INSTALLATION AND MAINTENANCE MANUAL

FOR

CABLE FAULT DETECTION SYSTEM

C0-700, CD-710

REVISED 3-27 80

MSHA APPROVAL NO. 98-119-0

PA APPROVAL NO. BFE-763-00

MANUAL PART NUMBER 100-0016

FOREWORD

One of the common repair problems that the mine mechanic/electrician has experienced is the "bad" trailing cable. The trailing cable has developed an open circuit in one or more leads, or else two or more leads have shorted together due to defective insulation or mechanical damage. On AC equipment, depending upon the open lead(s), we either have a Sfigle phase condition or the ground monitor will not pick up to allow the circuit breaker to be closed.

To find the open conductor we usually proceed along the cable and punctIXe the cable jacket and conductor insulators with the test leads of a volt meter or voltage tester to locate the open circuit.

This method of testing leaves much to be desired in that the person testing the cable may be badly shocked, burned or blinded if the test leads short out two power conductors. Equally serious Is the fact that we have set up a death trap that may unexpectedly catch a person handling the cable at a later date. especially if the work area is wet and the person is wearing leather boots and wet gloves. There have been several late electrocuitons caused by handling energized trailing cables with pinholes in the Jakets.

Finding an open In the ground or monitor conductor is usually accomplished by cutting into suspect splices or one person will twist or bend the splices and/or cable end another person will watch or listen for the ground monitor relay to pick up.

I. INTRODUCTION

The CD-700 will locate shorts and opens in underground trailing cables quickly and precisely. It will work best for an experienced operator who is familiar with its operation and understands trailing cable problems. For this reason, we recommend that you read this manual thoroughly before using the CD-700. You may want **to contact your representative for a demonstration before you use** the system. If be is oot available, please contact AMR directly.

The CD-700 system consists of two units, the transmitter and the **dett:Nnr The transmitter generates a test signal which is coupled** to the cable to find the faulted wire. The detector is used to trace this signal down the cable. When the signal can no longer be found you have passed the fault.

2. SPECIFICATIONS

- A. TRANSMITTER
  - 1. Input power - 117 VAC +- 20%
  - 2. Output frequency • 1200 Hz, +- 2% over temperature
  - 3. Maximum output voltage - 8.5 VAC
  - 4. Maximum output current - 3JO Ma RMS
  - 5. Weight - 7 lbs.
  - 6. Enclosure - 18 ga. stainless, 7 1/4L x 4 1/2W x 3 1/4H inches
  - 7. Operating temperature • -10 to 60 degrees C

- B. OETECTOR
  - 1. Input power - 9 voe battery (NEDA 1604A, 1604 0)
  - 2. Display sensitivity (sensitivity at maximum)

xl a Short • one light 4 ma
n • four fights 50 ma

" b. Open • one light 1 volt

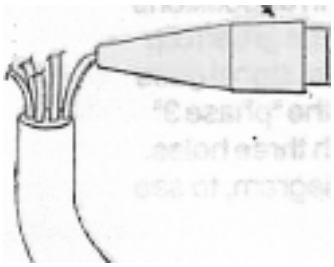
" • four lights 2.5 volts

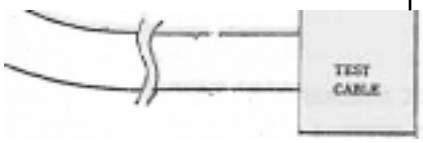
• 3. Weight-16oz.

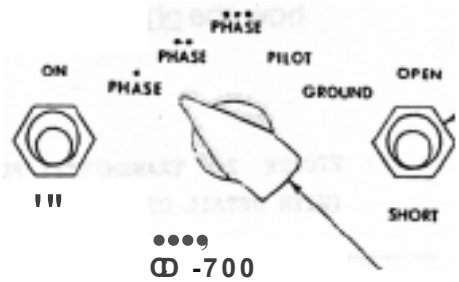
• 4. Endosure - molded ABS plastic with 18 ga stainless shield, 4-3/4L x 2 1/'ZW x 2 1/4Hinches

• 5. Operating temperature - -10 to +60 degrees C

• **6.** Intrinsic safety number • 9B-119-0




TEST
CABLE


PHASE
PHASE
PILOT
ON
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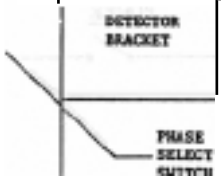
GROUND
OPEN
SHORT

