#4

Instructions

for the

Heathkit
ZENITH Educational Systems

ET-18-4 UTILITY ROM ACCESSORY

Model ET-18-4

TABLE OF CONTENTS

CAUTION

The Utility ROM can be easily damaged by static electricity if it is not properly handled before it is installed in the Robot. Do not remove the integrated circuit from its foam pad until you are ready to install it.

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

595-3076

INTRODUCTION

Several interesting, entertaining, and useful programs for your Hero Robot are presented in this Accessory. With it, you can quickly and easily demonstrate and use many of the Robot's sophisticated functions without entering lengthy programs. You can also use this Accessory to edit or alter your programs, and to interface with a properly equipped computer.

When installed, this accessory will allow you to press a single key to have your Robot seek the brightest light, measure distance with its sonar, display the time, etc. You can also "teach" or program your Robot to do various things and then reverse and repeat the operation with the press of a single key.

If you have a Speech Accessory installed, the Robot will talk, sing, and add voice comments to many of its functions. The Speech Option will give you one-key access to such features as a talking clock, speaking all the phrases in the Robot's ROM (read only memory), count sounds, speak up if it detects light, sound, or motion, and others. It will also speak in French and Spanish.

Another useful feature is the Phoneme Editor which allows you to easily alter phonemes in the RAM (random access memory), and to actually hear the sound as each phoneme code is displayed. The Editor also makes it easy to "debug" any type of program stored. Finally, if you have a properly equipped H/Z-89 or H/Z-90 Computer, the "dLoad" feature permits you to interface your Robot for programming and/or storing your favorite program routines.

INSTALLATION

You can install the Utility ROM Accessory in your Robot in just a few minutes by using the following instructions.

( ) Place the Robot's Power switch in the OFF positon.

( ) If your Robot is completely assembled, refer to Figure 1 and remove the rear panel. You may have to turn the head if you have an arm installed.

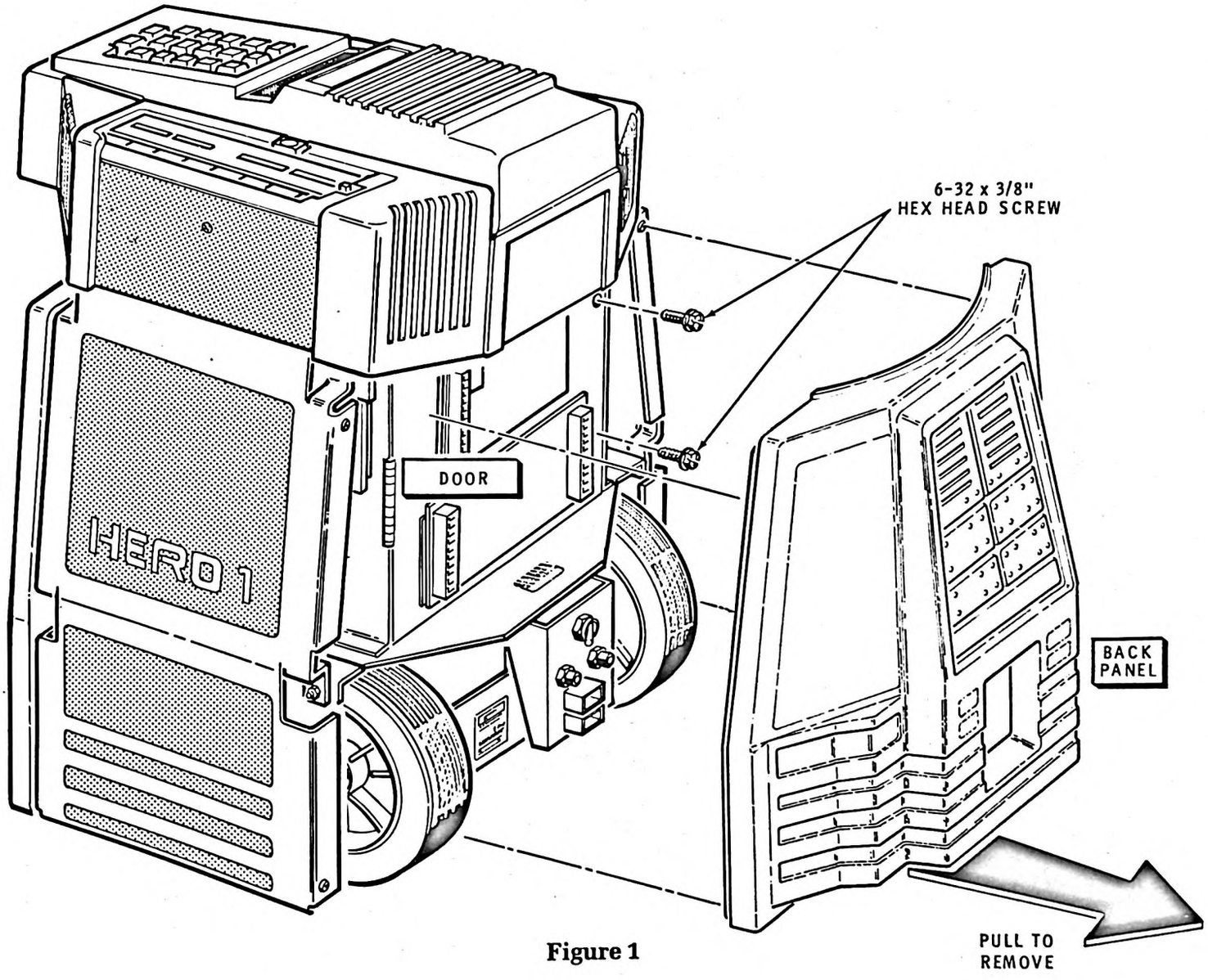

Figure 1

( ) Remove the two hex head screws from the door, and open the door.

