INSTRUMENTS
Gas Detection for Life!

INSTRUCTION MANUAL

RIKEN PORTABLE SAMPLE-DRAWING DETECTOR/ALARM

FOR DETECTOR OF COMBUSTIBLES, CARBON MONOXIDE, HYDROGEN SULFIDE AND OXYGEN DEFICIENCY

BATTERY POWERED

MODEL GX-111

"FOUR-RUNNER"

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C O N T E N T S

I L L U S T R A T I O N S

1. DESCRIPTION

A. General Description (See Figure 1)

The Model GX-111 "Four-Runner" is a battery powered, portable instrument that can detect and indicate concentrations of combustible gas in air, carbon monoxide, hydrogen sulfide and oxygen, all of them simultaneously. It will give an audible alarm tone and a visible indication when the concentration of any of the gases exceeds a preset level or when the oxygen concentration falls below its preset level. Samples of the atmosphere under test are draw into the instrument continuously by a built-in pump and analyzed for carbon monoxide(CO), hydrogen sulfide(H_2S) and oxygen content by means of separate electrochemical cells. At the same time the sample is analyzed for combustible gas content on a heated platinum filament in a Wheatstone bridge measuring circuit. Response from the electrochemical cells and the platinum element are amplified through solid state circuit to indicate on a liquid crystal display and to trip preset alarm circuits.

This instruments is microprocessor controlled and is fully automatic, requiring minimum inputs from the user. After turn-on, all processes, instrument status and results of sample analyzers are indicated on the display. Power is provided by four dry-cells accessible from the bottom, long hose and probe are provided for acquiring samples from locations that are not easily accesible and an alarm repeater on a long extension cable is provided to alert personnel in locations remote from the instrument.

Platinum elements with a sintered metal cover, low power solid state circuits, solid-state vibratory pump and current limiting elements in this instruments. Operating power is limited to 6V DC, provided by four D-size dry cells. If external power source is connected, this automatically disconnects the internal batteries.

The instrument has a rigid plastic upper section with a control panel and display on top and accessory connections on the side. The lower section is a sheet aluminum housing with a battery access door in the bottom and it is secured to the upper section by slotted shoulder screws which also attach to straps to hold it in the carrying case.

The instrument fits into a padded soft plastic case with a webbing shoulder strap and a pocket to contain the accessories.

The four-Runner is suitable and recommended for testing tanks, manholes, vessels and other spaces to determine safety from the standpoints of explosibility, H_2S and CO toxicity, and oxygen deficiency before entering and white work is in progress. It can be used to determine presence or absence of combustible gas, hydrogen sulfide, carbon monoxide or oxygen in pressure cylinders, pipelines and other closed systems. It is a valuable aid to safety of operations wherever confined spaces must be entered.

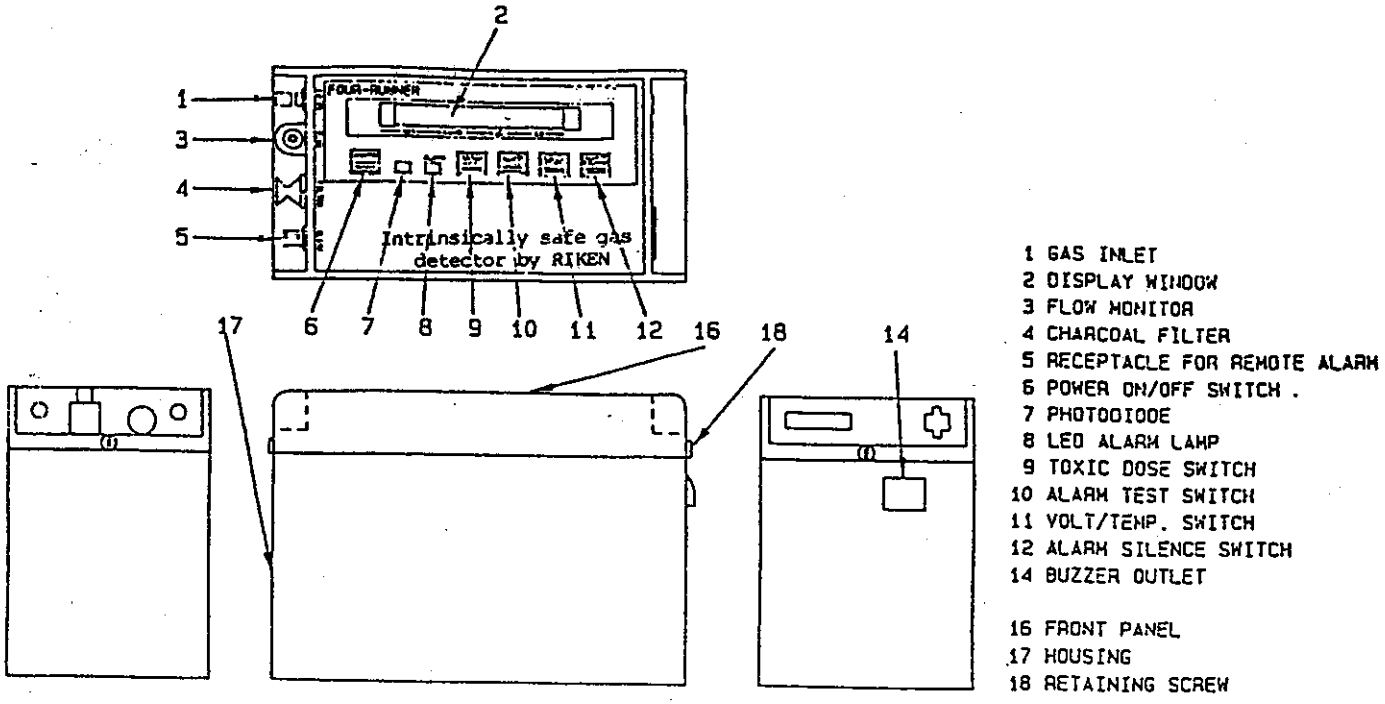


Fig. 1

Ⅱ. OPERATION (See Figure 2)

A. Preparing for Operation

1. Probe and Hose

Screw the probe onto the hose and connect the hose to the instrument by pulling the knurled locking collar away from the end of the hose, sliding the hose connector over the INLET nipple and releasing the locking collar. Gently pull on hose to be sure it is locked in place.

