Nov. 25, 1958 W. M. BURNSIDE 2,862,079

GOVERNOR SWITCH

Original Filed Sept. 10, 1954 3 Sheets-Sheet 1

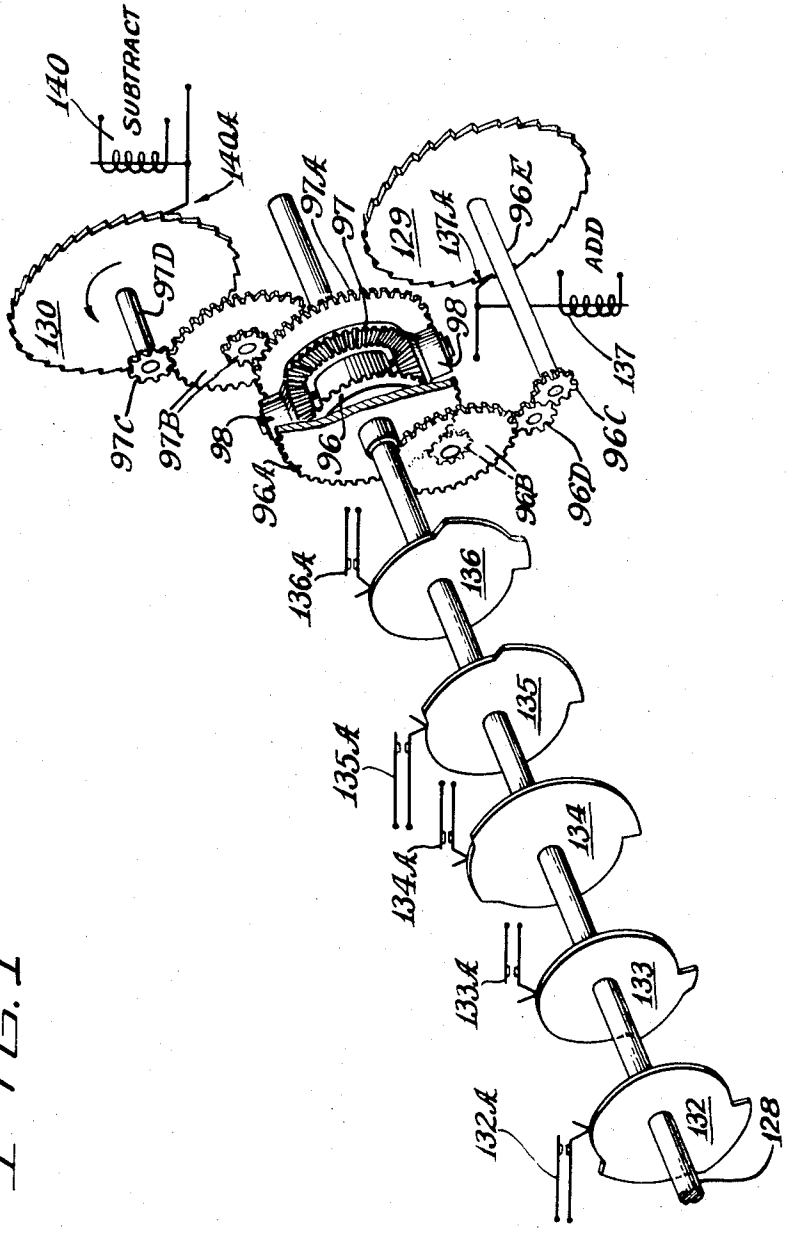

FIG. 1

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Nov. 25, 1958 W. M. BURNSIDE 2,862,079

GOVERNOR SWITCH

Original Filed Sept. 10, 1954 3 Sheets-Sheet 2

FIG. 2.

