

THE FISHER K-10 Dynamic SPACEEXPANDER@ Reverberation Unit

The FISHER *Spacexpander* adds a new dimension -reverberation -to most stereophonic (or monophonic) home music systems Natural reverberation is created by the reflections (echoing) of sound from the walls and ceiling Reverberation is just an echo a sound which reaches the listeners ear a fraction of a second after the sound from the original source is heard For example, in a large room or auditorium a single hand-clap is heard several times -first as a direct sound impulse, then as reflected sounds (echoes) with each one weaker than the one heard a fraction of a second before This dying out of sound is called "decay" -It depends on the size and shape of the room or auditorium, the covering on the walls and ceiling as well as the furnishings, the number of people and other objects contained in the enclosed area Unconsciously we estimate the size of an area by the amount of reverberation (how much the echo is delayed and how long it takes to decay)

The FISHER *Spacexpander* is designed to be used with FISHER high-fidelity components and radio-phonographs but it can be connected into other home music systems with a few, slight, changes in the original circuit even if it was not designed to use a *Spacexpander* or does not make use of the FISHER Direct Tape Monitor system of tape recording

While the FISHER *Spacexpander* is easy to install and simple to operate (there is only one front-panel control) positioning of the reverberation unit is most critical and it must be installed exactly as illustrated and connected as indicated if you want to obtain the best possible results from the *Spacexpander*

There are many ways of connecting a *Spacexpander* into a home system. The most frequently used connections, for the most common high-fidelity component combinations, are given here- use the connection instructions for the equipment which most nearly matches those used in your music system.

If none of the connection diagrams seem to be suitable for your system write *Richard Hamilton, Customer Relations Department, Fisher Radio Corporation, Long island City, NY. 11101* Be sure to include the make and model, and schematic diagrams, of all units in your home music system Remember, the *Spacexpander* is designed -specifically for *home* music systems and not for commercial recording, broadcasting or industrial installations or for use with amplifying attachments for musical instruments, like guitars, or electronic organs. Information regarding connections to systems other than home music types will not be supplied,

UNPACKING THE SPACEEXPANDER

Carefully check the shipping carton to make sure that all the units and interconnecting cables are removed. The carton should contain the following items;

- 1 Reverberation Chassis.
- 1 Electronics Chassis.
- 1 Control Unit (with knob, control plate and 4-foot interconnecting cable).
- 6 Audio interconnecting cables

Remove the tillers from the carton, if necessary, to make sure that none of the cables are overlooked or small parts discarded.

INSTALLATION PRECAUTIONS

- Electronics Chassis may be installed in any position.
- Electronics Chassis *must* be placed so that air can circulate around it freely to prevent overheating.
- Reverberation Chassis *must* be mounted with its flanges in a vertical plane (as illustrated).
- Reverberation Chassis *must* be mounted with complete shockmount material, as supplied.
- Reverberation Chassis *must* be isolated from mechanical vibrations from speakers.
- Control Unit cable may be increased to 12-feet total length.
- Connecting cables between the Electronics Chassis and the Reverberation Chassis may be increased to 20-feet total length.
- The power cable of the Electronics Chassis must be connected to a *switched* AC receptacle (outlet) on the associated high-fidelity instrument
- The Spacexpander MODE SELECTOR switch must be set to proper position

USING SPACEEXPANDER JACKS ON FISHER INSTRUMENTS

There are no problems when making connections to a FISHER stereo instrument with *Spacexpander* jacks. Just pullout the pair of horse-shoe shaped jumpers and insert the plugs of the interconnecting cables. DO NOT discard the jumpers (They can be handy when troubleshooting the home music system). The jumpers *must* be reinserted when the *Spacexpander* is disconnected. These jumpers complete the internal signal paths -without them the home music system will not play; no sounds, except for a slight hiss or hum will be heard from the speakers.

CONNECTIONS

Make the following connections between the *Spacexpander* Electronic Unit and the FISHER instrument *Spacexpander* jacks using 4 of the 6 audio interconnecting cables.

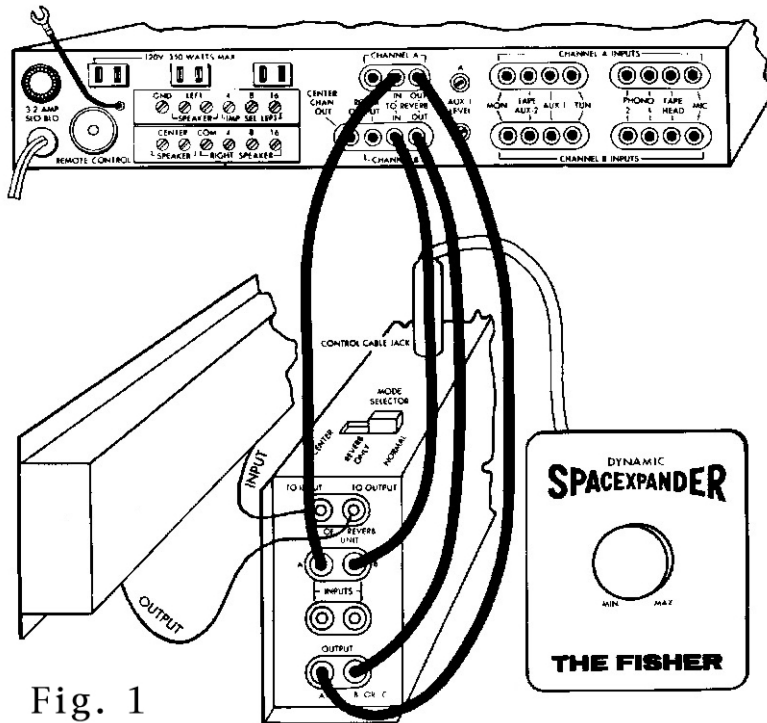


Fig. 1

Connecting to FISHER instruments with *Spacexpander* jacks is the easiest installation because these instruments were designed to go together.

- Left TO REVERB IN jack connected to (left) A INPUT of *Spacexpander*.
- Left TO REVERB OUT jack connected to (left) A OUTPUT of *Spacexpander*.
- Right TO REVERB IN jack connected to (right) B INPUT of *Spacexpander*.
- Right TO REVERB OUT jack connected to (right) B OUTPUT of *Spacexpander*.

Make the following connections between the *Spacexpander* Electronics Chassis and the Reverberation Chassis using 2 of the 6 audio interconnecting cables.

