

by G. WAREHAM

# SHORT CUTS in CALCULATION

## PART TWO—THE POWER OF TEN

There can be nothing more off-putting to the uninitiated than the profusion of "powers of ten" like  $10^{-3}$ ,  $10^9$ ,  $10^3$  and so on, which occurs in mathematical formulae. Engineers and designers find such expressions of immense value when dealing with very large or very small numbers, particularly when using a slide rule instead of a set of log tables.

Effort is saved in several ways. The first is in writing down numbers which would otherwise have a lot of noughts in them. Instead of 2,000,000, write  $2 \times 10^6$ . A positive index number indicates the number of noughts. Instead of 0.00007, write  $7 \times 10^{-5}$ . A negative index number indicates the number of decimal places.

Most of the quantities which occur in radio engineering contain only a few significant figures with a number of noughts or decimal places. One virtue of writing them with index numbers is that one is much less likely to make an error in the decimal factor. Indices come into their own when numbers have to be multiplied or divided. For instance:

$$\frac{5 \times 10^{12} \times 12 \times 10^9}{3 \times 10^9 \times 2 \times 10^{11}} = 100$$

There are only two rules, both very simple. The rules are:

- (a) To multiply, add the indices,
- (b) To divide, subtract the indices.

Thus,  $5 \times 10^{12} \times 12 \times 10^9 = 60 \times 10^{21}$   
and  $3 \times 10^9 \times 2 \times 10^{11} = 6 \times 10^{20}$

Therefore  $\frac{60 \times 10^{21}}{6 \times 10^{20}} = 10 \times 10^1 = 100$

which is all very nice provided you know that  $10^1 = 10$ . This may not be obvious, but it does come into a logical sequence:

$$\begin{aligned} 10 \times 10 \times 10 &= 10^3 \\ 10 \times 10 &= 10^2 \\ 10 &= 10^1 \\ 1 &= 10^0 \\ 1/10 &= 10^{-1} \\ 1/100 &= 10^{-2} \\ 1/1000 &= 10^{-3} \end{aligned}$$

and so on.

One other general point, before we get down to a practical example. Applying the first rule,

$$10^{\frac{1}{2}} \times 10^{\frac{1}{2}} = 10^1 = 10.$$

but  $\sqrt{10} \times \sqrt{10}$  is also equal to 10.

So  $10^{\frac{1}{2}} = \sqrt{10}$ .

In other words, raising something to the "power of one half" is just another way of saying: take its square root. Similarly  $10^{\frac{1}{3}}$  is a cube root,  $10^{\frac{1}{4}}$  a fourth root and so on.

### RESONANT FREQUENCY

What is the resonant frequency of a tuned circuit composed of a 150pF capacitor and a 80μH inductor? The formula  $f_0 = 1/(2\pi\sqrt{LC})$  assumes that  $L$  is in henries and  $C$  in farads. Indices come in useful here in avoiding noughts, because  $1\mu\text{H} = 10^{-6}\text{H}$  and  $1\text{pF} = 10^{-12}\text{F}$ . We write  $150 \times 10^{-12}\text{F}$  for 150pF and  $80 \times 10^{-6}\text{H}$  for 80μH, and forget about decimals. Also  $\sqrt{LC} = (LC)^{\frac{1}{2}}$ , which is just another way of writing the square root. Putting all this into our formula gives:

$$\begin{aligned} f_0 &= \frac{1}{2\pi(150 \times 10^{-12} \times 80 \times 10^{-6})^{\frac{1}{2}}} \\ &= \frac{1}{2\pi(12,000 \times 10^{-18})^{\frac{1}{2}}} \end{aligned}$$

At this point we exercise a little ingenuity so that we end up with a number whose square root is easy to find.