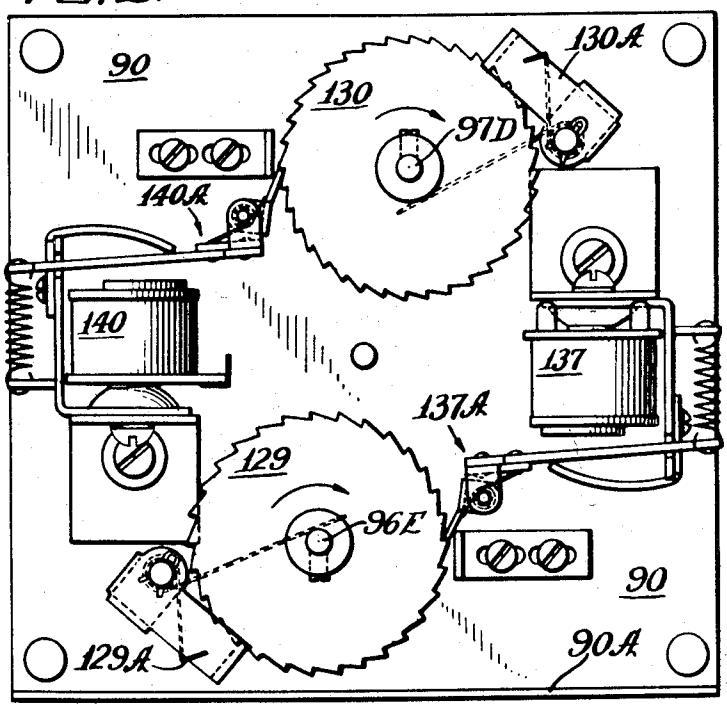
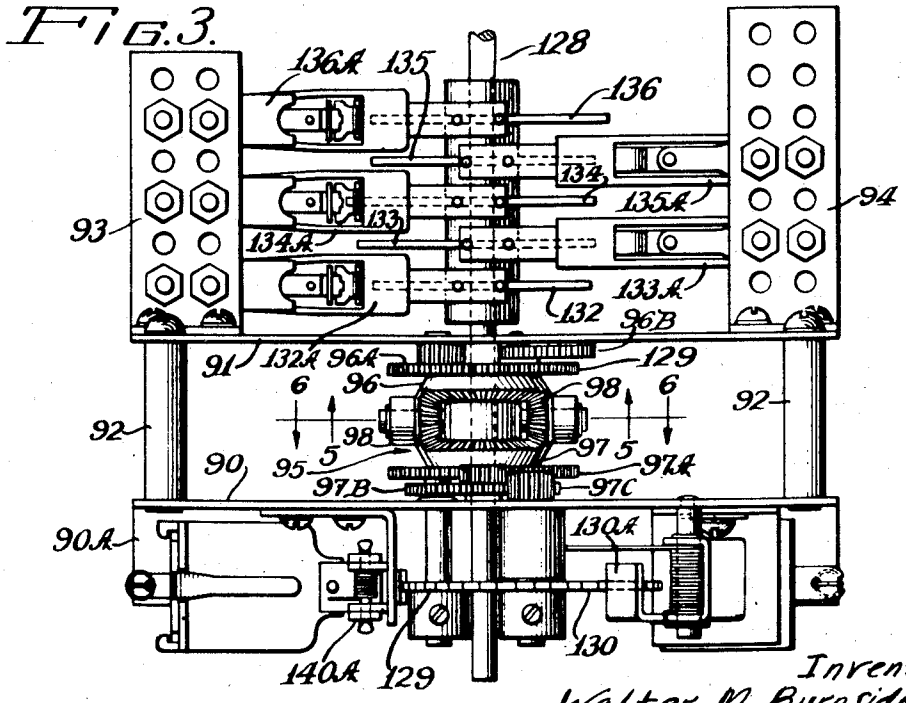


FIG. 3.



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Nov. 25, 1958 W. M. BURNSIDE 2,862,079

GOVERNOR SWITCH

Original Filed Sept. 10, 1954 3 Sheets-Sheet 3

FIG. 4.