2. Remote Alarm (See Figure 3)

If the remote alarm is desired, unscrew the cap covering the ALARM socket receptacle on the left side near the front of the isntrument and insert the pin plug, with the slot in the shell uppermost. Secure the connector by turning the knurled locking ring.

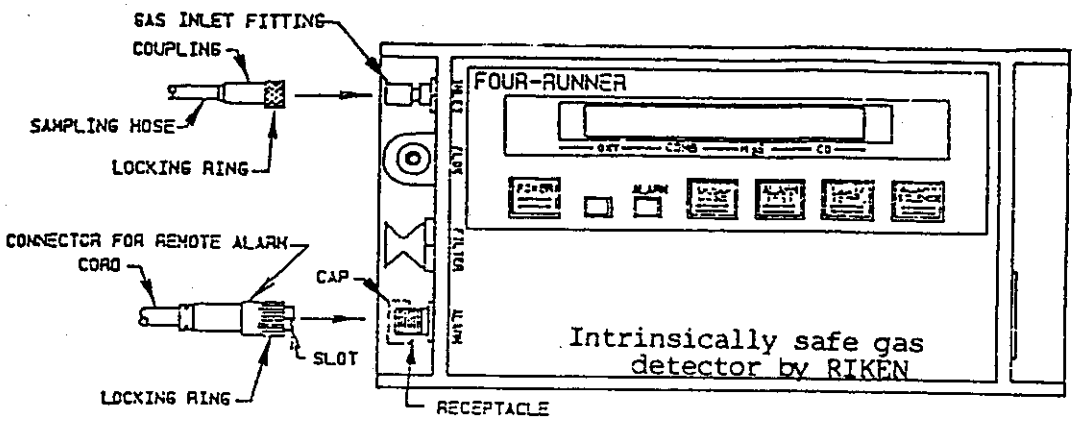


Fig. 2

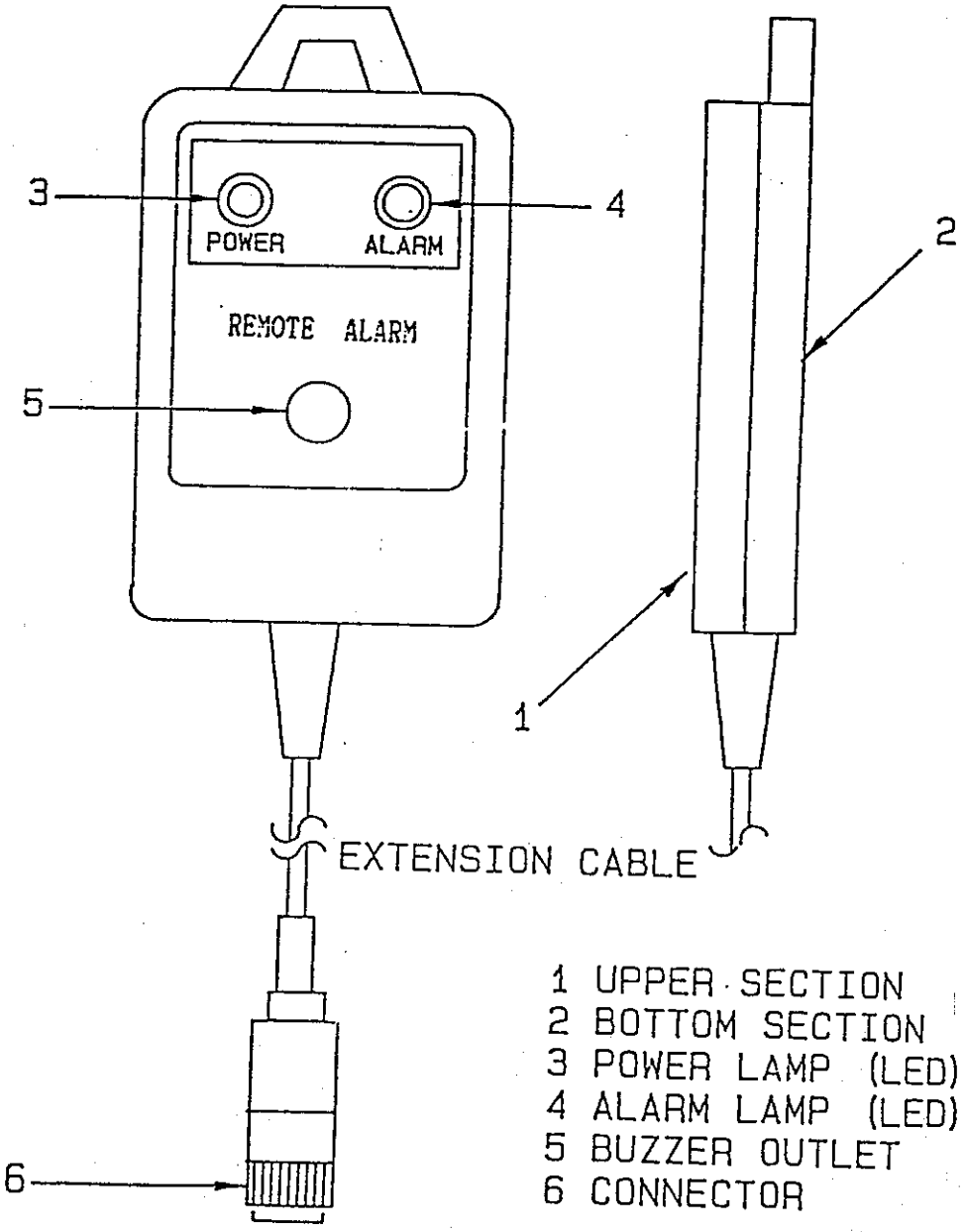

3
4
POWER
ALARM
REMOTE ALARM
5
2
1
EXTENSION CABLE
6
1 UPPER SECTION
2 BOTTOM SECTION
3 POWER LAMP (LED)
4 ALARM LAMP (LED)
5 BUZZER OUTLET
6 CONNECTOR

Fig. 3

B. Turning Instrument On

1. To turn instrument On, press the POWER switch once. To turn Off, press the switch again.

WARNING

The instrument must be in a gas-free atmosphere when turned on. If there is a presence of detectable gases, readings given later may be in error.

2. When the instrument is turned on the pump will start, white ball in flow indicator will oscillate, green POWER light in remote alarm will come on and the following message will appear on the display for 5 seconds :

WARMING-UP *

NOTE

Star at right end of display will blink to indicate that the instrument is operating properly.

3. If the remote alarm is not connected, the ALARM light will come on, the buzzer will " chirp " and the display will show :

CAUTION - REMOTE ALARM NOT CONN *

The alarm state will stop and the programming will resume if the REMOTE ALARM connector is inserted in the ALARM receptacle.

If it is desired to use the instrument without the REMOTE ALARM, press the ALARM SILENCE switch. The alarm state will stop and the programming will resume.

4. The display will show next :

AUTOMATIC ZERO / SPAN *

which indicates that adjustments are being made to zero the ranges for combustible, CO and H_2S and to set the span for oxygen at 21% (normal atmosphere). This adjustment takes 20 to 30 seconds to complete.

5. When the ZERO / SPAN adjustment is complete, the display will shows :

21.0% 0% LEL 0.0 PPM 0 PPM *

as the normal operating mode.

6. To assure that the instrument will be operable for an extended period, press the VOLT / TEMP switch. The buzzer will chirp once and the display will show for a 6 second period :

BATT X.XV (MIN 4.7V) TEMP YY ℃ *

indicating the present battery voltage as X.XV and the temperature of the incoming sample gas as YY℃.

7. To comfirm the levels at which the alarms are set, press the ALARM TEST switch. For 5 seconds the alarm light will come on, the buzzer will sound and the dispaly show :

A18.0% 30 % LEL 10.0 PPM 50 PPM *

indicating the factory set alarm levels for combustible, oxygen, H2S and CO. If desired, the alarm levels may be changed to suit a particular application (see paragraph Ⅲ. D.). The letter "A" at the left end of the display indicates that the alarm levels are being displayed not to be confused with a normal operatin display.

8. The instrument has now completed the automatic start-up cycle and is now ready to use.

C. T u r n - o n a n d O p e r a t i n g A b n o r m a l i t i e s

