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ELECTRIC POWER SUPPLY

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ELECTRIC POWER SUPPLY

Definition:-The current carrying conductors which are used underground are known as cables.

Types of electrical power cable used in a mine

- 1) Permanent cable (shaft and roadways cable)
- 2) Semi-flexible(conveyors, loaders, and other semi-permanent machines)
- 3) Flexible cable(coalcutters,drills,and other portable machines)

1)PERMANENT CABLE:-

These are **armoured cables** and may be either

- (a) Paper insulated cable.
- (b)Vulcanized bitumen insulated cable.
- (c)Compound insulated cable.

1(A) PILSDWA (Paper insulated level sheathed double wire armoured cable):-

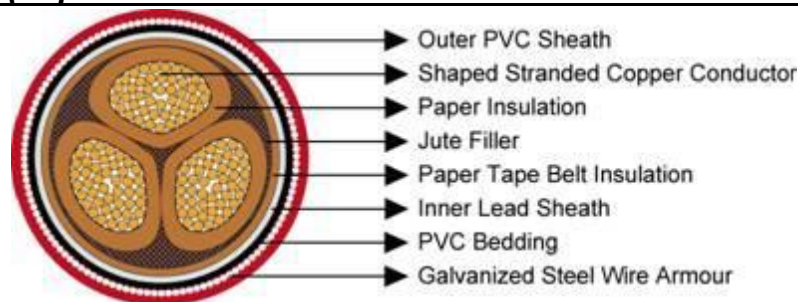


Fig. A typical 3 core cable

It consists of three:-

1)Copper core:-It consist of three copper wire either made up of circular section shape. The copper cores made of thin annealed copper wires.

2)Paper insulation:- All three copper conductors are insulated by papers individually then all the three conductors are coiled to a give a circular cross-section. The paper which is used for circulation should be oily in nature to reduce it hygroscopic tendency. The oily layer should be within or otherwise it will have a bleeding tendency.

3)Lead sheath:-To protect the cable form coming in contact with water and the paper conductor it is covered with a joint less lead tube. The paper insulated cable down through molten lead path for a joint less uniform lead sheath.

1st Jute bedding:-

The lead sheathing is very soft in nature, hence it may be readily scratched or cut by a steel wire used for armoring. Hence to protect it is covered by the 1st Jute bed. So, that it is not cut by the steel wire armoring.

2nd Jute bedding:-

Around the first bed and lay of thick steel wire are wound spirally to give mechanical strength to the cable. Between the two layers of wires there is a layer of jute bedding to protect the wires from each other.

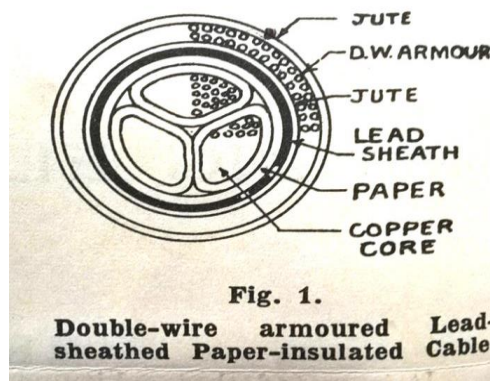
3rd Jute Bedding & White Wash:-

It gives a smooth surface to the cable. It is treated with a layer of coal tar. The coal tar prevents the entry of the water inside the cable but such a cable is sticky in nature, hence it is very difficult to take out the cable out the cable from the drum. To overcome this difficulty the cable is painted by a thin layer of warmish, which is known as white wash. It makes the cable non sticky in nature.

For the mining purpose double wire armoring are used as compare to single wire armoring. Cables protected by steel tape armoring are not used in mining because the tape offers too high an electrical resistance for earthing purpose.

ADVANTAGES:-

1. Armoring takes the complete weight of cable.
2. It acts as earth conductor.
3. Mechanical strength increases.
4. Crushing straight increases.



1(B) PILSSWA (Paper insulated lead sheath single wire armored cable):-

Its construction is same as PILSDWA but there is a single armoring in between 1st jute bedding and 2nd jute bedding.

A) Copper Core: It consists of three copper cores either made of circular section or sector shape. The copper cores are made of thin armoured copper wire.

B) Paper Insulation: All these copper conductors are insulated by paper individually then all the three conductors are coiled together & wrapped over by the paper to give a circular cross section. The paper used for installation should be oily in nature to reduce its hydroscopic tendency. The oil layer should be thin otherwise it will have a bleeding tendency.