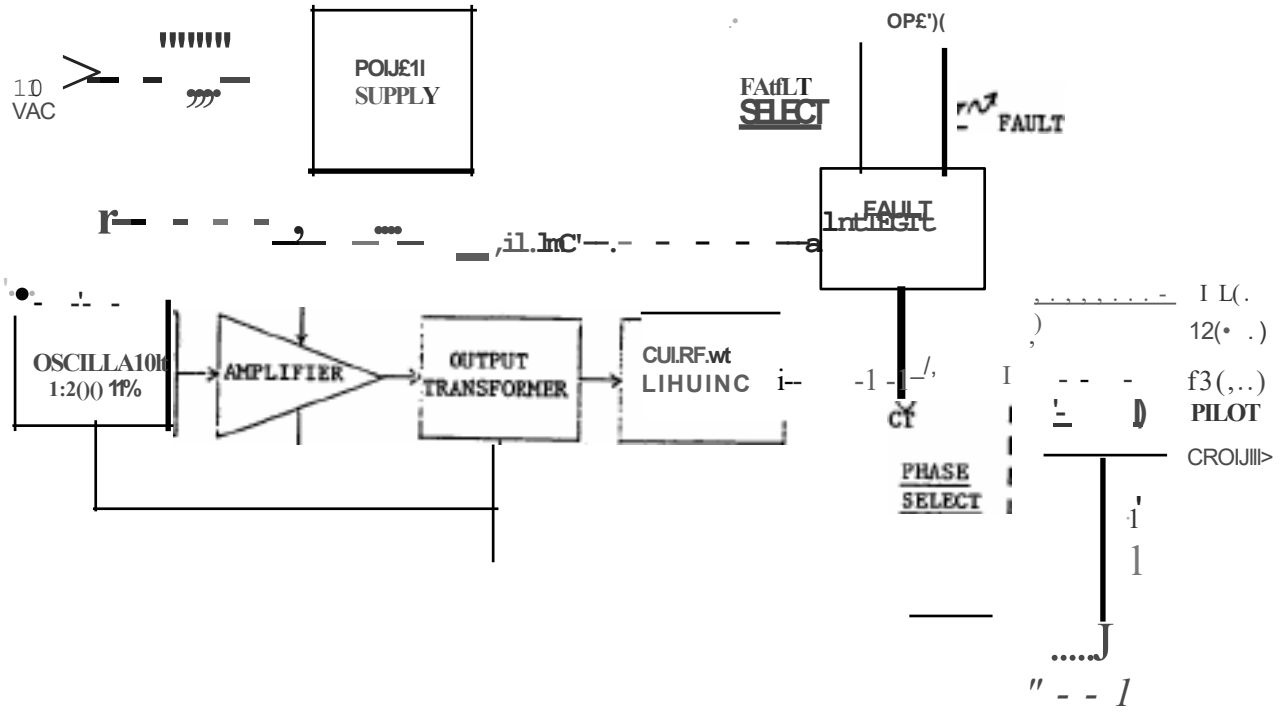

DETECTOR
BRACKET
PHASE
SELECT

3. OPERATION

A. TRANSMITTER

- Figure 1 shows a front view of the transmitter. The **oowerswitcti** turns the unit on and off. The test mode switch selects the type of fault which will fight the fllll!1 lamp. The phase select switch tells you which dip has the test signal. The dots above the phase positions tell which black clip has the test signal. Holes are punched in each black boot to match these dots. In au positions except "groun,d" the signal ground is on the green clip (ground). In the •ground" position, the test signal goes to the ground dip and the signal goes to the ·phase 3• clip, This dip, then, has a black boot with three holes. Look at Figure 2, the transmitter block diagram, to see how the phase sefects wtchworks.

FIGU'RE Z TIWISMITrEJI BLOCK DIACIAH
(VI1'R O!TAIL OF PHASe SELECT SWITCH)