As the instrument is progressing through its turn-on program or normal operaion it checks for malfunction such as an abnormality in the program, a low battery and a missing or faulty detector.

1. If some abnormality occurs in the memory of the microprocessorthe alarm will sound and the display will show :

MALFUNCTION CIRCUIT *

The alarm may be silenced by pressing the ALARM SILENCE switch. No further measurements can be made until the abnormality is corrected.

2. When the battery voltage is down to the alarm point (4.7V), the alarm will sound and the display will show :

REPLACE BATTERY *

Pressing the ALARM SILENCE SWITCH will silence the alarm.
At this time the cells should be replaced.

3. If the zero adjustment cannot be made, or there is a bad connection to the sensor or the sensor is missing, the alarm will sound and the display will show one or more of the following :

MALFUNCTION COMB GAS *

or

MALFUNCTION CO *

or

MALFUNCTION H_2S *

If the oxygen sensor cannot be adjusted to 21% or if the connection is bad or the sensor is missing, the alarm will sound and the display will show :

MALFUNCTION OXYGEN *

The alarm will silence when the ALARM SILENCE switch is pressed. The program will continue and the display will show **** in the circuit where the malfunction is located, for example :

21.0% **** % LEL 0.0PPM 0 PPM *

Measurements will be made in all circuits except where **** is displayed.

4. When the sample flow drops below 100 mℓ/min, because of any flow restriction, the alarm will sound and the display will show :

FLOW FAILURE *

The alarm may be silenced with the ALARM SILENCE switch, however measurements cannot be made until the flow restriction is corrected.

D. Using Instrument

1. Normal Operation

For portability the instrument may be carried in its case by means of the adjustable shoulder strap. Be sure to attach the leather holding straps in the case to the retaining screws at the top of each end to prevent the instrument from falling out of the case.

Move the tip of the probe around the area to be tested and allow 10 ~ 15 seconds for the sample to reach the instrument and instrument to repond.

2. Display

The sample is analyzed for all four gases simultaneously and the display will continuously indicate the concentrations of the gases as they are detected. The ranges displayed for each of the gases are as follows :

OXYGEN : 0.0~25.0% (0.1 vol%/digit)
(If concentration exceeds 25%, the display will show "OVER")

COMBUSTIBLE : 0~100% LEL (1%/digit)
(If concentration exceeds 100%, the display will show "OVER")

HYDROGEN SULFIDE : 0~30ppm(0.5ppm/digit),
Continuing 125ppm(1 ppm/digit)
(If concentration exceeds 250ppm, the display will show "OVER")

CARBON MONOXIDE : 0~100ppm
Continuing 250ppm(1 ppm/digit)
(If concentration exceeds 250ppm, the display will show "OVER")

Should the concentration of any of the gases pass its alarm point, (see paragraph B.7) the alarms will be activated.