- INPUT jack of Reverberation Chassis to jack marked TO INPUT OF REVERB UNIT (chassis)
- OUTPUT jack of Reverberation Chassis to jack marked to OUTPUT OF REVERB UNIT
- Set *Spacexpander* MODE SELECTOR switch to NORMAL.

USING FISHER DIRECT TAPE MONITOR JACKS AND SIMILAR CIRCUITS (for connecting Tape Recorders with separate Record and Playback heads).

The Direct Tape Monitor jacks are connected into the circuit in almost the exact same manner as the *Spacexpander* jacks with but one exception -the jacks do not need jumpers because they are selected by a front panel switch.

CONNECTIONS

The OUTPUT jacks, on the home music system instrument, may have exotic trade names or may be labeled simply, like TAPE OUT, RCRDR OUT, etc. These jacks are connected to the A (left) and B (right) inputs of the *Spacexpander*.

Spacexpander OUTPUTs, A (left) and B (right), are connected to the home music system jacks that may be labeled MONITOR, MON, TAPE MON, TAPE IN, TAPE PLAY, etc.,. Make sure that the cables are not crossed -the right-channel cables must connect to the right-channel jacks (and left to left) throughout the system.

Make sure *Spacexpander* MODE SELECTOR switch is set to NORMAL position for first listening tests,

Set DIRECT TAPE MONITOR switch to ON position.

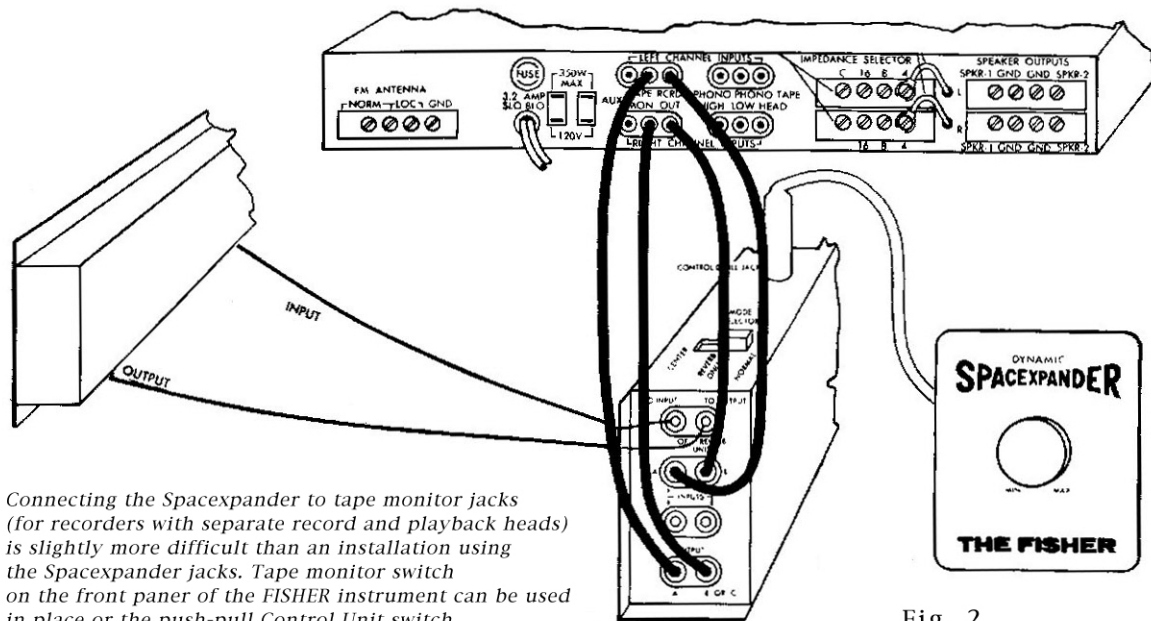


Fig. 2

SEPARATE PREAMPLIFIER/POWER AMPLIFIER CONNECTIONS

When separate control-preamplifier and power amplifier units are used in a home music system it is just as easy to connect the *Spacexpander* as when *Spacexpander* jacks are provided. The interconnecting cables between the control-preamplifier and power amplifier units make just about the same electrical connections as the horse-shoe shaped jumpers in the FISHER instruments with the *Spacexpander* jacks.

With some home music system components a slight increase in the audible hiss level may be noticed. This noise level *can* be reduced by turning down the input-level controls on the power amplifier chassis (when such a control is provided). The outputs from the control preamplifier *must* be increased to as high a level as possible (without distorting or unbalancing the sound heard from the speakers).

CONNECTIONS

For a home music system using separate control-preamplifier and power amplifier make the following connections to the *Spacexpander*;

- Control-preamp LEFT OUTPUT connected to *Spacexpander* A INPUT jack.
- Control-preamp RIGHT OUTPUT connected to *Spacexpander* B INPUT jack.
- *Spacexpander* A OUTPUT connected to power amplifier LEFT INPUT jack.
- *Spacexpander* B OUTPUT connected to power amplifier RIGHT INPUT jack

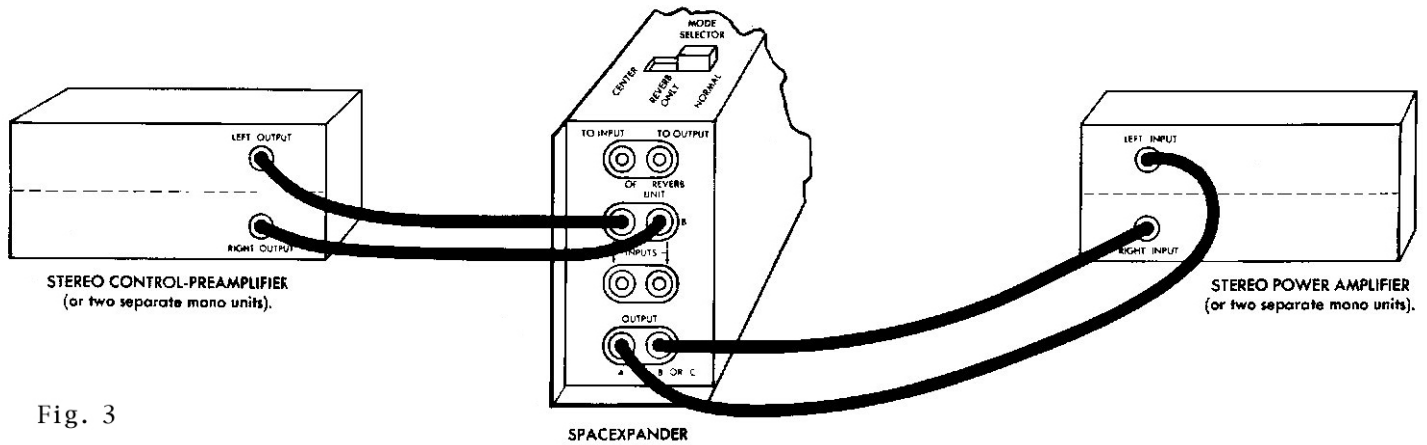


Fig. 3

ADDING SPACEXPANDER JACKS

Jacks for *Spacexpander* interconnecting cables can be added to most home music systems -just decide *where* to break into the signal path and *where* to mount the jacks (The signal paths in both schematics are indicated by the heavy line.).

