

MARCH 1968 2s 6d

# tape recorder

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ELEMENTS OF  
SOUND MIXERS

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THE INS AND OUTS OF  
SPOOLING

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RECORDING SEA BIRDS

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A LOOK AT SONY

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SERVICING-AN HONEST  
PROFESSION?

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GRUNDIG TK245 REVIEW

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SERVICING THE  
NATIONAL RQ-150

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*5" 900'	28/-	22/6			
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*7" 1800'	50/-	35/-	3" 450' Not Scotch	22/-	17/8
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551-16	1,650' Double Play on 5 1/2" reel	56/-	45/-	133/6	264/-
551-24	2,400' Double Play on 7" reel	72/6	55/-	163/6	324/-

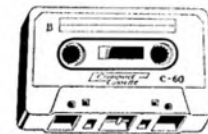
'600' SERIES PROFESSIONAL AUDIO TAPE (MYLAR BASE)					
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Jerry Keebles: 2nd violin

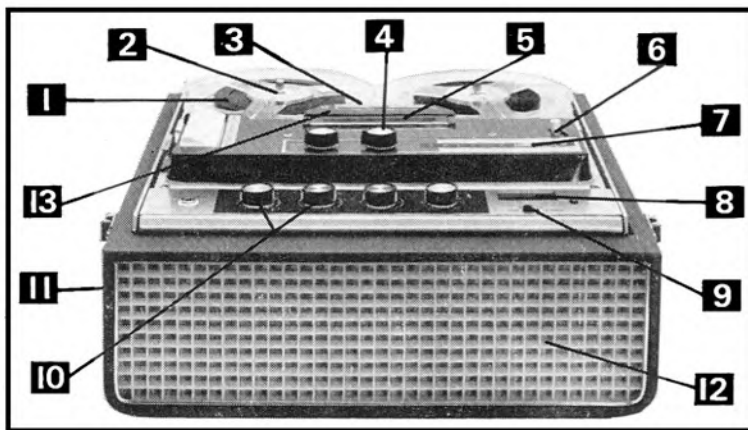
# What knobs does he turn to become 1st violin?



To Jerry, his violin is his living. And he's a superb violinist. But not the best. *Yet*. So when he's not playing before thousands, he's practising before his Truvox 100 Tape Recorder. He plays, then turns a knob, *and learns*. The Truvox 100 is the only tape recorder for Jerry. If you can catch him in a spare moment, he'll be glad to give you the reasons, button by button **1** 7" spools **2** Spool clamping **3** Duo play and Multiplay (R 104) **4** 3 speeds **5** Built-in splicing flap **6** Cue and inching control **7** Push button reset 4 Digit counter **8** Accurate V.U. Recording Meter **9** Tape/Source A-B monitor switch **10** Mic/Radio/PU mixing **11** Solid wood cabinet covered with tough washable P.V.C. **12** 8" x 5" loudspeaker **13** 3 heads

And there are a few features without buttons that make the R 104 Jerry's choice. Like **Solid state all-silicon transistor circuitry/Pre amplifier output fully variable 0-1 volt/3-motor Truvox Tape Deck/Separate record and playback heads/Micro-switch deck operation/Also available - Belgravia model finished in selected teak veneers.**

Jerry Keebles is a professional musician. So he simply can't afford anything less than the reproduction of the Truvox 100. **Prices R 102 (two track) R 104 (four track) 89 gns. Belgravia model 93 gns.**



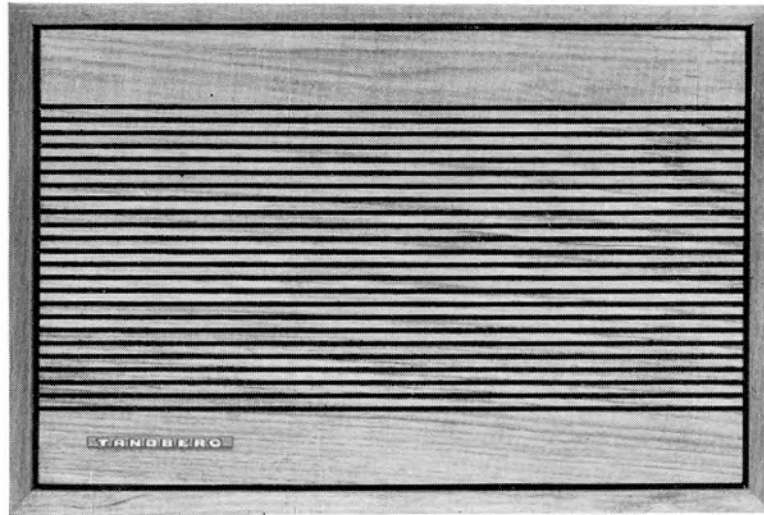
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For full details of the Truvox Series 100 recorders, tuner, amplifier and stereo tape units, and all Truvox sound equipment, write for your free copy of 'Sound with depth and colour'.

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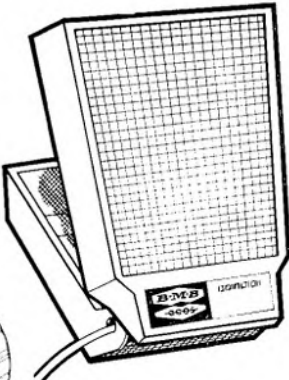
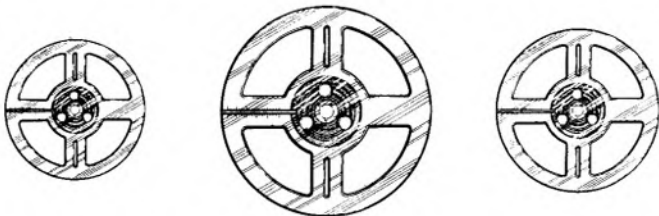
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# tape recorder

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MARCH 1968 VOLUME 10 NUMBER 3

INCORPORATING  
SOUND AND CINE

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## COVER PICTURE

Probably the most complex product ever offered to the domestic consumer, the Sony CV 2000 video tape recorder is shown undergoing tests before leaving the factory. Continuing his travels, Anthony Eden describes a visit to this enterprising Japanese company on page 121.

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## SUBSCRIPTION RATES

Annual subscription rates to *Tape Recorder* and its associated journal *Hi-Fi News* are 36s. and 38s. respectively. Overseas subscriptions are 38s. 6d. (U.S.A. \$4.60) for *Tape Recorder* and 38s. (U.S.A. \$4.60) for *Hi-Fi News*, from Link House Publications Ltd., Dingwall Avenue, Croydon, CR9 2TA.

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THERE NOW SEEMS little doubt that the days of the magnetic tape recorder are drawing to a close. Not even chromium dioxide tape can halt the trend toward smaller and more sophisticated information stores now being developed for computer applications. Until very recently, we regarded the thermo-plastic tape recorder as the most likely successor to present-day electro-magnetic systems, since it combined the virtue of electronic tape scanning (no track-changing, no whirring drums) with that of an inexpensive re-usable medium (molten plastic tape).

Past prophetic whims have consistently steered clear of photographic film, a much older storage medium than even the mechanical gramophone record, for the simple reason that film can only be used once. Current research at the California Institute of Technology Jet Propulsion Laboratory may, however, ultimately reduce film cost to such an extent that a really competitive 'disposable' photographic tape could supersede today's expensive but re-usable magnetic medium. A more fitting expression than 'disposable' might be 'permanent', since the owner of a film recorder would be obliged either to store indefinitely or physically destroy everything from H. W. Hellyer's "grandma's burlblings" downward.

Research at the Institute has progressed in the direction of squeezing great quantities of information from a ruby laser through a microscope on to minute areas of magnetised manganese bismuthide film. The actual recording process depends on a combination of thermal and magnetic phenomena and is capable of storing television pictures at one thousand times the density of a conventional video tape recorder. Bits of less than one micron diameter have been recorded successfully, using a technique known as Curie-point writing to reverse the magnetic field of a heated film spot.

Having developed the system, however, the Institute has one more small problem to overcome: the first film strips took four days *each* to produce, a period which has only now been reduced to a 'practical' level—three strips per day!

Seriously, there seems every possibility that mass-production will render the film commercially viable. Every likelihood, too, that lasers will eventually find their way out of the laboratory and into the home. The basic cost of manganese bismuthide film would not need to be reduced below—or even to—that of an equivalent area of 8 mm. cine film, since it would have an enormous advantage over the latter in terms of recording capacity.

The scissors and splicing-tape brigade, of whom we are proud members, are prone to anxious gnashings of teeth whenever cassettes or sheet-recorders are bandied as successors to the moving-tape medium. The sheet-recorder, already used for specialised dictation purposes, generally comprises an oxide-coated mat of

one shape or another, tracked by a moving recording head. A sophisticated film recorder might well adopt the stationary-mat medium in preference to reel-to-reel spooling, overcoming the mechanical wobbles that beset us today, simply by varying the angle of a laser.

But teeth gnashing is not called for. Mat-recording would overcome the time-wasting spooling operations that confound the tape enthusiast in his quest for a recorded item. Instead of fiddling with a twin-ended yo-yo, he would move the sensing head across the mat with all the convenience of a pickup over a gramophone record. Scissors and adhesives will become obsolete since manual mat-splicing is never likely to prove practical. Instead, tomorrow's recording enthusiast may edit electronically, either by dubbing from one recorder to another or—who knows?—from one part of the mat to another within a single recorder.

A pessimistic outlook? Not in our opinion. We regard the future of home entertainment in general, and of domestic recording in particular, as an exceedingly bright one. We must face the fact, though, that long strings of iron oxide are not the ultimate recording medium.

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# We'd like you to hear our latest number

## It's the TK145 de luxe. And it's quite a tape recorder

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What's more, you can make synchronised recordings by using the Monitoring Amplifier MA2, and the Earphones type SE3, both available as extras.



There are connecting sockets for recording/playback, monitor headphones and switchable extension loud-speaker. There's even a press-button reset for the position indicator! And—to guarantee cool operation over long periods of playing and recording, the TK145 de luxe has the exclusive Grundig single-unit combination of motor and mains transformer.

The uncrushable steel chassis is elegant in teak finish, with Silver G-line grille. The TK145 de luxe comes with 1,200 ft. of tape and a high-quality dynamic microphone . . . all that for just 46 gns! Like to hear more? Then send off the

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**GRUNDIG**



# WORLD OF TAPE

## DUPONT TO MARKET CHROMIUM DIOXIDE TAPE

MAGNETIC recording tape employing a chromium dioxide coating in place of conventional iron oxide has been developed by DuPont. The new tape, *Crolyn*, is said to accept significantly more recorded information than an equivalent area of iron oxide tape. Early applications are expected to be in video and data recording, though minor modifications are said to be necessary with audio recorders currently adjusted for iron oxide tape—presumably a change in bias.

## DEVALUATION—THE AFTER-EFFECTS

AFTER a comparatively uneventful month, in which distributors awaited the action of their competitors, a general increase in the price of imported tape recorders has occurred. *Ampex*, *Revox*, *Eltra*, and *Sony* have raised the prices on certain of their machines, examples being the £51 9s. *Eltra 1001* (now £57 15s.), the £61 19s. *Sony TC800* (now £69 10s.) and £69 10s. *Sony TC350* (now £78 15s.). These increases are reflected throughout the audio market, notable exceptions being *Tandberg*, *Grundig* and *AEG*, who are absorbing costs, at least until further notice.

## MALLORY INCREASE PRICES

INCREASES in the prices of certain mercury and manganese/alkaline batteries have been announced by *Mallory*. The company's products remain cheaper in this country than abroad but have hitherto been so cheap that buyers have been threatening sales by selling *Mallory* batteries overseas below the price charged by the manufacturer. Devaluation is said also to have been responsible for the increases (a 2s. 6d. *RM-1* is now 4s. 2d.), as 90% of the raw materials are imported. The last general price increase announced by *Mallory* was in 1962.

## SLOUGH RECORDING CONTEST

AMONG the events being organised for the 1968 Slough Festival are competitions for tape recordists, amateur film-makers and slide photographers. Three classes of entry are open in the tape recording category, *Class 551* being confined to users of equipment not

exceeding a total value of £40. Contributions may cover any topic, maximum duration being five minutes. *Class 552*, with no restriction on equipment, is for "sound snapshots, interviews, interesting or historic sounds" or "on the spot reports" with a maximum duration of eight minutes. "Music, live vocal or instrumental performances" may be entered in *Class 553*, again with no restriction on equipment. Maximum duration is ten minutes. Closing date for entry forms and fees (2s. 6d. per entry) is 30th March and all tapes must reach the organisers by Friday 12th April. Further details may be obtained from The General Secretary, Slough Festival, Slough Community Centre, Farnham Road, Slough, Buckinghamshire.

## AUDIO FAIR 1968

MULTICORE Solders, Sinclair and Yamaha will be among new exhibitors to the 1968 Audio Fair which is being held, as always, at the Hotel Russell on the weekend after Easter. The ballot for room positions was held on 16th January.

Normal routine will be followed, the exhibition opening to trade visitors from 11 a.m. to 4 p.m. on Thursday 18th April. General admittance will be from 4 p.m. to 9 p.m. that evening, 11 a.m. to 9 p.m. on Friday and Saturday, and 11 a.m. until 8 p.m. on Sunday. Tickets will be freely obtainable from certain audio dealers.

## INTERLOG TEACHING SYSTEM

AN inexpensive and flexible language teaching system has been developed by the Education Technology Service of *S. G. Brown Ltd.* Suitable for use with existing school tape equipment, the system comprises a 33 x 23 x 17 cm. portable switching unit, group junction box, and six headsets. Further switching units may be added to permit larger classes. Each student is supplied with a headset and combined microphone, through which he may monitor a taped lesson or converse in isolation with the instructor. The switching unit also permits an instructor to speak to the entire class and record the work of individual students. Permanent installation is unnecessary.



## NEXT MONTH

TAPE TRANSPORT MECHANISMS is the title of a new series by G. T. Rogers, commencing in our April issue. Vivian Capel will examine the causes of *Dropout*, offering a few cures, while Otto Musil describes the production of *Tesla* tape recorders in Czechoslovakia. Alec Tutchings will review the *Sony TC350*.

## OBITUARY

H. G. M. SPRATT, author of the widely acclaimed book *Magnetic Tape Recording*, died in January at the age of 55. For many years Mr. Spratt worked with the Minnesota Mining and Manufacturing Company, later moving into the field of general technical writing. A third edition of *Magnetic Tape Recording* was being prepared by Mr. Spratt and Mr. Graham Balmain.

## BOSCH SERVICING

SERVICING of *Uher* tape recorders, imported by *Bosch*, is now being undertaken from new premises at Rhodes Way, Radlett Road, Watford, Hertfordshire. Service enquiries should be made to Mr. Martin Cook (Watford 44233), but orders for spares should continue to be made through the *Bosch* showrooms at 205 Great Portland Street, London W.1.

## MOUNTAIN DIARY

A FI-CORD 202 and supplies of *Scotch 290* triple-play tape have lately been carried through the Andes mountains in Patagonia by a team of British climbers. The equipment was employed as a diary, from which a book and film will later be produced, to record the team's progress on the 9,000 ft. *Cordillera del Paine* mountain and the 4,000 ft. *Fortress* granite peak, hitherto unscaled.

## 1968 AUDIO ANNUAL

"CASSETTES and Coatings" is the title of a three-page feature by Graham Balmain in the 1968 *Audio Annual*, to be published on 16th January. Reprints of the major reviews in *Tape Recorder* and *Hi-Fi News* during 1967 will also appear, while Donald Aldous ("An Audiophile at Large") considers the vices and virtues of applied sound reinforcement. Stanley Kelly, James Moir and Geoffrey Horn discuss the respective topics of "Boxes for Loudspeakers", "Concert Halls" and "Your High Fidelity Dealer Looks Out". James Sugden completes the menu with an examination of "Equalisation". The *Audio Annual* may be ordered through a newsagent for 7s. 6d. or purchased direct from *Link House Publications Ltd.*, Dingwall Avenue, Croydon CR9 2TA at 8s. 6d. including postage. Also available from this address is the 1968 *Audio Diary*, price 7s. 6d. including postage.

## REVIEW POSTSCRIPTS

WE wish to apologise for mis-quoting the *Philips EL3312/GL559* price in our January issue. Recorder and speakers together are £57 15s., not £71 14s. 2d. as stated. We regret, also, that the *Columbia TA-33CX1774* tape record reviewed in February was deleted before the review appeared.

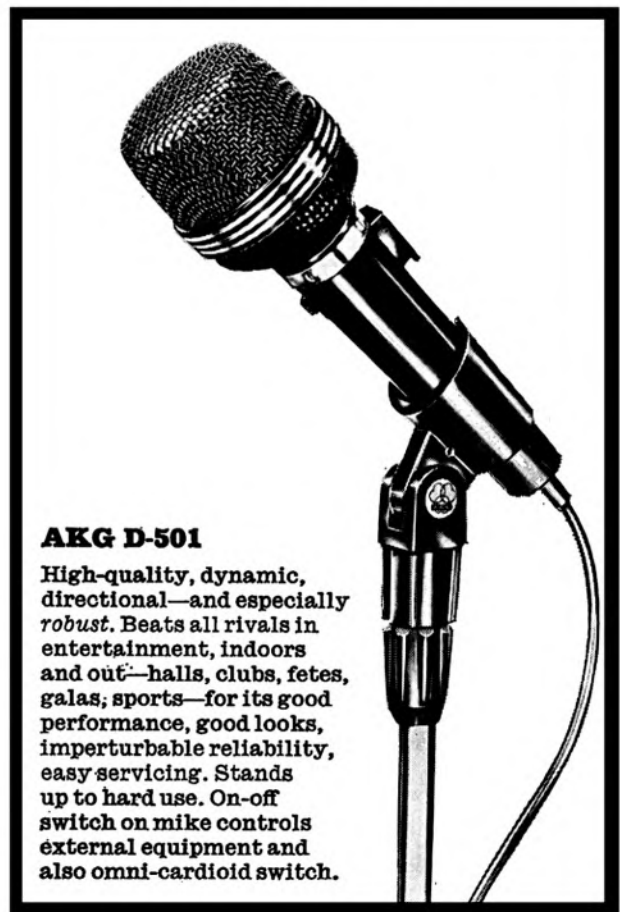
How many microphones  
between them cover all applications  
in clubs, pubs, halls, public address,  
galas, fetes, sports, good tape recording -  
indoors and out?

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# recording sea birds



by  
philip radford

## SOME ADVICE ON RECOGNISING AND TAPING COASTAL BIRD LIFE

**A** PROBLEM associated with recording the sounds of sea-birds is that many of the species concerned spend much of the year at sea, so that access is a difficulty. In the main, therefore, recording must be carried out when the birds come to land at the breeding season which, of course, is when they are most vocal. But even then approach is not easy, as nesting is often on precipitous cliffs or rocky islands. Landing from a boat may be dangerous and climbing sea-cliffs is not to be recommended for a novice, especially if clutching a prized portable tape recorder. Against this background, the noise of rollers, gusts and persistent winds may ruin any chance of success on a particular day. When time is limited, and usually it is limited for the amateur bird-recordist, the wait for suitable weather can be exasperating. It is also often more difficult to find shelter under such conditions than when recording land-birds. Yet to achieve good tapes from such desolate and exciting places is surely most satisfying. Perhaps more than with any other type of bird-sound recording, playback recalls a sense of occasion and even nostalgia to the recordist who was there.

### PARABOLIC REFLECTOR

Many outdoor recordists find a parabolic reflector of help in reducing extraneous noise, as well as concentrating a particular sound. But such a reflector is cumbersome to carry to a sea-bird breeding area and strong winds may make its use impossible. Some recordists find a light plastic washing bowl useful: the microphone is inserted into the bowl at a hole cut at the centre and is then directed towards the source of sound. The sides of the bowl give some protection from unwanted noise; the bowl is cheap and is easier to

carry than a parabolic reflector, although the acoustic results are hardly comparable.

Another improvisation is to place the microphone in a cut rubber ball or sponge. Having done this, some method must be devised of holding the microphone and attachments steady. A stout stick can be drilled to take a socket in which a microphone holder can be screwed; on arrival at the site the stick is plunged firmly into sand or earth and the apparatus set up. The microphone can then be directed up a cliff or towards a ground-nesting bird colony. If the recordist is at the top of a cliff, however, it is not always easy to incline the microphone downwards. It may be simpler to hang the microphone over the edge of the cliff.

