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Baumgartner

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[54] **SPRING-LOADED SNAP-ACTION STEPPING-SWITCH-OPERATING MECHANISM**

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[52] **U.S. Cl.** ..... **200/153 P,** 200/153 PA

[51] **Int. Cl.** **H01h 3/40**

[58] **Field of Search** ..... 200/153 P, 153 PA, 11, 200/11 TC, 18

[56] **References Cited**

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[57] **ABSTRACT**

A spring-loaded snap-action stepping-switch-operating mechanism includes a Geneva gear drive for loading a spring motor and also includes latch means for the spring of said motor automatically releasable when said spring is fully loaded and a step action thereof is desired. A novel arrangement of parts makes the mechanism compact and makes it possible to easily assemble, disassemble and service the same.

12 Claims, 5 Drawing Figures

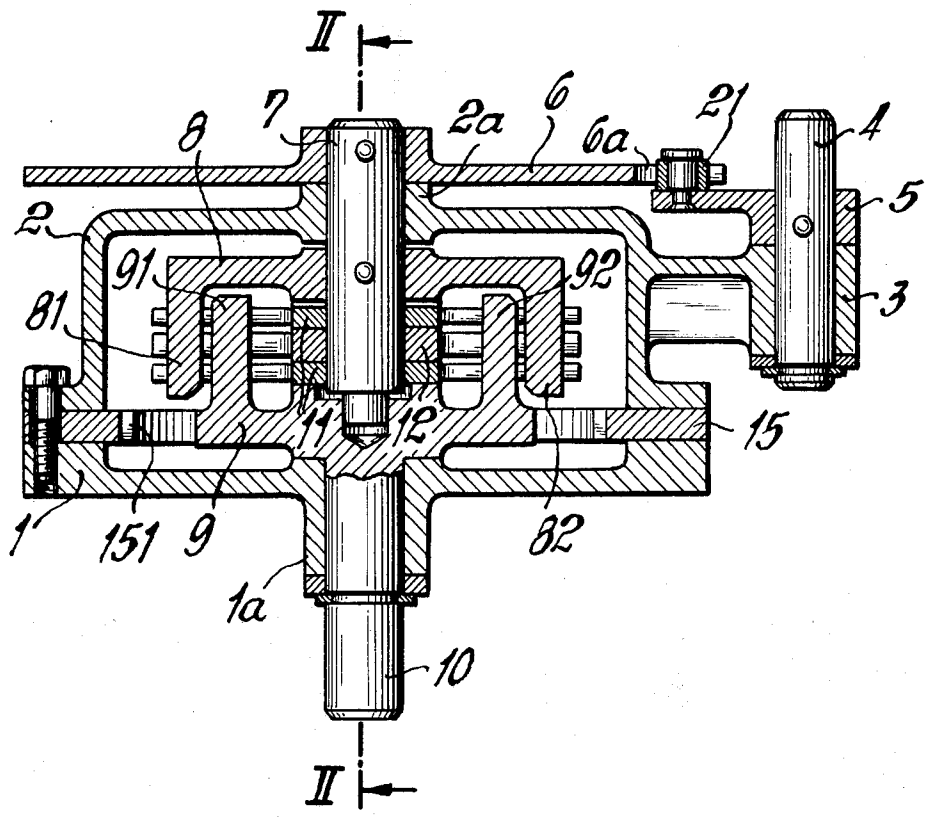
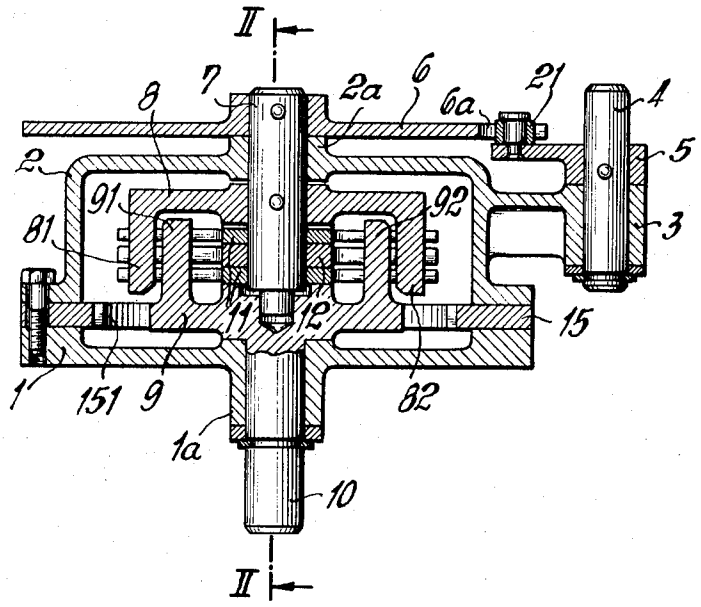


