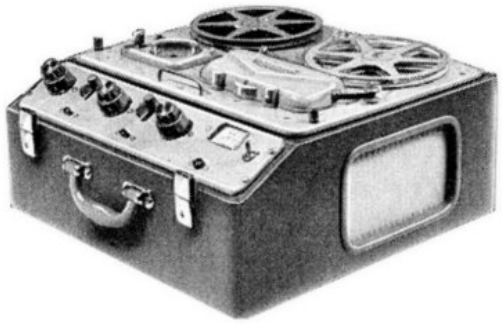
FERROGRAPH SERVICE NOTES PART 2



SERIES 420
BY H. W. HELLYER

Source “the tape recorder” May 1970

The Ferrograph may have been advertised as ‘incomparable’ for many years and certainly I would not wish to argue with its individual construction and design. But when I try to compare one Ferrograph model with another, so that prospective purchasers of second-hand ‘battleships’ may have some idea of what they may be getting, I find that comparisons are not just odious, they are overwhelming. This article was intended to be devoted to the deck, one fairly common factor of the range between the 3 and the completely restyled 7. I have sorted out the range of Series 4 machines that differed radically from that covered last month, but which have one common factor with the Series 5.

First a brief run down of differences, for which some readers have asked. Problem appears to be, so I am told, that an advertisement in a Classified column quotes only the briefest details and the seller may be miles from the hopeful buyer. Before wasting a stamp on a further enquiry, the buyer needs to know some basic facts about the offer. Some curious prefixes and suffixes have been used by Ferrograph to identify the various models. Staying with the Series 4, but with some reference also to later marques, the vital statistics of these ‘lettered’ types is as follows:

YD: Two-speed models for industrial use, with 600 ohms input and output. There is a high-gain stage tacked on as an afterthought, allowing that somebody might just possibly want to use a high-impedance microphone.

Digression-one does not usually think in terms of high-Z microphones. To do justice to the machine one uses low-Z microphones and matching transformers. For years, I employed Reslo and film Industries ribbons and colleagues were equally happy with the Grampian GR2.

Suffix A denotes ‘normal’ record and play facilities, and tape speeds of 9.5 and 19 cm/s (3 ¾ & 7 ½ i.p.s)

Suffix L after the ‘A’ denotes low-speed, 4.75 and 9.5 cm/s

Suffix H after the ‘A’ means this is the high speed model, 19 and 38 cm/s.

Series B has similar speed ranges but with a different monitoring arrangement, with an output of 20 mV into 1 Megohm, whereas the 'A', the normal facility, is 2.5W into an external 15 ohms loudspeaker, plus a 600 ohm 5mW balanced output. Monitoring during recording is an essential for live work, so the 'B' range is a better bargain.

Most of these differences originated with the Series 3, so it may be possible to unearth an ex-government model with the 'FN' suffix. These were Series 3C, dual-channel jobs with staggered heads. Although they were really intended for recording, the monitoring facility on them, with a small amplifier and speaker could easily be augmented. Playback is from either or both tracks so it takes very little ingenuity to convert this model to stereo operation, by modifying the three-way switch.

Suffix 'S' denotes stacked head for normal stereo operation.

Suffix 'CON' stands for the chassis-only version, suitable for rack mounting, lacking just the cabinet and the loudspeaker.

Coming on to the Series 4 machines, and in particular the Series 420 which is our main theme today, we find U, A and E employed for different purposes, a little confusingly. And the numbers, 422 and 424 identify quite different machines. To add to the bother, some of the previous sales brochures gave misleading information and an expensive conversion could well be required if one purchases a Series 4 blindly. The problem is that of voltage and frequency changes. Series 'U' is intended for 200/250 V, 50 Hz operation.

Series 'A' operates on 110 V, 60 Hz, and 'E' is that strange hybrid, the 110 V, 50 Hz version. According to the implication in some literature on the Series 4, all one needs to do to convert from U to A is change the motor pulley and the starter capacitor of the capstan motor.

Not true, I fear. The basic British machine has a 240 V capstan motor and the spooling motors are 150 V. 110 V Ferrographs need motors of half this rating, quite apart from the pulley to suit the frequency change. The start capacitor increases from 0.75 micro-farad to 2.5 micro-farad and then to 3 micro-farad for the E version.