### OBVIOUS GROUP

The obvious group of sea-birds to consider first, and probably the easiest to record, is that of the gulls. These birds have a variety of loud calls and their tapes may be in demand to provide a setting for stage or radio plays. Gulls are common round our coasts at all times of the year and their recording need not involve any hazardous expedition. Some of the more familiar calls are given by the well-known Herring Gull which breeds on cliffs and islands round much of Britain's coast, often in colonies. May and June are the normal breeding months. A challenging series of calls is made with the head up and neck stretched: "kew, kew, kew." Anxiety notes are a rhythmic "kah, kah, kah," given when an enemy approaches the colony. When recording, care must be taken not to over-modulate the tape with so loud a signal.

The most graceful small gull is the Kittiwake which lives at sea for much of the year and feeds from the Atlantic's surface. It

breeds in large colonies on sheer cliffs. Noise can be strangely intermittent at a Kittiwake colony: thousands of birds may remain almost silent for a while, then the shrill "kitti-wake, kitti-wake" increases and adds to a remarkable chorus. Recording may be difficult because of prevailing winds, which are often unrelenting at such sites; it may be an advantage to place the microphone inside the entrance of a rabbit's burrow. An abundant small gull which occurs inland as well as on estuaries and shores is the Black-Headed Gull; usually it can be taped by erecting the microphone by the banks of a tidal river, especially in autumn or winter. Harsh cries of threat and aggression are uttered: "krik, krik, krik." At breeding sites on sand-dunes it is even noisier; the territorial calls are loud and raucous and provide a good signal for recording. The Common Gull, which is superficially like a small Herring Gull, also spends much time inland. It breeds on moorland in Scotland and has sounds rather like those of a high-pitched Herring Gull.

The largest gull breeding in Britain is the Great Black-Backed Gull, often to be found on rocky islands. Sometimes it is possible to direct the microphone by fixing it in a cleft between boulders or stones. Guttural calls such as "ug, ug, ug" or "ouk, ouk" are produced and have rather a goose-like quality. A summer visitor to the British Isles is the smaller Lesser Black-Backed Gull; this breeds in similar places to the larger species. Sounds are like those of the Great Black-Backed Gull but of lesser amplitude. A chorus of ponderous, honking cries made by these large gulls can make a fascinating tape-recording.

### OCEANIC BIRD

A bird which may resemble a gull at a distance is the Fulmar, but actually it is a petrel or tube-nose. It is an oceanic bird and an expert glider and has extended its range of breeding in recent years. Now the Fulmar is a common cliff breeder even in North Cornwall, so successful recording of the attractive display notes should not be difficult. To record, a still day must be selected and the microphone directed at the pair of Fulmars on their ledge; the recordist waits patiently at the cliff-top trying to anticipate the onset of calling. There are days when Fulmars are not very vocal, but if the recordist has blank tapes his experience of sea-bird activities has increased.

Another petrel of British waters is the Manx Shearwater. This bird comes ashore to breed in May and June, using turf-covered marine islands off Scotland or Wales. The Manx Shearwater is so vulnerable to predation, mainly by the larger gulls, that it flies to land by night only. The recordist must be prepared to visit the colony at night and risk spraining both ankles; uncanny crooning sounds are given during flight and also from the burrows where it nests. The smallest British petrel is the Storm Petrel, well-known to seamen as it follows the wake of ships. The bird is again largely nocturnal at its breeding grounds. Purring and squeaking noises are made, often while the bird is on its nest in a burrow or under stones. A

(continued on page 127)

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T5

# ELEMENTS OF TAPE RECORDER CIRCUITS

## PART 10 SOUND MIXERS

BY G. T. ROGERS

FIG. 1

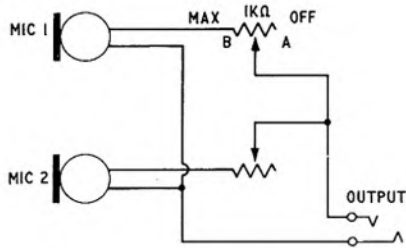


FIG. 2

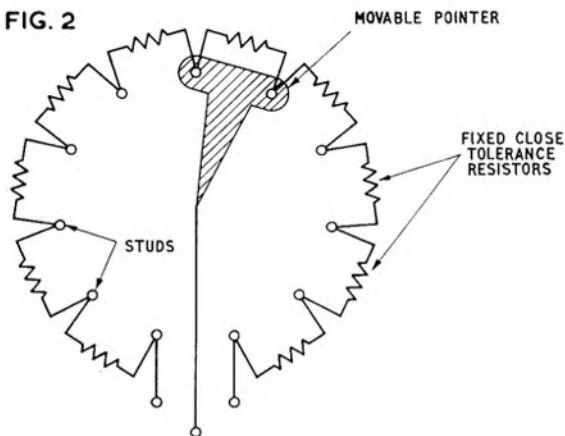


FIG. 3

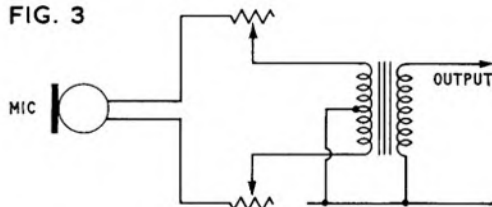


FIG. 4

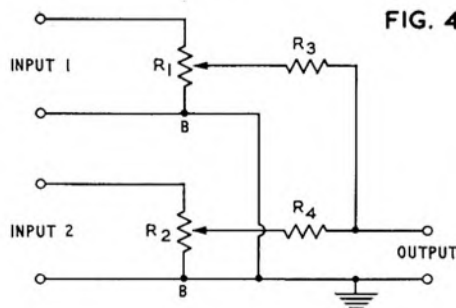
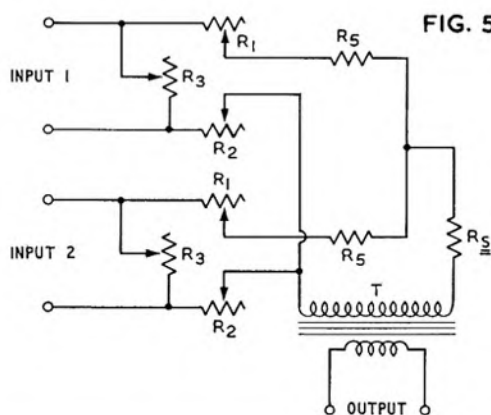


FIG. 5



**I**N Part 6 of this series, we examined a circuit for mixing both high and low level signals within the early stages of the record amplifier. For the amateur recordist this is a very useful circuit to have since it enables a low level microphone signal to be mixed with a high level signal which may come from another tape recorder or a gramophone pickup. As the recordist gains experience, more advanced recordings with more than one microphone can be undertaken with the outputs from each being mixed in the desired way before passing on to the recorder. In addition, a number of high level inputs may also be required.

The sound mixer allows the level of two or more input signals to be adjusted individually, and the desired level of each passed on to an output which is suitable for connecting to a high level input on the tape recorder. Since mixer circuits are complex, it is impractical to integrate these into the recorder itself. The mixer is therefore normally a separate unit.

When the output of an external mixer is connected to the tape recorder, both the input sensitivity and the input impedance of the record amplifier have to be considered. It will be recalled from earlier articles (Parts 1 and 5) that a signal source has to be matched to the input so that maximum power is transferred within the specified limits of distortion. The output of a good sound mixer has therefore to match, or be capable of matching, the associated amplifier. In a like manner, the sensitivity and impedance of the *mixer* inputs must be chosen to suit the microphones or high level signals likely to be connected to the unit.

(continued on page 115)



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**ELEMENTS OF TAPE RECORDER CIRCUITS CONTINUED**

If the mixer has to take signals from many different types of microphone, as for example in broadcasting installations, the input matching can be quite complex involving a broad range of sensitivities and impedances. Many microphones designed for professional work have a nominal output impedance of 600 ohms. This permits lengthy runs of connecting cable but these microphones have to be fed into a matching device, circuit or 600 ohm transformer. Ribbon microphones were at one time very popular for studio recording on account of their excellent overall quality and smooth frequency response. The impedance of the ribbon is extremely low and a matching transformer is often built into the microphone case to step up the impedance to 30 ohms, or in some cases 600 ohms to match broadcasting equipment. The impedance of a moving-coil microphone is about 30 ohms.

**NOT FEASIBLE**

It is not feasible to have separate inputs for all the different microphones likely to be encountered, but a versatile mixer might well have a switch for each input so that its impedance could be changed to suit the signal source. A high impedance position may also be included in this switch so that crystal microphones can be used if desired. High impedance microphones are not desirable in broadcasting, as the cable length is severely limited (see Part 5), but are common in domestic equipment where cable length can be short (up to 15 ft.). A sound mixer designed for the amateur might therefore have high impedance microphone inputs which could, of course, be converted to low impedance by using an external matching transformer. Table 1 will be useful as a summary of the input impedances required for various signal sources.

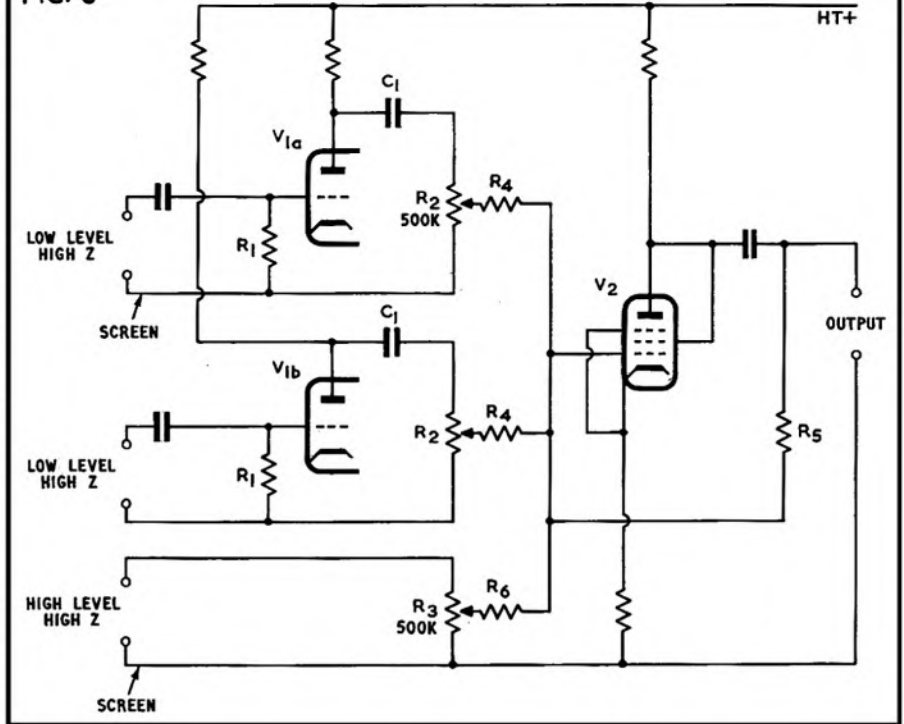
When two sound sources are mixed, either in a mixer or just as sound waves in air, the combined output will be the resultant or algebraic sum of the two original sounds.

In this context we must therefore consider the importance of phase difference between the two sound sources. If two microphones of identical characteristics, and positioned close together in the same sound field, are connected to the mixer in the proper way, the resultant output of the microphones will be in phase which means that the voltage from each will be positive at the same time. Under these conditions the output voltages of the microphones will reinforce each other and a properly mixed sound will be produced when the signal is subsequently amplified.

**OUT OF PHASE**

On the other hand, if one microphone has its electrical connections reversed the two signals will be 180° out of phase with each other and the resultant will be zero. In practice this would produce a very much reduced output. Although the electrical connections may be correct, special care is required when bi-directional or ribbon microphones are used. These microphones have a figure of eight characteristic which means that the phase of

**FIG. 6**



**TABLE 1**

Source	Approximate I/P Impedance	High/Low	Required Amplifier Sensitivity
Crystal pickup .. .. .	2 M	High	Low
Magnetic pickup .. .. .	60 K	High	High
Moving-coil microphone .. .. .	30 ohms	Low	High
Ribbon microphone .. .. .	30-1 K	Low	High
Crystal microphone .. .. .	60 K	High	Low
Tape head .. .. .	100 K	High	High
Radio tuner .. .. .	100 K	High	Low

**TABLE 2**

No.	1	2	3	4	5	6	7	8	9	10	OFF
Value (in K)	150	100	75	50	37.5	25	18.7	12.5	9.4	6.25	

the output can be reversed by turning them 180° relative to the sound source.

Another way in which antiphase signals can result is if the difference in distance between the microphones and the sound source is exactly half a wavelength. This form of destructive interference of course only applies to one frequency, and in audio mixing (15-20 kHz) will result in weak sound at this frequency.

**SIMPLE MIXER**

Fig. 1 shows a simple two-channel series mixer, suitable for a pair of low impedance microphones. Here two wire-wound or carbon potentiometers with logarithmic characteristics are used. These are called series faders and are wired up so that increments in series resistance are progressively increased in size as the knob is turned anti-clockwise towards the 'off'

position. We shall come back to the working of the fader in a minute, but let us first say a little more about the types in common use.

Carbon potentiometers are a popular type of fader on account of their low cost. The carbon potentiometer consists of a carbon track along which slides a moving contact so that, when the circuit is connected up, any desired voltage can be tapped off. The principal fault with carbon tracks is that they become noisy with age due to small pieces of the material becoming detached, making the track surfaces pitted. Another fault is that the pressure of the contact can alter with use and this changes the resistance, producing abrupt changes in loudness.

To overcome these difficulties, the more expensive wire-wound potentiometers can be used. They can be made to remain virtually noiseless over fairly long periods and can be

(continued on page 117)

tailored to a high degree of accuracy so that movement of the pointer can result in an accurate logarithmic change of resistance. This latter point is particularly valuable in sound mixer circuits since it means that the fader is capable of presenting the same resistance repeatedly at any given setting.

Another type of fader is the stepped contact fader which is useful where hard use is envisaged, for example in studios. This fader consists of a multi-stud contact with a movable pointer which makes contact with the next stud before breaking from the previous one. This make-before-break device avoids the possibility of large momentary changes in resistance which would cause noise and volume change. Instead, it adds or subtracts from the total resistance in circuit as the pointer is moved. Its construction, shown in fig. 2, is from fixed close-tolerance resistors which are chosen so that the fader has a logarithmic characteristic. Typical values for the individual resistors for a fader of 500 K total resistance are given in Table 2.

There is much controversy over whether the rotary or sliding types of fader are best for mixing. Even so the physical design must be carefully considered if the mixer has to be used for any length of time. Important points here are carefully placed control knobs which should be large enough to be gripped easily, and the position of the mixer itself.

The function of the fader in a mixer circuit is to increase the loudness to the ear in equal steps when the control knob is rotated in equal steps. Loudness is a subjective quantity which is difficult to measure absolutely with any degree of certainty since it depends on the response of the human ear, and this varies with the frequency. Loudness, however, also depends on the intensity of the sound-wave and this is a quantity that can be expressed accurately. In fact it is the power transmitted per unit area.

When discussing sound mixers, we are really concerned with a change in intensity which is measured by the decibel (dB) which is one tenth part of a Bel, a unit named after Alexander Graham Bell, the inventor of the telephone. The normal ear can easily detect a change of 3 dB in intensity, which results from a doubling of the power. Another way of expressing the decibel is by the important equation:

$$N = 10 \log_{10} P_2/P_1$$

where  $P_1$  and  $P_2$  represent the power (intensity) of the wave before and after the change respectively, and  $N$  equals the number of decibels.

#### VOLTAGE CHANGES

In our fader circuit, we are concerned with voltage changes and so it is essential to see how sound intensity is related to signal voltage. Increasing the voltage of the audio signal will increase the sound intensity produced at the end of the audio chain—but, if the voltage is doubled, the intensity change will be 6 dB and not the 3 dB which results from a doubling of the power. To show this we can use the well known formula:

$$P = V^2/R$$

This is a combination of Ohm's Law and the formula:

$$P \text{ (watts)} = I \times V$$

In a single mixer circuit, the total resistance or impedance  $R$  should be practically constant; therefore we can write the decibel equation as:  $N = 10 \log_{10} V_2^2 \div V_1^2 = 20 \log_{10} V_2 \div V_1$

This equation tells us that, as the voltage is doubled, the intensity of the sound changes by 6 dB, since:

$$20 \times \log_{10} 2 = 6$$

This is a logarithmic characteristic and our potentiometer must have a like characteristic so that equal changes in loudness are produced as the pointer is moved in equal steps.

Simple series faders have been used in broadcasting, though they are more likely to be found in domestic equipment. To minimise hum fields being induced in the programme line of these faders, it is desirable to use a balanced circuit where the potentiometers are mechanically linked as in fig. 3. A balanced circuit (see Part 5) is one in which both legs of the input and output are symmetrically disposed above earth, so the signal current will be in an opposite phase in the closed circuit. Any stray fields will induce currents identically in both leads which, however, will oppose each other when they flow through the primary of the transformer at the output and so will not appear in the signal.

Although the unbalanced and balanced series faders will work well enough for low-impedance microphones when used in pairs, problems can arise when several are wired together. Suppose four such faders are used and the fader for Input 1 is moved from the minimum to the maximum position (A to B in fig. 1), whilst the others are around the half-way position. The signal at Input 1 will be faded up, but in doing this the total resistance offered to the signal, as it passes through the mixer, will be reduced by the value of the fader for this input. In other words the impedance of the mixer output, as presented to the recorder, will be reduced. This is not serious when the impedance change is small, but when all four faders are used the impedance and hence volume change may be magnified and mixing will be very difficult if a properly balanced programme is required.

#### AFFECTS THE BALANCE

Another related problem which affects the balance of the programme as a whole is interaction. Considering the circuit in fig. 4, the potentiometers  $R_1$  and  $R_2$  act as potential dividers for Channels 1 and 2 respectively and fade out the inputs when the centre taps are turned towards earth at B. Interaction occurs when the operation of one channel control affects the output of the other channel, and obviously this should be reduced as much as possible. Consider the case in fig. 4 when  $R_1$  is at B—that is when it is faded out; in doing this we have made it easier for signals coming from Input 2 to go to earth, in other words the output from Channel 2 will also be reduced.

This problem can be improved to some extent by inserting the resistors  $R_3$  and  $R_4$  after the faders as shown. These resistors act as buffers and the higher their value the lower the interaction. A choice for the value of the interaction resistor, however, is always a compromise, since too high a value will result in serious attenuation of the mixer output. In

better class mixers fairly high values are in fact chosen and the overall attenuation, the 'insertion loss', compensated for by boosting the signal before or after mixing.

A solution to the problem of impedance change is a little more difficult, requiring a constant impedance balanced line circuit that presents the same impedance to the input and output at all settings of the fader control. This circuit is shown in fig. 5. The potentiometers are so arranged that when  $R_1$  and  $R_2$  are reduced in value the shunt resistor  $R_3$  is increased.  $R_1$  and  $R_2$  can be of equal values, and  $R_3$  can be calculated to satisfy constant impedance conditions. In this way the total impedance of the circuit combined with the input and output impedance is kept constant. The value of the series resistor  $R_5$  is important and depends on the number of inputs, the constant impedance from which they are fed, and the constant impedance to which the output of the mixer is connected. Constant impedance mixers are expensive owing to the high cost of the potentiometers. One popular way of connecting them up is as shown, using a transformer which results in an accurately matched coupling giving maximum signal output.

The mixing circuit introduced in Part 6 enabled both high and low level signals to be connected and it will have been noticed that the low level input had an extra stage of amplification. In fig. 6, which shows a basic circuit for a valve mixer, two of the three inputs are low level and each has its own preamplifier stage to boost the signal before mixing with the high level signal.

#### DOUBLE-TRIODE

The two preamplifiers V1 (a) and (b) can be a double-triode such as the ECC 83 and the input impedance is then determined by adjusting  $R_1$ . The amplified signal appears across the fader potentiometers  $R_2$  via the usual coupling capacitors  $C_1$ . The centre-taps of these faders are then connected to the interaction resistors  $R_4$ , which in addition to reducing interaction also insure that the grid of the pentode V2 will not be short-circuited when the faders are set at a minimum. The pentode acts as a line amplifier and employs anode-to-grid negative feedback to assist in maintaining a stable output and reduce distortion. The amount of feedback is determined by  $R_2$  which can be increased if more gain is required. Decreasing the value of the interaction resistors will also increase the gain, though this will have the undesirable effect of increasing the interaction. The impedance of the high level input is determined primarily by the resistance of the potentiometer  $R_3$ . The signal from this input is passed directly to the grid of the line amplifier through the interaction resistor  $R_4$ .

The inputs in fig. 6 are high impedance, so if it is required to use low impedance microphones a suitable step-up transformer with the appropriate turns ratio will be required. A low impedance cathode-follower output (see Part 6) can also be incorporated into the mixer if an additional triode stage is connected, and this will be essential if a long connecting cable is used.

