Aug. 9, 1955 T. J. HAVILAND 2,715,163

HIGH SPEED SAMPLING SWITCH

Filed Aug. 25, 1952 3 Sheets-Sheet 1

FIG. 2

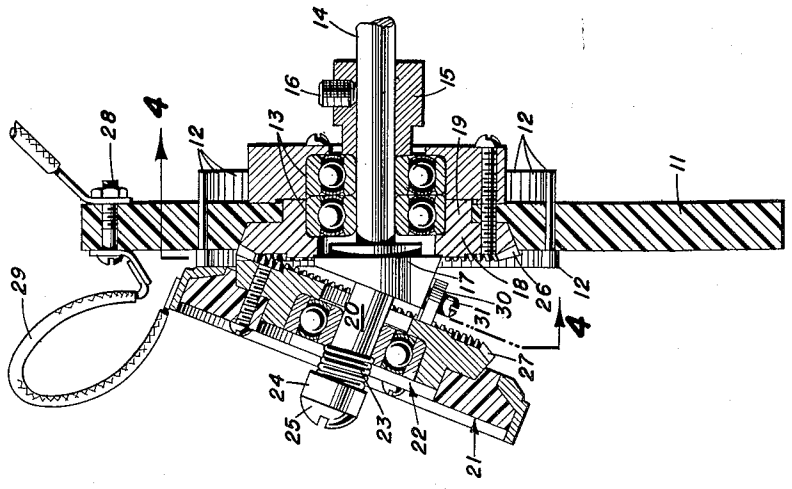


FIG. 1

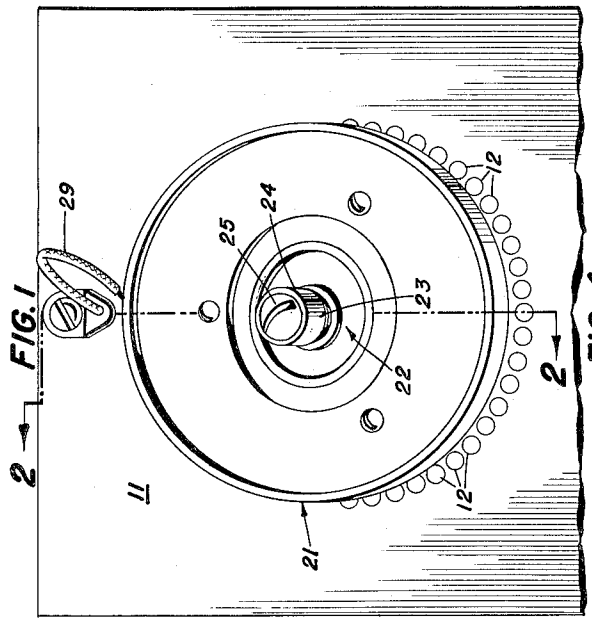
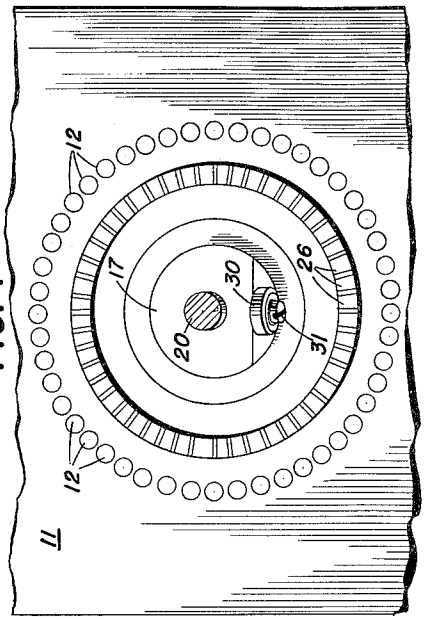