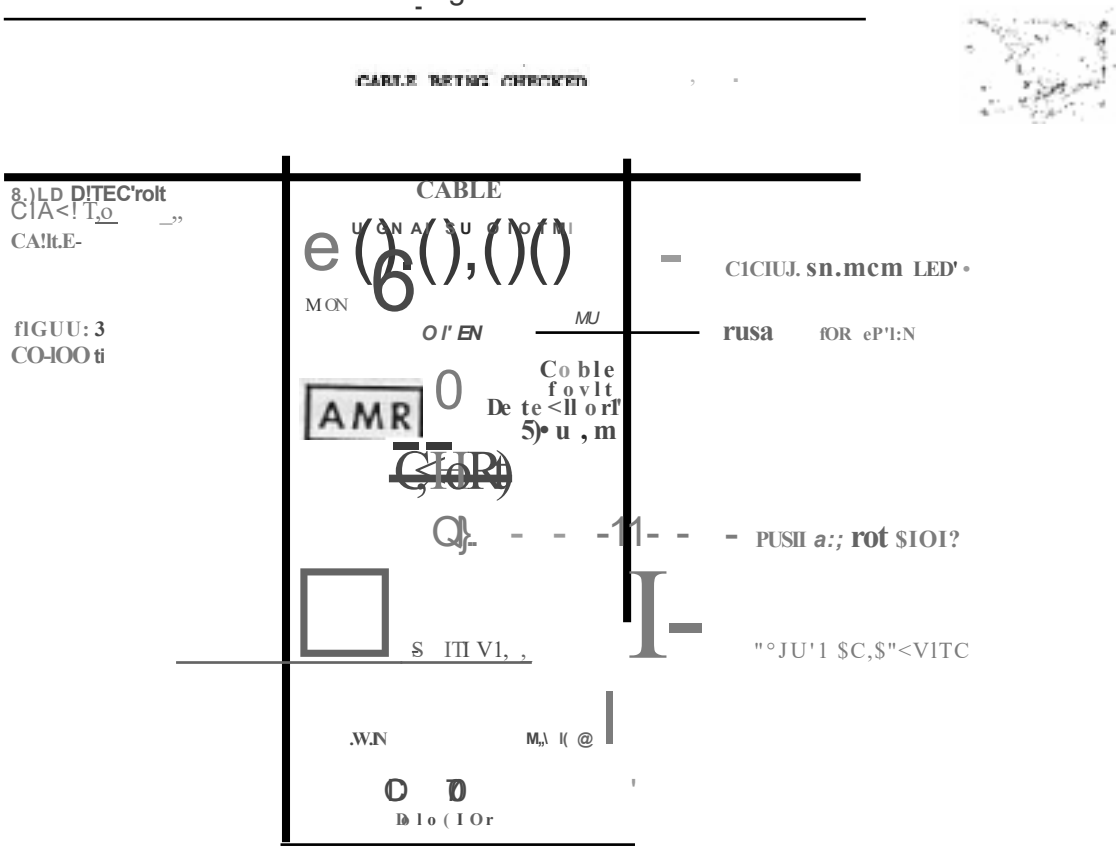


3. OPERNA(Ttiued)

- Thetrasmitter box hasa cable hook at the bottom, SO the test cable can be hung and protected. The detector bracket on the right side has a tab which can be used to lock the detector to the transmitter.

B. DETECTOR

- Figure 31s a top view of the detector. The openand **short buttons turn the detector on when either one is** pressed and set the unit to test for opens **or** shorts . The sensitivity knob is turned clockw ise to pick up weaker signals. It is very important that you set this knobproperly. See Section 4.8.4., Using the Detector for Shorts, and read It through a few times to be sure you unde rstand how to make this adjustment The signalstrength ligh ts give you a way to compare strong and weak signals. A very strong signal will light all four lights. As the signal gets weaker some of tholights willgo out. A very weak signal will turnon onlythe far left ig ht. All the lights will go out when there is no sig al-



4. LOCATING FAULTS WITH THE CD-700.

ALWAYS
BE SURE THAT 1HE BREAJCER IS OPEN.
REMOVE 1HE CABLE PWG FROM 1HE
POWER CENTER. l.OCJ< IT SO THAT IT
CANNCYf BE RECONNECI'BD.

A. CHECKOUT

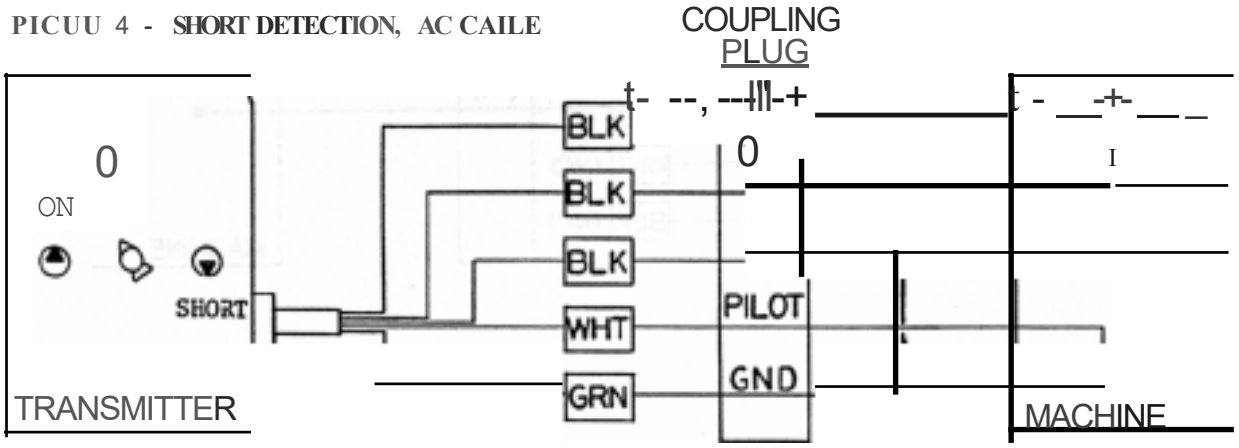
- Before starting to test a cable. you should check the CD-700 system out to see that is working property. **Turn the transmtiter's power switch on. Now hook a** black clip and the green clip together and make sure **no** other clips are touching each other. Set the test mode switch to lilllllll and turn the phase select knob unti the faul1 light comes on. Leave the phase select switch set here. Now take the detector and turn the sensitivity knob all the way clockwise. Press the short button three or four times. You should see all four lights flash. Holding the lilllllll button down, move the front of the detector (the encl that says 'CABLE") toward the shorted black and green clips, About tooe inch from the clips all four lights should be on. This indicates that the battery in the detector is good. Set the test mode sw_ch in the iwm pos ion. The flll,jJL light shou ld go out. Turn the ptlase select switch to another phase. The..!ml!l lamp shou ld come back on. F n d the black boot that has the test signal using the dots on the phase select switch and the punched holes in the boot. Press the llQm button on the detector and m o v e close to tho phase dip. About one inch from the clp all four i ghts should come on. The CD-700 system ls working property.

