Oct. 23, 1962 H. S. EADIE 3,059,497

DETENT

Filed March 9, 1960

Fig. 1.

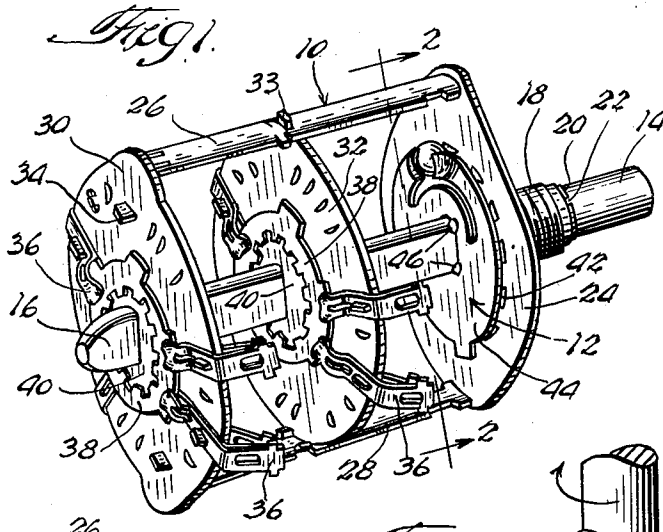


Fig. 2.

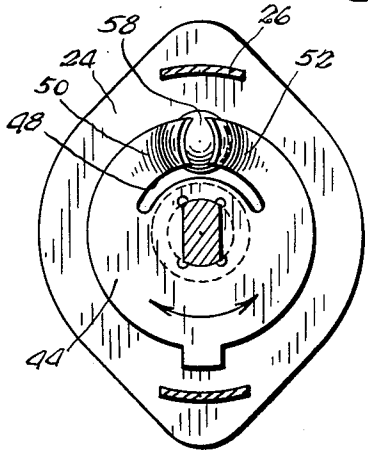


Fig. 3.

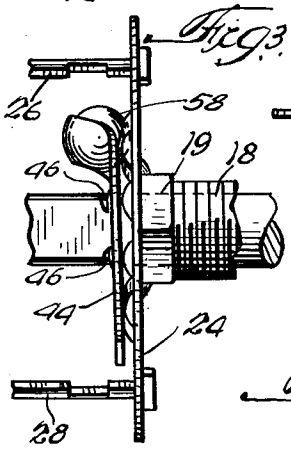


Fig. 7.

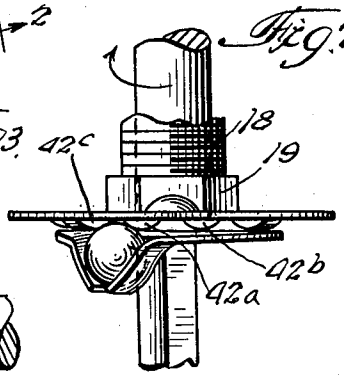


Fig. 6.

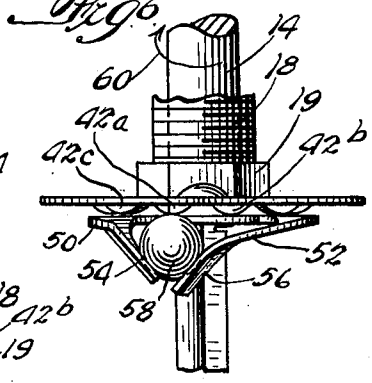


Fig. 4.

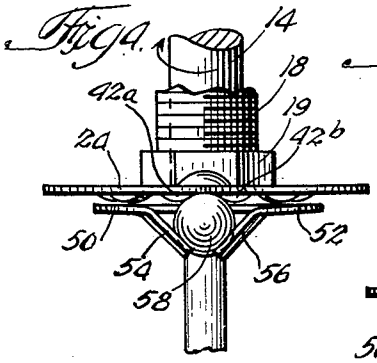
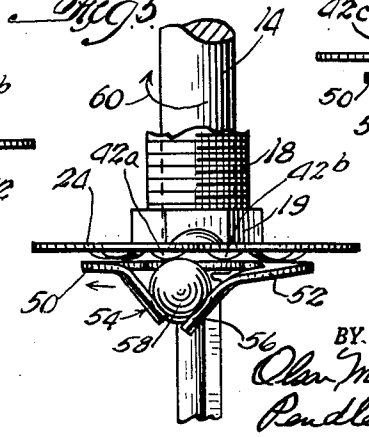


Fig. 5.



