Model GM-150
Ground Monitor

Revised July 21, 1983
3. Supplement 1.Added September 16, 1983

Patent #4153923

Manual Part Number 180-0003B

TABLE OF CONTENTS

TITLE **PAGE**

1. INTRODUCTION

The American Mine Research AC Frame Ground Monitor is a solid state frequency controlled system whose purpose is to monitor the continuity of the AC frame ground conductor on three phase equipment. It is a continuity monitor system that has a maximum allowable trip resistance of 75 ohms. The monitor can be operated pilotless, with standard type cable, or with a pilotwire and type G-GC cable.

The GM-150 system is a five unit monitor that is capable of monitoring five pieces of equipment supplied from one power center with only one monitor package. The receivers utilize an automatic frequency following technique to eliminate nuisance tripping due to slight frequency drifts in the transmitter. The Monitor also provides a 250 millisecond time delay to reduce nuisance tripping due to intermittent conditions in the mines. The circuit description and installation instructions are given in the following pages.

2. CIRCUIT DESCRIPTION

2.A. The AMR ground check monitor is composed of the following basic functional components:

- Power Supply
- Transmitter
- Receiver
- Current Transformers
- Three Phase Filters

2.B. General Operation Descrption

The AMR Ground Monitor system utilizes an audio frequency signal to monitor the continuity of the ground conductor. An audio signal is generated by the transmitter section. This signal is coupled on to the three phase power conductors going to the equipment being monitored by one of three phase filters. The signal then travels up the three conductors to the monitored piece of equipment. The signal is then coupled from the three phase lines to the ground conductor by the second three phase filter. The audio signal travels back to the power center through the ground conductor and passes through the current transformer to frame ground and the common side of the transmitter output. The current transformer couples the audio signal from the ground line to the receiver. The receiver then detects the signal and closes a relay which is part of the hold-in circuit for the three phase circuit which is part of the hold-in circuit for the three phase circuit breaker feeding the monitored equipment. If the audio signal is lost for any reason due to a broken ground conductor or any open whatsoever in the above transmission circuit, the relay is released and power is shut off to the machine being monitored.

3. INSTALLATION AND CHECKOUT PROCEDURE

3.A. General Installation Instructions

- All installation wiring shall be performing according to all applicable codes.
- All hookup wiring should be at least 18 AWG, type, THNN, or Equivalent insulations, except the transmitter output lead, which should be at lease 14 AWG. It may be preferable to use a larger size wire for mechanical strength reasons.
- All terminations and connections shall be made using approved termination and splice connectors.
- The MAIN AC power and the MAIN DC power should be visibly disconnected, locked and tagged out before and during installation of this equipment.

3.B. Installation Instruction For Low Voltage Pilotless Systems

The installation of the AMR GM-150 Ground Monitoring System consists mainly of the mounting and wiring of the following pieces of equipment:

- Master monitor enclosure and slave enclosure if applicable.
- One receiver current transformer on the ground line of each AC outlet to be monitored.
- One three phase filter on each of the above AC outlets
- One three phase filter on each piece of equipment to be monitored
- One remote indicator box for each main or slave enclosure if applicable

The schematic for the GM-150 system is shown in Figure 1.and should be referred to while installing the unit (see also Figure 8).

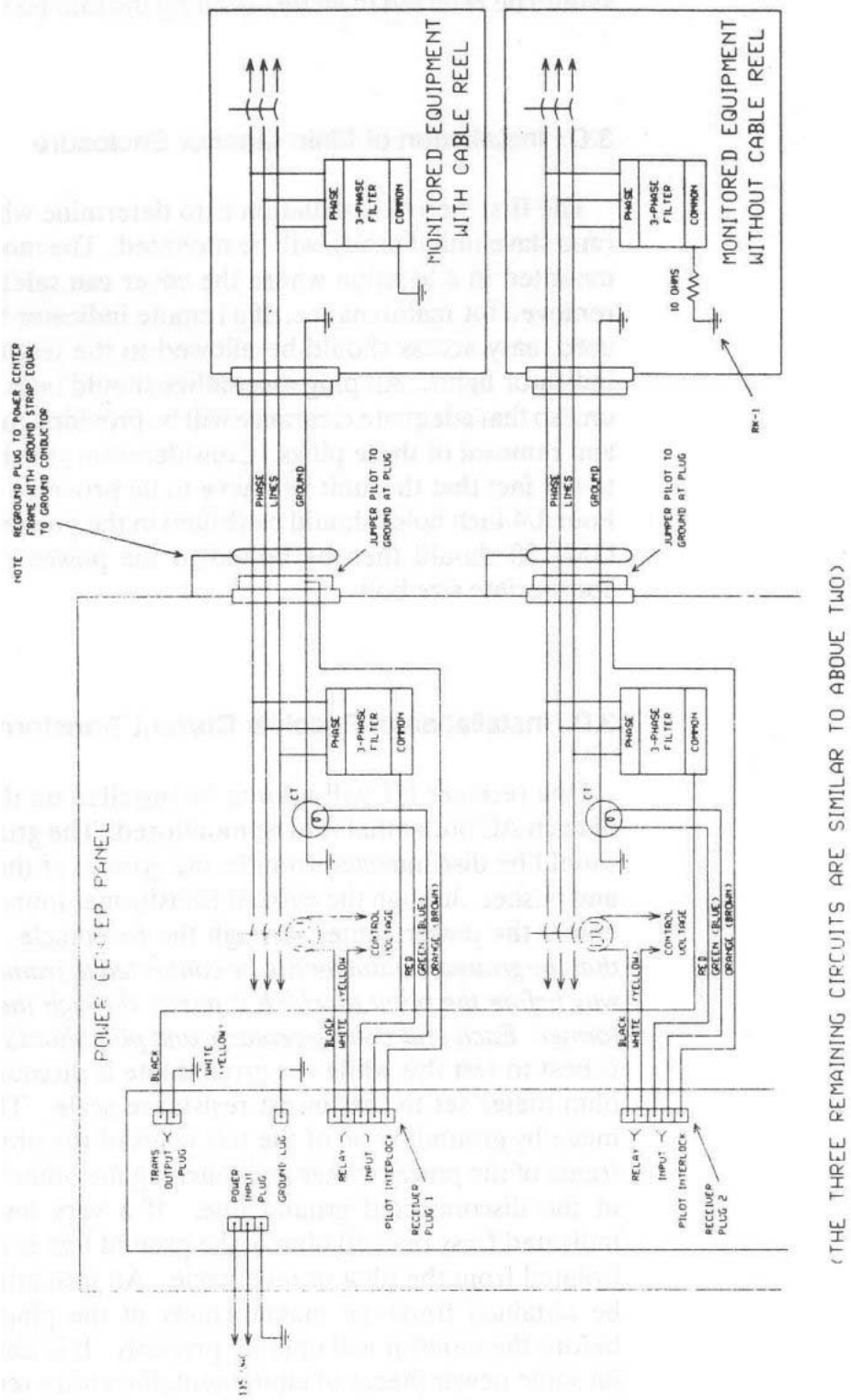
3.C. Installation of Main Monitor Enclosure

The first step in installation is to determine where the master (and slave unit if used), will be mounted. The monitor should be mounted in a location where the cover can safely and easily be removed for maintenance. If a remote indicator box is not being used, easy access should be allowed to the test button and trip indicator lights. All plug assemblies should be connected to the unit so that adequate clearance will be provided for easy insertion and removal of these plugs. Consideration should also be given to the fact that this unit will have to be provided with 115 VAC. Four ¼ inch holes should be drilled in the power center and the GM-150 should then be bolted to the power center using an appropriate size bolt.