Refer to Figure 2 for the location of the jumpers and integrated circuit socket U417 on the CPU circuit board.

( ) Check the position of the jumpers located just above U417. Reposition them, if necessary, to J8, J9, and J12, as shown. These jumpers configure the Robot for the type of ROM installed.

CAUTION: The integrated circuit Utility ROM you will handle in the next step can be easily damaged by static electricity. Before you remove the IC from its conductive foam pad, touch both the IC and the IC socket with both hands to neutralize static electricity. Then, do not let go of the IC until you install it in its socket.

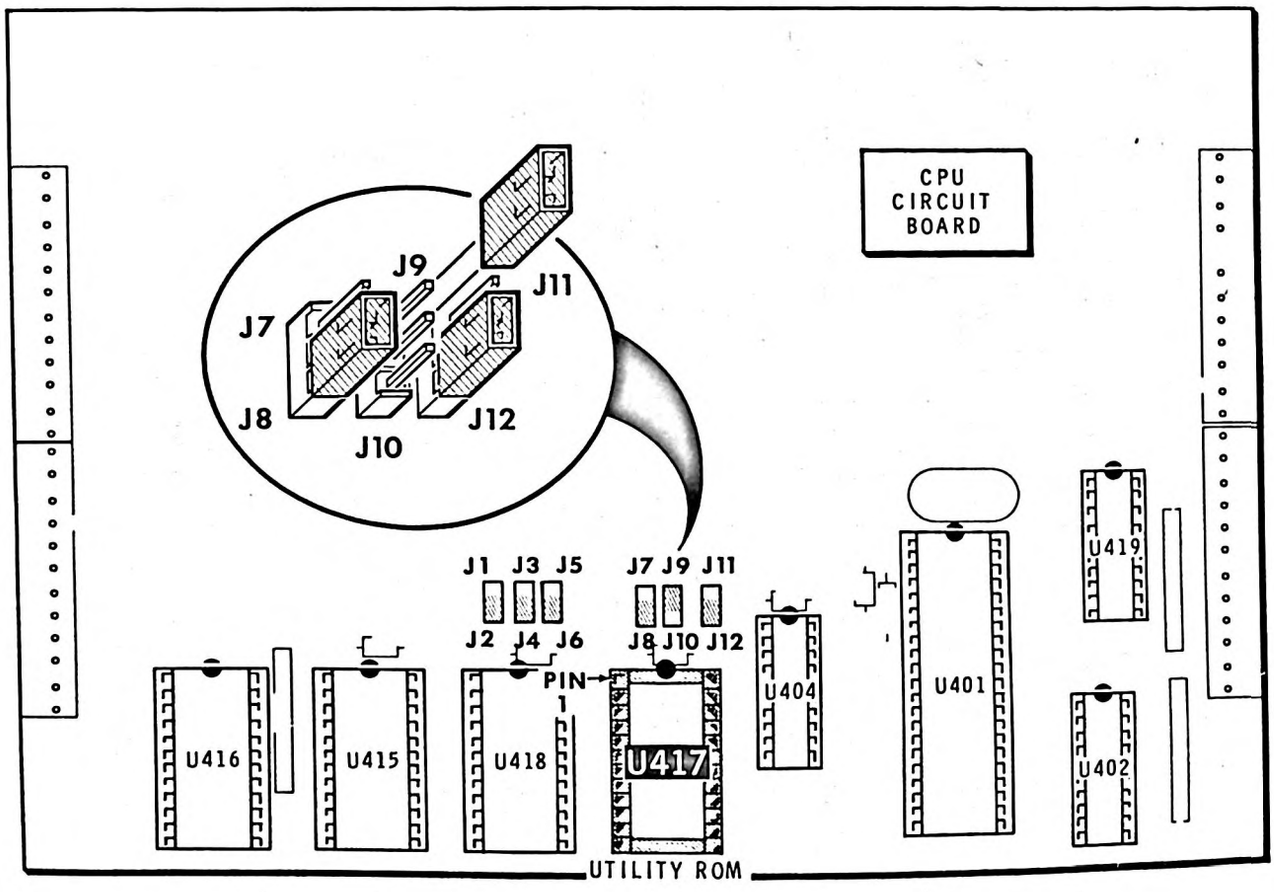

Figure 2

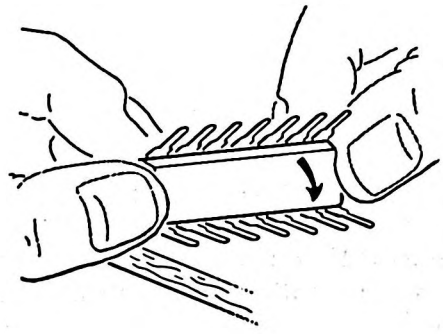

Figure 3

To straighten the pins of the IC, hold it in one hand while you touch your table top with the other. Then gently press the side of the IC on the table top to straighten the pins, as shown in Figure 3.