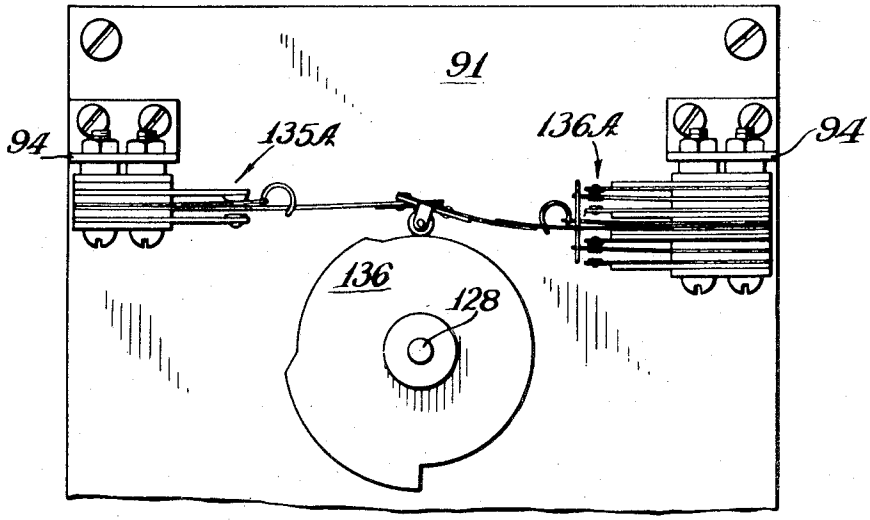


FIG. 5.

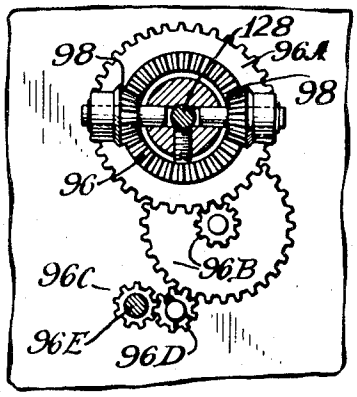


FIG. 6.

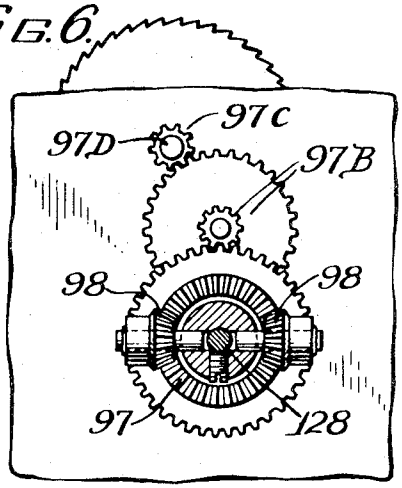
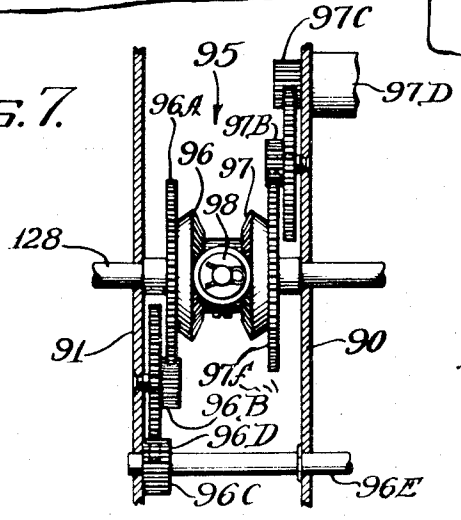


FIG. 7.



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United States Patent Office 2,862,079 Patented Nov. 25, 1958

2,862,079

GOVERNOR SWITCH

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Original application September 10, 1954, Serial No. 455,217, now Patent No. 2,709,593, dated May 31, 1955. Divided and this application April 12, 1955, Serial No. 500,797

7 Claims. (Cl. 200—105)

This invention pertains to electrical switches and has as a principal object the provision of a power-actuated type of switch used especially for selective control purposes in accordance with differential operating factors, the present application being a division of application Serial No. 455,217, now Patent No. 2,709,593, issued May 31, 1955.

More particularly, the present disclosures relate to a governor switch including shaft means for actuating a plurality of control switches, differential drive means for turning said shaft means at differential rates, and separate drive means individually operable to effect the different turning rates of the shaft means in response to input signals or control pulses applied thereto from some desired external source which supplies the governing factors.