3.D. Installation of Receiver Current Transformers

One receiver CT will have to be installed on the ground line of each AC outlet that is to be monitored. The ground conductor should be disconnected from frame ground of the power center and pushed through the current transformer immediately after it enters the power center through the receptacle. It is necessary that he ground conductor not be connected to frame ground I any way before the point at which it passes through the current transformer. Each and every receptacle and plug should be checked. It is best to test this while the ground line is disconnected with an ohm meter set the lowest resistance scale. This test can be made by grounding on of the test leads of the ohm meter to the frame of the power center and touching the other lead to the end of the disconnected ground line. If a very low resistance is indicated (less than 10 Ohms), the ground line is most likely not isolated from the plug or receptacle. An insulating sleeve must be obtained from manufacturer of the plug and installed before the monitor will operate properly. It is also possible that on some newer pieces of equipment, the entire receptacle might be isolated from the power center frame by mounting it on an

Figure 1. Wiring for GM-150-5 Continuity Ground Monitor



insulated board which is mounted to the power center. This accomplished the same purpose of not allowing the signal to get to frame ground before it passes through the CT. Once the CT is properly installed, the ground line should be connected back to the frame of the power center. The plug and receptacle must then be grounded to the frame of the power center with grounding straps which are at least half the size of the phase conductor

Two pieces of wire should be cut that are long enough to go from the CT lead to the GM-150 enclosure. Each wire should be crimped to the CT output leads with the terminals that are already installed on the CT leads. The wire should then be neatly routed and tied down through the power center to the GM-150 enclosure. The above procedure should then be followed for the installation of all five CT's.

Located the five receiver plugs that are enclose with the GM-150 unit. Note that there are five different colored wire (red, green, orange, black and white) that are stripped and tinned on the opposite end of each plug.

Note 1: Some GM-150 cable assemblies will use cable which contains a brown wire instead of an orange. This wire is used for pilot interlock. Please not this difference when the monitor is installed. Using a crip type insulated terminal, connect the two wires coming from each CT, to the red and green lead of each plug. Neither lead from the CT is polarized; therefore, each plug can be connected to either the red or green wires. When all five plugs are connected to their respective CT's, continue with the next step.

3.E. Installation of Three-Phase Filters at Power Center

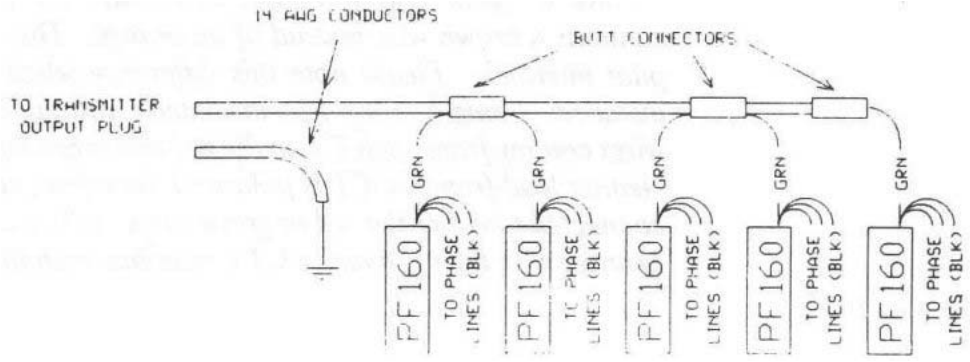
There are currently two different models of phase filters (Part No. 270-0002, 1000 VAC and 270-0003, 600 VAC) available with AMR Ground Monitoring Systems. The #270-0002, 1000 VAC units, can be used on 600 VAC systems, but the #270-0003, 600 VAC unit, should not be used on circuits that have phase to phase voltages in excess of the 600 VAC.

The phase filters should be mounted in the power center using the large cable ties to securely hold them in place. The three black phase wires should be connected to the phase lines on the load side o the breaker, as shown in Figure 2. All five phase

filters should be mounted and connected to the load side of their respective breakers.

The transmitter output plug should next be located and a piece of 14 AWG wire should be cut to go from the plug at the monitor to frame ground o the power center. Using a butt connector, fasten the wire to the white lead of the transmitter output plug and securely fasten the other end of the wire to the frame of the power center. A second 14 AWG wire should be connected to the black wire on the transmitter ooutput plug. This wire must now be connected to the green wire on each of the five PF-160 phase filters. A simple method of connecting the PG-160's to the transmitter output lead using the large butt connector is shown in Figure 2.

Figure 2



3.F. Installation of Three-Phase Filters on Equipment Being Monitored

The three-phase filter should be installed inside the electrical box on the equipment being monitored. The unit should be securely mounted to the piece of equipment using large cable ties. The green wire of the phase filter should be connected to frame ground of the equipment. The three black wires should be connected to the power phase lines as shown in Figure 1. It is necessary for this connection to be made at a point on the line

Side of the equipment disconnect device, so that the monitor will be able to continue monitoring when the equipment is shut down. One three-phase filter must be installed on each piece of equpment that is to be monitored.

In installations where a large number of non-cable reel equipment are to be monitored, some nuisance tripping of high resistance machines (ex. Shuttle cars and roof bolters with take up reels) may be experienced. This is caused by the excessive drain of transmitter current by the low resistance equipment without cable reels. The problem can be solved by the installation of a approximately 10 ohms of resistance in the green frame ground lead of each phase filter installed on non-cable reel equipment. This reduces transmitter current drain to these machines and completely eliminates this problem.

The installation of this resistance can be made either by the customer himself or by obtaining modification kit RK-1 from AMR. This addition is shown on the schematic in Figure1.

3.G. Connection of Tripping Point

The next connection made is the contacts of the monitor's tripping relay to the under voltage release or shunt trip in each AC breaker that is to be monitored. Locate the two wires coming out of the breaker that carry its' shunt trip or under voltage current. When the correct wires have been found, cut one of the wires and strip the insulation off both of the open ends. A wire must be connected to each of these ends, and then each wire must be routed to the main monitor enclosure. Locate the receiver plug which has the corresponding CT connected to it. The black and white wires of the cable plug should now be connected to the two leads coming from the breaker. All of the circuit breakers to be monitored must be connected in the same manner to their respective receiver plugs. (To change shut trip, refer to Figure 8 for internal change.)