4. LOCATING FAULTS WITH THE CD-700 (Continued)

B. SHORTS

- 1. AC Cable
- Figure 4 shows how to comect the test clips to an AC cable. Black boots go to phases, white to pilot, and green to ground. Cables without pilot wires leave the white boot connected. Turn the transmittet on and sEt the test made switch to "short". Now slowly turn the phase select switch to each position until the fault light comes on and stays on. Since the pilot is shorted to ground, the fault lamp will always come on in the "pilot" posnion, Proc eed to 4.B.4,. Using the Detector for Shorts.

PICUU 4 - SHORT DETECTION, AC CAILE

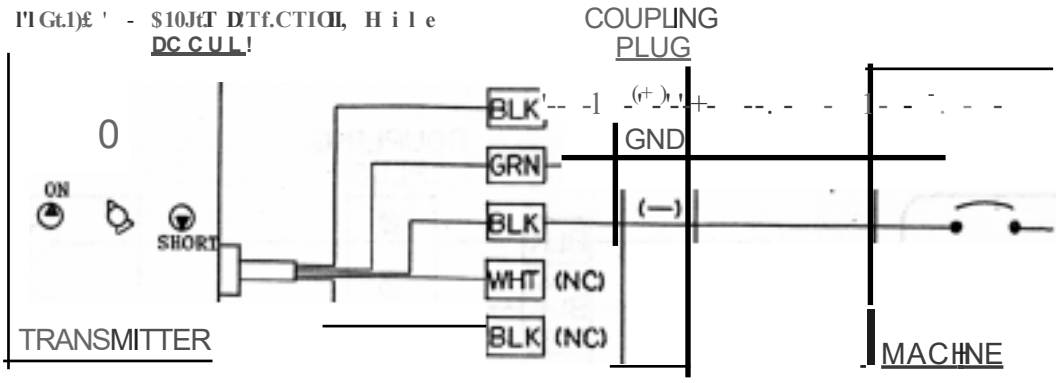


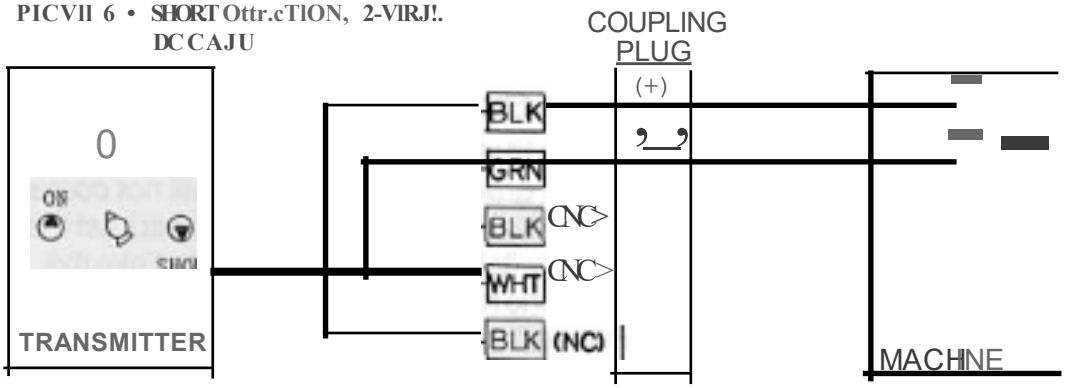
2. Phase-to-Phase Shorts

- If the fault is a true phase to-phase short with **no** connection to ground, the !alll1 lamp will not oome on wnh the standard AC cable hookup. Instead, set the phase select swltch to phase 1 (one dot). Take the phase 1 clip (one hole) and the green ground clip. Check phases 1-2, 2-3. and 1-3. When the two shorted phases are touched, the..li!J.!!t light will come on. Com ect the ground and phase 1 clips to these two phases. Proceed to 4.B.4.. Using the Detector for Shorts.

o 3. DCCable

- Hook up to DC cables is shown in Figures 5 and 6. For three wire DC cables,connect oneblackclip to minus, and thegreen dip *to* ground. For two wire DC cables, connect oneblack **cip** to plus and the green dip to minus. Now tu-n the phase select slowly until the!!!!!!.lamp comes on and stays on. Proooed to **4.B.4.• UsinatheDetectortorShorts.**





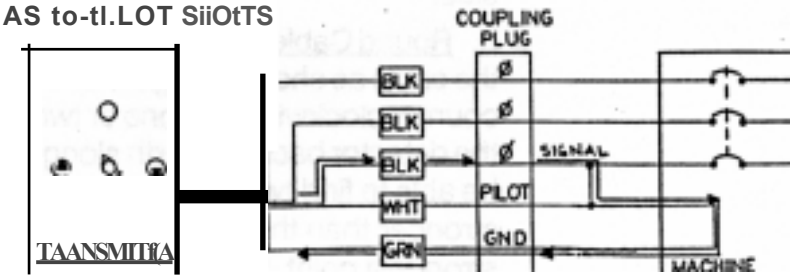
4. I.OOJING FAULTS WITHTHE CD-700 (Continued)