Heavy lines indicate typical signal path in one channel of a vacuum-tube stereo amplifier. Jumper indicates place where *Spacexpander* connections are made in a factory equipped chassis. Shaded areas are printed-circuit boards

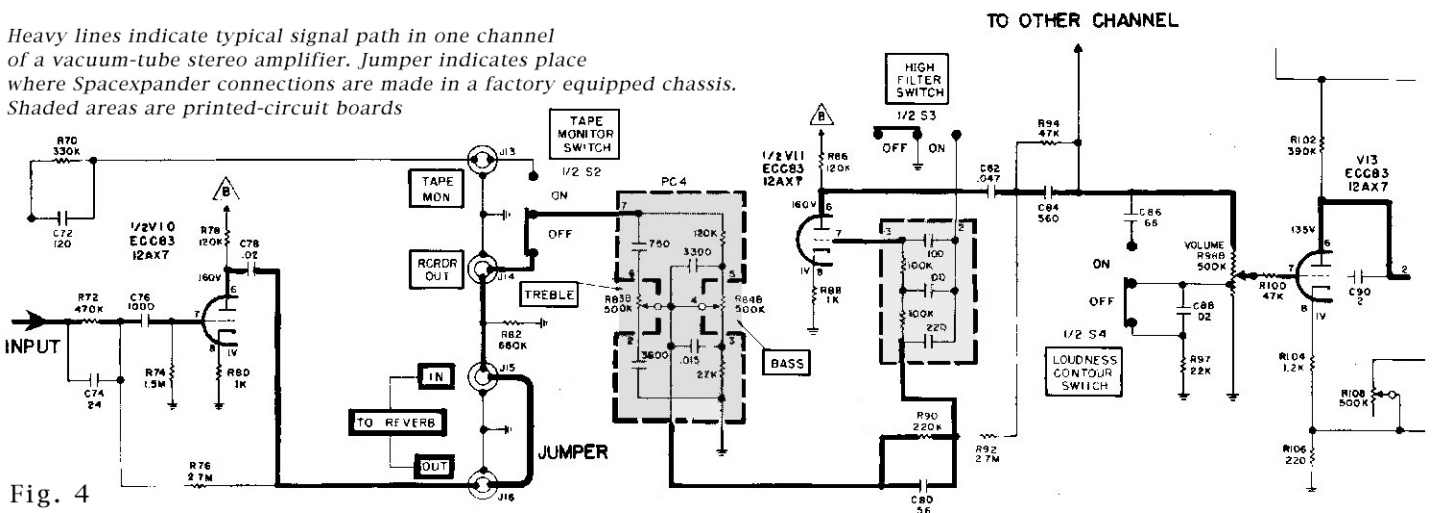


Fig. 4

Actually it is not necessary to install jacks. Where space is limited the cables can be wired directly into the circuit. Plugs on the *other* ends will go into the *Spacexpander* jacks. A feedthrough connector *can* be used to connect the two plugs together to take the place of the horse-shoe shaped jumper used to complete the circuit with factory-installed *Spacexpander* lacks.

DO NOT wire the cables directly into the circuit without providing strain relief of some sort. Solder terminals are not strong enough to withstand much pulling and repeated twisting of the cables will break the conductors of the cable where they are soldered to the home music system circuitry.

Modern home music systems may be either vacuum tube or transistor types (or a combination of both) and may use printed circuits as well as point-to-point wiring. Printed circuitry in the two schematics in this section has been shaded. The transistor home music system uses much more printed circuitry.

Printed circuits are more difficult to work with - but not impossible. The foil can be cut and small sections removed to isolate one circuit from the following one - you need only a sharp knife or a single-edged razor blade. If you make a mistake the cut connections can be repaired. Just solder a thin piece of copper wire across the cut in the foil.

If you are not certain where the best point to connect the is write *Richard Hamilton, Customer Relations Department, Fisher Radio Corporation, Long Island City, New York, 11101*, You must include a schematic diagram of your unit. It will be returned with the proper connections indicated.