3.H. Connection of Remote Indicator Enclosure

The GM-150 system has available an option of having its trip indicator lights and test button extended to a position remote to the main enclosure. The remote indicator assembly can be located at any convenient place on the power center. The remote indicator unit is connected to the master or slave unit by a rugged multi-wire flat cable assembly. This cable is plugged into the matching receptacle (align red dots) on the main board in to the master or slave enclosure and into the small pc board located in the remote indicator box. The multi-pin flat cable is connected properly by aligning the red mark on the connector and plug. Also pin #3 on the connector and plug is keyed for proper installation.

When the remote indicator option is used, the test button on the main enclosure is replaced with a two position topple switch which is parallel with the test button. In the event that the test button becomes inoperative, or the flat cable is severed, the toggle switch on the main enclosure can be closed and the unit will operate. The unit could be tested by opening the toggle switch until the remote indicator could be repaired or replaced.

The remote indicator box is mounted by the two ¼ inch bolts protruding from the back of the enclosure. Two 5/16 inch holes should be drilled in the power center at the location where the remote indicator is to be mounted. The remote indicator can now be slid in place and bolted using the two nuts supplied with the unit. Care should be taken to route the flat cable through the power center to the main enclosures so that it will not be damaged during regular servicing of the power center equipment.

3.I. Connection of Input Power to Monitor

Locate a point on the power center where 115VAC is available. Connect two leads to this supply and route the leads though the power center to the GM-150 system and connect the two 115 VAC leads to the black and white leads of the plug using crimp terminals. The green lead left on the power input plug should be frame grounded to the power center to insure that the monitor case is frame grounded. The ground bolt on the side of the GM-150 enclosure next to the power input plug should also have a wire run from it of the frame ground of the power center.

3.J. Connection of Pilot Interlock Feature

The GM-150 system also provides a pilot interlock feature that will satisfy the Bureau of Mine Regulations requiring the circuit breaker to open if the machine plug is accidentally removed while under load. This disconnect feature of the GM-150 does not contain the 259 milisecond time delay that is allowed in the approved monitor circuitry. This pilot interlock gives an immediate breaker trip upon removal of the three phase machine plug. If the pilot interlock feature is desired, connect the orange (brown) (see Note 1, Section 3.D.) wire on each receiver output plug to the pilot pin on the back of the power center. Each three phase plug that is used in any of the monitored outlets must contain a jumper wire that connects the pilot pins in the plug to the ground pin. This connection allows the pilot interlock current to flow into the frame ground of the power center.

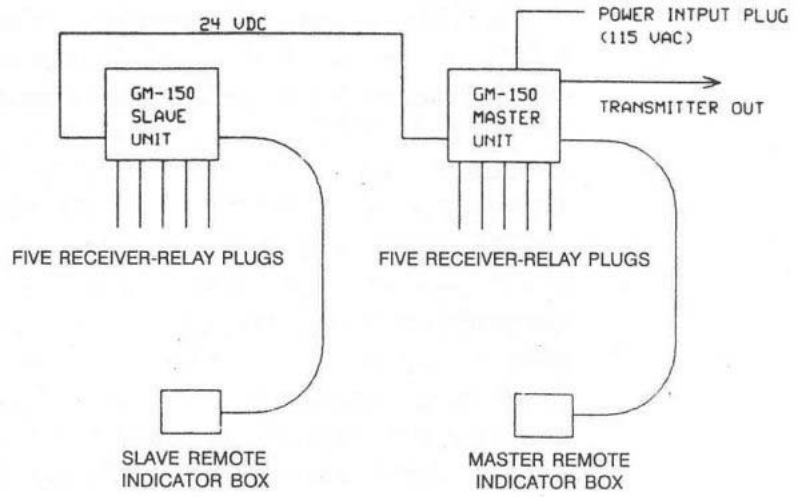
If it is not desirable to use the pilot interlock feature, the orange wires must be connected to frame ground of the power center or the frame ground bolt on the GM-150 main enclosure.

3.K. Connection of Slave Unit – GM-150

The GM-150 system can monitor up to five additional AC outlets by the addition of a slave enclosure. The slave enclosure will contain only the necessary number of receiver boards and relays for any number of circuits between six and ten. To equip a unit with more than ten circuits, an additional GM-150 master enclosure would have to be added. The slave unit operates from the DC power supply of the master unit.

This DC power is transferred by a cord that plugs into the two pin terminal, marked 24 VDC, on each box. The receiver input plugs that plug into the unit are connected identically to hose in the main enclosure. The slave box does not require connection for 115 VAC power or transmitter output. The connections for the GM-150 slave system are shown in Figure 4.

Figure 4



3.L. Operational Testing

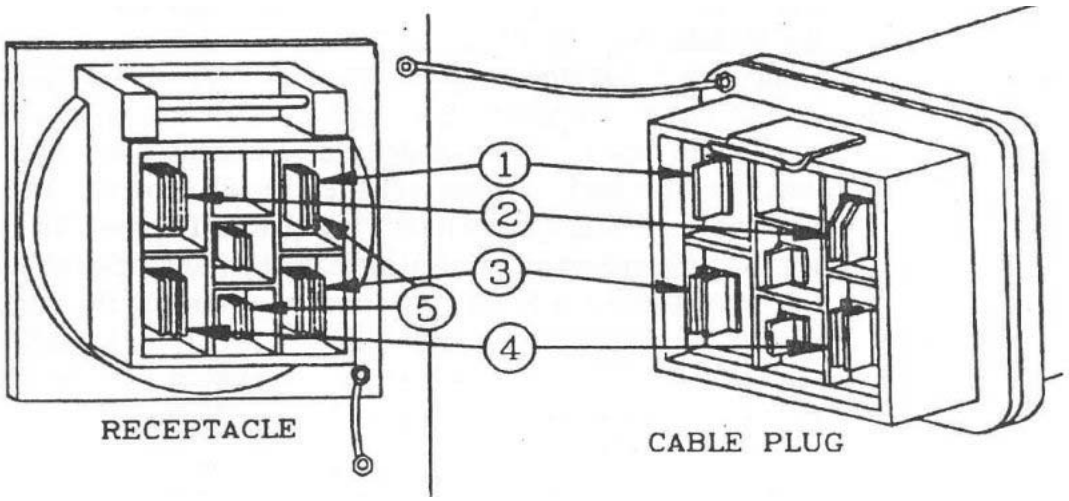
1. Verify that all wiring is connected as directed in previous instruction.
2. Apply voltage to power center and turn the monitor power switch to the "on" position. Allow the monitor a five minute warm up period before continuing with operational tests.
3. The following procedure will function test the monitor. Plug all the machine plugs available into the power center and then press the small reset button on either the remote indicator box or on the main unit. The trip indicator light for each circuit that has a machine plugged into it should now go out. If any problems are now apparent, refer to the Trouble Shooting Procedure in Section 4 of this manual. Set all the circuit breaker that have machines plugged into them. Now press the test button and hold it in for at least two seconds. All the circuit breakers should now trip and the corresponding trip indicator lights should come on. If any monitored circuit breakers on the power center have not yet been tested, move the machine plugs to these circuits and repeat the above procedure. If any problems develop, refer to the Trouble Shooting Procedure in Section 4.

