

## OPERATION

## INTRODUCTION

This section provides information on the operation and function of the controls, indicators and gauges used in connection with the coach automotive systems. Figure 2-1 illustrates the driver's compartment, highlighting the instrumentation and panels covered in later paragraphs in this section.

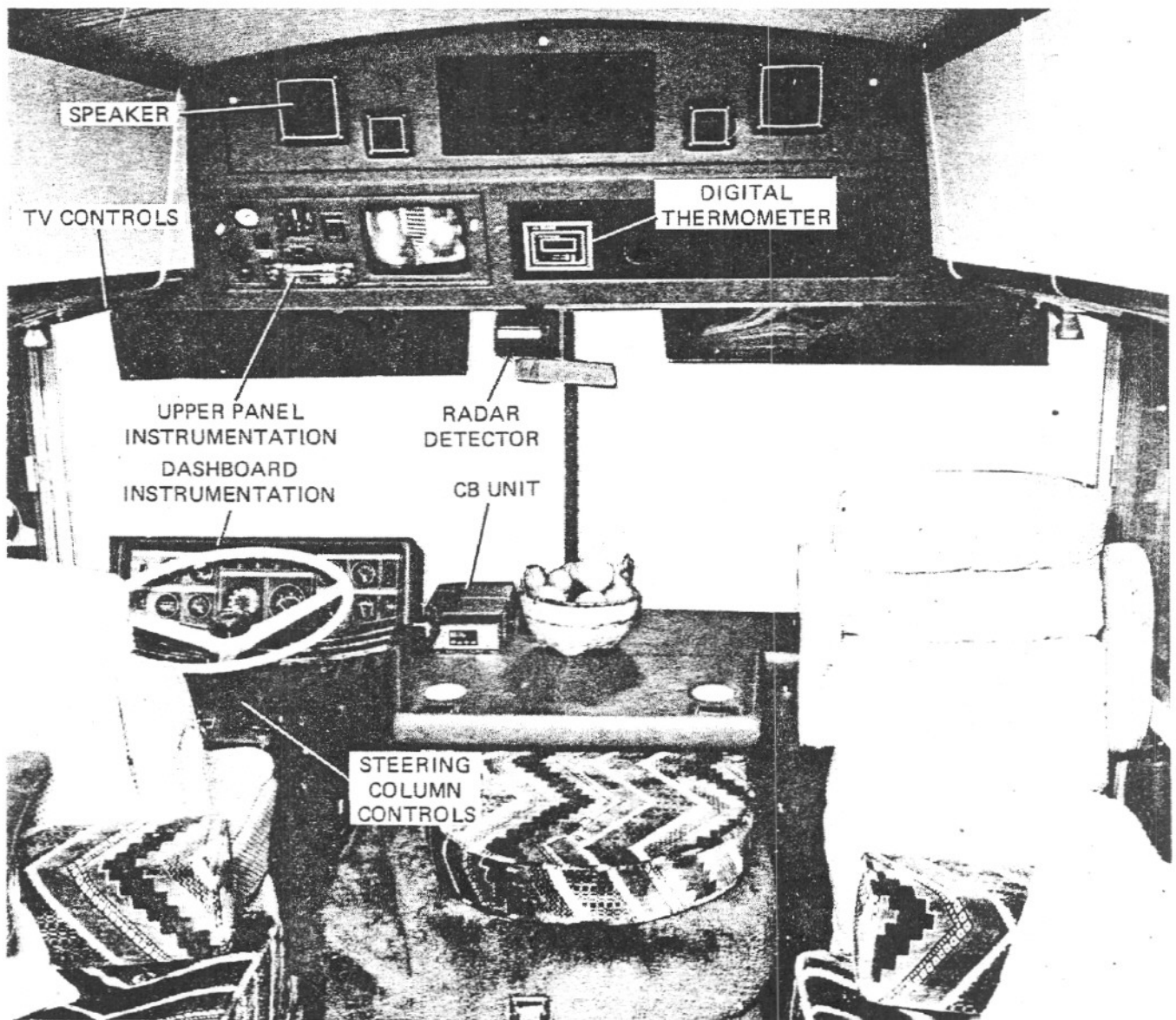
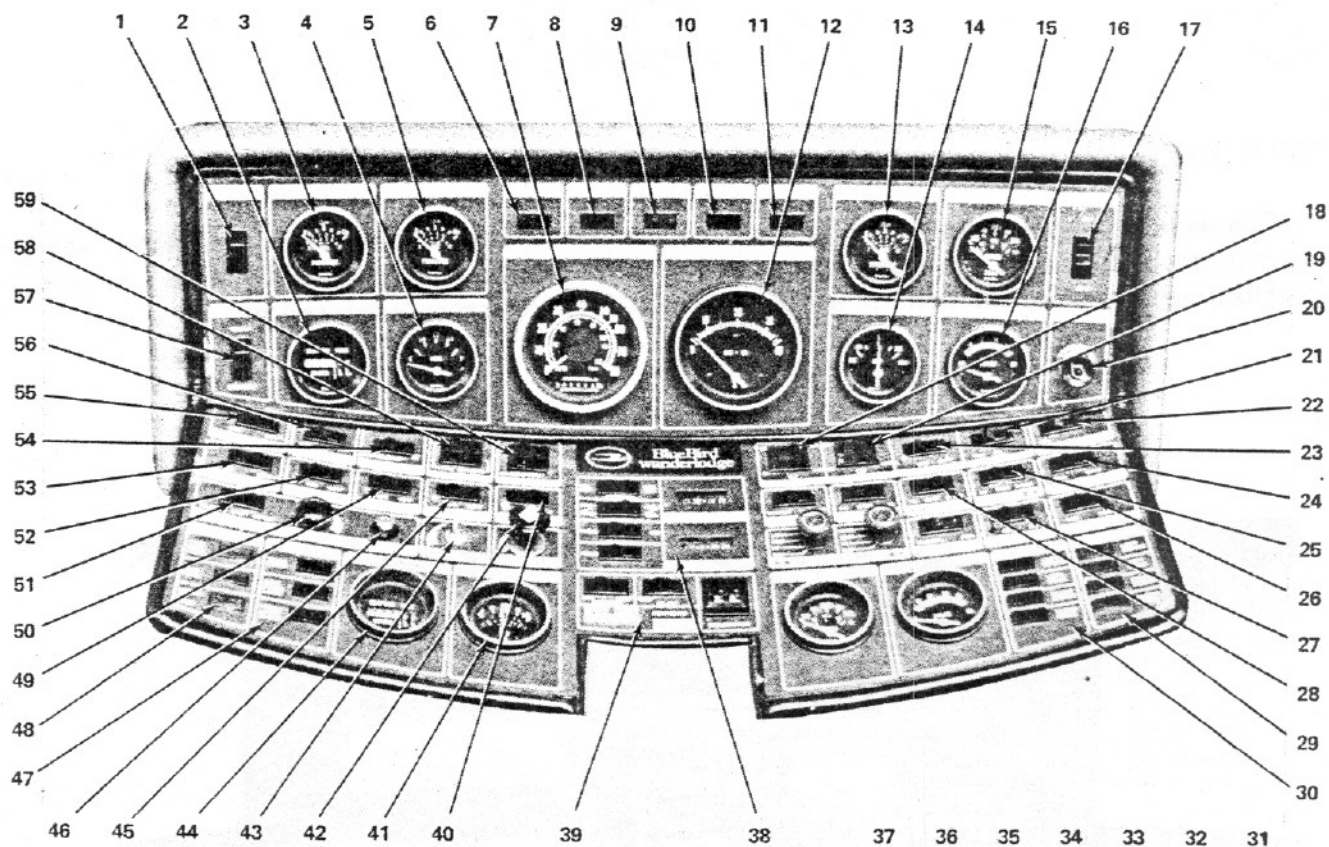


