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INSULATED LINK

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2 Sheets-Sheet 1

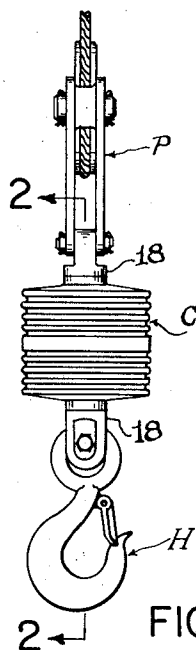


FIG. 1

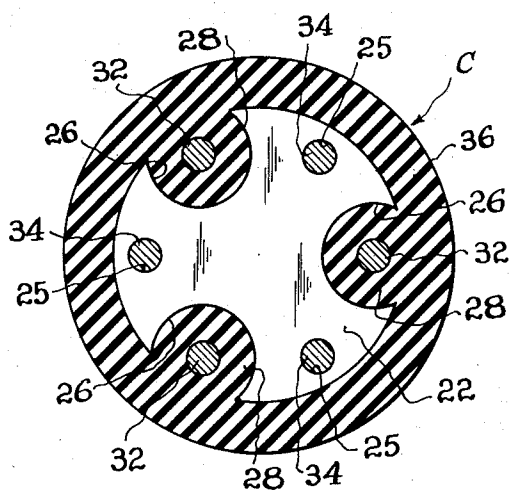


FIG. 3

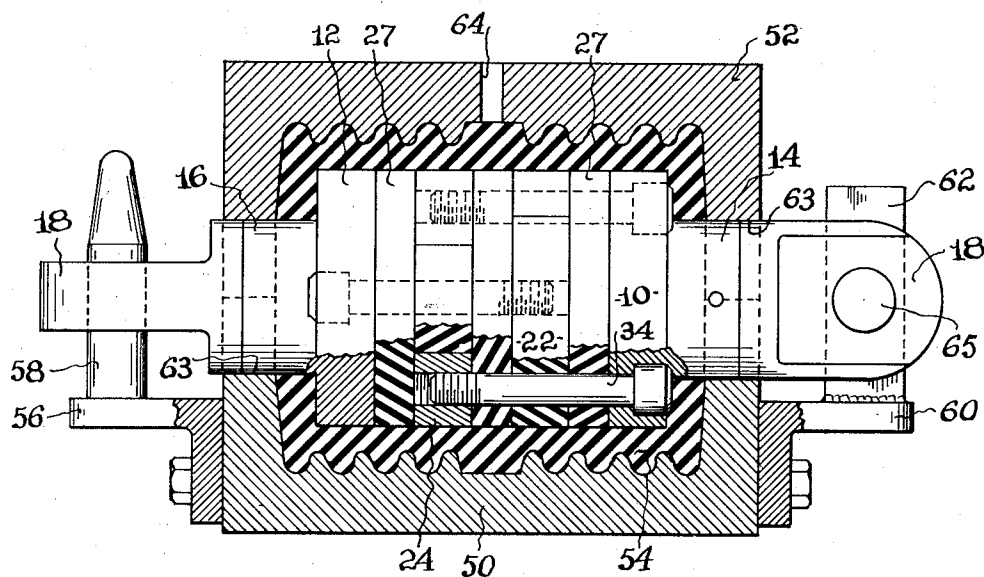


FIG. 4

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INSULATED LINK

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4 Claims. (Cl. 174—183)

The present invention relates to insulated links and to a method by which they are made. More specifically, it relates to links or insulated coupling devices used in heavy hoisting equipment to couple the hoisting hook to the hoist line in such a manner as to support the load and to electrically insulate it and the hook from the hoist line and boom.

One of the serious hazards confronted by operators of mobile cranes, and similar types of hoisting equipment, is that of the accidental contact of the boom or hoist line with overhead electric wires and cables which are frequently of high voltage. When such contact occurs, should an individual be standing on the ground and touching either the load being hoisted or any part of the apparatus, he provides a short to ground and can be seriously or fatally injured.

The present invention reduces the danger from such accidental contact with electric wires and cables by providing a load-carrying coupling or link of great structural strength combined with high dielectric strength between the hoist line and the hoisting hook in the position normally occupied by the "headache ball" in the conventional crane constructions.