4. The next checkout procedure on the monitor will test the single phase protection of the monitor and insure that it will trip when the machine ground line is opened. At least five jumper cords or short pieces of wire will be required to perform this test. AT NO TIME DURING THIS TEST SHOULD THE CIRCUIT BREAKER UNDER TEST EVER BE CLOSED OR SET AND A LOCK SHOULD BE ON THE BREAKER AT ALL TIMES. Remove one machine plug from the power center and using the jumpers, make the connections as shown in Figure 5. This should allow the monitor to pickup, and when the small reset button on the remote indicator or the main enclosure is pressed, the corresponding trip indicator light should go out. Remove the ground jumper which in Figure 5 is number 1. This should cause the monitor to trip after a time delay of ¼ second, and the trip indicator light for the circuit under test should come on. Reconnect the ground jumper to its original place. The monitor relay should again pickup and the trip indicator light should go off when the reset button is pressed. Now remove any one of the jumpers that are connecting the phases (jumpers 2, 3, or 4 in Figure 5). Removal of any one of the phase jumpers should again cause the monitor to trip after a time delay of 250 milliseconds. The trip indicator light should again come on. This test insures that the monitor will trip if any phase conductor in the cable is opened for more than 250 milliseconds. Return the phase jumper and reset the monitor trip indicators. Now remove the jumper that con-nects the pilot pin to ground (jumper 5 in Figure 5). The monitor should immediately trip with no time delay at all, and the correct trip indicator light should come on. Reconnect the pilot jumper, and again reset the trip indicator lights. This completes the tests for this circuit that is to be monitored by the GM-150 system. If any problems are encountered refer to the Trouble Shooting Procedure in Section 4.

5. The pilot interlock feature can be tested by the following procedure. Set all the breakers on the power center and press the reset button on either the remote indicator box or the main unit. Go to each machine plugged into the power center and turn the machine OFF so that it will drawing the minimum possible amount of current from the power center. Return to the unit, slowly remove each machine plug and observe if the correct circuit breaker immediately trips when the pilot pin is disconnected. There should be no 250 millisecond time delay in this

tripping action. Perform this test on all the circuits monitored by the GM-150 system. If any problems might occur during this procedure, refer to the Trouble Shooting Procedure in Section 4 of this manual.

Figure 5

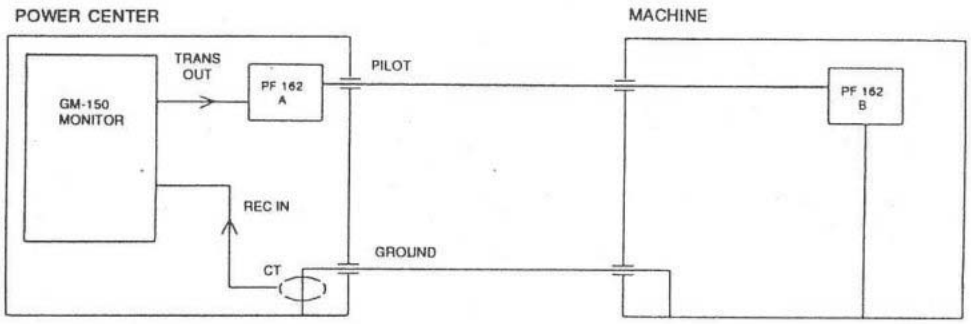


3. SUPPLEMENT – Installation of the GM-150 as a Pilot Wire Monitor

The installation and checkout procedures described elsewhere in Section 3 will apply to pilotless installations. The major differences are explained in the following section.

The GM-150 can monitor trailing cable grounds using a pilot wire. Two methods are accepted at present.

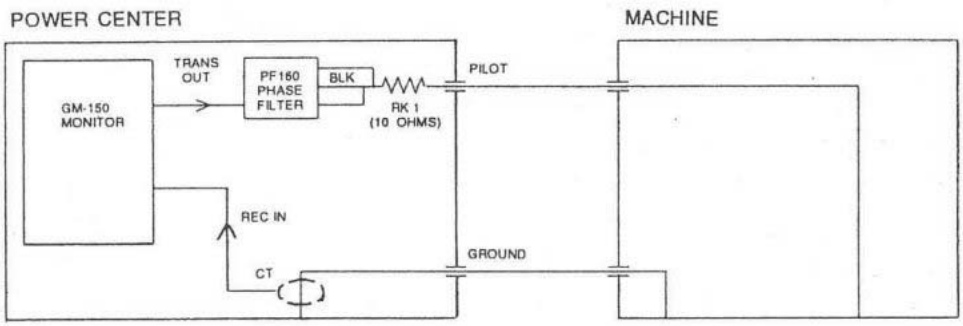
Figure 1S



The first method involves the use of a tuned filter pair (see Figure 1S). The transmitter output is connected to a power center filter (AMR #PF162-A). No polarity needs to be observed in the filter hookup. The other lead of this filter is connected to the pilot pin. The machine filter (AMR #162-B) is connected between the pilot wire and frame ground. Again, this filter is not polarized. These two filters in series create a tuned circuit having low impedance to the monitor frequency while reducing induced 60 cycle current. This approach is preferred, since it is able to detect pilot-to-ground shorts in the cable.

If there is not sufficient room to mount a machine filter (such as in pumps), the second approach is to simply run the monitor signal through the pilot wire directly to ground at the machine (see Figure 2S). A 1000 VAC phase filter (AMR #PF160) is placed in series with the pilot wire to reduce 60 cycle induced currents and to protect the ground monitor. This method is unable to detect pilot-to-ground shorts, as is the case with many impedance type monitors. When no filter pair is used and the monitor is used on noncable reel equipment with cables shorter than 250 ft., a 10 ohm resistor (AMR #RK-1) is inserted in series as in Figure 2S. The same GM-150 monitor may be used to monitor both pilotless and pilot wire applications at the same time.

