Ferrograph Series 7 cont.Part-4-service notes

tape recorder service

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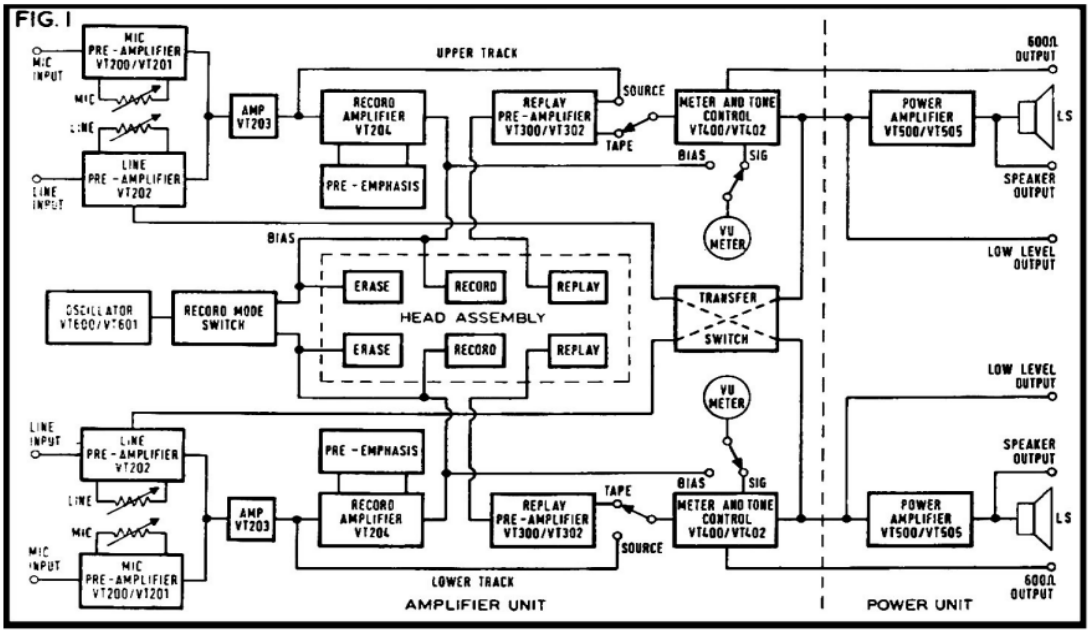
Source: ‘the tape recorder’ October 1971

A year ago for my sins, it seems- I promised to give details or the equalisation adjustments for any reader who wanted to know how Ferrograph ironed out some of the frequency response problems on the Series 7.

Anyone who has studied the service manual-a very comprehensive document-or had to service an ailing machine will verify that attention to detail and meticulous thoroughness are hallmarks of Ferrograph construction. One of the facets of this fastidiousness in the adjustment-or at least, possible tailoring-of the record and replay response curves.

Some alterations are within the control of the operator. Record gain can be preset as well as manual, bias can be altered and recording level set as desired. But frequency –conscious circuits have to be altered by changes in circuit time constants. This is done by altering components and adjusting presets within the machine.

Easiest way to understand the Ferrograph Series 7 circuits is reference to the **fig. 1** block diagram.

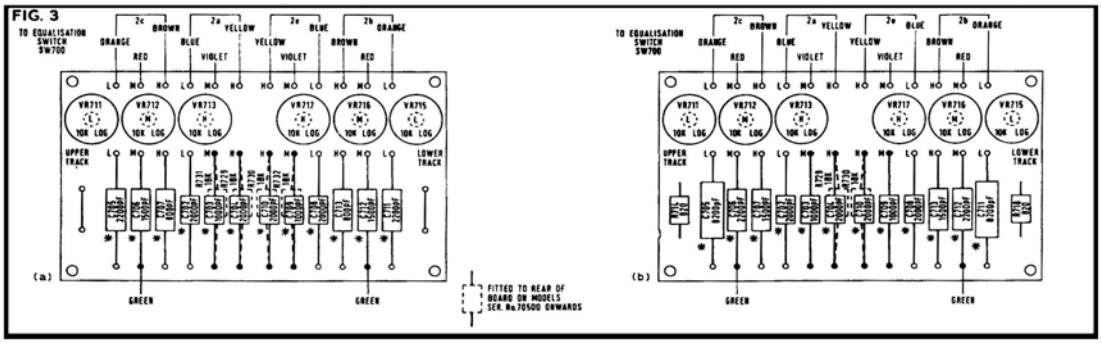


Stereo models are duplicated mono as far as the electronics are concerned. Line and microphone inputs have their own preamplifiers, with individual gain controls.