Figure 2-1. Driver's Compartment, Instrumentation Panels



- |                                |   |
|--------------------------------|---|
| 1. ACCESSORY Position          | 30. LEVELING WARNING SYSTEM Indicators  |
| 2. ENG. HOUR Meter             | 31. HORN SELECTOR Switch                |
| 3. ENG. OIL PRESSURE Gauge     | 32. DEFROST Fan Switch                  |
| 4. FUEL LEVEL Gauge            | 33. GENERATOR VOLTMETER                 |
| 5. AIR PRESSURE FRONT Gauge    | 34. RH Front AIR CONDITIONER Fan Switch |
| 6. LEFT TURN Indicator         | 35. LH Front AIR CONDITIONER Fan Switch |
| 7. Speedometer/Odometer        | 36. GENERATOR WATER TEMP. Gauge         |
| 8. ENGINE ALARM Indicator      | 37. HEAT SELECTOR Switch                |
| 9. HIGH BEAM Indicator         | 38. Digital Clock Panel                 |
| 10. LOW AIR Indicator          | 39. Electronic Horn Panel               |
| 11. RIGHT TURN Indicator       | 40. REAR LANDING Lights Switch          |
| 12. Engine RPM Gauge           | 41. GENERATOR OIL PRESSURE Gauge        |
| 13. AIR PRESSURE REAR Gauge    | 42. HEADLIGHTS Switch                   |
| 14. ENG. AMP METER             | 43. DASH LIGHTING DIMMER Control        |
| 15. ENG. WATER TEMP. Gauge     | 44. GENERATOR HOUR METER                |
| 16. ENG. VOLTMETER             | 45. FRONT LANDING Lights Switch         |
| 17. A/T Switch                 | 46. Spotlight AIM Control               |
| 18. L.H. WIPER Switch          | 47. ACCESSORY WARNING Indicators        |
| 19. R.H. WIPER Switch          | 48. FUEL MONITOR Indicators             |
| 20. LIGHTER                    | 49. REAR PARKING LIGHTS Switch          |
| 21. WINDSHIELD WASHER Switch   | 50. Spotlight SPEED Control             |
| 22. AUX. BATTERY Switch        | 51. SPOTLIGHT Selector Switch           |
| 23. WIPER HEATER Switch        | 52. DRIVING LIGHTS Switch               |
| 24. FRONT HEAT Switch          | 53. MARKER LIGHTS Switch                |
| 25. RH Front HEAT Fan Switch   | 54. AUXILIARY STEP Switch               |
| 26. LEVELING SYSTEM Switch     | 55. COMP. LIGHT MASTER Switch           |
| 27. AUX. PUMP Switch           | 56. BURGLAR ALARM Switch                |
| 28. LH Front HEAT Fan Switch   | 57. FUEL LEVEL Switch                   |
| 29. LEVELING SYSTEM Indicators | 58. COMP. DOORS Switch                  |
|                                | 59. ENTRY DOORS Switch                  |

Figure 2-2. Dashboard Instrumentation



## INSTRUMENTATION

All essential operating controls and gauges used to monitor and control the engine, generator and coach systems are conveniently grouped on the electro-luminescent dashboard panel, figure 2-2.

Additional instrumentation, accessible on the bulkhead above the driver, includes stereo AM/FM radio/cassette player, TV, generator ON-OFF switch, altimeter and diesel fuel filter monitors. Controls for TV operation are located on the left side bulkhead above the driver. The upper right panel mounts a digital inside/outside thermometer. Refer to figures 2-2 through 2-14 and the following paragraphs for locations and functions of operating controls and indicators.

### DASHBOARD INSTRUMENTATION

Controls and indicators are shown in figure 2-2.

**ENG. OIL PRESSURE GAUGE** — Indicates the pressure of the oil, not the amount of oil in the engine reservoir. This gauge will normally read on the high side during cruising speeds; and drop to the low side when the engine is idling.

#### CAUTION

No oil pressure, or low oil pressure readings when engine is operating are trouble indications! Check oil level. **DO NOT OPERATE THE ENGINE UNDER THESE CONDITIONS!**

**FUEL LEVEL GAUGE** — Indicates amount of diesel fuel remaining in fuel tank (approximately 250 gallons for all units, except rear bath, which holds a maximum of 150 gallons). This gauge reads only when the ignition switch is in ON or set to ACCESSORY position. The fuel gauge used on 31- and 33- foot units is a dual-function gauge; it displays diesel fuel tank supply when the FUEL LEVEL GAS/DIESEL switch is set to DIESEL position; and displays the fuel remaining in the generator fuel tank when the switch is set to the GAS position.

**ENGINE WATER TEMP. GAUGE** — Shows engine coolant temperatures from 100 to 240 degrees.

#### CAUTION

If the temperature gauge consistently indicates excessively high engine temperatures (100 degrees higher than the outside temperature), engine is overheating and should be stopped to prevent damage. Allow engine to cool before checking the radiator and/or reservoir coolant level.

**TURN SIGNALS** — The left or right green turn signal lights blink in conjunction with the outside directional lights when the turn signal lever is set to the corresponding position. Both turn signals blink in unison when the emergency flasher switch on the steering column is pressed inward (ON).

**HIGH BEAM INDICATOR** — Lights when headlights dimmer floor switch is pressed for high beam operation and HEADLIGHTS switch is ON.

**LOW AIR WARNING LIGHT AND BUZZER** — Warning indicator is lit whenever system air pressure is below 60 psi; a buzzer, located behind the panel, also sounds for low-pressure conditions.

#### CAUTION

**IT IS NOT SAFE TO DRIVE THE UNIT IF LOW AIR PRESSURE WARNING LIGHT IS ON AND AIR PRESSURE GAUGES DO NOT INDICATE WITHIN SAFE LIMITS (100 psi to 120 psi).**

**AIR PRESSURE FRONT/REAR GAUGES** — The dual air service brakes pressure systems are engine-operated and supply independent brake system air pressure for front and rear service brake systems, parking brake and air-operated accessories. During normal operation, each air pressure gauge reading will build up to approximately 100 psi to 120 psi shortly after the engine is turned on. The parking brake cannot be released until air pressure readings are at least 60 psi.

**ENG. AMP METER** — Center-reading ammeter graduated from -100 amperes to +100 amperes shows whether battery is charging or discharging while engine is operating. Normally, the pointer reads center-scale, or slightly to the right (charge).



This meter also indicates battery current drain when the ignition is off. It does not indicate the charging current supplied by the battery chargers when the engine is off and the coach is connected to ac power. (This charging current is shown on the ammeter behind the stepwell access panel.) If the engine is off, and ac power is available, the dashboard meter shows current drawn by any 12-volt appliances, while the stepwell meter displays charging current supplied to the battery and 12-volt loads. Starting the engine allows the engine alternator to provide the charging current source, indicated on the dash meter, and automatically shuts off the battery chargers. Excessive charging or discharging can indicate charging system problems. Check battery electrolyte levels, terminals and cables for looseness or corrosion.

**ENG. HOUR METER** — Indicates total hours of engine operation.

**ENG. VOLT METER** — Expanded-scale voltmeter graduated from 10 to 16 volts shows condition of battery charge when ignition is ON. Normally, battery voltage varies from 12 to 13 volts. With the engine operating, and no heavy battery loads, the battery charging voltage is about 14.7 volts. Battery voltage readings of less than 10.5 or more than 15 are usually a symptom of battery or electrical system failures.

**SPEEDOMETER/ODOMETER** — Indicates speed and accumulated mileage.

**TACHOMETER** — Indicates actual diesel engine RPM (revolutions per minute) X 100 on a 0 to 4,000 RPM scale. Use this gauge as an overall engine performance indicator.

#### NOTE

Diesel engines normally idle at about 500 to 700 RPM. During normal running, maintain 2,000 RPM for optimum performance. Normal operating range is 2,000 to 2,800 RPM.

**CIGARETTE LIGHTER** — Depress to heat the element, which pops out when hot.

**FRESH AIR CONTROLS** — Controls in front of co-pilot's seat adjust air flow to the co-pilot's side; driver's side air flow is controlled by a similar

control located to the right of the steering column.

**AIR CONDITIONER CONTROLS** — Dual three-speed blower controls set the speed of the automotive air conditioner blowers for the front left and right sides of the coach. The **AIR CONDITIONER** thermostat, located below the steering column, controls cooling air temperature by cycling the air conditioner compressor.

**HEAT SELECTOR SWITCH** — Operates solenoid valves in engine coolant line to divert coolant flow through water heater and chassis heaters when this switch is in **WINTER** position. Setting the switch to **SUMMER** position causes the coolant to flow through the hot water supply heater coil.

**FRONT HEAT SWITCHES** — The **FRONT HEAT ON-OFF** switch which operates solenoid valves to provide heat to front heater cores. The adjacent **HEAT HI-LOW** switches control blower air speed to the right and left sides.