The mains transformer has to be changed to suit the voltage, although this is not so great a problem, being a more generally available item. The one thing often overlooked is that the high wattage deck resistor must also be changed having a 250 ohm 27 W rating for 110 V models.

Add to all this another model, the 808, which is really a stereo Series 4 with the power amplifier and loudspeaker omitted. It has other differences, including a switched meter circuit, and did not appear in any great quantity. The 420 series took its place, so it is on this we shall concentrate.

Inputs 'for full depth recording', as the manual puts it are 2 mV into 1 Meg-ohm and 35 mV into 500 K. This compares with the general Series 4 input (the circuit of which was last month's fig.1) of 3 mV into 1 Meg-ohms and 100 mV into 80 K.

Some of the points to note about the main circuit, fig. 1, are (a) valve heater supply, (b) use of triodes throughout the amplifier, (c) auto-stop, (d) input isolation, (e) push-pull oscillator, (f) meter circuit, (g) added feedback – C55-lower track playback amplifier, and some special features of test procedure that are not obvious from the drawing. Taking these in order:

(a) Hum avoidance by DC heater supplies is a common practice, but is done here by a 19-0-19 V AC supply rectified by a couple of silicon diodes in a full-wave circuit, while the valves whose heaters are no so much a source of hum (meter and oscillator circuits for example) are powered from the AC winding. The full-wave circuit is based on the 19 V secondary but, after rectification and smoothing, there should be 12.6 V DC available for the heaters of the ECC83 triodes.

(b) In contrast with circuit shown last month, whose amplifier depended on pentodes, double-triode valves are employed in the Series 420, just as they are in the Series 6, whose circuit will be published next month, except that the oscillator, instead of being based on a pentode, uses a push-pull ECC82 just as in this month's circuit. Why the changes? Well, on might receive all sorts of high-falutin' theories about valve efficiencies, etc., but my view is simply that Ferrograph used the valve bases available in their basic amplifier chassis, and that was that.

(c) From valves it is not a far step to the auto-stop because, on this model, it derives its power from the same supply. Note that the solenoid coil L1 is in series with a 100 ohm, 1 W resistor, and that the latter is in the DC supply return path when the stop button or the auto-stop contacts short circuit the solenoid. This is, of course, a hold-in solenoid, energised while the deck is in the 'forward run' condition for play or record. Troubles in around the rectified circuit, sometimes even the valves themselves which have been known to develop heater to cathode short-circuits and upset voltage condition, can affect the mechanical operation of the deck. So the voltmeter is the first aid to service that one will need.

Auto-stop arm

Mechanically, the auto-stop switch is a pivoted arm with a short vertical rod at the end. The tape holds the arm in the 'switch –open' position with a light spring trying to return it to the 'switched-closed' position, as it would be with the tape absent, broken or slack. This auto stop is not intended to work during fast running, and the sensor arm is held off during this operation. Auto-stop operation on this machine is 'complete', that is, the machine reverts to neutral and has to be reset to run.

(d) The recording amplifiers consist of two-stage pre-amplifiers from the high-sensitivity socket followed by further two-stage sections from the low-sensitivity input. The monitoring signal for A-B comparison is from the anode of the third stage and it will be noted that, whereas each channel has a single ECC83 for its first two sections, the third section of each channel shares one valve, as does the fourth. This can be confusing for the chap who has to find his way around for the first time, and is defeating when one employs the subterfuge of gain testing, etc, by valve swapping.

Part of the reason for this device is hum-and-noise reduction by maintaining heater-cathode potentials of low-signal stages at the required level and balance. There should be very little bother with cross talk. Mixing, though rudimentary, is effective. Series 100 K, no matter what the position of the record gain potentiometers, even though both feed into the same grid.

(e) Mention has already been made of the push-pull oscillator and, as this circuit has some extra controls. Instead of the single preset potentiometer beside the output valve, we now find two controls on the top of the power/oscillator sub-chassis and one on side between the plug and socket connectors. The latter is the bias control for the upper track, the one nearest the inside of the cabinet is for the lower track, while the one nearest the mains transformer is the 'bias equalise' control. Its function is to compensate for any bias imbalance due to circuit and head discrepancies when the stereo machine is used in the mono mode. So a switch section connects this variable resistor to chassis in either mono mode, but it is left floating during stereo.

