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RELATIVELY ROTATING ELECTRICAL CONTACT WITH MERCURY-TYPE CONTACT

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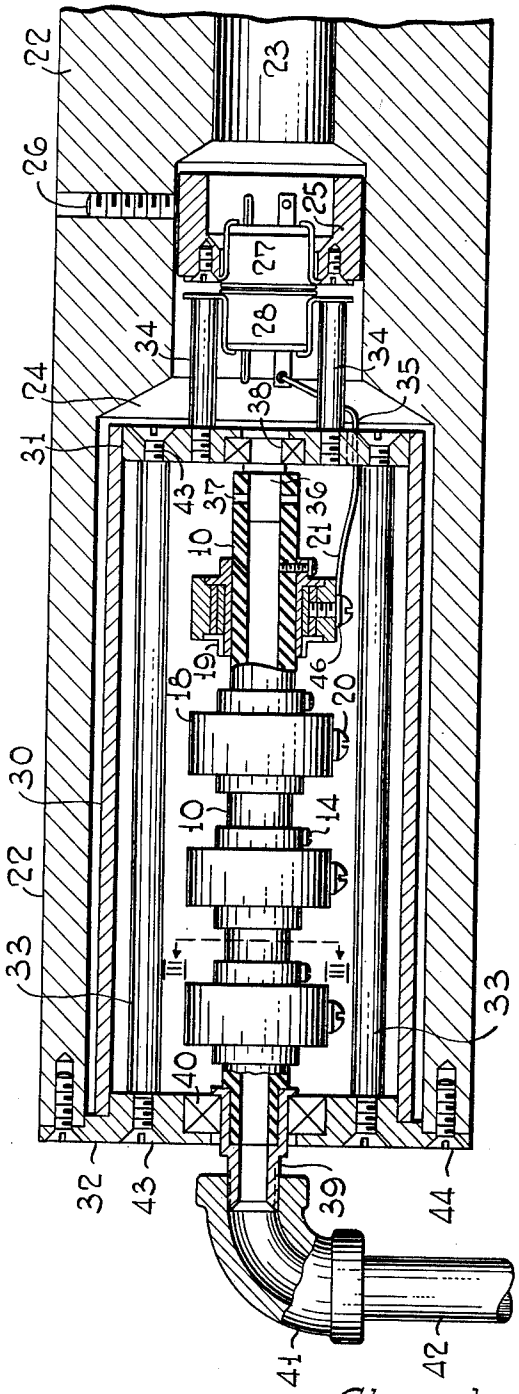


Fig. 2

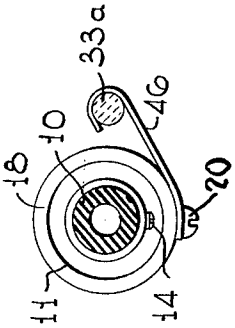


Fig. 3

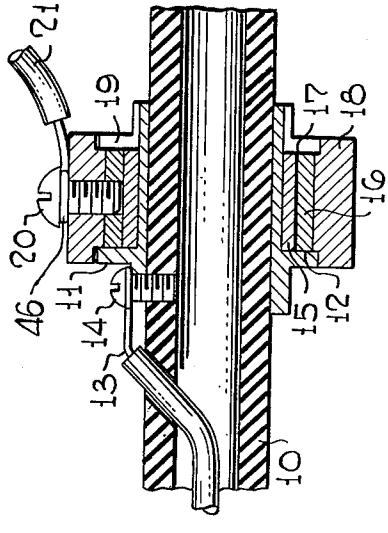


Fig. 1

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RELATIVELY ROTATING ELECTRICAL CONTACT WITH MERCURY-TYPE CONTACT

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2 Claims. (Cl. 339—5)

The present invention relates to an improved type of contact for supplying electrical current to relatively rotating elements. More particularly the invention relates to moving mercury-type contacts for transferring currents, the contacts being particularly designed for exclusion of air and moisture to ensure long life and consistently good electrical contact.