**AUXILIARY PUMP SWITCH** — Controls the auxiliary water pump (under left rear corner of coach) that circulates water through the heat exchanger, hot water heater and under-seat heaters.

**DEFROST SWITCH** — The **DEFROST HI-LOW** switch controls operation of the dual blower motors that direct defroster air to the front windows. Note that the automotive air conditioner blowers may also be used for defrosting when thermostat is in **OFF** position.

**ELEC./AIR HORN SELECTOR SWITCH** — This switch allows selection of air, electrical or musical horns on coaches so equipped.

**WIPER, WASHER AND HEATER CONTROLS** — Separate dual **ON-OFF HI-LOW** switches control the operation of L.H. and R.H. **WIPERS**. To the right of these controls is the **WIPER HEATER** switch, which activates a heating element built into each wiper blade assembly. These heaters are controlled thermostatically to operate whenever the temperature falls below 39 degrees F and they maintain wiper assembly temperature between 70 and 110 degrees to prevent dangerous ice build-up. The **WINDSHIELD WASHER** switch operates a pump which directs streams of water to each windshield surface.





**A/T SWITCH** — Activates anti-theft circuits.

**MARKER LIGHTS SWITCH** — Operate this control to turn on the clearance lamps located on the top, sides and ends of the coach.

**LANDING LIGHTS SWITCHES** — Controls ON—OFF operation of FRONT and REAR LANDING LIGHTS.

**REAR PARKING LIGHTS SWITCH** — Controls ON—OFF operation of rear parking lights.

**DRIVING LIGHTS SWITCH** — Controls front and rear driving lights.

**HEADLIGHTS SWITCH** — Varies headlights intensity from off to full brightness.

**COMP. LIGHT MASTER SWITCH** — ON—OFF switch controls operation of all exterior compartment lights.

**COMP. DOORS SWITCH** — Operates solenoid latches to secure exterior compartment doors by setting switch to LOCK; allows doors to be opened (key-operated) when switch is set to UNLOCK.

**FUEL MONITOR INDICATORS** — Three in-line indicators monitor diesel fuel supply flow (MAX FUEL FLOW), low fuel level (LOW FUEL) and the accumulation of condensate (WATER IN FUEL).

**ACCESSORY WARNING INDICATORS** — Three warning indicators alert the driver to the following: **SUSP. DUMP** — lights to indicate that suspension system has to be pressurized before coach is driven; **GEN. DOOR LOCK** — indicates that generator tray is extended; and, **HEADLIGHT ALERT** — to indicate that the headlights have been left on after the ignition has been turned off.

**ENGINE ALARM INDICATOR** — Indicator lights and buzzer sounds to alert driver when associated engine monitors detect an abnormal operating condition.

**ENTRY DOOR SWITCHES** — Dual switches to LOCK and UNLOCK entry door.

**DASH LIGHTING DIMMER CONTROL** — Adjusts intensity of electroluminescent panel markings.

**AUXILIARY STEP SWITCH/INDICATOR** — This indicator is lit whenever the entry step is extended. Use the switch to withdraw or extend the step.

**AUX. BATTERY SWITCH** — Operating this momentary switch connects the generator and engine batteries in parallel to provide a greater current source for hard-starting situations. Release switch after engine starts.

**BURGLAR ALARM SWITCH** — Activates coach burglar alarm system.

**DIGITAL CLOCK/ELAPSED TIMER** — The digital clock and elapsed time digital readout is located in the center of the dash, figure 2-3. Four controls to the left of the display set clock timing. To set **TIME DISPLAY**, press **HR.SET/MIN. SET** switch to **HR.SET** position and hold until correct hour is displayed; repeat with switch in **MIN.SET** position until correct minutes are displayed.

The **ELAPSED TIME** display will show elapsed time in terms of hours and minutes, or in minutes and seconds, depending on the position of the **HRS./MIN.—MIN./SEC.** switch. Set this switch as desired, press **ZERO** to reset the display to a 00:00 readout, and the elapsed time will count. Use the **HOLD/GO** switch to suspend operation of the elapsed time display when desired by setting this switch to **HOLD** position. For elapsed time operation leave switch in **GO** position.

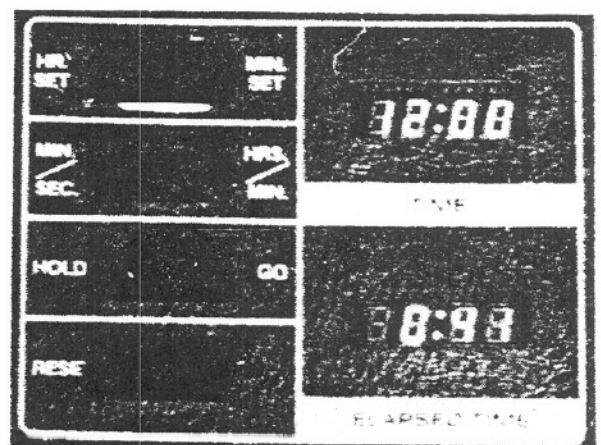


Figure 2-3. Digital Clock/Elapsed Time Display



**GENERATOR VOLTMETER** — Expanded-scale voltmeter, with scale graduations from 10 to 16 volts, shows the condition of the generator battery. Normally, the battery voltage varies from 12 to 13 volts; under starting load it may drop to about 10.5 volts and then rise to about 14.7 when the generator starts and begins charging the battery. Battery voltage readings less than 10.5 or more than 15 are usually a symptom of a battery or an electrical system failure.

**GENERATOR WATER TEMP. GAUGE** — Shows generator engine coolant temperature from 100 to 240 degrees. If consistently high temperatures are indicated, shut down the generator, wait for the engine to cool, then check radiator coolant level.

**GENERATOR OIL PRESSURE GAUGE** — Shows the oil pressure, not amount of oil in the generator engine reservoir. This gauge will normally read mid-scale (about 40). Low oil pressure indications are often a symptom of possible generator failure. Oil level should be checked on a regular basis.

**GENERATOR HOUR METER** — Indicates total hours of generator operation.

**MUSICAL HORN** — The Bluebird Musical Horn is a solid-state self-programmed electronic horn which can play a number of tunes available from the integral computer storage "library". This unit is located in the dash beneath the digital clock, as shown in figure 2-4.

All of the music, and the programs for playing the tunes, are stored in a "Read Only Memory" (ROM). The selections contained in this ROM can be chosen by setting the two thumbwheel SELECT switches to the appropriate selection number, then depressing the PLAY button to play out the tune. The POWER switch must be ON for the horn to

function. Note that the digital memory is not erased when power is disconnected from the unit, or if the POWER switch is set to OFF.

To play a tune of your own choosing, plug the auxiliary keyboard into the KEYBOARD connector and select the musical tones manually. Note that the thumbwheel switches must first be set to 0,0 for the keyboard to function.

## REMOTE SPOTLIGHT CONTROLS

The roof-mounted remote-control high-intensity spotlight is operated by the SPOTLIGHT controls located on the left side of the dash. The spotlight produces 100,000 BCP (beam candle-power) and can be turned on and off, positioned horizontally or vertically at an adjustable rate of speed, and can be used for spot- or flood-lighting. The following controls operate the spotlight:

**SPOT-OFF-FLOOD SWITCH** — Selects type of beam desired and controls ON-OFF operation.

**SPOTLIGHT AIM CONTROL** — Controls horizontal and vertical beam position.

**SPOTLIGHT SPEED CONTROL** — Adjusts speed of rotation.

## LEVELING JACKS CONTROLS

Four electrically-operated leveling jacks, one at each corner of the coach, are controlled at the dashboard by operation of the LEVELING MASTER switch. Each of the leveling jacks is independently operated and provides visual and audible status signals to the dashboard indicators and alarms to show that the jacks are down and the coach has been leveled automatically.

Use the following procedures to operate the leveling jacks:

1. Set LEVELING MASTER switch ON, note that four red LEVELING WARNING SYSTEM indicators are lit (LEFT FRONT, LEFT REAR, RIGHT FRONT, RIGHT REAR) indicating that the jacks are being lowered. If the ignition is ON, the alarm will also sound.