FIG. 1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8
7
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6
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II

FIG. 2

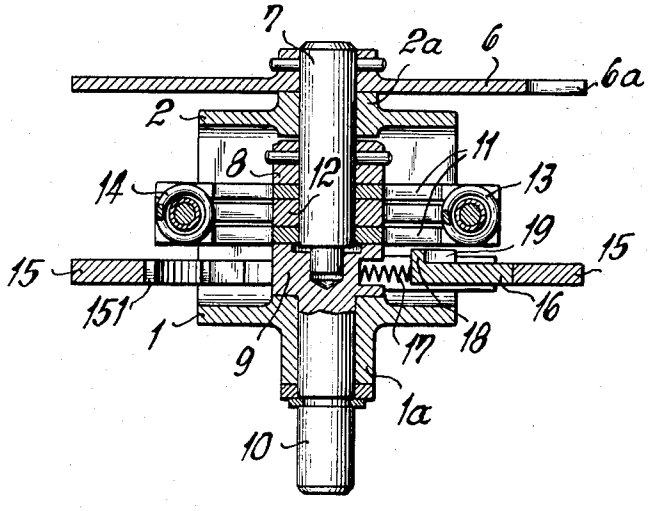
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FIG. 3

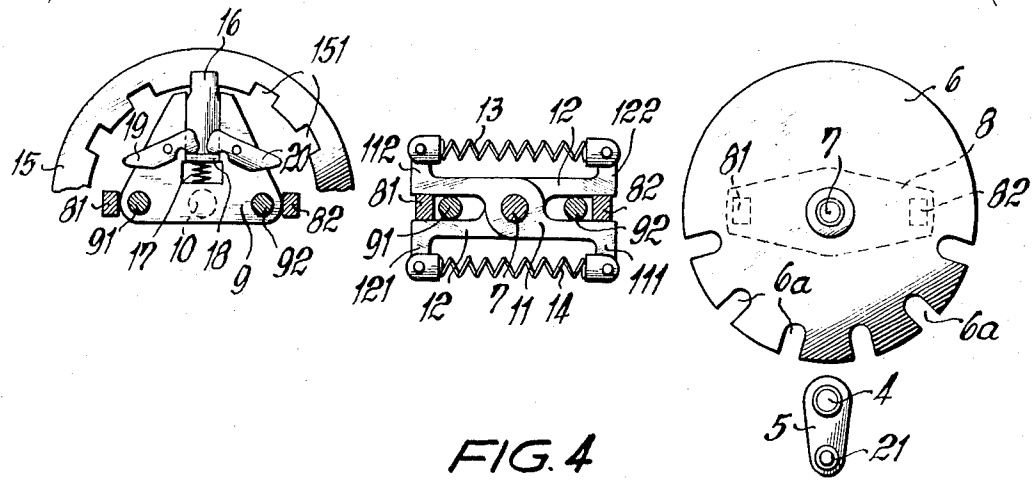


FIG. 4

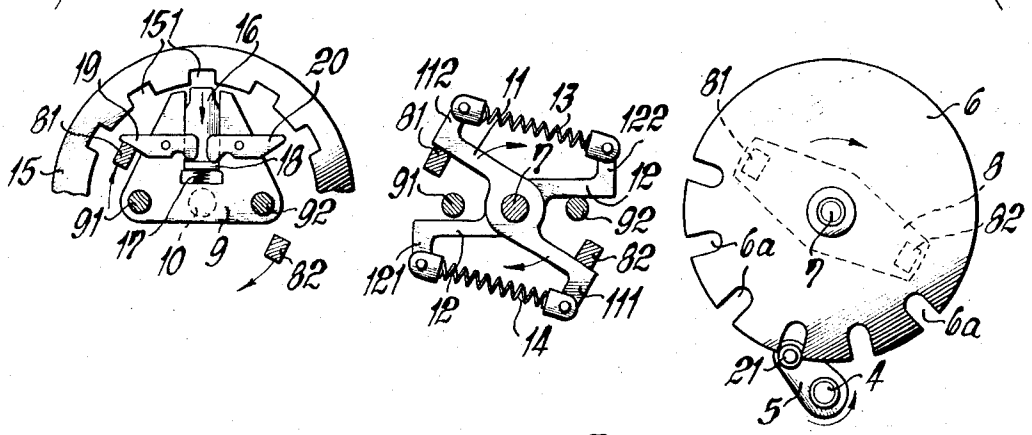
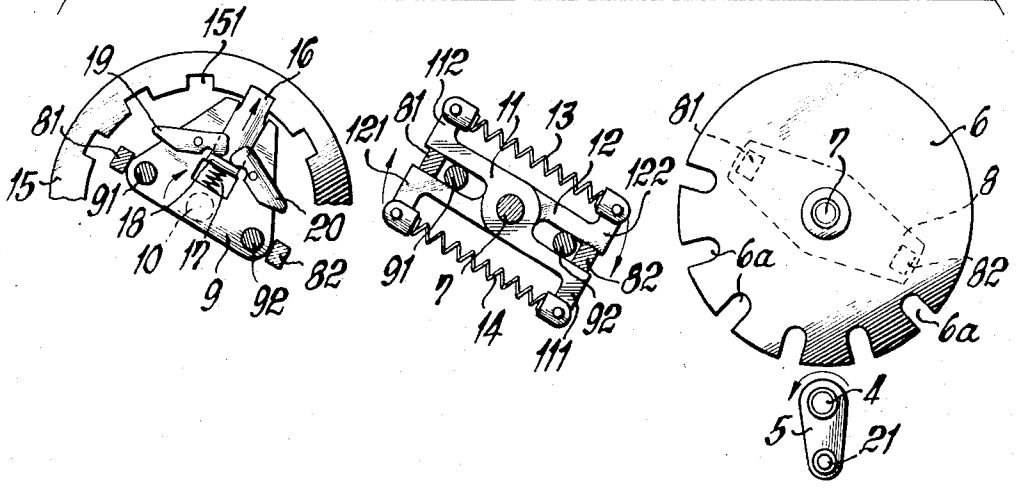


FIG. 5



SPRING-LOADED SNAP-ACTION STEPPING-SWITCH-OPERATING MECHANISM

BACKGROUND OF THE INVENTION

The present invention relates to spring-loaded snap-action stepping-switch-operating mechanism, as applied in electrical power engineering to operate Jansen type transfer switches for tap-changing power transformers, or to operate power change-over switches. Jansen type transfer switches for load tap changers for regulating transformers are well known in the art. One such transfer switch and the parts which are associated with it are disclosed in U.S. Pat. No. 3,176,089 to A. Bleibtreu et al., Mar. 30, 1965 for LOAD TAP CHANGERS FOR TRANSFORMERS, and reference may be had to this patent for a more complete background of the present invention. In systems of the kind under consideration movable contacts must be moved in opposite directions in discrete steps each of which must be performed with a snap-action. In some instances the number of steps may be only two, but in other instances the number of steps may be considerably larger.

In conventional power stepping-switch-operating mechanisms of the kind under consideration a spring motor is loaded either manually, or by means of an electric motor. When the spring is fully loaded it is restrained in the loaded position by means of a latch. When the latter is released the spring motor operates a Geneva gear which, in turn, produces the desired stepping action of a shaft operating the movable contacts of a power switching device. Such switch-operating mechanisms are bulky, difficult to assemble and to service and are inefficient because of considerable frictional losses which occur therein.

It is the primary object of this invention to provide stepping-switch-operating mechanisms which are not subject to the above limitations and drawbacks.