FIG. 4



INVENTOR
THOMAS J. HAVILAND

BY Q. D. O'Brien
Q. Baxter Warner
ATTORNEYS

Aug. 9, 1955 T. J. HAVILAND 2,715,163

HIGH SPEED SAMPLING SWITCH

Filed Aug. 25, 1952 3 Sheets-Sheet 2

FIG. 5

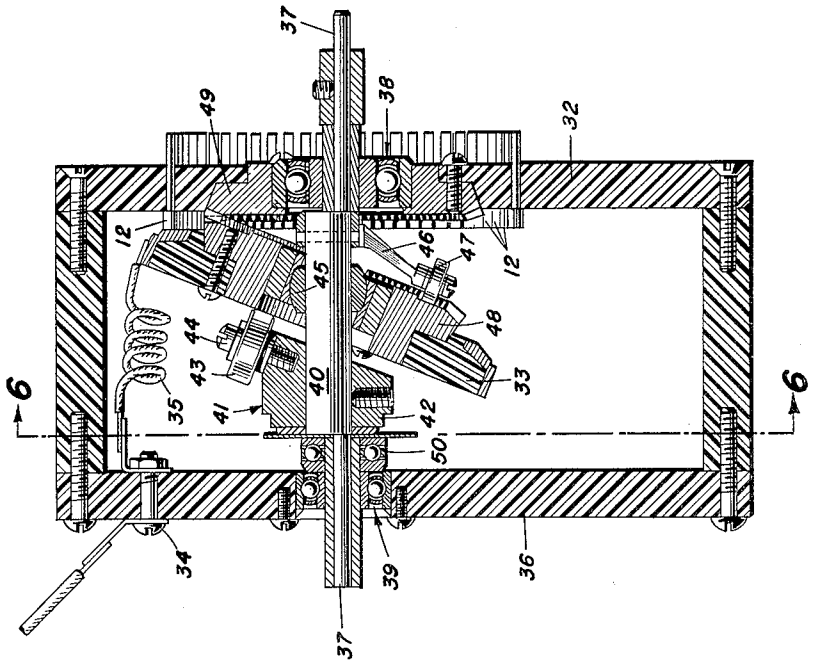
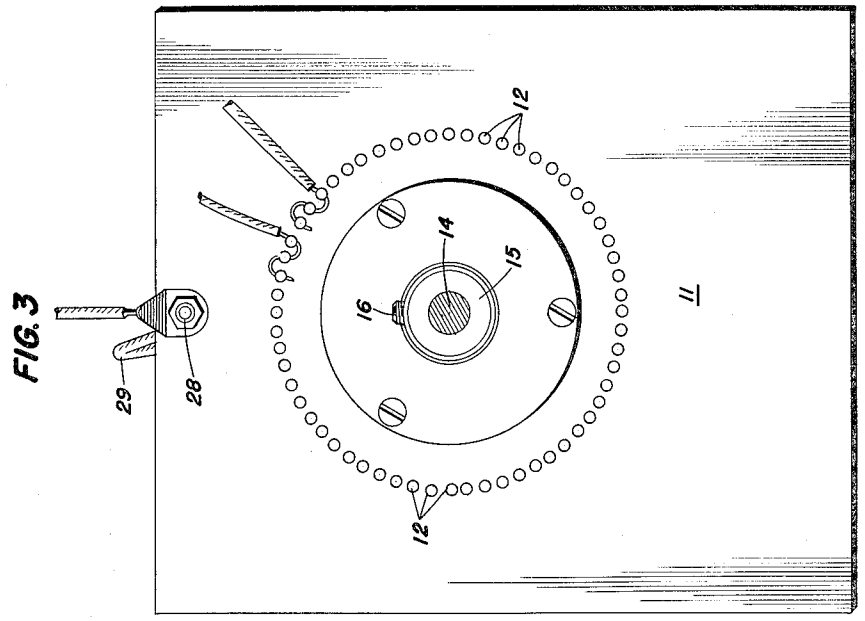


