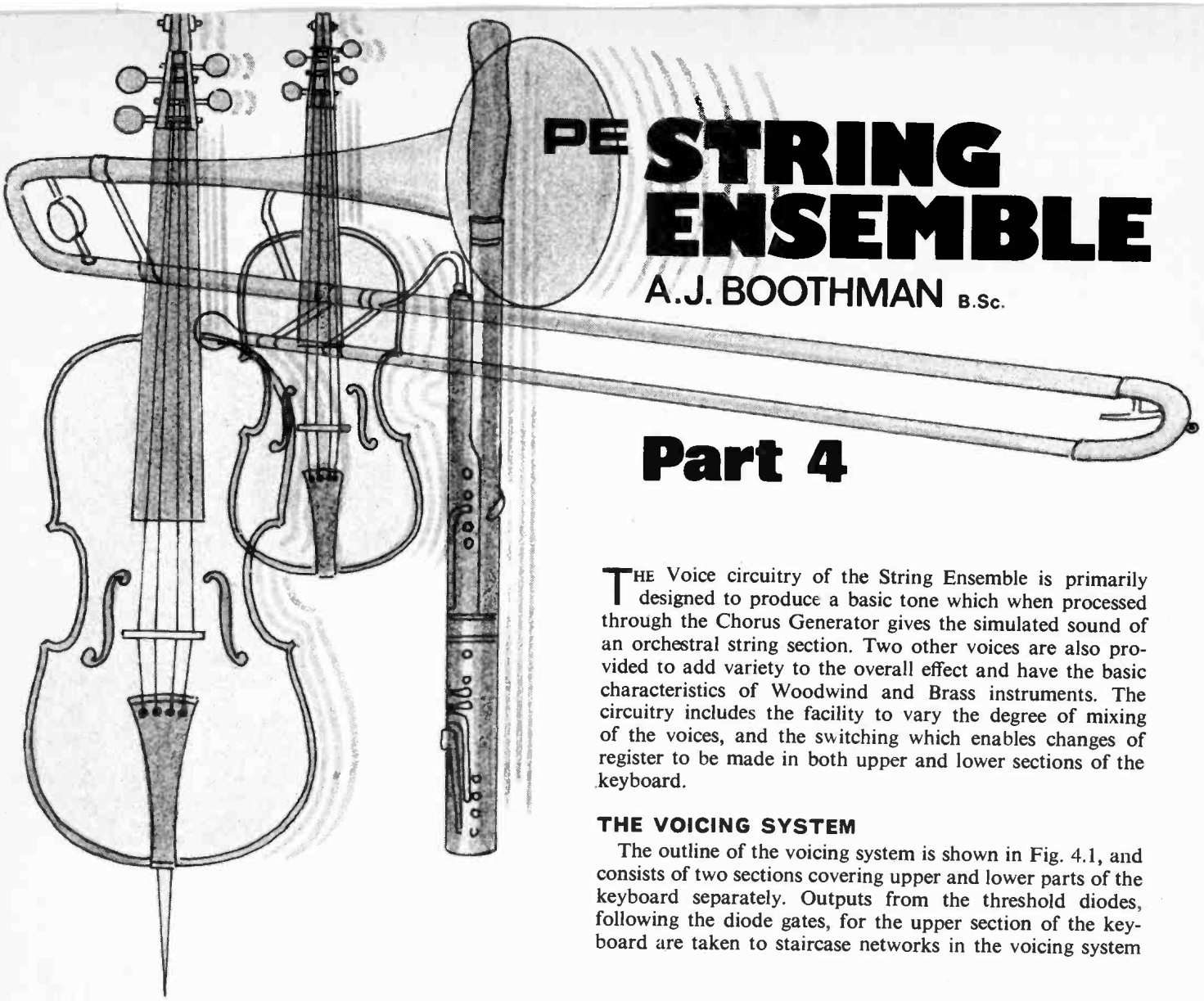


PE STRING ENSEMBLE

A.J. BOOTHMAN B.Sc.

Part 4

THE Voice circuitry of the String Ensemble is primarily designed to produce a basic tone which when processed through the Chorus Generator gives the simulated sound of an orchestral string section. Two other voices are also provided to add variety to the overall effect and have the basic characteristics of Woodwind and Brass instruments. The circuitry includes the facility to vary the degree of mixing of the voices, and the switching which enables changes of register to be made in both upper and lower sections of the keyboard.

