebetween, said elements being relatively adjustable for varying the respective periods of the said conditions.

Another object of this invention resides in the provision of mechanical commutator arrangements adapted for synchronizing the actuation of a plurality of circuits, said arrangements including means individually altering the adjustment of timing of one said circuit independently of the timing of the other circuits.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is an isometric view, with parts broken away, of a time-interval controller embodying the invention,

Fig. 2 is an exploded view of the controller of Fig. 1,

Fig. 3 is a cross-sectional view taken along the line 3—3 of Fig. 1, and

Fig. 4 is a perspective view of a modification of the invention.

Figs. 1 and 2 show an interval timer or controller constructed in accordance with the principles of this invention. A cylindrical housing **11** is formed of insulating material and with relatively small- and large-diameter bore portions **13** and **15**, respectively. The junction of the bore portions **13**, **15** defines an inwardly extending shoulder **17** (Fig. 2) of which an arcuate part **19** is recessed to receive a conforming arcuate conductive segment **21**, which is adapted to be secured in the recessed part in any suitable manner as, for example, by screws **23**.

A cooperating conductive segment **25**, of arcuate form similar to that of segment **21**, is embedded in a corresponding recess formed in the end of an insulating ring **27** and therein suitably secured as by screws **29**.

The segments **21** and **25** are insulatingly spaced from each other by a non-conducting ring **31**, which snugly fits in the large-diameter bore portion **15** in abutting relation to the shoulder **17** and the outer face of the segment **21**.

The inner diameter of ring **31** is somewhat larger than the inner diameter of the small-diameter bore portion **13** so that when the segments **21**, **25** and rings **27**, **31** are assembled, as shown in Fig. 1, and secured in assembly as by overlapping engagement of the caps of screws **32** and the outer end of ring **27**, a shallow circumferential trough **33** is formed of which the walls are the exposed adjacent faces of segments **21**, **25**, shoulder **17** and inner edge of ring **27**, the floor of the trough **33** being the inner periphery of ring **31**.

A rotary contactor assembly **35** is supported axially of the housing **11** and is adapted to be driven by any suitable motive means (not shown) through a shaft **37**. The contactor assembly **35** consists of a hub **39** adjustably secured to shaft **37** as by set screw **40**, and having radially extending anchor and pivot members **41** and **43**, respectively, which resiliently support a bellcrank **45** having a bevelled conductive wheel **47** journalled at the free end thereof. For dynamic balancing of the rotor, the bellcrank **45** is designed so that the wheel **47**, in normal operating position, is substantially diametrally opposite the anchor member **41**, with a spring **49** exerting sufficient tension to cause the bevelled edges of wheel **47** gently to bear against the inner edges of the upper parts of the trough walls, as shown in Fig. 3.

Thus, as the wheel **47** revolves in the trough **33**, it also rotates about its own axis **51**, and during a revolution of the rotor assembly, substantially point conductive connection between segments **21** and **25** is effected during the time that the wheel **47** simultaneously contacts the segments. Electrical contact is broken when only one segment or no segments are contacted by the wheel **47**.

The length of simultaneous contact time can be varied, according to this embodiment of the invention, and even while the rotor is spinning on its shaft, by making one of the segments, here segment **25**, angularly adjustable relative the other segment **21**. Thus, as shown, ring **27** is provided with a capped guide pin **53** threaded into a suitable opening in the wall of the ring. Pin **53** extends radially through a semi-circumferential slot **55** formed in the wall of housing **11**, and when screwed down, the cap of pin **53** bears against the outer edges of the walls of slot **55** and frictionally holds ring **27** in position. Loosening pin **53** frees ring **27** for angular displacement resulting in a corresponding angular displacement of segment **25** relative segment **21**.

Segment **21** can be connected to an external circuit **56** by means of a terminal **57**, which extends through a radial slot **59** formed in the large-diameter bore portion **15** of housing **11**. Connection of segment **25** to the external circuit is effected by a screw **61** and tab **63** arrangement, with the screw **61** establishing conductive connection to segment **25**.

A modification of the timer apparatus of this invention is shown in Fig. 4. According to this version, a pair of insulating discs **65**, **67** are individually adjustably mounted on a common sleeve **101**, which is itself adjustably carried on a shaft **69**. Simultaneous or conjoint adjustment of discs **65**, **67** in shaft **69** is accomplished by means of set screw **103**. Rotation of shaft **69** can be produced by any suitable motive means **71**. As shown, discs **65**, **67** are provided with integral or suitably attached collars **73**, **75**, each having set screws **77**, **79** by

means of which the respective discs can be secured to the sleeve **101**. It will be apparent that the means for securing the discs to the sleeve **101**, and sleeve **101** to shaft **69** are exemplary only and that any other suitable means can be employed providing for both individual and conjoint adjustability of the discs **65** and **67**.