Let's deal with the index number first. Taking the square root is simplicity itself. You simply divide the index by two. Thus the square root of  $10^2$  is  $10^1$ ; i.e.  $\sqrt{100} = 10$ . In the same way, the square root of  $10^{-18}$  is  $10^{-9}$ . We get into deeper water if the index is odd. For example, the square root of  $10^3$  is  $10^{1.5}$ , the value of which is not obvious. It's not as difficult as it looks, as we'll see in a moment, but for the time being note that, when taking square roots, we should if possible arrange for our indices to be even.

In the present example,  $10^{-18}$  has an even index, but we still have to deal with 12,000, a rather large number. We could reduce it like this:

$$12,000 \times 10^{-18} = 12 \times 10^3 \times 10^{-18} = 12 \times 10^{-15},$$

but this gives us an odd index and  $\sqrt{12}$ , which most of

us don't carry around in our heads. Try again:

$$12,000 \times 10^{-18} = 120 \times 10^2 \times 10^{-18} = 120 \times 10^{-16}$$

We now have an even index, and we have to find  $\sqrt{120}$ , which is so near to 11 that we can tolerate the small error.

To return to our formula, we can now write:

$$f_0 = \frac{1}{2\pi \times 11 \times 10^{-8}} \text{ c/s}$$

and since  $1/10^{-8} = 10^0/10^{-8} = 10^8$ ,

$$f_0 = \frac{10^8}{2\pi \times 11} \text{ c/s}$$

A negative index denominator equals a positive index numerator. To get the answer in Mc/s, divide by 1 million or  $10^6$ :

$$f_0 = \frac{10^2}{2\pi \times 11} = \frac{100}{2\pi \times 11} \text{ Mc/s}$$

$$= \frac{100}{6.28 \times 11} = \frac{100}{69.08} \text{ Mc/s}$$

Which is approximately  $100/70 = 1.4 \text{ Mc/s}$ .

Now let us see how we can deal with fractional indices. The commonest one is  $10^{0.5} = 10^{\frac{1}{2}} = \sqrt{10}$ . This comes into other indices; e.g.  $\sqrt{10^9} = 10^{4.5} = 10^4 \times 10^{0.5} = 10^4 \sqrt{10}$ . The thing to remember is that  $\sqrt{10} = 3.16$ . This can sometimes be taken as 3 without serious loss of accuracy, and it can sometimes be cancelled out against  $\pi$  if this happens to come on the other side of the fraction ( $\pi \approx 3.14$ ). Remember that  $10/\sqrt{10} = \sqrt{10}$ ; this often enables  $\sqrt{10}$  in the denominator to be transferred to the numerator, where it is less of a nuisance.



**INGENUITY**

## UNLIMITED!

IN THIS feature we hope, from time to time, to be able to publish suggestions submitted by some of our readers on the possible improvement of projects previously described in PRACTICAL ELECTRONICS; short contributions on other subjects may be included. The aim is not to find fault or undermine the abilities or knowledge of our contributors. It may well be that the original article is *par excellence* but it could be improved or adapted to suit individual requirements. The views expressed by readers are not necessarily those of the Editor.

### FLIP FLOP TACHOMETER

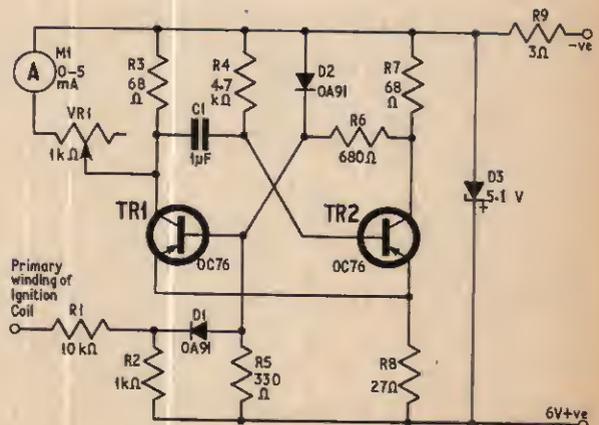
**A**FTER reading the article on "Logic Design" in the June issue I thought you might be interested in this circuit of a tachometer using a flip-flop.

