JUNE 1966 TWO SHILLINGS

tape recorder

THE CZECH APPROACH TO TAPE RECORDING — GRUNDIG TK400 REVIEW
OVERCOMING INTERFERENCE — A TIME-SWITCH FOR THE WEARITE DECK
SOME COMMENTS ON THE "WHICH?" REPORT — A VISIT TO GROZSOUND

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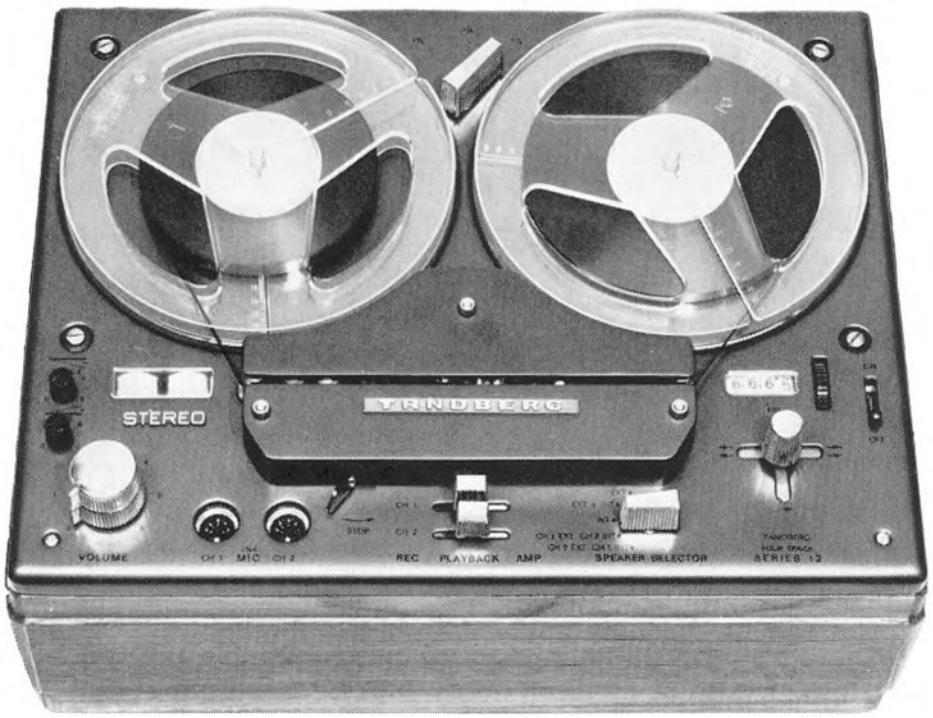

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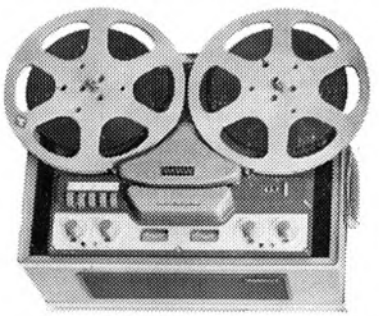

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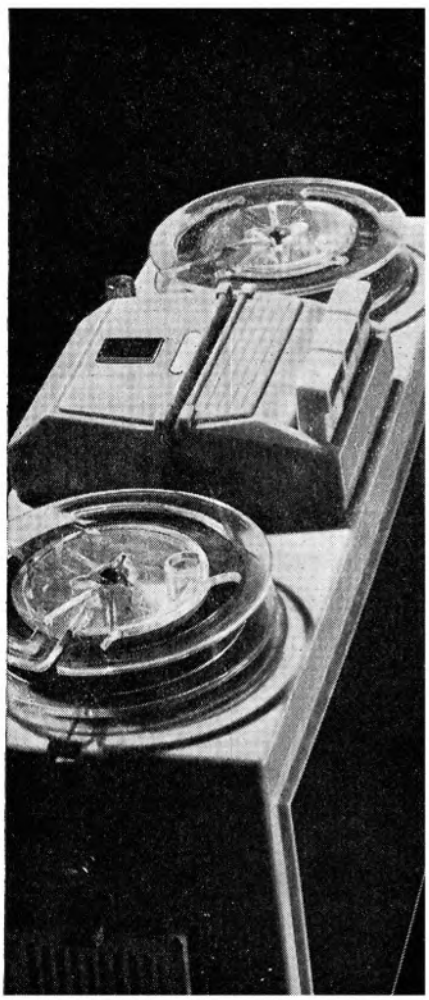

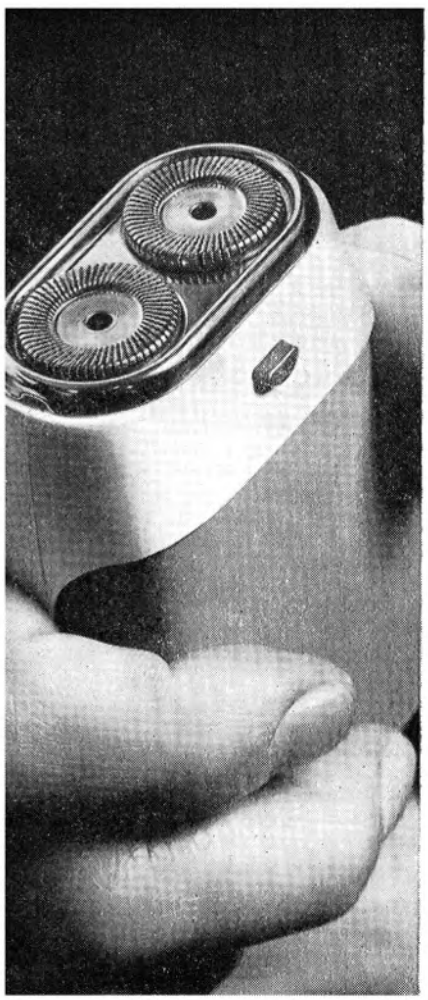

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editorial

MICHAEL GORDON DEVOTES a considerable portion of his contribution on *Battery Powered Tape Recorders* this month to the task of overcoming motor interference. We know not what he has in store for us as the series progresses, but an examination of the battery portables imported in their thousands from the Far East shows that interference is only one of many failings that owners seek to overcome.

Impelled to purchase, perhaps, by deceptive chromium finish, attractive plastic casing, and wily sales talk, the owners of these machines often find themselves struggling with high wow levels, DC bias, and sometimes even permanent-magnet erasure. Level meters have effective scales of half-an-inch or less ; gain and tone controls take only days to 'go noisy' ; monitor amplifiers are capable of barely audible output before distorting, and loudspeakers, in addition to creating sound waves of a sort, provoke sympathetic vibration in metal grilles, loose motor bearings and adjacent components of the control mechanism. To talk of motor interference is only to scratch the surface.

The designers of these cheap machines have standardized on plugs: miniature replicas of the GPO Jack are moulded permanently to the end of flimsy microphone cables. The microphone itself is moulded and can neither be tampered with by foolish prodders nor repaired when the 'remote-control' switch turns off for good. There is nothing wrong with moulded miniature jacks, but the accompanying miniature sockets sometimes feature such flimsy holding contacts that, in time, the jack will fail to connect with the adjacent circuit—as several million transistor radio owners may testify from experience with headphone sockets.

Even the faithful GPO Jack itself : "I've got the *Bulgin* at five-bob or this one here at three-and-six". We take 'that one there at three-and-six' only to find that the long screw holding the tip has been replaced by a rivet—and rivets work loose.

Designers from the Far East have no qualms about copying. For them it is natural, as well as profitable, to compliment a manufacturer on his original styling by copying it. Similarly, there can be no greater honour than to have the fruits of expensive research stolen by one's rival. Copying is not restricted to Western designs and techniques : in the East one imitates even the products of one's neighbour. The designs of a well-known company so impressed one Japanese soul that he faithfully reproduced the position of each control, the shape and location of each meter (adding a little plastic here and there). Another soul restricted himself to forming a company with a similar trading name!

The 'well-known company' can hardly complain. They have themselves made such play of an American invention that the glory of its development is reflected almost in full upon themselves. In cheapening the 'development' to suit the needs of their production lines, however, they diminished the very effectiveness of the principles on which the system had been based.

Whatever one feels about the morality of obvious copying, the main fault of many designers is their inclination to copy the wrong techniques, or to copy good ones in little more than name. We care not one wit whether our money ends in the pocket of a British manufacturer, a Swiss finance house or a Hong Kong bank. We want competitively-priced products of good overall quality, built to last and backed by agents of long standing. Fly-by-night service departments and bi-monthly model changes should have no place in today's industry.

For their own sakes, and for the sake of the uninformed impulsive customer, will Japanese designers please open their eyes a little wider in their search for new techniques ; modestly priced battery portables are as worthy of improvement as the many undoubtedly good semi-professional models coming to us from the rising sun. Will they examine the principles of AC erase—well worth adding to a machine with AC record bias? Will they strip down a *Grundig TK6*, an *EMI L4*, a *Uher 4000L*, a *Philips EL3586*—and see how decent portables are made? And having done so, will they copy the basic electronic and mechanical techniques rather than produce cheapened reproductions of these original designs ? Will they observe the modulation meters ; will they note the easy accessibility for servicing, the reliable components and the well-positioned controls ? Will they compare the electrical motor interference generated within and around their own designs with the blissful silence of a tape erased and reproduced on the aforementioned European designs?

But before deriding Eastern manufacturers for their limitations, British firms might profit by an examination of a few American designs. Even in Czechoslovakia, solenoid mechanisms are becoming the norm. The Europeans are fine technicians, the Japanese are fairly good at copying. But only in the USA is anyone doing any thinking.

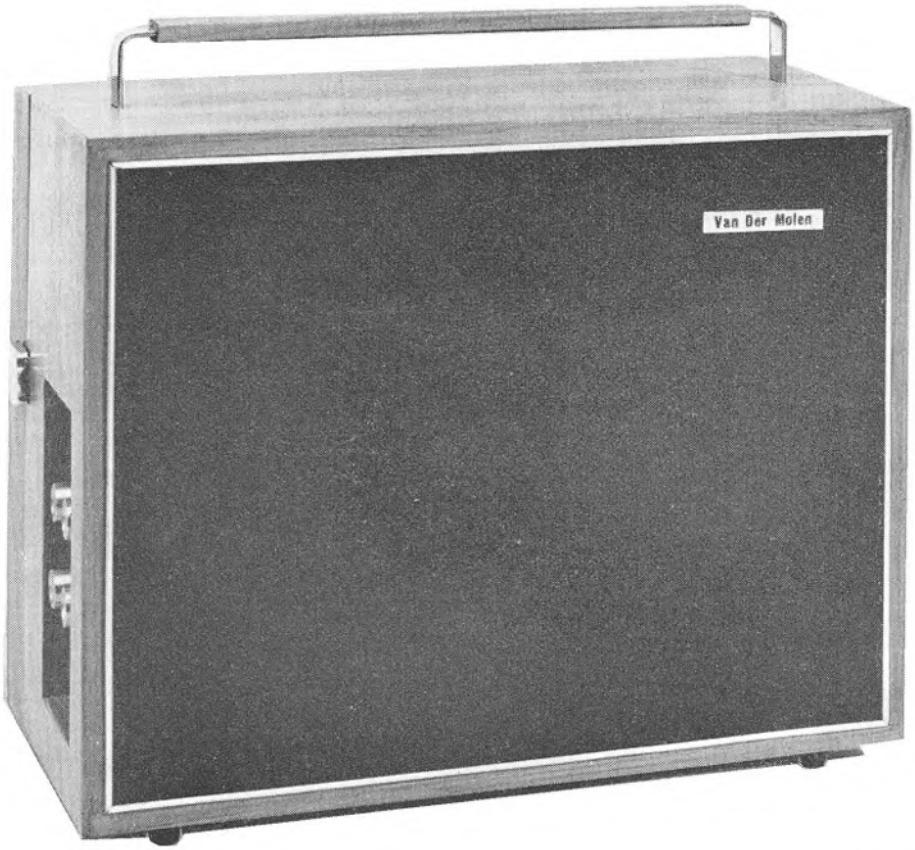
JUNE 1966 **VOLUME 8** **NUMBER 5**

COVER PICTURE

A taste of things to come. This photograph was one of several sent to us by Roger Gregory with his article 'Videotape Comes Home', to appear next month. The *Ampex HVR* depicted is one of the latest domestic video machines and employs 1in. tape at $9\frac{3}{5}$ i/s.

SUBSCRIPTION RATES

Annual subscription rates to *Tape Recorder* and its associated journal *Hi-Fi News* are 30s. and 38s. respectively, Overseas subscriptions are 32s. 6d. (USA $4.50) for *Tape Recorder* and 38s. (USA $5.40) for *Hi-Fi News*, from Link House Publications Ltd., Dingwall Avenue, Croydon, Surrey. *Tape Recorder* is published on the 14th of the preceding month unless that date falls on a Sunday, when it appears on the Saturday.



There's more to this tape recorder than meets the eye

A masterpiece of disguise, a portable tape recorder housed in a beautiful teak veneer cabinet. But don't be deceived, the works entrance is just around the back.

4 tracks 3 speeds — 5 watts output — 8″ round speaker — 7″ spools — fully transistorised.

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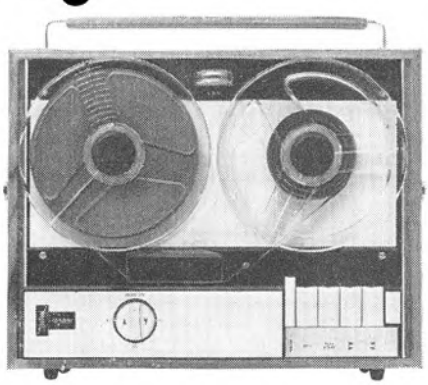

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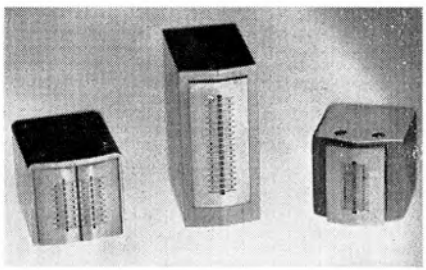
world of tape

INSTRUMENTATION RECORDING HEADS

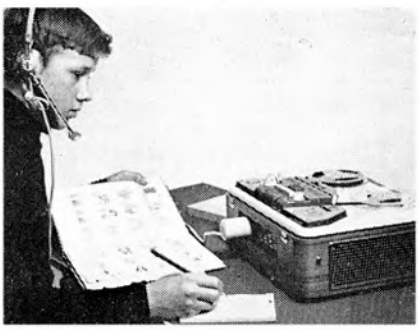


UP to 32 tracks on 1in. tape are possible with heads in the range lately announced by *Electro-Mechanical Systems Ltd.* Ferrite cores are employed in all record/replay heads, with effective gap widths of 1 micron and above. Bases of two thicknesses are available for special applications requiring the interlace of two adjacent heads. EMS heads are available in all standard configurations and also to *SBAC* and *IRIG* standards.

AMPEX ELECTRON BEAM RECORDER

NEW techniques of data recording are being introduced almost daily, though few may prove as promising to the future of audio and television recording as the electron beam recording system developed by *Ampex*. Although in every sense a tape recorder, the Ampex *ATM-13* does not rely on the conventional magnetic process of recording, the record head being a tiny cathode ray tube. The electron beam emitted by this tube is focused on a silver halide tape coating, scanning vertically and horizontally, modulation of the electron intensity registering as varying electrical charge over the area of tape being scanned. In the process of reproduction, the tape is coated with a plastic material which emits light when exposed to an electron beam, the light passing through the recorded pattern on to a photo-multiplier tube. The manufacturers believe that it will one day be possible to record up to 100 Mc/s at a 30dB signal-to-noise ratio.

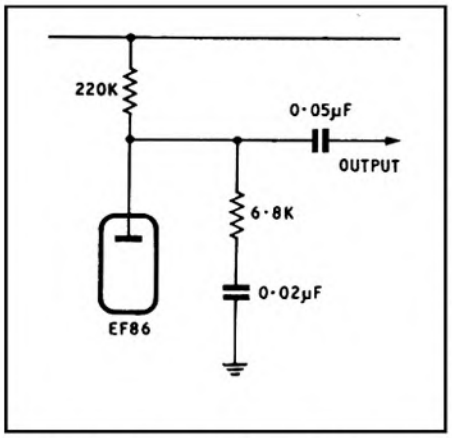
LUXOR LANGUAGE LABORATORY



BRITIMPEX are now handling a 'Mini-Lab' Language Laboratory based on the *Luxor MP283* mono tape recorder. A variety of accessories are available for the system, including six-way distribution boxes through which pupils may monitor with headphones the language course from a single recorder. Up to five of these boxes may be fed from one recorder, allowing 30 pupils to participate. The MP283 is being marketed at £62 9s. 6d., excluding earphones, microphones and amplifier.

AN ARTICLE CORRECTED

READER Malcolm Hill, Chairman of the Newcastle and District Tape Club, has pointed out that the article describing a *Stereo Tape Playback Pre-amplifier* published in the February issue might mislead some intending constructors. We should, perhaps, have added a note to this, explaining that it was in no sense a comprehensive device guaranteed to give a properly balanced sound with any combination of equipment. It is a simple, straightforward amplifier without compensation for the tape-head playback characteristics.



The circuit illustrated here may be added to each output to provide 140μS equalization, This will give a response roughly in accordance with the DIN/CCIR standard for 3¾ i/s operation, though the mid-frequency gain of the circuit will be correspondingly reduced by about 25dB As modified, the circuit should only be used when the input impedance of the following amplifier is 1M or greater, if the equalization is to remain correct. Also, the components added to give the equalization curve work in conjunction with the output impedance of the pentode circuit, and will not function correctly when the source impedance is much below 200K. Amplifiers with inputs for crystal microphones should provide a sensitivity and input impedance of the right order to take the outputs of this modified circuit, assuming that the inputs are coupled to a stereo tape replay head.

Another point to watch is that the proposed input grid resistors of 100K will cause an HF loss with tape heads of high inductance. For a 1H head the response will be down by 3dB at 16 Kc/s, and the resistance value of the grid leaks should be raised in proportion for heads of higher impedance. We thank Mr. Hill for these comments.

NEW DEPOT FOR KB

SERVICE and delivery of *Kolster Brandes* products in Scotland are now being organised from premises at 32 Milton Road, College Milton, East Kilbride. A member of the *STC* group, the company vacated their original premises to provide extra space for the manufacture of STC crossbar telephone exchange equipment.