Insulated coupling devices have in the past successfully performed structural supporting functions, as for example, in the support of electrical transmission lines. However, no devices satisfactory for use in heavy hoisting equipment have been available which combined extremely high insulating qualities with great structural strength of the magnitude required for connecting links in heavy hoisting equipment. The insulated coupling of the present invention embodies a novel relationship of load-carrying plates electrically insulated from one another so that effective use may be made of the load-carrying capacities of both the dielectric and of the intermediate structural plates.

It is an object of the present invention to provide a new and improved insulated load-carrying coupling having high dielectric strength and effective to provide insulation against the passage of high voltage current.

Another object of the present invention is to provide an insulated coupling to replace the "headache ball" of conventional hoisting equipment and which electrically insulates the hoist line from the hoisting hook.

Yet another object of the present invention is to provide a novel mobile crane construction wherein the terminal element, as for example a hoisting hook, is electrically insulated from the hoist line and boom to eliminate danger from electrical shock to personnel in contact with loads carried by the terminal elements.

Still another object of the invention is to provide a novel method of making an insulating coupling of the type described.

Other objects and the attendant advantages of the invention will be appreciated from the following detailed description considered with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

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Figure 1 is an elevational view of the terminal end of a crane unit showing the manner in which an insulating coupling constructed in accordance with the present invention is interposed between the cable and the hoisting hook;

Figure 2 is a longitudinal sectional view on an enlarged scale of the insulated coupling on the line 2—2 of Figure 1;

Figure 3 is a transverse sectional view of the coupling on line 3—3 of Figure 2; and

Figure 4 is a longitudinal sectional view through the mold used in the making of the insulating coupling and illustrates the positioning and centering of the coupling parts in the mold preparatory to the vulcanization of the rubber or rubber-like insulating material, portions of the uncured rubber components being broken away to show the separateness of these before curing.

Referring again to the drawings, attention is first directed to Figure 1 in which an insulated coupling made according to the present invention is designated generally by the reference character C and is shown positioned between the terminal pulley unit P and the hoisting hook H of a conventional crane construction, the coupling taking the place and performing the functions of the usual "headache ball."

The coupling C, according to a preferred embodiment of the present invention, comprises a series of four spaced steel plates separated from one another by dielectric plates or discs, alternate steel plates being bolted together by a plurality of bolts to form two pairs of interleaved plates electrically insulated from each other by the dielectric plates. The insulation of the two pairs of metal plates from each other is made possible by the presence of cutouts in the central plates of each pair through which the bolts pass. The cutouts around the bolts, in each case, are filled with a dielectric material which may be rubber or a rubber-like material and is integral with the outer enclosing casing.

Referring now to Figures 2 and 3, the specific details of an illustrative embodiment of the invention are seen to comprise a pair of end plates 10 and 12, preferably of mild steel, having flat inner faces and provided in their exterior faces with internally threaded integral sockets 14 and 16, respectively. Bifurcated clevis elements 18 have threaded ends and seat in sockets 14 and 16 in which they are locked in place by set screws 20. Each of the end plates 10 and 12 is provided with a plurality of equally spaced bolt-receiving, threaded, counter-bored holes 17 arranged around its perimeter. In the illustrated embodiment each end plate has three holes.

Flat center plates 22 and 24, also preferably of mild steel and of the same cross-sectional area as the end plates 10 and 12, are equally spaced therebetween and each has three threaded bolt holes 25 arranged to seat the bolts carried by one of the end plates. Plates 22 and 24 are also provided with three cutouts 26 interspaced equally between the bolt holes 25 and forming peripherally open cavities. Cutouts 26 are of substantially greater size than bolt holes 25 so as to be able to enclose the bolts in spaced relationship. Three bolts 32 are seated in the bolt holes 17 in end plate 10 and each extends through an aligned cutout 26 in adjacent center plate 22 to seat in threaded relationship in a threaded bolt hole 25 in center plate 24. Similarly, three bolts 34 seated in the bolt holes 17 in the end plate 12 extend through cutout portions 26 in adjacent center plate 24 and seat in threaded relationship in bolt holes 25 in the center plate 22. The relationship clearly requires that the plates 22 and 24 be so related that the threaded bolt-receiving holes 17 in one plate are in alignment with the cutouts 26 in the other.