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DETENT

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12 Claims. (Cl. 74—527)

This invention relates to an improved detent and more particularly to an improved detent mechanism, the preferred embodiment of which is especially adapted for multiposition rotary electrical switches of the type generally found in electrical and electronic equipment such as radios and television receivers.

In electronic equipment it is extremely important that switches close positively and quickly to avoid arcing and burning of contacts, unnecessary noise in signal circuits and faulty transmission.

It has been common in the switch art to employ toggle switches and various overcenter devices to insure positive closure of contacts and quick action. The fundamental desideratum of all switch mechanisms is quick, positive closure in the nature of a snap action. While toggle switches attain this and are usually satisfactory for two-position control, rotary switches are usually employed where a plurality of switch positions or signal channels are desired. In typical rotary switches employed in electronic equipment there are twelve possible control positions which are defined by a detent mechanism. Depending upon the construction and orientation of the switch contacts, one or more of these switch positions may be inactive and unused.

Various means have been employed for locating a rotary switch portion in a plurality of predetermined positions relative to spaced fixed contacts. These have included various indentations cooperating with balls, rollers, lever arms and the like. However, none of the detent mechanisms heretofore known has proven wholly satisfactory in that they have not insured a snap action in the nature of a toggle or overcenter action and thus they have not uniformly provided quick and positive contact closure. They have usually been susceptible to quiescent or stable positioning at dead center between two contact positions. The more satisfactory detent mechanisms heretofore known have been quite costly and difficult to manufacture.

It is therefore one object of this invention to provide an improved detent which is extremely simple in construction but provides positive positioning of two relatively rotatable parts.

It is a further object of this invention to provide an improved detent mechanism for use with rotary electrical switches wherein the switch may be actuated positively and quickly to a predetermined plurality of contact positions.

Another object of this invention is the provision of a detent mechanism for a rotary electrical switch in which the rotary portion thereof will naturally seat in one of a plurality of predetermined positions and will be free of stable dead center orientation between the predetermined positions.

It is still another object of this invention to provide a detent for an electrical switch which is simple and inexpensive to construct and which is virtually free of maintenance problems.

Another object of this invention is the provision of an improved detent for rotary electrical switches which does not consume excessive space and is easily manufactured.

Further and additional objects of this invention will become manifest from a consideration of this description, the accompanying drawings and the appended claims.

In one form of this invention a detent mechanism is

provided on a wafer type rotary electrical switch in which the detent mechanism includes a plate transverse to the switch shaft and having a circular pattern of undulations formed thereon concentrically with the shaft. A spring web member is secured to the shaft spaced from the plate and the spring member has two arcuate cantilever arms with their free ends spaced apart and shaped to resiliently retain a ball therebetween and urge the ball against the circular pattern of undulations.

For a more complete understanding of this invention reference will now be made to the accompanying drawing wherein:

FIG. 1 is a perspective view of a wafer type electrical switch incorporating one embodiment of this invention;

FIG. 2 is a sectional view of the switch of FIG. 1, taken on line 2—2 thereof and illustrating the details of the detent mechanism;

FIG. 3 is a side view of a fragment of the switch mechanism of FIG. 1 showing the detent mechanism;

FIG. 4 is a top view of the detent mechanism with portions of the associated switch omitted;

FIG. 5 is similar to FIG. 4 showing the shaft of the switch partially rotated;

FIG. 6 is a view similar to FIGS. 4 and 5 showing the switch mechanism rotated substantially to the mid-point between two positions; and

FIG. 7 is a view of the detent mechanism substantially the same as FIGS. 4–6 showing the switch shaft fully rotated to the next contact position.

Referring now to the drawings and more particularly to FIG. 1, a wafer-type electrical switch **10** is illustrated utilizing a detent mechanism **12** constructed in accordance with this invention. The switch mechanism consists of a central rotatable shaft **14** having a flattened major portion **16**. The shaft **14** is supported in an externally threaded bearing **18** and is secured thereto by a small snap ring **20** which seats in a recess **22** formed in shaft **14**. Bearing **18** has a hexagonal portion **19** to facilitate attachment to control panels and the like. A plate **24** which forms a part of the switch mechanism also constitutes a portion of the detent mechanism **12**. The plate supports two elongate struts **26** and **28** which, in turn, support switch wafers **30** and **32**. The struts **26** and **28** are secured in plate **24** and in wafer **30** by any appropriate means. In the instant structure they are staked to plate **24** and retained in wafer **30** by twisting the free end portion **34**. While two wafers are here employed, it will be obvious that any number of wafers may be inserted merely by lengthening the shaft **14** and the struts **26** and **28**. Central wafer **32** has lugs **33** which are retained in appropriate apertures in the struts **26** and **28**.