SUMMARY OF THE INVENTION

Stepping-switch-operating mechanisms embodying this invention include a pair of spring-supporting levers which are arranged cross-wise and pivotable about a common shaft. Each of these spring supporting levers has a pair of lever arms. Such mechanisms further include a pair of springs each affixed with the ends thereof to one of said pair of lever arms of each of said pair of spring-supporting levers. The mechanisms further include a spring-loaded crank-shaft operable by a Geneva gear drive and having axial extensions cooperating with one of said pair of spring-supporting levers for pivoting said one of said pair of spring-supporting levers to load said pair of springs. Mechanisms embodying this invention further include a pivotable stepping crankshaft having axial extensions cooperating with the other of said pair of spring-supporting levers to cause said pair of springs when expanding to impart a pivotal motion to said stepping crankshaft. A latch mechanism locks said stepping crankshaft in position against the bias of said pair of springs. The spring-loading crankshaft includes means for unlatching said latch mechanism to allow said pair of springs to impart said pivotal motion to said stepping crankshaft.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical section of a mechanism embodying the present invention;

FIG. 2 is a vertical section of the mechanism shown in FIG. 1 taken along II—II of FIG. 1; and

FIGS. 3—5 are diagrammatic exploded top plan views of the mechanism shown in FIGS. 1 and 2 in three different operating positions.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings, and more particularly to FIGS. 1 and 2 thereof, reference numeral 1 has been applied to indicate a base plate of a housing structure, and reference numeral 2 has been applied to indicate the cover plate of the housing structure. Plates 1 and 2 define a space for the constituent parts of the mechanism embodying this invention, and they also form bearings 1*a*, 2*a* for the constituent shafts 7, 10 of the mechanism embodying this invention. Cover plate 2 is provided with a lateral projection or flange forming a bearing 3 for driving shaft 4. Driving shaft 4 supports a crankshaft 5 having a radially outer end which supports roller 21. The latter engages recesses 6*a* in a Geneva gear 6. Geneva gear 6 is supported by shaft 7 resting in bearing 2*a* formed by cover plate 2. The spring-loading crankshaft 8 is also mounted on shaft 7 in such a fashion that Geneva gear 6 and crankshaft 8 moves simultaneously. This may be achieved by pinning both Geneva gear 6 and crankshaft 8 to shaft 7. The driven or stepping shaft 10 is arranged in coaxial relation to shaft 7, and below the latter and shaft 10 is supported by bearing 1*a* formed by base plate 1. The stepping crankshaft 9 may form an integral part of shaft 10 — as shown in FIG. 1 — or be fixedly mounted upon shaft 10. It will be apparent from the above that stepping crankshaft 9 is arranged at a lower level than spring-loading crankshaft 8. A pair of spring-supporting levers 11, 12 is arranged between spring-loading crankshaft 8 and stepping crankshaft 9. Each of levers 11 and 12 has two arms extending in opposite directions and both levers 11, 12 are arranged cross-wise and are pivotally mounted on shaft 7. In FIGS. 3 and 5 reference numerals 111 and 112 have been applied to indicate the ends of lever 11, and reference numerals 121 and 122 have been applied to indicate the ends of lever 12. The ends 111 and 121 are tied together by compression spring 14, and the ends 112 and 122 are tied together by compression spring 13. The spring-loading crankshaft 8 has two axially extending projections 81 and 82 which enter into the gaps formed by the arms of levers 11 and 12. In like fashion stepping crankshaft 9 has two axially extending projections 91, 92 which enter into the gaps formed by the arm of levers 11 and 12. Reference numeral 15 has been applied to indicate a gear segment which is arranged between base plate 1 and cover plate 2 at the same level as the arm of crankshaft 9. Gear segment 15 is provided with recesses 151 at the radially inner side thereof intended to receive slide latch 16. The number of recesses 151 in gear segment 15 is equal to the number of steps or operating positions which the mechanism is intended to have. It will be apparent from FIGS. 3 to 5 that gear segment 15 is arranged in coaxial relation to shaft 10 and radially outwardly from stepping crankshaft 9, while FIGS. 1 and 2 show that gear segment 15 is arranged at the same level as the arm of stepping crankshaft 9. Slide latch 16 is capable of en-