THE VOICING SYSTEM

The outline of the voicing system is shown in Fig. 4.1, and consists of two sections covering upper and lower parts of the keyboard separately. Outputs from the threshold diodes, following the diode gates, for the upper section of the keyboard are taken to staircase networks in the voicing system

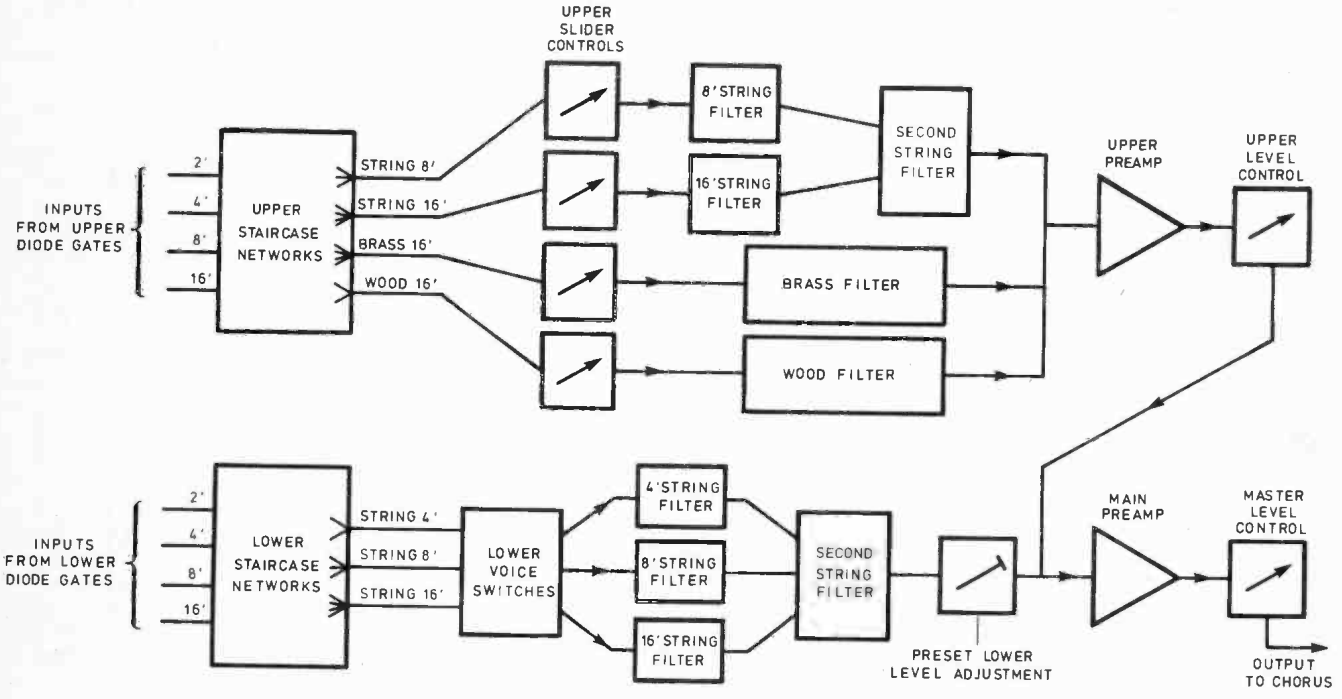


Fig. 4.1. Schematic of the voicing system

which produce stepped waveforms suitable for the four instruments, three at 16ft pitch and one at 8ft pitch. Each instrument is controlled by a slider potentiometer and has its own filter. The string voicing consists of a combination of both high and low pass filters which in conjunction with the second filter, which processes both registers, are in active form. Brass and Woodwind voices are produced by ringing band pass active filters and following a common preamplifier all upper voices are adjusted by a level control on the front panel.

A similar staircase network section produces stepped waveforms for strings in the lower section of the keyboard at 16ft, 8ft, and 4ft, which are then controlled by the lower voice switches and followed by similar string filters to the upper section with a preset level control on the Voice Board.

The combined voices from the full keyboard are amplified together and set by the master level control on the front panel. This signal is passed to the Chorus Generator for processing and returned to the Voice Board for distribution to the Swell Pedal and output sockets.

STAIRCASE NETWORKS

The effect of the Staircase networks is shown in Fig. 4.2 where waveforms (a) to (d) are square waves at 2ft, 4ft, 8ft, and 16ft each coming from the respective diode gate busbar. The square waves contain odd harmonics only which have limited use in the generation of musical instrument tones. Since the square waves on each busbar are octave related even harmonics are available by mixing outputs from each busbar. Generally an amplitude relationship is used where the level of each successively higher even harmonic content is half that of the harmonic below.

Waveform (e) in Fig. 4.2 is produced by mixing an input at 16ft (d) with half the level at 8ft (c), and is used as the base waveform for the woodwind. The description "staircase" can be understood from the shape obtained. Waveform (f) is produced by mixing an input at 16ft with half the level at 8ft, a quarter the level at 4ft, and one eighth the level at 2ft. This waveform is used for all 16ft strings and brass, giving the addition of higher even harmonics.