C) First Jute Bedding: The lead sheathing is very soft in nature hence it may be easily scratched or cut by the steel wires used for armoring, hence to protect this; it is covered by the first jute bedding so that it is not affected by steel wire armoring.

D) Second Jute Bedding & White Wash: It gives a smooth surface to the cable. It is treated with a layer of coal tar. The coal tar prevents the entry of the water inside the cable but such a cable is sticky in nature, hence it is very difficult to take out the cable from the drum. To overcome this difficulty the cable is painted by a thin layer of warmish, which is known as white wash. It makes the cable non sticky in nature.

ADVANTAGES:-

1. Armoring takes the complete weight of cable.
2. It acts as earth conductor.
3. Mechanical strength increases.
4. Crushing strength increases.

2) Compound Insulated Cable:-

All the three copper cores are insulated by a compound which is a combination of rubber & other patent material. Then all the three copper conductors are laid around each other & insulated by the compound to give a circular cross section.

Sometimes the cores of such a cable are insulated with vulcanized rubber, being then sheathed with compound and finally armoured.

Advantages of Compound Insulated Cable:-

- 1) Impervious to moisture.
- 2) Unaffected by low & high temperature.
- 3) Overall diameter is less.
- 4) Non hygroscopic in nature.
- 5) More flexible in nature.

Disadvantage of Compound Insulated Cable:-

- 1) It is costly

3) Vulcanised bitumen insulated cable:-

A)Copper core:- It consist of 3 copper core. The copper wires used for core consist of a small amount of tin. It is required to protect the copper form the sulphur which is used in vulcanized process.

B)Bitumen insulation:- All the copper core are insulated by sheath of vulcanized bitumen. The core are thin lead. Around each other and it's is again sheathed with bitumen to give a circular cross-section.

ADVANTAGES:-

- 1) Impervious to moisture.
- 2) Overall diameter is less.
- 3) Chances of cable breaking down in wet situations are less.

DISADVANTAGES:-

- 1) Larger in diameter.
- 2) Adversely affected by high temperature.
- 3) Adversely affected by low temperature.

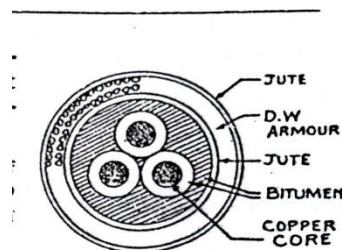


Fig. 2.
Double-wire armoured Vulcan-
ised-bitumen Insulated Cable.

2) Semi-flexible cable:-

A three core semi flexible cable had 3 copper core, each vulcanized rubber insulated and laid around center. The whole being tough rubber sheathed to give a circular cross-section for mechanical strength; it is armored by steel wires and overall sheathed with tough rubber.

Alternative the cable may have four cores one being used as an earth core, one as a pilot core and other two are as a power core or it may have five cores one being on earth. This cable is used in O/C mine to operate O/C machineries.

3)Flexible cable:-

Flexible cable requires:-

- 1) It should be very flexible.
- 2) Light in weight.
- 3) Water proof.
- 4) Mechanically strong.
- 5) Fire resistance.

Types of flexible cable:-1)Coal cutter Cable.

a)3-core D.C.(Individually screened):-

This has two power cores vulcanised rubber insulated, screened with tinned copper strand and sheathed with tougher rubber, and an unscreened earth core insulated with vulcanised rubber. The three core are laid around a rubber centre and sheathed overall with fire, oil and weather resisting polychloroprene compound (P.C.P).

b)5-core A.C (Collectively screened):-

This has 3 power cores, 1 earth core and 1 pilot core, all of equal area, each Vulcanised rubber insulated and laid in the same pitch circle around the cradle center. The whole is then sheathed with tough rubber, collectively screened, and sheathed overall with polychloroprene compound.

c) 5-core A.C(Collectively screened):-

This has 3 power cores and 1 earth core of equal size, each vulcanised rubber insulated and laid around a rubber cradle centre containing a smaller central pilot conductor. The whole is then sheathed with tough rubber, collectively screened and sheathed overall with P.C.P. compound.

d)5-core A.C(Individually screened):-

This has 3 power cores, each vulcanised rubber insulated and copper screened, together with an insulated but unscreened pilot core. These 4 cores are laid around and in contact with a central bare earth conductor and sheathed overall with P.C.P compound.

e)5-core A.C(Individually screened):-

This has 3 power cores, each vulcanised rubber insulated and copper screened, together with insulated but unscreened earth and pilot cores. All 5 are of equal conductor area and laid around a rubber centre, being sheathed overall with P.C.P. compound. If desired all the 5 cores may be screened.