One or two differences have come about since Ferrograph issued the diagram. The transfer switch, for example, (not on mono models) takes a signal after the tone control amplifier. The replayed signal from one track is passed to the line input of the other track and rerecorded as shaped by tone controls. Early models did not allow this: tone controls were inoperative for the transfer signal up to serial number 70,500.

That number is a crucial change point. Earlier models also had a centre position of the tape/source switch, labelled 'Normal'. A 48V relay in the power unit was energised by the same micro-switch that energises the oscillator when the record button is locked on. This had contacts switching the record signal via the output switch to the VU meter. During fast wind, stop or play modes, the tape signal reached the meters, but if the record button was pressed the meter registered the source signal.

On later models, additional components were fitted for equalising and these are shown dotted in our **fig.3**.



We shall refer to this drawing again later, where differences between the 'H' (high speed) and normal models will also be noted.

To get an idea of the way the equalisation is performed, it may be instructive to run briefly through the relevant parts of the circuit. Referring to **fig. 2a**, we find the replay signal from the head applied to the base of VT300 via an isolating capacitor. There are two components in this circuit worthy of note: possibly to give answers to some of those correspondents who complain: 'I continually get the **Light Programme** when I try to record….'

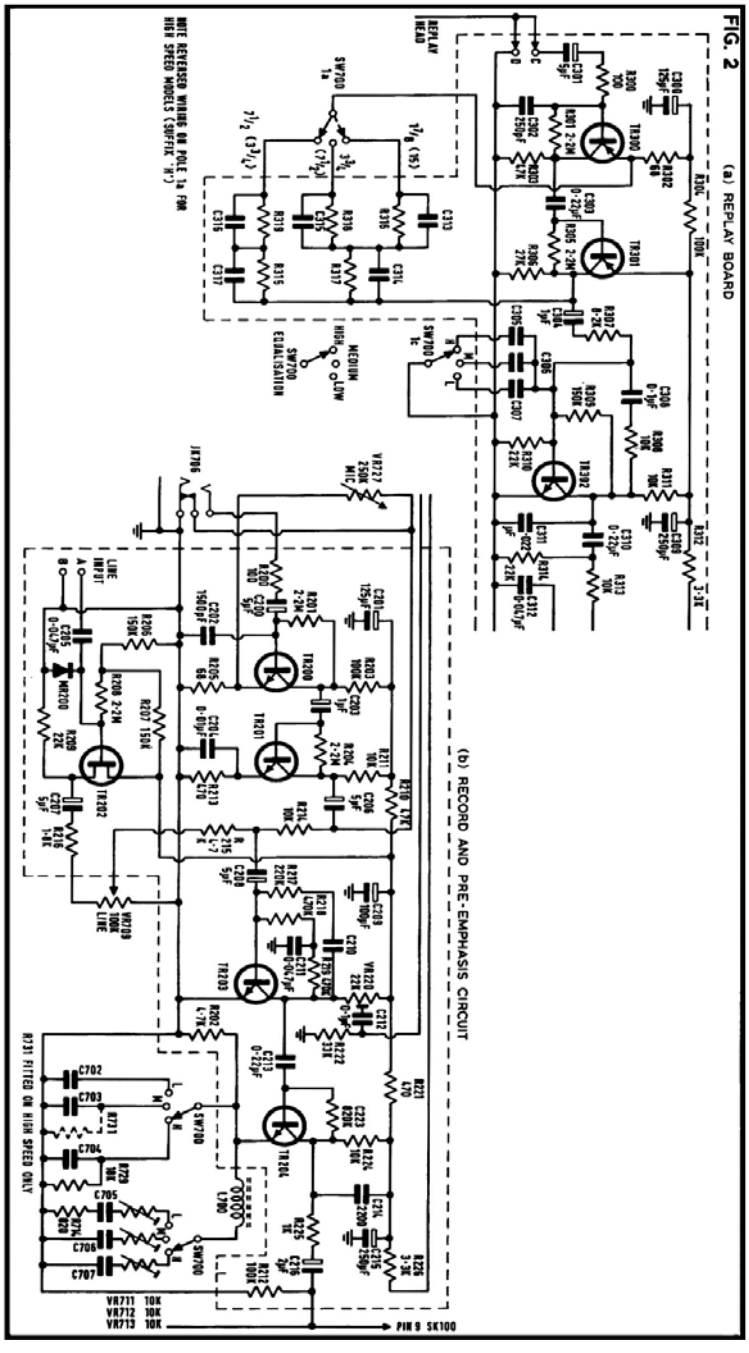
The important additions are R300 and C302, put there precisely to prevent such a mishap. Equalisation is applied via a negative feedback loop over VT300 and VT301. Switch SW700 selects the RC combination for the appropriate speed. Treble response is affected by the three capacitors C313, C315 and C316 and to some extent by C314, C317.