When you install the IC, position its pin 1 end upward toward the index mark on the circuit board. See Figure 4 to identify the pin 1 end of the IC. Be sure all of the pins enter their socket holes and that none are bent under. You will have to depend on your sense of feel for the pins that you cannot see. Finally, press the IC firmly into the socket. Once in the socket, the IC is protected from static electricity.

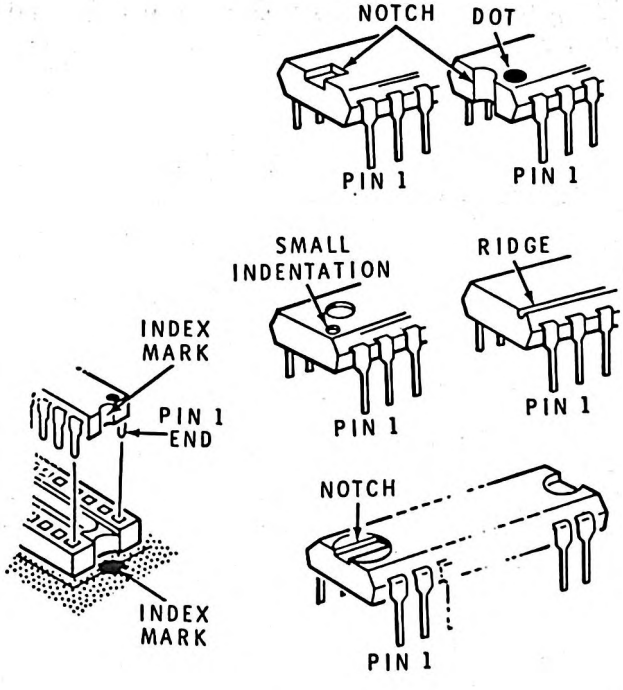

Figure 4

( ) Use the procedure described above and install the ROM IC at U417.

( ) Turn the Robot Power switch on and press **D**, then **F**. The display should read "d". Press **O** and observe a display of six digits (representing hours, minutes, and seconds). If you have a Speech Accessory installed, Hero will speak the "time" that is displayed. Later you can enter the correct time so it will be displayed (and spoken) each time you press **0** while using the demonstration menu.

( ) Close the door of the Robot and secure it with two 6-32 × 3/8" hex head screws.

This completes the installation and first brief test of your Utility ROM Accessory. You may wish to become familiar with its operation before you install the panel(s) on your Robot. If so, bypass the "Final Assembly" and proceed to "Operation" on Page 7. You can return to the Final Assembly when you have tried the routines and made any necessary adjustments.

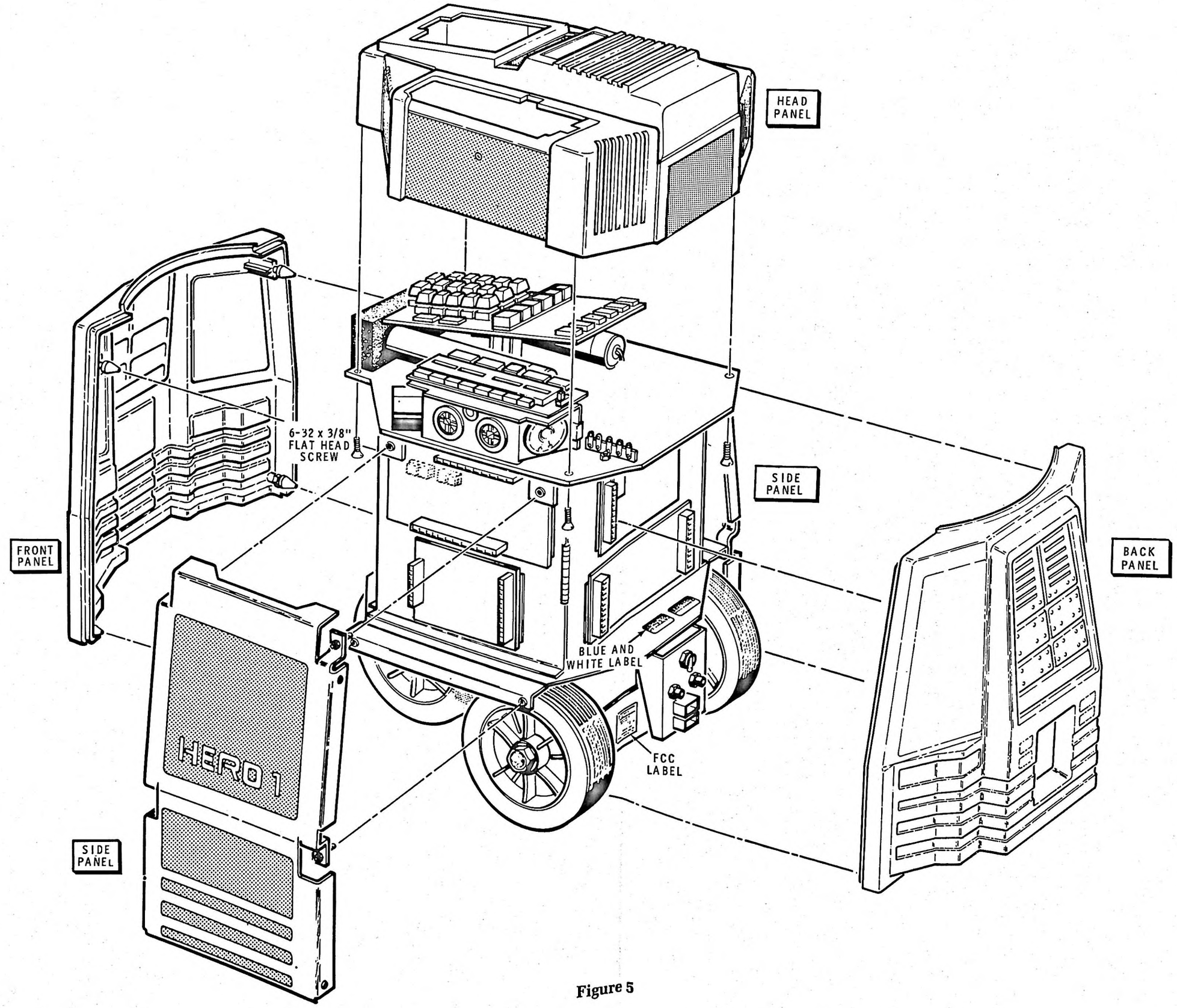
HEAD PANEL
6-32 x 3/8" FLAT HEAD SCREW
SIDE PANEL
FRONT PANEL
BACK PANEL
BLUE AND WHITE LABEL
FCC LABEL
HERO 1
SIDE PANEL