PROMOTING THE CASSETTE

A NUMBER of 'standard' questions put to the retail trade by potential purchasers of cassette recorders were answered in a recent issue of the *Philips* trade paper *Playback*. As presented, the replies form a convincing case for the cassette; the context was rather as follows:

Why Cassettes? When a recorder is used outdoors with accessories and, perhaps, a cine camera, the process of changing spools can be more difficult than it is in the home. Cassettes may be changed easily, without fast-winding, reducing the chance of part of an interview, or a valuable sound, being 'lost'. The tape is protected from damage by the cassette body and, being more compact, is easily stored. (A *Cassette Storage Pack* holding up to six tapes is available for the Philips *C*60 cassette.) Playing time is not as limited as it may seem, since each of the two tracks of a cassette lasts 30 minutes. A version of the C60 with increased playing time is currently being developed for the EL3300/1.

Why Narrow Tape? Although conventional ¼in. tape would have marginally increased the height of the EL3300/1, this was not the reason for the use of 0.15 in. (roughly ⅛in.) tape. The smaller tape meant that a less powerful motor was needed to provide stable transport.

What Future has the Cassette? The Philips cassette was developed not just with portable recorders in mind but with a view to a much wider field of application. The 'one hand loading' facility has already resulted in the introduction of tape machines in cars. This market is relatively untapped and will expand in the future.

NEXT MONTH

THE JULY ISSUE of *Tape Recorder* will be published on Tuesday, 14th June and will have a maroon cover. Roger Gregory's detailed examination of the booming American market for domestic television recorders —*Videotape Comes Home*—will appear alongside an article by C. W. W. Read describing recording amplifier circuits employing silicon planar transistors.

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SUNWAVE tape recorders and transceivers are guaranteed for high quality, small size, light weight and convenient portability. All SUNWAVE products are backed by our long experience, advanced research, great technical resources and the most modern facilities. You'll sell more tape recorders and transceivers if you feature SUNWAVE items.

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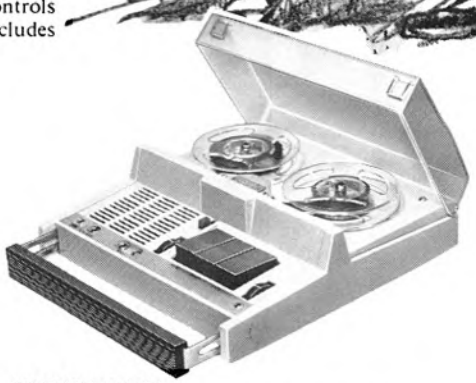
◇ Capstan drive ◇ 6 transistors ◇ 3-3/4″ and 1-7/8″ speeds ◇ Dynamic microphone with remote start/stop switch ◇ Positive speed change lever ◇ Simple push button controls ◇ Flat, lightweight design ◇ Optional equipment includes 4″ reels, adaptors for AC and telephone recording.

APOLEX RA-65
◇ Reel drive ◇ 4 transistors ◇ Crystal microphone ◇ 2-1/4″ dynamic speaker ◇ Size: 8-5/8″×7″×2-1/4″ ◇ Weight: 2 lbs. 10 ozs.



APOLEX RA-18
◇ Reel drive ◇ 5 transistors ◇ Push button controls ◇ Remote controlled crystal microphone ◇ Weight: 3 lbs. 5 ozs. ◇ Optional equipment includes adaptor for AC.

APOLEX Transceiver RT-100
◇ 9 transistors, 1 diode ◇ Range: 1.5 miles ◇ Audio output: 120mw ◇ Final stage input: 100mw ◇ Battery: 9V (006p×1) ◇ Size: 7-1/16″×2-3/4″×1-1/4″ ◇ Weight: 12 ozs. with battery.

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PART 2

MAGNETIC SOUND RECORDING

BASIC TECHNIQUES AND A POTTED HISTORY

BY C. N. G. MATTHEWS

Above : Blattner-Stille steel-tape recorder employed by the BBC in 1935

Left : A modern studio-quality battery-portable, the Nagra IIIB weighs 16lb. and costs some £330.

WE found last month that the sensation of sound is produced when a pressure wave of suitable frequency causes our eardrums to vibrate. It seems reasonable to expect that the same vibrations will be induced in everything else light enough to be moved.

Thus, if we mount a sharp needle on a thin diaphragm, the needle point will move in and out in time with any sound wave that strikes the diaphragm. And if we move a wax-coated strip of tinfoil steadily past the needle we can cause the sound wave to cut a track in the wax. The depth of the track will depend upon the variations in pressure produced by the sound wave, so we will have produced a permanent record of the sound. Later, if we move the track past the needle in the same direction as that in which the recording was made we shall cause the diaphragm to vibrate and the original sound will be reproduced.

This was the principle of the first practical phonograph, introduced by Edison in 1877. He developed a machine in which the sound track was cut on the outside of a revolving wax cylinder. Then, about eleven years later, the Berliner gramophone with flat discs and a rotating turntable was invented. By 1898, spring-driven gramophones with the old flared horns were being produced in America and it was in this year that *The Gramophone Company*, now *EMI*, was formed.

In all the early processes the original recording depended on the mechanical power of the sound itself. Reproduction was achieved by causing the diaphragm in the gramophone 'soundbox' to act on the column of air in the horn. By careful attention to design some remarkably good results were obtained but the power of a reproduced sound could never be great, and these mechanical devices did not respond at all well to either the upper or the lower ranges of sound frequencies. It was not until 1925, when electricity entered the gramophone industry, that sound recording as we know it today began to be possible.

Now we can take a sound wave and use it to produce an alternating current of the same frequency. This may at first be only a tiny current, but by the process of amplification we can give it all the power we need. We can record it by an electro-mechanical process on a 'master' from which millions of copies can be made. Or we can record it on tape which can be used over and over again. Then, by another electromagnetic process, we can turn the sound track on disc or tape back into an alternating voltage or current. This we can amplify and finally use to produce as much volume as we require from a loudspeaker.

Perhaps the key factor in all these processes is our ability to produce an electric current from tiny changes in air pressure. Any device constructed to do this is called a microphone. Of these there are many types, but for the time being we shall concern ourselves only with the carbon granule variety.

Loosely packed carbon has the property of changing its resistance in proportion to the pressure upon it. If we connect a battery across a capsule containing carbon granules a steady current will flow. But if a sound wave falls on the capsule its resistance will change in time with the pressure variations. Consequently, a sound frequency alternating current will be superimposed on the direct current due to the battery.

By putting a resistance **R** in series between battery and microphone, and by using a capacitor **C** to block off the battery EMF, we can produce an alternating voltage depending entirely upon the audio-frequency fluctuations of air pressure. This voltage we can feed into an amplifier which will produce all the power we need to operate an electromagnetic recorder. **Fig. 1** is the schematic diagram of a complete recording system.

If we are making gramophone records, the recording mechanism operates a needle-like tool which cuts a spiral track in a rotating disc. Nitro-cellulose is one material used for this purpose. From this disc metal moulds are made by electro-deposition and from these moulds the familiar gramophone records are mass-produced by ordinary plastic moulding methods.

In the gramophone itself a record is rotated at the same speed as the original master disc. A needle running lightly in the spiral track moves in time with variations in the spiral track caused by the recorded sound. We use these movements to produce an alternating voltage

(*continued overleaf*)

FIG. 1 RECORDING SYSTEM USING CARBON MICROPHONE

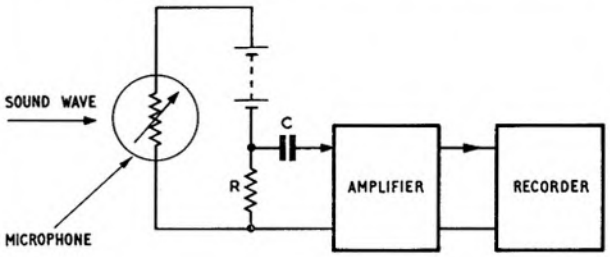
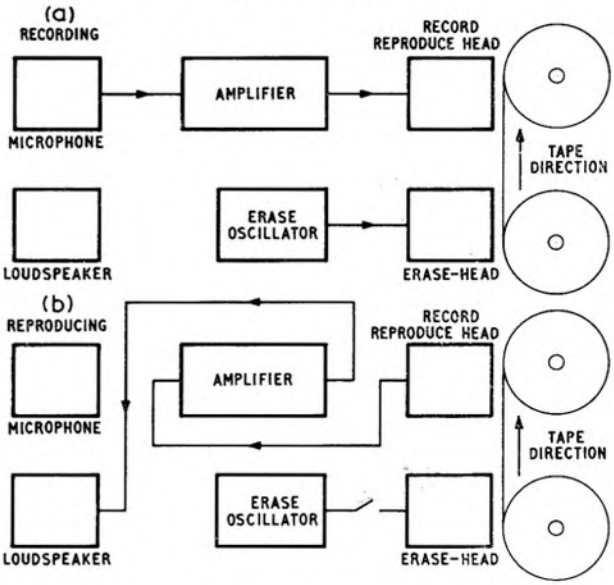


FIG. 2 TAPE RECORDER SCHEMATICS



which is amplified and eventually drives a loudspeaker.

Tape recorders, which appeared on the scene almost as early as the gramophone, use the same electrical effects applied in a different way. As long ago as 1899 Valdemar Poulson of Copenhagen invented the first practical magnetic recorder. It was intended for use as a phonograph and also for *automatically recording telephone messages*! Some things are not quite so new as we like to believe. Poulsen developed methods by which sound could be used to magnetise wire, steel tape, or paper coated with metallic powder. The recording could be erased and the wire or tape used over and over again.

By 1930 we had come a long way. A German steel-tape recorder called the *Blattnerphone* was used by the BBC to produce the first tape-recorded programmes, but this machine was soon replaced by recorders developed jointly by the BBC and Marconi's *Wireless Telegraph Company*. This carries us up to the outbreak of World War II, which of course lent impetus to research on all aspects of electronics, including tape recording. By the end of the war we had learned a good deal about magnetic tapes and by 1947 the *Ampex 200*, developed by Ampex of USA, was adopted in America for broadcasting purposes. This was probably the first really modern-style tape recorder to come into use, but it was about as big as a cabin trunk, whereas its modern equivalent, the *Kudelski Nagra*, can be carried on one finger.

Domestic tape recorders have made comparable progress and apart from their high-quality sound, allow an amateur to do something that he could not even attempt with a gramophone—produce his own musical and dramatic programmes.

Tape recorders use a microphone to convert sound waves into alternating voltages along the same lines as a disc recording machine. But the amplified voltage is used to drive a current through an electro-

(*continued on page 213*)

ZENER diode regulation is also useful at the power source feeding a Class-B playback amplifier. Such could be adopted, for instance, in a mains/battery recorder. It is well known that the power consumed by a Class-B transistor amplifier is proportional to the audio power delivered to the speaker. When such a stage is quiescent (i.e., carrying no signal) the standing or quiescent current is only a few milliamps. However, this rises to tens or hundreds of milliamps peak as the audio power fed to the speaker increases.

The power system is thus called upon to deliver currents from low to quite high values. Ideally, the supply voltage at the amplifier should remain substantially constant at all current values for the least signal distortion. This task is accomplished reasonably successfully by the use of large value reservoir and smoothing electrolytic capacitors. These charge up to the supply voltage and the energy of their charge is absorbed by the amplifier, the power supply itself sustaining the charge. This works provided the energy in the capacitors is always in excess of that required at any time by the amplifier.

The amplifier is not normally expected to sustain a continuous maximum power output. Maximum power is representative of a sine-wave signal delivered by the amplifier at the maximum power attainable from the output transistors. Sine-wave power is measured in root-mean-square (RMS) watts. This is the equivalent 'heating power' of the audio.

Take a Class-B amplifier whose output transistors could handle 5W of RMS signal. The *peak power* of this signal is twice the RMS power, or 10W. Thus, with a sustained sine-wave, 10W of peak audio would occur each cycle (at the positive and negative tips of the sine-wave). This would put quite a demand on the power system, and it is likely that the electrolytics would have inadequate reserve to sustain this demand without themselves losing energy of charge.

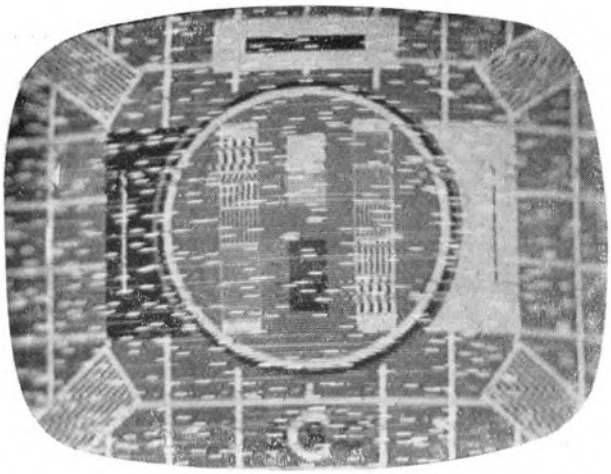
The result would be a substantial fall in supply *voltage*, depending on the capacity of the electrolytics the power demands, and the time period involved.

In practice, one does not usually record and play continuous sine-wave signals. Music, for instance, is usually of a waveform that rises to peak power for a very short period of time. Such short, peak demands can be adequately catered for, the charge in the electrolytics holding the voltage constant during these short periods. The *average power* of music, incidentally, which *peaks* at 10W is only a few milli-watts!

Power supplies, therefore, in much transistor equipment are designed on the basis of 'music-power', as distinct from sine-wave power. This means that there is little point in arranging for the transistors in a Class-B stage to cater for RMS power if the supply is designed for music-power.

Transistor audio equipment has thus brought with it this relatively new (to Great Britain) music-power rating. An amplifier with a music rating of, say, 10W at a specified distortion is incapable of delivering this on a sustained sine-wave. The audio power would fall (due to the demands on the power supply) and the distortion would consequently rise. In addition, if the Class-B output stage is also designed on the music-power basis, the transistors would themselves overheat and probably fail.

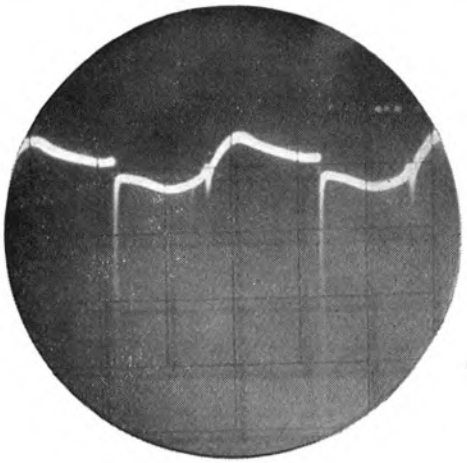
From the power supply point of view, a Zener diode voltage-regulating circuit would solve the problem almost completely. But if one records and replays organ music, for instance, which is often composed, in effect, of sustained complex sine-wave signals, there is not a lot of point in improving the supply regulation of the playback section if the transistors and their heat-sink mountings are unable to cater for the extra power. The fact that the power supply voltage falls on sustained sine-wave audio gives some degree of protection to the transistors! *(continued overleaf)*



BATTERY POWERED TAPE RECORDERS

overcoming interference

PART 7 BY MICHAEL GORDON



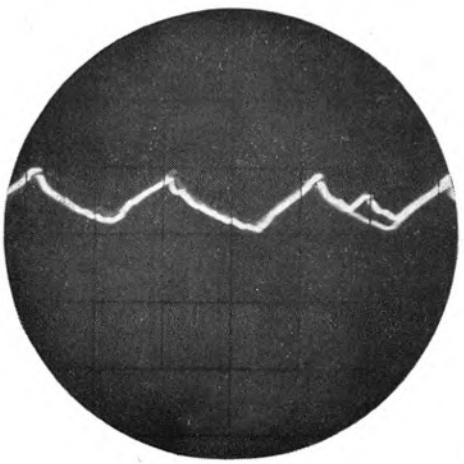


Fig. 1 (top): Picture disturbance caused by badly suppressed battery recorder motor.
Fig. 2 (centre): Oscilloscope waveform obtained from an unsuppressed DC motor.
Fig. 3 (bottom): Waveform from a properly suppressed DC motor.

BATTERY POWERED TAPE RECORDERS

CONTINUED

So much, then, for Zener diode circuits. Now let us look at some of the operational problems of DC drive motors used in battery-powered recorders, whether, in fact, they (the recorders as a whole) are powered direct from batteries or from the mains supply.

DC motors, as we have already seen, almost all employ commutator and brush gear. As the motor rotates so a small spark occurs at the point of brush contact with the commutator. There is also a small spark at the contacts of the centrifugal governor. These sparks do two things: they set up small electromagnetic interference fields, and they introduce a small irregular current component in the power supply circuits. Unless precautions are taken, therefore, DC motors can radiate signals which might interfere with radio or television receivers (usually the latter on Band 1—BBC—channels), and they can inject an interfering current component into the audio circuits of the associated tape recorder which manifests, on playback, as a rough crackle from the speaker on the programme material.

Battery and battery/mains recorders using DC motors are usually reasonably well suppressed from the audio angle by capacitors and so forth but they can still radiate an interference field on television Band 1. This may show as interference lines on the picture, especially in areas of weak BBC signal. The picture disturbance may appear something like that shown in **fig. 1,** or the interference may be more in the form of horizontal lines, as mentioned.

The interference spots are less random when the motor is running at a constant speed and when the radiation is mostly from the brush gear. When it originates mostly from the governor contacts the effect is more like that in **fig. 1.**

Prompted by a discussion with our Editor, the author decided to look into this motor interference problem in a little detail. Oscillograms of the voltage pulses produced by free-running completely unsuppressed motors and governor-controlled suppressed motors were obtained. **Fig. 2** shows the voltage waveform generated by a free-running, unsuppressed 6V motor. On the 'Y' (vertical) scale, each square (which is 1cm) is equal to 0.3V. The waveform shows transient peaks of voltage extending almost to an amplitude of 1V. In addition, smaller transients can be seen between the large ones.

These are produced by the sparking at the brushes, and their incredibly sharp rising nature implies that the interference they produce is the kind that could be radiated and cause TV interference.

The ripple effect on the waveform results from the changing EMF in the motor windings, and it is this that can get into the supply circuits and produce the 'motor sizzle' on playback.

Fig. 3 shows the waveform from a suppressed governor-controlled motor on the same 'Y' scale. While small pulses are still present on the main waveform, giving the roughness to the trailing parts of the display, the large amplitude transient pulses have been deleted.

As would be expected, the motor responsible for the **fig. 2** waveform caused quite heavy TV interference, and radio interference on a transistor receiver up to about 10ft. away. Very little TV interference was exhibited by the motor and governor system responsible for **fig. 3.** However, some could be observed on a weak Band 1 channel; but nothing at all on a strong BBC channel or on any Band III (ITV) channel. Radio interference was quite powerful on a transistor set placed about a foot or so from the motor, but nothing could be heard with the transistor set at the other side of the room, no matter how it was orientated.