3. Alarms

During an alarm state, the ALARM light and the buzzer in both the instrument and in the REMOTE ALARM (if used) will cycle in an on-off pattern. At the same time, the display will flash for the gas which is exceeding its alarm level. It is possible for more than one gas to be in the alarm state at the same time. Check the display carefully for the gas or gases in alarm. Pressing the ALARM SILENCE switch will cause the buzzer to stop, the display to stop flashing and the ALARM light to become steady until the alarm state passes. When the alarm state passes, the ALARM light will go out and the instrument will be in normal operation. If the ALARM SILENCE switch is not pressed, the alarms will continue even after the alarm stated has passed. Pressing the ALARM SILENCE switch then, will stop the alarms and return the instrument to normal operation.

4. Automatic CO/H2S Sensor Check

At 15 minutes intervals when the instrument is in normal operation, an automatic check is made on the CO and H2S sensors for proper connection. For a 20 second period the display will show :

15 MINUTE AUTO FUNCTION CHECK *

If an open circuit has occurred, e.g. a bad connection, the ALARM light will come on and the buzzer will sound steady, and the display will show :

MALFUNCTION CO *

or

MALFUNCTION H2S *

To stop the alarms, press the ALARM SILENCE switch. The program will continue and the display will show *** in the circuit where the "open" occurred. For example :

21.0% 0% LEL 0.0 PPM *** PPM *

Measurements can continue to be made in all ranges except where *** is displayed. If measurement in the malfunctioning circuit is desired, the instrument must be turned off, the malfunction corrected and the instrument restarted.

Ⅲ. CALIBRATION AND ALARMS

Since this instrument is microprocessor controlled the zero of the combustibles, CO and H_2S circuits and the span of the oxygen are set automatically by the programming. Manual adjustments are provided for the span of the combustibles, CO and H_2S circuits and for the oxygen zero. Adjustments are also provided for the alarm points for each gas. (See Figure 4).

Adjustments to the instrument are factory set and need not be changed except for inability to calibrate, malfunction or when a new sensor is installed.

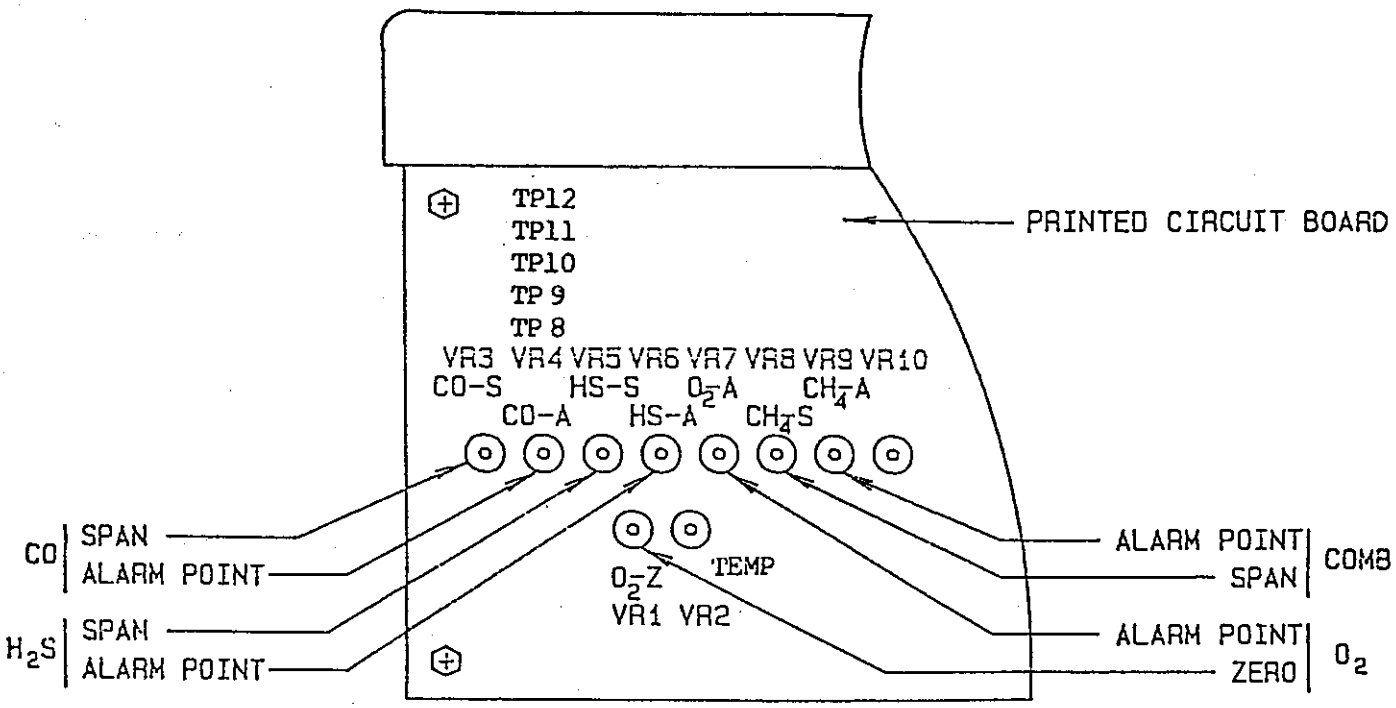


Fig. 4

In order to calibrate, first remove the slotted shoulder screws at each end and lift instrument out of its aluminum housing. Locate and identify the adjustment potentiometers at the left center of the circuit board, eight in a row with two in a row below the eight. Attach the hose and probe, turn the instrument on and allow it to go through its warm-up cycle.