Figure 5

FINAL ASSEMBLY

Refer to Figure 5 and perform the following steps.

( ) Remove the paper backing from the blue and white label, then press the label onto the base plate as shown. Mention the numbers on this label in any correspondence you have with Heath Company regarding your Utility ROM Accessory.

NOTE: If you were referred to this Accessory Manual from your Robot Assembly Manual, perform the steps that follow. Otherwise, simply replace the rear panel on the Robot and proceed to the Operation section.

( ) Install the blue and white label that was supplied with your Robot next to the ROM Accessory label. Refer to the numbers on this label in any correspondence you might have with Heath Company regarding your Robot.

( ) Install the FCC label on the battery cover as shown.

( ) Position the head panel carefully into place over the keyboard, sonar pad, and experimental board until the head panel sits squarely on the head plate.

( ) Attach the head panel to the head plate with four 6-32 × 3/8" flathead screws at the corners as shown. If you have any trouble getting to the four mounting holes, turn the head as needed.

( ) Apply a thin film of silicon grease to the four retainer pins in each of the two side panels. Then press the pins of the side panels firmly into the rubber grommets that are part of the chassis.

( ) Apply a thin film of silicon grease to the four tapered pins in the front panel and in the rear panel. Then mount the front and rear panels by pressing their pins firmly into the grommets of the side panels.

Should you need to remove the body panels for any reason, remember to remove the front and back panels first, then the side panels.

This completes the assembly of your Robot. The rest of this Manual describes the features and use of the Utility ROM Accessory, while the Robot User's Guide provides you with much more information on the overall operation of the Robot.

OPERATION

This section of the Manual will help you use most of the routines in your Utility ROM Accessory without having to study the User's Guide or Technical Manual. You can use those Manuals later if you want to enter and use some unique or sophisticated programs that are beyond the scope of this Manual.

If you have turned off your Robot, use the following procedure to load the Utility ROM's three main programs into keys **9**, **C**, and **F**, labeled "User 1", "User 2", and "User 3", respectively.

( ) Unless the Robot's batteries are fully charged, connect the Charger to your Robot and to an AC receptacle. Then turn on your Robot (and Charger).

Your display should read "HEro1.X" (the number at "X" indicates the version of the ROM installed). If you have the speech option installed, you should hear the word "Ready." After a few seconds, the display will change to a moving dash. With either "HEro1.X" or the moving dash displayed, the Robot is in the Executive mode.

( ) Press **D** to load the user keys. The "HEro 1.X" display does not change. However, the moving dash may stop momentarily and then continue moving.

NOTE: Once you have loaded the user keys, you need not reload them again unless you have turned off the Robot or entered a program that has written over a portion of the Utility Program's addresses between 0030 and 0031. In that case, return to the Executive mode (press **RESET**) and then press **D**.

Now you can press a single key to select one of the programs as follows:

F (User 3) — Demonstration Program

C (User 2) — Phoneme Editor

9 (User 1) — dLoad Program

Each of these programs and their use will be described separately.

DEMONSTRATION PROGRAM

Contained in the Demonstration Program (address 201B) are several routines that you can select by pressing a single key on the keyboard. You may wish to try each of the routines as they are described. Step marks (parentheses) are placed before the operations that you will perform, while explanatory information is in paragraph form. Figure 6 shows the Robot's keyboard.

NOTE 1: If you have a factory-assembled Robot, all necessary adjustments were properly made before shipment. If you assembled your Robot from a kit, you should have made the adjustments described in the "Test and Adjustment" section of your Assembly Manual. Should you find that further adjustment is needed, refer to Item 3 in the "In Case of Difficulty" section on Page 16. It will direct you to the proper adjustment.