The spaces between the center plates 22 and 24, and

between the end plates 10 and 12 and the adjacent center plate in each instance, are filled with insulation discs 27 of dielectric material. The cutouts 26 are filled by insulators 28 which position the bolts passing therethrough. The pressure of the discs 27 and insulators 28, because of the high dielectric characteristics of the material of which they are composed, insulate the two pairs of plates, comprising an end plate and a spaced center plate in each instance, and prevent the transmission of electric current through the unit even in the presence of very high voltages.

The entire unit, with the exception of the extending ends of the clevis elements 18, is enclosed by a casing 36 which, like discs 27 and insulators 28, is formed of an insulating material. As is seen in the drawings, casing 36 closely encloses the protected parts as though cast therearound, which in fact it is, and in a preferred form its outer wall is formed of adjacent grooves and ridges providing a serpentine sectional configuration to increase the surface length between its ends with resulting decrease in the danger of spark-over along its surface.

It would be possible to separate the metal plates of the assembly from one another by discs of high strength, high dielectric material such as plastic and then mold rubber or rubber-like material having high dielectric strength into the spaces and in the form of the outer casing. However, such practice may result in internal air pockets in the completed structure with resultant danger of breakdown of the insulation in the presence of high voltage. Accordingly, it is preferable, and as shown in Figures 2 and 3, to form the various insulating bodies integrally of a single homogeneous mass of dielectric such as rubber or rubber-like material cast or molded upon and around the metal structure after the latter has been assembled and properly related.

The present invention includes the method of constructing the unit by forming the insulation upon the metal parts by the use of the equipment illustrated in Figure 4. The apparatus comprises a mold adapted to receive the assembled metal parts of the coupling, and includes means to support the sets of steel plates in properly spaced relationship and within the mold cavity. The mold comprises a lower half 50 and an upper half 52 which cooperate to provide, when assembled, a cavity 54 of the size and configuration desired for the exterior casing 36 of the finished coupling. The lower mold section 50 has means to cooperate with the bifurcated end elements 18 of the coupling assembly to space the interleaved pairs of plates from each other and to center the assembly in the mold. These means include at one end a bracket 56 supporting an index pin 58 engageable in the pin receiving openings of one of the coupling's clevis elements 18. Similarly, at the other end of the lower section of the mold, a bracket 60 supports a guide bar 62 engageable between the bicurcated legs of the remaining clevis member 18 carrying a removable pin 65 adapted to seat in the openings of the clevis element, as shown in Figure 4. The opposite end walls of the mold are formed, partly in the lower section 50 and partly in the upper section 52, with aligned openings 63 of a size to seat and tightly clamp upon the sockets 14 and 16 integral with the end plates 10 and 12, respectively. With the mold sections clamped together by conventional means about the sockets 14 and 16, and with the clevis elements of the coupling connected to the aligned sockets, the coupling is prepared for the molding operation. Thus, it is seen that the two pairs of interleaved plates are supported in properly spaced axial alignment centrally of the mold by the index pin 58, the guide bar 62 and removable pins 65, and the tight fitting axial openings 63 in the mold sections. The assembled metallic parts, prior to being placed in the mold, are wrapped in a "prep" of unvulcanized rubber or rubber-like high dielectric material. The mold is then closed under pressure to force the "prep" into the open

spaces between the plates and into the cutout areas surrounding the bolts, and to form the integral outer dielectric coat 36. To permit the escape of displaced air and excess material, the upper mold section 52 is provided with a central vent opening 64. The rubber is then cured in the mold under appropriate pressure and temperature, Figure 4 showing the assembled coupling in the mold as during the curing stage.

The dielectric material used to form the dielectric body, including the outer casing 36, may be any abrasion-resistant material having high dielectric and substantial strength in compression which may be cured under heat and pressure. Many such materials are available and could be used although it is preferable to use an unvulcanized "prep" of high dielectric rubber or rubber-like material. Materials having a durometer hardness of about 60 or over, and a dielectric strength of 100 volts per mil, or higher, have suitable qualities and are preferred.