In the logging of oil well bore holes wherein useful information is sent to the surface through a single or multiple conductor cable while the latter is being reeled in or paid out from a cable reel to raise or lower the logging instrument in the bore hole it is, of course, necessary to provide for electrical contact between moving and stationary conductors. Ordinary slip rings and sliding contacts are not usually satisfactory for this purpose because the contact resistance tends to vary considerably and thus to obscure the desired electrical signals. To obviate this difficulty liquid connections have often been employed, for example those embodying a fixed cup of mercury into which a rotating contact is immersed. Connectors of this type have not been entirely satisfactory, however, because of the tendency of the mercury to oxidize, particularly as a result of the agitation of the mercury which naturally occurs in such a system. Similar oxidation troubles have occurred with films of mercury placed between relatively moving contacts. Hence, there has been need for a trouble-free movable electrical contact for transferring electrical currents between rotating and non-rotating elements.

It is an object of the present invention to provide an improved device for making electrical contact between relatively moving elements which is capable of handling even small currents without impairment of the current carrying capacity over long periods of use.

Another object of the invention is to provide a substantially noise-free rotating electrical contact of the type in which a film of mercury amalgam is maintained between relatively rotating elements and in which minimum contact of the mercury film with air and moisture is ensured to promote long service life.

The nature and objects of this invention will be more clearly ascertained from the ensuing description and from the accompanying drawings in which:

Fig. 1 is an enlarged sectional view of a typical contact unit embodying the present invention;

Fig. 2 is a side elevational view, partly in section, of an assembly of contacts embodying the present invention, particularly adapted for use on a well logging cable reel;

Fig. 3 is a sectional view taken along line III—III of Fig. 2.

With particular reference to Fig. 1 the elements of the contact unit which rotate relative to each other comprise bushing **15** and contact ring **16** between which is carried a film of mercury amalgam **17**. In the preferred embodiment of the invention the bushing and ring are made of copper or other metal which readily forms an amalgam with mercury and the surface of each of these elements that contacts the film of mercury is subjected to a special amalgamating treatment that will be described more fully hereinafter. Bushing **15** is supported by a sleeve **11** and ring **16** is carried by a ring holder **18** and held in place with a screw **20**. The various elements of the rotating assembly are held in proper position by retaining ring **19** which fits tightly onto sleeve **11**. Annular space **12** created between contact ring **16** and sleeve **11** and retainer **19** is made as narrow as possible, i. e. of the order of 0.002 to 0.003", thus providing essentially no more than

sufficient clearance to permit relative rotation between the moving parts, in order that access of amalgam film **17** to air will be kept at a minimum. Furthermore sleeve **11** and retainer **19** are preferably made of stainless steel or of other metal that is highly resistant to wetting by mercury in order that the mercury film will have substantially no tendency to creep into annular space **12**.

Conveniently sleeve **11** may be mounted on an insulating tube **10** through which conductor **13** may be carried to establish electrical contact with sleeve **11** and hence with bushing **15**. Screw **14** serves the dual purpose of holding sleeve **11** in place on tube **10** and of holding the terminal of conductor **13** in electrical contact with sleeve **11**. The terminal of conductor **21** is held in electrical contact with ring **16** by means of screw **20**. Thus electrical contact can be established between two relatively rotating parts, one associated with conductor **13** and the other with conductor **21**.