Waveform (g) is obtained by mixing a fundamental at 8ft with half the level at 4ft and a quarter the level at 2ft for the 8ft strings, whilst waveform (h) has a fundamental at 4ft with half the level at 2ft and is used for the 4ft strings in the lower section.

VOICE CIRCUITRY

Full circuit details are given in Fig. 4.3. Resistors R69 to R76 terminate the output busbars from the diode gate circuits and are essential in any tests of the diode gate system if the Voice Board is removed. R77 to R98 perform the staircasing function prior to slider or switch controllers. The upper string filters are associated with IC32, the brass with IC33, woodwind with IC34 and lower strings with IC35. VR16 and VR17 control the resonant frequencies of the brass and woodwind filters respectively and require setting to avoid the violent peak occurring within the keyboard range. IC36 amplifies all the upper voices and is followed by the upper level control VR18.

LOWER STRING CONTROLS

Switches S3 to S6 are interlinked. With S3 depressed the 16ft and 8ft waveforms from the lower section of the keyboard are linked to String I and II slider controls respectively, and

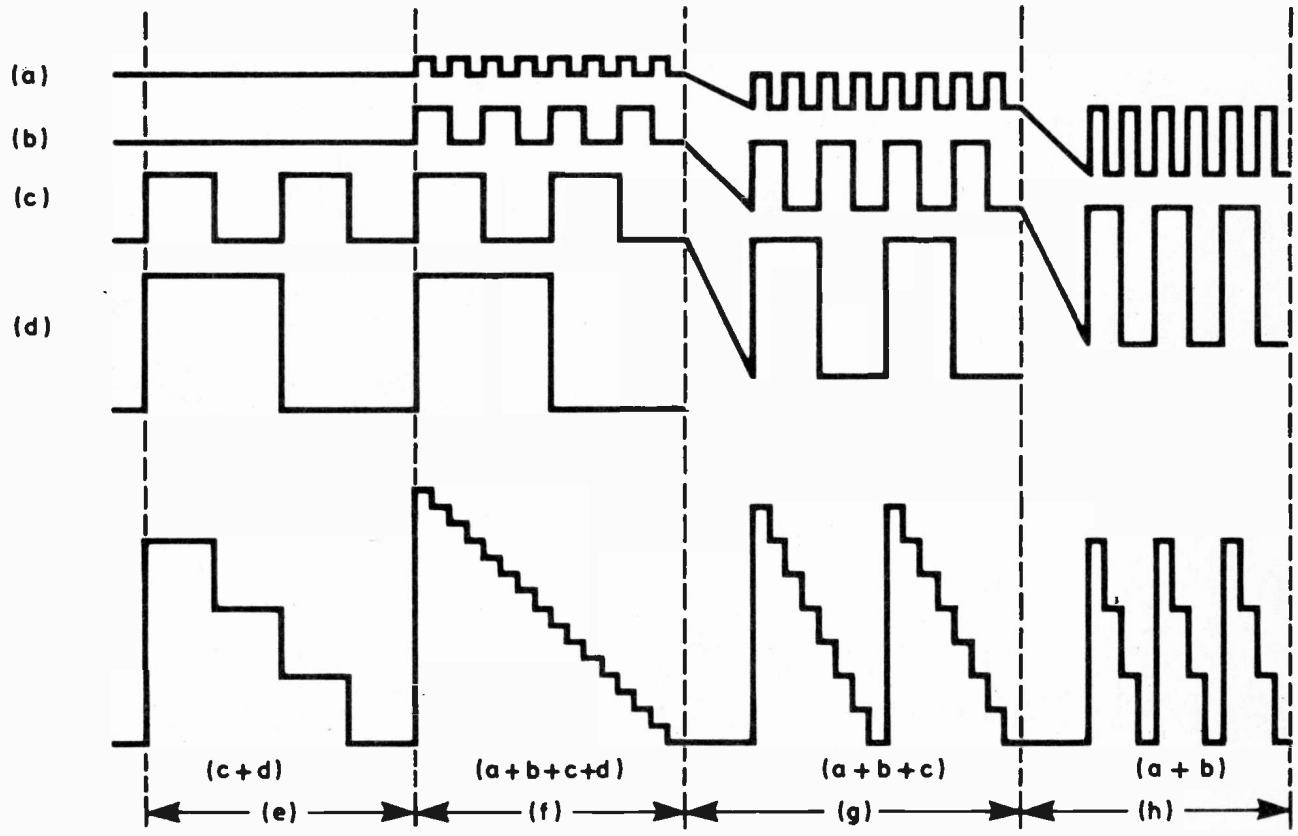


Fig. 4.2. Formation of staircase waveforms from octave related squarewaves

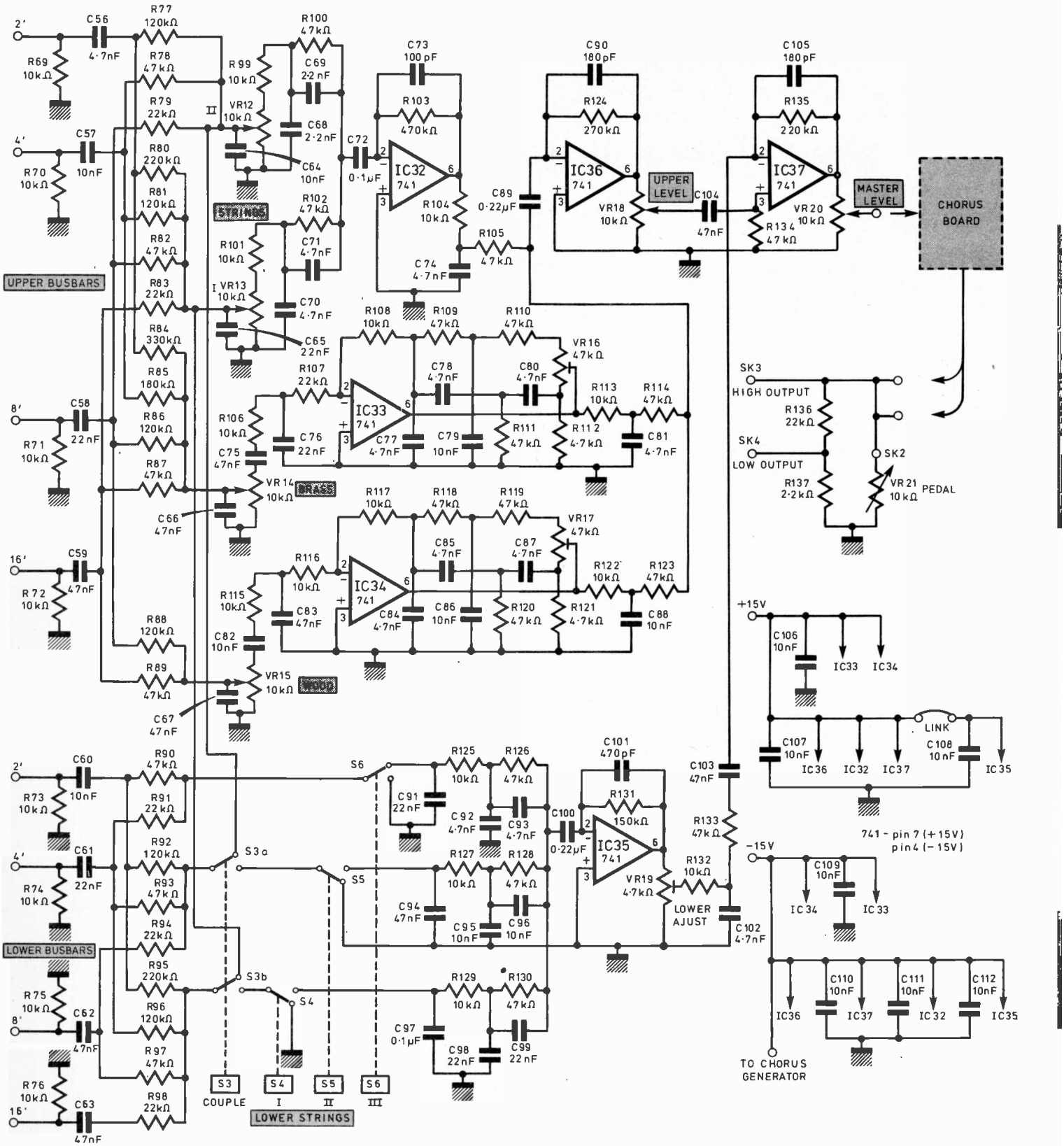


Fig. 4.3. The complete voice circuitry

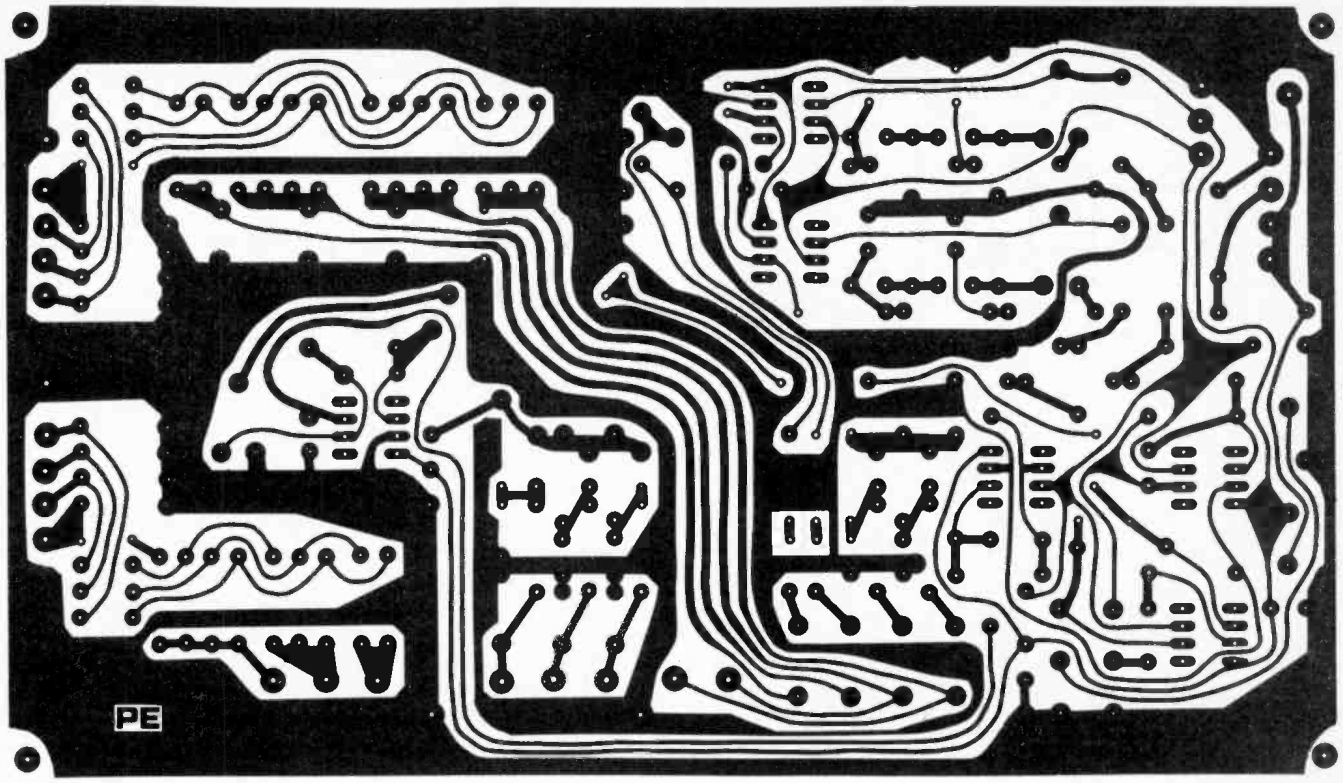


Fig. 4.4. Etching detail for the voice p.c.b.