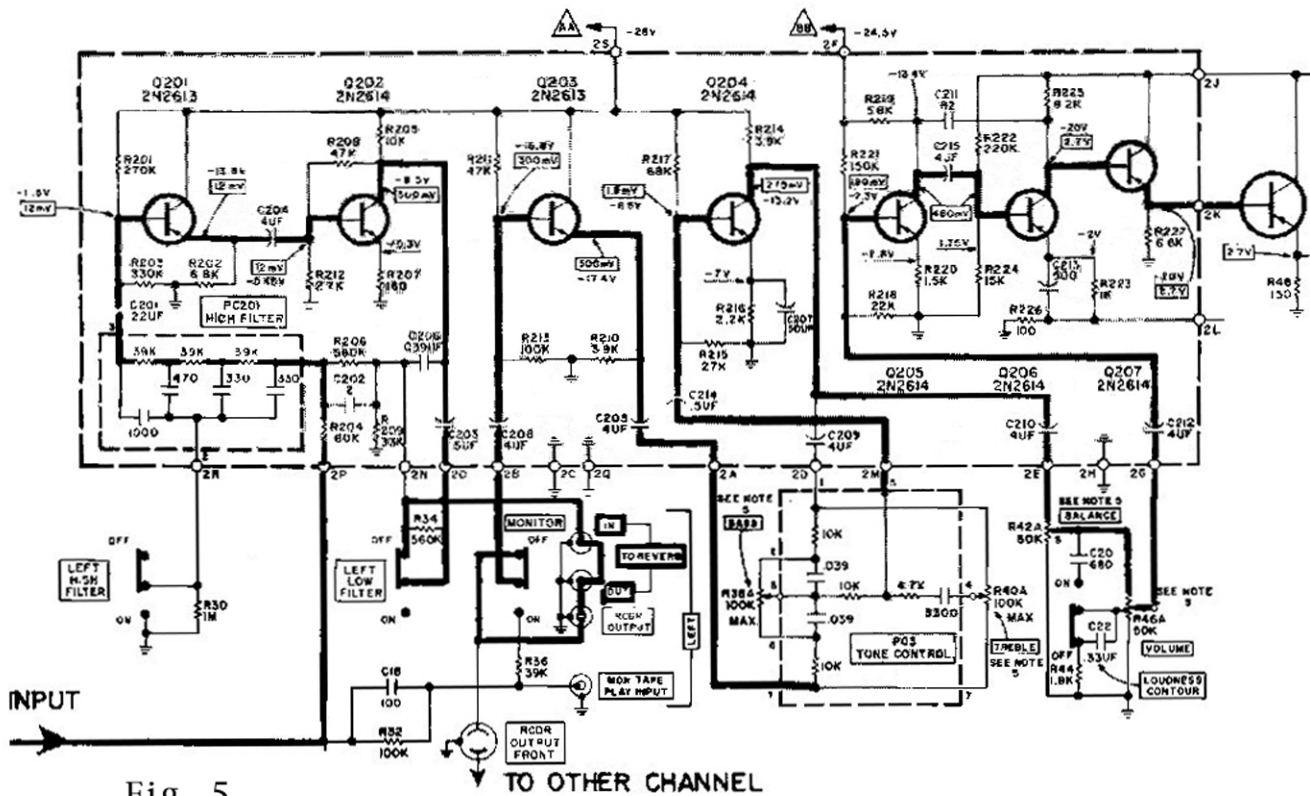


Fig. 5

Transistor stereo channel has similar signal path that is completed by jumper until Spacexpander is connected.

PRECAUTIONS

- Disconnect line cord from wall outlet before starting work on circuit modifications
- Remove all input and output cables connected to the chassis before working on circuit modifications
- Never cut the pig-tail leads of components when there is another way of breaking the signal path
- Never cut the pig-tail leads close to the body of the component.
- Double-check before you cut any conductor -either insulated wire or copper foil.
- Make clean, neat connections- any frayed ends of wire or lumps of solder may cause intermittent or permanent short circuits
- A low-heat soldering iron may not transfer heat fast enough to make good solder points- heat conduction along the leads of components make heat sinks a necessity,
- Never use anything but rosin-core solder for connections.
- A too-hot soldering iron can ruin plastic parts of sockets and plugs, transistors and other components as well as printed circuit boards.

WARNING: Transistors, printed circuitry and miniature components must be handled with extreme care. DO NOT attempt any modifications to high-fidelity instruments using this type of construction unless you have had previous experience. It takes only a second or two to damage expensive circuit components.

THE CENTER CHANNEL AND THE SPACEXPANDER

Reverberation can be added to the center channel in a home music system using the Spacexpander or the Spacexpander can be used to create a center-channel output (with or without reverberation) for any home music system that does not have one

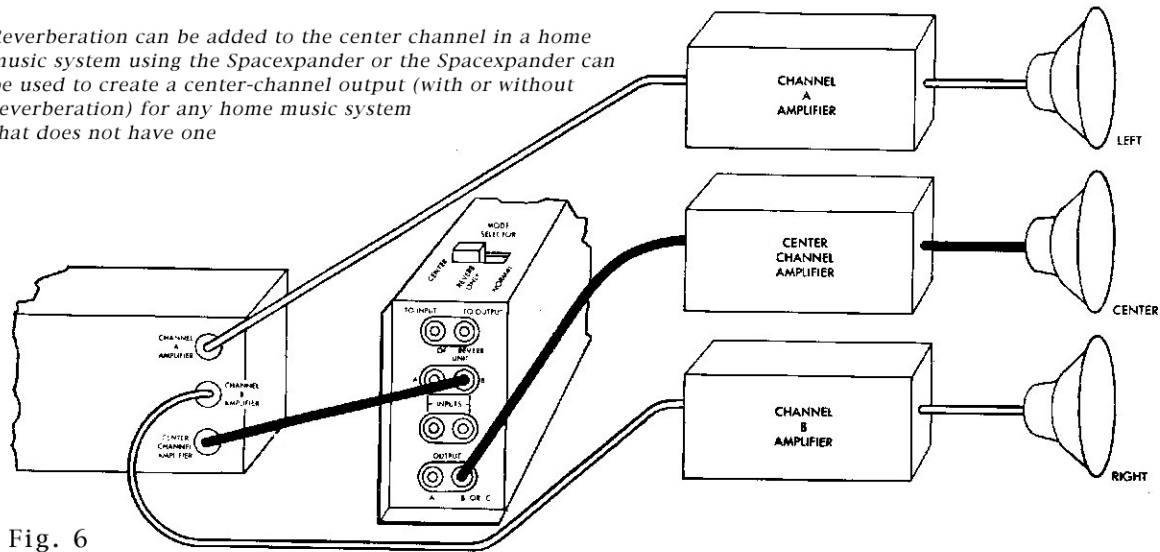


Fig. 6

Spacexpander center-channel reverberation can be used two ways - either full reverberation without any of the pure, original signal (MODE SELECTOR switch set to the REVERB ONLY position) or with the pure signal and an adjustable amount of reverberated signal when the MODE SELECTOR switch is set to the CENTER position. Try both positions before you decide where the MODE SELECTOR switch will be set - you may find that your original choice does not give you the effect you expected. Too much reverberation will give an unreal effect of a large, live, auditorium and excessive echoes will make all tones and notes so fuzzy or blurred that they will run together and be lost.

In the CENTER position the Control Unit knob will change the *amount* of reverberation heard from the center-channel speakers - it will not change the volume, just the reverberation. When the MODE SELECTOR switch is set to REVERB ONLY the Control Unit knob will act like a volume control for the center channel. The only sound you hear from the center channel will be reverberated sound. Since the Control Unit knob controls only the reverberated signal and there is no other signal in this mode, the reverberated sound from the center-channel speaker increases and decreases as the knob is rotated from the MINimum to MAXimum positions just like a volume control.