FIG. 3



INVENTOR
THOMAS J. HAVILAND

BY

ATTORNEYS

Aug. 9, 1955 T. J. HAVILAND 2,715,163

HIGH SPEED SAMPLING SWITCH

Filed Aug. 25, 1952 3 Sheets-Sheet 3

FIG. 7

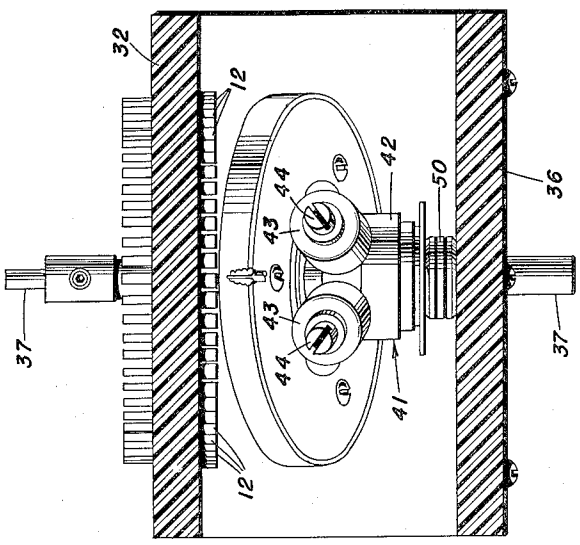
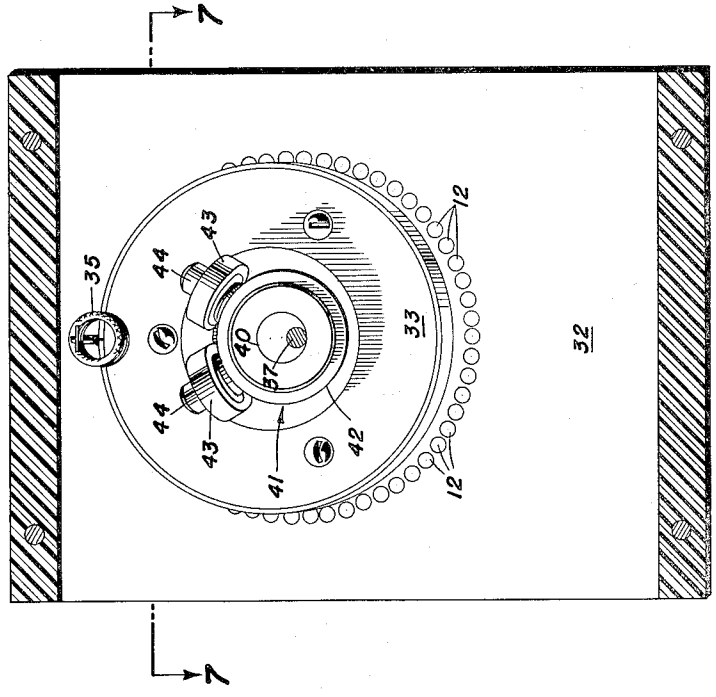


FIG. 6



INVENTOR
THOMAS J. HAVILAND

BY G. D. O'Brien
Q. Baxter Warren
ATTORNEYS

United States Patent Office 2,715,163 Patented Aug. 9, 1955

2,715,163

HIGH SPEED SAMPLING SWITCH

Thomas J. Haviland, Brookville, Md., assignor to the United States of America as represented by the Secretary of the Navy

Application August 25, 1952, Serial No. 306,165

1 Claim. (Cl. 200—27)

This invention relates generally to electrical switching arrangements, and more particularly to a high speed sampling switch of the multiple contact type whose contacts may be closed in succession for brief intervals to establish individual connections to a corresponding number of signal sources, as in share-the-time telemetry.

The underlying principle of this invention is that a plurality of stationary contacts are arranged in a circle and a single movable contact cooperates therewith. This movable contact comprises a disk-like conducting member which is mounted to engage only a single one of the stationary contacts at a time, which is accomplished by giving the disk a nutating motion.

It is an object of the invention to provide a high speed sampling switch whose contacts may be closed in succession for brief intervals to establish electrical connections to a corresponding number of signal sources, such as used in telemetering information from a guided missile or vehicle.

Still another object of the invention is to provide a high speed switch for successively closing and reopening a large number of electrical circuits.

Another object of the invention is to provide a high speed sampling switch arrangement that is simple in operation, compact, and efficient and reliable in operation.

Others objects and many of the attendant advantages of this invention will be appreciated readily 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 a front elevation of one embodiment of the invention;

Fig. 2 is a section in the plane 2—2 of Fig. 1;

Fig. 3 is a rear elevation;

Fig. 4 is a section mainly in plane 4—4 of Fig. 2;

Fig. 5 is a section, axial with respect to the shaft, of another embodiment of the invention;

Fig. 6 is a section in the plane 6—6 of Fig. 5; and

Fig. 7 is a section in the plane 7—7 of Fig. 6.

According to the invention, a high speed sampling switch is provided for use, in particular, with guided missile telemetry, although it is not to be limited thereto since it can be used in most applications requiring high speed switching. More specifically, the invention generally comprises a switch including an insulating base having a plurality of contacts arranged in a spaced annular series on the base. A shaft is rotatably mounted on the base axially of the contacts. The shaft has an end portion disposed to its axis. This end portion has mounted thereon a switch element that includes a disk having an edge selectively engageable with the contacts. When the shaft is rotated by suitable means, the switch element is caused to nutate. Gears are also provided on the base and on the switch element and are arranged to cooperate in order to prevent the switch element from rotating with the shaft.

Referring first to the embodiment shown in Figs. 1 through 4, a number of fixed contacts 12 are mounted in a circle on a suitable insulating base 11. A bore is provided in base 11 at the center of the circle to receive the ball bearings 13 which serve to mount a shaft 14 for free rotation.