Bass response can be tailored by alterations to the series resistors R315 or R317. The only significant difference between the circuit given and that of stereo models is a variable resistor, shunted with a capacitor (100 kohms, 600 pF); between the emitters of the first transistor of each channel (VT300). The resistor is adjusted for minimum crosstalk.

Part of the equalisation circuit is switch SW700 1c, which varies the treble lift according to selected speed by varying the capacitance across the base of VT302, and thus the phase shift. The idea is to get a small treble lift and then a rapid fall-off, to reduce hiss by keeping the frequency response only as wide as it has to be, then to make it tail off rapidly.

One of the effects of this sort of tailoring is to guard against high frequency pick-up from the oscillator circuits. However much one may filter the feed to the recording head or associated lines to the rest of the circuit (metering, monitoring and transfer links are common culprits here), there can be bias pick-up. If it is largely unavoidable, one gets rid of its effects by reducing the bandwidth. Reducing, that is, the unnecessary bandwidth beyond the specification, with a filter, or, in this case a carefully tailored curve.

In **Fig. 2a** there is one unexplained component. This is C312, whose function, in conjunction with R313, is to reduce the output from the replay preamplifier when the Ferrograph 7 is fast winding. The phenomenon of 'tweeter burnout' has been diagnosed as due to the high frequency energy generated when a tape recorder was rewound. Mid-frequency high amplitude tones become fierce HF shrieks, as our ears already inform us. The signal already at high frequency becomes supersonic and the tweeter goes haywire. Ferrograph protect users by putting C312 in circuit via the deck switching.



Digression…after having had to change many a loudspeaker unit through abuse I am always hopeful that loudspeaker protection will become more general. Manufacturers ought to concern themselves not only with circuits that prevent an amplifier from crumpling at the seams when its nominal 4 ohm load sinks below half that value on deep bass, but also with devices that can protect loudspeakers from misguided attempts to click switches.

So far, we have discussed equalisation components in the replay preamplifier. This is where you would expect to find them. Right? Wrong. The components we have so far been discussing are mounted on the replay board and another board called the equalisation board (or, more correctly, 'pre-emphasis board') is mounted at the front of the amplifier section, carrying components we shall meet in **fig. 2b**.

The reason for this is the need to maintain a good noise figure by avoiding interlinking screened cables from the replay board. Components are mounted thereon and can be changed as the needs arises, being suspended by their lead-out wires between raised pins. One can do quite a bit of fine adjustment to the replay curve by changes of value.

For now, let us note the required values, and here, of necessity, a table will be more helpful than pages of notes. There are high and medium speed versions, needing different resistors, mono and stereo versions (which, being duplicates, need not bother us at this point), and three production categories. These refer to machines from 70,000 to 70,499, 70,500 to 74,999 and 75,000 onwards. **Table 1** gives the values of components in **figs. 2a and 2b that** vary, and which are not specified in our circuits for this reason.