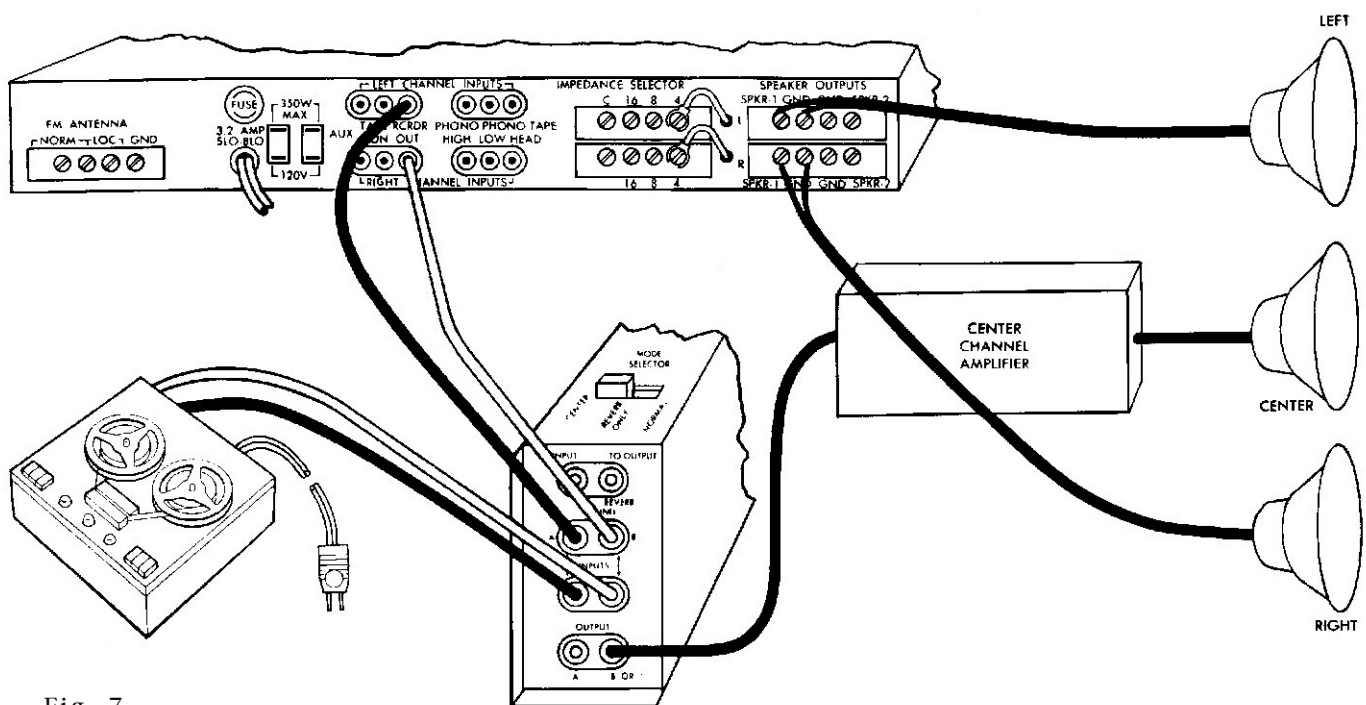


Fig. 7

When a center-channel output has not been designed into a unit, it can be created by the *Spacexpander*. (See Fig. 7, previous page). Any output jacks for a stereo tape recorder can be used as the signal source for the *Spacexpander* Inputs. A power amplifier and a speaker are needed to complete the center channel. The *Spacexpander* output cannot drive a speaker directly. It must be connected to a power amplifier, which, in turn, is connected to the speaker

The tape recorder signal input plugs are then inserted into the other pair of input jacks on the *Spacexpander* panel. The jacks for both A INPUTS and both B INPUTS are wired together, inside the *Spacexpander*, and the tape recorder will record the normal signal, without reverberation just as it did when connected to the jacks on the high-fidelity instrument chassis. The material recorded will not have reverberation added to it when you connect to these jacks Reverberation is added after this point.

FINISHING THE INSTALLATION

No matter which electrical connections are best suited to your home music system equipment, and your personal listening habits, the physical mounting of the Control Unit, Electronics Chassis and Reverberation Chassis remains the same.

The most convenient mounting locations for the Electronics Chassis and the Reverberation chassis may not be the best physical location for these units. While the Electronics Chassis may be mounted in any position it is best to mount it with the tubes at the top. This way the heat will rise away from the chassis, reducing the possibility of overheating the chassis and damaging any of the circuit components that are wired inside.

Wherever possible the AC power cord should be plugged into an outlet on the home music system equipment - an outlet that is turned *on* and *off* by the same power switch that controls the whole system. Accidentally leaving the *Spacexpander* on for many hours will only shorten its trouble-free life and cause the tubes to burn out sooner than necessary. The *on-off* switch on the Control Unit does not turn off the AC power to the *Spacexpander* - it only stops the reverberated signal from being amplified. The pure (not reverberated) signal still is amplified by the *Spacexpander* circuits.

The reverberation Chassis *must* be mounted against a vertical surface This unit is an electro-mechanical device and its exact mounting is very critical (For a more complete explanation of the method of operation of this critical mechanism read the section on HOW YOUR SPACEXPANDER WORKS.). Not only is the position of the Reverberation Chassis critical - so is its location.

It is subject to mechanical vibration - DO NOT mount it near the speakers The vibrations from the speakers can vibrate the mechanical portions of the *Spacexpander* which, in turn, will be amplified and heard from the speakers whose vibrations again will be picked up by the mechanical portion of the *Spacexpander* and amplified This *feedback* quickly becomes a howl, screech, whistle or groan, depending on how slowly or how rapidly the vibrations get back from the speakers. Generally this effect will occur only when the Reverberation Chassis is mounted on the back of a console cabinet - and then only when the instrument is played at high volume.