Each wafer has a plurality of metallic contacts **36** secured thereto and the contacts **36** are in engagement with a metallic annulus **38** supported on an insulating disk **40**. Disks **40** are rotatably suported in their respective wafers and have a generally rectangular central aperture to receive the flattened portion **16** of shaft **14**. Thus rotation of shaft **14** produces corresponding rotation of annular bridging contacts **38** which completes circuits between preselected contacts **36**.

To positively locate the bridging contacts **38** with respect to the fixed contacts **36** the detent mechanism **12** is provided. Plate **24** has in the described embodiment twelve protuberances or undulations **42** which are uniformly spaced in a circular pattern concentrically with the shaft **14**. A spring web **44** is secured to the shaft **14** as by staked corners **46**. The web **44** is spaced from the plate **24** a predetermined small distance, as best illustrated in FIG. 3. The web **44** is provided with an arcuate aperture **48** and a radial severance whereby two resilient arcuate arms **50** and **52** are defined. The length of the arcu-

ate severance **48** obviously determines the rigidity or resilience of the arms **50** and **52**.

The free ends of arms **50** and **52** are formed outwardly at a substantial angle. Thus, as shown best in FIG. 4, the free end **54** of arm **50** extends outwardly away from plate **24** and forms an angle in the order of about 90° with the free end **56** of resilient arm **52**. A steel ball **58** is retained between free ends **54** and **56** whereby the free ends **54** and **56** are distorted slightly and urge the ball **58** against the plate **24**. Under the influence of free ends **54** and **56** the wall will seat between two adjacent protuberances or undulations **42***a* and **42***b* whereby the ball and, in turn, the web **50** and shaft **14** are positively oriented to a particular position of rotation with respect to bushing **18** and wafers **42**. The protuberances **42***a* and **42***b* are shaped as shown in FIG. 4 to define a high central portion with adjacent sloping sides about the circular pattern whereby centering of the ball **58** between the adjacent protuberances is encouraged and insured.

As clearly shown in the figures the free ends **54** and **56** are shaped about their longitudinal axes to form arcuate retainers for the ball **58** to prevent radial displacement of the ball and insure motion of the ball in the predetermined circular pattern.

Operation of the detent mechanism is clearly illustrated in FIGS. 5, 6 and 7. In FIG. 5 the shaft **14** has been rotated slightly in the clockwise direction indicated by arrows **60**. In the particular embodiment herein described there are twelve possible switch positions. Thus each position represents an angular displacement of substantially 30°. In FIG. 5 angular movement of approximately 10° has been imparted to shaft **14**. In so moving shaft **14**, it will be noted that web **50** which is secured to the shaft has also moved through the 10° angular displacement but in so doing the ball **58** has remained somewhat behind and has been displaced to an angle slightly less than 10°. This produces what may be termed a cocking action of the detent mechanism.

To permit relative displacement of web **50** and ball **58** free end **56** of arm **52** has been distorted outwardly while free end **54** of arm **50** has relaxed somewhat and has moved inwardly toward plate **24**. This cocking action of the free ends **54** and **56** as the ball **58** is delayed by the resistance of the protuberance **42***a* is an important aspect of the operation of the instant detent mechanism.

FIG. 6 illustrates an unstable transient condition of the detent mechanism where the shaft **14** has been rotated in the clockwise direction indicated by arrow **60** to a position somewhat in excess of 15° from the starting point whereby the mechanism other than the ball **58** has already passed the dead center between the two adjacent switch positions. However, because of the retarding effect of the protuberance **42***a* on ball **58** the ball is substantially at the dead center position. As is clear from the drawing under this condition the free end **54** of resilient arm **50** is substantially relaxed while the free end **56** of the resilient arm **52** is distorted and under substantial tension. Thus the force of resilient arm **52** against ball **58** will immediately cause the ball **58** to move toward its normal position with respect to the two free ends **54** and **56** and this will move the ball **58** beyond the dead center position on protuberance **42***a*.

Merely releasing the rotational pressure on shaft **14** will thus permit the ball to center between protuberance **42***a* and the next adjacent protuberance **42***c* whereby the shaft **14** will positively locate in the next switch position, as illustrated in FIG. 7. This switch position is displaced 30° from the switch position illustrated in FIG. 4. It will be obvious that the switch functions in precisely the same manner at each position and that a multiposition switch having the unusual properties of quick action and positive contact closure is thereby provided by this invention.