When a sound mixer is permanently connected to either a tape head or magnetic gramophone cartridge, suitable equalisation  
(continued on page 127)



# THE INS AND OUTS OF SPOOLING

K. C. HART DESCRIBES THE LESS OBVIOUS APPLICATIONS OF SPOOL ROTATION COUNTERS

THE questions "How much time left?" and "Have I enough tape remaining on the spool to complete a recording which is going to run for  $x$  minutes" were very ably answered by J. A. Cook in the July 1967 issue of *Tape Recorder*. The fact that there was so much variation between index-counters came as rather a surprise to me, although I knew that my own counters registered only 75% of actual spool turns. For the purpose of my own findings which follow, however, these relationships are not important.

Tape recorder index counters can be used in several ways other than the obvious starting of a tape with a counter set at 000 and winding on to a desired index number.

For my methods, the best type of counter is that which is reset by a small knurled hand-wheel, and which can be positioned also to the intermediate numbers 111, 222, 333 and so on, up to 999 and 000. Index counters of the push-button instant reset type that can be reset to only 000 (or 0000) are less versatile, although I shall show what can be done with them.

## REGISTER FROM LEFT

To avoid possible confusion, I should say that my own index counters register from the left-hand spool, and are of the wheel reset type. My notes will apply fully to wheel reset counters driven from the right-hand spindle, but are not adaptable to push-button reset counters coupled to the right-hand spindle, because right-hand spool spindles cannot be made to run clockwise except when a tape is being rewound from right to left—an apparently fantastic statement, the reasons for which you will see in due course! Further, I shall assume that any two spools on your recorder will each have central cores or bosses of the same diameter. I mention this because I have two 4 in. (10.2 cm.) diameter Phillips spools, one having a core diameter of  $1\frac{3}{8}$  in. (3.5 cm.) and the other a core diameter of  $1\frac{1}{2}$  in. (4.4 cm.). Winding from one to the other throws out the index numbers, as shown on the dial or scale, by a total of 60.

If you always fill all tracks with one subject which you are likely to hear from beginning to end, then no rewinding is necessary, but in practice this is often far from what happens, or what can be done. For example, any given spool of tape may be 'full' and yet have a considerable variety of items recorded on it—items of such a nature that (say) neither the red nor the green leader can be labelled 'start'—except in so far as one of the colours may be at the end at which you commenced the series of recordings—and there is therefore no object in storing the tape with a leader of any particular colour 'outside' and ready for playback.

Under these conditions it often happens that, for example, the tape has been stored

with the red leader outside, yet it is desired to play a portion commencing with the green leader. If the required section is very near to the start of the green leader track (or tracks, if it is a four-track machine) then, of course, the spool is merely rewound to get the green leader 'outside' ready for playback. But it commonly occurs that the needed item is near to the end or middle of the track commencing with the leader which is trapped inside the spool, and to reach the item by the customary means, the spool has to be completely rewound to get the desired leader outside, then again fast-wound up to the desired index number on that track.

Let us take a specific case. A 5 in. (12.7 cm.) spool of Long Play tape might contain about 700 (index counted) turns of tape, and takes about three minutes to rewind. Let us suppose that we have such a spool, and that we require an item at index number 520 on the green start track, but find that the tape has been left in store with the red leader outside. Customarily we would completely rewind the tape to get the green leader outside, then reverse the spools left for right, and wind on to the desired index number: 520. The total index counted turns on rewinding become 700 for the first, plus 520 for the second, which equals 1220 turns, and the time taken would be about four to five minutes.

With my system, the full spool with the red lead would be placed on the right-hand spindle, and the red leader would be laced to an empty spool on the left-hand spindle. I should then fast-wind, with one brief stop, directly to index number 520 on the green start track. As I should have to wind only 180 turns (700 minus 520) I should reach the item in less than one minute. Here you may remark that 5 minutes or so is not worth bothering about, but suppose you had 12 such spools and you wished to extract items from various positions on each for re-recording with a second recorder, on to a single spool, and 6 out of the 12 spools were found to be 'wrongly wound'—then the time saved can amount to half an hour or more—time that would otherwise be devoted to nothing but the bore of watching tape pass from spool to spool.

## MORE THAN TIME-SAVING

Moreover, I do ask you to note that there is more to my system than time-saving: on those machines where tape cannot be rewound without passing it over the guide posts and through the play head, tape wear from scuffing on those posts (and sometimes also over the heads) is reduced to a minimum simply because so much rewinding is not called for. For mere rewinding on my own recorders, as there is no ornamental obstruction between the spools, I can rewind without lacing through

the head: I merely gain in terms of time.

Since a 5 in. (12.7 cm.) spool of Long Play tape is the size more often supplied with domestic recorders, this is the size I have chosen as a basis for discussion. I should remind you here that the figures given are *my* index counter readings, and if you wish to know the actual turns (which are not really necessary for our purposes here) you have to multiply my readings by four and divide by three.

There are two ways of preparing tapes for quick index finding (starting from 'the wrong end'), one mechanical and the other arithmetical. I shall describe both, and each will complement the other. Both are extremely simple, and you will see how to apply the method to all your tapes.

I will deal with the mechanical way first. Referring to the diagrams, at **fig. 1**, you place the full spool on the left spindle, and an empty spool on the right spindle, and set the index counter to 000, with the leader joint in, or exactly opposite the play head. The starting colour is of no importance.

At **fig. 2**, you wind to the right until the index reads 666: a number that, in this example, will bring you to within less than 111 counts of emptying the left-hand spool. Stop winding at exactly 666, and insert or trap a paper slip between the right-hand reel and the oncoming tape, as indicated by P in the figure. (If the spool was a smaller one, you would have to stop and insert the paper at a lower number—555 or 444; and for a larger spool you could, of course, run to a higher number: 777 or 888 to have less than 111 counts remaining on the left-hand spool. In the example illustrated, 666 suits our purpose because, as indicated on **fig. 2**, we could not run to 777 without completely emptying the left spool).

## CONTINUE WINDING

**Fig. 3** shows that after inserting the paper slip you continue winding right up to the coloured leader on the left spool. For the moment, ignore the index counter reading and set it to 000, as at **fig. 4**.

Now, **fig. 5**, wind from right to left and at the same time watch carefully until the paper slip is freed, then stop at once. Now note the index reading. It may read 945, as shown, and this will be because the counter has been running backwards from 000, 999, 998 and so on, downwards: the point is, however, that the tape is again in exactly the position it occupied when you first inserted the paper slip, which was 666, so, for ever afterwards, whenever you wish to start *that* tape from the wrong end and for reasons already stated, you will know that, commencing from a 000 start as in **fig. 4**, when you have wound down to 945, you will be able to stop, set the index to 666, and then carry on backwards (or

forwards) to the logged index number that you require. For this particular tape I have a note in my index book to the effect that 945=666, and both leaders of that tape are marked in the same way.

I feel I should again pause to remind you that the foregoing method applies only to those recorders fitted with wheel reset index counters that can be set to the intermediate series 111, 222, 333 and so on up to 999. Methods for the push-button type of counter will be dealt with later. I shall also later refer to the series 111, 222 and so on as 'triple digit numbers'—for want of a better term.

The simple mechanical method just described will make clear the arithmetical method—which requires no fiddling with, or watching for, paper slips.

Set the spools as in fig. 1, with the index counter at 000. Wind to the end, that is until the end leader joint is exactly opposite the play head as in fig. 3. Stop, and note the total turns count, which I have shown to be in this case, 721.

**HIGHEST POSSIBLE**

Deduct the highest possible triple digit number that will give a remainder of less than 111, and note the remainder. In this example it will be 721 minus 666 = 55. This, of course, means that there are 55 turn counts in excess of 666, so if you start from 000 (which may equally well be regarded as 1000 for our purposes) and wind backwards 55 counts, you can reset your index to 666, and that track will then agree with your index book. To make the index counter read 55 counts backwards, or to find out what it ought to read after moving backwards 55 counts, you have only to deduct 55 from 1000, and the answer is 945—the same as in our fig. 5!

As another example, I will take a 4 in. (10.2 cm.) spool of Double-Play tape which contains even more turns than a 5 in. (12.7 cm.) spool of Long-Play :—

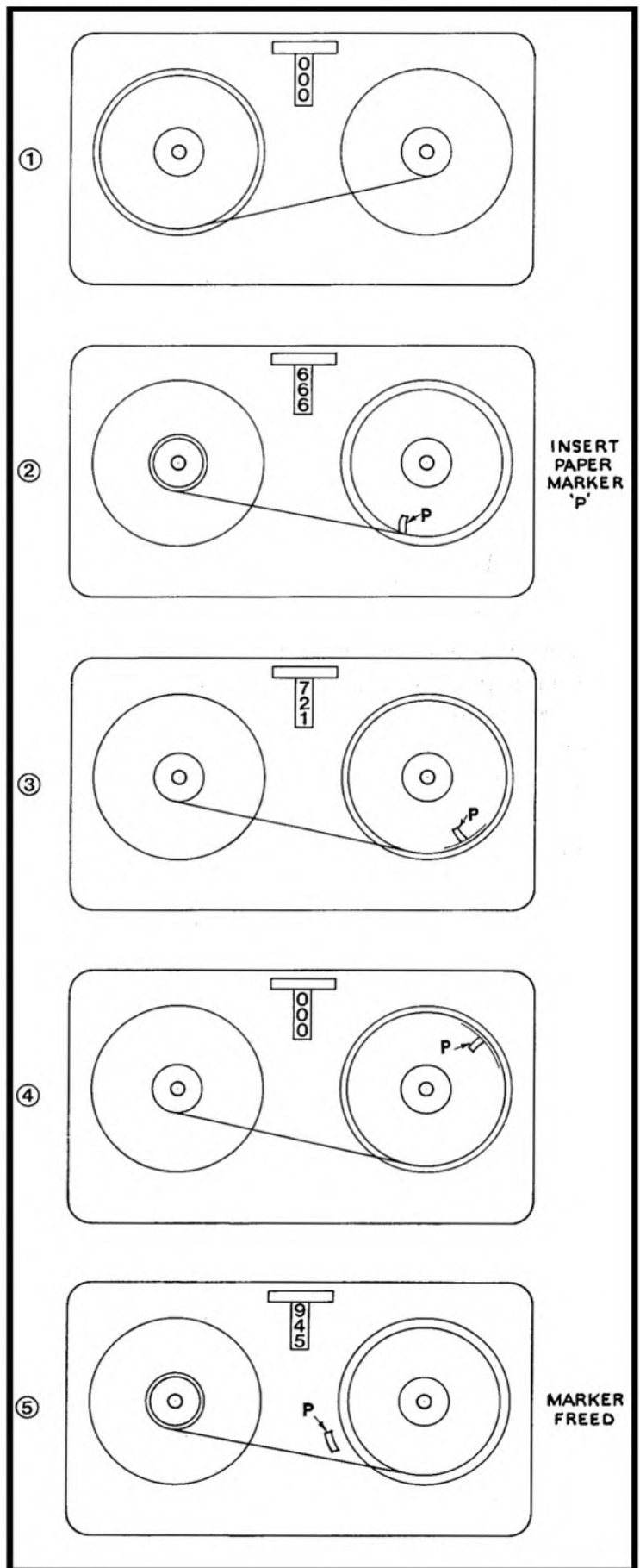
Total turns as measured by the index counter = 834.  $834 - 777 = 57$ .  $1000 - 57 = 943$ . Therefore I am able to code that tape to the effect that  $943 = 777$ .

On those machines with push button reset index counters which can be reset to only 000 (or 0000) and which count turns of the left-hand spool, there is still some advantage in reading off the exact total counts on each of your spools, and making a note of the readings for 'reverse indexing'—starting from 'the wrong end'.

Let us take as our first example the 5 in. (12.7 cm.) spool of Long-Play tape which has a count of 721. If we place this on the right-hand spindle, lace to an empty spool at the left, and set the counter to 000, we shall, in the first instance, know that 000 (which we read as 1000) = 721, and that  $999 = 720$ , and so on, downwards—the counter will be reading  $1000 - 721 = 279$  turns too many throughout that tape. In other words, to get an indexed tape position from the counter you could always deduct 279; but as this would be rather awkward except for those who are expert at mental arithmetic, there are therefore two courses open to you:

(i). The index counter may be set at 000, and then be allowed to freely run 279 turns down to 721, so that when you stop at this

(continued on page 137)



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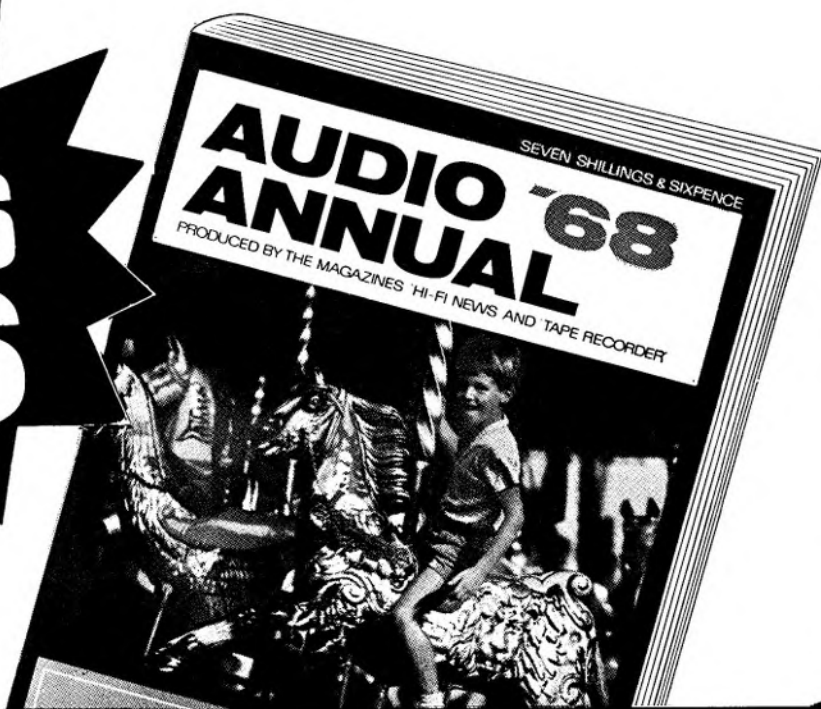
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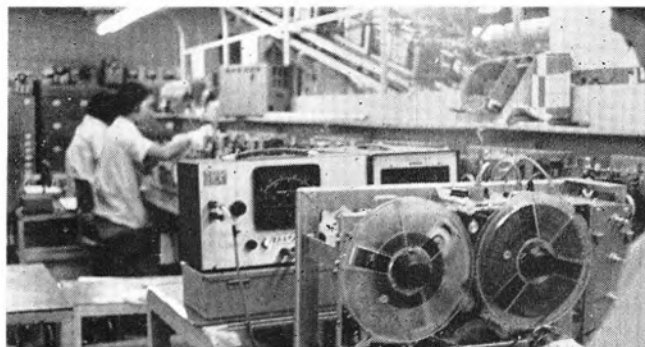


# a look at sony

## ANTHONY EDEN CONCLUDES HIS TOUR OF JAPANESE FACTORIES



**Above:** The main Sony plant at Shinagawa, Tokyo.  
**Below:** A TC530 undergoing final listening tests.



**Above:** Measuring wow and flutter levels of a TC530.  
**Below:** One of the massive Sony production lines.



ONE of the foremost names in Japanese industry is the *Sony Corporation*. With American style advertising and many revolutionary products, the company has established itself very firmly in the minds and lives of Japanese people. To further their aims, Sony have a new building in Ginza in the centre of Tokyo where not only their own products are displayed but those of many other companies. At weekends the building becomes a centre to bring all the family, with children and adults catered for alike. There are restaurants, clothing departments, the latest model of car, a bamboo pipe organ which is played periodically during the day, numerous electronic organs, closed circuit television and at strategic points in the seven storey building, Sony's own products.

Behind this magnificent showcase is the man who has developed the Sony Corporation from a starting capital of £200 in 1945 to its present position with sales of over £100 million per annum. Masaru Ibuka started out in a bomb-gutted department store in Tokyo; along with a business associate Akio Morita and seven technicians, Mr. Ibuka started producing short-wave con-

vertors for radio sets, so that people could once again listen to news from outside Japan. In 1948, at the request of the Japan Broadcasting Corporation (NHK), they started to design new broadcasting equipment. About that time Mr. Ibuka came across a U.S. Army tape recorder. He set to work to design a product using the principles of this machine. But there were difficulties: it was too heavy and too expensive and they sold only two machines. Since this did not make for a flourishing business, the small team of designers developed a lighter and cheaper version of the recorder and, as it was no use having tape recorders without tape, they were obliged to make that as well. Due to government restrictions on importing suitable tape bases such as *Mylar*, their first tape was made from strengthened paper.

They decided the only way to sell tape recorders was to educate the public, so they bought a demonstration truck and explained the potential uses of this new machine in schools. Eventually they sold well and thus started the evolution of the tape recorder in Japan. Sony went on to produce the world's first all-transistor radio and recently

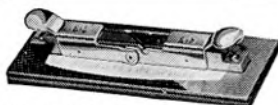
have developed video tape recorders and miniature television receivers. Today they have a large research laboratory near Yokohama where solid-state physics and fundamental materials are studied. Each year they invest some 6% of their profits into research, so that they can keep ahead in developments, the video tape recorder being a good example.

Sony have three factories in Japan. The main factory is in the Shinagawa district of Tokyo which I was privileged to visit. Transistors are produced at the Atsugi plant, 35 miles south west of Tokyo, while the Sendai plant, 250 miles north of Tokyo, produces magnetic tapes and ferrites. At the Atsugi plant, Sony recruited many girls from the country districts to work in the factory and, as with nearly all large companies in Japan, provided hostels for the girls to live in at very modest rents.

Sony have concentrated on three basic products only: tape recorders and ancillary equipment, television and radios, and the necessary components for them. They do not believe in expanding the range of products,

*(continued on page 123)*

# Bib audio aids



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The author watches a stage in TC530 assembly.



Mass testing of Sony domestic video tape recorders.

but rather on concentrating development within that range. In comparison with some of the other companies in Japan, Sony are quite small; but it has made a very big impact and influenced trends in electronics throughout the world.

The main factory in the Shinagawa district of Tokyo is in two parts. In one factory—which is at present being greatly expanded—domestic video recording equipment and colour televisions are being produced, and about a mile away in the other factory, tape recorders, radios and televisions are made. Of these production lines, I was particularly interested in tape recorder assembly. The actual manufacture of a tape recorder must be seen to be appreciated. Each part of the assembly line has been divided up so that one logical stage of assembly can be completed as the conveyor belt is moving continuously. Deft-fingered girls work at incredible speed to assemble their particular components within the prescribed time of about five minutes. I learn that initial training of girls for production line work takes about four weeks. After that the girls 'graduate' along the line to the more difficult parts of assembly and the most highly skilled part of the production line is in the final testing of each machine. I also learnt that Sony are very reluctant to introduce automation into production lines as it takes away versatility should it be necessary to incorporate minor modifications.

At the time of my visit they were trying new production methods, such as a machine being assembled completely by one girl. Such a technique, known as 'job enlargement' is slower and training more costly but the result is the production of a higher grade instrument. Such methods of assembly are already being used by certain companies in America and England. Of the tape recorders that Sony produce, I had the opportunity to watch the assembly and testing of the TC530 model. When a machine has been completed, a quick electrical check is made, and then it is set running and put on an overhead conveyor belt. The conveyor carries the tape recorders above the assembly line and after three hours running it is returned to ground

level for checking.

Firstly, the machine is shock tested by hitting the sides of the case with a rubber hammer. This is to check for loose connections, dry joints and electrical breakdown. Then the recording characteristics are determined. This involves checking and adjusting the level of treble boost applied to the tape during recording. The HF bias voltage is also measured and set at the correct level. Next, a pre-recorded tape is used to determine the correct bass boost on playback. Then a general overall frequency response check is carried out at spot frequencies. The deck mechanics are examined, speed variation and wobble being measured. On the machines under test the playback-only wobble figure was around 0.08% RMS. Finally the machine passes to a sound-proofed cubicle where a pre-recorded tape is played to check the reproducing system as a whole. Final checks while this is going on are for tightness of knobs, correct operation of switches and general worthiness. If the machine passes all tests satisfactorily, of which about 95% do, it is passed to the packing section.

Such a series of comprehensive tests should bring to light defects in any part of the system. Obviously such tests cannot reveal such things as long-term durability—only the quality of material determines this and Sony make sure these are kept up to standard. Although I did not see other production lines, I presume that most of the above tests are carried out on other machines. In all, the testing took around half an hour, and certainly proved the worthiness of each machine. With such an involved testing procedure, surely it would be worthwhile to include the test figures on a certificate with each machine? The additional time taken to note down the results of the tests would be easily repaid by the added confidence given to each purchaser, especially in this country. However, we only consume 1% of Sony's exports!