NOTE 2: Some of these routines use the Speech Accessory. Therefore, if you do not have one installed, you cannot expect to hear the sounds that are described. However, the display and other indicators should function as stated.

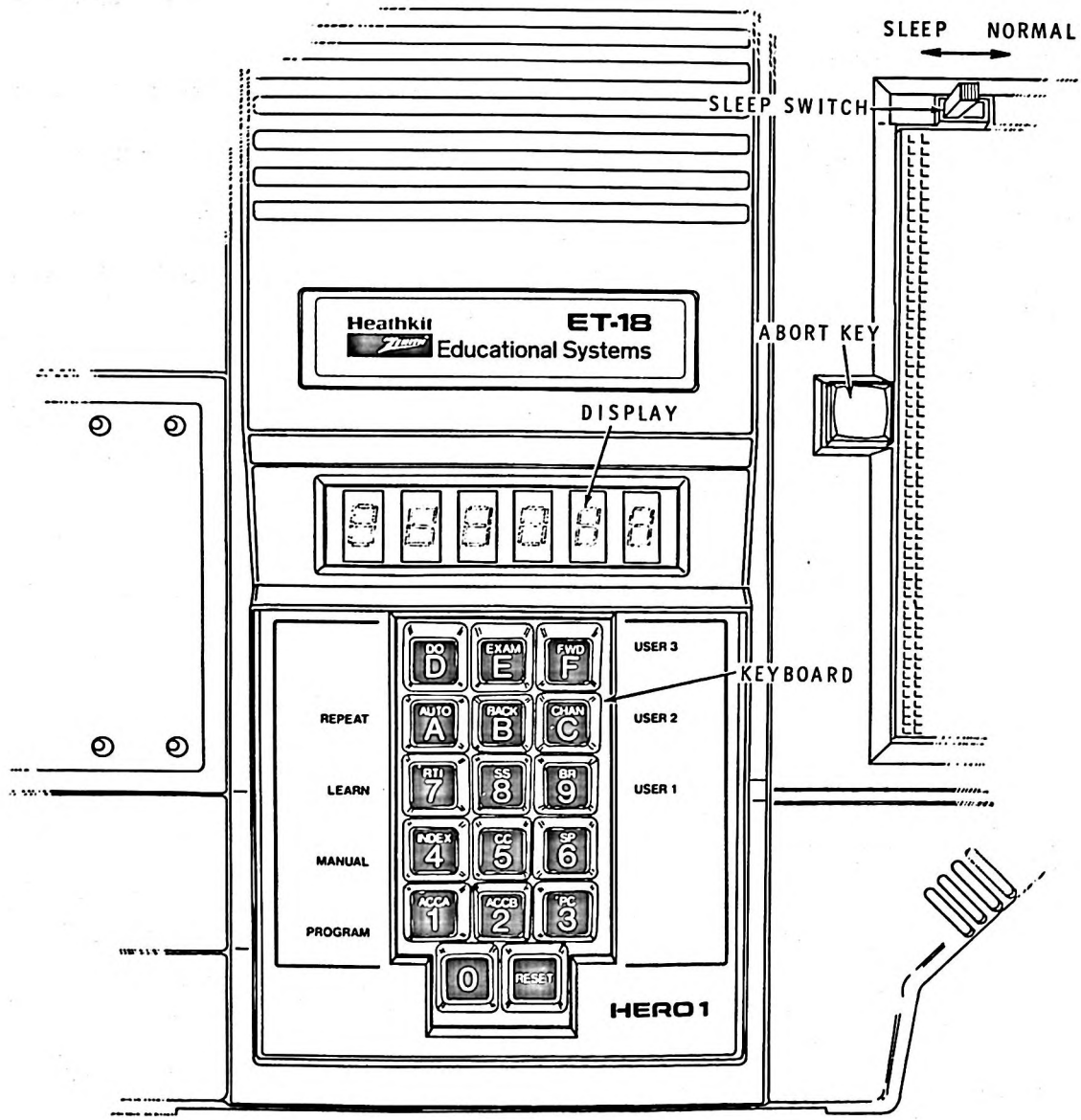

Figure 6

( ) Press **F** (User 3) to select the Demonstration program. The left-most display will read "d", and wait for you to select from the following Main Menu. Each item on this menu is described in the paragraphs that follow.

Main Menu

0 — Talking Clock	8 — Sonar
1 — open	9 — Alarm
2 — Reverse Routine	A — Sleep
3 — "Everything Said – –"	B — Count Sounds
4 — All Phrases in ROM	C — Laughter
5 — Seek Brightest Light	D — French
6 — Detect Motion	E — Spanish
7 — open	F — Song Menu

0 — Talking Clock: Displays the current time and speaks it. To set the time, perform the following steps.

( ) Press **RESET** to return to the Executive mode. Then press **3** and **5**.

The display will read "HH — SS".

( ) Enter two digits for the hour, two digits for the minute, and two zeros for the second. (For a 24-hour clock, 1:30 PM is 133000).

( ) Seléct AM (**D**), PM (**E**), or 24-hour clock (**F**). The Robot will return to the Executive mode.

( ) Press **F** to return to the Demonstration Program, then press **0** to read (and hear) the time.