2. When the jacks are down and the coach has been automatically leveled, the four green LEVELING SYSTEM indicators (LEFT FRONT, LEFT

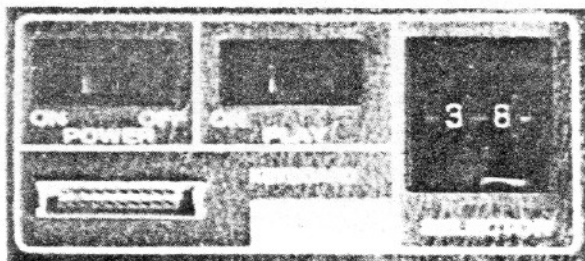


Figure 2-4. Musical Horn



REAR, RIGHT FRONT, RIGHT REAR) will also extinguish.

### CAUTION

If the jacks are not withdrawn before driving away (LEVELING switch set to OFF) the alarm will sound and the LEVELING WARNING SYSTEM indicators will be lit.

## STEERING COLUMN CONTROLS

The steering column contains the horn button, turn signal lever/speed control, emergency flasher, throttle control and air conditioner temperature control. The parking brake is located below the dash, to the right of the steering column.

**HORN** — Operate the horn by pressing in on the center section of the wheel. Select air or electric horn with the ELEC./AIR HORN SELECTOR switch on the dash.

**TURN SIGNAL LEVER** — Move lever upward to signal a right turn; move downward to signal a left turn.

**EMERGENCY FLASHER SWITCH** — The emergency flasher switch is located on the right side of the steering column. Push the switch inward to turn on the flashing warning lights; pull switch outward to shut flashers off. Note that the dash directional lights flash in unison.

**THROTTLE CONTROL** — Adjust the engine idle speed by pulling this control outward (increase), or pushing inward (decrease).

**A.C. TEMP. CONTROL** — Operates in conjunction with AIR CONDITIONER L.H. and R.H. blower controls to set auto air cooling temperature.

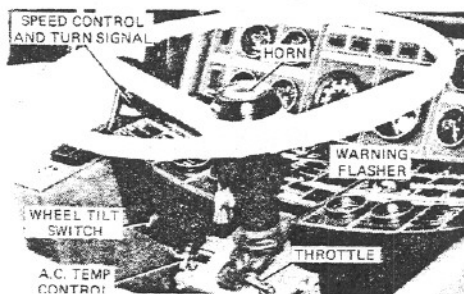


Figure 2-5. Steering Column Controls

**SPEED CONTROL** — The speed control, figure 2-6, is part of the turn signal lever. Before the speed control can be operated to lock in the coach speed, the coach must be traveling at least 35 to 40 miles per hour. Slide the switch left to the ON position and press in the SET SPEED button at the end of the lever to set the speed into the automatic controls. Note that the accelerator can be used to increase the speed of the coach, but the speed cannot be decreased unless the brake pedal is pressed, or the speed control switch is set to OFF. If you want to resume the speed you were traveling at just before the brake was pressed, just slide the switch left to the RESUME position and the coach will automatically return to the previous speed. Be sure to set the speed control OFF when it is not being used.



Figure 2-6. Speed Control

**PARKING BRAKE** — The PARKING BRAKE is located on the lower dash, to the right side of the steering column. Note that the parking brake cannot be released unless the system air pressure is at least 60 psi.

## CB TRANSCEIVER UNIT

Operation of the CB transceiver unit, figure 2-7, is regulated by the Federal Communications Commission (FCC). According to FCC rules, the transceiver is designed for licensed Class D operation on any of the 40 channels designated as the Citizen's Band and you are required to read and understand Part 95 of the FCC regulations prior to operating your unit. (A copy of this document is supplied with the CB unit.) Also, you MUST obtain a Class D Station License before operating the CB. Transmitting without a license can result in penalties. If you do not have a license, fill in the application provided with the CB and mail it to the FCC. No oral or written examinations are required.

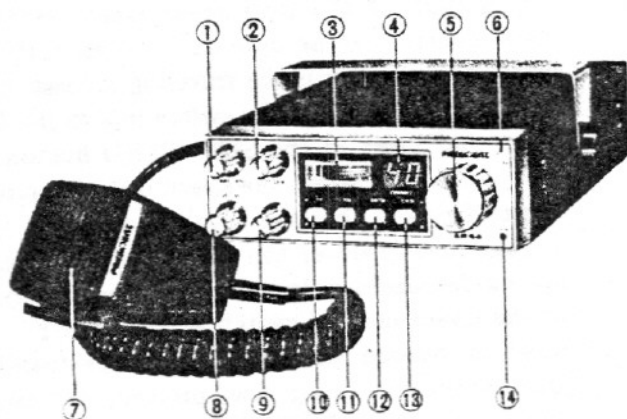


Figure 2-7. CB Transceiver Unit

**CONTROLS AND INDICATORS** — The functions of the controls and indicators shown in figure 2-7 are described in the following paragraphs:

**PRESS-TO-TALK SWITCH (7)** — Used during operation to control reception and transmission. Press the switch in to transmit; release to receive.

**ON-OFF/VOLUME CONTROL (8)** — During normal CB operation, turns unit on and off and controls speaker volume.

**SQUELCH CONTROL (9)** — Allows operator to set receiver squelch so that only signals above the set level are heard. Weaker signals and background noise are eliminated.

**RF GAIN CONTROL (2)** — Adjusts the receiver sensitivity to reduce interference from weaker transmitters on a busy channel. When turned fully clockwise, the receiver is at maximum sensitivity. As the control is turned counterclockwise, the receiver becomes less sensitive to interference from weaker transmitters, resulting in clearer reception of the desired signal. The RF GAIN control is very effective when used in a crowded urban area.

**ANL CONTROL (11)** — Reduces ignition noise and other man-made noises that may make the received signals unintelligible.

**TX/RX INDICATOR (6)** — The transmit/receive indicator lights red when transmitting, green when receiving.

**CHANNEL INDICATOR (4)** — Displays selected channel.

**PA/CB SWITCH (10)** — When the public address switch is in PA position, the operator can use the transceiver as a PA system through the roof-mount speaker. Keep switch in CB position for normal operation.

**S/R F METER (3)** — S/R F scale of meter indicates strength of received signals in "S" units. Relative RF output power of the transmitter is also shown.

**CHANNEL SELECTOR (5)** — This switch selects the desired channel for transmission and reception. All channels, except channel 9, may be used for communications between stations operating under different licenses. Channel 9 has been reserved by the FCC for emergency communications involving the immediate safety of individuals or immediate protection of property. Channel 9 may also be used to render assistance to a motorist. This is an FCC rule and applies to all operators of CB radios.

**DIMMER SWITCH (12)** — This switch is used to adjust the brightness of the LED channel display and the meter.

**CH9/OFF SWITCH (13)** — Placing this switch in CH9 position switches the receiver and transmitter to Channel 9 regardless of the channel selector position. Set to OFF position to restore normal operation.

**CH9 INDICATOR (14)** — Indicator lights red to show that CH9 switch is activated.

**MIC GAIN CONTROL (1)** — Varies the modulation level for best possible transmission. When CB is used in PA mode, this control allows adjustment of PA volume.

## OPERATION

1. Set OFF/VOLUME control (8) clockwise and note that these indicators light:
  - a. S/R F meter (3)
  - b. Channel indicator (4)
  - c. TX/RX indicator (6) lights green

Radio will not operate unless microphone is connected.



2. Adjust VOLUME control (8) for desired listening level. Be sure that PA/CB switch (10) is in CB position.

#### TO RECEIVE —

1. Select desired channel. Note that the S/Rf meter (3) indicates the relative strength of the received signals.

2. Adjust RF GAIN control (2) for clearest reception of selected signal, reducing unwanted signals in strong signal areas.

3. Adjust ANL control (11) to reduce unwanted noise and maintain minimum audio distortion.

4. Set SQUELCH control (9) fully counterclockwise, then advance control clockwise until background noise and undesired weak signals are eliminated.

#### TO TRANSMIT —

##### NOTE

Remember that Channel 9 has been designated as an emergency channel and that its use is primarily restricted to communications involving the immediate safety of life and protection of property; and, secondarily, to provide assistance to motorists. Many CB clubs, police, rescue units, hospitals and garages monitor Channel 9. Emergency calls made on any channel must be given priority!

Before transmitting, make sure that the channel is clear.

1. Position microphone close to your mouth and at a slight angle.

2. Monitor the channel and, when clear, press and hold the PTT switch (7). The pointer on the S/Rf meter (3) will deflect into the red area, indicating normal relative power output.