There are one or two small points about the oscillator that need airing. Recording mono can cause some bother on a machine intended for stereo use. This calls for extra switching to put the unused sections of heads, and some parts of the circuits, totally out of the way so that they cannot interfere with the active section. In the 420, the unused winding of the erase head is disconnected altogether to avoid cross-coupling (actually, a fault in this switch section produces an increase in noise level), but only one of the bias feed connections to the unused part of the recording head is disconnected. I would have been much happier with the unused section short-circuited altogether, but this requires only a very small modification and, if you are going to be as fussy as that, you would probably go along with Tom Reps (see December 1969 issue) and not switch heads at all!

(f) Another double triode is called into action in the meter circuit, but this is an ECC83, not an ECC82 as might have been expected. In fact, the other of the two ECC82 valves in this circuit-the first being the oscillator-is the shared output cathode-follower of the playback amplifier. Having been led a pretty dance once by V7 and V5 having been swapped over, I speak with some feeling!

The first half or the meter pair is a cathode follower and its job is to provide a charge circuit of the 0.22 micro-farad polyester capacitor in the grid of the next stage. The rectified signal becomes a negative voltage for the grid of V5b and the meter is in the cathode circuit. When the signal level is nil, a 1 mA backing-off current flows through the meter for full scale deflection, and increase in signal increases the bias to reduce anode current, and so meter deflection.

One adjustment of the meter circuit is for peak recording level for a given maximum distortion (3%). The grid resistor of the first half of the meter amplifier is selected to read 8 (nominal value is 1 M). The procedure is to begin by zeroing the meter, all controls turned to zero. Then an input signal of 50mV at 1 kHz is applied to Input 2. Distortion is measured at the output of the channel under test and the input recording gain is advanced until the meter reads 8. The tape is run at 19 cm/s and distortion on play is measured. If it is not between 2.5 and 3%, the recording level is varied to obtain this figure. Then the meter reading will not be 8, so the grid resistor must be altered to obtain this magic figure. Sounds suspiciously like cooking the books, but it works. Of course, it argues that all other points are in order, including bias and that bias equalisation we have already spoken about, which is of great importance. It also argues that the bias trap is correctly set, as we mentioned in the last article.

(g) A small point this but, when a machine is completely stereo, any discrepancy between channels sticks out a mile. There is a capacitor in the lower track circuit that is absent in the upper track playback circuit. No prizes for finding it. This is C55, a 47 pF feedback component from the junction of the treble boost corrector preset and the 1500 pF section of the feedback loop (which may vary slightly from this norm) to the cathode of the first playback preamplifier. The idea is to compensate for wiring differences. Because the amplifiers have to be differently sited, and on the 420 the playback amplifiers are on another sub-chassis running along the left side of the cabinet, there will be some difference in screened leads, and the extra feedback is given to correct for this.

Between the cathodes of the two preamplifiers, will be found a resistor network. This is variable to allow crosstalk reduction. In the mono mode, this crosstalk can be down around the noise level and careful adjustment of the common' controls will be needed. The worse conditions for noise and crosstalk tests are with the deck opened up, so load a smaller reel, use a fresh spool of tape, prop the deck open, and make your noise, distortion and crosstalk adjustments that way in the sure knowledge that, when you batten down he hatches, your figures will be several dB better.

With the compensating capacitor in mind, watch the routing of those cables. The forms should loop down neatly in the spaces below their natural 'fall'. Many a hum problem has arisen because a cable got itself hitched.

On small factor not yet mentioned is the adjustable head on the 424 model. The play head can be raised by a lever to read off a normal ¼ -track tape. This was necessary in the days when the 420 was spanking new and there were one or two odd track configurations to contend with. Trouble now is that ½ -track stereo tapes can give a right-hand channel loss on playback if you forget to bring the monitor head of the 424 down again.

Once again, we come to the end of a monthly article without having dealt with the subject which was originally projected. As the circuit of the Series 6 needs very little discussion further to what we have already said about the 4 and 420 and, indirectly, the 5, we can deal more explicitly with the deck in next month's article. Until then….

FIG. 1 FERROGRAPH 420 MAIN CIRCUIT DIAGRAM