The circuit is a monostable flip-flop, triggered by the pulse from the distributor, the transient peak of this pulse being 100 volts or more. The effective value of the pulse is reduced by R1 and R2.

In the stable state, TR2 is conducting, TR1 is cut off by the positive bias on its base. The first diode, D1, eliminates the positive half of the input pulse, and the negative half is applied to the base of TR1. TR1 then conducts, applying a heavy positive bias to TR2 base, thus cutting it off. The circuit remains in this state for a time (determined by R and C) and then flops back to the stable state again, thus producing a square waveform of the same frequency as the applied pulses. The 0-5mA meter reads the mean value of the ensuing waveform, this mean value being proportional to the frequency, as the amplitude is constant.

The Zener diode stabilises the supply voltage so that the meter reading does not vary with battery voltage. The second diode D2 protects the circuit against transient peaks.

H. A. Cook,  
Christchurch,  
Hampshire.



## A.M. TUNER CIRCUIT

I WAS especially pleased with the A.M. Tuner published in your "Bonanza Board" series in the March and April issues. I am very interested in miniature receivers and your circuit worked very well although the layout was rather critical if the printed circuit was not used.

I "played about" with this circuit for some time and some of your readers might be interested in the one which I built as a result of my experiments. It works quite well on local stations driving a crystal earpiece.

The main problem with respect to how small this receiver can be built is the length of the ferrite rod used to obtain satisfactory reception.—I managed to get reasonable volume from a 1½ in length.

Two old i.f. bases were fixed on to the rod and the tags on the bases used to anchor the components. A small 250pF trimmer served as a tuning capacitor. "Red Spot" transistors worked just as well as OC71s in this circuit and an SB305 or any "MAT" type used in the second stage improves the performance.

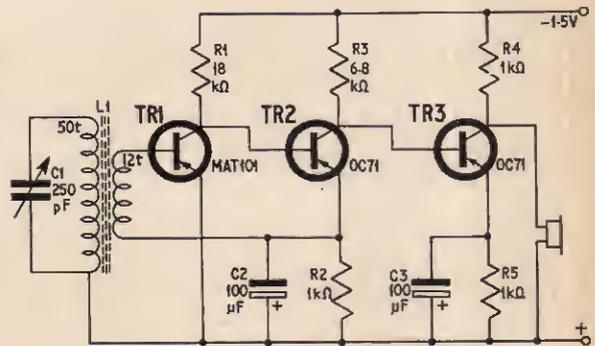
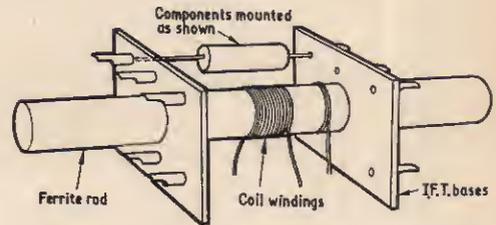
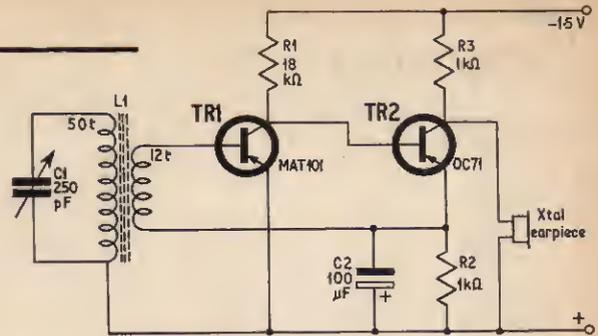
B. A. Austin,  
Solihull,  
Warks.

This is a good circuit, almost identical to one I tried. One disadvantage is a poor ratio between base d.c. current and r.f. current in TR1. Another is that the circuit will only operate satisfactorily using low voltage power supplies. The crystal earpiece cannot be driven to so high a volume as with BB3, and the circuit does not tolerate a wide variation in d.c. operating conditions. However, the sensitivity of the receiver is very good.—A.J.B.