gaging with the radially outer end thereof each of the recesses in gear segment **15.** To this end slide latch **15** is spring biased radially outwardly by means of a spring **17** whose radially outer end engages slide latch **16,** and whose radially inner end rests against stepping crankshaft **9.** Slide latch **16** can be moved radially inwardly against the bias of spring **17** by means of two operating levers **19** and **20** pivotally supported on the arm of stepping crankshaft **9.** The aforementioned projections **81, 82** of spring-loading crankshaft **8** cooperate with levers **19** and **20** to move slide latch **16** radially inwardly against the bias of spring **17.** To this end lever **19** is arranged in the path of part **81** and lever **20** is arranged in the path of part **82.**

The mode of operation of the spring-stepping drive which has been described above will now be explained more in detail in connection with FIGS. **3** to **5.**

FIG. **3** shows an initial or rest position of the mechanism. In order to perform a stepping operating driving shaft **4** is operated by motor means which have not been shown in the drawings. It may be assumed that the direction of operation is counterclockwise as indicated in FIG. **4** by an arrowhead, and that the angle of rotation of shaft **4** is 360°. As a result, the roller **21** engages one of the recesses **6***a* in Geneva gear **6** and moves or pivots Geneva gear **6** a predetermined angle. Since spring-loading crankshaft **8** is fixedly mounted on the same shaft **7** as Geneva gear **6,** spring-loading crankshaft **8** is moved or pivoted the same angle as Geneva gear **6.** The pivotal movement of spring-loading crankshaft **8** causes it projections **81** and **82** to act upon lever **11,** pivoting the latter around shaft **7** in clockwise direction as shown in FIG. **3.** Since the lever **12** is maintained in position by the projections **91** and **92** of stepping crankshaft **9,** which in turn, is maintained in position on account of the fact that slide latch **16** is in engagement with one of the recesses **151** of gear segment **15,** the movement of lever **11** relative to lever **12** causes loading, or compression, of compression springs **13** and **14.** During the last phase of the pivotal motion of Geneva gear **6** and of spring-loading crankshaft **8** the projection **81** of the latter engages one end of lever **19,** thus compelling radial inward movement of slide latch or locking lever **16** against the bias of spring **17.** Consequently stepping crankshaft **9** is no longer fixedly held in position, but is operated by springs **13** and **14** by the intermediary of lever **12** acting upon axially extending projections or abutments **91, 92** which form integral parts of stepping crankshaft **9.** Thus stepping crankshaft **9** is caused to snap from the position shown in FIGS. **3** and **4** to the position shown in FIG. **5.** This snap motion is transmitted from stepping crankshaft **9** to driving shaft **10** upon which stepping crankshaft **9** is fixedly mounted. The driving shaft **10** operates the movable contacts of a switching device which has not been shown in the drawings. One operating step has been completed when the crank mechanism **4, 5** for operating the Geneva gear **6** has returned to its initial position, as shown in FIG. **5.**

It will be understood that the angular motion of the crankshaft mechanism **4, 5** for each step of driving shaft **10** does not necessarily have to be 360°. It will be further understood that in the embodiment of the invention shown the motion of shaft **4** per step of shaft **10** needs to be but 180° if crankshaft **4, 5** is provided with two arms angularly displaced 180° of which each has a Geneva-gear-engaging roller **21** at the radially outer end thereof.

The number of recesses in the Geneva gear **6** depends upon the snap action stepping operation which is desired. Considering the operation of a load change-over switch having but two limit positions, the number of recesses **6***a* in Geneva gear **6** would be reduced to **2.** In that particular instance the number of recesses **151** in gear segment **15** would likewise be reduced to **2.**

The operation of the structure of FIGS. **1** and **2** when the direction of rotation of crankshaft **4, 5** is reversed is substantially self-evident. In that instance projections or abutments **81, 82** engage lever **12** and pivot the latter in counterclockwise direction as seen in FIG. **4,** thus loading springs **13, 14** and while this happens lever **11** is restrained in position by projections or abutments **91, 92** of stepping crankshaft **9,** latch **16** and latching segment **15.** At the end of the travel of crankshaft **8** projection or abutment **82** thereof engages lever **92,** thus compelling radial inward movement of latch member **16,** thus allowing springs **13, 14** to expand and to step shaft **10** one step forward.