While one particular embodiment of the detent mechanism has been described in substantial detail, it will be immediately apparent to one skilled in the art that the detent may be incorporated in other mechanisms and may be varied by alterating the size and shape of the various components such as the ball, the shape of the protuberances, and the particular shape of the resilient arms and free ends thereof.

Without further elaboration, the foregoing will so fully explain the character of my invention that others may, by applying current knowledge, readily adapt the same for use under varying conditions of service, while retaining certain features which may properly be said to constitute the essential items of novelty involved, which items are intended to be defined and secured to me by the following claims.

I claim:

1. A detent comprising bearing means, shaft means rotatably mounted on said bearing means, locating means fixed with respect to one of said first two means, said locating means including a generally planar portion generally normal to the axis of said shaft means and protuberant portions radially spaced from said shaft means and extending outwardly from the plane of said planar portion, two opposed resilient arm means having free ends spaced apart circumferentially to define a space, said resilient arms being fixed to the other of said first two means and radially disposed therefrom with the free ends thereof in predetermined spaced relationship with respect to said planar portion and said protuberances, and a rotatable member retained in said space between the free ends of said arm means and said protuberant portions, said arm means being individually yieldable in response to rotation of said shaft means in said bearing means.

2. A detent comprising bearing means, shaft means rotatably mounted on said bearing means, locating means fixed with respect to said bearing means, said locating means including a generally planar portion generally normal to the axis of said shaft means and protuberant portions radially spaced from said shaft means and extending outwardly from the plane of said planar portion in a generally circular configuration, two opposed resilient arm means having free ends spaced apart circumferentially to define a space, said resilient arms being fixed to the other of said first two means rotatable with said shaft means and radially disposed therefrom with the free ends thereof in predetermined spaced relationship in said space, and a rotatable ball member retained between the free ends of said arm means and said protuberant portions, said arm means being individually yieldable in response to rotation of said shaft means in said bearing means.

3. A detent comprising bearing means, shaft means rotatably mounted on said bearing means, a plate secured to and extending radially outward from said bearing means, said plate having means defining undulations generally circularly disposed and concentric with said shaft means, a web secured to said shaft means in spaced relationship with respect to said plate, two opposed resilient members extending from said web and having free resilient ends in circumferentially spaced relationship to define a space between said free ends and said plate, and a rotatable member retained in said space between said two free ends and said means defining undulations, said resilient members being individually yieldable in response to rotation of said shaft means in said bearing means.

4. A detent comprising bearing means, shaft means rotatably mounted on said bearing means, a plate secured to and extending radially outward from said bearing means, said plate having means defining undulations generally circularly disposed and concentric with said shaft means, a web secured to said shaft means in spaced relationship with respect to said plate, two resilient members extending from said web and having free resilient ends in circumferentially spaced relationship to define a space between said free ends and said plate, and a rotatable ball member retained in said space between said two free ends and said means defining undulations, said members being

individually yieldable in response to rotation of said shaft means in said bearing means.

5. A detent comprising bearing means, shaft means rotatably mounted on said bearing means, a plate secured to and extending radially outward from one of said first two means, said plate having means defining undulations generally circularly disposed and concentric with said shaft means, a web secured to the other of said two means in spaced relationship with respect to said plate, two resilient members extending from said web and having free resilient ends in circumferentially spaced relationship to define a space between said free ends and said plate, said free ends overlying said circularly disposed undulations and being circumferentially spaced, and a rotatable ball member retained in said space between said two free ends and said means defining undulations, said resilient members being individually yieldable in response to rotation of said shaft means in said bearing means.

6. A detent comprising bearing means, shaft means rotatably mounted on said bearing means, a plate secured to and extending radially outward from said bearing means, said plate having means defining undulations generally circularly disposed and concentric with said shaft means, a web secured to said shaft means in spaced relationship with respect to said plate, two resilient members extending from said web and having free resilient ends in circumferentially spaced relationship to define a space between said free ends and said plate, said free ends overlying said circularly disposed undulations and being circumferentially spaced, and a rotatable ball member retained in said space between said two free ends and said means defining undulations, said free ends being arcuately formed to entrap said ball member against said undulations, said resilient members being individually yieldable in response to rotation of said shaft means in said bearing means.

7. A detent for resiliently maintaining a shaft element in one of a predetermined plurality of positions of rotation relative to a supporting bearing element comprising locating means fixed with respect to one of said elements, said locating means including a generally planar portion generally normal to the axis of said shaft element and protuberant portions radially spaced from said shaft element and extending outwardly from the plane of said generally planar portion, two resilient arm means fixed to the other of said elements and radially disposed therefrom with the free ends thereof in predetermined circumferentially spaced relationship to define a space between said free ends and said locating means, and a rotatable member retained in said space between the free ends of said arm means and said protuberant portions, said arm means being individually yieldable in response to rotation of said shaft element in said bearing means.