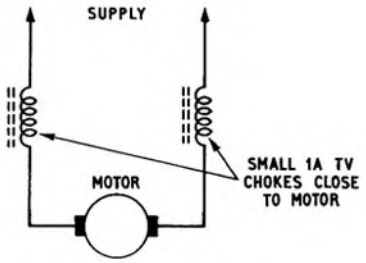
The conclusions, therefore, are that neither radio nor television interference from the DC motor and governor systems used in battery-powered tape recorders are particularly troublesome under ordinary conditions. Lack of suppression, however, and in areas of weak BBC signal, the interference might rise to a level to disturb neighbours' viewing. But this would be noticed (possibly) on one's own receiver.

It seems as though radio interference can be almost discounted, for it is unlikely that the recordist and a neighbouring transistor set listener would be operating simultaneously either side of and close to a party wall! However, it is a good exercise to check on the amount of interference—both radio and television—that is produced by the battery model, especially if this is frequently used indoors.

If television interference seems rather naughty, 90% of it can be cleared by wiring small TV suppressor chokes in the motor system supply leads. A choke should be connected in each lead, as close as possible to the motor supply terminals or tags, as shown in **fig. 4.**

These chokes have a low resistance as they consist of a few turns of insulated copper wire wound on a ferrite core. This endows them with a suitable value of inductance with high impedance at television frequencies. The chokes act as 'stoppers' to the television interference signals produced by the action of the motor, and thus prevent them from getting into the wiring from where they are radiated.

FIG. 4



Simple circuit to prevent radiation of most TV interference from DC motors.

Suitable chokes are made by *Belling and Lee* and they can also be obtained from *Radiospares* through a radio and television dealer. They come in various current ranges, but for the application in hand, 1A specimens are adequate.

Interference in the amplifier proper from the drive motor is mostly avoided by good design. However, even on good quality machines a very slight motor hash noise may be heard with the machine switched to 'playback' and running without a tape at maximum setting on the volume control. This, of course, will be emanating from the speaker, but this noise should be no louder than the mechanical noise of the running motor and capstan. In the best of machines no trace of electrical motor noise should be heard above the programme material at normal recording and playback levels.

Recorders which use a common battery (or power supply) for both the DC drive motor and the amplifiers are probably more subject to electrical motor noise from the speaker than machines using two batteries, one for the motor and the other for the amplifiers, When a common battery is used, direct coupling of the interference sometimes occurs through the common circuit. This is 'conducted interference', rather than the radiated interference that upsets radio and TV receivers.

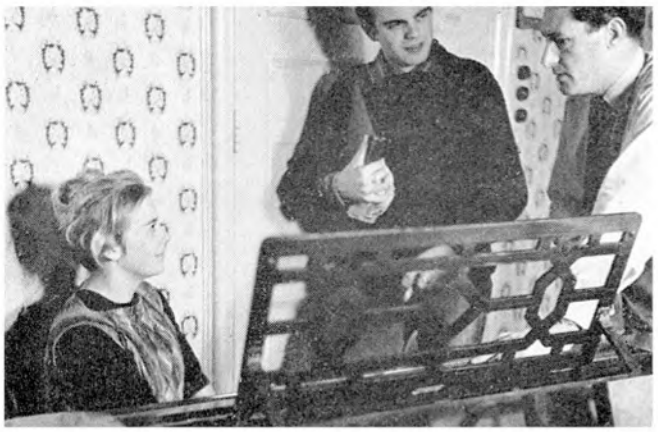
Excessive conducted interference can often be minimised by connecting a reasonably large capacitor across the supply leads to the motor. Again, this should be connected as close as possible to the motor; but when TV chokes are fitted, as in **fig. 4,** the capacitor should be connected across the supply input side of them, otherwise the TV suppression may be impaired. A capacitor up to about 0.5μF should clear much of the trouble.

It is also possible for motor interference to be induced from the motor supply leads into a transistor base or signal input lead in an early stage amplifier. This has been known to happen subsequent to a servicing operation due to inadvertent misplacement of the motor supply lead. This lead must at all times be kept as far as possible away from the early stages of the amplifiers.

Wear in the motor, on the brushes, commutator or governor contacts, can encourage excessive sparking and consequently a higher level of motor hash. General wear should be suspected if an originally interference-free machine gradually exhibits interference symptoms. Some motor systems, however, are completely sealed and little is possible in the way of service.

When a battery-powered machine is operated on the mains supply by virtue of a mains power unit described in Parts 5 and 6 of this series, motor interference may have a tendency to rise a little due to common impedance couplings in the supply circuits. The low impedance characteristic of the Zener diodes, though, discourage such unwanted couplings to some extent. Nevertheless, improvement may be possible by connecting a 0.5μF paper capacitor across the motor supply take-off at the unit, in addition to the suppression which may exist on the motor proper—in the recorder.

We have now insufficient space left to deal with battery charging techniques and charging circuits and systems. However, these will be examined next month.



The author (right) working with drama students on a lip-sync movie

Location photography on 8mm (cameraman is my critic John Makin)

SOUND AND CINE
PLANNING A SOUND FILM

BY ANTHONY WIGENS

THIS summer I am making a sound film. Through the winter I have been working with potential actors, talking with potential technicians, lecturing to potential helpers, living with themes and ideas. At length it all comes welling up and the camera beckons, the tape recorder calls.

It is a film that has to do many things for me. It has to yield material for articles and lectures. I want to use locations where the stills will look good. I want to try out new ideas, new techniques, new people.

Through the spring I talked to people in the know. For example, just before the *Amateur Cine World* 'Ten Best' film show I talked with the editor, Tony Rose, about sync sound recording techniques.

"They used a good method for *The Stray* at High Wycombe Film Society," said Tony. "They taped a wild track on the location sound sequences. Then they re-recorded the dialogue, each actor listening to the wild track on headphones and speaking in sync with his own words. Then they took this clean recording and cut the film into sync with it. It worked."

"You know," he went on, "there are plenty of ways of getting perfect lip sync. The problem is in the actors. It takes a professional to speak lines in sync with a picture." Well, that's one of those things I want to prove or disprove for myself in the film.

Later that same day I was talking to Mr. L. C. Osliff, technical director of *Filmprint Services*, the 8mm. copying specialists.

"I wish people would contact us before they make a film," he said sadly. "We could help them in many ways if they want copies made afterwards." He talked about lighting, and said that on the film Tony Rose had mentioned, *The Stray*, a follow-spot had been used in one scene that gave too great contrast for the copies to register, and that in fact the light showed on the wall behind the character, with all else in dense shadow.

He also mentioned that when a sound film is shot at 16 f/s they find it impossible to transfer sound, whereas at the higher running speed of 24 f/s not only is the sound quality improved but also the copies are kept in perfect sync.

But enough of technicalities. A film starts on paper, not in a laboratory. I listed the actors, the localities, made a nice mix of studio shots and exteriors, some scenes with lip sync requirements, some in long shot where sync need not be tight. The theme dawned which blended all the requirements, and I started to bash the typewriter.

The pattern of scripting I use is the conventional professional one, confining all dialogue to the right-hand half of the page, typed in caps. On the left, for the first script draft, I describe the scene, the action, and give key camera instructions, but not a shot-by-shot breakdown. Over on the right with the dialogue go the music and effects instructions.

Script shorthand includes the familiar camera instructions of *CU*, *MS* and *LS* (close up, medium shot, long shot), *track*, *pan*, *cut* and *fade*. Then add INT for interior. EXT for exterior, and when you bring in the music track, CUE GRAMS.

I enjoyed writing the script. I believe that if a thing is worth doing at all it is worth doing well. Once the basic script was complete I planned a full shooting script to be written in collaboration with my cameraman, with myself functioning as director and editor. Then there would be a further script broken down by locations and actors, to group all scenes that could be shot together, even if not adjacent in the script.

By this time it was the wood and the trees all over again. I couldn't see the one for the other. You live and dream and write a script and then find any kind of objective assessment is impossible to make. I've seen too many commercial films in which the director should have sought a second opinion before he committed dud ideas to tri-acetate, to be caught myself. I passed the script on. I gave it to John Makin, who succeeded me as editor of *Cine Camera* and spent three years living films with me. The next day he sent me the script back.

He wrote : "Frankly, disappointed". His comment on the theme : "Who cares ?". His comment on the visuals : "Dull".

So that was that.

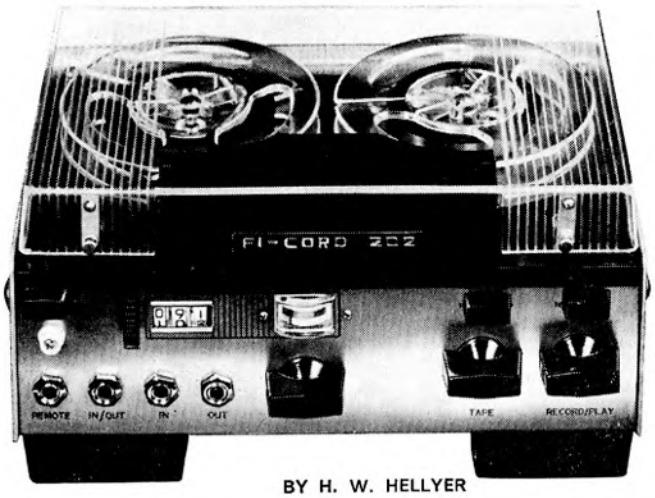
The moral of the story is that the "Worth doing well" part of the quality creed loomed over-large. Sadly, the film wasn't worth making in the first place, whether well-made or not.

A film without an audience is like a book without a reader. A bad film is an affront to its audience. Film stock is latent magic. It will grasp wonderful visions, remember them in colour and sound and reveal all it knows on demand. With this kind of magic we who know the spell have a moral duty not to abuse it.

Next month I'll tell you about the theme for my movie, which I decided *was* worth making, and in subsequent articles I'll tell you how my friends and I set about trying to make it well.

tape recorder service

No. 54 FI-CORD 202



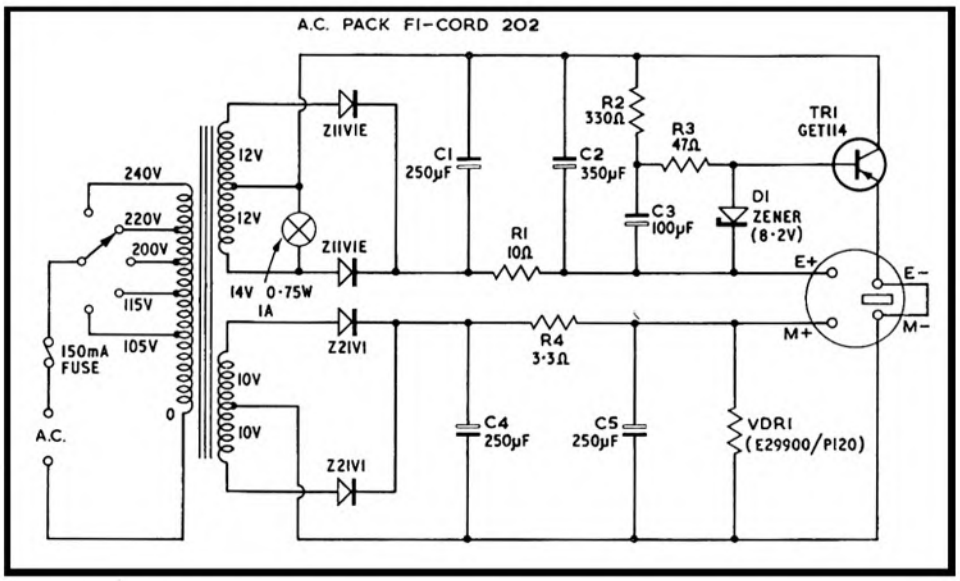
BY H. W. HELLYER

MANY times we have scoffed at the show-business compere who says: "Ladies and Gentlemen, the next act needs no introduction . . ." and proceeds to introduce it at considerable length. We shall not fall into the same trap. The name of *Fi-Cord* is well-known to all tape recording enthusiasts, and even those who never had occasion to go out in the field with a Fi-Cord *1A* join in the general lament at its demise.

But the *202* is a different proposition. It was never intended as a 'bigger and better 1A', but has its own particular character, and quite different facilities. Readers who want to gen up on the specifications may be referred to the service article which appeared in November 1964 *Tape Recorder*. Our purpose in this series of articles is to look beneath the covers, and discuss some of the features that would-be buyers have to take on trust. The best way of doing this is to deal with matters as the service engineer would, commencing with dismantling.

To digress a little, this is the difficulty the buyer faces: he can read and compare specifications; he can, if he knows no better, study the *Which?* expositions; he can diligently peruse reviews, in several magazines for good measure, but in the end, his choice will depend on his impressions, gained at the time of demonstration. And he may be haunted by a niggling doubt: "Am I buying a box of bombs? Was there something skated over lightly in the articles I have read?" Our purpose in this space is to fill in a few of the gaps that some reviewers do not have the opportunity to plug. The service engineer has the advantage that a number of machines can be assessed. He can note persistent troubles, and perhaps suggest a few cures of his own. The single machine sent to the reviewer may have a lone case of collywobbles, as we have recently seen (page 101, April 1966 issue).

It may even have been sent back and put right or exchanged prior to review. The doubt lingers. So let me state at the outset that the 202 is not one of the machines that returns regularly to this correspondent's bench. There must be quite a few of them about, but those that have come in for service had what might be called 'normal' faults. And it is not an especially difficult machine to repair—given the necessary information, such as is presented in the beautifully produced service manual.

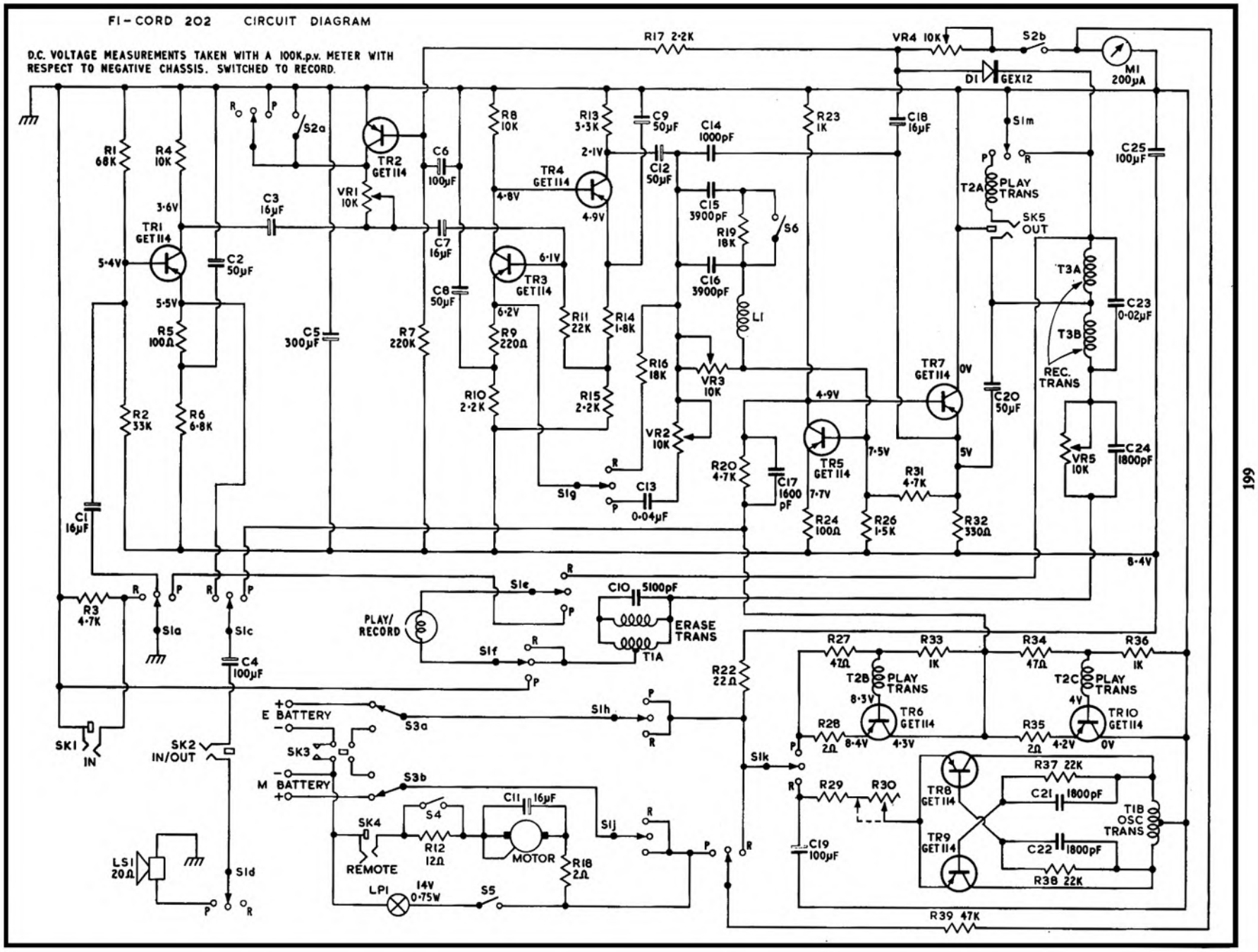


End of digression. To take up where we left off: dismantling. A good many tests can be made with the main case removed and the machine kept in its compact shape. After removing battery cassettes, lid and reels, take out the two screws in the rear of the case and one in each side, invert the machine so that the head cover is in the palm of one hand, and ease off the case with a gentle upward lift from the rear.

To get at the mechanism, and most of the components, it is necessary to swing the printed circuit panel clear, and this is the only part of the job likely to be tricky. The panel opens, book-fashion, but the leads and some components may be damaged, or the mechanism upset, if this is done clumsily. First, take off the record/play knob (turn clockwise and release screw) and then the securing nut of the switch spindle-bush. A bit of care is needed here to avoid marking the panel, and the old dodge of masking the surrounding panel with a disc of thin cardboard. Note that the hole through which the spindle comes is elongated to allow the swivel movement that follows, and remember not to re-tighten the securing nut when re-assembling until everything else is in place correctly. Next, turn to the rear, where the remote socket and speed switch are situated, and take out the two screws at the top of this plate. The printed circuit is now free to be moved.

As we hope to be able to describe the AC power pack, about which several queries have been received, it is not possible to go into great detail about the mechanics. But it should be mentioned that, as with most battery portables, loading on the motor makes a great difference to its efficiency and regularity. In this machine, one point to check is that the belt runs truly over the motor pulley, and at the right angle, and that the speed-change fork repositions it correctly on the appropriate step. The belt is flat in section and has a twist between the motor and the jockey pulley—not, be it noted, between jockey and flywheel or flywheel and motor, which quickly snarls matters up. The

(continued on page 200)



position of the belt run is adjustable by the bracket beneath the rewind spool assembly (and deck), and two screws are accessible once the turntable has been removed.