Figure 2S



4. TROUBLE SHOOTING

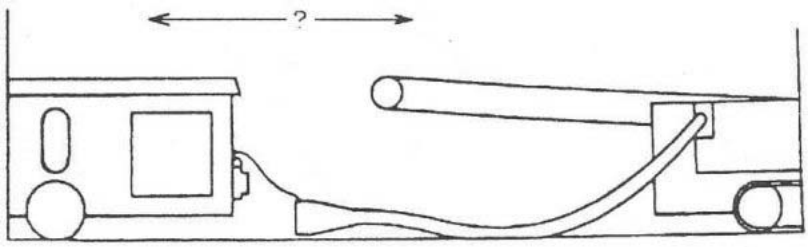
4.A. General Instructions

Experience indicates that the most common problems encountered are faulty wiring connections, broken or intermittent connections in the trailing cable or ground wires not isolated from the frame before passing through the receiver CT (see Section 4.D.). Before going into the detailed Trouble Shooting Procedures outlined below, all wiring should be verified to the correct according to the electrical schematics, and examined to insure proper electrical and mechanical integrity.

The Trouble Shooting Procedure for the AMR Ground Monitoring System is a simple process of elimination. The idea is to eliminate as quickly as possible the different components of the system to pinpoint the problem area. The following procedure should quickly lead to the source of the trouble.

4.B. Procedure for GM-150 Single Unit Failure

4.B.I. Determine Location of Problem



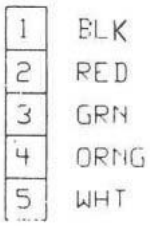
- Remove power from the circuit under test by opening the circuit breaker at the power center feeding that piece of equipment.
- Remove the machine cable plug from the power center.
- Verify that the power has been removed by using a voltohm meter (VOM).
- Connect the three phase conductors to the ground conductor at the receptacle outlet on the power center. This can be done by using the phase filter found in the TK-150 Test Kit or a piece of bare wire that can be bent to connect the three phase terminals to the ground terminal of the receptacle. If the pilot interlock feature is being used. It will also be necessary to connect a jumper from the pilot pin to the ground pin.
- If the red trip indicator light for this circuit now stays out when the reset button is pressed, this indicates that all the monitor equipment in the power center is working and the problem is limited to the following areas:
    - In the trailing cable or on the machine being monitored. (see Section 4.B.3.)
    - The monitor is out of calibration.
- If the red trip indicator light can not be reset after the jumpers are installed, this indicates the problem is within the power center and you should proceed with the following Section.

4.B.2. Location of Problem within the Power Center

- Remove power from the power center and visually check all wiring connections from the ground monitor to the phase filter, current transformer (CT), and to the phase, ground, and pilot connections. If any wiring errors are suspected, the following checks can be made with a volt-ohm meter to verify correct wiring.

- With the volt-ohm meter set to the lowest resistance scale, remove the transmitter output plug from the master unit and place one probe on the silver pin of the plug and the other probe on the frame ground of the power center. This resistance should not be more than one or two ohms. If the resistance is greater, this indicates that the transmitter is not properly grounded.
- The following tests will be made on five pin receiver input plug. To insure that eh monitor is installed correctly, all receiver input plugs must be checked. Refer to Figure 6, the drawing of the receiver input plug.

Figure 6



- With the volt-ohm meter still set for the lowest resistance scale, place one probe in pin #4 of the receiver input plug and one probe on the frame ground of the power center. The meter should indicate a resistance of one or two ohms if the pilot interlock circuit is properly made. (A plug with the correct pilot to ground jumper will have to be connected to the corresponding receptacle for the plug you are checking.)
- Leaving the volt-ohm meter set on the resistance scale, place one probe in pin #2 and one probe in pin#3 of the receiver input plug. The receiver current transformer (CT) can usually be assumed to be good if this resistance is less than five ohms. If the indicated resistance if found to be higher, check the wiring and replace the CT if necessary.

- Place one probe of the volt-ohm meter, still set on the lowest resistance scale, on the frame of the GM-150 master unit and the other probe on frame ground of the power center. If the resistance is less than one or two ohms, this indicates that a wire is correctly run from the frame ground bolt of the GM-150 to the frame ground of the power center.
- Set the volt-ohm meter to a scale sufficient to measure the tripping voltage (117 VAC for most under voltage trip circuits) and then place the probe in pin #1 and pin #5 of the receiver input plug. The correct voltage is not found; trace the wiring to the correct breaker to identify the problem. A good test of the breaker trip mechanism is to short pin #1 and #5 together and attempt to set the breaker. If the breaker will not set properly, the problem is either in the wiring going to the breaker, or in the breaker itself.

- Apply power to the ground monitor unit. Check to make sure the circuit breaker going to the piece of equipment is still off.
- Install the jumpers again on the male receptacle as you did in #1
- Using a second jumper connect all four terminals on the phase filter located in the circuit of the power center together.
- Attempt to reset the monitor trip indicator light; if it stays out when reset, this indicates that the phase filter is defective and should be replaced.
- The GM-150 main monitor enclosure can be checked by using the test plug that is enclose with each TK-150 kit or by switching receiver boards from a known good circuit to the circuit that has failed. The TK-150 test plug is used by removing the transmitter output plug and the correct receiver input plug from the GM-150 enclosure. The test plug should then be connected to the transmitter output socket and the other end plugged into the receiver input. The small wire with the alligator clip on it should be connected to the ground bolt on the main GM-150 enclosure. If the trip indicator light on the monitor now stays on when reset,

this indicates that there is either loose wiring inside the GM-150 main enclosure (check wires going to the terminal strip from the five pin plug tested) or the receiver card is defective and must be replaced.

A spare receiver card is contained in the TK-159 Test Kit. If the problem is still not solved, replace the relay adjacent to the receiver card.

4.B.3. Location of Problem in the Trailing Cable or on Machine

- Remove all power from the machine and leave the cable plug disconnected from the power center so as to have visual disconnect. Lock out and tag the plug to insure safety during the following procedure.
- With an ohm meter set to the lowest ohms scale, check to see if the ground pin is isolated from the frame of the plug. This can be done by placing the probe on the ground pin and the other on the frame of the plug. Move the cable at the strain relief as much as possible and if the meter indicates a low resistance (less than 10 ohms), the plug must be taken apart and the ground wires isolated from the cable plug frame. FI the pilot interlock feature is being used, pace one probe on the ground pin and one probe on the pilot pin of the plug. There should be a low resistance short in this circuit (less than 10 ohms) indicating that the correct jumper has been installed in the plug between pilot and ground.
- On the newer pieces of distribution equipment, the entire power receptacle may be isolated from the frame of the equipment by mounting the receptacle on an insulated board. If this is the case with the unit you are working on, it will not be necessary or advisable to isolate the ground through the plug and the receptacle.
- Visually inspect the cable for cuts or bad splices. The probability is high that the problem will be in the cable.
- Remove the cover from the control box on the piece of equipment and visually check all connections.
- Leaving one person to observe the red trip indicator light on the monitor, go up and short the four terminals of the phase filter on the machine as in Section 4.B.2.