2 — Reverse Routine: Requires that you first teach the Robot a head or arm routine (not a body or steering routine) with the teaching pendant at location 0100. Then, when you press **2**, the Robot will do and undo the routine that it was taught. The following steps demonstrate the Reverse routine:

CAUTION: Because this routine rewrites the program in reverse order at location 0500, it destroys any data or program that you may have stored there. If you wish to save the data of 0500, download the program to tape before you use the reverse routine.

The following steps demonstrate the Reverse routine:

( ) Connect the teaching pendant (remote control) to the Robot, then press **RESET** to place the Robot in the Executive mode.

( ) Be sure your Robot is initialized. If you are not sure, press **31** and wait for about a minute. When initialization is complete, the Robot will return to the Executive mode and say "ready." Initialization sets the motors to their home positions so the computer knows exactly where they are.

( ) Press **7** to enter the Learn mode and press 0100 for the starting address. When the display again shows "7----", enter 0200 as the maximum address. Now the teaching pendant has control of the Robot and its movements will be stored at location 0100.

( ) Place the pendant's FUNCTION switch in the ARM position and turn the ROTARY switch to the HEAD position.

( ) Press the Trigger and use the MOTION switch to turn the head first one way and then the other. Note that nothing happens unless you press the Trigger.

( ) Change the Rotary switch to other positions and move the arm and wrist in either direction. Then press **RESET**.

( ) Press **F** (User 3) to reenter the Demonstration Program. Then press **2** and the Robot will repeat the motions, first in reverse and then forward.

To exit or stop the reverse routine, press **RESET** or **ABORT**.

The preceding was merely a sample to demonstrate the Reverse routine. You can later perform other routines and use them with the single keystroke. See "Learn Mode" on Page 23 of your User's Guide for more details. See also "Programming from the Keyboard" on Page 25.

Remember: any codes or programs that you enter will be lost if you turn off the Robot.

3 — "Everything Said": Speaks the phrase "Everything that has ever been said, or ever will be said", which demonstrates the Robot's vocabulary.

4 — All Phrases in ROM: Speaks all of the pre-programmed phrases in the main ROM while displaying their addresses.

5 — Seek Brightest Light: Robot's head scans the room, measuring and comparing ambient light levels. After searching, its head returns to point at the brightest light and it tells you to turn out the light. If you do not have an arm installed, there will be pauses during the normal arm pointing phases.

6 — Detect Motion: Robot responds to the slightest movement in front of its motion transducers. Press any key to quit.

8 — Sonar: The Robot looks for a sonar reflection at a preset distance of approximately 15 inches in front of it. If the reflection is too close or too far, it tells you so. If the reflection remains steady within 4/10 inch for four consecutive readings, the Robot congratulates you and returns to the main menu.

9 — Alarm: This routine allows you to teach or program the Robot to do something at a specified time, such as nudging your bed and/or telling you to "get up." If you use the Speech Accessory, be sure to read "Making the Robot Talk" on Page 30 of your Robot User's Guide, and refer to your Phoneme Dictionary.

Use the following steps to teach your Robot a simple routine and have it perform the routine at a specified time.

( ) Press **7** to enter the learning mode and then press **0100** for the address.

( ) Press **0200** for the maximum address. Then use your teaching pendant to run the Robot through a routine.

( ) Press **RESET** and **AE00FF**. Then press **C** and **3F** to change to the Robot mode and press **RESET**.

NOTE: Be sure you have set the clock in your Robot. If you want your routine to begin more than 11 hours and 59 minutes later, you must set the time as for a 24-hour clock.

( ) Press **F** and then **9**. When "_____ al" appears, enter the time that you want the routine to begin. At "_____ Ad", enter the address of the program (**00FF**).

When the time comes, the Robot will do as it was programmed.

A — Sleep: Shows how the Robot saves energy by "sleeping." About every 10 seconds, the Robot will awaken and ask "is anybody there?". If it hears a loud enough sound, it will say "Please be quiet, I am trying to sleep," then it will remain awake and return to the main menu. If it does not hear anything, it will go back to sleep and repeat the cycle.

To put your Robot to sleep, place the SLEEP switch in the SLEEP position, then press **A**. To awaken, simply make a noise (tap on its head) after it asks "is anybody there?", then return the SLEEP switch to the Normal position and wait until the Robot returns to the "d" prompt.

CAUTION: Always use the above procedure to awaken the Robot. Do not change the SLEEP switch to the Normal position while the Robot is sleeping. It will think it has just been turned on for the first time and come up in the Executive mode. If you accidentally press **RESET** while the Robot is awake and the Sleep switch is in the Sleep position, it will go to sleep for an undefined period. In that case, return the Sleep switch to Normal and press **RESET**. After several seconds, the Robot will return to the Executive mode.

B — Count Sounds: The Robot will count the number of loud sounds, spaced from 1/4 to 1/2 second apart (such as hand claps, taps on the head, voice, etc.) and then say the number. The most it will count is five. The second time the Robot counts to 2, it will return to the main menu. NOTE: If the Sound adjustment on the sense board or the Volume adjustment on the speech board are improperly set random noises or its own voice may trigger the count cycle. Readjust if necessary.

C — Laughter: After starting this routine, the Robot will laugh until any key (0 – F) is pressed.