3. Contact the party you wish to speak with. Speak clearly and in a normal voice. To hear a reply, release the PTT switch.

#### INTERPRETING S/Rf METER READINGS —

The CB unit is equipped with a multi-function meter. The S/Rf scale indicates both the relative transmitter output power and the received signal strength. By interpretation, the meter can also indicate the condition of the CB antenna circuit.

The received signal strength scale is calibrated in S units, the stronger the received signal, the more the meter deflects to the right. For example, S1 represents a very weak signal, S5 is an average signal, and S9 is an extremely strong signal. When using RF GAIN control (2) these readings apply when the control is clockwise (maximum gain). The meter will still show relative signal strength when RF gain is used and it should be used as a monitor when setting the RF GAIN to the correct level. As an example, the desired voice signals may be received at an S9 level but, at the same time, interfering signals are being received at an S3 level. (Strength of the interference can be read on the meter during a break in transmissions of the higher signal.) To cut down on the weaker signals, adjust receiver sensitivity with the RF GAIN control so that the strength of the S9 signal drops to an S6 level, and this will eliminate the interference.

For best performance and system reliability, the antenna SWR (Standing Wave Ratio) must be as low as possible. A low SWR ensures that most of the RF output energy is being radiated through the antenna, instead of being reflected back into the transmitter. A high SWR reduces communications range and, if sustained, can shorten the life of the equipment.

**USING SQUELCH CONTROL —** With the control fully open (counterclockwise), the receiver is so sensitive that even very weak signals from low power "Walkie-Talkies" and distant radio sets may be received. Many of these signals will be unintelligible due to range and atmospheric conditions. As the SQUELCH control is advanced clockwise, stronger and stronger signals are required to "unsquelch" the receiver. In this way, the operator can establish the desired level that a signal must exceed before it is audible.

**PUBLIC ADDRESS OPERATION —** The PA feature allows the operator to hear messages from outside the coach, as well as make announcements over the PA speaker.

1. To hear received signals over the PA speaker instead of the internal CB speaker, place PA/CB switch in PA position. Adjust loudness with the VOLUME control.

2. To use the PA speaker for public announcements, or as a one-way intercom, place the PA/CB switch in PA position, press PTT switch and speak

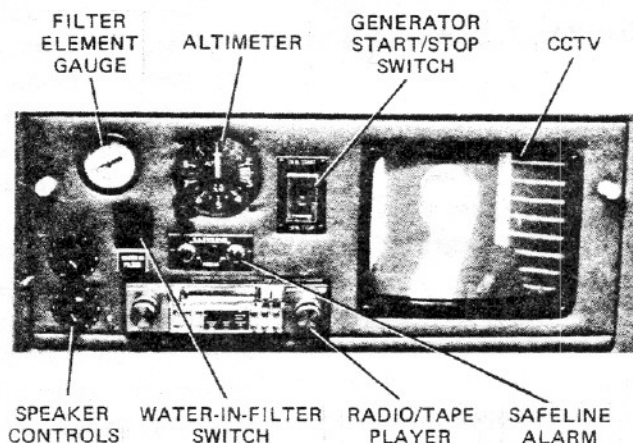


Figure 2-8. Upper Panel

into the microphone. Speaker loudness depends only on voice level and microphone gain setting. In this mode, the VOLUME control has no effect on voice level. To silence received signals that may be heard when the PTT switch is released, turn the VOLUME control fully counterclockwise, but do not turn it off.

#### OVERHEAD INSTRUMENTATION

The upper panel, figure 2-8, located on the bulkhead directly over the driver, contains the FM/AM stereo tuner/cassette tape player, Safeline Alarm panel, generator start-stop switch, altimeter, water-in-filter gauge and test switch, speaker fader controls and closed-circuit TV/receiver. The digital thermometer panel is located on the center bulkhead.

#### FM/AM STEREO TUNER/CASSETTE PLAYER

##### OPERATING CONTROLS (Figure 2-9)

**VOLUME/ON-OFF/BALANCE/TREBLE CONTROL** — In the normal position, this control is a

conventional volume/power on-off control. To use for balancing the stereo outputs, push the control inward and adjust as required; to adjust treble response, pull the control outward to adjust.

**BASS CONTROL** — Turn this outer ring clockwise to increase bass response; turn counterclockwise to decrease bass response.

**TUNING CONTROL** — Provides manual and automatic station selection. For manual selection, turn the control until the digital readout shows the desired station, then adjust for fine tuning. To use for automatic station selection, just depress the control momentarily and it will advance upward in frequency to the next clear station. Note that the control works automatically only in an increasing range; it will not select downward. (This control is also used in setting the time display, described later on.)

**FADER CONTROL** — Balances front/rear speakers.

**FM/AM SWITCH** — Depress inward for FM operation; release outward for AM operation.

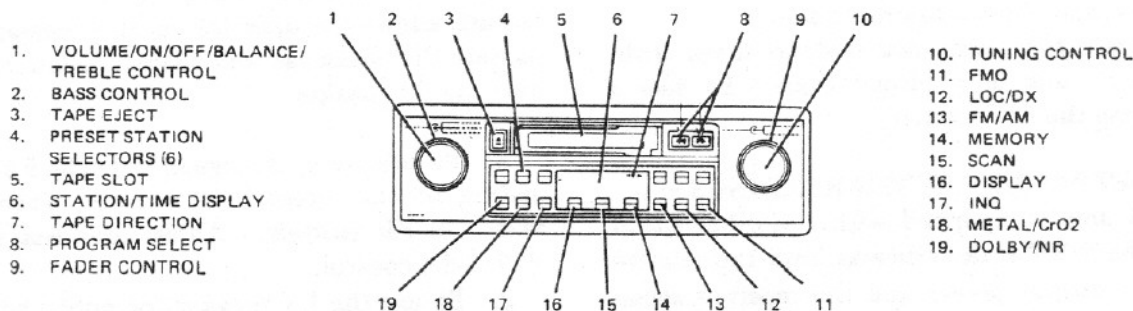


Figure 2-9. FM/AM Stereo Tuner/Cassette Player



**LOC/DX SWITCH** — Increases tuning sensitivity for long-range (DX) stations when released to out position; push inward for local (LOC) stations.

**FMO SWITCH** — When pressed inward, this switch improves reception of “noisy” signals” in weak signal areas.

**1 THROUGH 6 PRESET STATION SWITCHES** — These switches operate with the MEMORY button to store stations for memory selection.

**DOLBY NR SWITCH** — Depress to ON position when playing tapes recorded by the Dolby Noise Reduction system; leave switch in outward position for other tapes.

**METAL/CRO2 SWITCH** — Press this switch inward when playing metal or CrO2 tapes; leave switch in the outward position for all other tapes.

**INQ SWITCH** — Press switch inward for “Impulse Noise Quieting” to eliminate impulse-type noises on FM stations.

**DISPLAY SWITCH** — Depress this switch momentarily to display the selected radio station on the digital readout. After five seconds the display reverts back to a time readout.

**MEMORY SWITCH** — Depress this switch to use the MEMOry function and insert the selected AM or FM station into memory. This switch is also used to set the display time, together with the TUNING control.

**EJECT, TAPE SLOT, PROGRAM SELECT** — Insert cassette into slot with exposed tape on right side. To eject tape, push EJECT button; to reverse tape, press both PROGRAM SELECT buttons at the same time.

#### **RADIO OPERATION —**

1. Turn POWER switch ON and adjust the VOLUME control. Select AM or FM operation.

2. Adjust TUNING control for desired station. Note that digital display shows station frequency. For automatic station selection, depress TUNING control inward to tune radio to the next available higher-frequency station. Note that stations can be selected only in an increasing range, not in a decreasing frequency range.

3. Adjust BASS, TREBLE and BALANCE controls as desired.

4. To insert a selected station into MEMOry (up to six may be chosen), tune into the station and push in the MEMORY switch. Note that the MEMORY indicator will light for five seconds to show that the memory is functioning. During this five-second period, press in one of the six memory pushbuttons to lock the station into memory. Repeat with the remaining five pushbuttons for the additional stations to be selected.

#### **TAPE OPERATION —**

1. Insert the tape into the tape slot with the open side of the tape to the right.

2. Turn POWER switch ON, adjust VOLUME, tone and BALANCE controls.

3. Select the DOLBY NR and METAL/CRO2 switches as desired to match the tape used.

4. Push either PROGRAM SELECT switch for the desired direction of tape play. To rewind, in either direction, the switch must be pressed inward fully. Note that the tape deck can be reversed at any time by pressing both switches simultaneously. Otherwise, the tape will automatically reverse at the end.