During my visit to Sony I had an opportunity to discuss tape recording problems with Mr. Shiro Hojo, General Manager of video tape recording production. Tape recorders, I learnt, are Sony's most successful

product, being 38% of their net sales. Production increased some 40% last year, expansion coming from both home and export markets. Interest and development is now centred on video tape recorders, and again Sony are adopting their old policy of educating the market for this new form of home movies and its vast industrial applications. Big campaigns are at present going on in America and Japan to further interest in video recording.

Without doubt Sony has centred its export activities on America, but with the present condition of market trends there, interest is turning to Europe. Generally this represents a different kind of market altogether. In America the demand is for constant change, whether an improvement is in fact brought about or not. Here in England, due to lack of cash, squeezes and freezes, and a more conservative outlook on life generally, it appears the British enthusiast demands a machine that fulfils his own requirements adequately and will stand up to a number of years of hard wear. Hence one tends to find that the quality and durability of European equipment—at its best and price for price—tends to be better than its Japanese counterpart. My impression during our talks at Sony was that they realised they could not compete with the best European equipment, and so directed their sales into two categories which have wider and better possibilities for them. The first category is the mono battery and mains/battery portable tape recorder, and the second is the medium-priced stereo tape recorder range. So far they have been most successful in filling these two categories, satisfying the demand and developing appropriate machines.

With the rate of increase of trade to America diminishing—a small but nevertheless significant pointer to future trends—greater interest has been promoted in the British market for tape recorders. Also, with the feeder arrangements set up between some Japanese companies and their English agents for British requirements, it will be interesting to see what new tape recorder models the Japanese introduce as a result of these developments.

# SERVICING AN HONEST OCCUPATION?



H. W. HELLYER CONSIDERS THE ETHICS OF HIS PROFESSION

THERE'S an old Chinese custom, so I am told, of paying the doctor only when you are well and stopping contributions when you are sick. Something similar might not be a bad idea in the radio, television and audio servicing business.

At least, so it would appear, to judge from the bleats one hears about the high cost of service when our readers' tape recorders go wrong. To redress matters somewhat—if this humble contributor may be permitted to put the dealer's point of view—let us take a look at service procedures in the tape recorder and hi-fi field.

First, a comparison: when the average television receiver goes wrong, there is a frantic call for help, and the serviceman is expected to come before the telephone is replaced on its hook. He does his magic juggling in the mysterious innards of the set and picture and sound re-appear. Only very occasionally is there any qualitative judgement made of the picture, and extremely rarely of the sound. In any case, the finer points of video resolution are seldom realisable by the average receiver on site, and the quality of the sound broadcast by television stations often borders on the ridiculous. Ever listened to the background music of such programmes as *Peyton Place?* (No!—Ed.)

A very different situation exists when the engineer undertakes a repair to a tape recorder or, as might be expected, any part of a hi-fi rig. Quality is the prime feature of judgement. It is no flattery to say that the general reader of this magazine is likely to be a bit fussy about his audio standards—and it is his machine, or the property of someone very like him, that the audio engineer has to tackle. Therefore, the repair consists of a little bit more than merely getting it going. One must bring the job up to manufacturer's specification, or as near it as economically possible. And even with quite cheap machines, it needs only a small deviation from these standards to offend the critical ear of owner and engineer alike.

## DEAD GEAR

Which brings us to another important point. Most of us who, for our sins, are committed to the daily task of bringing dead audio gear to life, are ourselves enthusiasts. Some of us, they tell me, are quite mad!

But it is not just because we are a trifle fussy that repairs to tape recorders tend to cost a bob or two more than the average radio repair. The cost is principally made up of labour charges: testing, diagnosing, repair and

retesting take time. Add to this the fact that most groups of machines employ special parts, which must be obtained—and paid for—preventing the easy 'one-shot' repair likely with radio and television mending.

The amount of time taken on final testing depends on the quality of the tape recorder. Obviously, those machines that operate at higher standards require more meticulous tests. The very minimum of test gear includes a standard test-tape for frequency response, head alignment tapes, of which there are several types for different purposes, a good signal generator, with attenuator and matching pads to cope with the widely varying conditions, a valve voltmeter, a reliable output meter, and perhaps an oscilloscope. While the ear is the final arbiter, and quite close tolerance wow and flutter tests can be made without it, the addition of a wow and flutter meter completes the test bench 'assessment gear'. We have not yet considered the standard equipment needed for deeper inspection: meters of various sorts, transistor testers, stroboscopes, and so on.

So we may accept the argument that tape recorder and hi-fi test and repair is no job for the casual handyman. Skilled engineers cost money. They must be employed fully to make their existence worthwhile to their employers. This means that the workshop has to be organised properly, and it also means that the jobs themselves must be tackled with some sort of systematic approach.

## VARY GREATLY

Tape recorders vary greatly in design and construction. It is almost unbelievable how many different ways there are of doing the same thing! Despite this, we can break down the job procedure into a number of essential operations. These can be costed, from experience of average time taken, and the whole list of operations and costs tabled in much the same way as our leading vehicle repair depots lay out their work invoices and estimates. As an example of this tabulating, and to underline my argument that tape recorder test and repair jobs are often complicated and time consuming, a specimen job card is illustrated.

This was the brainchild of R. J. Lovell, Managing Director of *Tape Recorder & Hi-Fi Centres*, Bristol and Cardiff, and perhaps it would be better to let him commence with a description of the idea behind it.

"Our idea is threefold. First, we aim to show the customer what he is getting for his money; second, we enhance a reputation for responsible work, and guarantee what we do and thirdly, we protect ourselves against any future complaint by showing not only what we have done, but also by listing accessories and so on when the job is booked in."

This third point is covered by the compartments on the obverse of the job card, where microphone, record lead, spool, tape and mains plug, if any, can be ticked off. Other compartments are for business purposes, aiding

costing and having reference to maker's guarantees, etc. The part of the card that concerns us here is the reverse side, where the various operations are listed and costed. Mr. Lovell had a few words to say on this subject also.

"We have lumped together the general jobs that have to be done on any machine that passes through the workshop. Such things as drive testing, brake checks, head alignment, lubrication and degaussing have to be done on all jobs, or they cannot be properly tested. So this is all covered by our basic labour charge. And it is surprising how many repairs can be done within this price bracket alone."

It might be said that these tasks are routine maintenance, which any responsible owner should be able to do for himself. But not all tape recorder owners are readers of this magazine and machines are brought in for repair with bits hanging from them, with odd lengths of wire and elastic substituted for drive belts, with hairpins or paper-clips in place of vital levers, or, in the least serious cases, with their head channels cluttered with parings of old tape and mysterious wads of fluff. All this is 'bread-and-butter work' to the engineer, and accounts for many of the lower-priced repairs.

It is when we come to such items as brake and clutch adjustment that the extra time can be spent and the extra labour charge made necessary. Take for example the very popular deck produced by *Philips* for their *EL3541* range, with all its variants. These come to our workshop at the rate of several a week, and practically every machine that has not been serviced for a year or more needs a new belt. The clue, always, is that the tensioning pulley is against its limiting stop when the belt is running.

## NEW BELT

But as soon as we fit a new belt, we find ourselves involved in clutch adjustment, perhaps renewal of Vulcanan plugs in the lower drums, almost certainly fitting new neoprene washers to achieve the correct clutch and turntable height, and often resetting the inner bushes of the drums themselves, where wear and tear plus lack of lubrication has taken its toll.

The patient dismantling and re-assembly of clutches several times is almost a habit when servicing these machines, and the running tests must always end with fast winding from end to end of a spool in each direction to make sure the torque remains correct. The belt renewal charge allows a little extra for the simpler jobs to compensate for the extra time. Even then, it is necessary to have a clutch adjustment charge to cover those other jobs, older *Thorn* decks, the *BSR TD2*, where adjustment again involves complete stripping and rebuilding, the *Grundig TK20* and family which can be quite tricky, and the multi-part assembly of such as the *Akai*.

A small charge for pressure-pad work can include refitting, resetting and complete

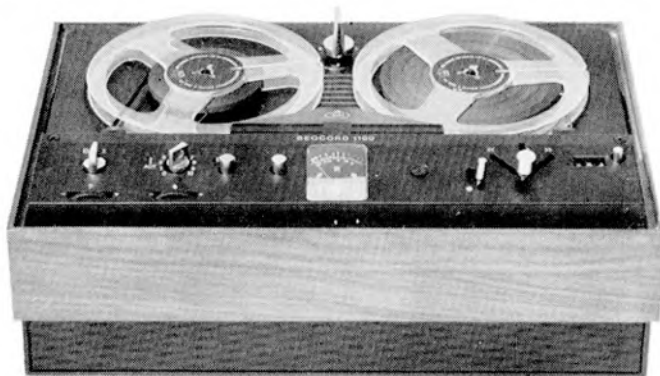




## Bang & Olufsen – for those who consider design and quality before price.



Bang & Olufsen present the Beocord 1100 – a fully transistorised, 2 track mono tape recorder with advanced technical specifications to semi-professional standards.



This 1/2 track mono tape recorder incorporates many of the advanced features of the famous Beocord 2000 de luxe series, plus automatic/manual recording, built-in 10 watt RMS amplifier and integral monitor loudspeaker. All spool sizes up to 7" may be used.

The amplifier with its associated independent bass and treble controls facilitates the use of the Beocord 1100 as the heart of a Hi-Fi system.

Designed with minimum overall dimensions, the Beocord 1100 may be accommodated on a bookcase. A fold away carrying handle, plexiglass dust cover and full 7" spool of tape are provided.

Available with Teak or Rosewood plinth.

### TECHNICAL DATA

#### Tape Speeds

1½ in. 3½ in.  
7½ in. per. second.

#### Fast Forward and Fast Rewind

Approx. 150 seconds in both directions for LP tape (1800 ft.)

#### Controls, Mechanical

On/off switch and speed selector.  
Tape control lever.  
Tape counter reset button.  
Pause control lever.

#### Automatic Stop

At end of tape or if tape breaks; actuated by metal foil during normal forward operation.

#### Inputs

Microphone 50-200 Ω.  
Gramophone 2.2MΩ/75mV and  
Radio 47KΩ/1.6mV.

#### Outputs

Radio output, 4.7KΩ/0.6V max.  
Loudspeaker output 10 watts/4 Ω.

#### Power Output

10 watts. (built-in loudspeaker max. 3 watt).

Loudspeaker Impedance  
4 Ω.

#### Heads

Combined record and playback head, 30 mHy  
Gap 3 microns. Erase head; Ferrite, 2 mHy.  
Gap. 2 × 100 microns.

#### Erase and Bias Frequency

60 kc/s.

#### Frequency Response

1½ in./sec.: 30- 8000 Hz (± 2 dB 40- 6000 Hz).  
3½ in./sec.: 30-16000 Hz (± 2 dB 40-12000 Hz).  
7½ in./sec.: 30-20000 Hz (± 2 dB 40-16000 Hz).

#### Wow and Flutter

7½ ips - 2%, 3½ ips - 6%, 1½ ips - 6%, all values peak to peak.

#### Weight

28.6 lb.

#### Dimensions

W = 17½ in.  
D = 11½ in.  
H = 7½ in. with dust cover.

**BANG & OLUFSEN**, United Kingdom Division, Eastbrook Road, Gloucester. Telephone: OGL2 21591.  
London Showrooms: 70/71 Welbeck Street, London, W.1. Telephone: 01-486 2144.

scarcer petrel is Leach's Fork-Tailed Petrel which nests on remote islands in Irish and Scottish waters. While breeding, its habits are nocturnal. Notes are said to be high-pitched croons which are often rhythmic in character.

Terns may be recognised as being more slender than gulls; the tail is forked and usually a black crown is present on the head. All tern species are migrants to the British Isles; the most frequently seen is the Common Tern which nests colonially on shingle or sand-dunes. A harsh "kree-ah, kree-ah" is given as an alarm call if the colony is approached. Display and other calls are variants of "krik, krik, krik." With patience and a calm day, most calls may be taped if the recording apparatus is set up near a nesting colony. The Arctic Tern, having arrived from winter quarters near Antarctica, breeds farther north than Common Tern and at similar sites. Sounds are like Common Tern, but with the addition of whistling call-notes: "ke-ee, ke-ee."

RARER TERN

The Roseate Tern is rarer and has longer tail streamers. This charming rosy-tinted tern breeds very locally round Britain's coasts. Some notes are as Common or Arctic Tern, but a rasping "arck, arck" is made as an anxiety call. The Little Tern has a white forehead and nests on sand or shingle beaches, hence it is often disturbed by human visitors. Calls are a high-frequency "krik, krik" and a repeated "kirri, kirri, kirri." A tern which breeds on marshes is the Black Tern; it migrates over Britain in spring and autumn but at present is lost as an English breeding bird. It should be possible to record the thin "kit, kit" calls as it feeds on spring passage. Those recordists who take continental holidays might tape it on its breeding marshes during June; both Denmark and Holland have appreciable nesting populations. The largest British tern, and the most clamorous, is the Sandwich Tern which now breeds mainly around northern Britain. Calls are largely variations of a rasping "kir-ick, kir-ick" which is somewhat less harsh than that of Common Tern. The alarm call is a hard "gurit".

NOT APPRECIATED

Two large sea-birds which are not appreciated by fishermen are Cormorant and Shag. At their breeding-sites on the ledges of cliffs or recesses in rocks, various grunting croaks or rasps are produced occasionally. To tape these sounds is a challenge in gaining access to difficult sea-cliffs or islets; recording from a small boat has many obvious hazards and it is preferable to land in order to give stability to the microphone and to reduce wave and splashing noises. Another fish-eater is the Gannet which nests in large numbers on rocky marine islands such as the Bass Rock or Grassholm. These ganneteries are, of course, protected and landings are precarious in any case. Noises of a barking nature are uttered when breeding, otherwise it is silent.

The auk family has four representatives

which breed in British waters; all are diving sea-birds with short necks and small wings which beat rapidly. Puffins are perhaps the most fascinating—they have big beaks striped in red, blue and yellow. They nest on turf islands or on sloping cliffs. Puffins are not shy at human approach; the call-note is a low-frequency growl: "o-ar, o-ar". This can be recorded at leisure; even, maybe, reclining in sunshine on soft and scented turf. Guillemots, so often victims when oil is discharged into the sea, are also auks. They nest on the ledges of sheer cliffs, often in dense concentrations. Should one bird call, the others seem to be stimulated, which is helpful to the recordist. The obvious method of recording is to hang the microphone over the edge of the cliff; of course it twists and sways and catches on an outcrop of rock which had not been noticed. Yet, with perseverance and the luck of good weather conditions in May or June an attractive tape of harsh "ararr, ararr" calls, of varying frequencies and durations, can be obtained.

THICK-SET

Another auk is the Razorbill which is more thick-set than the Guillemot and has a deeper beak. The cliffs where breeding occurs are mainly to the north and west of Britain; whistling and growling notes are produced. The fourth auk which breeds in Britain is the Black Guillemot, to be found on rocky coasts and in small groups. The call is whistling in character: "wist, wist." Other sounds are of a whining type.

EASIER PREY

In contrast to the auks, skuas are ground-nesting species, so the recordist can work from relatively level situations. The two skuas breeding in Britain choose Scottish isles such as the Orkneys or Shetlands, hence most bird-recordists are faced with a long journey before they can erect their microphone. Skuas are pirates, obtaining their food by chasing and forcing other birds to disgorge; terns and small gulls are the common victims. The largest skua is the Great Skua, a powerful brown bird. Intruders at a breeding colony are greeted by hard, threatening calls: "chuk, chuk" and the recordist may merely set up his apparatus and wait to be attacked. More patience is necessary, however, to record the loud "ah, ah, ah" notes of the bird's sexual display. When chasing other birds Great Skuas call: "ske-ar, ske-ar" and it is possible that skuas got their name for this reason; a recordist would indeed have to be an opportunist to tape this sound. The Arctic Skua is smaller and nests colonially on moorland. High-pitched cries or mewling sounds are produced.

ROMANTIC AND ISOLATED

Thus the recording of sea-birds' sounds can take the naturalist to many romantic and isolated areas. The adventure associated with obtaining the tape is an event to be remembered always. Playback gives more than an interesting reproduction of calls; the whole scene of cliffs and white surf and the smell of seaweed returns to the mind. Almost certainly, another expedition is planned for the following summer to listen for new sea-birds' sounds.

circuits will be required which can be built into the preamplifier. Exactly how this can be done for a tape-head has already been revealed in Part 7. The point to note here, however, is that additional stages of amplification may be required to overcome the decrease in gain which inevitably occurs when frequency selective circuits are incorporated. This may be very important in a sound mixer, since the gain of the channel is already reduced by the resistance of the faders and interaction resistors.

BASIC CIRCUIT

Whilst fig. 6 gives the basic circuit for a mixer with a line amplifier which compensates for the insertion loss due to the resistive components, in practice many refinements can be employed to improve the overall distortion and also the noise generated in the more sensitive input circuit. In this context low-noise triodes and pentodes are used in valved preamplifiers, and high stability, close tolerance resistors are used throughout to reduce thermal noise as much as possible, enabling a high signal-to-noise ratio to be obtained. The specification for the signal-to-noise ratio of the mixer is very important and should obviously be at least as high as that of the associated tape recorder so that negligible noise is added by the mixer. Points which should have careful consideration in the design of the mixer are therefore *mains hum* which can develop from insufficiently smoothed anode voltages, and *earth loops* which occur if earth connections are made in different points in the circuit so that minute voltage differences can occur causing minor currents to flow and so generate hum.

Distortion is another important factor and this should be negligible so that the quality of the signal is not impaired before it is passed on to the recorder. We have already seen how correct input matching helps to reduce distortion, and this is reflected in the complex input circuitry found in some mixers. Our discussion on distortion in amplifiers (Part 6) applies equally to sound mixers, negative feedback playing an important part here.

CONCLUSION

In this series we have been principally concerned with valve circuits; however, there are circuits where the use of transistors has a distinct advantage. One such circuit is the microphone preamplifier which can be built into the input circuit of a mixer. Intensive research in the semi-conductor field has led to the use of transistors in low-noise, distortion free, circuits which are suitable for the early stages of the best audio amplifiers. This fact, together with their small size and low operating temperature, explain why transistors are often preferred to valves in sound mixer circuits. It is not intended to discuss transistors at any length, but it is worth saying that, unlike their valve counterparts they require signal *current* as distinct from signal *voltage* to operate them. This enables the low impedance signal source to be coupled directly to the base of the transistor. When domestic microphones are used, a step-down matching transformer or a special matching circuit will be required.

**T**HE cost of an educational broadcast from a television studio with every technical facility can run well over £1,500 for a 30-minute session, but this will be justified by the very large viewing audience. Apart from actors, the programme personnel may include technical director, lighting director, vision mixer, script girl, cameramen, set designers, make-up artist, wardrobe, electricians and sound engineers. Equipment involved will include some very expensive cameras, an extensive lighting grid, a fully equipped video control room, and a sound control room with tape recorders, racks of audio amplifiers, gramophone turn-tables, a reverberation unit and a large audio control console. The studio itself will be large enough to take three or four small sets and will have a high ceiling to take the lighting grid and to allow camera and microphone booms free movement overhead. The floor will be smooth to allow the camera mountings to track freely. There will be hardly any reverberation in the studio due to the dampening effect of the acoustically treated walls.

In fact, a typical TV studio—one that can be found anywhere in the country whether at Tyne-Tees, Southern, Anglia or the BBC. It is expensive to install and run, the techniques involved in producing an educational programme being similar to those used in producing any other non-dramatic or non-musical programme anywhere else in the country.

#### SET PROCEDURE

There is a set procedure for warming and lining up the cameras. Each cameraman has a shot card clipped to his camera. This is prepared by the production team and indicates each shot that he is to offer by a number and a brief description. He can hear the director's instructions over his headphones and he can talk back to the control room. The camera will either carry a lens turret supporting from three to six different lenses, or one zoom lens, probably with a ratio of 10:1. The turret will

contain lenses of different focal length and will be rotated when needed to bring the various lenses in front of the tube to give the effect of different distances from the scene.

The camera will be supported by a heavy mobile pedestal with adjustments for height and steering, or on a boom dolly. The most versatile of the pedestals is balanced on compressed nitrogen and its ring steering allows the cameraman to direct the camera with one hand into any desired position while working the camera controls with the other hand. The pedestal mounting has the advantage of requiring little floor space and can be pushed or turned around very quickly on its own axis. At least two men are needed to crew the boom dolly or small crane which makes it possible to raise the camera to any desired height, depending on the length of the boom. This camera can tilt up or down, boom up or boom down, pan left or right, dolly in or dolly back, travel past the scene or follow the scene. This mounting is essential for studio production numbers, the mass spectacle, large area or high angle shots.