As mentioned above an important feature of the invention is the manner in which the contacting surfaces of bushing **15** and ring **16** are amalgamated to establish noise-free electrical contact. The surfaces to be treated are first cleaned with nitric acid of about 30 to 40% concentration after which the surfaces are given a preliminary amalgamating treatment by placing them in contact with mercury for 48 hours. The surfaces are then polished with fine sandpaper until they are smooth and are again placed in contact with mercury for a few minutes. This treatment is repeated until rough surfaces are no longer formed during the polishing step. Bushing **15** and ring **16** are so selected that when finally fitted together the clearance between them will be of the order of 0.003 to 0.005". The resulting assembled contact unit will be found to present very little friction as well as a low order of electrical resistance. As heretofore stated by providing sleeve and retainer elements non-wettable by mercury as well as by maintaining the annular clearance at a very small value a very efficient seal against air diffusion results so that the assembly can be employed for carrying appreciable currents over periods of many months without erratic performance.

An assembly of rotatable contacts made in accordance with this invention which is eminently suitable for use in conjunction with a well logging cable reel is shown in Figures 2 and 3. The shaft of a cable reel is shown as element **22** in Figure 2 and has a central bore **23** through which the conductors of the cable on the reel may pass. The end of shaft **22** is provided with an enlarged recess **24** into which the contact assembly about to be described may be fitted. At the junction of the enlarged recess **24** and the bore **23** of the shaft a plug holder **25** is inserted and the latter is held in place with a set screw **26**. The plug holder **25** receives a plug **27** to the terminals of which may be attached the various conductors (not shown) of the cable on the reel.

The contact assembly which fits into recess **24** is housed within a cylindrical case **30** provided with end plates **31** and **32**. The assembly of cylindrical case and end plates is held together by means of a plurality of spacing rods **33** which receive screws **43** that fit into countersunk holes in the end plates **31** and **32**. The spacing rods **33** also serve to impart added rigidity to the assembly, thus making it possible to construct the cylindrical case **30** and the end plates of plastic material. A socket **28** which is adapted to engage plug **27** is held in proper position by spacing rods **34** to so engage plug **27**. The assembly within the case **30** is held in proper position in recess **24** by means of screws **44**. A spindle **36** is rotatably supported in the center of end plate **31** by means of bearing **38**. A similar bearing **40** in the center of end plate **32** rotatably supports a nipple **39**. One end of insulating tube **10** fits into nipple **39** and the other end of tube **10** is supported on spindle **36** and held in place by pin **37**. A plurality of ring and bushing contacts are supported on insulating tube **10** in the manner already described in connection with Figure 1. Conductors **21**, only one of which is shown, pass through hole **35** in end plate **31** and are connected to selected terminals of socket **28**. Conductors **13** (shown in Figure 1) pass out of the assembly through nipple **39** and if desired through elbow **41** and pipe **42** to the well logging recording equipment.

As shown in Figure 3 ring holders **18** are held in fixed relation to case **30** by means of brackets **46** attached to non-conducting spacing rod **33***a*. Furthermore brackets **46** are so placed that they support the weight of ring holders **18**, rings **16**, and the weight of conductors **21** not otherwise supported, thus making rings **16** essentially free floating with respect to bushings **15**. It will be seen that this reduces the friction between rings **16** and bushings **15** to the barest minimum, which is an additional important feature of this invention.

It is to be understood that this invention is not to be limited by the specific embodiments described herein, as many modifications thereof are possible within its scope, as defined by the appended claims.

What is claimed is:

1. An electrical contact assembly comprising a supporting sleeve, a cylindrical bushing held by said sleeve, a cylindrical ring slidably fitted over said bushing and rotatable with respect thereto, said ring and said bushing being constructed of a metal capable of amalgamation with mercury, said supporting sleeve having collar portions constructed of mercury-non-wettable material adjacent the sides of said bushing and said ring whereby to define with said sides an annular space of essentially no more than

sufficient clearance to permit relative rotation of said ring and said bushing, a film of mercury amalgam on the inner surface of said ring, and a film of mercury amalgam on the outer surface of said bushing in contact with said first named amalgam film.

2. Contact assembly according to claim 1 including a spindle on which said supporting sleeve is mounted, a case rotatably holding said spindle, and a bracket, held by said case, supporting said ring whereby to render said ring essentially free floating with respect to said bushing.

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