- Return the cable plug t the power center and lock out the circuit breaker so that power can not be placed on the machine.
- If the red trip indicator light now goes out, when the reset button is pushed, this indicates that the machine filter is bad and should be replaced.
- If the red trip indicator light stays on when reset, this indicates that the problem is in the cable or the associated wiring on the machine.
- The cable or machine wiring can be checked by using a jumper to short one phase to ground at the three phase filter on the machine. Place the probe of a volt-ohm meter, set to the lowest resistance scale, on the ground pin of the machine cable plug at the power center end of the cable. With the other probe, find the phase pin in the plug which contains the short. This resistance should be less than 4 to 5 ohms on machines that do not have cable take-up reels. If the machine does have a take-up reel, hold the ohm meter on the phase and ground pins while another person slowly pulls the cable off the reel. This resistance should not exceed 25-35 ohms. If a higher resistance is measured, the cable reel brushes should be serviced. All three phases should be checked in this manner to further isolate the problem.

4.C. Procedure For Multiple Unit Failure GM-150

4.C.1. Procedure for Power Supply Failure

- Check to see if all the circuit trip indicator lights are on. If these lights are on, this indicates the power supply is good and you can proceed to Section 4.B.2.
- If the trip indicator lights are off, check to see if the monitor power switch is in the “on” position.
- Remove the GM-150 cover and with a volt-ohm meter, insure that the unit has 115 VAC control voltage.

- Reset the power input circuit breaker by pressing its red button and then releasing it. Do this several times to insure that the breaker resets.
- Locate the trans-power circuit board and replace it with the spare unit in Test Kit TK-150.

If the above steps do not return the unit to service, remove and replace the entire GM-150 enclosure and return defective GM-150 unit to AMR for repair.

4.C.2. Procedure for Transmitter Failure

- Remove the GM-150 cover and reset the transmitter output circuit breaker by pressing the red button on the breaker and then releasing it. Do this several times to insure that the breaker resets.
- Visually inspect the transmitter output plug and associated wiring for continuity.
- Locate and remove the trans-power circuit board from the GM-150 and replace it with the spare unit in Test Kit TK-150.
- If the above steps do not return the unit to service, remove and replace the entire GM-150 enclosure and return the defective GM-150 unit to AMR for repair.

5. SPECIFICATIONS

5.A. Specifications GM-150

Electrical - General

- Power source – voltage 115 VAC + 20%, - 40% b.
- Power source current .400 amp

Electrical – Transmitter

- Frequency – 4.150 KHZ, typical
- Output signal current – 10 amp P/P into ¼ ohm

Electrical – Receiver

- Monitor trip resistance adjustable to 75 ohms
- Relay contact rating – 5 amps
- Time delay 250 m/Sec.

Mechanical

- Dimensions – length 14.5" (including mounting tab)
  width 9.5"
  height 4.5"
- Weight – 10 lbs.

5.B. Specifications Three Phase Filters

PF-160 (Part #270-002)

- Electrical
  - Maximum 3 phase voltage – 1000 VAC
  - Fusing – available upon request

- Mechanical
    - Dimensions – 2” O.D. x 5”
    - Weight - .5 lbs.

PF-165 (Part #270-0003)

- Electrical
    - Maximum 3 phase voltage – 600 VAC(2) Fusing- available upon request
- Mechanical
    - Dimensions – 1 1/8” O.D. x 4” (2) Weight - .25 lbs.

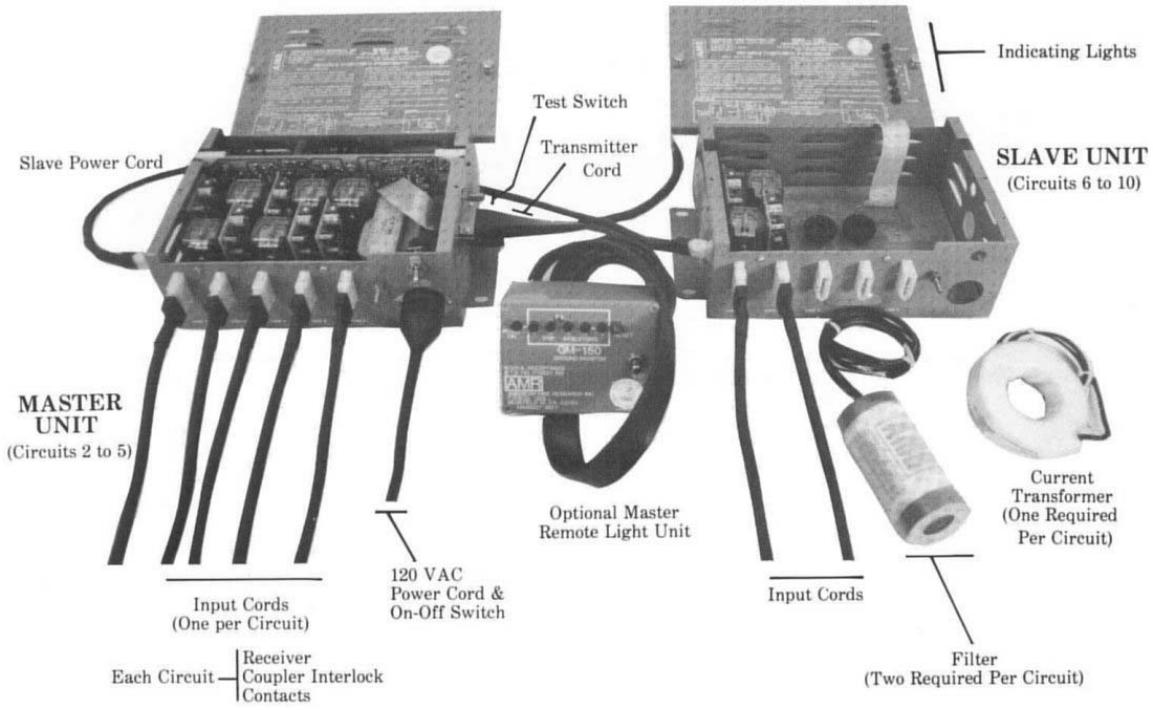
5.C. Specifications Receiver Current Transformer CT-130

- Mechanical
    - Dimensions – 3/8” O.D. x 2”
    - Weight – 1.25 lbs.