Shaft 14 carries a collar 15 secured by a set screw 16, abutting the rear face of bearing 13, and an angle fitting 17 at the front, engaging the forward surface 18 of a metallic insert 19, so that thus the shaft 14 is held against end play. The angle fitting 17 has its rear surface normal to the shaft 14, but its front surface at an angle thereto as shown, and a second shaft 20 extends normal to said front surface. Thus, as shaft 14 turns about its axis, the axis of shaft 20 describes a conical surface.

A movable contact element 21 which is shaped as a disk, is mounted on shaft 20 by means of a ball bearing 22, so that as shaft 14 turns, the element 21 is nutated. A spring 23 held against the inner race of bearing 22 by a collar 24 and a screw 25 carried by shaft 20, holds the edge of element 21 against the respective contacts 12 as this nutation takes place.

In order to prevent the disk 21 from rotating with the shaft 14, a set of intermeshing teeth is provided, teeth 26 being carried by the stationary insert 19 while teeth 27 are provided on the nutating portion. Thus teeth 26 and teeth 27 may conveniently be provided by using two similar bevel gears. If these gears have the same number of teeth, no rotation of disk 21 can take place, and the motion of the disk is thus restricted to pure nutation.

In operation, this nutation will cause the rear or inner edge portion of disk 21 to make electrical contact in succession with the stationary contacts 12, and thus establish connection of said contacts 12 with a single common output terminal 28 which is connected to the disk 21 by a flexible conductor 29. Thus, as shaft 14 rotates the successive contacts are made periodically and always in the same order and for equal time intervals. While it is not always necessary, an additional bearing 30 may be held to the angle fitting 17 by a screw 31, as shown, to bear against the rear face of disk 21 to assist in keeping proper alinement of the disk 21 and to further decrease the friction during operation.

Referring now to Figs. 5, 6 and 7, which illustrate the second embodiment of the invention, the structure has a general similarity to that just described but differs in certain details.

Here the stationary contacts 12 are carried as before in an insulating panel 32 and their ends are traversed successively by the edge portion of a nutating disk 33, whereby they are connected in turn to a single output terminal 34 which is electrically connected to the disk 33 by a flexible conductor 35.

In this embodiment two panels, 32 and 36 support the shaft 37 for rotation, with suitable ball bearings 38 and 39, as shown. The shaft 37 has an eccentric portion 40 which thus constitutes a crank. The portion 40 has a cam 41 secured thereto, consisting of an angle block 42 and two rollers 43, 43, which may conveniently comprise ball bearings, held to block 42 by screws 44. The outer races of these rollers 43 engage the outer surface of disk 33, so that as the shaft 37 turns, the rollers 43 force the disk 33 to nutate about a central spherical bearing 45 within the disk 33.

The offset portion 40 also carries an arm 46 with a roller 47 mounted in its outer end, the roller being in engagement with the inner surface of the bevel gear 48 carried by the disk. The teeth of this gear 48 engage the teeth of its duplicate companion bevel gear 49 mounted stationarily in panel 32, so that the motion of the disk 33 is restricted to pure nutation, just as is the disk 21 of the first embodiment. An additional bearing 50 may be desirable in order to take up the thrust.

Upon rotation of shaft 37, the crank portion 40 thereof will rotate the spherical bearing 45 as well as the

ball bearings **43** and **47** which engage the disk **33** and will cause it to nutate, thereby successively closing the circuits of the circle of contacts **12**.

With either embodiment, as many contacts **12** may be provided as are required to control the existing circuits, and each circuit will be completed and broken once for each turn of the shaft. When used with a share-the-time telemetric system this switch can thus control the operation of any reasonable number of separate channels.

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

What is claimed is:

An electrical switch comprising, a first panel, a plurality of spaced annularly arranged contacts mounted on said first panel, a second panel spaced from said first panel and cooperating therewith to define a housing, a shaft having an eccentric intermediate portion in the housing, a spherical bearing mounted on said eccentric

portion, a switch element including a disk having a conductive rim mounted thereon and electrically insulated therefrom, said rim being selectively engageable with said contacts, said disk being mounted for nutating motion upon said spherical bearing, an arm fixed on said eccentric portion of said shaft between said disk and said first panel, a first roller mounted on said arm and bearing on said disk, an angle block fixed to said eccentric portion adjacent said second panel, a pair of rollers mounted on said angle block and bearing on said disk, a first annular gear mounted on said first panel, and a second annular gear mounted on said disk and meshing with said first gear to prevent rotation of said disk.

References Cited in the file of this patent

UNITED STATES PATENTS

947,736	Martin	Jan. 25, 1910
2,478,929	Lochman	Aug. 16, 1949

FOREIGN PATENTS

448,604	Germany	Aug. 27, 1927