- 4. Using the Detector for Shorts
- a. RatCable• Placethefrontof thedetector against thecableasshownInFigure3. PushtheSII!Idbutton andtum the sensitivityknobclockwiseuntil one or two ofthelightsoomeon. Nowmovethedetector acrossthe topofthecableandtotheotherside, andobserve the lightindication on thedetecto r. One side of the flat cablemayhaveastrongersignalthantheother. Place thedetector atthestrongestpoint andadjustthe sens iyityuntilthe fourthig ht just berelycomeson. Youshouldalwayscheckbothsidesol thecablewhen tracing a fault to be sureyouarelooking atthestronger side.
- b. RoundCable·Placethefrontof thedetector against thecable as shown in Figure 3. Tum the sensitivity knob countet clockwiseuntiloneor twolightscomeon. Move thedetectorback andforthalongthecable. Youshould be able to find 1Yt0strong signalpoints, but one willbe stronger than the other. Place the detector at the strongest poi,nt then tum the sensitivity knob until the fourthlight is barely It. Go to Sectiond., Checking the Cable.
- c. HighResi stanceShorts- Whenadjustingthedetector to findsomo shorts, youwillfind that, evenw h the sensitivityknob at maxi:num, all four lightswillnot come on. Just rememberthat,aslongasthenumberoflights staysthe seme, youhavenotpassedthetault.
- d. CheckingtheCable- Walk down thecable toward themachine, checking thecable about every20 feet. tt youcan stillfind a spot on thecablewhichgivesyouthe same numberoflightsyouhadat first,youhavenot passedtheshort. Whenyoureachapointonthecable where someor all of thelightswillnot come on,you shouldbegin to beck track. Youwillbeable to find the short withinonefootand, withpractice,withinInches.
- When the shorthas been repaired, thelaull.Jamp should be offin allphasepositions of thephase select switch. Tumthe transmitter off, hangupthetestclips andput thedetector backin itsbracket.

4. LOCATING FAULTS WITH THE CD-700 (Continued)

- e. Phase-to-Pilot Shorts - Phase-to-pilot shorts can be confusing when using the CD-700. The transmitter will show a phase-to-ground short, but when you follow the signal down the cable, you will walk all the way to the machine. This happens because the signal actually flows up the phase wire, through the short to the pilot wire, up the pilot wire, up the pilot wire to the machine and back down the ground wire. Refer IO figure 7. If you have this problem, hook the ground clip to the pilot wire and trace the cable again.

FIGURE 7 - PHASE-TO-PILOT SHORTS



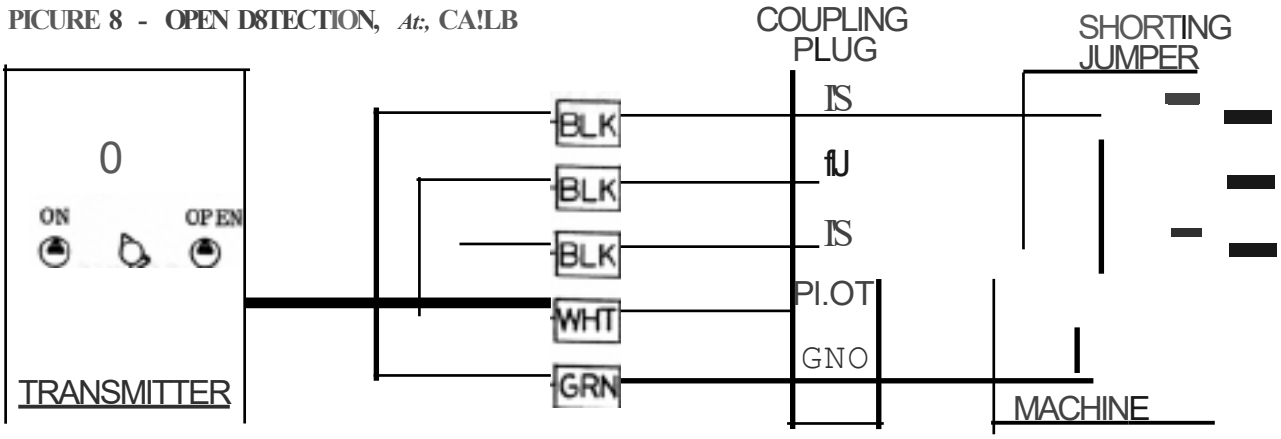
C. OPENS

- 1. AC cable
- An open phase in AC cable should be indicated by a single phase condition on the mining machine. An open pilot or ground should trip the ground monitor.
- To locate the fault, open the breaker and remove the cable plug from the power center. Lock out and tag the plug so it cannot be reconnected while you are working.
- Remove the junction box or control box cover and short all phases to ground using the shorting jumper, supplied with the CD-700. If you are using tone type ground monitors that employ phase filter, refer to Section C.3., Phase fitters. Check the transmitter and detector using Section 4.A., Checkout.