6. GM-150 COMPONENT ASSEMBLIES

Model GM-150-5

140-0003	Main assembly (non-remote main)
050-0002	Power switch
050-0003	Test switch
162.0003	Relay, 8-pin, 24 VDC, 10A (five per unit)
195-0001	Power cable assembly (one per unit)
195-0002	Output cable assembly (one per unit)
195-0003	Receiver/relay cable assembly (five per unit)
195-0006	Flat cable assembly, 20-conductor (one per unit)
235-0035	Receiver printed circuit board assembly (five per unit)
235-0012	Fault lamp printed circuit board assembly (one per unit)
253-0040	Power supply/transmitter printed circuit board assembly (one per unit)



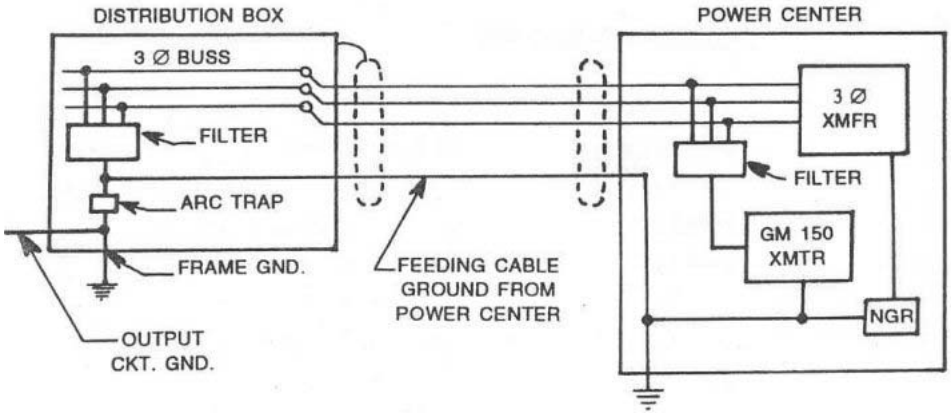
Model GM-150-10R

140-0004	Main assembly (non-remote main)
140-0006	Main assembly (remote slave)
162-0003	Relay, 8-pin, 24VDC, 10A (ten per unit)
195-0001	Power cable assembly (one per unit)
195-0002	Output cable assembly (one per unit)
195-0003	Receiver/relay cable assembly (five per unit)
195-0005	Slave cable assembly (one per unit)
235-0035	Receiver printed circuit board assembly (five per unit)
253-0040	Power supply/transmitter printed circuit board assembly (one per unit)
270-0101	Remote test/indicator assembly (main)
270-0102	Remote test/indicator assembly (slave)

7. INTERMACHINE ARC PROTECTION

The American Mine Research, Inc. GM-150 system can be used with any type of arc suppression device. The two common types of devices in use today re the diode suppressors and the inductance type suppressors. The signal of the GM-150 will pass directly through the diode type device and the device will simply add an additional amount of resistance to the circuit. In most cases, the amount of additional resistance would not cause any nuisance tripping. If any problems do develop, the circuit containing the diode arc suppressor can be calibrated by the procedure in Section 4 of this manual.

The inductance type arc suppressors can be more of a problem because they often add a much larger value of resistance t the monitor signal. This feature can sometimes be used to our advantage to block the monitor signal from going where it shouldn't go. An example of this is shown in Figure 7.



In this application, a three phase filter is placed in a distribution box to provide a return path for the ground monitor located in the transformer. If a second ground monitoring system was installed in the distribution box for its circuits, this filter would provide a dead short in the transmitter. It is necessary to install a blocking inductor or an arc trip to prevent this drain on the distribution box's transmitter. The arc trap would block the signal flow of the distribution box's transmitter from going directly through the transformers return filter.

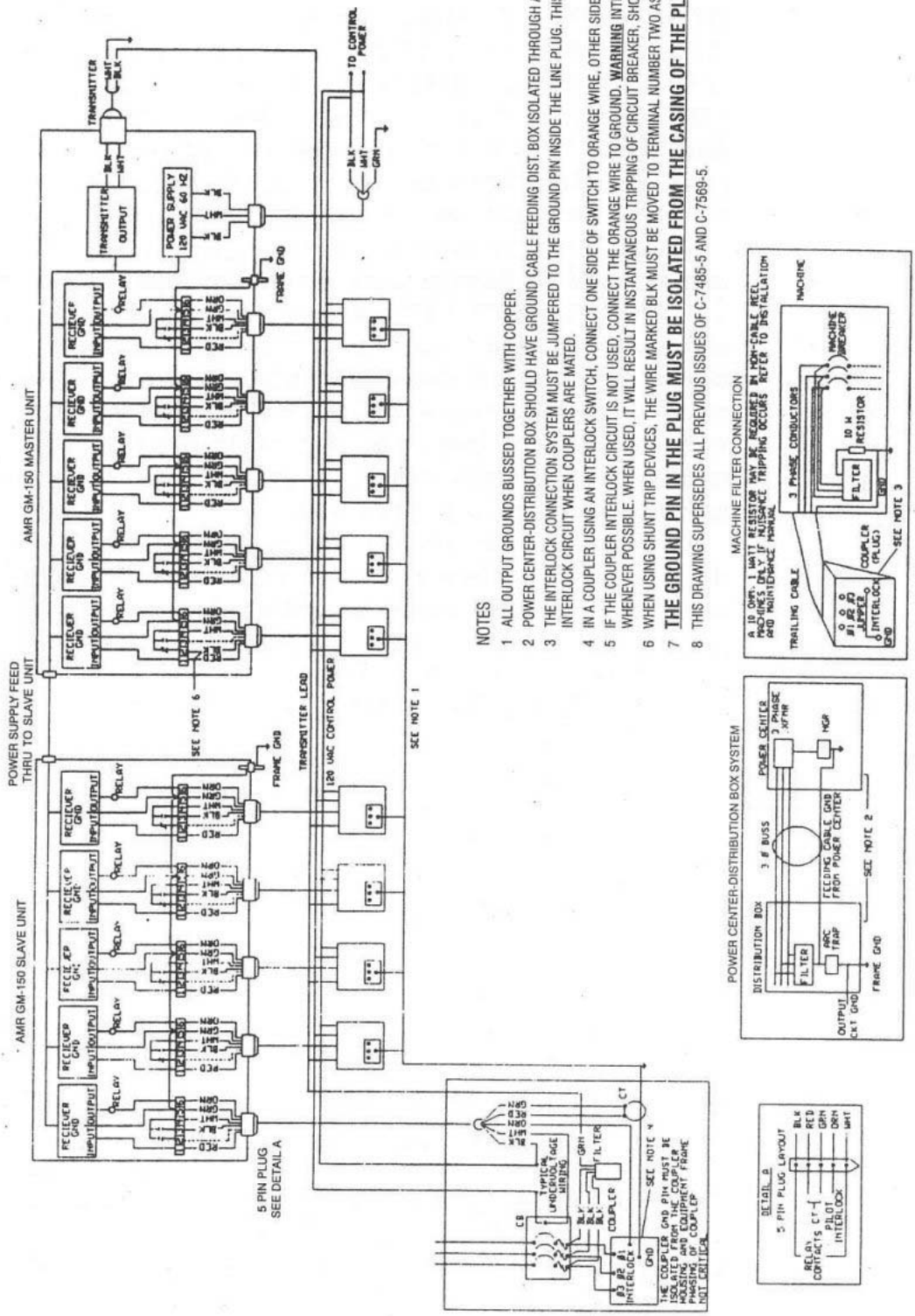
If it's necessary to install the inductor type of arc trap directly in the path of the monitor signal, an arc trap bypass filter, #PF-170 (AMR Part #270-0011) will have to be connected across the arc trap to allow the signal to get to frame ground of the power center. Any standard AMR three phase filter can be used by connecting the three black leads of the filter to one side of ht arc trap an the green lead of the filter to the other side. A 1 uf capacitor with a voltage rating of at least 200 volts could also be used in place of the three phase filter.