#### COMBINATION OF LENSES

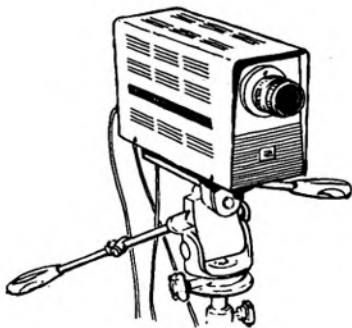
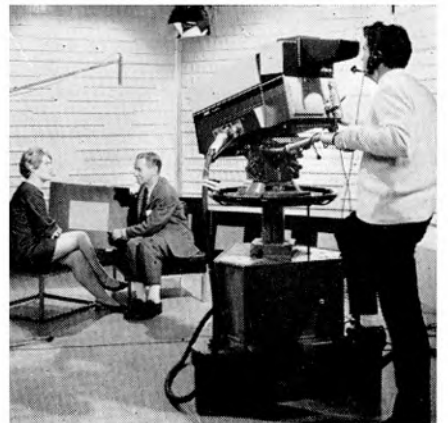
The combination of wide angle, standard, and narrow angle or telephoto lenses helps the cameraman to show the whole scene and action so that the viewer is informed about: (a) the location of the action, (b) selected parts of the scene at a closer range, (c) smaller but important detail in close-ups and, (d) minute detail in big close-ups. Rotation of the turret is achieved by use of special gearing to move the lens quickly and smoothly to the next position and to line it up in the correct position in front of the tube. This is always done when the camera is off the air.

Cameramen avoid tracking or panning with a very wide angle lens for this tends to curve both horizontal and vertical straight lines—the degree varying in different parts of the picture with the result that these lines appear to twist. Tracking in and out with a telephoto lens is also avoided unless the track is a very

A typical studio layout  
—an Anglia commercial  
advertisement set.



EMI 2001 colour camera now being  
used by ABC, Anglia, Yorkshire  
Television and the BBC.



# CLOSED CIRCUIT

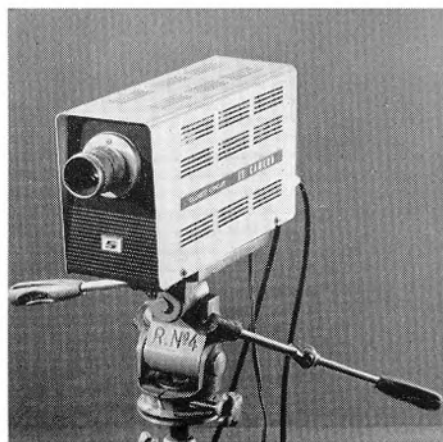
No 5 CAMERA TECHNIQUE  
BY RICHARD GOLDING

long one or the floor is perfectly level, for the slightest jolt of the camera will result in the picture shuddering out of all proportion. Panning across a static scene with any type of lens is also avoided if the only purpose of the pan is to get from one subject to another, for this movement does nothing for the action and only draws attention to the camera technique. Pans are used to follow moving subjects but a slow pan is permissible on a static scene if the scene is sufficiently far away for the eye to take in all detail uncovered by the pan. Cutting between two moving cameras, especially if they are panning, or between one moving camera and one static camera, is regarded as bad technique and is not done.

#### LIMITED SPACE

A zoom lens is sometimes preferred to a turret combination, especially where floor space is limited. An important feature of the zoom lens is that it enables the effective lens angle to be altered over a wide range, ensuring perfect framing of the scene with the minimum of adjustment. A zoom in narrows the lens angle and blows up the centre of the shot to fill the whole screen. The zoom out widens the lens angle and gives a long shot of a larger area. The disadvantage of this type of lens, however, is its effect on depth of field when zooming in, and stretching when zooming out. This is more noticeable with extreme narrow-angle shots where the perspective alters to give a flat fore-shortened effect similar to those so often seen in close-ups of cricket games, the wickets appearing only a few feet apart. The lens is extremely useful for fast camerawork and the zoom shot can take the eye rapidly from a wide field to concentrate on a small part of this field and vice-versa. Used with discretion it can be very dramatic indeed, but its shock effect is so often overdone. Its greatest value, perhaps, is in its ability to creep in without being noticed by the viewer to give correct framing of some important detail. When a zoom lens is panned it is at a slight disadvantage, needing a greater

**Shibaden HV-14 camera**  
for closed circuit  
applications.



arc of movement than the normal wide-angle lens.

Switching of the various camera positions is either carried out by the director or the vision mixer, and editing arrangements will have been decided during rehearsal. The preview picture monitors in the video control room give continuous pictures from the various sources and will show cameras offering their next shots, film inserts running on to their cue points, captions, effects and so on. The editing will be immediate and will be directed towards telling the story in a clear, direct fashion, using mostly a straight cut on movement within the frame to change from one camera position to another when the action is continuous in time. Cutting on the movement of the character as he sits down, stands up or turns around makes the cut less noticeable. Cutting from a static picture to another static picture makes the cut stand out.

Mixing or cross-fading from one source to another is used to indicate a lapse in time during a scene or between scenes. It is not usual to mix from one scene to another when the action is continuous in time. Anything shorter than two seconds for a mix defeats the object of the mix and three seconds is about the normal time that should be allowed for cross-fading from one scene to another. A long lapse of time is usually indicated by a fade-out to black followed by a fade-in from black.

#### ESTABLISHED TECHNIQUES

Just as Broadcast TV has had to adapt established cinema film techniques, so CCTV must take established studio techniques and cut them down to its own size. The situation is not altogether dictated by funds available, though this is a great consideration, but rather by the difference in end product. Its audiences are comparatively minute and more specialised, and because the picture needs only to be relayed to one or two rooms or to a video recorder the equipment required does not

**Nivico KV 800**  
video tape  
recorder



necessarily have to be of Broadcast quality. Available manpower, space and power supplies have to be taken into consideration, and portability and ease of operation of equipment must play a great part.

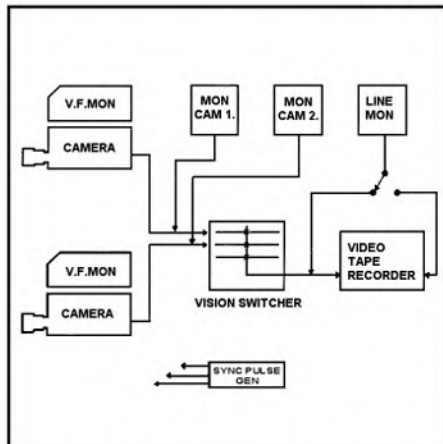
A fairly inexpensive camera, typical of models in this price range, is the Shibaden HV-14. Its price is £165. It is fully transistorised with video and RF outputs which means that it can be used with either a video monitor or a standard 625-line TV set. It comes with a standard  $f/1.9$  25 mm. lens in a 'C' mount which permits the use of normal 16 mm. cine camera lenses. It is fitted with a vidicon tube, an impedance matching transformer and 15 ft. of coaxial cable with connectors. Maximum cable length, however, using special cable, is 2,900 ft. It weighs, less lens and cable, only 7 lb. and its dimensions are approximately 15 x 10 x 28 cm. It contains an automatic light control system in addition to provision for easy manual adjustment and focusing.

In the standard version with the 25 mm. lens its versatility is fairly limited, as one would expect. For a straightforward observation of a demonstration it can give excellent results, provided the lighting is right; but cutting from various camera angles is out unless you are making a video tape recording. Even here you may finish up with scenes separated by unpleasant picture rolls. You could make this camera more versatile by adding a zoom lens. One of the cheapest is the manually operated 4-1 Canon  $f/1.8$  zoom which costs about £120. The motorised version comes at about £260. A 10-1 manually operated Angenieux will cost around £350. But even with the addition of a zoom lens it will be virtually impossible to present a programme with any pace or variety with just the one camera position. For the efficient closed circuit system, two cameras are necessary.

I have been shopping around to find a complete two-camera system for under £1000 and

*(continued on page 130)*

**Two-camera scheme**  
devised by  
**Video Ltd.**



**CLOSED CIRCUIT CONTINUED**

have been able to find a scheme that includes two cameras, three monitors, a vision mixer, a sync pulse generator and a video tape recorder for under this price. This is presented as an example of a complete package obtainable from Mr. K. Wilkinson of *Video Ltd.* The scheme can be modified to any extent according to need and is offered as an example only.

The VTR is a new model on the market—the *Nivico KV-800*—and costs £360. It has a

rotary two-head recording system with 405 or 625 line standard and uses 1/2 in. (1.27 cm.) wide tape at a speed of 9.45 (24 cm/s).

Mr Wilkinson has this to say about the system: "When recording from alternate video sources, i.e. cameras, the change-over from Source 'A' to Source 'B' can cause the video tape recorder to become unstable for a brief but nevertheless noticeable period. Direct switching between composite video sources interrupts the sync pulses. To obtain a satisfactory video recording the video sources should be synchronised either to a sync pulse generator or by means of slaving one video

source to the other. Direct switching of synchronised video sources can be accomplished with the minimum of sync interruption. Ideally, the VTR should be fed continually with sync pulses during the entire operation. This can be achieved by using a video mixer. The output from the mixer will retain sync pulses at all times, enabling direct switching, mixing or fading of the video sources. The VTR can be allowed to lock into the sync pulses before commencing the recording."

The price of the video mixer is around £250 and further details may be obtained from *Video Ltd., 2 Bath Road, Woking, Surrey.*

**SERVICING—AN HONEST PROFESSION? CONTINUED**

"They are intended as a guide, both to the engineer, and to the customer. They can explain what work has gone into a repair that may have taken a fair amount of time. But above all, they show that the work is being done in a methodical way."

He went on to emphasise that a stick-on guarantee label covering the customer for three months repeat service went out with every completed job. "This is, provided he brings the original card back to prove the work done—also a safeguard for the workshop staff who would take a dim view of being asked to do a free 'burnout' repair a week or two after a belt change. It has happened!"

There are other aids to organisation, such as the multi-purpose card that tells a customer when his machine is ready, how much the

repair will cost, or if it is awaiting spares, or even, in some sad cases, unrepairable. Estimates are also printed in such a way as to ensure legal safeguards for both parties. A basic charge is necessary for preparing an estimate—often taking as much time as actually completing the repair.

All these things are merely the 'customer' end of the repair business. There are numerous hidden tasks that help keep servicing economic. In particular, the ordering and stocking of spare parts can be brought to a fine art. Some makers are very helpful, listing parts in easily noted sequence, and with clear part numbers. Others—sadly, some of the larger firms—appear to follow no sequence at all, or to list part numbers that have no bearing on the spare number quoted on the delivery notes.

Yet others send parts with no price stated, leaving us to guess, or keep our unfortunate customer waiting for an already mended piece

of equipment until the invoice arrives. A few insist on sending small parts COD, which adds at least 7s. 6d. to the price, and, most annoying of all, one or two makers reply to our order—after some delay—with a pro-forma invoice, wanting cash in advance; which would not matter so much if it did not involve yet more dead time and cluttered workshop space while the machine languished for its life-giving spare part.

All of which may help to show that servicing is not the sinecure some cynics have inferred from sensational reports of overcharging that occasionally crop up in the press. In general, the specialist dealer does a good job. He has to: he wants his customers to return gladly, not with a grudge. After all, he is mainly in business to sell. Service, like it or not, is a necessary evil. But you can take it from this old hand—it is an interesting occupation. Life is never dull.

**whatever the make . . .**

4-TRACK STEREO	Deposit		12 Monthly Cash Payments		Price
	£	s. d.	£	s. d.	
Philips EL3312	14	15 0	3	11 8	55
Ferguson 3232	18	2 3	4	10 7	69
Sony TC200	18	18 0	4	14 6	72
Philips EL3555	19	13 9	4	18 6	75
Akai I710	20	14 9	5	3 9	79
Tandberg 74	24	8 3	6	2 1	93
Sony TC260	25	9 3	6	7 4	97
Tandberg Series 12	27	11 3	6	17 10	105
Revox 7362 or 4-T	31	4 9	7	16 3	119
Sony TC530	31	12 6	7	18 2	120
Akai M8	32	16 3	8	4 1	125
Beocord 2000K De Luxe	32	16 3	8	4 1	125
Beocord 2000T De Luxe	33	17 3	8	9 4	129
Akai X300	48	11 3	12	2 10	185
Akai X355	62	14 9	15	3 9	239

4-TRACK MONAURAL	Deposit		12 Monthly Cash Payments		Price
	£	s. d.	£	s. d.	
Ferguson 3224	6	11 3	1	12 10	25
Fidelity Playtime 4	7	1 9	1	15 6	27
Fidelity Playmatic 4	8	2 9	2	0 9	31
Elizabethan LZ34	8	18 6	2	4 8	34
Ferguson 3218	8	18 6	2	4 8	34
Telefunken 201	8	18 6	2	4 8	34
Ferguson 3222	9	3 9	2	6 0	35
Philips EL4305	9	9 0	2	7 3	36
Grundig TK140	10	2 2	2	10 7	38½
Philips EL4306	11	0 6	2	15 2	42
Ferguson 3214	11	11 0	2	17 9	44
Truvox 44	12	6 9	3	1 9	47
Ferguson 3216	12	17 3	3	4 4	49
Tandberg 843	15	9 9	3	17 6	59
Philips EL3556	16	5 6	4	1 5	62
Truvox R104	23	7 3	5	16 10	89

**SPECIAL OFFER SAVE £21**



**TELEFUNKEN 204E**

4-Track Stereo/Mono, recording/Playback 3½, 7½ i.p.s.—Two 7" built-in speakers. Two 6 watts output stages. Transistorized. Multi-play facilities. Brand New. Guaranteed.

Current list price 106 gns. **Our Price 86 gns.** £22.12.0 deposit and 12 Mthly instalments of £5.12.10. Carr. & Pkg. free.

STEREO TAPE UNIT	Deposit		12 Monthly Cash Payments		Price
	£	s. d.	£	s. d.	
Sony TC250A	14	19 3	3	14 10	57
Sony TC350	19	13 9	4	18 6	75
Beocord 1500 De Luxe	25	9 3	6	7 4	97
Tandberg 64X	33	18 0	7	10 0	118
Revox 77CS	36	19 0	9	1 8	139
Revox 77CSV	41	19 0	10	8 4	159

MAINS TWIN TRACK	Deposit		12 Monthly Cash Payments		Price
	£	s. d.	£	s. d.	
Brenell Mk. V3	19	8 6	4	17 2	74
Brenell Mk. V3 (Meter)	20	14 9	5	3 9	79
Truvox R102	23	7 3	5	16 10	89
Brenell V36'M	24	8 3	6	2 1	93
Ferrograph 631	24	18 9	6	4 9	95
Ferrograph 631/H	26	5 0	6	11 3	100

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Latest model **REPS M10**

4-track

- ★ 10 watts output
- ★ 3 speeds
- ★ Monitor on internal speaker
- ★ Large record level meter
- ★ Separate Bass and Treble

Microphone, Tape and Radio Lead.  
2-year Guarantee. BRAND NEW.

List price 69 gns. **Our PRICE 59 gns.**  
Deposit £15. 9. 9, and 12 payments of £3. 17. 6.

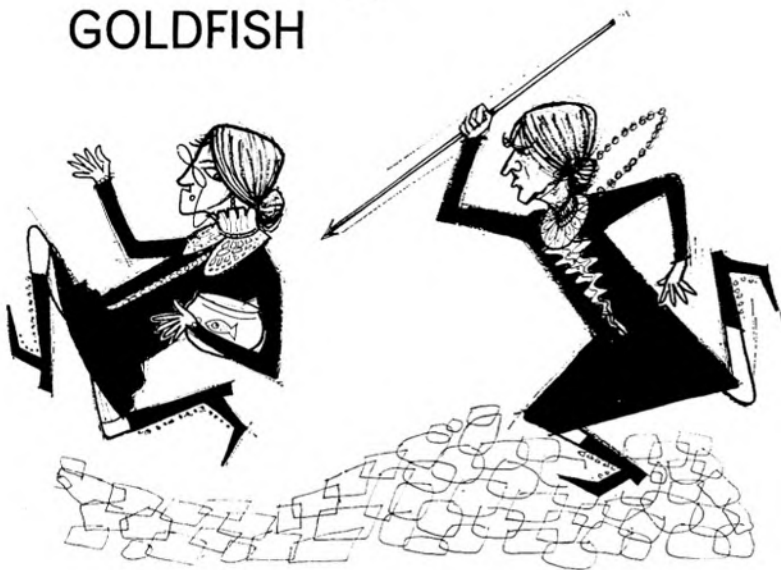
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**THE RECORDER CO**

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Telephone: 01-794 4977

# DEATH OF A GOLDFISH



A SHORT PLAY SCRIPT BY DAVID HAINES

**GLADYS:** (*calling*) Violet ! Violet !  
**VIOLET:** (*distance*) What d'yer want ?  
**GLADYS:** Where are yer ?  
**VIOLET:** Hupstairs. I'm making the beds.  
**GLADYS:** Come down to the sitting-room.  
**VIOLET:** What the 'ell for ?  
**GLADYS:** Come and look at Stanley.  
**VIOLET:** What's the matter with 'im ?  
**GLADYS:** I think 'e's dead. 'E's floating on top of the water.

(*Violet's footsteps descend stairs rapidly*)

**VIOLET:** (*entering*) 'E was all right this morning.

**GLADYS:** P'raps 'e's eaten something that didn't agree with 'im.

**VIOLET:** Would 'e revive, d'yer think, if we changed the water ?

**GLADYS:** I doubt it.

**VIOLET:** Could we try dissolving a couple of aspreens? Or some sort of powder?

**GLADYS:** You're thinking of cats.

**VIOLET:** (*contempt*) Kets ! I've never liked kets and I never will ! Give me a goldfish any day.

**GLADYS:** (*firmly*) We're going to 'ave a cat from now on. I've put up with this goldfish of yours far too long.

**VIOLET:** So you poisoned 'im, I suppose, to make way for a ket ?

**GLADYS:** This 'ere goldfish 'as died of old age. It's a pity you don't jump in the bowl and follow 'is example.

**VIOLET:** Look oo's talking. I'm not nearly so old as you—you'll be dead long before me.

(*Front-door bell rings, briefly*)

**GLADYS:** Oo's that, I wonder ? 'Ave a look through the curtain and mind they don't see yer. It's probably the vicar.

**VIOLET:** Why, it's little Leslie !

**GLADYS:** Are you sure ? Let me look . . . (*excited*) that's Leslie all right ! Quick, Violet, lend us yer lipstick !

**VIOLET:** What's the use of lipstick to an old geyser like you ?

**GLADYS:** Go and open the door while I get ready—and put the kettle on.

**VIOLET:** It's already on. I was thinking of washing me feet.

**GLADYS:** And remember—'e's my nephew, not yours !

**VIOLET:** (*dignity*) I'm a relation by courtesy.

**GLADYS:** You're not—you're just an 'anger-on. Go and answer the door before 'e clears off !

**VIOLET:** All right . . . but I'm supposed to be yer personal friend—not yer personal slave.

(*Front-door bell rings again. Door opened*)

**VIOLET:** (*gushing*) Do come in, Leslie . . . I like yer suit. Aren't you looking nice ?

**LESLIE:** (*aloofly*) Good afternoon. I can't stay long, I'm afraid. (*door shut*) How's Aunt Gladys ?

**GLADYS:** (*from sitting-room*) I'm in 'ere, Leslie ! Come in and warm yer-self up. Violet—go and make the tea !

**LESLIE:** Please don't trouble—I've only popped in for a minute or two.

**GLADYS:** Sit down, Leslie, and tell me all about yerself. I notice you've grown a moustache.

**LESLIE:** (*off-hand*) Oh, didn't I have it last time ?

**GLADYS:** You certainly did not. (*raising voice*) Violet !

**VIOLET:** (*distance*) What d'yer want ?

**GLADYS:** Leslie would like some of them sausage-rolls !

**LESLIE:** I'm not hungry, really I'm not—

**GLADYS:** (*interrupting*) There's nothing wrong with 'em. She only made 'em the day before yesterday.

**LESLIE:** All the same, I'm not hungry.

**GLADYS:** You 'aven't been to see us for nearly eighteen months.

**LESLIE:** Didn't you get my Christmas card?

**GLADYS:** When you was a boy, Leslie, you used to come round 'ere every Saturday afternoon. And you was very fond of sausage-rolls.