A. Oxygen zero

The oxygen circuit is automatically calibrated on atmospheric air, but the zero setting must be adjusted manually.

1. Locate the oxygen zero O_2-Z (VR1) potentiometer, left one of the lower pair.

2. Expose sample probe tip to a known oxygen-free sample, such as nitrogen, argon or helium.

NOTE

If the sample exists within a large container at atmospheric pressure, the probe tip may be inserted into the container. If sample is under pressure the mixture should be allowed to flow directly into the probe tip at a slight positive pressure.

3. Watch display carefully. If oxygen reading does not go exactly to zero, adjust it by turning O_2-Z zero potentiometer. Turn counterclockwise to bring down toward zero.

4. If zero adjustment cannot be made, have oxygen cell reactivated.

5. If instrument cannot bring reading to 20.9 during the warm-up cycle, replace cell or have it reactivated.

B. Combustibles Span

The combustibles circuit zero is automatically adjusted during the warm-up, but the span setting must be adjusted manually :

1. Locate the combustibles span CH_4-S (VR8) potentiometer, sixth from left.

2. Expose sample probe tip to a known calibrating gas sample.
(See Note in step Ⅲ.A.2. above)

3. Watch combustibles display carefully. If reading does not correspond to desired value, adjust it by turning SPAN potentiometer. Turn clockwise to increase reading.

4. Recheck zero (turn instrument off and then on), and repeat above steps until correct reading is obtained.

5. If reading cannot be set high enough, replace detector.

C. H_2S and CO Span

The H_2S and CO circuits operate the same as the Combustibles Span except for the following :

1. Use the appropriate H_2S or CO calibrating gas and observe display reading of gas being tested.

2. Span adjustment for H_2S is third from left, marked HS-S (VR5) and span adjustment for CO is the first one, marked CO-S (VR3).

D. Alarm Adjustments

Alarm adjustment for all four gases are made the same way. To determine the existing alarm settings, press the ALARM TEST switch. The display will show the individual alarm setting for each gas and the steady alarm will occur for a period of 15 seconds. (Press ALARM SILENCE to cancel the alarm). To change an alarm adjustment :

1. Locate the alarm potentiometer of the gas circuit to be adjusted. From the left CO is the second one, CO-A (VR4); H_2S is the fourth one, HS-A (VR6); O_2 is the fifth one, O2-A (VR7) and combustibles is the seventh one CH_4-A (VR9)

2. Press the ALARM TEST switch to display alarm setting.
   Press the ALARM SILENCE switch to cancel the alarm.

NOTE

Display will hold reading for only 15 seconds. If additional time is needed, repeat this step as many times as necessary.

3. Adjust the potentiometer selected in step 1 above to the desired value: Combustibles, H_2S and CO settings change in 5%, 5 PPM and 5 PPM increments respectively. The O_2 setting changes in 0.5% increments.

Ⅳ. MAINTENANCE

Maintenance on the Model GX-111 consists mostly of replacing the expendable parts such as battery cells, charcoal filter and when necessary, the sensors.

A. Battery Cell Replacement

The Model GX-111 comes with carbon zinc disposable cells. It can also be used with Ni-Cd rechargeable cells, but they must be removed for recharging. When the REPLACE BATTERY message is shown on the display, the battery voltage has fallen below the minimum useable value and the instrument will not operate properly. The carbon zinc cells must be replaced with fresh ones or the Ni-Cd cells must be recharged. To remove and replace battery cells :

1. Remove instrument from carrying case and invert to expose battery access door on the bottom.

2. Life finger latch to release door and remove door.

3. Pull up on orange colored ribbon and remove old cells.

4. Lay orange ribbon loosely across cell holder and inset the new cells with polarity as shown on the bottom of the holder (negative case to spring, positive button to metal tab). Use all new cells, don't mix old cells with fresh new ones. Instrument uses four D-size cells.

5. Replace battery access door and latch in place.

6. Invert instrument and install in carrying case, securing it with leather holding straps in case.

B. Charcoal Filter Replacement

Charcoal filter is attached to a knob on the left side near the front of the instrument. Filter should be replaced when the CO reading becomes suspect, i.e. when the CO reading responds to known hydrocarbon gases or H_2S. Otherwise,replace filter after 500 hours of instrument operation.
To replace filter :

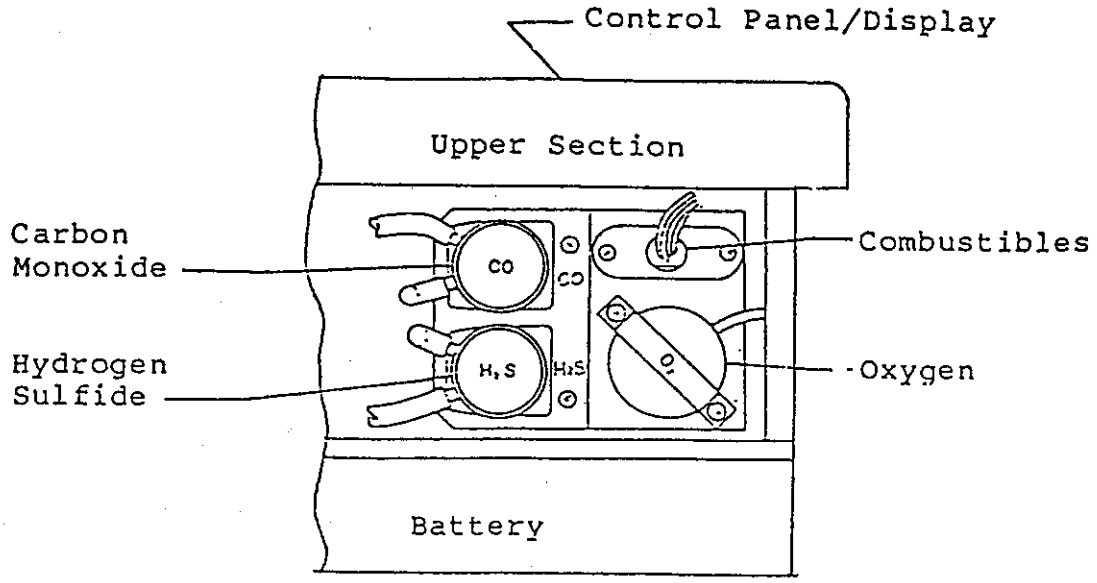
1. Pull knob containing filter cartridge directly out of instrument.