As with other similar machines, a guide to motor efficiency is the current it consumes under operating conditions. In this case, put the speed button in the 3¾ i/s position, connect a 0-1mA meter to the remote socket, remove one cell and short circuit the cassette so that the machine is under-run (supplied from six instead of seven cells), let the belt rest temporarily in the speed-change fork and note that the motor current is less than 50mA. Then replace the missing cell, slide the button to the 7½ i/s position and load the motor gently by a touch on the pulley, to bring in the governor action. Between a current consumption of 80 to 150mA, the speed of the motor should not vary by more than 2%. The governor action can be checked by noting the random kicks of the ammeter about a mean reading.

A certain amount of information has been given in the November 1964 article, and we can now concentrate on the circuit diagram. Most important factor is the list of modifications brought out since the 202 came on the market—the revised version is known as the *202A*. For the purpose of explanation, the 202 circuit is given, and modifications indicated. One of the features omitted in the later version is the automatic volume control network—which may have stilled a few of those howls of protest we heard from the purists. RV1 is retained, but TR2 is now absent, S1b and S2a are no longer needed, C6, R7 and R17 are omitted, breaking the loop from the meter circuit.

This is the most important change, but others worth noting are the addition of a 100μF electrolytic across the meter, omission of the indicator lamp LP1, combination of the Line and Microphone input sockets. fitting of a push-button for battery checking (see below), addition of a coil between R18 and S1j as part of the suppressor circuit, and alteration of the remote control socket to take a 3mm. jack plug. Component changes are: C17, 1800pF; R39, 68K.

LOWER SCALE

The 'test batteries' button comes into play when the motor switch is at play and the tape switch horizontal to show the state of the motor supply; with the switch at record, the lower scale of the VU-meter shows the state of the amplifier batteries. When the pointer crosses from the white section to the red, batteries need changing. In each case, the complete cassette should be replaced. To avoid false readings, keep the volume control at minimum for battery tests.

The circuit has several features that will interest us, most easily described by running through the series of audio frequency tests to the amplifier, which is common to both Play and Record. The input is at 1 Kc/s, and before testing, again to avoid false and misleading results, the oscillator section should be rendered inoperative. This can be done by opening the R29, R30 junction, the emitter return of the oscillator pair Tr8, Tr9. (It should be explained that these two components are placed in series or parallel, i.e., made roughly adjustable as indicated on the diagram, to give some control of bias current.)

The preamplifier stage, Tr1, can be tested with a 1 Kc/s input from a 22-ohm source to the input socket, with volume control fully clockwise, and measuring the output at the junction of C3, C7 with an AC millivoltmeter. For 0.001V in, we should expect 0.012V out. With the input to the input/output socket, stage gain should be up by about 6dB. This test is made with the machine switched to record, but for play the input should be between the switch side of C1 and chassis, for the same performance.

In the original circuit, RV1 was arranged to switch in Tr2 when fully anti-clockwise, so that the impedance of Tr2, now the collector load for Tr1 with regard to AC conditions, varied inversely with the amplitude of the signal, thus giving a measure of automatic volume control. This is not a very sophisticated method, and restricts the dynamic range of the machine, which critics very soon pointed out. No doubt this was one reason the circuit was dropped. AVC is all very fine for the 'dictating machine' type of equipment, where speech is the most usual signal and intelligibility the prime aim, but the 202A is a bit more ambitious in its specification. Again, as previously discussed in this series, AVC has particular problems at audio frequencies if the dynamic range is to be maintained, and other makers who feature 'Automatics' have fairly elaborate circuits. (*An article is being prepared on the subject of AGC*—Ed.)

Tr3 and Tr4 form an equalising stage. They are directly coupled with R16 switched in during record as feedback resistor, keeping the response reasonably flat over the frequency range. With the input at the 'in' socket as before, but reduced to 200mV, a reading of 0.25V should be expected at Tr4 collector. A capacitor should be employed to block DC from the meter. To check the frequency response over the whole range, it is only necessary to make spot checks, and the following figures should be obtained. At 50 c/s and at 8 Kc/s, 1dB down; at 12 Kc/s, 3dB down, relative to 0dB at 1 Kc/s. Again, these measurements are at record, and the only difference for play is that an input of 500mV across a 47-ohm resistor inserted in the play head lead (disconnect at S1f) should give the same results.

For frequency response during playback, a slightly different method of checking is desirable, altering the input to obtain the same output, to prevent limiting and false readings. Then we would expect an increase in gain at low frequencies due to the combination of RV2 and C13, and RV2 is usually at about a quarter of full value for best results. Readings would be: 50 c/s, —18dB; 100 c/s, —15dB; 200 c/s, —10dB; 400 c/s, —6dB; 500 c/s, —4dB; 1 Kc/s, 0dB; 2 Kc/s, +2dB; 4 Kc/s, +3dB; 6 Kc/s, +4dB; 8 Kc/s, +6dB; 10 Kc/s, +9dB; and 12 Kc/s, +11dB.

SERIES RESISTOR

Current drive to the next stage is limited by the series resistor RV3. Also in the coupling section is a network including the series combination C16, L1, which resonates at 11-12 Kc/s, thus forming a low impedance path which increases the drive to Tr5 at the resonant frequency. C15 is also switched in when S6 closes, in the 3¾ i/s position. The resonant frequency of the network is approximately 8 Kc/s under these conditions, giving boost at this frequency.

Tr5 is directly coupled to Tr7, the two forming a driver stage. In the emitter circuit of Tr7 are both the play and record transformers, the circuit being selected by S1m. During record, the signal is developed across T3A and B, supplying head current via RV5 the erase head and oscillator transformer combination, S1f and S1e. Head current is measured across a 47-ohm resistor inserted in the head lead (conveniently between the head and S1e). Using an AC millivoltmeter, a reading of 240mA maximum should be expected, and at this value, the meter should deflect to the left-hand edge of the red scale. RV4 can be adjusted to set the meter.

During play, so long as there is no plug in the output socket, SK5, the play transformer T2A is energised and this winding is coupled to T2B and T2C, although it is not convenient to show this diagrammatically. T2 feeds the single-ended Class-B amplifier pair, Tr6 and Tr10. To check the complete amplifier, the output across the loudspeaker should be measured, for a given input, and here a little fiddle is necessary, for the arrangement is such that this cannot be done without a bit of dismantling; but it *is* possible simply by partly inserting the jack in the in/out socket SK2, with the AC meter connected to the jack. An input of 0.003V should produce a 1.9V reading across the speaker. Alternatively, use a 20-ohm resistor, and measure the voltage developed across this. For an entirely accurate measurement, the waveform should be checked to ensure there is no limiting at maximum output. But it is possible to get a good idea by listening carefully for the onset of distortion of a 'mid-range tone' and turn back a little until the ear is unable to detect any harshness. My colleagues Messrs. Tutchings and Plumtree may frown upon such empirical methods, but needs must when an impatient owner drives . . .

STRAIGHTFORWARD ARRANGEMENT

Reference has already been made to the oscillator, and a glance at the circuit shows that it is a fairly straightforward arrangement, a push-pull circuit built around Tr8 and Tr9. The oscillator frequency is between 55 and 63 Kc/s, the erase head voltage is 36V AC, and the bias to the record head, adjusted by juggling with R29 and R30, should be between 28 and 32V.

Finally, the power packs, of which two standard types are available. The DC pack suitable for coupling the Fi-Cord 202 or 202A to a 12V source, such as a car battery, was shown in the November 1964 article, but the AC pack, which has been the subject of some enquiries, is shown here, and a few words about it may help. A fully isolated transformer is used, with two separate, centre-tapped secondary windings. The amplifier supply section has a 12-0-12V supply,

(*continued on page 202*)

A TIME - SWITCH FOR THE WEARITE DECK

W. BOURKE DESCRIBES AN INGENIOUS ACCESSORY

OWNERS of *Ferrograph* tape equipment may have experienced difficulty in attempting to use a time-switch, due to the considerable torque required to operate the deck, and to the fact that the rectifier valve needs to produce HT before the deck solenoid holds in position. **Fig. 1** shows a relatively simple mechanical device which the writer has used with complete success for more than three years. No doubt readers will be able to improve on its rather rudimentary character—by employing a micro-switch for the motor, for instance.

The bracket holding the motor switch and outer cable stop is cut from wood, to fit snugly to the rounded corner of the Wearite deck. It is held to the deck by a wood screw and a support bracket to a table, or similar fixture. The nylon or Terylene heavy gauge thread is tied on to a 1¼in. Terry clip and the other end passed through the cable bracket and casing, finally being tied on to the motor spindle. A piece of extension tubing is pushed over this after allowing sufficient take-up slack in the nylon thread, to allow the valves to heat up before the start button engages. As will be seen, the motor, when switched on by the time-switch, draws the Terry clip and start button forward. After the button locks into position, the Terry clip slips round the extension tube hitting the striker plate on the motor switch and knocking it to the off position.

Almost any type of motor that can drive a reduction gear to give a final speed of 5-10 r.p.m. should suffice. For example, a $\frac{1}{10}$ h.p. motor of 500 r.p.m. used with a 100:1 reduction gear to give 5 r.p.m. should provide ample operating torque.

Any available slow speed motor is worth trying, as the work required of it can easily be reduced by attaching a weight on to the nylon thread just below the table. The main point, apart from the torque required, is the fact that a time of about 90 seconds is necessary between the closing of the time switch contact and the moment when the striker plate, hitting the pear switch, stops the slow speed motor. This period of time depends on two things: (1) The r.p.m. speed of the motor, and (2) the length of the nylon take-up loop. It will be seen that with the latter we have a means, within limits, of adjusting the time lapse to that required, by lengthening or shortening the nylon take-up loop. A good quality nylon or Terylene should be used, and in practice a gauge will be found which will take the normal operating strain but will break should the pear switch not operate, and the take-up motor be left running.

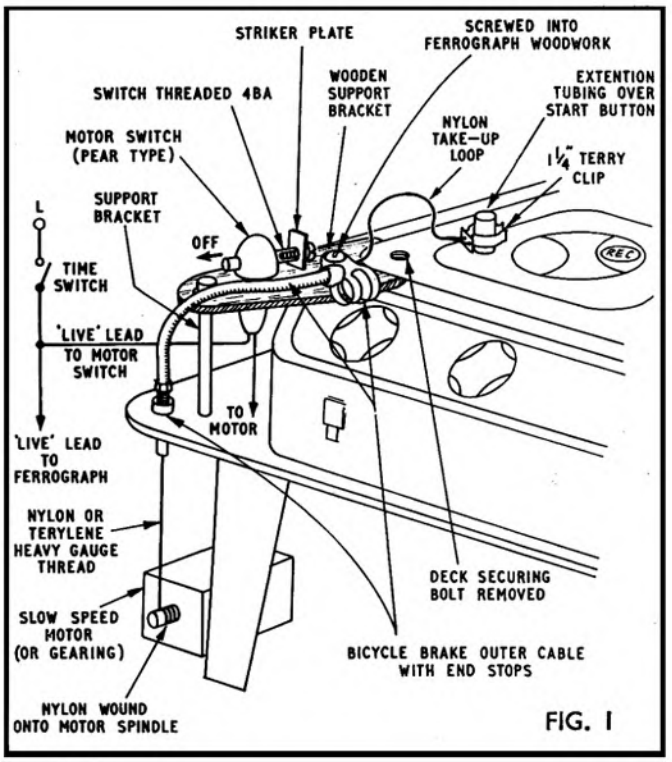
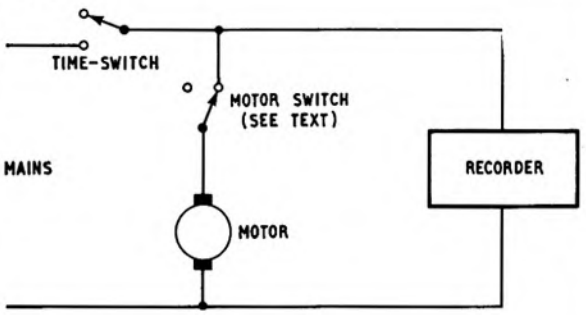


FIG. 1

FIG. 2



book reviews

CIRCUITS FOR AUDIO AND TAPE RECORDING. Compiled by F. C. Judd. 78 pages, 94 illustrations. Price 7s. 6d. Published by *Haymarket Press Ltd.*, 9 Harrow Road, London, W.2.

THE idea behind this book was excellent: to bring together in a single, inexpensive—if rather flimsy—volume a wide range of circuits both for the keen newcomer to tape recording and electronics and for the experimenter, at the same time reprinting a selection of such circuits which have previously appeared in a magazine and which are now out of print.

However, there are too many inaccuracies, both in the printing of the circuits and texts and sometimes errors in the designs, to make the book ideal for the beginner; many of the circuits are too basic, or somewhat dated, to interest anyone who would spot the mistakes first time and who would prefer anyway to build from better circuits (or design his own).

One example is the transistorised tape record amplifier circuit: as printed it could hardly work satisfactorily as the bias cannot flow through the head. The pre-emphasis is a function of the gain control setting, and I feel doubtful whether any crystal microphone could drive that circuit to full modulation as implied. No voltages, and insufficient component values to build the amplifier, are given, and the circuit can hardly be regarded as a *typical* recording circuit as stated. Nowhere in the book is a proper peak-reading meter design given, and the so-called VU-meter is not in fact one.

Another example, the circuit for a 'general purpose transistor power amplifier' is rather crude by modern standards, and obviously misdrawn for two reasons: firstly, C9 and C8 will short out all AF signals in the amplifier output stage! and secondly the 'overall' feedback—with some extraordinary claims for its effects—is virtually zero at AF, being provided only by a very small capacitor.

A potentially interesting circuit was one for a microphone preamp combined with a volume compressor. This looks like being a *limiter* in practice, and the attack time, distortion and control signal thump would make it unsuitable for serious use.

Even *Mullard* circuits have not emerged unblemished, which is a pity as they are among the best. There are too many printing errors, which give the impression that the book was never proof-read at all—even the compiler's initials at the foreword have been muddled. A chunk of text has become transposed from at least one circuit to another (between the microphone matching units, several pages apart) giving a misleading or confusing impression of the circuits. And why oh why were circuits reproduced that were misdrawn when they were originally published, some with original errata notes and with *additional* reference to the same sad mistakes? This is just messy.

Other small quibbles are the use of mΩ for MΩ, the use of old

(*continued overleaf*)

photographs and illustrations, advocacy of multipoint earthing, and the reference to *notes* of A and C *major* when no other notes (or chords) are concerned. I found many more faults for which there is not room here. Readers will gather that I am not enthusiastic about this book. One would have hoped for better material from Mr. Judd.

J.H.F.

SIX PLAYS FOR RADIO. By Giles Cooper. **NEW RADIO DRAMA,** plays by Colin Finbow, Ian Rodger, Rhys Adrian, Stephen Grenfell, Joe Orton and Simon Raven. Price 15s. each. Both published by *British Broadcasting Corporation*, 35 Marylebone High Street, London, W.1.

FOR the amateur recordist, as distinct from the literary critic, the main interest of these volumes must be as a study in the techniques of sound drama. Here we have established masters of radio writing, such as Giles Cooper and Stephen Grenfell, together with others less well known, giving, as it were, the circuit diagram of conceptions designed to be heard and not seen. Readers of *Tape Recorder* will not need to be persuaded that sound has a peculiar ability to stimulate the imagination by forcing the listener to create his own images. For my part, I find it possible to become almost excessively involved in a radio play, if it be well-done: a thing which is much less easy when watching a television play or theatrical production.

It is this quality of sound which the recordist will seek to capture: it is failure to seek what the recorder alone can do which leads to the abandonment of the hobby by so many. Just as a painter will explore visual possibilities in his mind, and learn much from doing so even though he touch not a brush, so a recordist could well read through these plays, and work out in his mind how he would set about recording them. Take an example:

> "Fade the moan of the record. Bring up night creatures and the snarl of the tiger in the distance and fade. Fade in the gong. It comes up full and dies away."

I can visualise a tape club devoting an evening to doing that, or perhaps:

> "Fade in the outdoor sounds of a rest billet behind the lines. A bird sings nearby. Soldiers being drilled in the distance. A bugler sounds the 'Letters' call—'Letters from lousy Lily . . . letters from lousy Lou'."

Even without twiddling a knob, one could profit from quiet thought or discussion on the problems of making those effects and putting them together.

All but one of Giles Cooper's plays were first broadcast in the Third Programme; but most of those in the other volume were Home Service productions and are free from those qualities of obscurity and strangeness which for many people mar Third Programme drama—generally, let it be said, because they will not use their minds and imagination.

All these plays are, of course, copyright, and may not be performed without prior permission—the necessary sources being given in each case. What would be the situation should a group of amateur recordists wish to make use of excerpts only from the plays? Presumably that would constitute "fair dealing for the purpose of research or private study"; but it would require little effort, and be to say the least an act of courtesy, to seek the permission of the author before making use of his work. I cannot think that consent would be withheld.

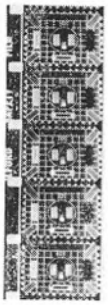
P.D.T.

conventionally rectified and filtered, with a 14V indicator lamp across one section, lighting up as soon as AC is connected. The zener diode D1 controls the base bias of Tr1. Its action is that it forms a high resistance at voltages lower than its rating (8.2V) and a low resistance at voltages above this limit. The internal resistance of Tr1 depends on the base current and so the supply is regulated electronically at about 8.2V. This is necessary with the type of amplifier circuit employed, with Class-B output and a push-pull oscillator, giving fairly wide variations in current drawn.

The motor supply section is less complicated, depending only on the voltage-dependent resistor VDR1 to keep the supply voltage constant with variations in motor loading.

The author is indebted to S. B. Duer, Joint Managing Director of Fi-Cord International, for permission to publish the foregoing notes, and for the information which assisted in their preparation.

OUR READERS WRITE . . .



. . . about video recording

From: H. Walker, 'Eldersfield,' Whitchurch, Ross-on-Wye, Herefordshire.

DEAR SIR, Thank you for your April Editorial.

Dare I suggest that there is no need for the enthusiast with "a few hundred pounds" to wait for video recording of TV. Here is a sample of what has been done a number of times and by different people over the past 15 years. The system has the advantage in that for colour you simply use a colour signal on a colour TV set plus colour film.

You can get results on 8mm. film but the increase in frame speed (16 to 25 f/s) is not always a success.

Surely the biggest hindrance to recording TV in the home is the law dealing with copyright and performing rights. This is particularly so in the U.K. *Yours faithfully*

(Since Mr. Walker submitted his letter, the Mechanical Copyright Protection Society have announced a special licence for domestic recording of television broadcasts. The cost is £5 per annum—**Ed.**)

. . . about a chloroform switch-cleaner

From: M. H. O. Hoddinott, 19 Dicksons Drive, Chester.