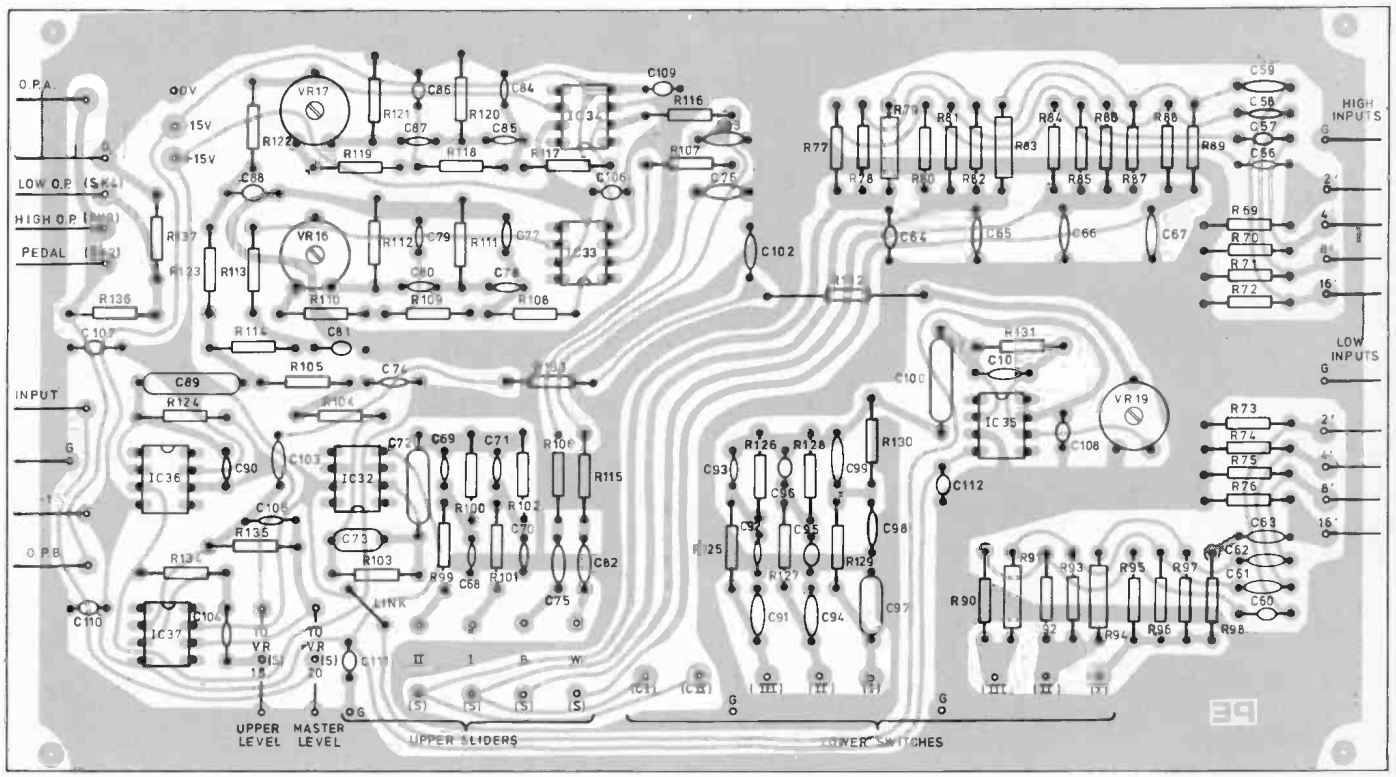


Fig. 4.5. Showing component assembly and drillings

COMPONENTS . . .

VOICING SYSTEM

Resistors

R69–76	10kΩ	R105	47kΩ
R77	120kΩ	R106	10kΩ
R78	47kΩ	R107	22kΩ
R79	22kΩ	R108	10kΩ
R80	220kΩ	R109–111	47kΩ
R81	120kΩ	R112	4.7kΩ
R82	47kΩ	R113	10kΩ
R83	22kΩ	R114	47kΩ
R84	330kΩ	R115–116	10kΩ
R85	180kΩ	R117	10kΩ
R86	120kΩ	R118–120	47kΩ
R87	47kΩ	R121	4·7kΩ
R88	120kΩ	R122	10kΩ
R89–90	47kΩ	R123	47kΩ
R91	22kΩ	R124	270kΩ
R92	120kΩ	R125	10kΩ
R93	47kΩ	R126	47kΩ
R94	22kΩ	R127	10kΩ
R95	220kΩ	R128	47kΩ
R96	120kΩ	R129	10kΩ
R97	47kΩ	R130	47kΩ
R98	22kΩ	R131	150kΩ
R99	10kΩ	R132	10kΩ
R100	47kΩ	R133	47kΩ
R101	10kΩ	R134	47kΩ
R102	47kΩ	R135	220kΩ
R103	470kΩ	R136	22kΩ
R104	10kΩ	R137	2·2kΩ

¼ watt 5% carbon film

Capacitors

C56	4·7nF ceramic	C82	47nF ceramic
C57	10nF ceramic	C83	47nF ceramic
C58	22nF ceramic	C84–85	4·7nF ceramic
C59	47nF ceramic	C86	10nF ceramic
C60	10nF ceramic	C87	4·7nF ceramic
C61	22nF ceramic	C88	10nF ceramic
C62–63	47nF ceramic	C89	0·22μF polyester
C64	10nF ceramic	C90	180pF
C65	22nF ceramic	C91	22nF ceramic
C66–67	47nF ceramic	C92–93	4·7nF ceramic
C68–69	2·2nF ceramic	C94	47nF ceramic
C70–71	4·7nF ceramic	C95–96	10nF ceramic
C72	0·1μF polyester	C97	0·1μF polyester
C73	100pF	C98–99	22nF ceramic
C74	4·7nF ceramic	C100	0·22μF polyester
C75	47nF ceramic	C101	470pF ceramic
C76	22nF ceramic	C102	4·7nF ceramic
C77–78	4·7nF ceramic	C103	47nF ceramic
C79	10nF ceramic	C104	47nF ceramic
C80	4·7nF ceramic	C105	180pF
C81	10nF ceramic	C106–112	10nF ceramic

Potentiometers

VR12–15 10kΩ lin Sliders, VR16–17 47kΩ Presets 100mW submin. VR18 10kΩ lin, VR19 4·7kΩ Preset, VR20 10kΩ lin, VR21 10kΩ Pedal

Integrated Circuits

IC32–37 741

Miscellaneous

SK2–4 Mono standard jack. S3–6 bank of two-pole two-way switches interlocked. 47 terminal pins 1 printed circuit board.

the 4ft signal is inoperative. S4, 5 and 6 convert the lower section to 16ft, 8ft and 4ft strings only, but more than one control button may be depressed at the same time. Except when in the couple condition the Lower Voices have a fixed amplitude preset by VR19, and balancing of the two parts of the keyboard is achieved with the Upper Level Control.