**LESLIE:** I've been very busy, Aunt Gladys. You must realise that I'm a fully-grown man.

**GLADYS:** I'm your own flesh and blood, Leslie. I'm your only surviving relative. (*raising voice*) Violet !

'Urry up with them sausage-rolls !

**VIOLET:** (*distance*) I'm coming as fast as I can . . .

**GLADYS:** This 'ouse, Leslie, is free'old property. It'll be yours when I'm dead and gone. Meantime, it's yer duty to come and see me.

**LESLIE:** I do my best, Aunt Gladys.

**GLADYS:** You keep chopping and changing yer lodgings. We don't even know where you live.

**VIOLET:** (*entering*) 'Ere we are ! A nice pot of tea—and I've warmed up the sausage-rolls. Where shall I put the tray, Gladys ? We're using the table for my new jigsaw.

**GLADYS:** Leslie can 'ave the tray on 'is lap.

**LESLIE:** I'm sorry, but it would spoil the crease in my trousers. In any case, I've left my car outside and I've got to go and see some people.

**GLADYS:** You've got a car ?

**LESLIE:** It's not mine, actually—it goes with my new appointment.

**GLADYS:** You've changed your job ? Without telling me ?

**LESLIE:** Time doesn't stand still, Aunt Gladys. One must make progress.

**GLADYS:** Put that tray on the piano, Violet—let's see if we can spot this new car.

**LESLIE:** There's no use in trying to see it from the window. I parked it round the corner. But I really *must* be going—my wife is out in the car waiting for me.

**GLADYS:** (*astounded*) Your wife ? Your wife, did you say ?

**LESLIE:** Yes, I've been married for quite some time.

**GLADYS:** What next, I wonder ? Why don't you bring 'er in ? What's wrong with 'er ? Webbed feet ?

**LESLIE:** (*coldly*) My wife is perfectly normal.

**GLADYS:** Then why don't you bring 'er in ?

**LESLIE:** Because I'd be too ashamed.

**GLADYS:** (*puzzled*) Ashamed ?

**LESLIE:** You live in filth and squalor.

**VIOLET:** (*also puzzled*) Filth and squalor ? What's 'e talking about ?

**LESLIE:** Just look at all this dust and dirt ! Look at that fly-paper, for instance—it's absolutely black with flies.

(*continued on page 145*)

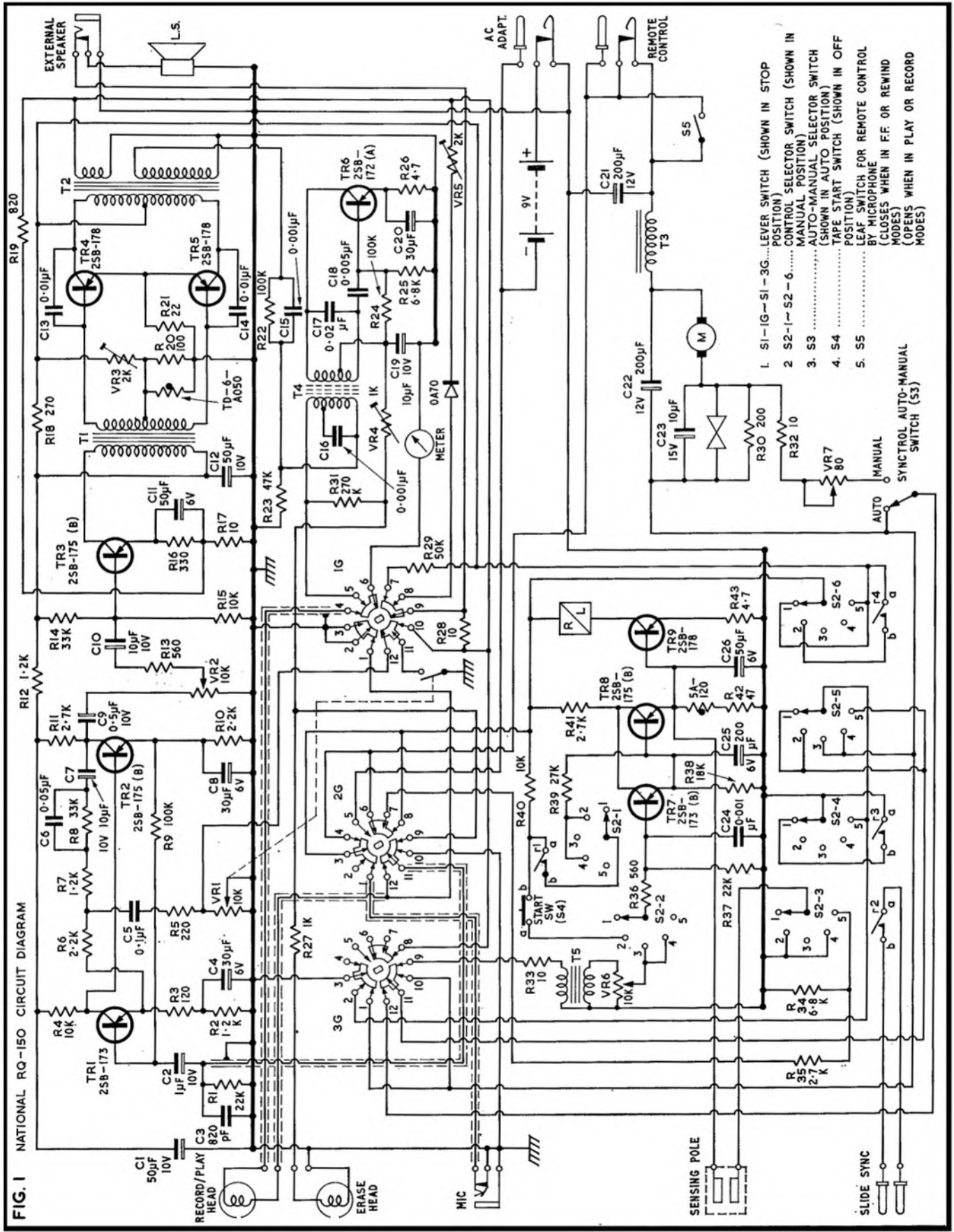


FIG. 1 NATIONAL RQ-150 CIRCUIT DIAGRAM

1. S1 - IG-S1 - 3G..... LEVER SWITCH (SHOWN IN STOP POSITION)
2. S2 - 1- S2 - 6..... CONTROL SELECTOR SWITCH (SHOWN IN MANUAL POSITION)
3. S3 ..... AUTO-MANUAL SELECTOR SWITCH (SHOWN IN AUTO POSITION)
4. S4 ..... TAPE START SWITCH (SHOWN IN OFF POSITION)
5. S5 ..... LEAF SWITCH FOR REMOTE CONTROL BY MICROPHONE IN F.F. OR REWIND MODES (CLOSES WHEN IN F.F. OR REWIND MODES) (OPENS WHEN IN PLAY OR RECORD MODES)

**N**OW, hold it! Before the howls of indignation rise, allow me to explain that the reason for choosing one of the—to put it politely—less highly regarded machines of the battery-operated portable variety is simply that requests for service information have usually included the heart-rending cry “My dealer just does not want to know!” It might, therefore, be of some benefit to those unfortunate chaps who are forced to tackle the job themselves, with no information, for us to use our space this month in describing the dismantling, construction and assembly, adjustment and repair of one of these typical products from Japan.

#### WHAT IS IT ?

First, what is it? As stated above, it is a battery-powered portable, weighing nearly 6 lb., driven by six U2-size cells, which should give about 15 hours continuous playing time. Battery life-time figures are very variable. Using a high-power battery, and operating the machine in fairly regular but not protracted bursts, as, for example, in gathering sound-effects or programme notes, the accumulated lifetime can be considerably extended. But using the machine infrequently results in the battery life curve shelving downwards pretty rapidly after the first few hours of drawing current. This phenomenon is well-known to regular users of battery-operated equipment and is mentioned here merely to forestall those inevitable complaints from readers who appear to expect anything with a trade mark to last forever.

The *RQ-150* has several interesting features. Among them is the provision of a foil-operated auto-stop, a voice-operated stop-start control, provision for slide-sync, with variable speed selected by an Auto-Manual control, normal two-speed selection of  $3\frac{3}{4}$  and  $1\frac{1}{2}$  i/s, (9.5 and 4.8 cm/s), DC erasure but AC bias, takes a 5 in. (12.9 cm.) spool and rewinds fairly respectably in about four minutes. Forward wind is slower, approximately twice the time of rewind. It has an upward-facing speaker, being quite a shallow instrument, of little over 3 in. thickness. The controls and sockets are along the front facing, with just the single function selector knob, sync control button, knobs and record-level meter facing upwards on the top deck.

The drive system is a combination of belt and pulley, with the initial drive from a fairly powerful DC motor whose pulley engages on the rubber-tyred facing of the main pulley—not strictly a flywheel, although for convenience we may regard it as such. This method of motor drive, which we have seen on several other machines, allows some speed adjustment by lateral movement of the motor, which is, of course, horizontally mounted and sprung into engagement. As we move the motor mounting bracket inwards, toward the flywheel centre, the pulley traces out a shorter track and thus the flywheel revolves faster. Because of the automatic control and the possibility of maladjustments or faults in the electrical system, it is necessary to make extra sure of the basic speed of the motor drive on models of this sort.

It should be hardly necessary to add, for the benefit of those who may have missed the Bunny-girl advertising of last year's Radio Show, that the *National* range of equipment is

imported by *Unamec* and distributed via leading wholesalers. *Unamec* stands for *United Africa Mechanical & Electrical Company* and their headquarters is at P.O. Box 1, Blackfriars Road, London S.E.1. The *RQ-150*, which has been one of their best-sellers, came out several years ago at £46 4s. One has to go quite a bit higher in price to obtain another machine with the same facilities but, on the other hand, one would get far more for one's money in terms of frequency response, with a wobble figure that the distributor would not be reluctant to quote!

To be quite fair, on several of these machines that have arrived in our workshop with complaints of severe speed fluctuation, we have found the trouble to be little more than ‘flashings’ of rubber on the flywheel facing, which may succumb to some careful scraping down. But before we can do this, we must dismantle the machine.

This is one of those ‘upside-down’ machines whose mechanism nestles in the top cover and which can be damaged quite easily if the correct sequence of dismantling is not followed. So first we take away the bottom cover by removing its obvious fixing screws and not-so-obvious side screws or pillars, on which the carrying handle is clipped. A pair of pliers is the easiest tool for this job. And a piece of slotted card, rather like the button-stick of old soldiers’ hallowed memory, is a necessary adjunct to the operation, unless you prefer your plastic cases scratched.

#### CAPSTAN SLEEVE

Do not forget to remove the  $3\frac{3}{4}$  i/s (9.5 cm/s) capstan sleeve if it is fitted, and pull off the head cover, which fits on pins of the main deck. Then remove the screw securing the function knob and lift this off, finally pulling off the left and right round knobs (selector and sync controls), taking care not to lose the little bits of plastic foam that help bond them in place. One small point; before removing the function selector knob, turn it to the ‘Play’ position. This allows the case cut-out to clear the pinch roller and its lever system when we finally get around to taking it off. Remember this point also on re-assembly, or some damage might be caused as the case is forced into place.

Next step is to turn the machine upside down and take out the four screws that hold the mechanism into the upper case. The two rear ones are fairly obvious; one at the left of the deck plate as viewed in plan, and the other near the rear of the longest of the three printed circuit panels. But the front two are somewhat obscured by the edges of the printed panels and some of the wiring. They are approximately symmetrical with the rear pair, and this is the best guide. After this, hold the contraption together and reinvert it, push in the fast forward button to clear the case, and lift the whole shell off from the rear. Lift until the case just clears the spool carrier spindles, then ease forward slightly to clear socket and control cut-outs and lift clear. Reverse procedure to re-assemble but take care, when doing so, that the meter slots into its cut-out. It is easily damaged if the case is pressed down too soon.

At this point, we must have recourse to one of the HWH-back-of-envelope drawings, reproduced, if the Link House draughtsmen can follow me, as fig. 2. Here we have the mechanism in its neutral position, with the brakes

engaged and the motor lifted off the flywheel pulley by a simple lifter at the front of its mounting bracket. A vertical spring at the rear tends to keep the motor in engagement when this lifter is removed by lever action from the main cam. To show this in detail would clutter up the drawing, but its action is quite obvious on inspection. The only thing that needs attention is a check that the lifter is quite clear during all functions.

#### CRITICAL POSITION

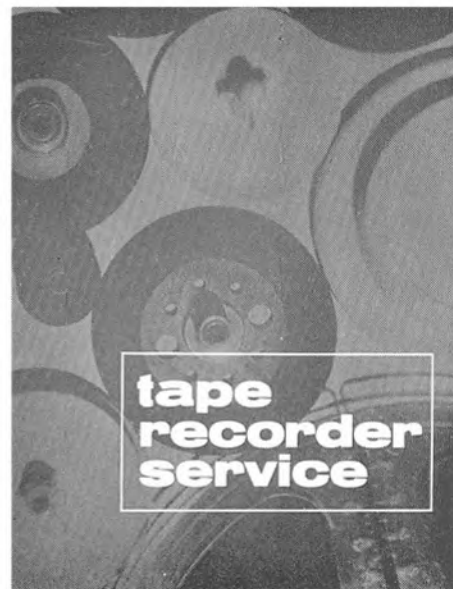
Alteration of the motor position, as we have stated, changes the basic speed because of its direct drive method of operation. There are two screws holding the main mounting bracket to the baseplate, and the holes in the bracket are elongated to allow this adjustment. Speed should be within  $\pm 3\%$  at  $3\frac{3}{4}$  i/s (9.5 cm/s) when the supply source is 9V and the auto-manual switch is at ‘auto’. This basic speed test must be checked before we can adjust the ‘manual’ settings, for which there are a couple of modifications to increase the range and rate of control, as we shall note later. But a word of warning is needed: there are other screws on the motor suspension assembly whose purpose may not at first be apparent. Do not touch them. They hold the motor in its case and the case central in the mounting bracket, and any alteration can be the very devil to put right. Of course, if it is necessary to change the motor then they will have to be removed. One prevalent reason for having to do this is—I regret to say—a habit of lacing with oil any part that is seen to be moving. Oil around the brushes of a DC motor will lead to sparking and ultimate ruin. A slight smear of light grease at the end bearing alone should always suffice. And even this needs care, lest capillary action causes the lubricant to creep along the spindle and touch the rubber of the flywheel tyre.

(continued on page 135)

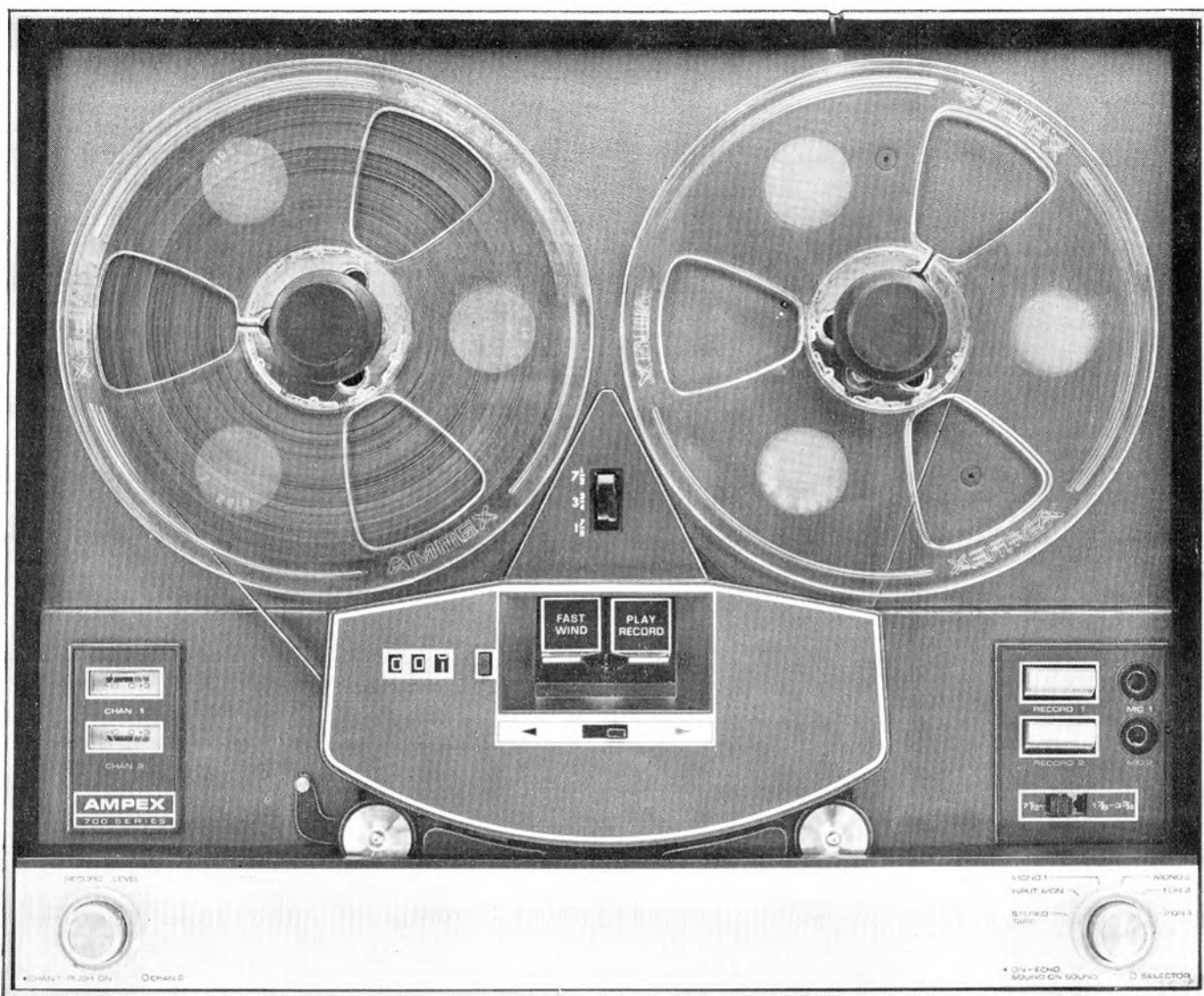
#### NATIONAL

RQ-150

BY H. W. HELLYER







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**AMPEX**

CA-9 TR2

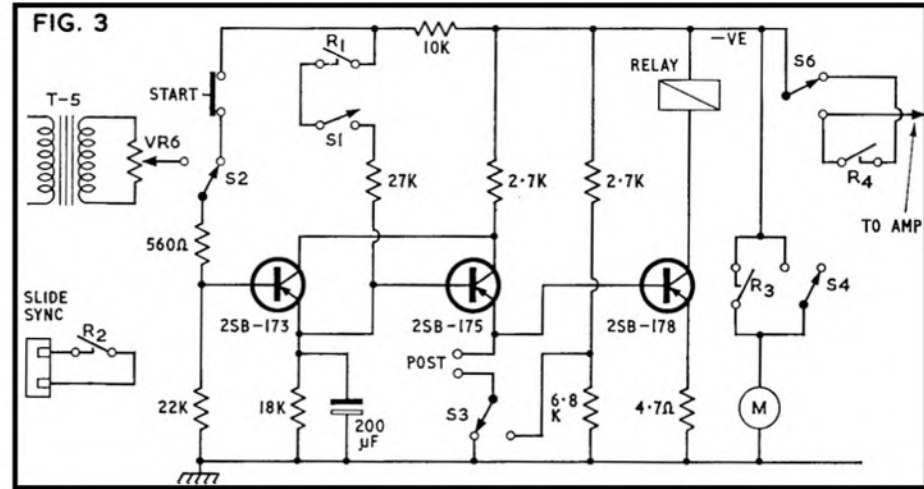
The lever action from the main cam is not shown in fig. 2, but it should be apparent that a very important part of the whole mechanism is the brake and lifter actuating disc BCD. The lifter rods LBL and RBL, are looped around pegs on this disc and the action of the two springs attached to the right brake RB swivel assembly needs checking if there is a tendency to sluggish action. This will, of course, affect the motor lift mechanism as well. The left brake, LB, is not so bad. There is a little play in the action, and the hold-on spring needs to be checked if there is a tendency for spillage when forward winding is neutralised. The brakes are both arc type, composition holding on a milled section of the spool carrier drums, below the carrier itself but above the belt groove.

The belts are comparatively thick rubber types and have not, to date, given any trouble. I am touching wood, for changing the take-up belt, TUB, is a project not less difficult than the aforementioned removal of the flywheel. The assembly, as shown in fig. 2, depends on a rocker guide pulley, GP, so arranged that the belt rubs around the edge of both the RH turntable lower section and the fast forward roller, FFR. Thus, take-up tension is maintained in proportion to the weight of tape on the spool, much as in a slipping belt design, but as the belt is running on several surfaces, any mucky bearings or damaged spindles will severely upset take-up and has been known to cause wow by the reflected retarding action on the flywheel itself. It is worth noting that the belt bushing is secured to the main flywheel spindle by two set screws, and there is always a faint possibility of trouble at this point.