Fig. 1 (top). Simplified A.M. Radio Tuner

Fig. 2 (centre). Ferrite rod component assembly

Fig. 3 (right). Added stage for greater output



## ELECTROLYSIS FOR PRINTED CIRCUITS

IN YOUR articles on printed circuitry (March Issue), you are constantly stressing the danger of allowing the etching fluid to come into contact with the body. I do not know exactly what this substance is, but I know that nitric acid is also commonly used for etching.

The precautions needed to be taken when using these substances, together with the fear of acids which many people possess, may well discourage many people from attempting printed circuitry.

However, when making printed circuits, I now use a method which I once thought of and used when I had run out of acid during the local holiday week: this was electrolysis.

To make the circuit, simply paint the circuit design onto the laminate board with shellac and allow to dry, then attach a crocodile clip to an unpainted part with a lead running from the clip to the positive terminal of a car battery or low voltage transformer and rectifier unit. Immerse the board in copper sulphate solution and place a piece of copper wire somewhere in the solution so that it does not touch the board or clip. Attach this

wire to the negative of the power source and the process will begin.

The unpainted copper will slowly pass into solution. When the current has ceased to flow, the unwanted copper should have all been etched away. If isolated patches of copper remain, it will be found that these are very thin and are easily removed with a pen-knife.

This process is both safe and cheap, as the amount of electricity used is almost negligible and copper is deposited from the solution and onto the negative wire at a rate equal to that at which it is being removed from the board, hence the copper sulphate solution remains at an almost constant concentration and none is lost. The slight increase in concentration is due to some loss of water.

For an average sized board, the length of time needed using 12V, 2oz would be about one hour.

This method has been thoroughly tested and used and I assure you that it is entirely successful.

P. R. Newell,  
Blackburn,  
Lancashire.

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R2	68k $\Omega$	R8	5.6k $\Omega$
R3	10k $\Omega$	R9	220 $\Omega$
R4	5.6k $\Omega$	R10	100 $\Omega$
R5	1k $\Omega$	R11	680 $\Omega$
R6	330 $\Omega$		

### Potentiometer

VR1 5k $\Omega$  preset skeleton miniature or panel mounting control

### Capacitors

C1	1 $\mu$ F	elect.	15V
C2	16 $\mu$ F	elect.	15V
C3	16 $\mu$ F	elect.	15V
C4	16 $\mu$ F	elect.	15V
C5	160 $\mu$ F	elect.	10V
C6	160 $\mu$ F	elect.	10V

### Transistors

TR1, 2, 3, 4 NKT277 or NKT274 (4 off)  
(Newmarket)

TR5 NKT777 or NKT773 (Newmarket)

### Loudspeaker

LS1 25 ohms, 5 inch, round (Plessey)

### Battery

BY1 9 volt type PP9

### Miscellaneous

Sample Veroboard  
Battery connectors  
P.V.C. covered wire

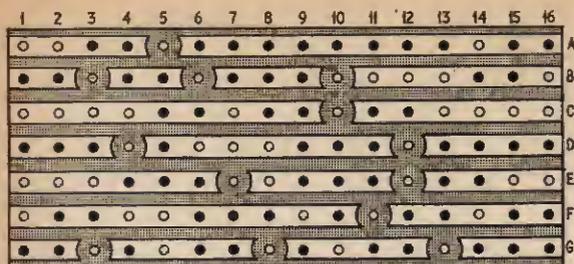


Fig. 2. Underside view of the board showing the copper strip breaks

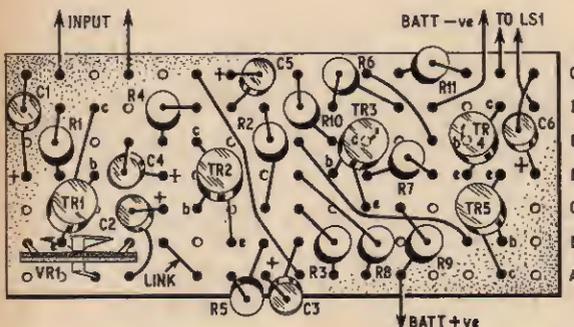


Fig. 3. Component layout on the board and connections for input and loudspeaker

reduce any distortion that could otherwise occur, due to the slightly uneven driving voltages on the bases of the two output transistors. This negative feedback also effectively lowers the source impedance of the driver stage, and thus the output impedance of the output stages. Resistors R7 and R8 form a voltage divider base bias network for TR3.