An any installation, it is best to do an initial test to determine the arcing potential between the different machines of the section. This type of test is will described in Reference 1. The arcing potential test should be repeated occasionally to be sure that no unsafe conditions have developed. If further engineering assistance might be required, contact American Mine Research, Inc.

---

1 "Intermachine Arcing Resulting From Induced Voltages in AC Mining Equipment Cables" by Ralph I. Krek and Robert A. Wolf, Mining Enforcement and Safety Administration.

Figure 8



NOTES

1. ALL OUTPUT GROUNDS BUSSED TOGETHER WITH COPPER.
2. POWER CENTER-DISTRIBUTION BOX SHOULD HAVE GROUND CABLE FEEDING DIST. BOX ISOLATED THROUGH AN INDUCTIVE ARC-TRAP.
3. THE INTERLOCK CONNECTION SYSTEM MUST BE JUMPERED TO THE GROUND PIN INSIDE THE LINE PLUG. THIS WILL COMPLETE INTERLOCK CIRCUIT WHEN COUPLERS ARE MATED.
4. IN A COUPLER USING AN INTERLOCK SWITCH, CONNECT ONE SIDE OF SWITCH TO ORANGE WIRE, OTHER SIDE OF SWITCH TO GROUND.
5. IF THE COUPLER INTERLOCK CIRCUIT IS NOT USED, CONNECT THE ORANGE WIRE TO GROUND. **WARNING** INTERLOCK SHOULD BE USED WHENEVER POSSIBLE. WHEN USED, IT WILL RESULT IN INSTANTANEOUS TRIPPING OF CIRCUIT BREAKER, SHOULD PLUG BE REMOVED.
6. WHEN USING SHUNT TRIP DEVICES, THE WIRE MARKED BLK MUST BE MOVED TO TERMINAL NUMBER TWO AS SHOWN.
7. **THE GROUND PIN IN THE PLUG MUST BE ISOLATED FROM THE CASING OF THE PLUG.**
8. THIS DRAWING SUPERSEDES ALL PREVIOUS ISSUES OF C-7485-5 AND C-7569-5.

APPENDIX A

EQUIPMENT REQUIRED FOR INSTALLATION

The following list of equipment is recommended for the underground installation of an American Mine Research, Inc. Ground Monitor System:

- Volt-ohm meter
- Crimping tool (for butt connectors)
- Wire strippers
- Wire cutters
- Electric drill with ¼" bit
- Extension cord for drill
- Center tap
- Hammer
- Sockets, ratchet, short extension and speed drive (for rapid removal and replacement of machine distribution box covers)
- Two adjustable end wrenches (10" or 12")
- Various size screw drivers
- An adequate length of 16-2 cable for installation of receiver current transformers, trip circuits and AC input power
- An adequate length of #14 wire to connect transmitter output to ground and all phase filters
- Small butt connectors for connection of power, current transformers, and trip circuits (#16 wire)
- Large butt connectors for transmitter output lead
- Large ring terminals for leads that must be frame grounded
- Small ty-raps for neat routing of wire through power center
- Large ty-raps for installation of phase filters

APPENDIX B

COMPONENT SUB-ASSEMBLIES

Part Number	Description
050-0002	Power switch (toggle)
050-0003	Test switch (push)
081-0006	Enclosure
081-0007	Enclosure cover
125-0003	Current transformer modified
125-0004	Remote test/indicator enclosure
125-0005	Remote test/indicator cover
140-0003	Main assy GM-150 (non-remote main)
140-0004	Main assy GM-150 (remote main)
140-0005	Main assy GM-150 (non-remote slave)
140-0006	Main assy GM-150 (remote slave)
140-0008	Test Unit, TU-175
145-0001	Test Kit, TK-150
162-0003	Relay, 24 VDC, 5A
180-0003	Installation & maintenance manual
195-0001	Power cable assy (STD 1', 6', or 10')
195-0002	Output cable assy (1', 6', or 10')
195-0003	Receiver/relay cable assy (1', 6', or 10')
195-0005	Slave cable assy (STD 2.5', & 7.5')
195-0006	Flat cable 20 conductor (non-remote)
195-0007	Flat cable 20 conductor (remote, STD 5' & 10')
253-0006	Mother board assy (main)
253-0035	Receiver board assy
253-0012	Fault lamp board assy
253-0040	Power supply/transmitter board assy
253-0019	Mother board assy (slave)
270-0002	Small 3 phase filter, PF-160, 100V
270-0003	Mini 3 phase filter, PF-165, 600V
270-0008	Machine load resistor, RK-1
270-0011	Arc trap by-pass filter, PF-170
270-0101	Remote test/indicator assy GM-150 (main)
270-0102	Remote test/indicator assy GM-150 (slave)

WARRANTY

American Mine Research Inc., warrants that each product manufactured by it is free from defects in material and workmanship under normal usage and service. The obligation under this warranty shall be limited to the repair or exchange of any part or demonstrated to be defective; provided, such part or parts is returned to American Mine Research, Inc.'s plant or to an authorized agent of American Mine Research, Inc., within ninety (90) days after delivery of the product to the original purchaser; such return to be made at the sole expense of the original purchaser.

THE WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER WARRANTIES, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, AND OF ANY AND ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF AMERICAN MINE RESEARCH, INC. AMERICAN MINE RESEARCH, INC. NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY LIABILITY OTHER THAN THIS WARRANTY IN CONNECTION WITH THE SALE OF ITS PRODUCTS OR ANY PART OR PARTS THEREOF.

THIS WARRANTY SHALL NOT APPLY TO ANY PRODUCT OR ANY PART THEREOF WHICH HAS BEEN SUBJECT TO ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, OR MISUSE, INCLUDING ANY PRODUCT OR ANY PART THEREOF ON WHICK THE SERIAL NUMBER HAS BEEN ALTERED, DEFACED, OR REMOVED.

THIS WARRANTY SHALL FURTHER NOT APPLY TO ANY PRODUCT OR ANY PART THEREOF WHICH HAS BEEN CONNECTED, INSTALLED, OR ADJUSTED OTHERWISE THAN IN ACCORDANCE WITH AMERICAN MINE RESEARCH INC.'S INSTRUCTIONS AND/OR SPECIFICATIONS.

American Mine Research, Inc. reserves the right to discontinue any product model at any time or with MSHA approval to change specifications or designs at any time without prior notice and without incurring any obligetions thereby.