Other objects relate to the provision of switches actuated by cams of desired control shape on a differential shaft means, and a differential gear means with separately operable electromagnetic means for effecting reverse action of the shaft means at different rates in response to similar input or governing pulses.

Additional objects and aspects of the invention pertain to details of the connections, structures, and operation of the illustrative embodiment described hereinafter in view of the annexed drawing in which:

Fig. 1 is a skeletonized perspective of the essential components of the governor switch;

Fig. 2 is a front elevation of the governor unit;

Fig. 3 is a top plan view of the governor unit;

Fig. 4 is a fragmentary rear elevation of the cam switch means of the governor unit;

Fig. 5 is a fragmentary vertical section of the differential gear means looking in the direction of lines 5—5 of Fig. 3;

Fig. 6 is a fragmentary vertical section of the differential gear means looking in the direction of lines 6—6 of Fig. 3;

Fig. 7 is a fragmentary vertical section through the complete differential gear means of Figs. 5 and 6 looking at right angles to the latter views.

The governor switch is constructed as a compact unit, as will appear from the top plan view in Fig. 3 wherein the structure is seen to include a pair of frame plates **90** and **91** secured in spaced relation by means of spacers **92**, plate **90** having an offset mounting flange **90A**. Brackets **93** and **94** are bolted to plate **91** to serve as mounts for the several snap switches **132A–136A**, which ride the corresponding cam discs **132–136** fast on the governor shaft **128**, the relative positions of the cams and switches being illustrated in Fig. 4.

Referring still to Fig. 3, it will be observed that the differential gear unit generally indicated at **95** is disposed between the mounting plates, and as shown in the detail of Fig. 7, consists of bevel gears **96** and **97** meshing with a pair of planetary pinions **98** carried on a stub shaft fixed on the governor shaft **128**. The bevel gear **96** is driven (Figs. 5 and 8) from stub shaft **96E** through a train of gears **96A**, **96B**, **96C**, **96D**; whereas the other bevel gear **97** and its companion gear **97A** is similarly driven through intermediates **97B** from drive pinion **97C** on stub shaft **97D**.

The gear ratios for the gears associated with the differential gears **96**, **97** are not the same, so that for equal displacements of the stub shafts **96E** and **97D** the rotation of shaft **128** will be different.

As seen in Fig. 2, the stub shaft **96E** is driven by the ratchet gear **129** fast thereon, while the other stub shaft **97D** is driven by ratchet gear **130**, there being separate electromagnets **137** and **140** mounted on the plate **90** with corresponding pawl means **137A**, **140A** for stepping said ratchets to produce the aforesaid opposite rotative movements of the governor shaft, each ratchet having a corresponding holding pawl **129A**, **130A** to prevent retrograde movement.

The operation of the governor will be understood from the skeletonized view of Fig. 1 in which the electromagnet **137** may be energized from any desired control circuit (not shown), such as that described in said Patent No. 3,709,503, thereby moving the ratchet gear **129** one step for each impulse to the coil, the resulting motion of stub shaft **96E** being transmitted through pinions **96C**, **96D**, and the intermediate gearing **96B** to gear **96A** and its bevel gear **96**, with a resultant displacement of the planetary pinions **98**, which are carried for planetary rotation on the governor shaft **128**.

Impulsing of the electromagnet **140** from any other desired control source (not shown) produces a similar step-by-step movement of the stub shaft **97D**, which motion is transmitted through the gearing **97C**, **97B**, **97A** to the differential bevel gear **97**, resulting in a reverse movement of shaft **128** from that produced by actuation of coil **137**.

The gear ratios mentioned heretofore, as well as the mathematical development or evolution of the several cams **132–136** and angular locating thereof will produce the desired operations at different times responsive to rotation of the governor shafts, said operations being averaged on computed frequency tables based upon a desired or predicted frequency of operation of the drive means or electromagnets **137** and **140**, depending upon the desired performance required of the unit and which will form the basis for the selection of said ratios and cam characteristics.