2. Pull spent filter cartridge off of knob and replace with a new cartridge, pressing firmly into place. Cartridge is held in place by O-ring friction fit. Lightly moisten O-ring for ease in assembling.

3. Push filter on knob back into place. Knob is held in place by O-ring friction fit. Be sure knob is fully inserted.

C. Sensor Replacement

The sensors are grouped together in the sampling system and are easily replaced. To gain access to the sensors, first remove instrument from its carrying case, then remove shoulder screws, from each end, slide instrument out of housing and lay instrument on its front. The sensors are accessible, grouped together at one side.



SENSOR LOCATION

1. CO and H_2S Sensors

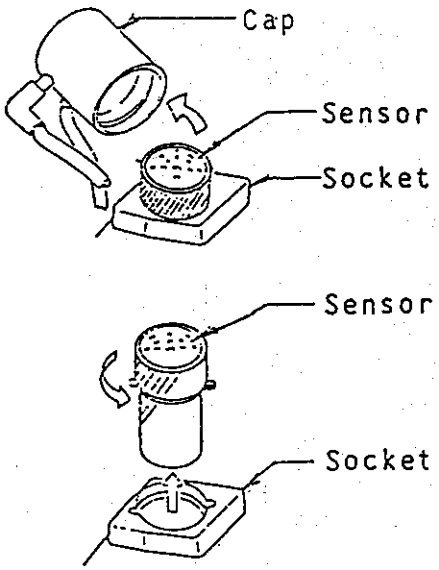
The CO and H_2S sensors are installed in bayonet type sockets and are covered by plastic caps with drilled holes and hoses attached, to carry the sample across the active face. To replace sensor :

a. Pull plastic cap with hoses off of sensor. Cap is held in place by O-ring friction fit, so pull gently but firmly.

b. Push down on sensor and rotate about 1/8 turn counterclockwise to unlock, then pull sensor out of its socket.

c. When replacing sensor, insert so that tabs on sensor match notches on socket, then push sensor down and rotate clockwise about 1/8 turn to lock in place.

d. Lightly moisten O-rings in cap, then push cap over sensor.



CAUTION

If O-rings are dry, excessive force needed to replace cap may damage sensor or sensor socket.

2. Oxygen Sensor

Oxygen sensor is held in place in a cavity in an aluminum block by a spring clip secured by two captive screws. To replace oxygen sensor :

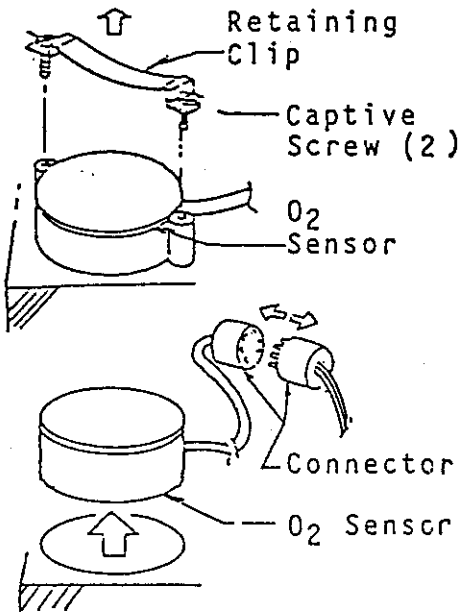
a. Unscrew two captive screws in spring clip, from their stand-offs and remove spring clip.

b. Unplug 7-pin connector on cable leading to oxygen sensor.

c. Lift out sensor and replace with new or newly reactivated sensor.

d. When installing new sensor, be sure active face of sensor rests against the O-ring seal at the bottom of the cavity.

e. Replace spring clip, tighten screws and reconnect 7-pin plug.



3. Combustibles Sensor

Combustibles sensor, like the oxygen sensor, is held in place in a different cavity in the same aluminum block, by a retaining clip secured by two captive screws. To replace sensor :

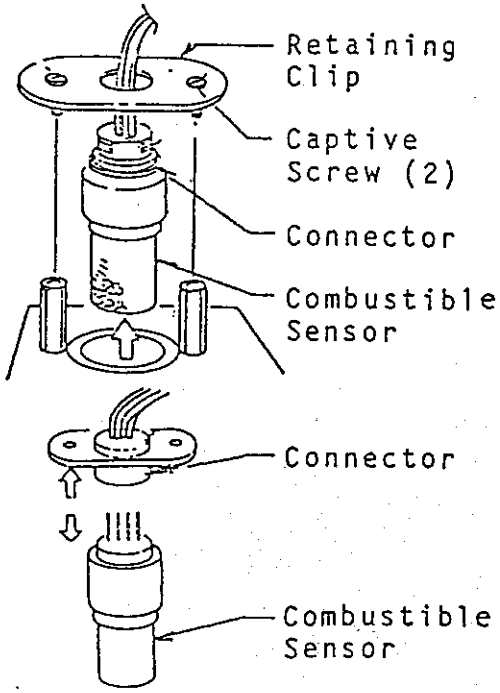
a. Remove two captive screws in retaining clip from their stand-offs and remove retaining clip.

b. Pull sensor out of its cavity.

c. Pull sensor off of its connector and place a new sensor on the connector.