DEAR SIR, In the April issue of *Tape Recorder* you published a letter from a reader troubled with a noisy amplifier control. May I put forward my own brand of switch cleaner which I have found to be just as efficient as proprietary brands—and a fraction of the cost. Buy a couple of fluid ounces of chloroform from a chemist and allow to dissolve in it a blob of vaseline about the size of two match heads. This will probably take overnight. This solution, if carefully injected on to spindles, carbon tracks, and switch contacts, whilst operating them, is very effective in both cleaning and lubricating.

As chloroform is a very powerful solvent for a wide range of plastics it must not be allowed to touch any part made of this material.

Yours faithfully

. . . about a competent dealer

From: J. M. Hassett, Strawberry Hill, Cork, Ireland.

DEAR SIR, How I enjoyed the recent letters in *Our Readers Write* regarding bad service and faults discovered in brand new and 'tested' machines ; they do not say for what the machines were tested! I too have suffered and can be amused at the other fellow's discomfort. However, I would like to recount a recent experience.

As a result of a careful search of reviews in *Tape Recorder* I bought a portable which was very highly recommended. I had never actually seen this machine but duly posted off my cheque when the dealer told me (by letter) he would of course give service if anything went wrong. He was about 300 miles away from here.

When I finally got the machine from the Customs' clutches—it was very beautifully packed—it was to discover that it would play back only very faintly. Though sorely disappointed, at 11 p.m. I called on a local ham to have a look. In ten minutes he had looked at the circuit supplied, said "It should be somewhere round here", found the loose end of a transistor, dabbed it with a hot iron and it played perfectly. Ah! But then I began to hear a squeak in the motor and the wow on any new material recorded.

Rather than tinker too far, and on my friend's advice, I wrote to the dealer and asked what I should do to cure the squeak. Result—one new motor *by return of post* with detailed instructions for fitting—I had told him I had a friend qualified to carry out instructions. The original motor had apparently been damaged in transit. When fitted and adjusted we got perfect results.

Since then the dealer has written and asked how things were going. He has answered innumerable questions re matching, inputs, outputs, leads, DIN plugs and what not—always cheerfully and almost always by return of post. When complimented on his service he said he did not think it was anything more than should be given.

The only thing wrong with your complaint letters was that the "bad service" and impertinent dealers could not be named. In *Variations on an Oxide Theme* (March issue) Peter Turner said : "The more I see of it the more I think that there is no jewel like a good dealer".

Why hide his light—the machine was a *Q-Cord* and the dealer was Colin Braddock of *The Tape Recorder Centre*, 266 Waterloo Road, Blackpool. May his leads never cross! Thank you, Mr. Braddock.

Yours faithfully

. . . about head alignment

From: A. Tutchings, Tutchings Electronics Ltd., 14 Rook Hill Road, Friars Cliff, Christchurch, Hampshire.

DEAR SIR, In the April Readers' Letters section Mr. A. L. Oliver makes a plea for a simple method of aligning playback heads so that tapes may be interchanged without loss of quality. He does not mention the equally annoying effects of vertical misalignment of the erase, record and playback heads which can give rise to background noise from old recordings which are imperfectly erased.

We recently produced a very cheap kit (5s.) which was designed for tape correspondents who are plagued by these very common troubles.

Complete erasing across the full width of the tape is one way of ensuring that no earlier recordings interfere with a newly-recorded tape, no matter on which machine it is played. The kit provides two pieces of magnetic rubber so that a tape may be 'bulk erased' by fast spooling over one or more pieces of the material.

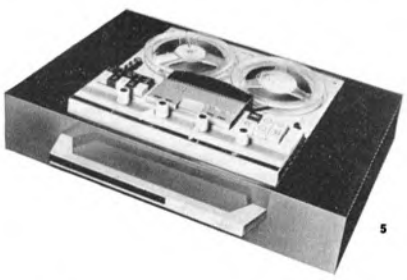
Azimuth alignment is accomplished by a slightly more elegant version of the method described by Mr. Oliver of using a pre-recorded tape which is assumed to be recorded to correct azimuth. We provide 40ft. of full-track white-noise tape recorded to exact azimuth which contains all frequencies simultaneously and is a great improvement on a normal speech and music recording where the high frequency noise provides a constant reference so that the operation can be performed by ear using no test gear whatsoever.

For the expert and service dealer, we can provide a full-track white-noise test-tape with Track 3 erased to a width of 45 mil for aligning a ¼-track head in azimuth *and* height. But the kit does it the easy way!

Yours faithfully

THE CZECH APPROACH TO TAPE RECORDING

THE CZECH APPROACH TO TAPE RECORDING



A SURVEY BY
OTTO MUSIL

Sonet B3: White draw-bars with black square locks are visible on either side of the deck 1

B42: Four-track recorder operating at 3¾ i/s 2

B41: A two-track machine of simple attendance 3

Blues: Rather larger than the **Start**, but capable of better reproduction 4

B43: A stereo machine with side-facing internal loudspeakers 5

Start: can be easily put in a brief-case 6

Uran: Diameter of wound tape is indicated on scales under both reels 7

Sonet: A robust recorder of similar appearance to the **Sonet Duo** 8

B4: The three-speed founder of a new series 9

THE widely branched electronics industry in Czechoslovakia established its good tradition before the war. Nowadays it manufactures nearly all kinds of electronic consumer goods and an ample assortment of components that are necessary for the manufacture of wireless and television receivers, audio amplifiers, record-players, tape recorders and similar products. All the enterprises of the trust were united 20 years ago under the *Tesla* trade mark (after an outstanding Yugoslav electro-technician, Nicola Tesla), and they have been state-owned since.

While the production of radio-technical goods, namely receivers of all sorts, is mainly for the home market. record-players and a growing number of tape recorders have become current items of sale in both Western Europe and America. Although the number of tape recorders offered is not high, all variants are represented, from the cheapest portables up to a luxurious stereophonic unit.

A small battery recorder, *Start*, is capable of instant operation in any location. The machine has one speed, and rewind together with instant stop are the only facilities of this cheap machine. A tilting permanent magnet, which serves as an erase head, necessitates use of

(*continued overleaf*)

A SURVEY BY OTTO MUSIL

TABLE SHOWING TECHNICAL DATA OF CZECHOSLOVAK TAPE RECORDERS ▼

	Model	Dimensions (in.)	Weight (lb.)	Power Supply	Consumption	Tape Speed (i/s)	Spool Capacity (in.)	Tracks	Recording	Playback	Frequency Range (c/s)	Output Power	Signal-to-Noise Ratio	Wow and Flutter	Tone Control/ Monitoring	Programme Indicator	Level Indicator	Loudspeaker size (in.)
Sonet B3: White draw-bars with black square locks are visible on either side of the deck 1	Start	9½ x 6½ x 4	6½	9V (six monocells) 12V (car battery) 120 or 220V (mains)	170-200mA	1⅞	3	2	mono	mono	150-6,000	200mW	32dB	1%	no/no	—	—	2½
B42: Four-track recorder operating at 3¾ i/s 2	Blues	9½ x 9 x 4½	7½	9V (six monocells) 12V (car battery) 120 or 220V (mains)	170-200mA	1⅞	3	2	mono	mono	100-6,000	250mW	33dB	1%	no/no	—	—	3 x 5
B41: A two-track machine of simple attendance 3	Uran	10½ x 8½ x 4	7½	9V (six monocells) 12V (car battery) 120 or 220V (mains)	2.5W	1⅞, 3¾	4 (5 with lid off)	2	mono	mono	50-5,000 50-13,000	700mW	40dB	0.5% 0.4%	yes/yes	wound-tape diameter type	meter	3 x 5
Blues: Rather larger than the **Start,** but capable of better reproduction 4	Sonet	13¾ x 7½ x 11½	26½	110, 120, 150, 200, 220, 240V	45W	3¾	5	2	mono	mono	50-10,000	1.5W	35dB	0.4%	yes/no	—	exclamation mark	4½ x 6
B43: A stereo machine with side-facing internal loudspeakers 5	Sonet Duo	13¾ x 7½ x 11½	27½	110, 120, 150, 200, 220, 240V	50W	1⅞, 3¾	5	2	mono	mono	70-6,000 50-12,000	1.5W	35dB	0.6% 0.4%	yes/no	3 digit	exclamation mark	4½ x 6
Start: can be easily put in a brief-case 6	Sonet B3	14 x 7½ x 11½	25	110, 120, 150, 200, 220, 240V	60W	1⅞, 3¾	7	4	mono	mono (stereo amplifier available)	50-7,000 50-14,000	2.5W	35dB	0.5% 0.3%	yes/yes	4 digit	magic-eye	4½ x 6
Uran: Diameter of wound tape is indicated on scales under both reels 7	B4	12½ x 11½ x 4½	15½	120, 220V	30W	⅞, 1⅞, 3¾	7	4	mono	mono (stereo amplifier available)	100-4,000 60-8,000 50-16,000	4.5W	40dB	0.5% 0.3% 0.2%	yes/yes	4 digit	illuminated meter	3 x 5
Sonet: A robust recorder of similar appearance to the **Sonet Duo** 8	B41	12½ x 11½ x 4½	14	120, 220V	25W	3¾	7	2	mono	mono	50-14,000	3W	40dB	0.3%	yes/no	—	illuminated meter	3 x 5
B4: The three-speed founder of a new series 9	B42	12½ x 11½ x 4½	14½	120, 220V	25W	3¾	7	4	mono	mono (stereo amplifier available)	50-15,000	3W	40dB	0.3%	yes/no	—	illuminated meter	3 x 5
	B43	22½ x 15½ x 6	20	120, 220V	37W	⅞, 1⅞, 3¾	7	4	stereo	stereo	100-4,000 60-8,000 50-16,000	2 x 4.5W	40dB	0.5% 0.3% 0.2%	yes/yes	4 digit	illuminated meter	two 4½ x 6

THE CZECH APPROACH TO TAPE RECORDING

CONTINUED

pre-erased tapes for recording, though it is not essential. Another condition for obtaining louder and undistorted sound is connection of a larger loudspeaker into the appropriate socket to replace the built-in miniature type which can be employed at most for monitoring.

This shortcoming has been avoided by mounting a wide-band elliptical loudspeaker into a similar tape recorder called *Blues*. A high-quality dynamic microphone attached to this machine gives superior speech recording than is possible with less expensive portables. In addition to six monocells, the tape recorder can be supplied from a 12V car battery (a resistor for reducing the supply voltage to 9V is installed) or from the mains with the aid of an adaptor built in a separate casing of bakelite. Two types of mains adaptors are supplied —for either 220 or 120V 50 c/s mains.

It is not difficult to see that the above described tape recorders in no case can be compared with standard machines operating at higher speeds. For that reason, and as a result of customers' requirements for a more perfect portable, the *Uran* tape recorder has been designed. Two speeds, 4in. spools (or even 5in. if you do not mind the lid being removed), modulation level indicator showing supply voltage value during playback effective tone control—all guarantee that with this equipment anywhere in the open recordings can be made that will hardly be recognized from those produced at home with a good mains machine.

Readiness to operate under various circumstances is ensured not only by a simple push-button control but also in the way the flywheel axis is reliably mounted between two ball bearings ; thus the recorder can be run in any position without perceptible speed variation. To supply the device, either six dry cells are inserted or a mains unit is employed, this taking the form of a handsome supply box which may itself be placed in the battery compartment.

It is obvious that all portables are fully transistorized now. On the other hand, the mains models still use valves, at least on their power stages, though transistors are becoming more predominant even in this field. At present tape recorders of the *Sonet* series, that find favour in many European countries, are all complemented with valves. Endurance is the main advantage of these machines ; it was achieved by introducing sliding lever controls for playback, fast-forward and rewind. The push-button for recording is interlocked to prevent erasing of tape by mistake.

The simplest type *Sonet* operates at $3\frac{3}{4}$ i/s only ; it is a $\frac{1}{2}$-track type which can be supplied with any AC mains voltage between 110 and 250V. A magic-eye functioning as a modulation level indicator seems to be quite sufficient and all usual connection sockets, including a socket for monitoring by headphones, will probably satisfy anyone who does not want more than a recorder for current domestic application.

The derived machine *Sonet Duo* (not illustrated) has the additional $1\frac{7}{8}$ i/s speed, a digital tape counter and push-button switching of individual input connections. In spite of the fact that its appearance is a little old-fashioned when compared with some modern machines, it is still being produced and exported to several Western and Eastern countries. To characterise its mechanical system, let us translate the humorous name which it was given in Germany : "A tape recorder for wood-cutters". Thus was expressed the fact that this unusually reliable design will withstand robust handling under difficult conditions. Its heavy weight may probably cause troubles and also the 5in. maximum reel diameter can be criticised ; however, it is necessary to realize that the *Sonet Duo* was developed back in 1959 and has been sold successfully since.

The well tried mechanical version finally became a basis of another tape recorder which is suitable for larger reels too. This $\frac{1}{4}$-track design is called *Sonet B3*. Although the sliding controls remained unchanged, the electrical circuitry differs considerably. For the first time transistors are used in the input circuits and the newly introduced combined heads allow a greater proportion of the price to be allocated to widening the frequency response. Among other new items, separate volume controls of individual inputs (microphone, radio, pickup) appear, ensuring thus easy mixing of signals from various sources without additional equipment. Total level of signals can be then adjusted by an independent summation control. Moreover, a separate volume control of loudspeaker monitoring, a knob serving also as tone control at playback, proved to be sufficiently useful in practice. To be able to reproduce recordings in stereo, the owner must buy a small three-transistor amplifier which, together with the AF section of a radio set, will amplify the second channel signals. Volume of the signals is regulated on the radio. Performance of the *B3* is excellent when the tape quality corresponds to world standards.

Most Czech tape recordists are convinced that the Tesla *B4* is the best tape recorder ever produced in their homeland. Certainly the number of these machines exported to various parts of the world confirms their opinion. Even at first sight it is clear that both design and look of the new model are absolutely different from all the types so far described.

The new B4 series has been developed in accordance with most modern achievements of sound engineering. It was styled by a prominent Czech designer, the cabinet being made of two shades of grey plastic. All the members of the series are fully transistorized and their electrical as well as mechanical values offer a considerable improvement in comparison with other recorders on the market. From the control viewpoint, the best was done to make operation as easy as possible. For that reason, electromagnetic servo mechanisms have been introduced instead of fully mechanical controls, where pressure of stiff springs must be always overcome by force. Now the operator needs merely to touch a push-button and instantly the tape transport starts. This system is also applied for remote pinch-wheel retraction (pause control) and for automatic stop through metal switch leaders at ends of tapes. Among other values listed in the table for the B4 series, mainly low weights and nearly negligible power consumptions will captivate the potential customer.

But let us return to the original type, B4. Its features are current for all up-to-date devices and already the Sonet B3 is provided with most of them. But there are two items that are worth mentioning. First is the not too usual speed of $\frac{15}{16}$ i/s at which surprisingly long recordings of speech can be produced (e.g., 34 hours with a 7in. reel of double-play tape). Then superimposition, a well known facility to switch off the erasing head, is installed. However, a special circuit in the B4 allows the erase bias to build up slowly so that, for instance, you can start speaking while pre-recorded music slowly (for approx. three seconds) fades away.

The B41 and *B42* tape recorders are much simpler models built in the same cabinet as the B4 and also based on its structure. The designer's intention in this case is obvious : one speed, omission of some controls as well as of tape counter, and simplified electrical section—this, together with high quantities in which these machines are produced, leads to their low purchase prices. And really, the two-track *B41* is the cheapest mains recorder though its quality is still acceptable.

On the other hand, a compact luxurious unit, like the *B43* tape recorder, is relatively expensive and there is a good reason for this. Being mechanically equal to B4, it has twice as much electrical equipment, so that both stereo recording and playback can be carried out without any further equipment. Of course, it is assumed that the B43 will be completed with two suitable loudspeakers as the built-in elliptical speakers could hardly be sufficient for perfect stereo performance. The increased number of push-buttons on the deck reveals that new functions have been added to the original design. There are so many of them (parallel replay of various tracks, duoplay, multiplay) that it really would be a mistake for a beginner to buy this model and remain uncertain of its full potential.

Finally, it should be said that this article is by no means an advertisement, being written purely as a result of the author's daily experience.

WHICH?

ON TAPE RECORDERS

A POSTAL INTERVIEW, WITH COMMENTS

BY GRAHAM BALMAIN

IN the January issue, the Editor praised *Which?* for "the most comprehensive, honest, accurate and down-to-earth survey of domestic tape recorders that we have ever seen". I second that wholeheartedly, even more since I wrote to *Which?* asking for their help in this 'interview'. The replies I received showed, as I had hoped and expected, that a *Which?* report is like an iceberg—only the top tenth shows.

My questions and their replies are reproduced below, exactly as originally put, with an occasional further comment from me immediately following.

Question : Out of the hundreds of mains-powered machines costing between £25 and £45 available, how did you choose which were to be tested?

Answer : When one comes to add up the brands and models, there are not the hundreds that one might suppose which are (a) mains-operated, (b) priced between £25 and £45, (c) in production at the time our tests began (June 1965) and (d) likely to be still in production at the time of publication (November 1965). Our market research is very thorough and we believe we traced virtually all the recorders which met those four conditions—this produced a list of approximately 40 models. Where one manufacturer made several different models (e.g., *Elizabethan*) we picked the newest ones, and for the rest we picked the brands and models most generally available. There is little point in testing a tape recorder which—whatever its merits—people are not going to be able to buy. You will see that, in one case, we tested the two-track and four-track versions of otherwise identical machines—to see what difference the number of tracks made to their performance. We also gave in the report in *Which?* a list of machines which were basically similar to those we had tested.

Question : Given that you can test only a limited number of machines, would it not be more useful to include as many basically different designs as possible, rather than to duplicate some?

Answer : We think you will agree that there are very few 'basic' designs for tape recorders in the price range. A high proportion of them had one or other of the *BSR* tape decks. We try to include as many variations as possible, but—as we have explained above—we also consider it essential to test what is readily available.

Author's Comment : I do not agree, but I put the question badly. What I meant was overall design of the 'innards', including the electronics ; similar chassis tend to produce similar performance, in my experience.

Question : Do you deliberately buy more than one sample of any or all the machines tested, or only when the first one seems to be faulty?

Answer : We originally bought two samples of each machine, except in the case of *Cossor/Stella* and *HMV/Marconiphone/Ultra*, where we purchased one sample of each brand. If and when either of these two samples of each machine failed in any way, a third sample was bought.

Question : Expense apart, would you consider it desirable to buy several examples of each machine as a matter of course (if you do not already do so) for the sake of some statistical assessment of the results?