It will be apparent from the foregoing that the spring stepping mechanism embodying this invention is simpler, less expensive, and more compact than comparable prior art devices. The springs **13** and **14** are readily accessible, and the assembley of the structure is easy and requires little time. The accessibility of springs **12** and **13** is important because it makes it possible to replace these springs without disassembling the entire mechanism. The dual arrangement of projections **81** and **82** and of projections **91,92** minimize friction in the bearings of the structure. Since the Geneva gear **6** is arranged ahead of the spring motor means **13, 14** — seen in the direction from the driving shaft **4** to the driven shaft **10** — the distance between the driven contacts of a switch to be operated in discrete steps and that of the switch-operating springs is minimized with attendent increase of the efficiency of the drive. It should also be noted that the Geneva gear **6** is maintained in its various positions of rest by springs **13, 14,** i.e. there is no need for providing additional means for arresting Geneva gear **6** in its positions of rest.

I claim as my invention:

1. A spring-loaded snap-action stepping-switch-operating mechanism including

a. a pair of spring-supporting levers (**11, 12**) arranged cross-wise, pivotable about a common shaft and each having a pair of lever arms;

b. a pair of springs (**13,14**) each affixed with the ends thereof to one of (**13, 14**) pair of lever arms of each of said pair of spring-supporting levers (**11, 12**);

c. a pivotable spring-loading crankshaft (**8**) operable by a Geneva gear drive (**4, 5, 6**) and having axial extensions (**81, 82**) cooperating with one of said pair of spring-supporting levers (**11, 12**) for pivoting said one of said pair of spring-supporting levers to load said pair of springs (**13, 14**);

d. a pivotable stepping crankshaft (**9**) having axial extensions (**91, 92**) cooperating with the other of said pair of spring-supporting levers (**11, 12**) to cause said pair of springs (**13, 14**) when expanding to impart a pivotal motion to said stepping crankshaft;

e. a latch mechanism (**15, 16, 17, 19, 20**) for latching said stepping crankshaft (**9**) in position against the bias of said pair of springs (**11, 12**); and

f. means operable by said spring-winding crankshaft (8) for unlatching said latch mechanism (15, 16, 17, 19, 20) to allow said pair of springs to impart said pivotal motion to said stepping crankshaft (9).

2. A switch operating mechanism as specified in claim 1 wherein said latch mechanism (15, 16, 17, 19, 20) includes a radially outwardly spring-biased latch member (16) supported by said stepping crankshaft (9) and a gear segment (15) arranged in coaxial relation to said stepping crankshaft (9) and having recesses (151) engaged by the radially outer end of said latch member (16).

3. A switch-operating mechanism as specified in claim 1 wherein said Geneva gear drive (4, 5, 6) includes a shaft (7) supporting a Geneva gear (6) which shaft (7) further supports a crank arm jointly forming with said crank arm said spring-loading crankshaft (8).

4. A switch operating mechanism as specified in claim 1 wherein said spring-loading crankshaft (8) and said stepping crankshaft (9) are arranged in coaxial relation, and wherein said spring-loading crankshaft supports said Geneva gear (6) of said Geneva gear drive (4, 5, 6).

5. A switch-operating mechanism as specified in claim 1 wherein said spring-loading crankshaft (8) is arranged at a level above said pair of spring-supporting levers (11, 12) and above said pair of springs (13, 14), said stepping crankshaft (9) is arranged at a level below said pair of spring-supporting levers (11, 12) and below said pair of springs (13, 14) said spring-loading crankshaft being provided with axially downwardly extending projections (81, 82) forming abutments cooperating with one of said pair of spring-supporting levers (11, 12) for loading said pair of springs (13, 14), said stepping crankshaft (9) being provided with axially upwardly extending projections (91, 92) forming abutments cooperating with the other of said pair of spring-supporting levers (11, 12) for joint motion with said other of said pair of spring-supporting levers under the action of said pair of springs (13, 14).