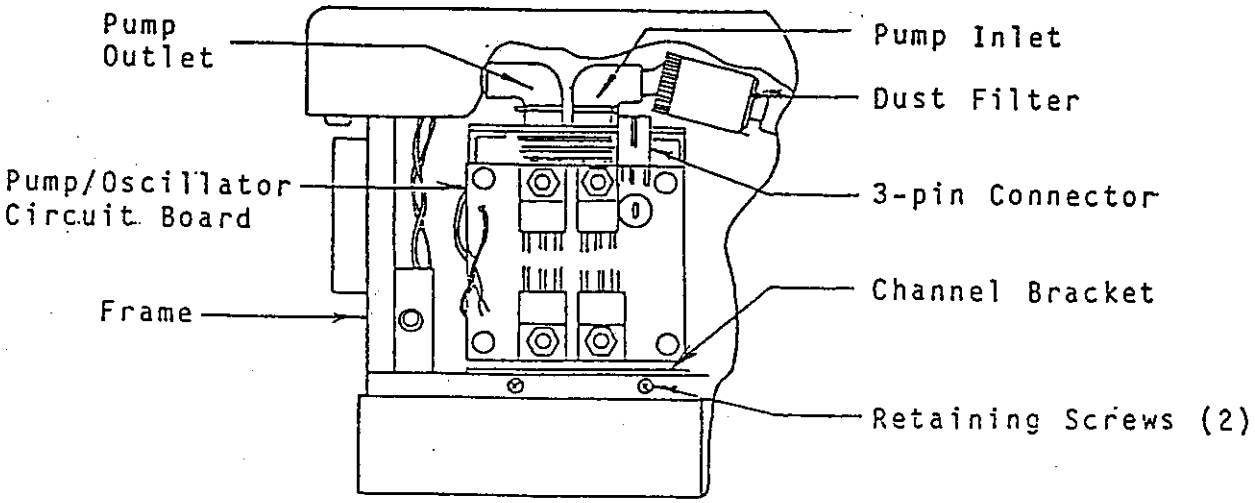
d. Verify that O-ring seal is in its groove at top of cavity and insert the sensor so that its shoulder rests on the aluminum block.

e. Locate the retaining clip in place and tighten the captive screws.



D. Pump Replacement

Pump, a vibratory type, with its oscillator circuit board attached, is located to the left of the sensors. It normally needs very little maintenance, however it can be removed for service, or moved aside for dust filter cartridge replacement. To replace pump :



1. Remove two screws located on the frame, at the bottom of the pump.
2. Lift channel bracket in front of pump out of frame.
3. Slide pump forward, lifting out at the bottom, to gain access to the inlet and outlet elbows on top of the pump.
4. Pull three-pin connector off of top of pump circuit board.
5. Squeeze tangs of clamp on inlet elbow and remove elbow from inlet nipple on pump.
6. Remove elbow from outlet nipple in the same manner.
7. Pump is now free to be removed from housing.
8. Replace pump in reverse order being sure hoses are fittings are not kinked or pinched.

E. Dust Filter Replacement

Dust filter element is a cylindrical paper type, similar to those used in cigarettes, and needs replacing when readings become suspect or when the flow alarm occurs. The dust filter is located next to the pump, in the line from the inlet to the pump. To replace filter element :

1. Perform steps IV.D.1. through IV.D.5. (above) to gain access to dust filter. Pull filter out as far as connecting hose will allow.
2. Unscrew knurled section from body. This section holds the paper filter element and an O-ring to seal the filter body.
3. Pull out old filter element, clean cavity and insert new element.
4. Re-assemble the parts in reverse order, being sure hoses and fittings are not kinked or pinched.

F. Flow System (See Figure 5)

Flow system is composed of the pump, sensors, filters, pressure switch and flow indicator, all connected together with hoses and fittings. If for any reason it becomes necessary to open the flow system, e.g. if water is drawn into the system, access to the system is gained as follows :

1. Invert instrument and remove the four screws that hold upper section to the frame (two on each end).
2. Turn the instrument upright and fold over the upper section to expose the sampling system.
3. System components may now be easily removed, cleaned and replaced.
4. When replacing components, care must be taken to avoid kinking or pinching the hoses and fittings.