4. LOCATING FAULTS WITH THE CD-700 (Continued)

- Make your connections to phases with black clips, pilot with white and ground with green as shown in Figure 8. If the problem is an open ground, temporarily remove the chain connecting the cutter to the power center frame. If this isn't done, the transminer won't indicate an open in the ground position. When you are finished testing, be sure to **reconnect the chain.**
- Turn the transminer on and turn the phase select switch slowly until the fault lamp comes on. Pause at each position to give the test circuit time to read an open wire. Now go to Section 4.8.4., Using the Detector for Open Cables.

PICTURE 8 - OPEN DETECTION, ATC CABLE



2. DC Cable

- To begin locating the fault, open the breaker and remove the plug. Lock out and tag the plug to prevent reconnection while you work. On DC machines a broken power line just stops the machine. An open ground can only be checked with a volt-ohm meter (VOM) or the transminer. Short the plus, the minus, and the ground together at the machine end and measure for low resistance at the cable plug end. You can also use the transmitter for this job. Read Section 4.8.2., and set the test mode to open. Use the two clips to check for an open. The fault light should be **off when you touch plus, minus, and ground.**

4. LOCATING FAULTS Willi T H ECD-700 (Continued)

- Remove the junction box or control box cover and shon au power wires together with the shorting !umper. If you are using tone type ground monitors tha1 employ phase filters refer to Section C.3.. Phase filters. Check the transmitter and detector using Section 4.A., Checkout
- Transmitter hoOk\.PS for open location are st-own in Figures 9 and 1o. For three wire DC, connect one black clip to plus and one to minus, then connect other three clips to the ground. For two wire DC, connect one black clip to plus and all the other clips to minus.
- **Turn the transmitter on and ti.Kn the Phase select** switch slowly to each position. When the liwl1 lamp comes on, you hava found th open. Now proceed to Section 4.. Usni g the Detector tor Opens.

FIQJRE 9 - OPEN DETECTION; 3-VIRE DC CABLE

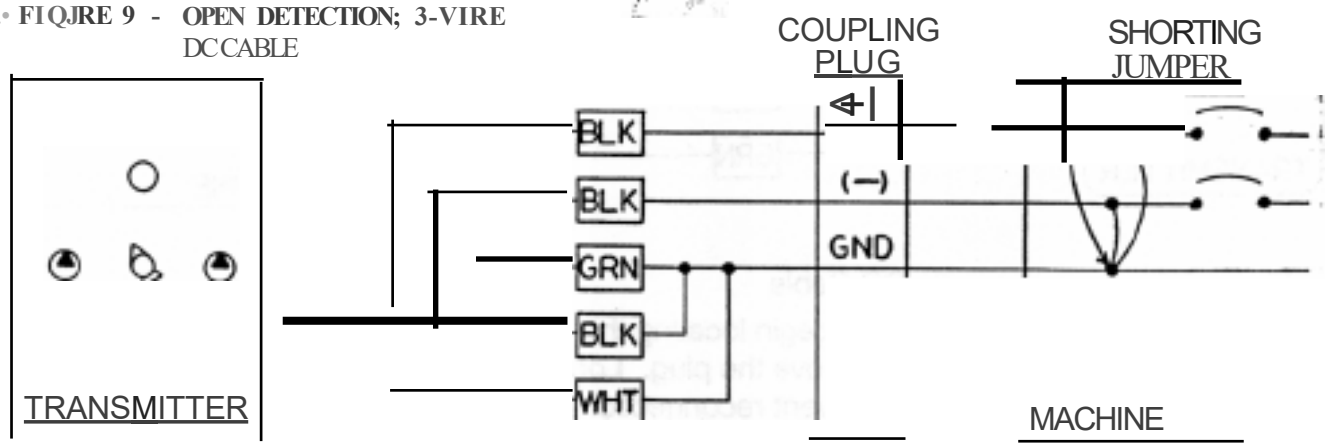
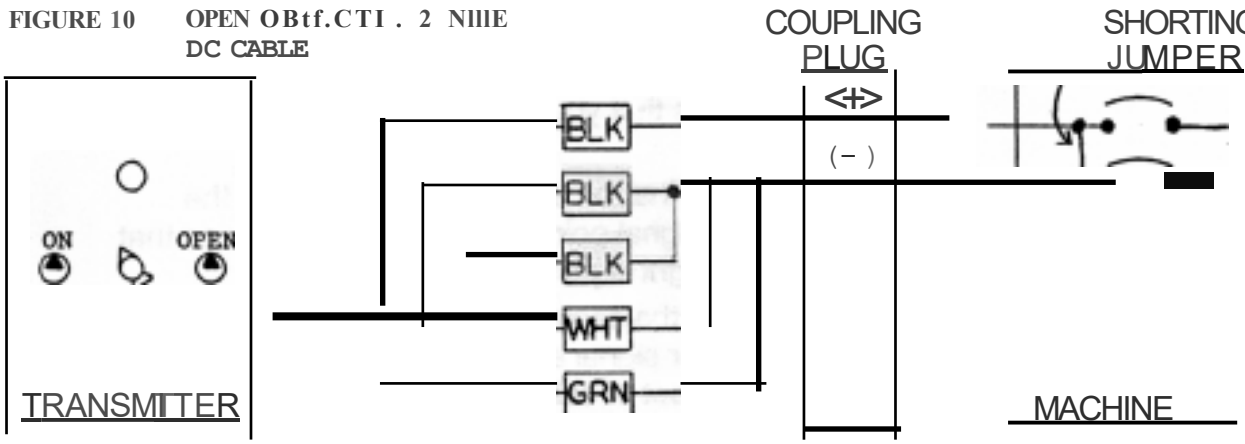