**DIGITAL CLOCK OPERATION** — To set the time into the clock, push in and hold MEMORY switch while turning the TUNING CONTROL counterclockwise to set hours; or counterclockwise to set minutes. Keep operating the MEMORY button until the correct time is set, then release.

**ALTIMETER** — Indicates coach height above sea level. (Zeroing adjustment can be used to calibrate unit at known elevations.)

**FILTER ELEMENT GAUGE** — Shows condition of Racor filter in terms of fuel line vacuum. High vacuum readings indicate restricted fuel flow.

**WATER-IN-FILTER SWITCH/INDICATOR** — The indicator portion of this switch will light when excessive condensate has accumulated in the Racor filter bowl.

**SAFELINE CONNECTION ALARM** — Contains a buzzer, ON-OFF switch and dual alarm indicators, one red and one amber. The Safeline alarm operates whenever the shoreline is connected to the coach and the ignition switch is in ON position,



as a reminder to disconnect the shoreline before driving away. The alarm is given when the buzzer sounds and red indicator lamp lights. The buzzer alarm can be disabled in favor of the blinking amber indicator lamp by setting the buzzer switch to the OFF position.

**SPEAKER CONTROLS** — Adjust sound distribution between front and rear speakers.

**GENERATOR START/STOP SWITCH** — Provides local control for generator operation. Press this center-off momentary switch to **START** position and hold until generator starts, as indicated by the switch indicator illuminating. If generator does not start within 15 to 20 seconds, release switch, wait 30 seconds, then try again. To shut down the generator, press to **OFF** position and hold until light extinguishes.

#### CAUTION

Do not start the generator when a heavy circuit load is on-line, such as the air conditioners. This can cause an excessive strain on the generator rotating components and may result in equipment damage.

#### NOTE

When starting a diesel-type generator during extreme cold weather, press the switch in to **OFF** position for a minute. This activates the pre-heater in the fuel supply line to aid in easier starting.

#### FLOOR AND SIDE CONTROLS (Figure 2-10)

**HIGH BEAM SWITCH** — Press switch once to turn on high beams (when normal headlights are on). Note that **HIGH BEAM** light on dash is lit. Press the switch again to restore normal headlights.

**AIR HORN FOOT SWITCH** — Operates 'highway' horns.

**BRAKES** — The coach is equipped with a dual air brake system which includes two independent systems for the front and rear service brakes. A separate reservoir and panel-mounted pressure gauge is provided for each service brake system.

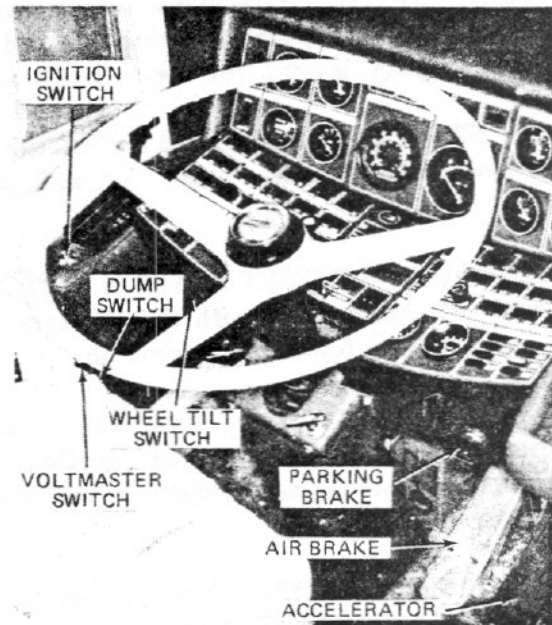


Figure 2-10. Floor and Side Controls

**ACCELERATOR** — The accelerator pedal controls the speed of the coach by opening and closing the engine control fuel flow line. This pedal also controls the transmission low-gear kick-down mechanism which provides rapid acceleration from slow speeds.

**IGNITION SWITCH**—The ignition switch is a four-position, standard-type key switch. In **OFF** position (center), ignition and accessory positions are disabled and the key can be inserted or removed. In **ON** position (right) the battery is connected to the ignition circuits and the key can be advanced to **START** to start the engine. **ACCESSORY** position (left) allows operation of accessories without activating the ignition circuits. Note that **CCTV** operation occurs only in **ON** position; setting the ignition to **OFF** allows use of standard TV.

#### NOTE

The engine can be started only when the transmission selector is in the **N** (neutral) position.

**VOLT MASTER SWITCH** — Set this switch **OFF** to turn off all 12-volt supplies except the digital clocks, monitoring panels and burglar alarm.

**DUMP SWITCH** — This switch controls the inflation of the coach air suspension system. When the



coach is parked for any period of time, set switch to ON to dump the air bags. Note that the SUSP. DUMP ACCESSORY WARNING light is lit. Set the switch to the OFF position to re-inflate the air bags before driving away. (System air pressure must be at least 65 psi.)

**WHEEL TILT SWITCH** — Controls air-operated steering wheel tilt mechanism to allow positioning of steering wheel to one of three detent positions. Flip lever back to lock wheel into position.

#### CAUTION

Always make sure that lever is in the fully locked position in whichever detent setting is used. Do not change the wheel tilt setting while the coach is in motion.

#### COMPASS UNIT

The compass, mounted above the dash panel, is a high-precision automotive-type unit, accurate to within 5 degrees. The compass mechanism is floated in a special fluid that is unaffected by temperature extremes. If it is necessary to re-calibrate the unit, follow manufacturer's directions.

#### RADAR DETECTOR

A radar detector is installed as standard equipment on your coach. This unit, shown in figure 2-11, is designed to activate when transmissions are received from radar-type speed detection equipment. Please remember: the purpose of the radar is to encourage caution — not speeding!

#### NOTE

Because some states have ruled radar detection equipment illegal, it is the responsibility of the driver or owner to obey the appropriate laws. (There are two thumbscrews that are provided which may be loosened for easy removal of the unit.)

**CONTROLS AND INDICATORS** — Operating controls and indicators are listed below:

**CHECK SPEED Indicator** — Provides flashing red warning light indicating radar detection.

**ON-OFF Sensitivity Control** — Applies power

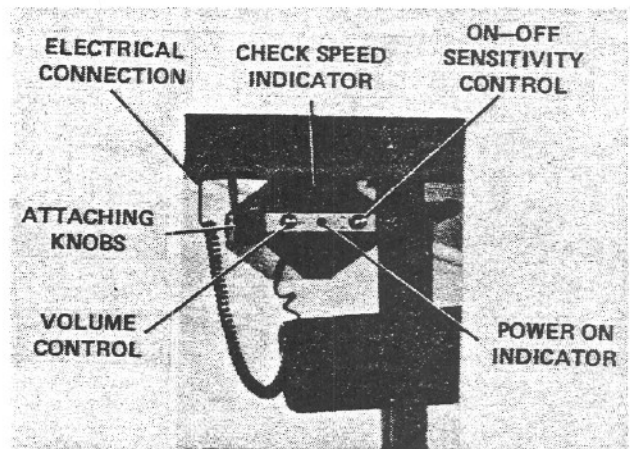


Figure 2-11. Radar Detector

to unit and adjusts sensitivity threshold for maximum response.

**VOLUME Control** — Sets volume of audible warning signal.

**POWER Indicator** — Lights when power is on.

**OPERATION** — Although the detector is designed to prevent reception of false alarms, microwave telecommunications towers can sometimes cause a false alarm. The extreme sensitivity of the unit makes it most important for the driver to heed ALL warnings. Reflected radar scatter from a moving radar, going in the same direction ahead of you, or behind you, can be detected by your unit. Remember, the unit can detect up to 10 times the effective distance of police radar!

Operate the radar detector as follows:

1. Turn on unit by rotating the ON/OFF sensitivity control clockwise past the "click". The green POWER indicator will light. The unit may beep a few times, then it will stop as it warms up.

2. After initial beeping has stopped, turn the sensitivity control clockwise again until a constant beeping is audible. Then back off the control in a counter-clockwise direction, slowly, until the beeping stops. The unit is now set at its highest sensitivity level.