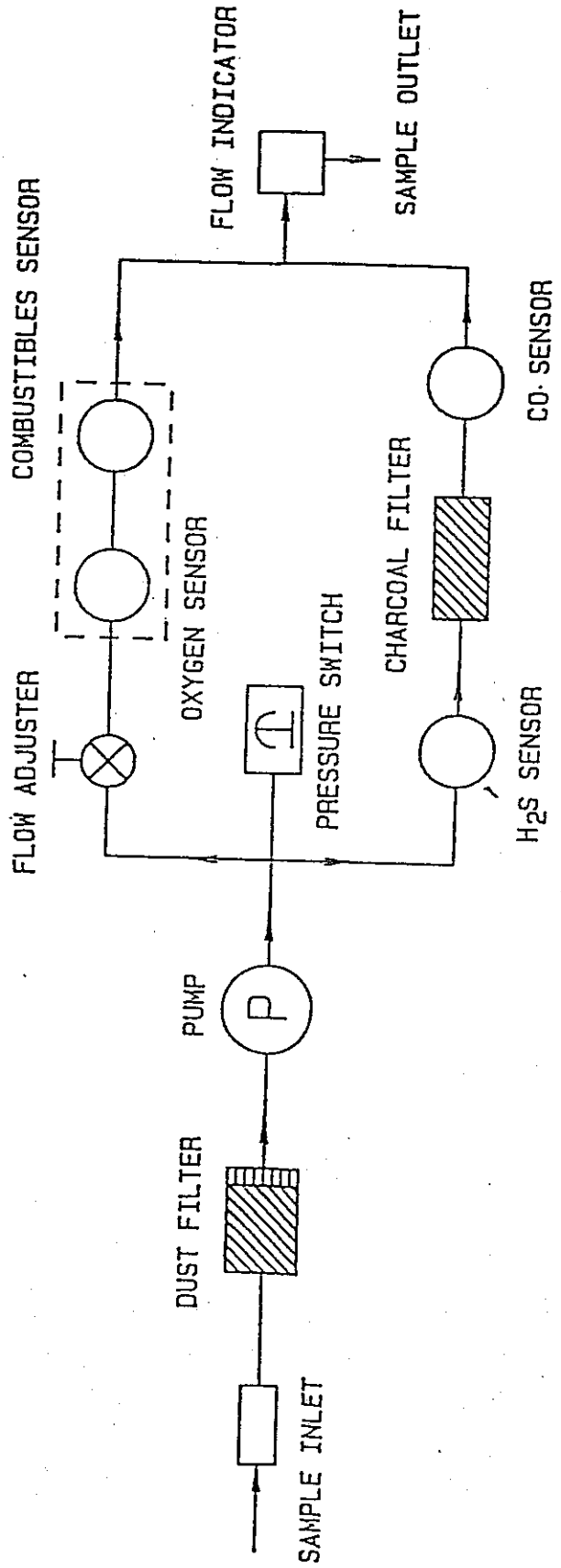

SAMPLE INLET
DUST FILTER
PUMP
P
FLOW ADJUSTER
COMBUSTIBLES SENSOR
OXYGEN SENSOR
PRESSURE SWITCH
CHARCOAL FILTER
H_2S SENSOR
CO SENSOR
FLOW INDICATOR
SAMPLE OUTLET

Fig. 5

V. PARTS LIST

Description
Filter element, probe (cotton balls)
Filter element, internal (cigarette)
Filter element, charcoal
Battery, Size D Carbon Zinc
Combustibles Detector
Oxygen cell
CO cell
H_2S cell
Probe

When ordering parts, please specify Model GX-111 and serial number.

GUIDANCE ABOUT THE GAS MEASUREMENT

AT COAL SHIP

It is not possible to measure CH_4 concentration when O_2 concentration in the hatch is below 10% (*1)
Then, please apply the dilutor for the measerement.

<HOW TO USE>

<HOW TO CONNECT>... Refer to Fig. 1

First step;

Measure the gas without dilutor

When O_2 concentration is above 10%

When O_2 concentration is below 10%

A

Read the indication values of O_2, CH_4, CO and H_2S. *2

B

Read the indication values of O_2, CO and H_2S only. *2

ONLY CH_4

Apply the dilutor

(Refer to Fig. 1)

C

The correct concentration of CH_4 is twice of the indication value for CH_4. *3

*1 :Because of the detection principle of catalytic combustion method.

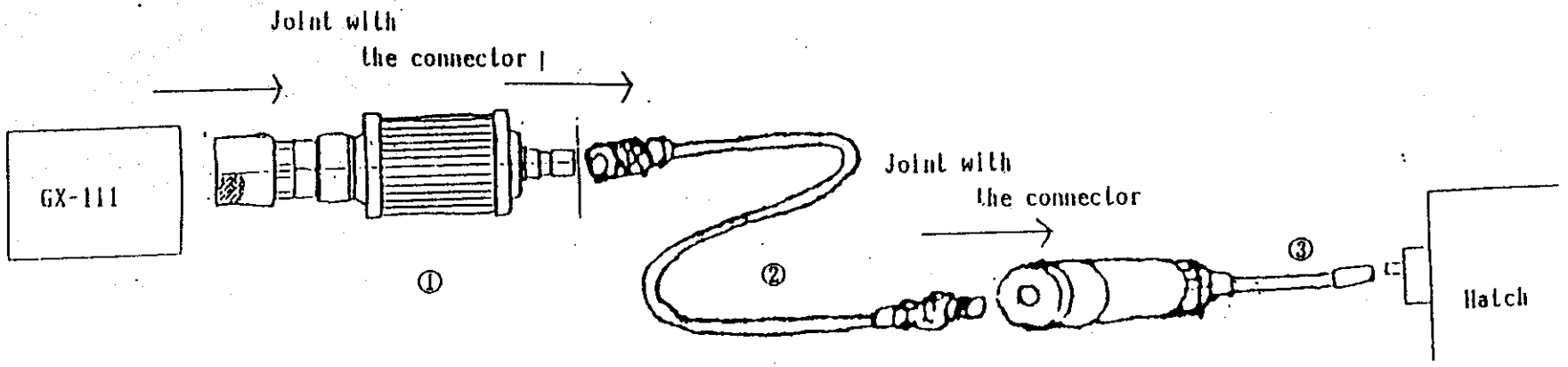
*2 :The dilutor is not necessary, do not use the dilutor.

*3 :The indication value should be multipllied twice, as the sampling gas is diluted with the ratio 1:1.

RIKEN KEIKI CO., LTD.

<HOW TO CONNECT> Fig.1

☆Apply the dilutor (C)!



① Dilutor

② Sampling hose

③ Sampling probe
(with red rubber)

☆The dilutor is not necessary, do not use the dilutor. (A·B)