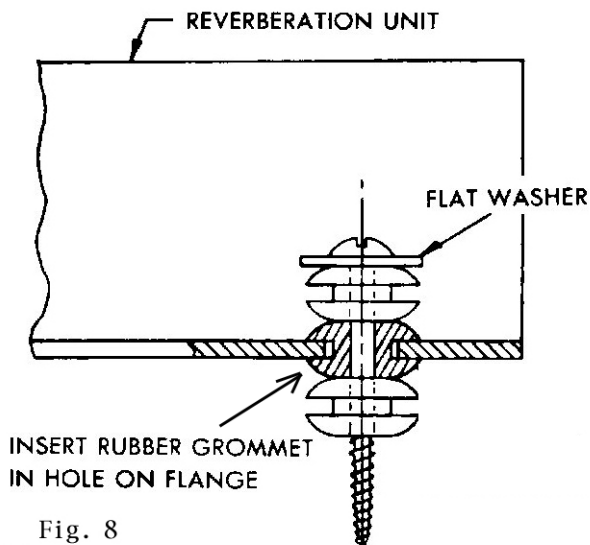


Fig. 8

Component-type high-fidelity systems seldom have mechanical feedback problems since the speakers are usually separated from the electronic equipment.

When properly installed, the Reverberation Chassis will float on the shock mounts and, under normal conditions there will be no feedback. DO NOT over tighten the wood screws through the grommets, when mounting the Reverberation Unit. Leave some freeplay - 1/32 inch is enough Compressing the grommets reduces the effectiveness of the shock mount assembly by being too firm.

OPERATION

The two controls of the *Spacexpander* can be preset once you have selected positions that satisfy your listening preference. The MODE SELECTOR switch on the Electronics Chassis is probably the most important (and least used) control. Its position determines the way the reverberation is added to the home music system. You have your choice of three different effects.

MODE SELECTOR

NORMAL is used for most listening. In this position you can add as much reverberation (or none) as you want to your regular listening material - stereo or monophonic radio, tape, or phonograph. As you rotate the Control Unit knob from MIN (minimum) to MAX (maximum) the amount of reverberation will increase from practically none to more than that usually heard in an auditorium. Some place between these extremes is the amount of reverberation that creates the illusion that is pleasing to you. Once this point has been found you need never rotate the knob again - except to demonstrate the *Spacexpander* to friends. To turn the reverberation *off* just pull up gently on the Control Unit knob until it clicks and all reverberation will be gone. Push the knob down and you have the same amount of reverberation you originally selected without hunting for a special adjustment.

REVERB ONLY is used mostly with center channel and monophonic systems or for special effects. THIS IS NOT A STEREOPHONIC MODE OF OPERATION. All signals coming out of the *Spacexpander* in this MODE SELECTOR position are monophonic. The Control Unit knob will just increase and decrease the sound from the speakers since there is *only* a reverberated signal - the knob can be set to the MAX position and forgotten because the volume control of the home music system will now have the same effect on the operation of the home music system. The push-pull switch on the Control Unit knob must be pressed in or no sound will be heard from the speaker(s). In the REVERB ONLY position the sound heard will be an unnatural sound - just echoes without any of the pure original sound. Since this is something that you would never hear normally, it is considered a special effect. But if you use a small amount of this unnatural sound in a center channel, it will blend with the normal sound from the left and right channel speakers. This mode of operation will not create exactly the same sound quality as when the MODE SELECTOR switch is in the NORMAL position and used for the center channel. The NORMAL position produces a variable blend of the pure, original signal and the reverberated signal - REVERB ONLY is just that: there is no pure, original signal to blend electronically, with the reverberated signal and all you hear is the echo effect.

CENTER -this position of the MODE SELECTOR switch is also a monophonic output mode of operation. The signal at OUTPUT A and OUTPUT B or C is the same. THIS IS NOT A STEREOPHONIC MODE OF OPERATION. Operation in this position is like that in NORMAL except it is not stereo. The Control Unit knob blends the amount of reverberation, or turns it *off* or *on*, exactly as it does in the NORMAL position.

CONTROL UNIT KNOB

In the NORMAL and CENTER positions of the MODE SELECTOR switch the Control Unit knob varies the amount of *reverberation* from MIN (minimum) to MAX (maximum) as the markings on the control plate indicate. The pure, original signal does not change volume as the control knob is rotated. In the REVERB ONLY position of the MODE SELECTOR switch there is no pure, original signal - *only* the reverberated signal. Rotating the knob in this mode is like adjusting the volume control on the home music system control panel.

Push-pull ON-OFF switch- Besides rotating, the Control Unit knob also moves in and out. Pulling the knob out, until a slight click is heard, will stop the reverberation just as if you turned the knob to the MIN position. Once you select the amount of reverberation you can use the push-pull action to turn it on and off without rotating the knob. THIS SWITCH DOES NOT TURN OFF THE POWER TO THE ELECTRONICS UNIT - THE TUBES STAY LIGHTED. It only controls the reverberated signals.

HOW THE SPACEXPANDER WORKS

The *Spacexpander*, a result of many years of research and design is an electro-mechanical device. It is separated into two major sections - an amplifier (Electronics Chassis) and a mechanical transducer (the Reverberation Chassis). The control Unit is, electrically, part of the amplifier.

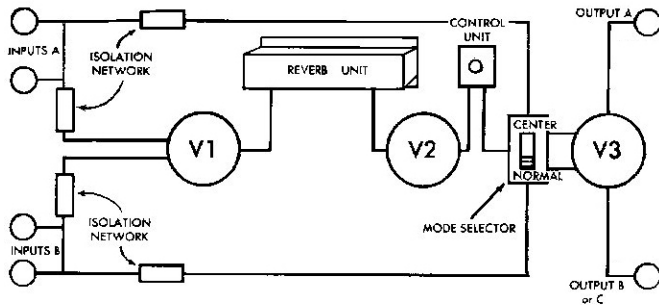


Fig. 9

The amplifier is not really an amplifier - because of the losses in the isolation networks and the Reverberation Chassis the overall gain (between inputs and outputs) is about 1. All the amplifier does is make up for the losses. The volume control setting of your home music system should be set to just about the same setting whether the *Spacexpander* is connected to the jacks or the jumpers are in place.

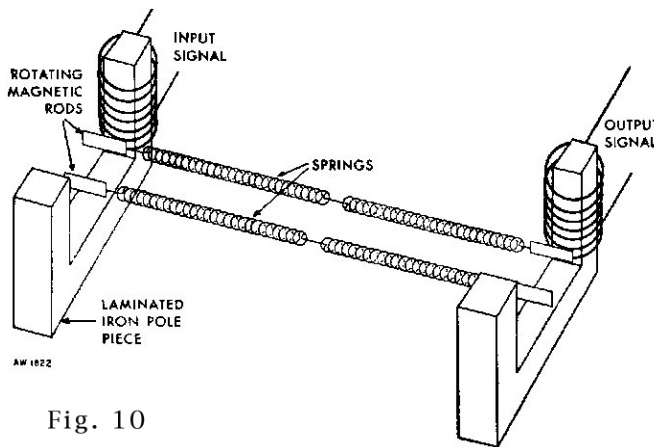


Fig. 10

The heart of the *Spacexpander* is the Reverberation Chassis. It is here that the delay, echoes and decay are generated they simulate the echoes of a well-designed auditorium. A small amount of the signals at the INPUT jacks (see block diagram) are fed to V1 through the isolation networks.