3. Should the unit start beeping constantly at non-police radar signals (false alarms) turn sensitivity control counter-clockwise until the beeping stops. This de-sensitizing of the unit allows for its operation in heavily microwave-concentrated areas without excessive false alarms.



## SEAT CONTROLS

Electrically- and air-operated seat adjustments are built into the driver's and co-pilot's seats. A typical control panel is shown in figure 2-12.

Three **ELECTRIC SEAT CONTROLS** are used to control seat bench tilt; up-down and front-back seat movement; and seat back tilt. The **SIDE SLIDE** switch operates an air cylinder which locks the position of the slide mechanism beneath the seat. Set switch **ON** to disengage the seat slide lock, adjust side-to-side position, then set to **LOCKED** to re-engage lock mechanism. This switch must be kept **LOCKED** to secure the seat during travel.

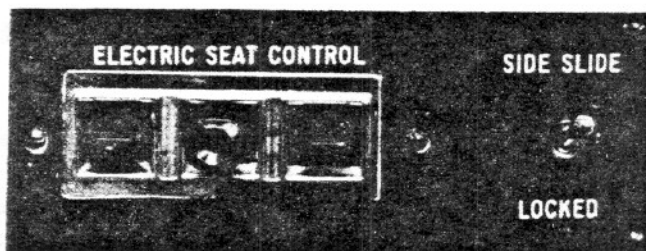


Figure 2-12. Seat Controls

## CLOSED-CIRCUIT TV/RECEIVER SYSTEM

Besides the TV receiver on the upper panel, the CCTV/receiver system also includes:

- CCTV camera, located in the rear bulkhead;
- VHF/UHF tuning and TV receiver controls, on the side panel above and to the left of the driver;
- Roof-mounted TV antenna/rotator, remotely operated by controls in the side compartment above and to the rear of the co-pilot.

**CCTV OPERATION** — When the system is used for CCTV operation, the rear-facing CCTV camera transmits images directly to the monitor via coach cabling. CCTV operation can only occur when the ignition is **ON**. For normal operation, when the ignition is **OFF**, the system functions as a conventional TV receiver, via the controls shown in figure 2-13. Also, it is normal for the system to

require a brief warmup period before achieving full resolution. Note that CCTV camera controls are preset and the standard lens supplied with the unit is designed to focus from about two feet to infinity.



Figure 2-13. TV Controls

**TV OPERATION** — Use the monitor as a standard TV, with ignition **OFF**, via the TV panel controls.

## TV ANTENNA AND ROTATOR SYSTEM

The control components of the antenna and rotator are a hand-held switch-operated rotator, radome-type TV roof antenna, and a coupler-switcher for the antenna or cable inputs.

The A-C switch on the coupler selects antenna (A) or cable (C) input via connections in shoreline compartment at the rear of the coach. Additional switches on the coupler route the antenna/cable inputs to the TV receiver.

The antenna rotator controls the position of the TV antenna within the radome. The three-position momentary switch (center OFF) provides right/left antenna rotation, with antenna position displayed on the control unit. The rotator power supply is also located in the radome, which, in addition to the antenna, also includes an amplifier and rotator mechanism. The remote power supply is designed to operate from either 120 volts ac or 12 volts dc. A 30-foot length of low-loss coaxial cable and three-wire rotator control cable interconnect the antenna and power supply. Both of these cables are contained within a prefabricated, single-jacketed cable assembly, included with the unit.



Note that a .8 ampere fuse is connected in series with the 12-volt dc supply line to the unit. In the event that the TV set exhibits problems relating to low antenna input ("ghosts", etc.) check this fuse before servicing the TV set.

## OPERATION

With the TV on and a station tuned in, rotate the antenna by pressing the rocker switch located on the control unit. Press the right side of the switch to turn the antenna clockwise; press the left side to turn the antenna counter-clockwise. Although the actual antenna movement is not visible, the indicator arrow on the control unit lights and shows the direction of the antenna. When the antenna has made one full turn (360 degrees), the End of Rotation light comes on. Observe the picture while rotating the antenna, first in one direction, then the other, to obtain best picture quality.

## DIESEL ENGINE OPERATION

Proper operation and maintenance are key factors in determining the useful life and operating economy of a diesel engine. Follow these directions for trouble-free, economical engine operation.

**TO START ENGINE** — Caterpillar diesel engines will start at temperatures above 10 degrees F (-12 degrees C) without using a starting aid. However, for temperatures below 10 degrees F it may be necessary to activate the engine block heater (120 v ac-operated) to heat the crankcase oil. The engine block heater switch, located near the engine hood on the co-pilot's side, should be set ON; the adjacent indicator lamp will light. Remember to set switch OFF when the heater is no longer needed.

1. Place transmission in NEUTRAL.
2. Push accelerator pedal to half-speed.
3. Turn ignition switch to START. If engine fails to start within 30 seconds, release the starter switch and wait 60 seconds to allow the starter motor to cool before trying again.
4. As soon as the engine starts, reduce engine speed to low idle. Use throttle control on steering column as necessary to set idle speed.
5. Do not apply a load to the engine or increase engine speed until oil pressure gauge indicates

normal. Oil pressure should rise within 15 seconds after engine starts.

6. Operate the engine at low load until all systems reach operating temperatures. Check all gauges during warmup period.

## AFTER ENGINE STARTS —

1. Reduce speed to low idle, with no load. When normal oil pressure is reached, run engine at low load for 5 minutes before applying full load. Rapid acceleration causes heavy exhaust smoke and high fuel consumption.

2. Accelerate to near-governed RPM. To avoid lugging, operate in a gear range low enough to permit the engine to accelerate under load.

3. Continue to accelerate until cruising speed is reached. Under load, maintain engine speed between 80% and 100% of rated RPM.

4. On upgrade, downshift if engine starts to labor. Downshift until a gear is reached in which the engine will pull without lugging.

5. **DO NOT LUG ENGINE.** Lugging results in excessive smoke and high fuel usage. A lug condition exists when an increase in engine speed cannot be achieved with an increase in accelerator pedal position; or when the engine speed decreases with the accelerator pedal floored. Do not lug engine below 2,000 RPM for more than several seconds.

6. On downgrades, do not coast or put transmission in NEUTRAL. Select the correct gear to keep the engine speed below high idle and retard the vehicle. A simple rule to follow is to select the same gear that would be used to go up the grade.

7. Before stopping the engine, operate at low idle for 30 seconds. This will allow hot areas in the engine to cool gradually, extending engine life.

## DO NOT OPERATE THE ENGINE AT LOW IDLE FOR LONG PERIODS

**TO STOP ENGINE** — Turn ignition switch OFF.

## TRAILER HITCH CAPACITY

Hitch capacity is 7,500 pounds tow; 750 pounds tongue. Refer to figure 10-1 for electrical wiring.





## TOWING

### CAUTION

Do not tow a vehicle equipped with Allison automatic transmission unless the rear drive shaft has been removed, or the rear wheels raised from the ground. Use caution when towing unit by front axle or cross-member. Damage to wiring and/or air lines can result because of proximity of these items to front cross-member.

## TRANSMISSION START-UP INSPECTION

All Allison automatic transmissions delivered to an original retail purchaser of highway vehicles are eligible for a Transmission Start-Up Inspection if presented to an authorized Detroit Diesel Allison Service outlet within 90 days after delivery, or within 10,000 miles, whichever comes first. This inspection includes a complete check of the transmission installation and a road test to ensure that the transmission is operating satisfactorily. The inspection will be performed at no additional charge except for filter elements, lubricants and other maintenance materials. It is recommended that you take advantage of this service to realize the maximum benefits from your Allison-equipped vehicle. (Check the Yellow Pages under Transmissions - Truck or Engines - Diesel, for your nearest authorized service outlet.)

## OPERATION

The Allison transmission provides four forward gears and one reverse gear. Speed selection is provided through the transmission shift lever located on the side wall, shown in figure 2-14.

The selector lever must be in N (neutral) position when the engine is started. If the engine can start in any other position, the neutral start switch is defective and should be replaced as soon as possible. Use D (drive) position for all normal driving conditions so that the coach begins moving in first gear and, as the accelerator is depressed, the transmission upshifts automatically into 2nd, 3rd, and

4th gears. As the coach slows down, the transmission automatically downshifts to the correct gear. Use a low gear (2nd or 3rd) when road, load or traffic conditions make it desirable to restrict automatic shifting to a lower range. When conditions improve, return range selector to normal D position. These positions also provide progressively greater engine braking action (the lower the gear range, the greater the braking effect). Use 1st gear when pulling through mud and snow or driving up steep grades. This position provides the maximum engine braking power. Use R (reverse) for backing the vehicle. The vehicle should be completely stopped before shifting from a forward gear to reverse. Reverse gear provides the greatest tractive advantage.