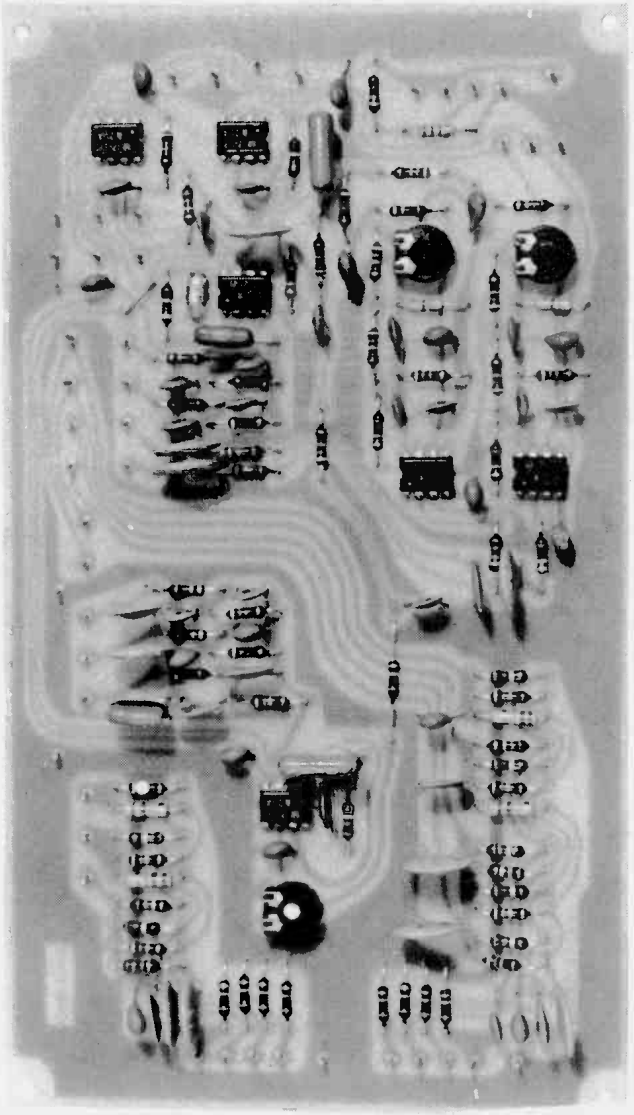
PREAMPLIFIER

Upper and Lower Voices are fed to the complementary (anti-phase) inputs of preamplifier IC37 to compensate for the additional inverting amplifier, IC36, in the upper voice channel. The main purpose of the Master Level Control VR20 is to compensate for the many modes and styles in which the instrument may be played, either melodic or chordal, single or multi-voiced, and it may be used to prevent overloading of the Chorus Generator input under extreme conditions.

OUTPUT AND SUPPLIES

After processing by the Chorus Generator the signal is returned to the Voice Board on which it is controlled by the Expression Pedal via socket SK2. Divider resistors R136 and R137 give high and low level outputs at SK3 and SK4.

The Voice Board is powered by +15 volt and −15 volt supplies obtained from the regulators on the PSU/Tone Generator Board, and capacitors C106 to C112 are incorporated to ensure stable operation to the 741 Operational Amplifiers.