6. A switch-operating mechanism a specified in claim 5 wherein said latch mechanism (15, 16, 17, 19, 20) is arranged in the path of travel of said downwardly extending projections (81, 82) of said spring-loading crankshaft (8) to cause unlatching thereof at the end of pivotal motions of said spring-loading crankshaft (8).

7. A switch-operating mechanism as specified in claim 6 wherein said latch mechanism (15, 16, 17, 19, 20) includes a pair of latch operating levers (19, 20) pivotally supported by said stepping crankshaft (9) and arranged in the paths of travel of said downwardly extending projections (81, 82) of said spring-loading crankshaft (8).

8. A switch-operating mechanism as specified in claim 1 including a housing (1, 2) for said pair of spring-supporting levers (11, 12) said pair of springs (13, 14) said spring-loading crankshaft (8) and said stepping crankshaft (9), said housing (1,2) forming bearings (1a, 2a) for said spring-loading crankshaft (8) and said stepping crankshaft (9) and having a lateral bracket forming a bearing (3) for an additional crankshaft (4, 5) operating a Geneva gear arranged outside and housing (1, 2) in coaxial relation to said spring-loading crankshaft (8) and said stepping crankshaft (9).

9. A spring-loaded snap-action stepping-switch-operating mechanism including

a. a pair of spring-supporting levers (11, 12) arranged crosswise, pivotable about a common shaft and each having a pair of lever arms;

b. a pair of compression springs (13, 14) each affixed with the ends thereof to one of said pair of lever arms of each of said pair of spring-supporting levers (11, 12)

c. a pair of pivotable crankshafts (8, 9) arranged in coaxial relation to said common shaft, the arms of each of said pair of crankshafts (8, 9) being arranged to opposite sides of said pair of spring-supporting levers (11, 12) and sandwiching said spring-supporting levers (11, 12) each of said arms of each of said pair of crankshafts (8, 9) having a pair of axially extending projections (81, 82; 91, 92) forming abutments for cooperatively engaging said pair of spring-supporting levers (11, 12);

d. a Geneva gear drive (4, 5, 6) for operating one of said pair of crankshafts including a Geneva gear (6) arranged in coaxial relation to said one of said pair of crankshafts (8, 9) and

e. a latch mechanism for maintaining the other of said pair of crankshafts (8, 9) in angularly displaced positions, said latch mechanism including a pair of latch operating levers (19, 20) pivotally supported by the arm of said other of said pair of crankshafts (8, 9), and each of said pair of latch-operating levers (19, 20) being arranged in the path of movement of one of said pair of axially extending projections (81, 82) of said one of said pair of crankshafts (8, 9).

10. A switch-operating mechanism as specified in claim 9 including a base plate (1) and a cover plate (2) forming bearings (1a, 2a) for said pair of crankshafts (8, 9) said Geneva gear (6) being arranged on the outside of said cover plate (2), and said cover plate forming a bearing (3) for an additional crank mechanism (4, 5, 21) engaging recesses (6a) in said Geneva gear (6) for driving said Geneva gear in discrete consecutive steps.

11. A switch-operating mechanism as specified in claim 9 wherein said latch mechanism includes a fixed gear segment (15) arranged in coaxial relation to said pair of crankshafts (8, 9) and having recesses (151) at the radially inner side thereof, a spring biased latch (16) slidably supported by said other of said pair of crankshafts 8, 9) and having a radially outer end for engaging said recesses (151) in said gear segment (15), and wherein each of said pair of latch operating levers (19, 20) has a pair of arms, one of said pair of arms being adapted to engage said latch to move said latch radially inwardly against said spring bias thereof and the other of said pair of arms of each of said pair of latch-operating levers (19, 20) being arranged in the path of movement of one of said axially extending projections (81, 82) of said one of said pair of crankshafts (8, 9).

12. A switch-operating mechanism as specified in claim 9 wherein said Geneva gear (6) is fixedly mounted on the shaft (7) of said one of said pair of crankshafts (8, 9) and wherein said shaft (7) further pivotally supports said pair of spring-supporting levers (11, 12).

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