Answer : In the radio/tape-recorder/record-player/TV-set field, we do not normally consider it necessary to buy more than two samples of each machine. To be as fair and to get as representative samples as possible, we buy the two samples in different shops and should the samples differ in any way at any stage of testing, further samples are bought. Perhaps ideally one might buy and test ten or even twenty machines of each type, but this could delay the report by as much as a year, increasing the likelihood of the models being out of production by the time the report was ready. This would also cost a disproportionately large sum of money, which could hardly be justified by the small extra amount of information likely to be obtained.

Question : Did you test each recorder with only the reel of tape supplied with it?

Answer : No. We asked each manufacturer what brand of tape he recommended for his machine. We bought reels of 5¾in. LP tape of the relevant recommended brand for each machine and carried out the tests with this.

Question : If not, did you investigate the mechanical or electrical behaviour of the recorders with any other tapes. systematically?

Answer : No, since it seems reasonable to assume that when the manufacturer recommends or supplies a reel of tape with the machine, he will have decided that this is the best tape for the mechanics of his machine and will also optimise the bias settings for this tape.

Author's Comment : I agree up to a point. However, there are one or two 'peculiar' tapes, peculiar in that their bias requirements are unusually higher or lower than most of the domestic tapes on the market. Once a machine has been adjusted in respect of bias and equalisation for such tapes, it sounds markedly different if a more nearly average tape is used on it, and this point is often not made clear by the machine manufacturer. The user has to learn by experience, and he may in the process get a false impression of the relative qualities of various brands of tape. Manufacturers' 'recommendations' to use this or that brand are always open to more than one interpretation, and are rarely likely to have the compelling effect which is sometimes necessary.

Question : How did you define and assess the wear of tape mentioned?

Answer : The wear of tape was assessed by the amount of tape dust which had accumulated on the erase heads, capstan spindles and rubber pinch-wheels of the machines (both samples) at the end of 80 hours playing.

Author's Comment : As some tapes habitually produce more dust than others, whatever machine is used, and as different brands appear to have been used on the different machines, this does not seem to me to be a useful test. The (admittedly mild) conclusion in the published report could therefore apply to the tape as much as to the machine.

Question : The survey reports a range of speed differences on individual machines amounting to about 3%. Did you check the mean speeds to confirm whether or not they came within ±2% of the nominal, the limit suggested in BS1568:1960?

Answer : BS1568 requires that the maximum permissible deviation from the mean speed should be within 2%. The speed was checked at three points on each machine—at the beginning, middle and end of a reel. The results showed that differences between samples were generally as large as differences between brands and the variation showed an error of up to about 3%. There was only one exception where the error was around 6% and, since this was just one of the many BSR decks, we took it to be a faulty sample.

Question : Did you do any other systematic tests covered by or arising from BS1568 of the kind which would ensure the satisfactory playing of tape records or tapes recorded on other machines (e.g., playback frequency response ; the widths, vertical positions and angular alignment of head tracks ; efficiency of guiding, etc.)?

Answer : We checked every aspect of performance that we found mentioned in the average specification. All the parameters you mention were checked, even though detailed reference was not made in the published report. Where some aspect of the performance of most of the machines complies with the standard there is no point in detailing the results in a published review. Only one make of machine was found to have the heads consistently out of alignment in azimuth and this was mentioned in the report. (*continued on page 209*

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Ferguson 3214 ...	11 11 0	2 17 9	44
Grundig TK400	12 6 9	3 1 9	47
Grundig TK23L	12 17 3	3 4 4	49
Tandberg 843 ...	15 9 9	3 17 6	59
Wyndsor Vanguard	15 9 9	3 17 6	59
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Question : Did you test efficiency of erasure?

Answer : Yes. We did this by recording a signal at a frequency of 1 Kc/s for one minute on each machine. When this was replayed a half minute of it was erased. Then this programme of a half-minute signal, followed by a half-minute erased signal, was played through each machine and the signal/noise voltages measured.

Author's Comment : One assumes this was done at the highest speed of which the machine was capable.

Question : Comments in the survey suggest that you think a high rewind speed to be a virtue. However, apart from the braking difficulties you mention on one machine, polyester-based tapes almost always wind badly at very high speeds, which leaves their edges open to subsequent damage in using or handling. Would you not consider a moderate winding speed more desirable?

Answer : We would not advocate that a machine should have such a high rewind speed that it caused damage to tapes. On the other hand—as we said in the report—a machine which takes much more than 3½ minutes to rewind a 5¾in. LP reel is on the slow side. We considered an adequate rewind speed to be between 350 and 480 ft./min. This is not exceptionally fast, especially when one machine rewound at over 1,200 ft./min.

Question : In what positions did you set tone controls for the electrical, acoustic and listening tests?

Answer : The tone controls for the listening tests were preset by the laboratory staff so that the machines gave—in their opinion—the most satisfactory results. For the electrical and acoustic frequency response tests two sets of measurements were taken—one set with the tone controls at maximum and the other with minimum treble cut.

Author's Comment : Surely this should read : ". . . with *maximum* treble cut"?

Question : Regarding distortion, did you check whether magic eyes (or ears) were correctly set to make the best possible use of the tape, or did the reported test apply only to the playback amplifier?

Answer : No, we tested the machines as bought.

Question : You mentioned versatility, but not that it might be traded (at a given price) for robustness and reliability. Would you consider a simple but reliable machine a better buy for a beginner than a more versatile but less robust one?

Answer : Yes. It is clear that you have to pay for versatility, and for many people the money is wasted.

Author's Comment : Hear, hear!

Question : Did any machines fail to meet their makers' specifications in respects other than frequency ranges and distortion, which you cover?

Answer : This is a difficult question to answer since the manufacturers vary the amount of information they give on their printed leaflets. Apart from the claimed frequency response (mentioned in our report) and wow and flutter (generally optimistic), most of the information given is indisputable fact—e.g., types of valves, size of speaker, etc. Actual weights and dimensions, incidentally, rarely seem to match what the manufacturer says—but the discrepancies are rarely serious.

Author's Comment : As I have said before, in this magazine and elsewhere, most tape recorder specifications contain only the barest minimum of useful information, the rest merely confirming that the machine has features essential for making tape recordings, or even for working at all.

Obviously one could have asked many more questions, but I thought those above covered fairly well the less obvious points : those which people either cannot see or do not think of looking for when they choose a tape recorder, but which nevertheless cause as much annoyance when they *are* found later to be wrong as the more obvious ones which the report discussed so well.

However, there is one important point which deserves further discussion : that of electrical safety. *Which?* tested all the recorders to BS415:1957, and commented : ". . . a recorder should normally have an earth connection, and live parts (or potentially live parts) should not be accessible wherever you may happen to poke your finger. The X and Y had exposed metal parts and no earth connections . . . On the X you got a perceptible shock by touching the deck. We consider the Y electrically unsatisfactory and the samples of the X we tested potentially dangerous. All the other recorders had some fault, and, although not dangerous, these faults might well have been avoided."

Personally, I fail to see any good reason for *not* providing means for earthing any mains-powered recorder. The cost of the third wire is hardly likely to give even an accountant heart-failure—and you and I pay for the third pin on the plug, after all. The one valid technical reason is that one may get hum when the recorder is connected to other equipment, but this can be so easily overcome, once the connection has been made, by the use of one of the available multi-way adaptors which allow the plug to be inserted with the earth pin outside the adaptor case. Or, better still, by fitting a screw terminal to the back of the recorder case and connecting the earth wire to that. This single advantage of 2-wire mains leads is far outweighed by lack of safety, not to mention the very small number of times one is likely to be bothered with hum.

The practice of not earthing tape recorders is a pernicious Continental habit which, in my view, should be made illegal here instead of being merely frowned on but nevertheless permitted. Perhaps readers would like to send us their opinions on this matter?

Now a few quotes from the report, with comments where appropriate :

". . . and another (socket) for making direct recordings from a radio or from a record player (officially illegal)". The Germans at least have got over this silly state of affairs quite neatly by including in the purchase price of every recorder a blanket royalty fee which permits the user to record anything from radio or records. Surely this is a sensible and practicable way here to prevent both making recordists feel guilty and the well-known and widespread infringement of the copyright laws?

"No recorder gave much worse results when used with a microphone than when recording direct. This indicated that the microphones were generally adequate."

"As a matter of interest, the general standard of reproduction was lower than with the £24 to £45 record players which we reported on in January 1963."

"Manufacturers' claims about frequency response, incidentally, are rarely met electrically, never acoustically."

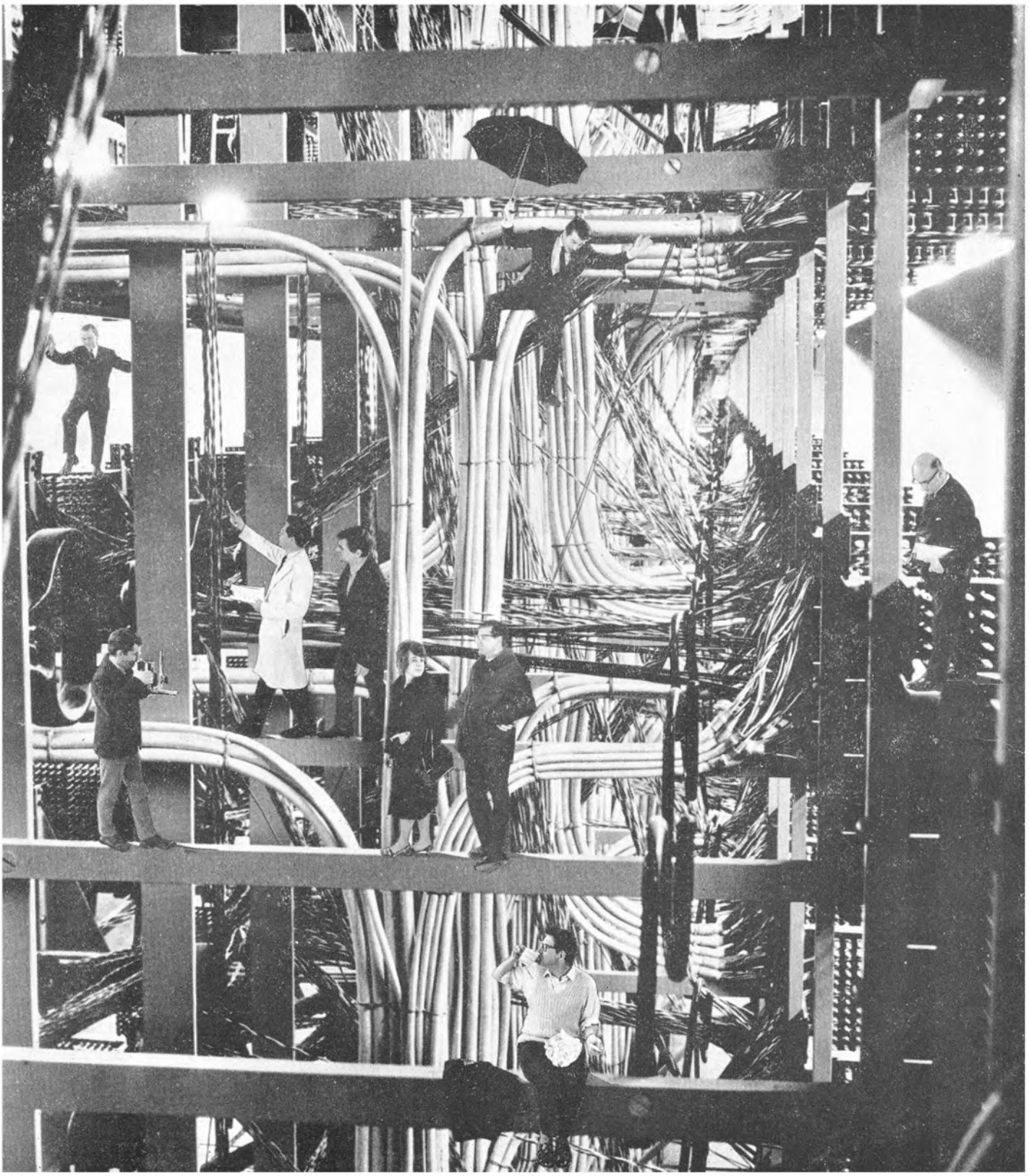
"The performance of most of the remaining recorders fell off steeply below about 100 cycles per second or above about 6,000 cycles per second. The poorest machines, with a performance worse even than this, were . . ."

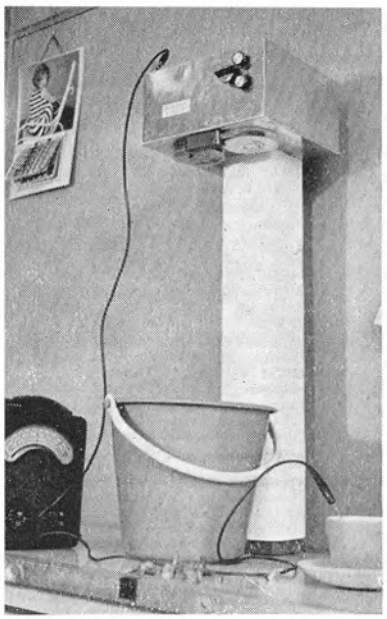
One begins to see here why tape recording is not the popular activity it ought to be—remember the price class here is £25-£45, and the cheapest recorder is *not* one of "the poorest machines". Again : "Recorders which would also play at 7½ i/s generally did better at this speed, but not much better . . . The A and B were the best, performing a little better at this speed than the C at 3¾ i/s".

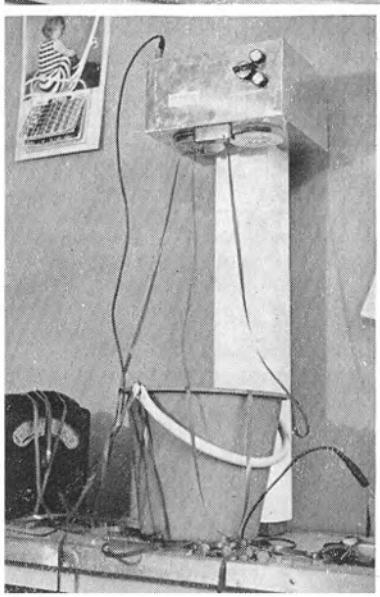
I am continually surprised by the immense variations in the basic design quality shown by recorders in this price class having similar facilities. Playback amplifiers seem to fare worst, although there is no real reason why the sound quality from a good tape record should not approach hi-fi standards if taken from the preamplifier output. As I know from personal experience, it is usually possible to improve reproduction considerably by paying a little attention to the layout of the head input stage, and also by connecting the secondary of the output transformer into the cathode circuit of the output valve, without spending a penny on components and without making the thing unsuitable for mass production. (And, please, let no one object to losing a bit of gain thereby ; whatever else this kind of recorder may be short of, it does not lack gain—there is usually enough to rattle the box to pieces.) In other words, a few more hours spent on the development of middle-class machines would cost the buyer practically nothing but please his neighbours (and possibly him) tremendously. Further, for another 5-10s. spent on the output transformer and HT smoothing, one could get a little bass response and even manage to drive an external loudspeaker fairly respectably.

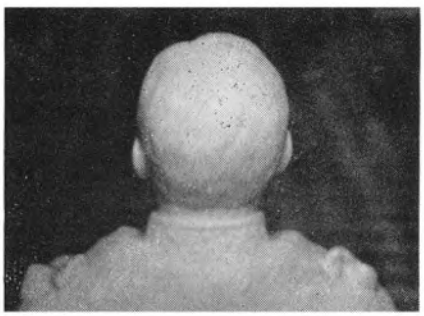
Finally, another word of praise to *Which?* for preserving the anonymity of their test staff. The typescript reply I got from them was marked at the bottom "/iw24.2.66". "iw" is the lady who forwarded the reply and, I suspect, paraphrased it to prevent my identifying the author by his style, otherwise one might have thought it stood for "I wonder". Anyway, thank you Mr. / for being so thorough ; it seems a pity you could not let us know in some way just *how* thorough.

a visit to Grozsound . . .









H. W. HELLYER DESCRIBES HIS RECENT TOUR OF A CONTINENTAL FACTORY

Fig. 1 (above left):
The Grozsound 'Monoped' before playback.

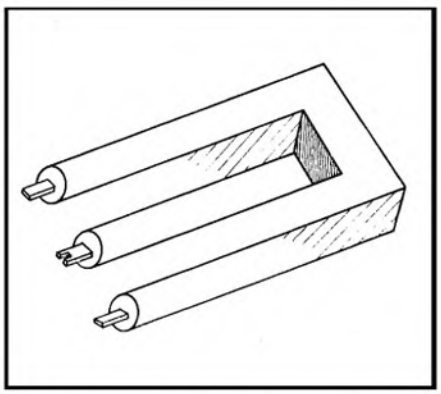
Fig. 2 (immediate left):
The Grozsound 'Monoped' in neutral mode (note resonator).

Fig. 3 (top):
Triple-wound record/play head.

Fig. 4 (above right):
Three-head tickling tool.

Fig. 5 (immediate right):
"Meticulous mishandling".

Fig. 6 (far left):
Fully automated production line.



COME through the op-art gates set among dwarf pines in some of Europe's loveliest country and follow a discreetly gravelled drive to the level of the lakeside; suddenly you are on the site of the factory that prides itself as being "The Home of The Tape Recorder With Class".

First impressions are that one has entered an exclusive clinic. White-coated acolytes flit along sound-proofed corridors and everywhere a pervasive hint of carbon tetrachloride is borne on the air-conditioning. Clinical, too, is the approach of Herr Groz and his colleagues to the business—one feels the word 'art' would be more appropriate—of turning out "Tape Recorders of Class For The Masses", as their recent advertising puts it. "We are investigating all the most modern approaches to the medium," he explained through his interpreter, whose thick Liverpudlian accent was in turn a sign that *Grozsound* are switched on, as I think they say.

We were less interested in the busy factory floor than in the research and development section, where it is hinted that ideas of a revolutionary nature are taking shape. And we were fortunate that the boffin in charge should be none other than that shy genious Mr. Henry Ebbarc, whose impressively rated *Padbie* amplifier was reviewed in the April 1965 *Hi-Fi News*. Mr. Ebbarc, or Nhoj as he is familiarly known to his European friends, is an ardent anti-cassettee, and we looked forward to some evidence of his delving in the spooling and tape-threading field. As our illustrations show, we were well rewarded.

The new Grozsound machine reverts to the 'upright look', with no pretensions about false functionality. The vertical approach has been carried a stage farther and a completely wow-free clutchless machine has been evolved by mounting the spool carriers *below* the amplifiers, with a dual-purpose resonator at a critical distance beneath the main body and beside the slender leg, making a compact and attractive design, as **fig. 1** illustrates. Complete control is effected by a single large gilded knob in the front, amplifier functions being automatic. Two circular controls provide 'on' and 'off' facilities respectively.