The output of V1 goes to the input of the reverberation transducer. Here the electrical signals are converted into a twisting, semirotary mechanical motion. The movement of the magnetic rods is transmitted along the springs.

The springs are not identical the wire sizes are not the same and the number of turns-to-the-inch are different too. Because of these differences, the motion produced by the magnetic rods takes 29 milliseconds (0.029 sec.) to reach the output end of one spring and 37 milliseconds to reach the output end of the other. Here, the movement of the magnetic rods generates a very weak reverberated signal which goes to an amplifier stage (V2) to be made stronger. Some of the mechanical motion goes back along the springs. One echo returns to the starting point 58 milliseconds after it started and the other, traveling slower, returns to its input magnetic rod after 74 milliseconds (one millisecond is only 1/1000 of a second, remember). Again the rotational mechanical motion, weaker than it was when it first started, heads for the output transducer. These second echoes arrive at the output transducer (and the output of V3) some 87 and 111 milliseconds after the pure, original signal went through V3.

From one sound we have had five signals at the output jacks. The first echo of the original, pure signal appeared 29 milliseconds later; another 37 milliseconds, a third after 87 milliseconds, a fourth, after 111 milliseconds. Of course the mechanical reflections do not just stop after two echoes (signals) have appeared at the output transducers - they continue, back and forth, getting weaker each time until they cannot be heard. The number of reflections (echoes) heard will depend on the setting of the Control Unit knob and the loudness of the original sound at the input to the *Spacexpander*.

TROUBLESHOOTING GUIDE

NO REVERBERATION monophono only. If there is no reverberation (or much less than usual) when listening to a monophonic record played with a stereo phonograph cartridge just reverse the leads (*for one channel only*) where they attach to the terminals at the rear of the cartridge inside the tone arm.

FEEDBACK-If the home music system moans, squeals or whistles whenever the Control Unit knob is turned slightly clockwise the Reverberation Chassis is either too close to the speakers or the shock mount assembly has been over tightened (If this occurs after the *Spacexpander* has been operating satisfactorily for some time it may indicate that the rubber has lost its resilience due to

exposure to too much heat or a chemical reaction to fumes, aerosol sprays or furniture polish.
Replace rubber grommets if they have become hard or gummy

HUM ADJUSTMENT-The *Spaceexpander* is adjusted at the factory, but after continued use, or changing a vacuum tube, it may be necessary to change the adjustment:

To check for minimum hum.

- Set the home music system input SELECTOR to an unused position .Disconnect one pair of plugs if all jacks are used.
- Turn the BASS and VOLUME controls to their maximum clockwise positions.
- Insert a screwdriver through the opening in the Electronics Chassis marked HUM ADJUST
- Rotate the shaft of the HUM ADJUST control for minimum hum from the speakers.

Does not go on (tubes do not light up).

- Check:
- AC outlet (use test lamp).
 - Line cord and plug.

**Distortion (both channels) any position of MODE SELECTOR switch,
Hum, Weak or No audio output (Tubes light up.)**

- Disconnect *Spaceexpander* temporarily (reinsert jumpers) to be sure that other components of home music system are operating normally

- Check:
- HUM ADJUST control R11.

- Test:
- V3

- Power supply for voltages at CR1, C5A R9; C5B, R9, R10; C5C, R10, R12; C5D, R12. V3 socket for proper voltages.

No reverberation (both channels) no audio output in REVERB ONLY position of MODE SELECTOR switch. Hum, Weak or No REVERB output.

- Listen to voice -comedy or news
- Set Control Unit knob to MAX position.
- Push Control Unit knob down.

- Check:
- Control Unit plug and interconnecting cable.
 - Reverberation Unit jacks, plugs and interconnecting cables
 - R24 and S1 on Control Unit.

- Test
- V1 and V2.
 - V1 and V2 sockets for proper voltages

No reverberation (PHONO-MONO only)

- Check phasing of phono cartridge.

Reverberation only (no pure signal) any position of MODE SELECTOR switch.