The conjoint adjustability of the discs is particularly advantageous where it is desired to use the controller to control or synchronize a plurality of circuits **105**. In such a case, multiple pairs of discs constructed similarly to discs **65**, **67**, each having suitably designed segments may be used. Each such pair is individually adjustably mounted on respective sleeves, which sleeves, in turn are adjustably mounted on the shaft. Discs **93**, **95**, to be more fully described herebelow, are illustrative of such another pair of discs. In this manner, provision is made for independent adjustment of the timing of individual circuits indefinitely or in synchronism with that of other circuits.

As shown in Fig. 4, conductive arcuate segments **81**, **83** are embedded in a peripheral portion of discs **65**, **67**, respectively, and the segments are conductively interconnected by a conductor **85** that is soldered or otherwise attached at its ends to the segments **81**, **83**.

Connection to the external circuit **105** to be controlled is effected by means of roller brush contactors comprising conductive rollers **87**, **89** rotatably supported at the end of spring members **91**, **93**, respectively, so that the rollers gently bear against and contact the peripheries of discs **65**, **67**. The spring members **91**, **93** are affixed at their opposite ends to a terminal strip **95**.

In operation, the rollers **87**, **89** ride along the peripheries of the associated discs **65**. **67** as the latter are caused to rotate. When both rollers are in simultaneous contact with the conductive segments **81**, **83** of the respective discs, the circuit is closed; at all other times the circuit is open.

The duration of the closed-circuit condition is readily altered by adjusting the relative orientation of the discs **65**, **67**. Thus, when the conductive segments **81**, **83** are in complete juxtaposition, the conductive time interval is a maximum. As the relative positions of the conductive segments are altered such that only parts of the segments are in a juxtaposed relation, the conductive time intervals are correspondingly reduced.

Where it is desired to open a normally closed circuit for adjustable short intervals, conductive discs **93**, **95** can be employed each having respective insulating segments **97**, **99** arranged in a manner similar to that of the conductive segments **81**, **83** on the insulating discs **65**, **67**. Here also, the duration of the desired time interval is varied by adjusting the relative orientation of the discs.

In the foregoing description of the embodiment of the invention illustrated in Figs. 1–3, a single pair of cooperating segmental rings and associated contactor assembly are disclosed. It will be apparent, however, that where a plurality of circuits are to be controlled in synchronism or other timed sequence, a corresponding plurality of pairs of segmental rings can be provided, each pair having a respective rotor similar to rotor **35** (Fig. 2), all individually adjustably mounted on the same shaft. Such additional pairs of rings and the associated rotors would thus be individually adjustable to afford any desired time relationship among the respective circuits.

Thus, when a plurality of time-interval controllers are used and after having been preliminary synchronized as

by relaxing the set screws in the respective hubs and rotating the plural rotor assemblies relative their common shaft until a desired alignment or synchronization is achieved, the time interval of each may be varied without disturbing the synchronization. For example, if the adjustable conductive segment is positioned with respect to the fixed segment in each controller in such manner that the adjustable segment is first contacted by the associated conductive wheel, the time intervals of all controllers begin simultaneously. Similarly, if the adjustable segment is positioned relative to the fixed segment in each controller in such manner that the fixed segment is first contacted by the associated conductive wheel, the time intervals of all controllers end simultaneously.

Obviously many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. Adjustable switch mechanism for electric circuits, comprising a pair of rotatable disc members, each said member having peripheral conducting and insulating parts, the conducting parts of said members being conductively interconnected, means for adjusting the connected members relatively to each other to vary the spatial alignment of the respective conducting and insulating parts, and a conductive rotatable wheel contacting both of said members for connecting said conducting parts to the electric circuits, whereby upon adjustment of said connected members selective electric conduction of said circuits is obtained for predetermined time intervals.

2. The mechanism defined in claim 1 wherein said wheel comprises roller brush means yieldably mounted for point rolling contact along the periphery of said disc members.

3. The mechanism defined in claim 1 wherein said contact means comprises roller brush means including a V-shaped roller edge, said roller brush means being mounted yieldably for rolling contact along the periphery of said disc members.

4. Rotary switch apparatus for an electric circuit, comprising relatively rotatable elements, one said element having spaced conductive parts and spaced insulating parts, means to re-orient said parts, the other said element comprising a conductive contact wheel adapted for periodic simultaneous conductive engagement with said conductive parts, and means for coupling said elements to the circuit.

5. Electric current-controlling apparatus comprising rotary means interrupting the current circuit periodically, said rotary means comprising a stator and a rotor, said stator having a pair of relatively adjustable segmented rings disposed in spaced coaxial alignment, said rotor including a conductive roller supported rotatably for simultaneous engagement with said rings, and means for varying the period of the interruptions.

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