Mr. Ebbarc explained the clutchless system to us, while reserving some of the more secret details, in which certain tape manufacturers

(continued on page 213)

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*Grundig TK46 4 Tr. St.	107 gns.
Grundig TK120	29½ gns.
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Philips 3553	36 gns.
Philips 2 Tr. Auto 3552	24 gns.
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Sony 500	105 gns.
Sony 600	127 gns.
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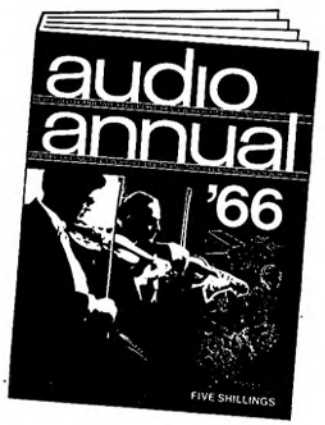

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would surely be most interested. The problem has always been to drive a tape at constant speed, while preserving both take-up torque and back tension at a necessarily varying amount depending on the quantity of tape on each spool. A secondary problem, but one which the brilliant Nhoj mind has coupled with the tape drive factor, has been location of the required spot on the tape, without the wearying business of respooling—and, like Martin York and me, forgetting where the tape position indicator left off!

"The idea was sparked by Rafe Seabrook's complaint that nobody cared about making the perfect tape machine," said Mr. Ebbarc. "We have now done this. Like many another epic discovery, this is essentially simple. The tape is unspooled in what is known as 'controlled laxity' into the receptor beneath the machine, pulled from the free-running reservoir spool by the capstan drive alone. There is thus no back tension, and, what is more important, no varying pull by a clutched take-up spool. A single motor can thus be used with none of the usual defects that exponents of three-motor systems are so ready to enumerate."

When the recording or playback function is neutralised by a simple thumb-press on the cover suspended between the spools, the tape is released from the head channel and is free for take-up (**fig. 2**). The next operation is the key to the startling new concept in tape recorder design. When the pivoted cover is pressed and held at either edge, the motor coils are switched and full power is applied, re-spooling the tape at the phenomenal speed of 3,700 r.p.m. Polystyrene self-lubricating guides, not visible in our picture, lower themselves automatically into the tape path, maintaining even spooling. At this high speed, with a new type of tape position indicator geared to the weight of tape on the spool (and easily adjustable for various brands of tape), an exact position can be determined in less time than it takes to lower the pickup on a gramophone record. Here, at last, is a challenge to the disc's prime advantage, and an answer to the claims of cassette makers that the spools are easily removed and replaced at any point of the recording.

"Ah, but", we said, "what about tape breakage?" What would happen as the slack was finally taken up and the spinning motor continued to exert its pull? Here, Mr. Ebbarc permitted himself a sly grin. The safety device is a patented Groz invention, based on the Krikchap principle. As the tape was recorded, the tape position indicator acted as a measuring device, applying a regulated tension to a spring in a delay charge circuit, which then reverses and discharges through the motor field-backing coil, a special winding, so that a proportionate back-EMF is applied, with a sharp drop near the end of the winding period provided by a backed-off zener diode in a trip circuit. As the back-EMF reaches the 'knee' of the zener voltage, a large current flows, energises a subsidiary coil and opposes the motion. The resulting self-opposition (well-known motor-dynamo principle) brings the motor to a controlled, rapid and exact halt.

A further item on the secret list is a development of the Padbie amplifier, enabling high speed monitoring. The sound is compressed, tripled and decompressed so that it is heard at three times the speed (or a little less, due to the Doppler effect, not yet overcome) *but at the same pitch.* Using the Colin Cherry cocktail party syndrome, as it was described, one could recognise vital portions of the recording, even when played through at speeds which rendered sounds unintelligible *en masse*. But as this would require a further complication of mechanical coupling to the fast wind and read-off system, Mr. Ebbarc explained that only the machines specially made for classified customers would have this modification fitted.

A word about the dual-purpose domestic receptor-resonator bucket is necessary. This device is made of moulded Polyesterethylenyfoam, with a very high reverberant content — not yet fully understood. Even with a simple crystal microphone placed edge-on all motor noise is cancelled and true sound is obtained.

During playback the resonator can be placed on top of the cabinet, lipping under the pressure-packed external loudspeaker. Our botanist friends would doubtless recognise the damping material employed within the cabinet. It was bred from a strain of Haark plant brought back by Herr Groz from a recent visit to South America. The jungle sponge is particularly suited to audio damping, since it flourishes in noisy surroundings and thrives on stray magnetism.

Innovations are nothing strange to the Grozsound organisation, where work is at present going on toward an eventual elimination of bias. "The cross-field system is the first step," we were told, "but *Akai* are tackling this problem from the wrong end." Instead of separating bias and signal fields and doing all manner of strange electromechanical things to keep one from interacting with the other, Grozsound are thinking along the lines of special tapes with ready induced bias, collected by an overwind on the integrated three-head system (**fig. 3**), and used to pre-magnetise the head in direct relation to the signal waveform.* The oscillator is retained for erasure, but even this function is receiving a 'new look', we understand. If the new tape is produced in sufficient quantity to bring the costs below the present figure of 97 pfennig per metre, it may be possible to employ a simple form of self-oscillating magnet to re-energise the bias field.

Adjustments to the new machine have been reduced to the minimum, and **fig. 4** shows the simple three-head 'tickling-tool' developed from practical suggestions received as a result of an appeal to factory staff.

On our tour of such parts of the Grozsound works as were not too highly secret to be viewed, we were struck by the remarkable absence of thronging operatives. "Automation", explained our guide as we entered the assembly hall (**fig. 6**) "down to the last process. Indeed," he added with what was perhaps a touch of exaggeration, "on one occasion a Works Foreman overslept and nobody switched the assembly line on—with the result that an entire day's production was lost . . . and we did not even realise it," he added proudly, "until the empty boxes began coming back from the retailers. That is real automation for you."

However, we were pleased to see that there will be plenty of work for new arrivals as the season swings into gear. An extension of the factory will house fourteen production lines, including seven new machines, from pocket portable to architect-designed living units. Also scheduled are the special soap-proof tranducers for Doctor Tanka's bathtub blood circulator (*Hi-Fi News*, March 1966), integrated transceivers for unscheduled police call reception, and a completely new line in pocket radiograms, which shows the diversity of interest that is the hallmark of the "zizz and boom brigade" (*Financial Times*, 15th April).

With all this activity, it is not surprising that the G-Z Test Department is one of the busiest in the organisation. "We are never satisfied," said Mr. Ebbarc, just before we donned our ear-muffs. Testing to destruction is the fate of every ninth machine, and despite rigorous security precautions our photographer, was fortunate to secure the picture we reproduce as **fig. 5**, showing the sort of meticulous mishandling that went on in one corner of the workshop.

Coming away from the secluded factory, as night fell over the dwarf pines and round-the-clock progress marched forward, we felt ourselves proud to be associated, in however small a way, with the Tape Recorder field, of which Herr Groz, Mr. Ebbarc and their colleagues are so worthy and diligent exemplars.

* **Errata.** We regret that fig. 3 has become mixed in transit. This is actually a rear view of the bust of the founder, mounted in the main hall of the Grozsound factory.

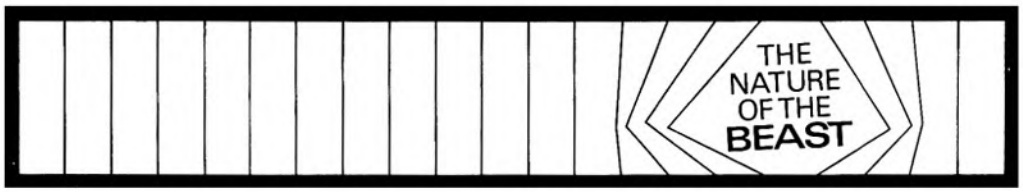
magnetic device called the recording head. Past a gap in this head is drawn a magnetisable tape. By a process which we shall examine next month, the tape becomes magnetised to a degree depending upon the value and direction of the audio-frequency current at each instant as it passes the gap. Thus we produce a magnetic instead of a mechanical recording of the sound.

If we wish, we can wipe out the recording with an 'erase' head. This is similar to the recording head but it carries a fixed-frequency alternating current at above sound frequency. Again for reasons that we shall be examining next month, this destroys the magnetism of the tape.

To play back the recording we draw the tape past a 'replay' head. This is very similar to the recording head, but no audio-frequency voltage is applied to it. Instead, the moving magnetic tape generates audio-frequency currents which, through an amplifier, drive the loudspeaker. Thus we can use the same machine for both recording and reproduction.

Most modern tape recorders have only two heads: record/reproduce and erase—they use the same amplifier for both recording and reproducing. It is simply a matter of having a single control which operates a multicontact switch that makes suitable changes in the connections.

Fig. 2 is a very much simplified schematic diagram of a tape recorder in its record and reproduce modes, showing the differences in signal current paths.



DURING the twelve years or so of my active interest in recording, quite a number of machines have passed through my hands, either from ownership or from use. I have reached the conclusion that the principal enemy recordists have to face is what is known as the *stylist*. So far as I can gather, the idea is that when a machine has been designed to meet a given specification, it is then handed over to some fellow who decides what it shall look like ; and the principal criterion by which he decides is whether or not it has the kind of appearance which he thinks is likely to make it sell.

Now, heaven knows that this approach is not confined to tape-recorders : it is the way in which most 'consumer durables' are presented ; and since the standard used for judgment is ephemeral, depending upon what the blessed word 'contemporary' happens to mean that week, the goods so presented are ephemeral, despite being called 'durables'. That, of course, is part of the game : to make things so that they rapidly look old-fashioned, and thus to stimulate the desire for another, 'contemporary' article which, in terms of what it does, may have no advantage over the oldie-of-eighteen-months and may even not work so well.

In the recording and hi-fi worlds there are, praise be, a few firms who will not adopt this method ; but in the majority of cases one has only to lay hands on a machine and try to record with it to become aware of the fact that the way in which it has been made is not primarily related to what it is intended to do. The myth behind this philosophy — if such it deserves to be called—is that there is something called 'beauty' or 'style' which is added on to things afterwards, by people called 'artists' or 'stylists'. Because beauty and function are regarded as different things, they are separable ; and because what attracts people to buy is the external appearance, or 'beauty' of the thing, should there be a clash between function and style, style wins. Style, it seems, hits the cash-register : thus style is supreme. Therefore the prototype of many a good recorder has been handed over to the stylists, transformed, and issued as something which looks, and is, quite other than that which it was intended it should be.

Art, as a matter of fact, is nothing more (and nothing less) than the making of things ; and things should be made for a purpose, be that purpose the storage of sound on magnetic tape or the organisation of experience into a picture, a poem or a sonata. People who make things differ in the things they make rather than in the personalities they are : as the philosopher Coomaraswami once said : The artist is not a special kind of man : every man is a special kind of artist. In other words : make a thing to work perfectly, and it will look right. Beauty, as Eric Gill used to say, looks after herself. If you doubt this, think of anything which works perfectly, and say if it be not beautiful ; or think of anything which is truly beautiful, and see if it does not do perfectly what it was intended to do.

This is an article about tape-recorders, not about aesthetics ; but the aesthetics are relevant, for recorders are bedevilled by nothing so much as their failure to work ; and the reason why they fail to work is because they are designed to sell on appearance, not to record sound. This becomes apparent at once if one touches a professional machine : the stylistic heresy is not without its effects even here ; but I defy anybody to say that a professional machine does not work better than the amateur machine, and that the reason is not that function has been allowed more of its proper place.

The other enemy, of course, is price : the professional machine costs a whole lot of money—but then it is expected to work all day and every day, not only from time to time, like the general-purpose machine. It is also a great deal bigger and heavier, which would not do for the g.p. machine. Recorders for the amateur should be designed to function for the amateur : to do the things he needs. Therefore they have to be reasonably light and portable, but strong enough to withstand being carried around—possibly being carried in the rain from a car or bus in and out of halls and churches. Function, therefore, should dictate the kind of box the machine is put into : function, not how it looks in the shop window or even in the smart lounge. That is not to say that it should be put into a steel-bound box of heavy deal ; but it does say that the box should be robust, able to stand a few knocks without getting shabby in ten minutes, and be washable.

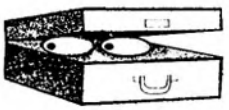
One of the things that make one feel that recorders are designed by people who have never used one is the type of hinge often used for lids : we have reached the stage where all lids lift completely off, but how many can actually be taken off if the recorder happens to be placed, as it commonly is, close to a wall ? One has then to heave the thing off the shelf, remove the lid, and heave the recorder back on to the shelf. Hinges should allow for removal without all that fuss.

Recorders tend to be heavy, for various good reasons. The boxes they come in should therefore facilitate handling, and be provided with a second finger-grip as well as the carrying-handle : a great help when heaving the thing about, but not fitted to any machine I know except one of the early Reflectographs. The mains lead should be detachable : I detest plugs crashing about inside pockets in the case, and having to stuff coils of lead into inadequate spaces. Further, I like to leave a mains lead permanently plumbed into my recorder-shelf at home, and include another in my sack of leads and plugs for location work. The plug should be keyed so that it will only push in in one way; but the amount of current taken by a recorder is small, and the plug need not be vast, as some are.

Even the recorder case, as I see it, needs to be designed to *function*, not to be looked at ; and one of its functions is to admit cooling air to innards which generate quite a bit of heat. I have known of recorders which were subject to various kinds of malfunction, such as flutter, merely because they became too hot. Cooling air can only enter through the case ; but many manufacturers seem content with a few little holes in the base. These allow air to enter, but there is nowhere for it to get out except through the various apertures in the deck-plate. The result is that you can fry an egg on some machines which have been running for an hour ; and one of the things one is warned not to do with magnetic tape is to allow it to get hot. How much print-through, I wonder, has been caused by boiling-hot spool-holders ? This heat cannot be necessary : its dissipation is a matter of carefully-designed ventilation, and a few holes bored at random in the recorder case will not do.

No part of a recorder can be carelessly designed if the machine is to be a good one. I am not a technologist and I can only leave such things as speed-stability and electronic function to the expert : I am concerned with design as it affects me in practice. I use things which I do not fully understand ; but so do the vast majority of recordists. So I am going to assume that my ideal machine makes high-quality recordings, and concentrate on myself as the user.

The machine is set up, and a recording session is about to begin. I thread the tape on to the machine. Why does this simple operation have often to be done several times ? The tape-path on some machines is so complicated that to get it right first time is a rarity : the deck simply bristles—almost literally bristles—with projections, pillars, guides, slots and the rest which seem to have been designed to make the operation difficult. Here the design of the head-covers is important, so that they lead the tape naturally into the correct path : I know



A CONTROVERSIAL CRITIQUE OF RECORDER DESIGN

BY PETER TURNER

machines on which they might have been made to cause the tape to catch. And you can bet your bottom dollar that if a deck is difficult to thread, it has snags when it comes to editing the tape later—of which I shall have more to say.

Too many recorders limit the size of spool which can be accommodated. This is necessary on battery portables, but should not be on a mains machine. One does not need to be able to leave spools on the deck—indeed, it is a very bad thing to leave a full spool, recorded or not, on a hot deck. The introduction of thin tape has made spool size of less importance ; but stereo doubles consumption, and an eight- or ten-inch reel is often called for at a long session. There should always be a means provided for anchoring the spool to the spool-holder : it makes for quieter and tighter spooling.

Tape ready ? Right : we'll plug in the microphones. The sockets for this ought to be right under one's hand ; but on how many machines are they on the back somewhere, so that one has to grope about where one cannot see, perhaps having to pull the machine forward on a shelf because the plugs cannot be inserted close to a wall ? There should be no inputs or outputs on the back of a machine: one wants them where they are accessible. I know machines on which one has to open some kind of sliding panel before one can get at sockets. For my money, only a socket for a function which is very rarely used should be on the back ; and if it is as little used as that it is doubtful whether it is worth having.

That brings me to a general consideration which I regard as important. Facilities cost money ; and I want my money to go in really good-quality basic functions, not on frills. It seems to me that a recorder should be so designed that facilities can be added afterwards if required, rather than provided on the basic machine. I have often wondered how many machines are bought because they provide this and that, and this and that are never ever used. I have a stereo machine which provides for dubbing from track to track, playing and recording at the same time and all that jazz. I have never used these facilities except to find out how to do it ; and I suspect that most owners of this machine are like me. Those who undertake the kind of work which necessitates the gadgetry should be able to add the facility. I also believe that superimposition is rarely used and rarely satisfactory: a serious recordist will eventually need a mixer of some kind anyway. Many machines provide for a high- and low-level input. and it is useful to be able to mix these. How often it is *done* is another matter... My general point is that facilities one does not need are not worth buying : extra quality in the essentials is.

It should not be necessary these days to have to pull out plugs in order to replay a tape without howl-back ; but on some machines one has to. One ought to be able to leave connections as long as one wishes : this is of particular advantage on one's permanent set-up at home.

The use I make of recorders demands a great deal of editing ; and I do not know how anyone makes much progress with the art without editing. One would never guess this from the design of most machines! What is needed is a replay head across which the tape can be rocked and the sound heard. That means that the replay head has to be in circuit when the tape transport is stationary. There should be some means of taking off the brakes so that the tape can be easily moved across the head, and of re-applying them when the spot to be marked has been found (to hold the tape still). Of equal importance is accessibility to the heads. One needs this for the simple task of cleaning them ; but for editing it is essential. Head-covers should be removable without fuss and screwdrivers, leaving the whole head-assembly open and accessible. If pressure-pads are fitted, they should stand off the replay head enough to permit the introduction of the chinagraph pencil ; but these days pressure-pads should have disappeared, and contact between head and tape maintained by other means. When the tape has been marked, it should be withdrawable from the head-assembly without fouling posts and guides : it has to be cut, and should be possible to take it from head to cutting-block without difficulty. It is quite maddening to have to disentangle the tape each time from a forest of pads and guides ; and very easy actually to damage the tape in the process.

Many manufacturers provide a capstan motor which is running all the time the machine is switched on. This has advantages ; but it should be possible to switch the motor off when it is not required—as when the amplifier is being used for replay from a source other than the tape. Many machines provide for this ; but I know of none which provide for the use of the motors without switching on the electronics at the same time. Yet I often wish to rewind tapes without using the electronics at all ; and what ages valves most, the experts tell me, is switching them off and on. It cannot be difficult to add separate switches for different functions, I should have thought.