D & E — French and Spanish: Demonstrate that the Robot's vocabulary is not limited to the English language.

F — Skip to Song Menu: The display will read "SonGS," and you can select any of several (or return to the main menu) by pressing one key as follows:

Song Menu

Obviously, you must have a Speech Accessory installed to use the Song Menu.

0 — Return to the main Menu: Leaves the Song menu and returns to the main menu so you can run other demonstration routines.

1 — Scales; Just a warmup.

2 — Jingle Bells

3 — Old McDonald

This completes the discussion of the Demonstration Program (User 3). Press **RESET** to return to the Executive mode.

PHONEME EDITOR

Although primarily developed for editing phoneme strings with the Speech Accessory, you can use the Phoneme Editor (address 2900) to alter any program or other data in the RAM. You should have an understanding of phonemes and programming before you attempt to use this feature. See your User's Guide and Technical Manual.

( ) From the Executive mode, press **C** (User 2). At the "_____ Fr." prompt, enter the beginning address of the string you wish to change. If you have a Speech Accessory, enter **FA46** which starts "All Phrases in ROM".

( ) At the "_____ La." prompt, enter the address to be used as an upper limit (**FEEE** for the Speech Accessory). In actual practice, allow enough space so you can insert a few phonemes or codes if necessary, but not so many as to allow the editor to write over a program you want to save).

( ) Press **7** to enable the sound of the phoneme that is displayed. Then press **F** and listen to the sound as its code is displayed. Hold down the **F** key, and the display will change rapidly as the words are spoken.

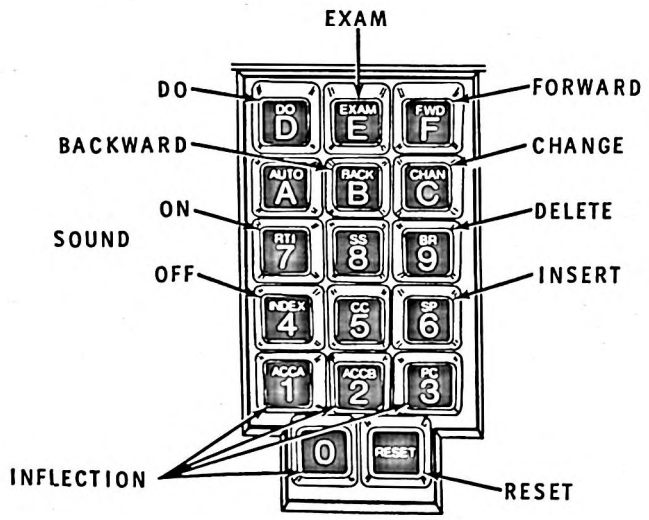

Figure 7

Listed below are some of the features of the Editor, and their associated keys, as shown in Figure 7. You will learn more quickly if you practice using the Editor function. Since this example is editing a program in ROM (read only memory) you cannot actually alter the codes.

0, 1, 2, and 3: Changes the inflection level of the current phoneme.

4 and 7: Disables or Enables the sound of the phoneme currently displayed.

6 and 9: Allows insertion or deletion of the byte currently displayed.

F and B: Allows scrolling forward or backward.

C: Allows you to change the byte displayed.

D: Speaks the phrase from its beginning address and turns off the sound.

E: Allows you to examine any location in memory. Enter the address at the "_____ Ad." prompt. This routine also turns off the sound. Note: This does not change the beginning address of the phrase executed by "D". If you wish to execute another phrase or program, press **RESET** and then reenter the Editor by pressing **C** (User 2), or by **A D XXXX** (the same address that you entered).

Your Robot Speech Phoneme Dictionary will help you select the right codes for the sounds you wish to enter.

dLoad PROGRAM

This program (address 2A60) will permit interfacing with a properly equipped Heath/Zenith computer. It is essentially the same as the program presented by HUG (Heath User's Group) in their REMark magazine. Actually, this is just the receiving half of a pair of programs, one of which resides in the computer.

In order to use this utility program, you will need the following hardware and software:

- An H/Z-89/90 computer with at least 48K of memory.
- The HUG dLoad disk, CP/M 80 version 2.2.04.
- H-88-10 wire-wrap board with an Intel 8255 PIA or a Z-89-11 Multi-purpose I/O board.

To run dLoad:

1. Connect the cable from the computer Parallel port to the Robot's experimental board as shown in Figure 8.

2. With both the computer and the Robot turned on, type "DLOAD FILENAME. HEX" and press RETURN on the computer. The dLoad program will ask whether you are using the HUG interface or a Z-89-11.

3. Type **H** for HUG or **Z** for Z-89-11. The computer will read the disk file and prompt: "Type D to Download."

4. Run the dLoad program on the Robot by pressing **9** (User 3) or 2A60.

5. Press **D** on the computer. When the procedure has been completed, the Robot will return to the Executive mode (say "Ready" and display "HEro1.X").

Caution: Since the dLoad program uses a portion of the Robot's memory as a staging area for data transfer, user programs must not be originated below 046H.

Additional information on programming and operating your Robot, as well as troubleshooting information, can be found in the User's Guide and Technical Manual.

