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LIMIT SWITCH

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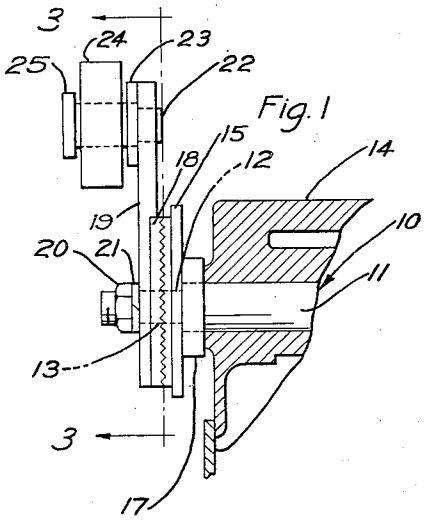

Fig. 1

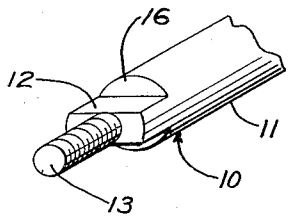

Fig. 2

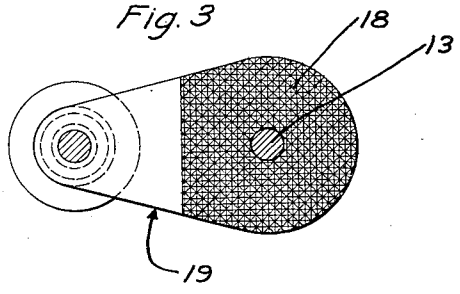

Fig. 3

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LIMIT SWITCH

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3 Claims. (Cl. 287—52.02)

1

This invention relates to operating levers for various types of equipment and is more particularly concerned with levers that are required to operate in magnetic fields.

It is often desirable to provide operating arms for limit switches or the like that are mounted on movable equipment in such a way that, upon predetermined movement of such equipment, the operating arm will engage a fixed surface and will be displaced thereby to bring about the rotation of a shaft or the like in order to set a switch to some predetermined desired position. In such apparatus, the switch operating arm is attached to an operating shaft and is held thereby in some predetermined angular position. The operating arm is moved from this predetermined position upon engagement of the switch arm with a fixed surface located in the path of movement of the equipment. The predetermined or equilibrium position of the switch arm is usually maintained by a spring or the like acting on the operating shaft. The angular position of the operating arm relative to the shaft is usually adjustable so that the switch arm can be used in different installations without structural modification. To this end, it is customary to knurl a portion of the surface of the switch arm or lever that is adjacent the axis of rotation thereof. Means are provided to press this surface against the knurled surface of a disc that is keyed to the shaft that is to be operated by the lever. It can be seen that with this mode of attachment, any desired angular disposition of the lever can be effected by temporarily loosening the pressing means, relatively rotating the knurled surfaces until the desired angular position of the arm is obtained and thereafter tightening the pressing means to press again the knurled surfaces into driving engagement.

Where operating arms of the foregoing type are required to function in a magnetic field, the maintenance of the equilibrium position of the operating arm until the desired engagement between said arm and the fixed surface occurs is much more difficult of attainment. This is because the magnetic field, acting on the lever, exerts a torque that unbalances the equilibrium of the lever and causes premature movement thereof away from the desired predetermined position. While it is apparent that the foregoing difficulty can be overcome by making the lever or arm of some non-magnetic material, the resulting construction is unsatisfactory due to the fact that non-magnetic materials are not susceptible of knurling in any inexpensive or commercially feasible manner.

It is therefore an object of this invention to provide a switch arm or operating lever that is not responsive to magnetic fields and yet is provided with a surface adjacent the axis of rotation that is easily knurled so as to render the angular position of the arm readily adjustable.

2

Other objects and advantages of this invention will be apparent upon consideration of the following detailed description of a preferred embodiment thereof in conjunction with the annexed drawing in which:

Figure 1 is a view partially in elevation and partially in vertical section of a switch arm showing the switch actuating shaft;

Figure 2 is a perspective view of the switch actuating shaft of Figure 1; and

Figure 3 is a view taken along the line 3—3 of Figure 1.

Referring to the drawings with greater particularity, a switch operating shaft 10 comprised of a cylindrical shank portion 11, an intermediate portion 12 of generally rectangular cross section, and an externally threaded end portion 13 is connected by any conventional means to a switch, not shown, so that upon angular displacement of the shaft 10 the switch is biased to a desired position. The cylindrical portion 11 of the shaft 10 is mounted for rotation in a housing 14 with a portion thereof as well as the portions 12 and 13 projecting in the manner shown in Figure 1. Fitting over the portion 12 of generally rectangular cross section is a coupling disc 15 having one knurled face and one smooth face. The disc 15 is provided with a central aperture conforming in outline to the portion 12 of the shaft 10. Thus, the disc 15, when mounted as shown in Figure 1, has a portion of its smooth face abutting the shoulder 16 defined by the end of portion 11 of the shaft 10 and is non-rotatably mounted on said shaft. The remainder of the smooth face of the disc 15 rests against the surface of a plain washer 17 disposed on the portion 11 of the shaft 10 between the disc 15 and the housing 14. The washer 17 is provided with a round central aperture adapted to fit with clearance over the cylindrical portion 11 of the shaft 10.