### NOTE

In the lower ranges, 1st, 2nd and 3rd, the transmission will not upshift to the highest gear selected unless the recommended engine governed speed for that gear is exceeded.

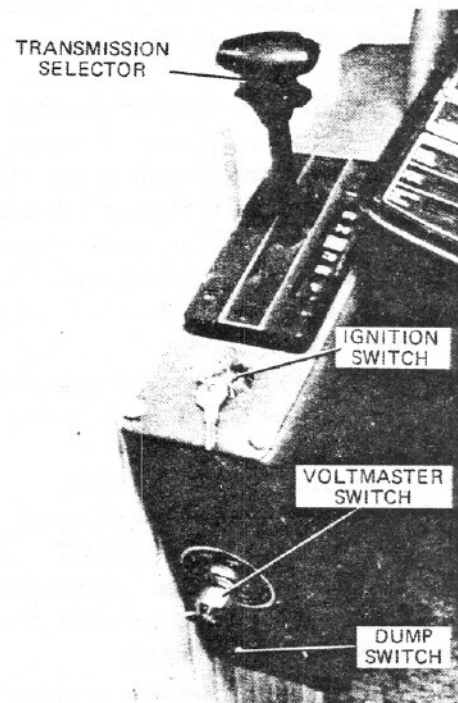


Figure 2-14. Transmission Shift Selector





## DRIVING TIPS

**ACCELERATOR CONTROL** — Foot pressure on the accelerator pedal influences the automatic shifting. When the pedal is fully depressed against the floor pedal stop, the transmission automatically upshifts near the recommended governed speed of the engine. A partially-depressed position of the pedal causes the upshifts to occur sooner at a lower engine speed. Shift timing is accomplished by using a cam and cable from the throttle. This method provides the accurate shift spacing and control necessary for maximum performance.

**DOWNSHIFT CONTROL** — The transmission can be downshifted or upshifted, even at full throttle, and, although there is no speed limitation on upshifting, there is a limitation on downshifting and reverse. Good driving practices indicate that downshifting should be avoided when the vehicle is over the maximum speed attainable in the next lower gear. Therefore, the good driving habits have been designed into the Allison transmission shift pattern for your benefit. The downshift inhibitors within the valve body prevent those harmful shifts when the vehicle is traveling too fast for the next lower gear.

If downshifts are attempted at excessive speeds, the inhibitors prevent the selected downshift until the vehicle reaches an acceptable speed.

### USING THE ENGINE TO SLOW THE UNIT —

To use the engine as a braking force, shift the range selector to the next lower gear range. If the vehicle exceeds maximum speed for a lower gear, use the brakes to slow the vehicle to an acceptable speed until the transmission may be downshifted safely.

An automatic transmission, compared with a manual-shift transmission, has a longer "coast-down" time. Until becoming accustomed to this characteristic, it may be necessary to manually downshift to reduce speed.

With a little experience in driving with the automatic transmission, you will learn to decelerate a bit sooner, or brake until automatic downshift occurs. This will reduce the need for manual downshifting.

## TRANSMISSION OIL TEMPERATURE

Extended operation at low vehicle speeds, with the engine at full throttle, can cause excessively high temperatures in the transmission. These temperatures may tend to overheat the engine cooling system as well as cause possible damage to the transmission. If excessive temperature is indicated by the engine coolant temperature gauge, stop the vehicle and determine the cause. If the cooling system appears to be functioning properly, the transmission is probably overheated. Shift to N and accelerate the engine to 1,200 to 1,500 RPM. This should reduce the oil sump temperature to operating level within a short time. If high temperatures persist, stop the engine and have the overheating condition investigated by service personnel.

### CAUTION

Do not operate the engine for more than 30 seconds at full throttle with the transmission in gear and the unit stationary. Prolonged operation of this type will cause the transmission oil temperature to become excessively high and may result in severe overheating damage to transmission components.

If the transmission overheats during normal operation, check transmission oil level.

## GENERAL INFORMATION — CATERPILLAR DIESEL ENGINES

Check crankcase oil level before starting and when refueling. Always check oil level with engine stopped. The dipstick has 2 markings, and the distance between them represents 3 quarts (2.8 litre). Use oils that meet any of the following engine service classifications:

- SC and SD (MS - Motor Severe Oils)
- CB (Supplement 1 Oils)
- CC (MIL-L-2104B Specification Oils)
- CD (MIL-L-2104C; Recommended Usage)

Use SAE 10W, 10W/30, 10W/40 or -30 grade oils, depending on the temperature.

**CHECK** (with engine stopped) fan, water pump and accessory drive belts for cracks, breaks and



frayed edges. Belts for multiple-groove pulleys are sold in matched sets. Replace, as a set, if one belt is defective. While checking belts, look for oil, water or fuel leaks.

**CHECK** (with engine stopped) for water in the fuel. Drain a cupful of fuel from the bottom of the tank to remove water or sediment. Fill fuel tanks after completing a run. Partially-filled tanks will collect moisture if the coach is allowed to sit for an appreciable length of time. Use Number 2-D diesel fuel (with a minimum cetane number of 40) in Caterpillar 3208 Diesel engines. Keep fuel clean. Inspect Racor filter bowl periodically and observe WATER-IN-FUEL indications on the dashboard gauge. Remove and clean filter bowl as necessary.

Use Number 1-D diesel fuel in cold temperatures when white smoke must be minimized on starting up.

**CHECK** coolant level (with engine cool and off). Fill to the proper level with water and permanent-type anti-freeze. Adding Caterpillar Cooling System Conditioner to permanent-type anti-freeze is recommended if protection is above -20 degrees F (-29 degrees C). Use clean water that is low in scale-forming minerals, not softened water. Leave space for expansion.

## AIR SUSPENSION SYSTEM

Your motorhome is equipped with a dump system for the air suspension bags. Dumping these air bags when the vehicle is parked allows the rubber bumpers to come together and eliminate vehicle "springiness". Dump the suspension system by turning ON the air switch located just below the 12 volt electrical MASTER switch on the transmission shift housing.

### NOTE

The accessory air tank must contain at least 65 PSI pressure for the air switch to function. The accessory air tank pressure does not register on the dash air pressure gauges.

When the switch is turned ON it applies air pressure to three air pilot-operated valves on the suspension system. Two of these valves are located

on the rear axle; and one is located on the front axle. The pilot air shifts the valves, cutting off the air supply to the air bags and allows the air in the bags to escape. After the suspension system has been dumped, and the ignition is turned on, a warning pilot light is illuminated on the dash to warn the driver that the system is dumped and not to drive the vehicle until the air switch is set to the OFF position.

### NOTE

If the leveling jacks are to be used while the coach is parked, the jacks must be lowered to level the vehicle BEFORE the air bags are dumped. If the air bags are dumped before the jacks are down, the vehicle comes too close to ground level for the jacks to fold outward properly, which could damage the jacks.

## RACOR FUEL FILTER

A Racor fuel filter/preheater (shown in figure 6-1) is incorporated in the diesel fuel supply line and processes the fuel supply for maximum purity. The primary stage of the filter separates liquid and solid contamination down to 30 microns by centrifugal action. Because contaminants are heavier than the liquid they fall to the bottom of the bowl and can be drained off by operating a petcock at the bottom. The second stage, coalescing, functions when minute particles of liquid contaminants (lighter than the fluid) remain in suspension and flow up with the fluid into the lower part of the filter/separator shell. Here the minute particles tend to bead on the inner wall of the shell and fall to the bottom of the replaceable cartridge due to their weight. The third and final stage is filtration, where the fluid enters the replaceable cartridge and the remaining solids (down to one micron) are removed. The fuel is then supplied to the engine.

The fuel filter also includes a built-in preheater, which operates from the 12-volt battery supply; and a water sensor, which lights a dashboard indicator when the water level in the filter bowl is high enough to require drainage. Note that the terminals for the electrical hook-ups are imbedded in the filter bowl. The upper terminals are for the heater connection; the lower terminals connect to the water level sensor probe.