FIGURE 10 OPEN OBtf.CTI . 2 NIIIE DC CABLE



3. PhaseFitters

- If ttis hard to short all wires to 11ound with lhe shorting jumpers, a special filter canbe permanently installed in eachmachine. This filter hasno effect on the operation of lhe miningmachine, but Itacts as a shorting jumperwhen you are testing foropens. There are two filters available: The PF-160 (1000 VAC max.) and the PF-165 (600 VAC mil)(.).
- These filters do affect the ability Of the CD-700 to find shorts and opens. The following **table** will show these differencas:
  - Impedance(Phase to Ground@ 1200 Hz) = 1300 ohm
  - (both PF-160 and PF-185)

	With ener wio Filter
• Max short resistancefound	350 ohm 2000 ohm
• Min. open resistance found	1500 ohm 350 ohm

- Wehave found that most faultscan be found with phase filtors installed, and that the filterssave a lot of timein locatingopens If youa eady use AMR ground monitors or other tone monItOlfng systems, the filters are on your machines. You will probably never need your shorting jumpers.

4. LOCATING FAUITS WTI1-l1HE CD-700 (Continued)

- 4. Using the Detector for Opens.
- Reread Section 3.8. The detector is used In exactly the same way for botn shorts andopens. The only differemce is that you press the button, not the l!!JQ!!.
- Remember that on an cables you must find Ihe strongest signal point and set the sensttillity so that the fourth light is just barely on.
- Walk doWn the cable toward themaehineand check the cable for signal about every twenty feet. Check about two feet of cable each time to find the strongest signal for roundcable. When you reach a point on the cable where most or allof the lights are o,ut backtraek to findthe exact location of the open.
- When the open hasbeenrepaired,the fault lamp on the transmitter shoud be off in every position of the **phase select switch. Turn the transmitter off. Remove** theshortng jumpersWtheywereused.
- S. Water in the Cable Jacket
- Water can be absorbed into the cable jacket through holes In the outer sheath or through poorly made splices. The *water* willsoak into the cable and form a sheild to the test signal used to locate opens. The **waterwiUhaveno effed onthekxation of shorts. Since** thewaterrarely penertatesfarinto thecable,there will be lengthsperhaps aslongastwenty feetwhereyouwill notbeableto findasignal. Thiscaneasilybe mistaken fortheopen. Itisalwaysa goodideato checkthecable thirty or fortyfeetpastthe point whereyoulosesigna.l ttthesignal ispickedupaga,in the openisstilfarther downthecable. Youshould remember findingthis problembecauseitmaycausewater shortsIn aspliceat alater date. Thissection of thecableshould be removed andcarefullyreparied assoonaspossible.

5. THE MODEL CD-710 PORTABLE CABLE FAUI:r DETECTOR

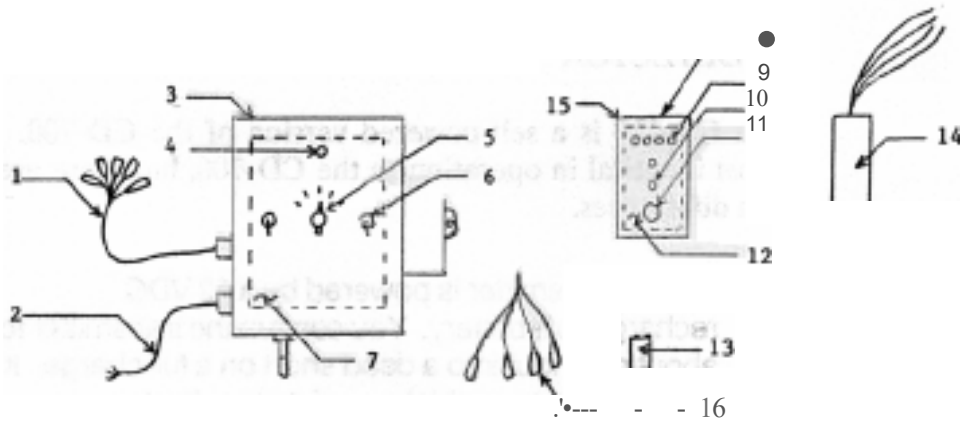
The CD-710 *is* a self-powered ven ion of the CD-700. It *is* almost identical in operation to the CD-700, but there are two maindifferences.