The metallic parts may be made in appropriate sizes and thicknesses and of a wide variety of materials, but it is preferred to use mild steel in sizes and thicknesses selected for a load to be carried.

The assembly is characterized in that the flat structural steel parts attached to the opposite ends are completely electrically insulated from one another despite the fact that portions of such structures pass through one another. The relationship provides structural strength while retaining the required degree of electrical insulation between the ends since large flat areas act against one another through large masses of high strength rubber or rubber-like material.

In use, the assembly is substituted for the conventional "headache ball" and, as shown in Figure 1, serves to transmit loads from the hook H to the pulley assembly P and thence to the boom of the mobile crane. As stated, the distribution of the load forces over the large flat areas of the metallic plates and of the placing of dielectric material under compression results in a capability to withstand heavy loads. The dielectric qualities of the rubber-like material effectively insulate the two ends of the coupling assembly (and thus the hook and pulley means) from one another so that if the boom or cable strikes a high tension line there is no direct path to ground through the load and a person in contact with the load is protected from electrical shock. The outer casing 36 of the coupling provides a highly important insulating covering for the entire coupling and safeguards against the possibility of high potential currents jumping between metal components of the structure.

As an example of an actual installation, an insulated coupling according to the present invention, of a length of ten inches and a diameter of nine inches, and having mild steel metallic parts and rubber insulation, weighs about 65 pounds. Such a coupling is designed (with a suitable safety factor) to lift loads of 12,000 pounds and to insulate electrically against 33,000 volts of alternating current. With appropriately chosen materials such a coupling has been load-tested to 110,000 pounds and has been insulated against currents in excess of 100,000 volts.

While the particular apparatus herein shown and disclosed in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as defined in the appended claims.

We claim:

1. An insulated coupling assembly comprising four relatively flat metallic plates of similar external size and configuration lying parallel to one another and separated by dielectric material, said plates comprising a pair of end plates and a plurality of center plates, each of the center plates having a plurality of threaded axial bolt holes and an equal number of enlarged cutout portions ar-

ranged alternately and equiangularly adjacent the periphery thereof, said end plates having a plurality of axial apertures equal in number and disposition to the number of bolt holes in said center plates, each of said end plates carrying bolts having heads seated in the said apertures therein, said bolts extending through cutout portions in the next adjacent center plate and into threaded engagement with threaded bolt holes in the more remote center plate, the outer faces of said end plates having clevis means attached thereto.

2. An insulated coupling assembly as defined in claim 1, further characterized in that said cutout portions are filled with dielectric material and in that the assembly has an outer coating of dielectric material, with the exception of the said clevis means.

3. An insulated coupling assembly as defined in claim 2 wherein the dielectric material forming said outer coating filling said cutout portions, and separating said four plates from one another is a single integral mass of material, and wherein said material is of structural strength in the order of at least durometer 60 and of insulating quality in the order of at least 100 volts per mil.

4. A method for constructing insulated coupling assemblies comprising the steps providing two end plates each having a flat face and clevis means attached to the other side thereof and a plurality of bolt receiving apertures extending axially therethrough, providing two center plates having threaded bolt receiving openings similar in number and arrangement to those in said end plates and an equal number of enlarged cutout portions spaced

medially between said threaded bolt receiving openings, assembling said four plates in parallel relationship by inserting a bolt through each aperture in each end plate, through a cutout portion in the next adjoining center plate and into threaded engagement with a threaded bolt hole in the more remote center plate, whereby to form an assembly comprising two interleaved pairs of flat metallic plates having clevis means extending axially outwardly from the ends thereof, wrapping said assembly in a "prep" of rubber or rubber-like material, providing a mold having means to engage said clevis means to position said pairs of plates in axial alignment and longitudinally spaced to positions wherein they are out of metal-to-metal contact with one another, positioning said wrapped assembly in said mold, closing the mold under pressure whereby to force the "prep" to flow to fill the spaces between the plates and the spaces in said cutout portions around said bolts, and to form a coating around the assembly, and curing the plastic material under heat and pressure.

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