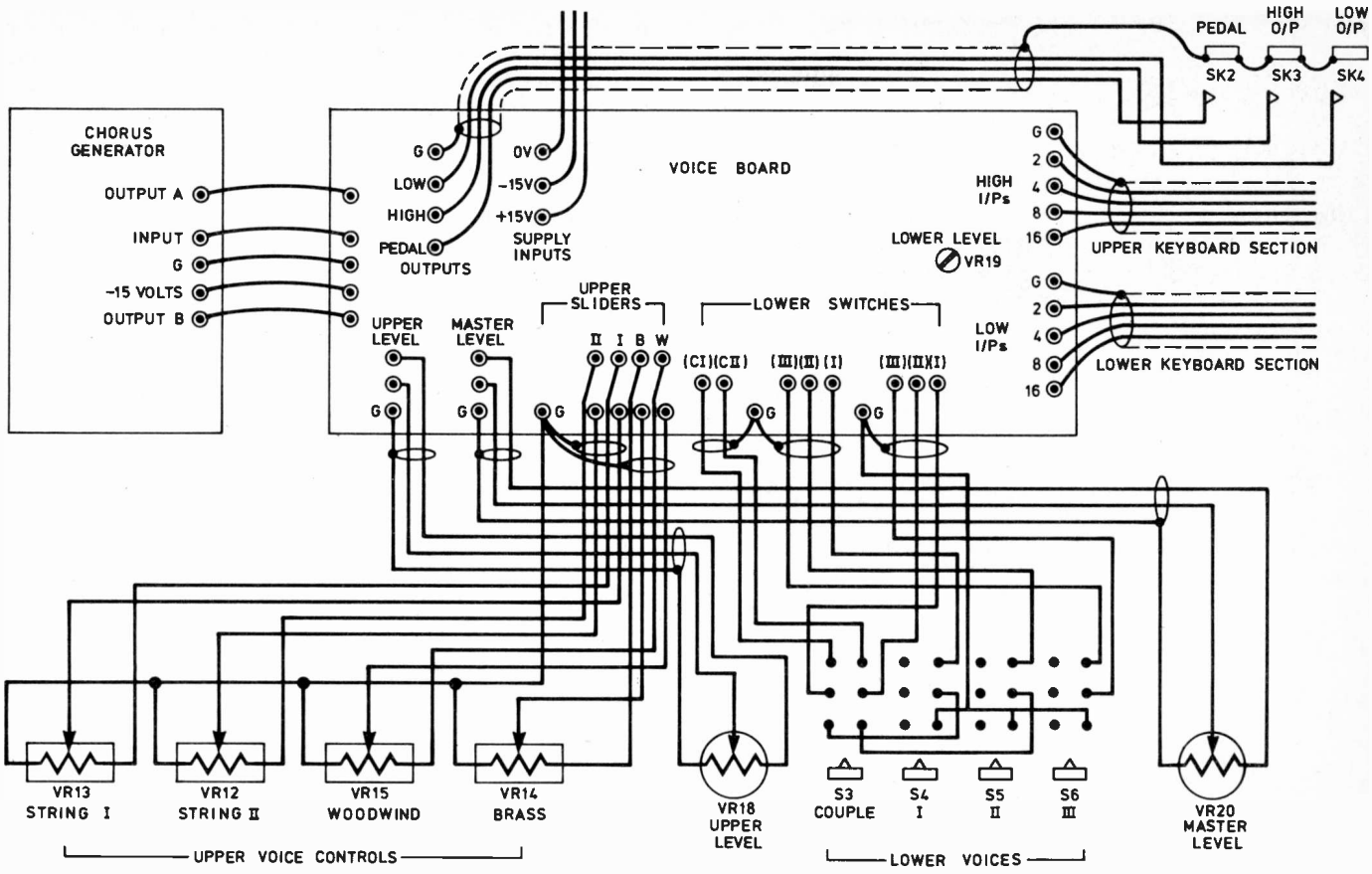


Fig. 4.6. Voice and Chorus interwiring

VOICE BOARD CONSTRUCTION

The Voice circuits described are mounted on a printed circuit board, the etching and drilling details of which are given in Fig. 4.4, with the component assembly details in Fig. 4.5. To assemble the board the terminal pins should first be inserted followed by resistors, i.c.s, preset potentiometers, small capacitors, large capacitors and the wire link next to R103.

INTERWIRING OF THE VOICE AND CHORUS CIRCUITRY

The Chorus Generator interfaces with the Voice Board only, as shown in Fig. 4.6, whilst the Voice Board provides connections to all controls and output sockets. The wiring details given in Fig. 4.6 should be followed carefully, and it should be particularly noted that in some cases screen connections are made at one end of a cable only whilst in others both ends of the screen are connected.

Supply inputs to the Voice Board are taken direct from the PSU/Tone Generator at +15 volts, −15 volts, and 0 volts. Pedal and output signals are taken through a single 3-core screened cable to sockets SK2–SK4 with both ends of the screen connected.

High and low inputs are each taken from the diode gate busbars through a four-core screened cable with the screen connected at each end. The Upper and Master Level Controls are connected by two-core screened cables with the screen soldered at both ends.

UPPER VOICE CONTROLS

A ground lead is taken from the Voice Board and connected to one of the slider controls. A lead is then taken from this point to each voice potentiometer. The remaining terminals on VR12 and VR13 are connected via a four-core screened cable with the screen soldered at the Voice Board end, but not to the potentiometers. Similarly VR14 and VR15 are connected via a four-core screened cable.

LOWER VOICE SWITCHES

A ground lead is taken to the tags (or pins) shown on S4, S5 and S6, which are strapped together. Three multi-screened leads are then used to complete interconnection to the switches and in each case the screen is only soldered to the Voice Board end whilst the other end is cropped and cleaned up to prevent shorting to other switch connections.

The first lead is two-core and interconnects the relevant pins on the Voice Board to S3. The second lead is three-core and interconnects the Voice Board to S3. The second lead is also three-core and interconnects to the two tags shown on S3 and one tag on S6. Ordinary wire connections are then made as shown between S3 and S4, and between S3 and S5.

Note: Omissions from Part One Components List are C6, C7, C9, C12–10nF ceramic, C8–68pF.

In Fig. 2.5 diodes D23–30 should be reversed. Fig. 2.2 shows them correctly polarised.

In Fig. 3.6 IC28 should be a 14 pin device. The two extreme left pin connections should be ignored.

NEXT MONTH—Cabinet construction