8. A detent for resiliently maintaining a shaft in one of a predetermined plurality of positions of rotation relative to a supporting bearing means comprising locating means fixed with respect to said bearing means, said locating means including a generally planar portion generally normal to the axis of said shaft and protuberant portions radially spaced from said shaft and extending outwardly from the plane of said generally planar portion, two resilient arm means rotatable with said shaft and extending radially therefrom, the end portions thereof being arcuate and overlying said protuberant portions, the free ends of said end portions being circumferentially juxtaposed and angularly disposed with respect to said plane to define a space between said free ends and said locating means, a rotatable ball member being resiliently retained in said space between said end portions and urged against said protuberant portions, said arm means being individually yieldable in response to rotation of said shaft in said bearing means.

9. A detent for resiliently maintaining a shaft in one of a predetermined plurality of positions of rotation relative to a supporting bearing means comprising locating means fixed with respect to said bearing means, said locating means including a generally planar portion generally normal to the axis of said shaft and protuberant portions radially spaced from said shaft and extending outwardly from the plane of said generally planar portion, said protuberant portions being generally uniformly spaced and circularly disposed concentrically with said shaft, each of said protuberant portions having sloping side walls extending circumferentially from said plane, two resilient arm means rotatable with said shaft and extending radially therefrom, the end portions thereof being arcuate and overlying said protuberant portions, the free ends of said end portions being circumferentially juxtaposed and angularly disposed with respect to said plane to define a space between said free ends and said locating means, a rotatable ball member being resiliently retained in said space between said end portions and urged against said protuberant portions, said arm means being individually yieldable in response to rotation of said shaft in said bearing means.

10. A detent for resiliently maintaining a shaft in one of a predetermined plurality of positions of rotation relative to a supporting bearing means comprising locating means fixed with respect to said bearing means, said locating means including a generally planar portion generally normal to the axis of said shaft and protuberant portions radially spaced from said shaft and extending outwardly from the plane of said generally planar portion, said protuberant portions being generally uniformly spaced and circularly disposed concentrically with said shaft, each of said protuberant portions having sloping side walls extending circumferentially from said plane, two resilient arm means rotatable with said shaft and extending radially therefrom, the end portions thereof being arcuate and overlying said protuberant portions, the free ends of said end portions being circumferentially juxtaposed and angularly disposed with respect to said plane to define a space between said free ends and said locating means, each of said end portions having an arcuate cross section, a rotatable ball member being resiliently retained in said space between said end portions and urged against said protuberant portions, said arm means being individually yieldable in response to rotation of said shaft in said bearing means.

11. A detent for resiliently maintaining a shaft in one of a predetermined plurality of positions of rotation relative to a supporting bearing means comprising a plate fixed relative to said bearing means and generally normal to the axis of said shaft, said plate having a circular pattern of protuberances thereon radially spaced from and concentric with said shaft, a generally circular resilient means secured to said shaft in spaced relationship to said plate, said resilient means having an arcuate severance intermediate said shaft and the periphery of said resilient means, and a radial severance between said arcuate severance and said periphery whereby two resilient arms are formed, the free ends of said arms being angularly disposed outwardly from said plate to define a space between said free ends and said plate, and a rotatable ball member being resiliently retained in said space between said free ends and urged against said protuberances thereby, said arms being individually yieldable in response to rotation of said shaft in said bearing means.

12. A detent for resiliently maintaining a shaft in one of a predetermined plurality of positions of rotation relative to a supporting bearing means comprising a plate fixed relative to said bearing means and generally normal to the axis of said shaft, said plate having a circular pattern of protuberances thereon radially spaced from and concentric with said shaft, a generally circular resilient means secured to said shaft in spaced relationship to said plate, said resilient means having an arcuate severance intermediate said shaft and the periphery of said resilient

means, and a radial severance between said arcuate severance and said periphery whereby two resilient arms are formed, the free ends of said arms being angularly disposed outwardly from said plate and having an arcuate cross section to define a space between said free ends and said plate, and a rotatable ball member being resiliently retained in said space between said free ends, said arms being individually yieldable in response to rotation of said shaft in said bearing means and urged against said protuberances thereby, radial displacement of said ball member being prevented by the arcuate shape of said free ends.

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