The actual pinch pressure is adjustable, with a spring attached to a lug on the arm and a nutted rod, the nut indicated by the legend 'ADJ' in fig. 2. The correct pressure should be 6 ounces, measured in the normal way by spring gauge coupled to a loop around the roller spindle and pulled until slippage occurs. But beware of hasty diagnosis on this machine. The fairly large amount of back tension provided by the rewind coupling can give false indications. Dust and surplus oil around the belt pulley, which acts as a driving cam on rewind, can add an ounce to the necessary pressure, and quite severe wow. Always check with a slack loop at the left and allow the tape gradually to take up the tension. If this is done with a recorded 3 kHz signal, the discrepancy is immediately evident. I don't think even Mr. Myall is going to argue about that.

#### LESS OBVIOUS

Of the less obvious causes of erratic running, we should mention the double coupling of the flywheel. Though the drawings do not show it, the assembly is in three parts; flywheel proper, driving section, rubber-faced, which the motor pulley engages and which is mounted on the main spindle, and the belt bushing previously mentioned. A large strap across the bottom with a nylon pad provides the bottom bearing. A large locknut clamps the flywheel to the main drum (F in fig. 2), but there is a hidden intermediate guide plate



through which the spindle must run cleanly and this is held to the sub-plate assembly above the main deck by two screws and spring washers. At the top, the upper bearing is clamped into place with the usual three-screw plate, and is easily removed for cleaning and lubrication—but watch the circlip below the capstan sleeve and the two washers. They are not the same, these tricky little washers, and if you re-assemble with the phenolic one to the bottom, you may eventually find it grinding away into the bearing and causing more trouble. Do not blame the makers!

Something similar in the way of multi-part assembly occurs with the spool carriers. On the take-up side, especially, one must watch for grit around the clamp washer and for the tension of the spring beneath the upper turntable. The whole assembly is easily removed when the top screw is taken out, but is not so easy to take to bits, clean and re-assemble. There is a large plate washer above the clutch drum, and this must be clean. Below the drum is a star washer and three small washers, all dissimilar. Again, they *must* go back in the right sequence. Any increase in clutch pressure for take-up can be made by bending up the star washer arms very slightly. Note that rewind action allows this assembly to run free, but the belt is still in the pulley groove and there should be just enough tension to keep the tape taut. Similarly, fast forward action brings the FFR pulley into engagement with the RH drum and the GP assembly moves outwards, i.e. to the right in fig. 2, removing the belt from the drum temporarily. The alignment of the take-up guide arm is most important. Look for a binding pin at the quadrant slot or a dislodged spring at the pivot post near the front end.

#### FEW WORDS

As to circuitry; fig. 1 shows the complete circuit, and although it looks complicated because of the switching, we can see that it is really nothing to write home about. The record/play sections can be dismissed in a few words. On replay there are two stages of amplification with the necessary equalisation in a simple feedback loop, not switched for speed, with driver stage and push-pull output, and about the only adjustment that may need checking is the base voltage of the output pair. There is a 'correct' procedure for adjusting

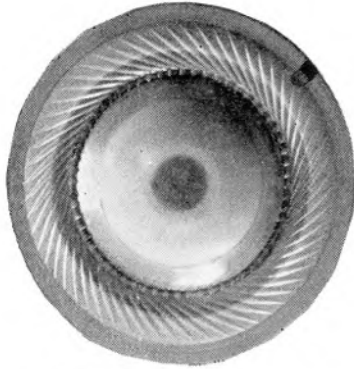
this voltage, and a 2 K preset is provided. As with many transistor radios, the procedure does not allow for possible fault conditions, and a much better method is to check for crossover distortion with a fully modulated signal while reading current drawn by the amplifier. A maximum with this circuit is 50 mA, from a regulated 9 V supply, and the quiescent conditions allow 25 mA drawing. The way to check is simply to plug in the microphone, 'kill' the motor with the remote switch, switch the machine to play and insert a milliammeter in the feed line from an AC adaptor. With volume control at minimum, adjust the 2 K preset for 25 mA, note direction of rotation which increases current and angle of preset that gives about 45 mA. Then play a tape and turn up the control for best quality, keeping well within the limits of the two marks. Reduce the battery or convertor input and note you should go down well below 8.5 V before any discernible difference sets in.

#### MUCH THE SAME

On record, much the same circuit applies for the amplifier, except that the tone control potentiometer VR1 is shorted out. VR2 still acts as the level control; the loudspeaker is switched out but monitoring is available from the secondary winding of the output transformer via the loading resistor R28, which allows sufficient drive for a pair of low impedance headphones. It is advisable, for this sort of work, to add an external series gain control to the headphones, to avoid discomfort. The only adjustment we need bother about here is the set level control for the VU meter, which should allow a reading of 0-VU with an input of 1-3 mV at the microphone socket, using a 1 kHz signal and with the gain control set to give 4.5 mV reading across a 100-ohm resistor in the head return lead; bias killed, of course.

Which brings us to bias, and our other necessary adjustments for such quality results as the machine may be able to give. The oscillator frequency should be 35 kHz and, if this is correct and the dust-core of the coil properly set, an oscilloscope across our inserted 100-ohm resistor will give us the expected straight-line Lissajous figure, using the vertical input for the tape recorder and the horizontal input for the external frequency source. The line

(continued on page 137)



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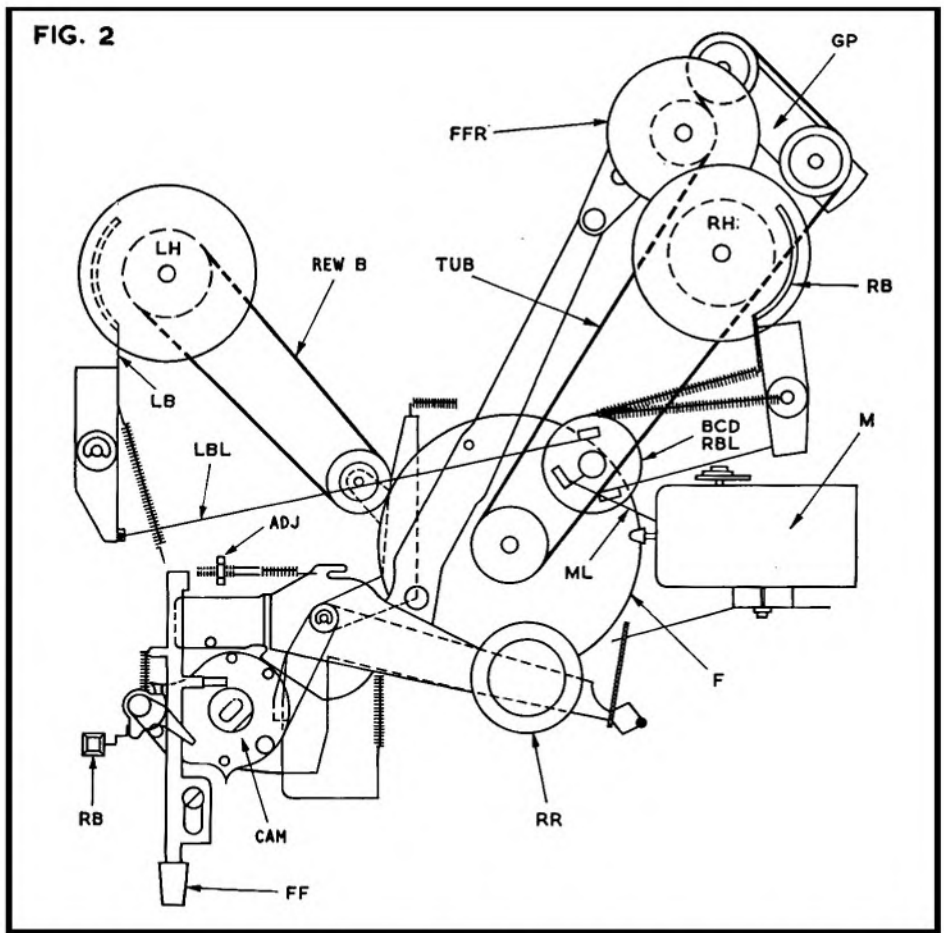
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takes up its usual "northwest-southeast" orientation. A valve voltmeter across the 100-ohm resistor, with no signal input, should give us 80 mV (i.e. 0.8 mA bias current), but a reading between 0.5 and 1 V indicates all is well. A 1 K preset allows some adjustment; the higher the bias the lower the distortion but the lower, also, the HF response. Adjust for the lowest reading compatible with lack of distortion. If you do this when monitoring via an external amplifier, it is very much easier to judge results. Erase current is not adjustable. Erase is DC, and the head itself is a prime cause of trouble. Current should lie between 4 and 8 mA, but some variation of the 1 K series resistor may be helpful before giving up hope and ordering a new head. Incidentally, watch the connections to the heads—these must go back correctly to maintain the phase relationship, or distortion will result. A small point, and worthy of note for any machine that employs this system.

Finally, the sync control circuit, and our redrawn section of the main diagram, **fig. 3**. We have the added facilities of manual speed control, voice-operated start and automatic start, plus slide synchronisation, by use of a simple, three-transistor circuit, one relay and an auto-stop split post. The switches S1-S6 are part of the main selector. On manual operation, S1 and S2 open, the transistors are cut out, as shown, and the relay is not powered. The motor and the amplifier are both switched on and powered directly from the main line. The 80 ohms "Syncrol" now allows a speed variation from 8.6 to 10.9 cm/s providing the power source is between 8.5 and 9.5V as stated before—you *must* check the basic tape speed before making any alterations. If, with the manual operation correct, reverting to auto gives incorrect speed, slight alterations to the 10-ohm resistor to T5 can help for slow running, especially if the machine shows a tendency to stop with the sync control at minimum. But always make sure that mechanical conditions are not causing this. One can so easily get into a horrible tangle by covering a fault with another adjustment! However, needs must . . . insert a bit more

**FIG. 2**



series resistance to augment the sync control or bypass the motor with about 270 ohms (between yellow and blue connections) if the machine will not match the projector at slower speeds.

Auto-stop depends on shorting of the sensing post contacts, taking the base of TR9 to chassis and cutting off the relay, which activated when the start button was pressed. Remember that the selector completes the S1 circuit in the auto position, leaving only TR7 cut off until the start button closes. For

voice operation, the relay is activated by the amplified signal fed to the circuit via T5 with variable sensitivity regulated by VR6. The 200  $\mu$ F capacitor in the emitter of TR7 (directly coupled to TR8 base), charges up to give a two second safety delay. In the auto-stop mode, because S1 is closed, the relay can re-activate when the short is removed from the sensing post. Similarly, when slide sync is employed the relay contacts R2 tell the slide projector when to switch over. And now, au revoir till next month.

**INS AND OUTS OF SPOOLING CONTINUED**

number and position the spools, the index will read correctly throughout down to zero, or—

(ii). The index counter may be allowed to run freely from a 0 start, 79 turns down to 921 before positioning the spools, so that all subsequent index readings will be exactly 200 above those in your index book for that tape, and, of course, 200 is a number easily deducted.

(For our purposes here, if the index counter has four figures, the thousands series may be ignored, or even blanked out with sticky paper.)

Method (i) is reasonably satisfactory for spools with a comparatively large number of turns because it does not take so very long to run back to the 'total turns' figure on the counter; but, of course, method (ii) is the best for shorter tapes, since you will be de-

ducting numbers in round hundreds, and would never have to exceed 100 free turns of the counter before mounting the tape spools.

Suppose, for example, you have a spool containing 482 counts of tape and you wish to start from the 'wrong end'.

With the push button reset to 000 you will know that  $1000=482$ ; and if you left it like that, all tape numbers would be  $1000 - 482 = 518$  turns too high, but if you free-run the counter backwards only 18 counts to 982, on replacing the spools the index will read exactly 500 counts too high ( $982 - 482 = 500$ ), a number easily deducted to agree with your log book index numbers for that tape.

Even tapes which have a single recording over the whole tape width will not always require a complete rewind back to the start after each use. For example there may be a portion of music about three-quarters of the way towards the end, and you may wish to hear this portion more often than the earlier recordings, or you may find that when you

are making up tape letters to friends, you frequently wish to transfer that particular item to the tape letters. In these cases it would always pay to leave the spool in storage 'wrongly wound', then, at each use, the item could be reached by only a quarter spooling from right to left, instead of the customary complete rewind, after use, followed by a three-quarters fast wind from left to right to reach the item next time.

Later, if the Editor will kindly allow me a little more space, I hope to show how, during tape editing with two recorders (as distinct from tape cutting), partly run spools can be temporarily removed to run other tapes, without complete rewinding, and without losing the index number settings. I also hope to show how partly run tapes can be 'turned over' to get at the opposite track or tracks, and to arrive there at exactly the correct index setting for the new track—again with an absolute minimum of fast winding.

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# equipment reviews

**MANUFACTURER'S SPECIFICATION.** Quarter-track stereo tape recorder with single-channel power amplifier and speaker. Switchable AGC. **Tape speeds:**  $7\frac{1}{2}$  and  $3\frac{3}{4}$  i/s (19.1 and 9.5 cm/s). **Wow and flutter** (respective):  $\pm 0.12\%$  and  $\pm 0.15\%$  to DIN 45511. **Frequency range** (respective): 50 Hz—16 kHz and 50 Hz—12.5 kHz. **Inputs:** 2-40 mV at 1 M (microphone), 4-80 mV at 44 K (radio) and 90-1,800 mV at 1 M (phono). **Outputs:** 1 V at 22 K (line) and 4 W at 15 ohms (loudspeaker). **Dimensions:** 16 x 13 x  $7\frac{1}{2}$  in. (40.8 x 33.2 x 19.1 cm.) **Weight:** 30 lb. **Price:** £87 3s. **Distributor:** Grundig (Great Britain) Ltd., Newlands Park, Sydenham, London, S.E.26.

GRUNDIG  
TK245 STEREO  
AUTOMATIC

**V**ALVES are used throughout this recorder because variable-mu (gain) valves are still the best solution to autogain control with a long time-constant, and it was logical to follow through on valves as they also provide adequate power output with less trouble than transistors.

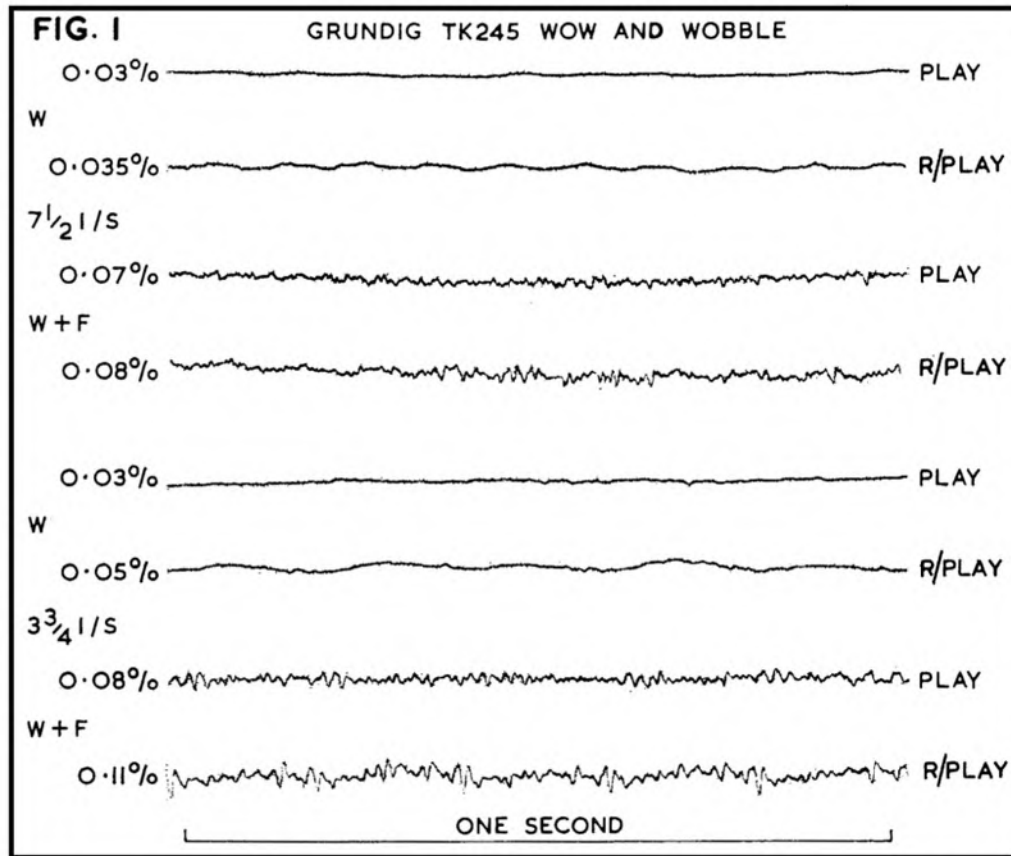
The autogain time-constant is very long: it takes 12 minutes to recover full gain after a one second 10 dB overload. The gain is within 3 dB of full gain after seven minutes. The control bias is discharged whenever the stop button is pressed, so that full gain is available after each stoppage. The magic-eye remains active when the autogain facility is used so that the AGC action can be observed at all times.

The record button locks down independently of the start button so that the gain can be set before the tape starts to move if a sample signal is fed to the recorder for a few seconds before pressing the start button. You will see from the photograph of the recorder that most of the controls are true push-buttons. From left to right they are: multiplay for track-to-track transfer, manual gain setting, record, pause and start. Fast wind and rewind are controlled by the usual Grundig slide bar and the stop control is in the form of a large press tab.

The tone control doubles as a multiplay gain control and the coaxially mounted switch lever selects top or bottom mono tracks, stereo, or simultaneous play of top and bottom tracks on mono.

The right-hand playback gain control also doubles as a manual gain control during recording, when the manual button is pressed and the coaxial lever selects microphone or radio/phono inputs.

Long-term tape speeds were correct within 1% limits from beginning to end of a 7 in. (18 cm) reel. Short-term stability was exceedingly good as shown by the pen recordings of fig. 1. At  $7\frac{1}{2}$  i/s (19.1 cm/s) the play-only wow (10 Hz bandwidth) from a low wobble test-tape was 0.03% RMS. Record/play wow was 0.035% under the worst conditions



where the record and play wows were in step. It will be seen that the 10 Hz capstan wow only becomes evident on the cumulative record-play test. Combined wow and flutter with a meter bandwidth of 200 Hz was 0.07% on play and 0.08% on record-play.

The  $3\frac{3}{4}$  i/s (9.5 cm/s) readings for the same sequence were 0.03%, 0.05% and 0.11%. Again the capstan wow (5 Hz) was only evident on the record/play traces.

The mono play-only responses of the top and bottom tracks from 70 and 140  $\mu$ S test-tapes are shown in fig. 2. It will be seen that the high frequency responses differ on the top and bottom tracks. System noise with no tape passing the head was 36 dB below test-tape level.

Peak recording level with the magic-eye beams just clashing was exactly 12 dB above test-tape level on both manual and autogain

operation. Third-harmonic distortion at peak recording level was 5.6% at  $7\frac{1}{2}$  i/s (19.1 cm/s) at 500 Hz, 5% at 1 kHz and 5.8% at 3 kHz. The readings showed little change when a signal 10 dB above overload was reduced by the AGC circuit. Thus the total dynamic range of the recorder was 48 dB unweighted. The ratio of peak recording level to erased tape noise was measured as 52 dB through a 200 Hz high-pass filter to eliminate mains hum.

The record/play responses of fig. 3 show the same 'wavelength wobbles' at low frequencies, due to the short pole face heads, and similar high frequency differences as were seen in the play-only responses of fig. 2. These differences are thought to be due to playback equalisation errors on the bottom channel.

I have had occasion in the past to criticise the sound quality of the output stages and

(continued on page 141)

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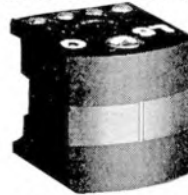
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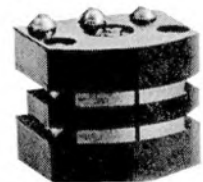
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## MINIFLUX TAPE HEADS

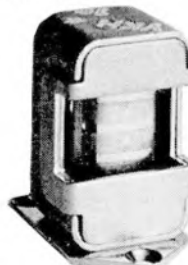
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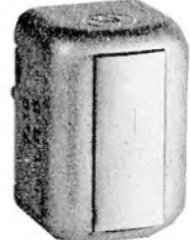
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Miniflux Type VKH4. Quarter-track stereo rec./play head as used on Reflectograph, Brenell, SP5, Truvox, Elizabethan FT1, etc. Listed at 6 gns., offered at 55/- each.