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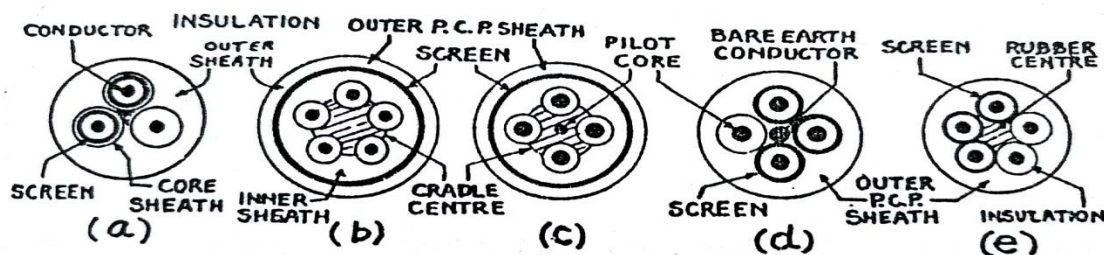


Fig. 8. Standard Types of Coalcutter Cable.

2)Drill Cable(Flexible cable):-

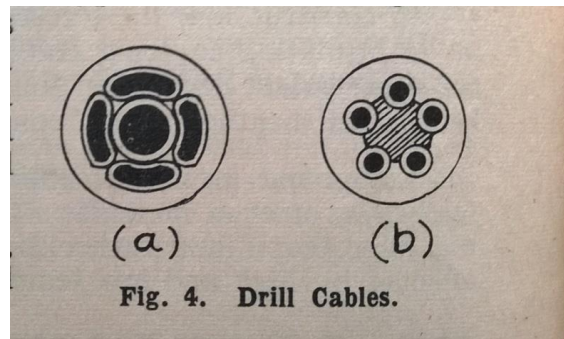
These are lighter than coal cutter cables and operate at 125volts, 3 phases. They are normally unscreened as accidents at this voltage are unlikely to be serious.

a) 5-core(Short lay):-

This has 3 sector shaped power cores and 1 pilot core, all are vulcanised rubber insulated and laid in a close spiral around a rubber-covered earth conductor. The whole is PCP sheathed. The cable is use for the short length only.

b) 5-core(Normal lay):-

This has 3 insulated power cores, 1 earth core and 1 pilot core laid around a cradle center and PCP sheathed overall.



Place

1. Shaft
2. Underground levels
3. C. C. M.
4. Coal drill
5. Watery places
6. Belt conveyor
7. Loader

Cable Used

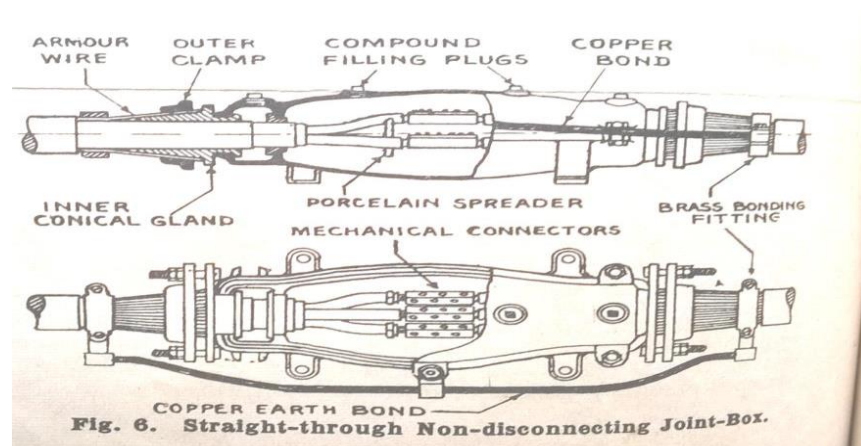
PILSDWA.
PILSDWA, PILSSWA, bitumen insulated or compound insulated depending on condition.
Five core A.C. vulcanised rubber insulated (collectively screened), flexible cable.
Flexible cable, drill cable (five core A.C. cables unscreened).
Permanent cable, compound insulated.
Semi-flexible, three, four or five core vulcanised rubber insulated & armoured cable.
Flexible, five core vulcanised rubber insulated collectively screened cable.