Bearing against the knurled face of the disc 15 is the knurled portion 18 of a switch arm 19. The switch arm 19 is provided with an aperture so that it may be mounted for angular displacement about the end portion 13 of the shaft 10. To establish a driving connection between the switch arm 19 and the shaft 10, the former is placed in the Figure 1 position with its knurled portion 18 facing the knurled portion of the disc 15. The knurled portion 18 is held in driving engagement with the corresponding portion of the disc 15 by a nut 20 that is threaded over the end portion 13 of the shaft 10 and drawn against a lock washer 21 which, in turn, bears against switch arm 19.

At the end of the switch arm 19 remote from the connection to shaft 10, a stud 22 projects

therefrom in a direction extending away from the housing 14. This stud is provided with an end flange 25 and a washer 23 between which a cylindrical roller 24 is mounted for free rotation.

It can now be seen that the device of Figure 1 may be used as an operator for a limit switch, mounted on movable apparatus and that after predetermined movement of such apparatus the switch arm roller 24 may engage some stationary part in the path of movement in order to cause the switch arm to move from one angular position to another thereby to cause a change in the condition of some circuit that is to be controlled.

It is to be understood that the shaft 10 is normally held in one predetermined position by spring means or the like of conventional design and that it is displaced from this position by movement of the switch arm 19. The arm 19 and the shaft 10 are keyed together by the engagement of the knurled portion 18 of the arm 19 with the knurled portion of the disc 15 which in turn is mounted for rotation with shaft 10. This being the case, it is apparent that the angular disposition of the arm 19 with respect to the shaft 10 can be easily adjusted by merely loosening the nut 20 and disengaging the knurled portions of the switch arm 19 and the disc 15. The switch arm 19 is then rotated to the desired position and the nut 20 is again tightened.

A switch arm of the foregoing type when used under ordinary conditions may be made in a single piece of magnetic material such as iron or steel. It has been found, however, that such switch arms, when used in a strong magnetic field, are biased by the action of the field so that the predetermined position is not maintained until the roller 24 contacts some element that is supposed to cause the switch arm to move to a different position. Furthermore, the non-magnetic materials may not be used because they cannot be provided with a satisfactory knurled portion at 18.

It has been discovered, as a part of this invention, that the foregoing difficulties may be overcome by making switch arm 19 of non-magnetic material except for knurled inserted portion 18. The knurled portion 18 is made in the form of a generally circular insert as shown in Fig. 3 and fitting in a recess of complementary configuration provided in the arm 19. The portion 18 of magnetic material is brazed in position and provided with a knurled surface. This construction is very advantageous in that the magnetic material of which the portion 18 is made may be readily knurled, but because it surrounds the portion 13 of the shaft 10, there is little or no tendency for a magnetic field to cause the switch arm to move in an angular sense about the axis of the shaft 10. This is true because an approximately equal portion of magnetic material is disposed in all radial directions from the center of the end portion 13 of the shaft 10. Thus, there is no moment tending to cause rotation incident to exposure for operation in magnetic fields, the entire arm being maintained in equilibrium until displaced by engagement with some fixed element in the path of movement of the apparatus on which the arm and assembly is mounted.

It will be understood that the foregoing general description is exemplary and explanatory of the invention, but that the invention in its broader aspects is not limited to operating arms for switches but may comprise operating levers for other types of apparatus.

What is claimed is:

1. Operating means comprising a rotatable shaft, an arm for effecting angular displacement of said shaft, said arm being of non-magnetic material, and means connecting said arm to said shaft, and means including an insert of magnetic material affixed to said arm and substantially uniformly distributed about the axis of said shaft and means secured to said rotatable shaft and cooperating with said insert to establish a driving connection between said arm and said shaft.

2. Operating means comprising a rotatable shaft, an arm of non-magnetic material for effecting angular displacement of said shaft, and means connecting said arm to said shaft, said means comprising a disk keyed to said shaft, an insert attached to said arm, means for pressing a surface of said insert against a surface of said disk to establish connection between the shaft and the arm, said insert being of magnetic material and being substantially uniformly distributed about the axis of rotation of said shaft whereby the arm retains its equilibrium in a magnetic field.

3. Operating means comprising a rotatable shaft, an arm of non-magnetic material for effecting angular displacement of said shaft, said arm being mounted on an end of said shaft, and means adjustably connecting said arm to said shaft, said means comprising a disk keyed to said shaft, said disk having a knurled surface, an insert permanently secured to said arm, said insert having a knurled surface arranged to contact the knurled surface of said disk, and means for pressing a surface of said insert against a surface of said disk to establish a driving connection between the shaft and the arm, said insert being of magnetic material and being substantially uniformly distributed about the axis of rotation of said shaft whereby the arm retains its equilibrium in a magnetic field.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
967,508	Fortas et al.	Aug. 16, 1910
1,088,247	Thompson	Feb. 24, 1914
1,929,708	Morris	Oct. 10, 1933

FOREIGN PATENTS

Number	Country	Date
214,122	Switzerland	July 1, 1941