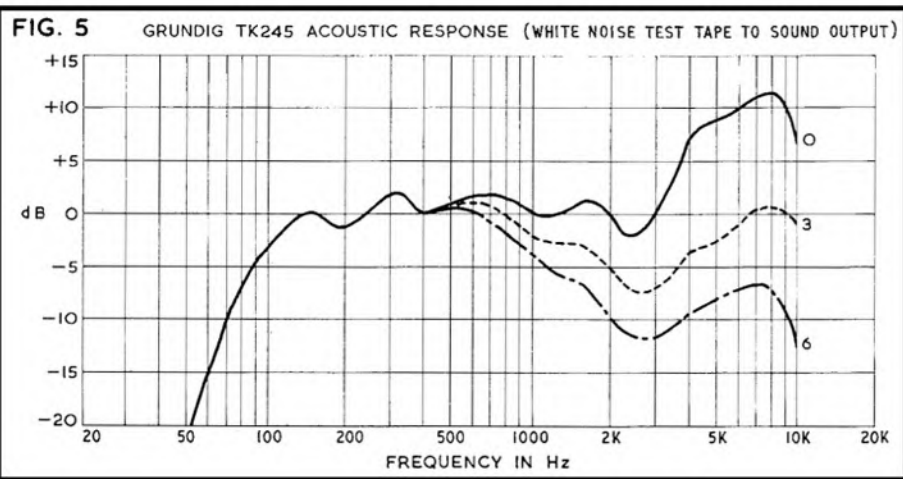
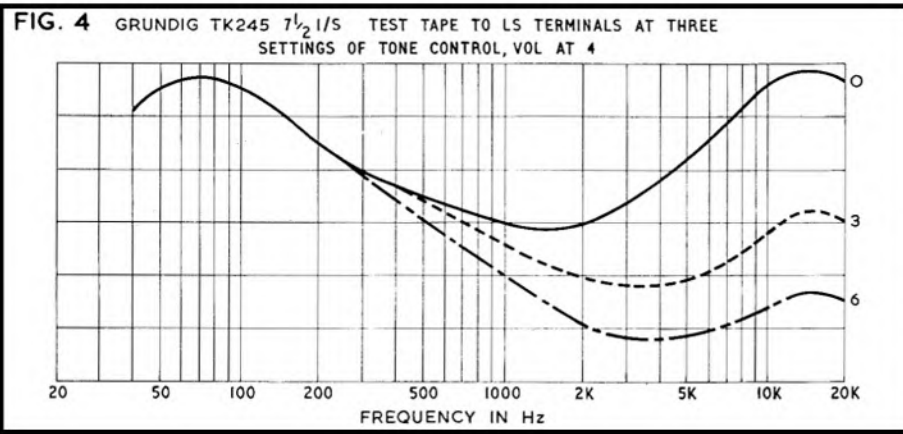
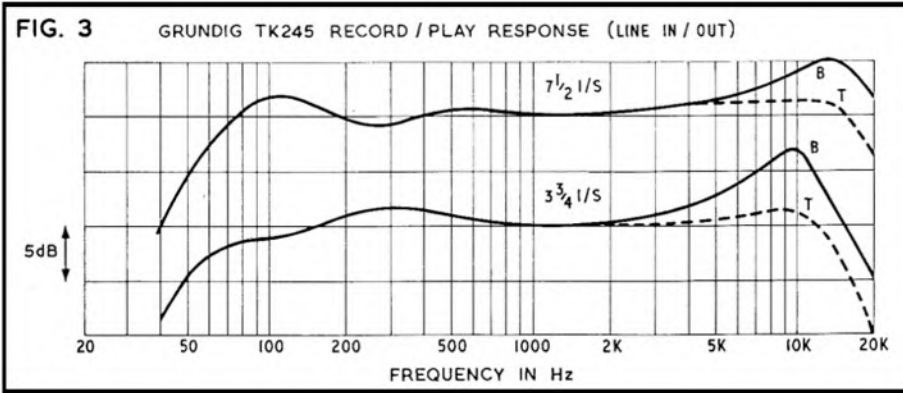
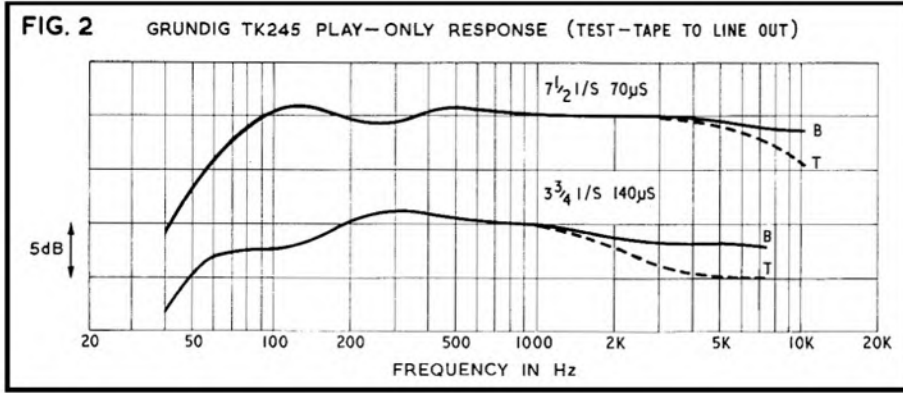


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speakers of Continental recorders, but the Grundig TK245 incorporates a complex passive equalising circuit which does two jobs at the same time: at medium and high volume levels it provides bass and treble lift to compensate the poor bass response of the speaker and cabinet together with the high note loss due to off-axis listening which is almost inevitable on a table-mounted machine of this type. It also incorporates a tone compensated volume control which boosts the bass still more at low volume settings to make allowance for the well known drop in low-frequency sensitivity of the ear at low listening levels.

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It is only possible to use an equalised volume control such as this if the sensitivity and frequency response of the speaker are known. In this case it has come off very well and the sound quality remains well balanced (although of course unnatural as it would become 'unbalanced' in real life if heard at a greater distance corresponding to low loudness) at all volume control settings, and further tone control is available to compensate for different programme content or room acoustics. The electrical responses of fig. 4 show the voltage variation with frequency across the internal loudspeaker terminals at various tone control settings. The volume control setting remained constant at 4.

The acoustic responses of fig. 5 were measured on the speaker axis while playing a white-noise test-tape at the same volume and tone control settings as those of fig. 4.

**COMMENT**

The completely unskilled user will find this machine easy to operate and capable of excellent recordings and sound quality without any knob twiddling whatsoever. On the other hand, the technical enthusiast will find plenty to interest him in the form of track-to-track transfer, stereo recording, mono playback of stereo recordings by combining the top and bottom tracks, etc. It should be pointed out that full stereo playback is only possible by feeding the line outputs to matched power amplifiers and wide-range speakers. A single amplifier-speaker combination fed from the line output of the bottom track will give stereo of sorts, but it may be difficult to match the carefully equalised output of the internal speaker of the recorder with that of a radio set, for example, used for the other channel.

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and orchestra conducted by Abbot Mason. Pickwick  
P4T-433. 7½ i/s (19.1 cm/s) four-track stereo. 35s.

A MOST SATISFACTORY showing of Leonard  
Bernstein's difficult score; a band of similar size  
and scope to the Pit-Orchestra at *Her Majesty's*  
during the London stage-production: but it is  
the singers who shine on this tape—unusually  
well for a cover-version—and yet receive no  
credits anywhere on the 'sleeve', just "Orchestra  
and Chorus".

This is not the complete score by any means,  
but as much as can be packed on to the tape;  
there is a hustling in linking and tempos which  
undermines articulation and ensemble, seem-  
ingly in the interests of the timing-schedule.

Stereo is very fair, with balances perfectly  
justifiable within a theatre framework. All  
ambience and echo are concentrated in the  
right-hand lane, as met with before on Pickwick  
productions; a periodic left-hand drop-out on  
Track A (not found on the second 'side') which  
I presume to be caused by indifferent tape-  
contact on the top edge of the record-head  
during the high-speed dubbing, has also made  
its bow again.

Copying-level is pretty high and this, com-  
bined with the necessarily strident brass, may  
be enough to upset any high-gain equipment  
with tendencies to first-stage overload. Simi-  
larly, if one's equalising and tone-control  
networks display any proud treble-peaks, this  
tape will surely find them.

The high standards of musicianship in the  
arrangements lapse rather at the turn (*I feel  
pretty*); too much allegiance to Palm-Court  
really to suit a Puerto-Rican exile tenement:  
perhaps it is intentional! Apart from this, a  
good 'Story'. **B.R.J.P.**

**LOLLIPOPS.** *Midsummer Night's Dream* (Mendel-  
sohn) and other items. Royal Philharmonic Or-  
chestra conducted by Sir Thomas Beecham. **World  
Record Club TT558**, 3½ i/s (9.5 cm/s) twin-track  
mono. 29s. 6d.

SIR THOMAS BEECHAM was always scornful of a  
too serious approach to music, and one of his  
ways of demonstrating this was to serve up  
light-hearted orchestral delicacies with such  
elegance that they could not fail to delight  
prosaic music lovers. These pieces came to be  
known as 'Lollipops' and the collection of them  
recorded here is typical.

It is doubtless true to say that Mendelssohn's  
Overture to *A Midsummer Night's Dream*

contains more solid nutriment than the description 'lollipop' suggests, but there is that delicate, fairy-like quality in the music, the sort of thing that Sir Thomas revelled in. It is hard to believe that Mendelssohn was only 17 years old when he wrote it. In common with Bach, Mozart and Benjamin Britten, his juvenile compositions show a developed sense of style. Some of the other pieces are less well known and fall more definitely into the category of sweetmeat; but the grace with which they are served makes them very acceptable.

The recorded dynamic range is good, so that the softer passages show up in contrast to the more powerful ones, and the background noise is very low. The balance rather favours the violins, giving a rather bright quality to the recorded sound, and this shows up as a slight lack of warmth when using the tape recorder's internal speaker.

A critic is said once to have remarked that these lollipops could not help but be bullseyes. They are certainly improved by being served on the end of Sir Thomas's stick. **G.G.**

#### HELLO, DOLLY! AND BYE BYE BIRDIE.

Johnny Mack Singers and Orchestra. Pickwick P4T-432. 7½ i/s (19.1 cm/s) four-track stereo. 35s.

AS THE TITLES say—*Hello* and *Goodbye*—which rather sums up reaction to this version of the leading show-numbers.

Accompaniments are smartly-arranged and well-played, but the singers seem listless, for all their accuracy of timing and pitching too—for the most part. It is, in fact, a rather over-meticulous, almost slavish adherence to the beat of detailed arrangements which threatens the undoing of this album.

Not that the Johnny Mack singers are anything but exceedingly able, but the recording, technically so good, cannot avoid conveying an impression of a sunny day outside the studio, and the participants seeking only to get the tracks safely in the can, then back in the pool.

The words of the 'boy' soloist in *It Only Takes a Moment* are not likely to be missed; usually a favourable point of distinctness, but here over-enunciated almost to the point of preciousness. (Why is his echo all on the right, with a dead-dry left-hand ambience around him, one wonders?) **B.R.J.P.**

**ROSSINI/DUKAS.** *La Boutique Fantasque* (Rossini/Respighi), *The Sorcerer's Apprentice* (Dukas). Philharmonia Orchestra conducted by Alceo Galliera. World Record Club TT582, 3½ i/s (9.5 cm/s) twin-track mono. 29s. 6d.

IT IS DIFFICULT to think of this highly colourful ballet by Respighi as being anything other than a brilliant orchestral suite, though in fact the music started life as a collection of piano pieces by Rossini. Respighi is nothing if not an imaginative orchestrator, and this ballet suite has become an established concert item, played for the sake of the music alone. The *Sorcerer's Apprentice* is another well-known orchestral frolic, so wonderful scoring is a feature of this very pleasing recording.

The members of the Philharmonia orchestra show off their technique to good effect, particularly in the woodwind exchanges of the Respighi ballet suite. Galliera maintains a very even, though perhaps too inflexible

rhythm, and one could have wished for more graciousness in the more delicate passages. The Can-Can makes a very joyful noise, suitably 'grotesco', with the trumpets making their cheeky entries to good effect.

There were one or two minor drop-out patches on the review copy at the beginning of track two, but none serious enough to spoil the music. The recording quality is well up to standard and the sections of the orchestra are well balanced. This should prove a popular issue with those who like colourful and lively orchestral music. **G.G.**

**PROKOFIEV.** Chout ('The Clown') Ballet Suite, Op 21a. London Symphony Orchestra conducted by Walter Susskind. World Record Club TCM65. 3½ i/s twin-track mono. 29s.

"THE BUFFOON" WAS THE first of Prokofiev's ballets, and 'Grove' describes the music as being a "sheer extravagance of studiously displeasing sounds". So it is, in a *Rite of Spring* sort of way, though it is sweet and harmonious compared to some modern compositions. Some of the themes remind one strongly of *Peter and The Wolf*, which Prokofiev was to compose some fifteen years later, so it may well be that he was trying out some of his experimental ideas.

The recording quality is not too bad, though there is rather a lot of hiss on the review copy, and one or two patches of drop-out. Wide range equipment shows up some edgy sounding string tone which needs filtering off. The performance is as colourful as the music, so I have no doubt many will enjoy this issue. **G.G.**

**SOUTH PACIFIC AND MUSIC MAN.** Cyril Holloway and the Royal Farnsworth Orchestra. Pickwick P4T-418. 7½ i/s (19.1 cm/s) four-track stereo. 35s.

THE RETURN-HALF of this tape is an excellently-played selection of numbers, of which *Seventy-Six Trombones* is the most popular. A sizeable orchestra is fully scored though perhaps not brilliantly so—each time the last-but-one bar of *Trombones* happens, it disagrees in melody-notes with the show-version (surprising in such a well-known tune), and its drummed-out ending is painfully abrupt.

The performance, however, is brilliantly recorded, giving a very fair stereo spread without resorting to gimmicks. There are odd drop-outs, by loss of contact of the copying-tape with its recording-head rather than faulty tape, slight fluttery failures of treble, but appearing very briefly on top track only. Had our own head been dirty the effect might well have been missed.

Side One, however, is something of a mystery. A list of tunes from *South Pacific* appears on the box, the first being *Overture* in similar type. All the best-known tunes are in fact heard, but neither complete nor in their right order; Side One is in fact a continuous segue run, a pot-pourri dodging from tune to tune: in the manner of an overture, certainly, but occupying the entire side.

There is much chopping and changing in the arranging, with almost musical-switch effect; if this is to the listener's taste, well and good, but it is faintly off-putting when compared with what they say on the label. **B.R.J.P.**

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There's even a dead goldfish in the bowl—and you've done nothing about it.

**GLADYS:** In the first place, that fly-paper is almost new—the flies 'ave 'ardly used it. In the second place, the goldfish died only this morning.

**LESLIE:** You force me to say it: you're a couple of eccentric and dirty old ladies!

**GLADYS:** (*mildly*) No one's forcing you, Leslie—you say what you say of yer own free will.

**VIOLET:** I was planning to wash me feet the very moment 'e rang the bell.

**LESLIE:** Even your speech is slovenly—you are both constantly dropping your aitches. You've degenerated beyond all hope of recovery!

**GLADYS:** You'd better clear off, then, before you get contaminated.

**LESLIE:** (*remembering his future inheritance*) Please understand that I don't want us to part in anger.

**GLADYS:** It's up to you, Leslie—it's up to you.

**LESLIE:** Is there anything you'd like me to do before I go?

**GLADYS:** We can manage, thank you.

**LESLIE:** Shall I get some more coal? Can I wind the clock or something?

**GLADYS:** (*sudden thought*) There is *one* thing you can do . . .

**LESLIE:** Yes?

**GLADYS:** You can get rid of Violet's goldfish.

**LESLIE:** Can't it go on the fire?

**GLADYS:** I'm not running a crematorium. Put it in a paper bag and take it away with yer.

**LESLIE:** (*offended*) Oh, I say—must I?

**GLADYS:** Violet—give 'im a paper bag.

**VIOLET:** 'Ere you are, Leslie . . . just let me empty out me cough-drops. 'Ere, would you like one?

**LESLIE:** No I would not! Just give me the bag! Thank you . . . (*slight splashing sound*) Ugh! (*pause*) And now I really *must* go. I daresay I can dispose of this somewhere outside.

**GLADYS:** Goodbye, Leslie.

**LESLIE:** I can't promise anything definite, but I'll try to pop round as soon as I can.

**GLADYS:** It's up to you, Leslie—it's up to you.

**LESLIE:** Goodbye, then—and try to clear up some of this mess. (*Exit. Front-door slam*)

**GLADYS:** Well, Violet—what d'yer make of that?

**VIOLET:** I can't make 'im out, I really can't.

**GLADYS:** Nor can I. 'E was always such a nice boy. Pour us a cup of tea and switch on the telly. It's time for wrestling.

**VIOLET:** All right, all right . . .

**GLADYS:** And for Gawd's sake, before yer do anything else, go and empty that goldfish bowl. (*a brief cascade of water*) Not over me, blast yer!

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**Your tapes to disc.** 7in. 45—18/-, 10in. L.P.—48/-, 12in. L.P.—55/-. 4-day postal service. Masters and Vinylite pressings. Top professional quality. S.A.E. photo leaflet: Derooy Studios, High Bank, Hawk Street, Carnforth, Lancs.

**J & B Recordings.** Tape to disc—latest high level disc cutting, all speeds. Mastering pressings, studio, mobile. 14 Willows Avenue, Surrey. MITcham 9952.

## MISCELLANEOUS

**Repairs.** Our modern service department, equipped with the latest test equipment (including a wow and flutter meter and multiplex Stereo Signal Generator) is able to repair Hi-Fi and Tape Recording equipment to manufacturers standards. Telesonic Ltd., 92 Tottenham Court Road, London, W.1. 01-636-8177.

**Skilled** tape recorder repairs carried out by expert personnel of many years experience backed by extensive test equipment: Wow and flutter meter, audio valve voltmeter, audio generator, oscilloscope, etc., with final test performance figures quoted if required—Ferrograph specialists. Tape Recorder Centre, Tel-Lee-Radio, 220 The Broadway, Wimbledon, S.W.19. 01-542-4946.

**Manchester Education Committee.** Tenders are invited for the supply of tape players for use in schools. Specifications and tender forms from the Supplies Officer, Stores Department, Chadderton Street, Manchester 4, returnable by Monday, 11th March, 1968.

**Tapespondents.** Free sound magazines. Far and Wide Recording Club, Eccles, Maudstone. Details free (S.A.E. please).

**Make 1968** the year you discovered a wonderful new hobby—join Worldwide Tapetalk, Britain's largest, friendliest Tape Exchange. Particulars 35 The Gardens, Harrow.

**Get "1968 Audio Annual".** Top features include: Loudspeakers in public—public insults to the audio ear; A look at the audio reproducing chain in a new light following the signal from composer's brain to listener's brain via a multitude of stages; The future of tape recording; A look at concert hall acoustics; The flapping baffle—comprehensive survey of a rediscovered new invention; A look at audio marketing from the retail angle. Plus a selection of the more important equipment reviews that appeared in *Hi-Fi News* and *Tape Recorder* during 1967. 7/6 from newsagents or 8/6 (pp) from Link House, Dingwall Avenue, Croydon, CR9 2TA.

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7- $\frac{1}{2}$ ips (19 cm/sec)	384 min at 1- $\frac{7}{8}$ ips (stereo 7" 35 $\mu$ tape)	1- $\frac{7}{8}$ ips 30-8,000 c/s
3-ips (9.5 cm/sec)		
1-ips (4.8 cm/sec)		
<b>Wow and flutter</b>	<b>Input impedance</b>	<b>Weight</b>
7-ips: 0.15% R.M.S.	Microphone 50K ohm	18 lbs. (8.6 kg)
3-ips: 0.20% R.M.S.	Line in 200K ohm	<b>Accessories</b>
1-ips: 0.30% R.M.S.	<b>Output impedance</b>	Empty reel 7"
	Line out 2K ohm	Patch cord x 2
	Headphone 8 ohm or 10K ohm	Reel stopper x 2
<b>Recording time</b>	<b>Frequency response</b>	Splicing tape
96 min at 7- $\frac{1}{2}$ ips	7- $\frac{1}{2}$ ips 20-20,000 c/s	Dust cover
(stereo 7" 35 $\mu$ tape)	( $\pm$ 3db 30-15,000 c/s)	<b>Price about 59 gns.</b>

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