❖ **Cable Joint Box:-**

The permanent cables are jointed using the cable joint box. A joint box must fulfill the following conditions:

- 1) It must effectively protect the conductors from injury.
- 2) It must preserve the efficiency & continuity of the insulation & exclude moisture.
- 3) It must secure the cable armoured & bend it in such away as to maintain the continuity of the earth in system.

A joint box is made of cast iron or mild steel, split longitudinally to give the access to the conductors & assembled after the work is finished. The actual joint between the conductors is made by a mechanical connector. When the joint has been completed, it is covered with several layers of insulation tape. Each core is separated by porcelain plates. Each end of the joint box is provided with an armoured clamp & saddling clamp which seals the cable at its entry into the joint box & effectively secure the steel wire armoured. When all collection has been made the box is filled with a special bituminous compound through the compound filling holes which are provided in the upper half of the box. The compound is solid at normal working temperature. Finally it is most important that a copper bond is provided between the armouring to maintaining the continuity of the earthing system.



❖ **Care & Maintenance of Cable:-**

- 1) The operator should handle the cable carefully so that it is not damaged by the moving machines.
- 2) Except when it is in use, cable should be coiled on the drum.
- 3) The cable should be examined & tested by an electrician when first installed & thereafter once in every 24 hours.
- 4) The cable should be examined by the machine operator before starting the machine.
- 5) If any defect is found in cable, it should be withdrawn at once.
- 6) The length of drilling cable in use should be kept down to a minimum.
- 7) Spare cable should be ready for use in mines so that a defected cable may replace immediately.
- 8) The cable should prevent from the falling object material from the roof.

❖ **Bleeding of the Cable:-**

If a paper insulated cable is hanged vertically in a shaft it bleeds, in other words the oil which is observed by the paper tries to flow down & if oil is access the pressure developed by the oil may be sufficient to burst the lead sheet of the cable, this is known as bleeding of the cable. To prevent this oil used should be properly viscous & a proper method should be used to make the insulated paper oily in nature. PILSDWA & PILSSWA are bleeding type of cable while the bitumen insulated & compound insulated cables are known as no bleeding type of cable.

In the case of lead sheath and bitumen insulation. The insulation is in very soft form in nature. Due to the flow of the high current and high temperature the insulation is melt and converted into liquid form. When the cable are suspended vertically the liquid flow downward and coming through the cable.

❖ **Flame Proof Enclosure:-**

It has been defined as an apparatus that can withstand without injury, an explosion of the inflammable gas that may occur within it & can prevent the transmission of flame to the atmosphere to ignite the inflammable gas which may be present in the surrounding atmosphere. In all the gassy mines, electrical motor, switchgear, control panel etc. are required to be flame proof.

❖ **Intrinsically Safe Apparatus:-**

Intrinsically safe apparatus denotes that any sparking that may occur in normal work is incapable of causing explosion of inflammable gas. The spark coming out in the apparatus operating current is less than one ampere. It is achieved in case of low power apparatus such as telephones signaling system, remote control & exploder etc.

❖ **Screening of cable:-**

In flexible cable around the bitumen insulation there is a thin layer of copper wire is known as screening of cable.

It is of two types-

1) Collectively screened:-

If all the cores are laid together at the centre and screened collectively that type of screening is known as collective screening.

2) Individually screened:-

If only the power cores are screened separately with the help of thin copper wires such type of screening is known as individual screening.

Advantages of screening:-

- 1) It used as a earthing.
- 2) It increases the flexibility of cable.
- 3) It is simple and cheap.
- 4) It is easier to repair.

Disadvantage:-

- 1) In the case of short circuit, from the power core the heavy current are passed through the cable.

❖ **Repair of Cable:-**

The permanent cable is not repaired, only flexible cable is repaired. If flexible cable is damage insulation is cut then the cable is repaired. The repair of cable is always done in dry ventilated and well light in workshop on the surface. Cut the insulation screening for about 0.3m on either side of the damage. Separate the insulation is beveled at an angle 45° with knife. Each core is bind with insulation tape such that no layer is trapped between the air.

The cores are then placed in Vulcanised path filled with paraffin wax to be heated upto 300°C for 30 to 45 min. After Vulcanised the cores are taken out and cool it down. The screening tape is taped & connected with the connective screen of the cable. The cable is again treated with tough rubber & P. C. P. compound to give the original design of the cable. Now the cable is again ready for the use.