It is contemplated that the invention shall not be limited to any precise details of structure, arrangement, operation or circuit plan or connection, excepting as may be specifically required by the appended claims.

I claim:

1. Governor means of the class described comprising a plurality of governor switches and corresponding actuating cams driven from a common shaft, separate electromagnetic drive units for rotating said shaft different angular amounts in opposite directions responsive to impulse-operation of said drive units, differential gear means interconnecting said shaft with said drive units, separate energizing circuits for said drive units, said governor switches being adapted for connection in circuits to be controlled, and being opened and closed by said cams in accordance with the relative frequency of operation of said drive units.

2. A governor switch comprising a plurality of governing switches adapted to be connected in circuits to be controlled, cam means rotatable in opposite directions to actuate said governor switches, a common shaft for said cam means, differential gearing driving said shaft in opposite directions at different gear ratios, and electromagnetic stepping means selectively operable to drive said differential gearing in said opposite directions.

3. A differential switch comprising a shaft, switch operating means carried by said shaft, two electromagnetic ratchet devices each adapted for connection to a separate control circuit to be respectively and independently actuated thereby and each including a ratio-determining mechanism of different ratio value from the other, and differential drive means rotatively interconnecting said shaft with both ratchet devices to be stepped in opposite directions by actuation of one or the other of said devices; the angular displacements of the shaft imparted by the said ratchet devices in accordance with the ratio value aforesaid being different in each case.

4. A switch mechanism comprising a rotatable shaft, cams rotatable with said shaft, switch means mounted adjacent said shaft for actuation severally by said cams; separate reversely-operating ratchet stepping mechanisms and ratio-determining means drivingly interconnecting the same with said shaft; separate electromagnet actuating means for each stepping ratchet mechanism and respectively energizable by sequential pulses to effect stepping action of the appertaining ratchet mechanism; the magnitude of each step produced by one said stepping mechanism being different from that of the other said mechanism in accordance with the relative ratios of said determining means whereby the reverse stepping movements imparted thereby to said shaft will be of different magnitude in opposite directions and the relative rates of travel of said switch-operating cams will be correspondingly different in said opposite directions.

5. In a power-actuated switch mechanism, in combination: a shaft; a differential gear set including a pair of reversely drivable gears concentrically rotatable with said shaft and planetary gear means drivingly interconnecting said shaft with each of said concentric gears to produce reverse rotations as aforesaid responsive to angular movement of one or the other of the concentric gears; and electromagnetic stepping mechanism including separately energizable electromagnetic devices adapted to be intermittently pulsed, and a ratio-drive means drivingly interconnecting each of said concentric gears with one of said stepping mechanisms, whereby actuation of either of the latter will produce step-by-step reverse angular

displacements of said shaft at different relative ratios per step responsive to pulsing of the appertaining electromagnetic device; and switch-actuating means carried by said shaft.

6. A governor switch comprising a switch-actuating shaft rotatable in opposite directions; a plurality of switch devices mounted adjacent said shaft; means moved by rotation of said shaft in either direction for selectively actuating certain of said switch devices at some angular position of travel of the shaft in either direction; a differential drive mechanism connected to drive said shaft reversely dependently upon application of reverse driving pulses to said differential mechanism; and means including separate electromagnetic means respectively actuating gear means of different ratios having driving connection with said differential mechanism for operation responding to pulses of substantially the same duration to produce rates of actuation of said switch means by said shaft means which are different in opposite directions.

7. Switch mechanism of the class described comprising a shaft, switch-operating members rotated by said shaft, switch means actuated respectively by said members; a differential gear drive connecting with said shaft and having two driving gears differentially interdriven by a pair of planetary idling pinions; a toothed stepping ratchet for each of said driving gears and means drivingly connecting the same therewith, the number of teeth on said ratchets being unlike; and pawl means operable to step each of said ratchets independently; the driving connections between said ratchets and the corresponding differential driving gears being in opposite senses, whereby stepping of one of said ratchets produces a reverse rotation of said shaft from the other ratchet, and at a different angular rate.

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