	REPLAY BOARD												RECORD BOARD			
Serial No.	C305	C306	C307	C313	C314	C315	C316	C317	R315	R316	R317	R318	R319	R714	R729	R731	R718
70,000 H to 70,499 M	·015µF	·022µF	·047µF	1500pF	·01µF	1500pF	1500pF	·01µF	68K	3·3K	120K	6·8K	18K	—	—	—	—
	·022µF	·047µF	·15µF	1500pF	·01µF	1500pF	1500pF	·01µF	68K	6·8K	120K	12K	18K	820	—	—	820
70,500 H to 74,999 M	·015µF	·022µF	·047µF	1500pF	·01µF	4000pF	2000pF	·0068µF	150K	3·3K	120K	5·6K	15K	—	18K	18K	—
	·022µF	·047µF	·15µF	4000pF	·0068µF	2000pF	4000pF	·01µF	120K	18K	150K	15K	5·6K	820	18K	—	820 stereo only
75,000 H on M	·015µF	·022µF	·047µF	1500pF	·01µF	4000pF	2000pF	·01µF	150K	3·3K	120K	5·6K	10K	—	18K	18K	—
	·022µF	·047µF	·15µF	4000pF	·01µF	2000pF	4000pF	·01µF	120K	5·6K	150K	10K	12K	820	18K	—	820 stereo only

Variable resistors RV711, RV712, RV713 all 10K presets. Record Board: C702 = 2000pF, C703 = 1000pF, C704 = 2000pF, C705 = 8.. 0pF, C706 = 2200pF, C707 = 1500pF

The equalisation components of **fig. 2a** are fixed. Some variation can be effected by direct component changes and by careful selection within the tolerances. The pre-emphasis, however, allows more immediate variation, with preset resistors RV711, 712 and 713 for the low, medium and high speed selection respectively.

A better understanding of how and why we should adjust these can be gained from a look at the sub-circuit of VT204, and its feed transistor VT203. From the collector load of the latter it will be noted that a take-off point is provided. This supplies the ‘source’ signal.
Note that the take-off is via a bass-reducing circuit, C212 and R222. This is because the input to this stage from the matching impedance transfer stage, a FET with unity voltage gain, (signals to gate, follower configuration), has been bass boosted by the feedback circuit C210, R217.

RV220 is adjusted at high speed setting, to give the same output level at the ‘600 ohms output’ socket when the tape/source switch is in either position.

Heavy Feedback

The second take-off from the collector of VT203 is via C213 to the base of the record amplifier VT204. This amplifier has heavy negative feedback. To give the necessary high frequency boost to the signal applied to the record head, reduction of this feedback is needed, which can be done by varying the negative feedback, i.e. altering the C702 TO C704 values.

A little twitch at the end of the high frequency response is given by the CR components in series with the inductor L700, these being across the emitter bypass capacitors previously mentioned.

Once again, a table could help to detail the various adjustments, but here we shall attempt a summary instead. The crucial frequencies are different for the different speeds of operation. At 38 cm/s we are interested in the bands 8 to 18 kHz and 18 to 22 kHz; at 19 cm/s 5 to 15 kHz and 15 to 18 kHz; at 9.5 cm/s, 3 to 10 kHz and 10 to 15 kHz. In each case, the capacitor in circuit is trimmed (shunted?) for adjustment at the lower of the two frequency bands, while the resistor takes care of the upper band, while the resistor takes care of the upper band, i.e. the twitch at the top.

The relevant components, again with regard only to the mono version, are from high to low speed respectively: C704, R713; C703, R712; and C702, R711. This coupling does not depend on whether the machine is a high or low speed version. The frequency response has to be checked overall. That is, first we trim up the replay response as necessary, using a test tape, for the following limits: 38 cm/s 30 Hz to 20 kHz +/- 2 dB; 19 cm/s 30 Hz to 17 kHz +/- 2 dB; 9.5 cm/s 40 Hz to 14 kHz +/- 3 dB.

Only when this is right can we check the overall record/replay response curve and this also entails our having checked the bias setting. I have dealt with this before and cannot waste space repeating it. Please refer to August and September 1970 issues.

Recording tests are carried out with sine wave signals between 30 Hz and 17 kHz, at constant level 20 dB below maximum recording level. Aim to produce around 200 mV at the 600 ohms output and that should be as near right as is necessary. Frequency response limits will be as follows: 38 cm/s 30 Hz to 20 kHz +/- 2 dB; 19 cm/s 30Hz to 17 kHz +/- 2 dB; 9.5 cm/s 40 Hz to 14 kHz +/- 3 dB.