- **1.** The transmitter is powered by a 12 VOE rechargeable battery. You can run the transmitter for about one hour Into a dead short on a full charge. It will run much longer on higher resistance shorts and opens. * In cold weather (32 Degrees F and lower), the transmitter may operate for only 20 minutes into a dead short.
- Leave the transmitter plugged in when 8\18r the CD-710 is not being used. A removeable 115 VAC plug and cord are provided for recharging.
- Before using the transmitte,r the battery charge can be tested by turning the un on and holding the battery 'test" button for 3 seconds. The red lamp beside the button should be it without flickering ij the battery Is adequately charged This doE>S not gua,antee a full charge.
- **2.** An earphone has been added to the detector so t h a t can be used in bright light where the detector display mey be difficult to see.
- A loud tone indicates a strong signal. If the tone is weak or cannot be heard, there is no signal.

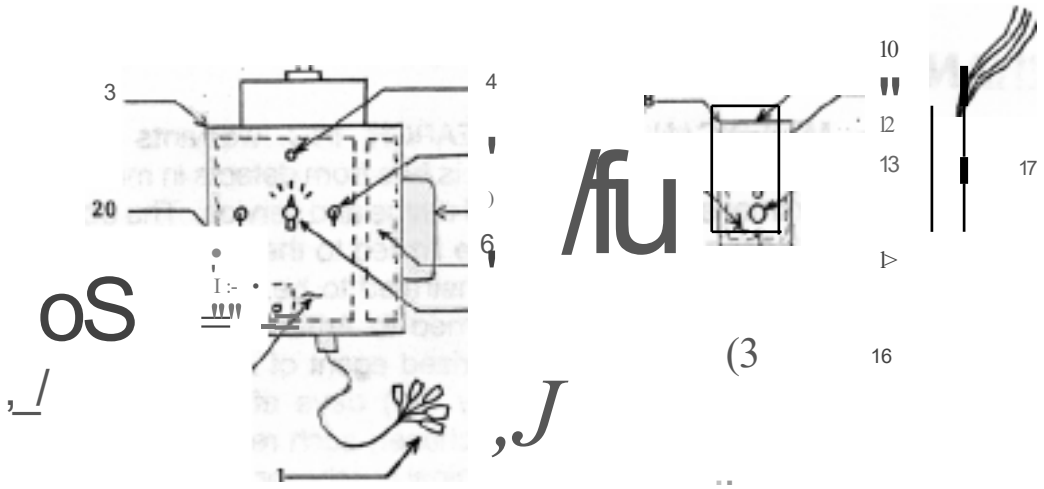
NOTE: When using the CD-710 to locate opens, may be necessary to (TOUnd the case of the transmitter. A Jumper wire with two alligator clips is included for the purpose. Any connection to earth ground is all right (roof bolts, framE>S of grounded machinery etc.). On high voltage cables, just use the ground on the section of the cable toward the power center or substation.

If the transmitter is not grounded, is possible to pass the fautl with no loss of lights or tone. tt you have this problem with the CD-710, recheck your connection from the transmitter frame to earth ground.

FIGUI 11 - CD-700 ASSDBLI&S



NO.	PIN AND DESCBIPIION
1	# 195-0017 Transmitter Gable Assembly
2	#195-0018117 VAC Power Cord Assembly
3	#081-0047 Transmitter Enclosure
	#081-0048 Trensmitter *Cover*
4	#033-0007 Faut Lamp
5	#200-0001 Phase Select Switch Knob
6	# 185-0010 Switch Boot
7	#253-0036 Transmitter PCB Assembly
8	#125-0013 Detector Cover
	#211-0017 Detector Enclosu-e
9	#065-0002 Lamp Lens
10	#185-0005 Switeh Boot
11	#200-0003 Sensitivity Control Knob
12	#253-0037 Detector PCB Assembly
13	#275-0004 Battery, 9 voe
14	#270-0002 Machine Filter (AMR # PF-160)
15	#081-0046 Detector Plate
16	#195-0016 Shonlng Jumper AsselT'bly



NO	PIN AND DESCRIPTION
1	#195-0023 Transmitter Cable Assembly
2	#195-0038 Recharger Cable Assembly
3	# 081-0067 Transmitter Enclosure
	#081-0068 Transmitter Cover
4	# 033-0011 Fault Lamp
5	#185-0010 Switch Boot
6	#200-0001 Phase Select Switch Knob
7	#079-0004 Handle
8	#253-0071 Transmitter PCB Assembly
9	#275-0003 Battery, Rechargeable 12 voe
10	#125-0019 Detector Cover
	# 211-0017 Detector Enclosure
11	#065-0002 Lamp Lens
12	#185-0005 Switch Boot
13	#200-0003 Sensitivity Control Knob
14	#253-0061 Detector PCB Assembly
15	#039-0003 Earphone
16	#275-0004 Battery, 9 voe
17	#270-0002 Machine Filter (AMR #PF-160)
18	#081-0046 Detector Plate
19	#195-0016 Shorfug Jumper Assembly
20	#253-0050 Battery Test PCB Assembly

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