I think there is a lot to be said for the good, old-fashioned, positive switch in place of push-buttons, at least for some functions. Whichever method is adopted, the keys should be large enough for male fingers to operate with ease without pressing two at once ; and switches should be grouped logically, so that those which control the recording process should be separate from those controlling replay. Switches should not require pounds of pressure to operate : the silky touch is one of the marks of a well-made machine. Control knobs should function properly : that is, they should not merely rotate a spindle, they should be accurately calibrated so that they can be returned precisely to the same place when required, which means that they must be designed to avoid parallax error and that the calibration shall be visible. That will involve a contrast in colours, and that is the kind of consideration which should decide what colours are used—not what a 'stylist' thinks looks right. You may tell me that sliders should take the place of rotating controls. I agree ; but they are expensive and I am not sure that I want to pay for them. In any case the remarks about calibration apply. Too often one is given some imprecise dot as the only reference point, yet any serious recordist knows how often he needs to re-set a control knob precisely as it was for the previous run.

Most recordists do a certain amount of their own servicing, even though it be confined to giving the machine a brush out from time to time. Therefore the innards should be accessible ; but on most machines one has to remove a formidable array of screws, grub-screws, pillars and posts before one can get at the works. This is unnecessary: it will not deter the resolute tinkerer, *and it insults the intelligent.* One famous deck provides two finger-screws, which undone, the whole deck-plate hinges up to allow vision of mechanics and electronics. Would that more decks were so designed ; and I regret to say that the finger-screws have disappeared from the latest version of even that deck.

A domestic machine, I believe, should not be regarded as, or offered as, a complete hi-fi installation. To make it such, if it could be done, would involve vast size and a high price, even if transistors were used throughout. A recorder is meant to record, and record well. If it provides a high-quality signal which can be fed to a hi-fi installation for play-back, that is all one needs : *he who does not possess such a rig*

(*continued on page 218*)

MANUFACTURERS SPECIFICATION. Quarter-track two-speed automatic tape recorder. **Spool Capacity:** 7in. **Tape Speeds:** 7½ and 3¾ i/s. **Wow and Flutter:** 0.2% **Frequency Response:** 40 c/s—16 Kc/s at 7½ i/s, 40 c/s—15 Kc/s at 3¾ i/s, +3dB—5dB. **Input Sensitivities:** 2.2—45mV across 1.5M. **Output Power:** 4W. **High Impedance Output:** 700mV across 15K. **Loudspeaker:** 5-ohm 4½ x 3¾ in. elliptical. **Distortion:** 5% maximum. **Dimensions:** 13¾ x 11½ x 7in. **Price:** £49 7s. **Manufacturer:** **Grundig (Great Britain) Ltd., Newlands Park, Sydenham, London, S.E.26.**

GRUNDIG TK 400 AUTOMATIC

THE last automatic *Grundig* reviewed was the *TK23A* in July 1965. This had a manual control facility together with a magic eye which made operation of the automatic control circuits easy to measure.

The TK400 is automatic only, so that we have to approach the tests in a slightly different way. Only one input socket is provided, and this is used for microphone, gramophone, radio or line inputs.

A switched 'Speech' or 'Music' time-constant is provided to control the recovery time of the AGC circuits.

Tape speeds of 7½ and 3¾ i/s are provided, and a new and clever wind-rewind control is fitted which varies the speed from zero to the highest speed smoothly for ease of editing or finding a given programme ; this is operated from the single fixed-speed motor through a pair of fabric belts which can be tightened or slackened by means of the swinging wind lever to provide any desired speed with smooth braking as required.

Tape speed is changed by slipping the flywheel belt from one motor pulley diameter to another by means of the push-pull control between the reels at the rear of the machine.

Long-term tape speed was measured by strobe tape and found to be accurate within ±1% at all parts of a 7in. reel.

Short-term speed variations were measured by recording a 3 Kc/s tone at either speed and replaying through a frequency discriminator and high-speed pen recorder to give the fluttergrams of **fig. 1.** These show that slight 12 c/s flutter can occur at 7½ i/s when record and replay flutters happen to be in phase (lower trace), but that the RMS readings of 0.05% to 0.08% are very satisfactory at this speed. At 3¾ i/s, the slight 50 c/s flutter at motor rotation frequency (3,000 r.p.m.) is not quite so well smoothed by the flywheel, and the flywheel or capstan wow has been reduced to about 6 c/s. The best and worst RMS readings were 0.1% and 0.16% respectively.

The play-only responses were measured at line output by playing test-tapes recorded to the time-constants marked against the curves of **fig. 2.** It will be seen that the playback equalisation is to approximately 50 and 100 μS time-constants.

Fig. 3 shows the overall microphone input to line output record/play response, with a very small (0.1mV) microphone input signal to avoid operation of the AGC circuits and to allow for the very considerable high note pre-emphasis used to record to the above time-constants. It will be seen that the high note response is sensibly level to 15 Kc/s at both speeds within the specification limits. The low note response, however, falls quickly below 100 c/s and is well outside the specification limits at 40 c/s. Some of this bass cut is obviously due to head contour effects, and some may be due to bass feedback via the AGC circuits which try and follow each cycle of such very low frequency signals.

Operation of the AGC circuits was checked by feeding a low level 500 c/s signal to the microphone socket, starting at 0.5mV and then slowly increasing the signal to the specified 45mV input. The AGC began to hold down the gain at 2mV input where the recorded signal was 6dB above test-tape level, and the recorded signal did not exceed 7dB above test-tape level for the highest input signal. Recovery time depended somewhat on the extent of the AGC operation and, of course, on the setting of the 'Speech'/'Music' switch.

System noise with no tape passing the heads was 41dB below test-tape level at 7½ i/s, and 36dB below test-tape level at 3¾ i/s. With the maximum recorded level limited to +7dB on test-tape level, the maximum possible dynamic range is 48dB at 7½ i/s and 43dB at 3¾ i/s.

Tape erased on the machine showed a noise level 3dB above system noise, so that the signal-to-noise ratios are 45dB and 40dB respectively for the high and low speeds.

FIG. 1 GRUNDIG TK400 WOW AND FLUTTER

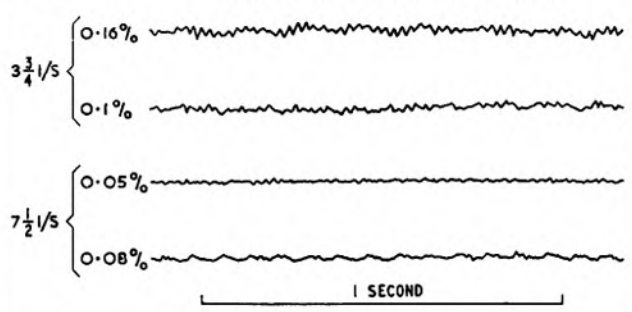


FIG. 2 GRUNDIG TK400 PLAYBACK RESPONSE

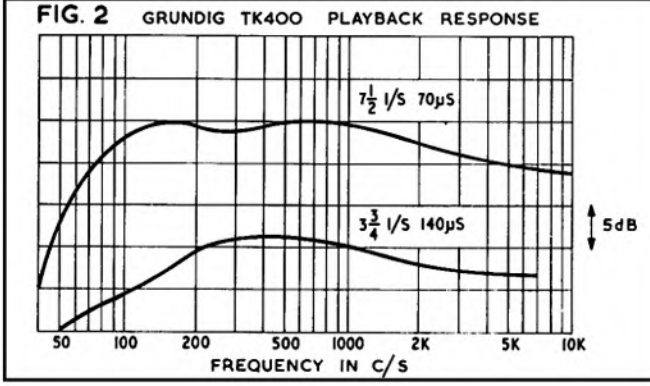
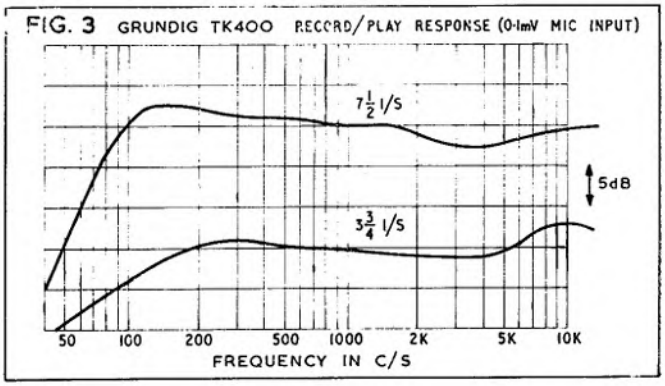


FIG. 3 GRUNDIG TK400 RECORD/PLAY RESPONSE (0·1mV MIC INPUT)



The tape to acoustic output response was measured by playing a 7½ i/s white-noise test-tape recorded with 25 one-third octave bands of filtered white-noise to a time-constant of 70μS, and measuring the sound output on the speaker axis. The resultant response is shown in **fig. 4** solid line, but a correction derived from **fig. 2** amounting to 6dB at 10 Kc/s must be applied to compensate for the difference between the test-tape time-constant and the actual recorded response. The corrected response at high frequencies is shown by the dotted line. It would have been possible to record the white-noise bands on the recorder itself, but this invites trouble from unknown operation of the AGC circuits and was therefore not attempted. The corrected response is sensibly level from 220 c/s to 8 Kc/s within ±3dB, and this agrees with subjective assessment of the balance and frequency response.

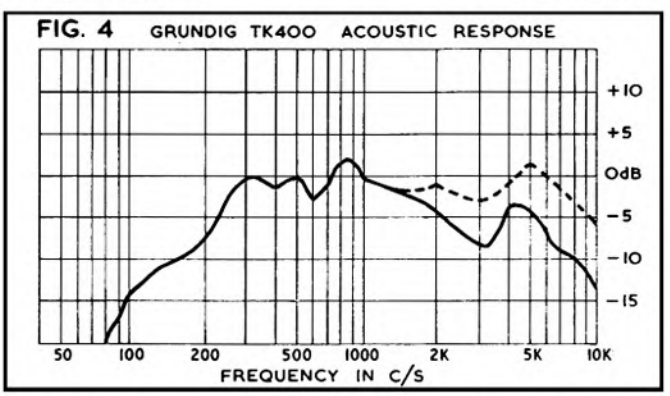
The acoustic response of the *GDM311* microphone supplied with this recorder is shown in **fig. 5.** This response has been taken many times before on various Grundig recorders, and it matches the other responses in general shape, showing a broad peak in the mid-high frequency range, together with a bass cut below 200 c/s, which makes it well suited to speech recording under domestic conditions.

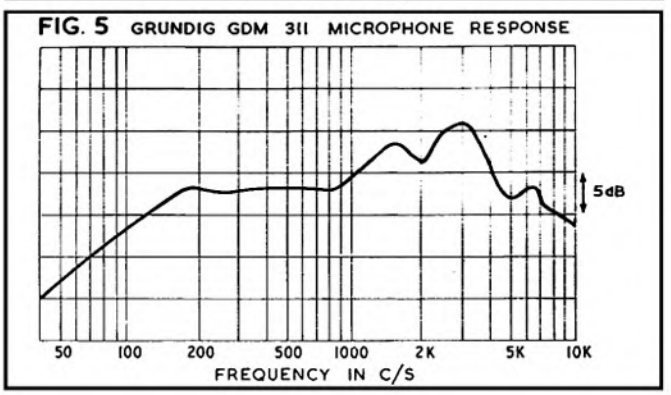
COMMENT

I must admit to a slightly 'blind' feeling in dealing with an Automatic-only recorder such as this. I suppose it would be too much to ask the manufacturers to provide a little tag under the head cover which could be shorted to earth to incapacitate the AGC circuit, marked "For reviewers only"! Given a circuit diagram, it is of course possible to find the AGC bias line and tie it down to earth—but this means dismantling the recorder and perhaps introducing other faults in the process. Without such procedure it is difficult to decide whether the low peak recording level of 7dB above test-tape level is a fault in the setting of the limiting level of the AGC circuits, or the usual effect of underbiasing to give the very wide range frequency response at the lowest tape speed. I suspect it to be the latter!

The instruction book makes it clear that radio, gramophone and line inputs must be attenuated down to a level of a few millivolts before feeding the recording lead. This of course is done in countries which build radios and radiograms to DIN standards, but even the efficient AGC will not cope with the 2-3W output of the extension speaker terminals of the average radio set if it is fed directly to the input socket. In other words, the recorder is nearly fool-proof—but not B . . . fool-proof!

A. Tutchings.





is not concerned with hi-fi anyway. Therefore the internal play-back power-stage should be confessedly of monitoring quality only—as indeed it commonly is, whatever the advertisements may say: it lets you know what is on the tape, and nothing more. But since a full replay rig is too heavy and too cumbersome for most people to carry around, all recorders should provide an outlet for earphones, with adjustable level control, from the replay-preamplifier. These days, 'phones provide very good quality, and are far more reliable for balancing microphones than the miserable loudspeakers fitted to recorder boxes.

The very slow speeds are of use only for recording speech, and not much good at that. I prefer two speeds only, obtained from pole-switching the motor, which can then provide the capstan-drive without idler pulleys: the performance from the important aspect of wow and flutter is greatly improved. Those who go in for recording every word of an all-day conference need a special rig; and fifteen-sixteenths speeds will not greatly help them. I am all for simplicity: it cuts out a load of trouble. Modern tapes and heads do well enough at three-and-three-quarters; but if one is to edit, seven-and-a-half is the minimum speed; and there is something to be said for a machine which runs only at that speed.

I should love interchangeable head-blocks, with full, half and quarter-track heads; but I fear that the resulting machine would be too costly for me. But at least I should *use* such a facility; and I would sooner pay for that than some of the gadgetry which I have bought willy-nilly and never use. Perhaps I could have the facility with the machine, and buy the extra head-assemblies later. Indeed, it seems to me that machines should be designed so that they provide the basic functions for the original price, and make provision for adding other facilities as the need arises. I also believe that the gap between the better amateur machines and the professional range is too great: there ought to be a basic machine of the kind I have described for something in the region of £150, without frills but making provision for them. The same manufacturer would provide mixers, remote-control units, additional head-blocks and the like, which would be ideally matched to the machine, and connect to it without fuss.

CONTINENTAL FIENDS

Those connections! Give me the good old jack every time: I detest both phono-plugs and those fiendish continental things. I recognise the elegance of doing everything with one plug and socket *à la* DIN; but the wretched, flimsy plugs squash if trodden upon, and the soldering, for bunglers like me, is a misery. Your jack is a solid piece of kit, which goes home with a tidy click and stays put: a firm, positive fit with one only function. The jack is an example of that kind of 'feel' I like with machines: foolproof and no-nonsense.

Other rare facilities I should like to see on my machine are: the ability to switch from fast wind to fast rewind and back without stopping first; a variable speed rewind; a no-tape stop which brings everything to a halt and removes the pinch-wheel from the capstan (failure to do this is one of my few criticisms of a favourite machine). I recognise that what I want is going to cost money; but the machine I have in mind is not one of those which you scrap a year later to get the latest, tinned-up marvel: it will last for years.

I am not, I fancy, likely to see my ideal machine: the whole ethos of the industrial system is against it. Manufacturers produce new models with bewildering frequency and, as a rule, with nothing to commend them other than novelty. My machine would not be produced in a new version every year: it would be gradually evolved as time went on and experience and the advent of true technical advance made necessary: there are a few of the best machines produced somewhat like that as things are, but one and all suffer from the depredations of the stylists and most seem to be giving way to the pressure around them. What is frankly termed "planned obsolescence" is difficult to resist because we, the customers, are deceived by glitter and advertising patter, and go chasing after the latest marvel rather than stand out for what we know to be better. I wish that I thought that a market still exists for quality without compromise, and in a few fields it may be so yet. By the look of things in the showroom, recordists have gone over to the enemy. Ah well . . . back to my plastic toys.

tape reviews

CLASSICS — GEORGE GOODALL
JAZZ & FOLK — TONY FARSKY
SPOKEN WORD — MAURICE PODBREY

GERRY MULLIGAN MEETS JOHNNY HODGES Six items by Gerry Mulligan (baritone saxophone), Johnny Hodges (alto saxophone) and others. **World Record Club TT494.** 3¾ i/s twin-track mono. 29s. 6d.

WORLD RECORD CLUB has now issued a large number of recordings of top jazzmen who do not normally play together. As is clear from some of these tapes, success in terms of good jazz does not always result from these meetings.

But there can be no doubt about this tape—the jazz is superb from beginning to end. This was no casual meeting of two great jazzmen. The ground was carefully prepared. Mulligan and Hodges both provided three compositions. The rhythm section, consisting of Mel Lewis drums, Buddy Clark bass, and Claude Williamson piano, was selected by Mulligan.

The result is thirty minutes of inspired, relaxed, swinging, cool jazz. It is extremely difficult to believe that Hodges and Mulligan had not played together before, in view of the flawless performances. Nor is it possible to pick out any of the six items as better than the rest. *Bunny*, *What's the Rush*, *Back Beat*, *What's it all about*, *Eighteen Carrots for Rabbit* and *Shady Side* all are full of charm, feeling and great musicianship.

The backing provided by the rhythm section is near perfect, and Claude Williamson plays some fine sensitive piano. A must for any serious collector of jazz tapes. **T.F.**

HONEGGER Pacific 231 and other items. Philharmonia Orchestra conducted by Hermann Scherchen. **World Record Club TCM 61.** 3¾ i/c twin-track mono. 29s. 6d.

THE MUSIC IN THE selection presented here ranges from the noisy and brash to the blissful and pastoral. The loud climaxes of *Pacific 231* (the first of the six items on this programme) remind one of the dissonances of the *Rite of Spring*. Honegger was no innovator and though he was a 'modern' composer, one never loses one's place in his music. Honegger himself said that J. S. Bach was his model, though in the programme presented here there is very little in the music that is intellectual, though occasional contrapuntal passages appear which may be considered purely so. The sweet and peaceful character of *Pastorale d'Ete* on Track 2 comes as a welcome sustained relief from the jagged rocks of the preceding items.

The recording quality is very good throughout. The orchestra appear willing to give of their best under Scherchen's conducting, so for those who wish to sample some of this Swiss composer's better known and less known work, this is a well-recommended issue. **G.G.**

COUNT BASIE PLAYS NEAL HEFTI Count Basie and his Orchestra with eleven items. **World Record Club TT492.** 3¾ i/s twin-track mono. 29s. 6d.

THE WORK AND IMPORTANCE of arrangers in contributing to the success of big bands on the jazz scene has not always received proper recognition. Neal Hefti, however, is widely known and associated with the creation of the Basie sound of the fifties. Personally, I doubt whether Hefti's scores achieve the swing of the pre-war Basie band, but I have certainly enjoyed and enthused over many Hefti creations.

These performances, recorded in 1958, follow a set dreary routine and are too full of clichés to be taken very seriously as good jazz. It is only on *Late Date*, *Pony Tail* and *Sloo Foot* that we can hear something like the sound of the Hefti-Basie partnership at its best. The rest of the tape is made up of *Has anyone Here seen Basie*, *Cute*, *Pensive Miss*, *It's Awf'ly Nice to be with You*, *Scoot*, *A little Tempo Please*, *Count Down* and *Bag 'a Bones*. **T.F.**

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