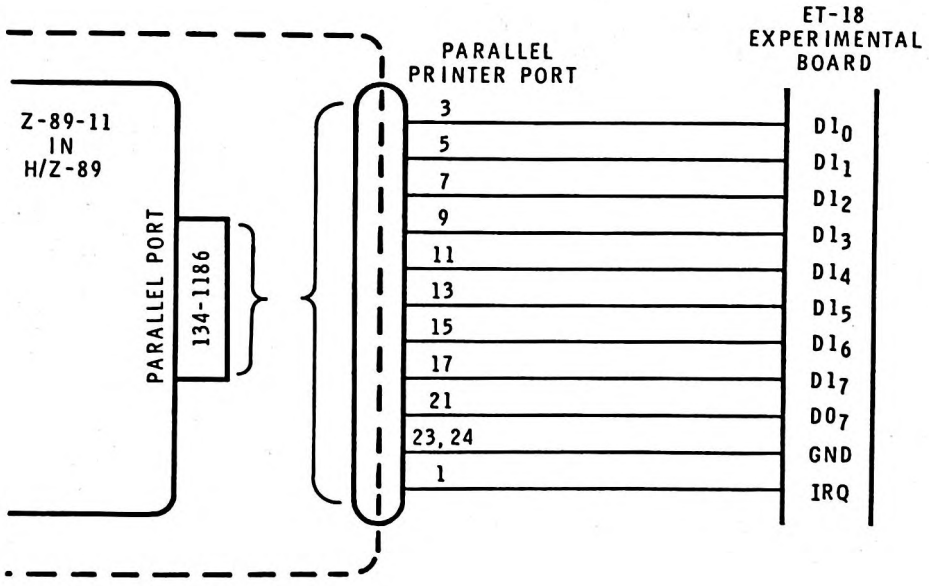

Figure 8

FOR THE ADVANCED PROGRAMMER

Some additional routines are contained in the Utility ROM, with which an advanced programmer can develop his/her own software. They are:

MACHL (2039) — Tests the mode byte to determine which mode the Robot is in, then changes to machine mode if necessary.

ROBOTL (2032) — Robot mode.

DOIT (2060) is used to select 1 of 128 possible subroutines. The destination addresses must be in tabular form as in the table below, with the following entry conditions: The Index Register must contain the Table Address (2), and Accumulator A must contain the number of the selection.

```
SONGTAB     DW      GOBACK          ;0  BACK TO MAIN MENU
            DW      INFLEC          ;1  LA LA'S
            DW      JINGLE          ;2  JINGLE BELLS...
            DW      MCDONALD        ;3  ...HAD A ROBOT...
            DW      INVALID         ;4
            DW      INVALID         ;5
            DW      INVALID         ;6
            DW      INVALID         ;7
            DW      INVALID         ;8
            DW      INVALID         ;9
            DW      INVALID         ;A
            DW      INVALID         ;B
            DW      INVALID         ;C
            DW      INVALID         ;D
            DW      INVALID         ;E
            DW      INVALID         ;F  ***RESERVED***
```

Much additional information is contained in your Robot User's and Technical Manuals.

IN CASE OF DIFFICULTY

Should you experience a difficulty in the operation of the Utility ROM, you might be able to isolate the problem by performing a few simple checks:

NOTE: Before you suspect a problem in the Utility ROM, be sure your Robot is otherwise operating properly with the batteries charged (or with the Charger connected and turned on). If the display does not read "HEro1.X" (and speak "ready") when first turned on or after pressing RESET, refer to the "Troubleshooting" section in your Technical Manual.

1. Be sure your Robot is initialized.

2. With the Robot turned on and in the Executive mode (display reading HEro1.X), press **D** to load keys **9**, **C**, and **F** (User 1, User 2, and User 3). Then press **F** (User 1) to select the Demonstration Program. The left- most display should read "d.". If it does not, make the following checks.

   a. Check the installation of the Utility ROM. Be sure the pin 1 end of the ROM is positioned toward the index mark on the circuit board.

   b. Be sure the ROM is fully seated in its socket and that all of its pins have entered their correct socket holes. Then press **D** and **F** again.

   c. If the display still does not read "d", remove the Utility ROM from its socket and examine its pins. You may find one that had bent under when the ROM was installed. If so, carefully straighten the bent pin and reinstall the ROM. Then try again.

   d. If you did not find any bent pins on the ROM, test the normal operation of the Robot with the ROM removed. Press **RESET** and, if "HEro1.X" is displayed, try loading and running a simple program, and try other normal routines.

   e. Carefully reinstall the Utility ROM in its socket, then press **D** and **F**. The display should now read "d." and you can select one of the routines in the Demonstration Program.

3. Some of the demonstration routines require that sound, light, motion, or sonar detectors be properly adjusted. If a routine does not give the proper response, see the following list to determine which adjustment might be required.

ROUTINE	ADJUSTMENT
0 — Talking clock	Speech Board, Volume and Pitch controls.
3 — "Everything said —"	
4 — All Phrases	
5 — Brightest light	Sense Board, Light control.
6 — Detect motion	Motion Detector Board, Sensitivity control.
8 — Sonar	Sonar Transmit Board, Frequency (and jumper).
B — Count sounds	Sense Board, Sound control.

Refer to "Adjustments" in the Robot Technical Manual, Page 43, for the proper method of adjusting the controls.