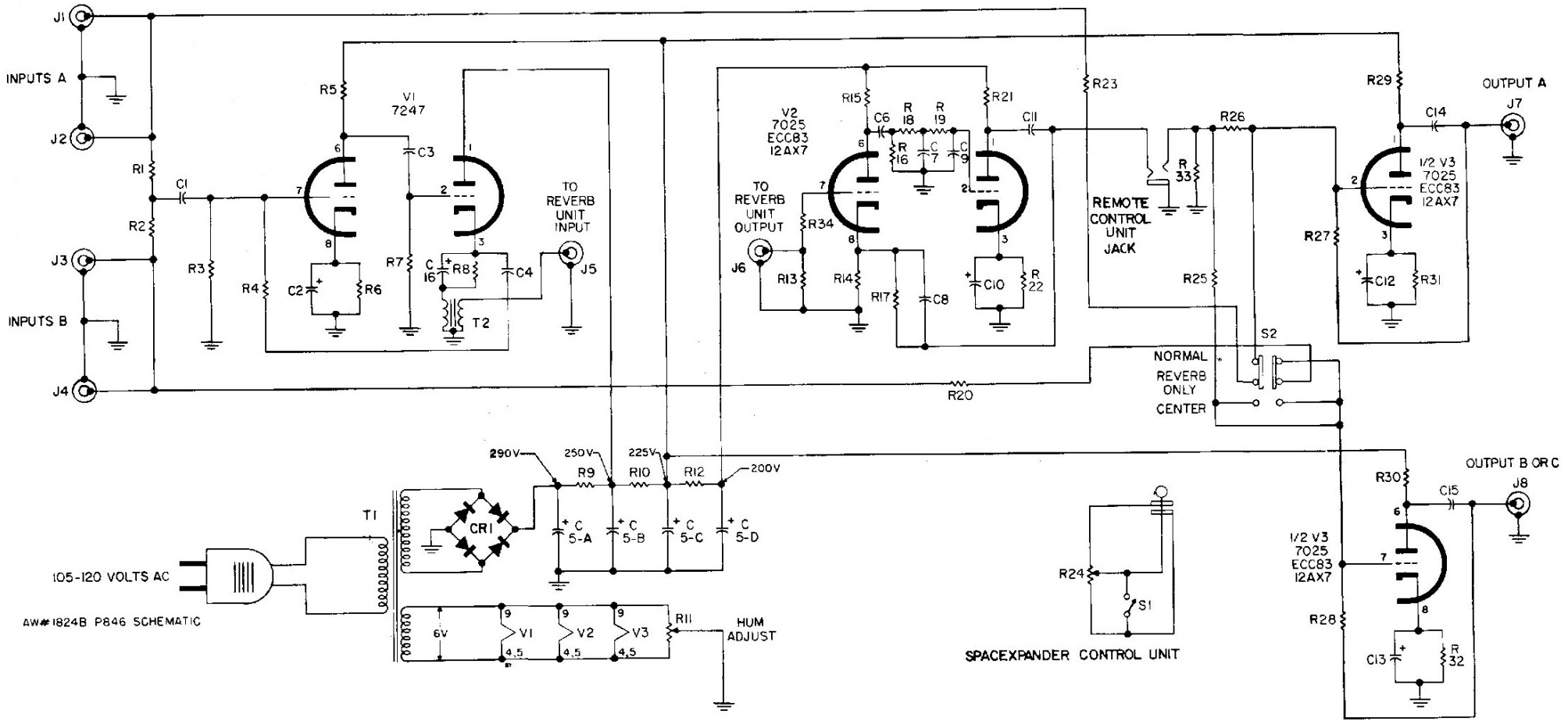
- Check:
- Set MODE SELECTOR to NORMAL position.
 - S2 for proper operation.
 - Control Unit jack, plug and interconnecting cable.
 - R24 and S1 in Control Unit.

Feed back (when system volume or Control Unit knob turned up.)

- Check"
- Shock mount assembly

TECHNICAL SPECIFICATIONS

DELAY TIME	33 milliseconds
DECAY TIME	2 seconds maximum at 300 cps
MINIMUM INPUT VOLTAGE REQUIRED	0.2 Volt
MAXIMUM ALLOWABLE INPUT VOLTAGE	5 Volts
INPUT IMPEDANCE	250K Ohms
OUTPUT IMPEDANCE	2000 Ohms
OUTPUT VOLTAGE	0.2 - 5 Volts
GAIN	Unity
HUM LEVEL	80 db below 2.5 Volts
POWER CONSUMPTION	16 Watts



AW#1824B P846 SCHEMATIC

PARTS DESCRIPTION LIST

CAPACITORS

10% tolerance for all fixed capacitors, unless otherwise noted or marked GMV
(guaranteed minimum value.)

Symbol Description	Part Number	Symbol Description	Part Number
C1 Ceramic, 220uuf 1000V	C50072-20	C6 Ceramic, 470uuf 1000V	C50072-13
C2 Electrolytic, 50uf 3V	C50283-1	C7 Ceramic, 270 uuf 1000V	C50072-16
C3 Ceramic, .0027uf 1000V	C50072-17	C8 Ceramic, 12uuf NPO 1000V	C50070-2
C4 Ceramic, .01uf 20% 500V	C50089-3	C9 Ceramic, 270uuf 1000V	C50072-16
C5 Electrolytic, four-section	C50180-25	C10 Electrolytic, 50uf 3V	C50283-1
A 40uf 350V		C11 Ceramic .0027uf 1000V	C50072-17
B 40uf 350V		C12, 13 Electrolytic, 50uf 3V	C50283-1
C 10uf 300V		C14, 15 Mylar, .1uf 400V	C50197-32
D 10uf 300V		C16 Electrolytic, 25uf 8V	C639-114

RESISTORS

In ohms, 10% tolerance, 1/2 watt, unless otherwise noted. K = kilohm, M = megohm.

Symbol Description	Part Number	Symbol Description	Part Number
R1, 2 Dep. Carbon 470K 5% 1/2W	R33DC474J	R18, 19 Dep. Carbon, 100K 5% 1/2W	R33DC104J
R3 Composition, 2.2M	RC20BF225K	R20 Dep. Carbon, 470K 5% 1/2W	R33DC474J
R4 Composition, 10M	RC20BF105K	R21 Dep. Carbon, 270K 5% 1/2W	R33DC274J
R5 Dep. Carbon, 330K 5% 1/2W	R33DC334J	R22 Composition, 3.3K	RC20BF332K
R6 Composition, 3.3K	RC20BF332K	R23 Dep. Carbon, 470K 5% 1/2W	R33DC474J
R7 Composition, 1M	RC20BF105K	R24 Pot, 250K	R846-113
R8 Composition, 680	RC20BF681K	Space-expander control	
R9 Composition, 2.7K	RC20BF272K	R25, 26 Dep. Carbon, 220K, 5% 1/2W	R33DC224J
R10 Composition, 12K	RC20BF123K	R27, 28 Dep. Carbon, 470K 5% 1/2W	R33DC474J
R11 Pot, 500 Hum Adj.	RS16-128	R29, 30 Dep. Carbon, 220K 5% 1/2W	R33DC224J
R12 Composition, 56K	RC20BF563K	R31, 32 Dep. Carbon, 2.7K 5% 1/2W	R33DC272J
R13 Dep. Carbon, 47K 5% 1/2W	R33DC473J	R33 Composition, 2.2M	RC20BF225K
R14 Dep. Carbon, 2.7K 5% 1/2W	R33DC272J	R34 Dep. Carbon, 47K 5% 1/2W	R33DC473J
R15 Dep. Carbon, 330K 5% 1/2W	R33DC334J		
R16 Composition, 2.2M	RC20BF225K		
R17 Composition, 680K 5% 1/2W	RC20BF684J		

MISCELLANEOUS

Symbol Description	Part Number	Symbol Description	Part Number
CR1 Selenium rectifier	SR50253-2	T2 Transformer, matching	T846-123
S1 Switch off-on	Part of R24	— Reverberation unit	A846-109
S2 Switch, slide	S846-118	— Space-expander control plate	AS846-116
T1 Transformer, power	T846-115		