The upper end of R7 is directly coupled to the common emitter junction of TR4-TR5; d.c. negative feedback is thus obtained, stabilising the working voltages of TR3.

The driver stage is fed, via C4, from the common emitter preamplifier TR2, which in turn is fed from the emitter follower input circuit TR1. The emitter load of TR1 is a potentiometer, VR1, which serves as a volume control. To prevent overall positive feedback and consequent instability, the decoupling network R6 and C5 is inserted between TR2 and the output stages.

## CONSTRUCTION

Following the procedure outlined in the introductory article break the copper strips in the sample piece of Veroboard as shown in Fig. 3 and connect the flying leads.

The components are fairly cramped on the board so it is probably best to start assembly by wiring up the output and driver stages. Before connecting the supplies to test this part of the circuit, check the wiring. Connect the 25 ohm loudspeaker; then connect the 9 volt supply with a milliammeter in series.

Check that the current, with the base of TR3 shorted to ground via a large value capacitor, is less than 10mA. If a voltmeter is available, check that the voltage between the common emitter junction of the output transistors and battery positive is about 4½ volts. A functional check can now be made by removing the shorting capacitor from TR3 base and connecting an

input signal to TR3 base via a blocking capacitor. The current will then rise significantly. If satisfactory, wire up and check the rest of the circuit, taking care to monitor the total current of the unit at all times.

## VARIATIONS

If the unit is to be used as a normal audio amplifier, either with a microphone, pick-up, or with a radio tuner, omit R1, C1, and TR1 from the circuit, and couple the input, via a 16 $\mu$ F capacitor, to the top end of VR1.

With the component values shown in the circuit diagram, the frequency response of the unit is considered to be adequate for normal domestic use, although the results are by no means hi fi. The low frequency response can be improved, however, by replacing C6 with a 1000 $\mu$ F capacitor.

Using a 25 ohm loudspeaker, about 200mW of output power is available at reasonable quality; greater output power can be obtained using the same speaker, but distortion then becomes excessive. Undistorted output power can be increased by using a lower impedance speaker, but in this case larger transient currents have to be handled by the output transistors which may be damaged as a result.

*Never disconnect the loudspeaker when the power supply is on or the output transistors may be damaged.* It should be possible to use this amplifier with speaker impedances as low as five or even three ohms, but in this case a 100mA fuse should be wired in the negative supply line as a safety precaution against damaging the output transistors. The maximum output voltage that is available without distortion is about 7 volts peak-to-peak (approximately 2.5 volts r.m.s.), with a 25 ohm loudspeaker.

If the unit is to be built into a composite piece of equipment, replace VR1 with a front panel mounted volume control and knob.

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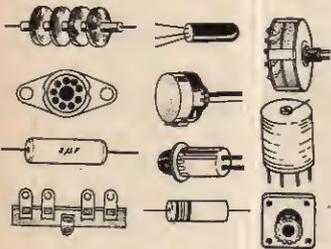
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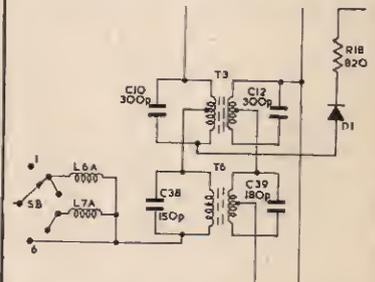


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Suitable to control elements, heater, soldering irons and boiling rings up to 2,500 watt. Complete adjustable, normal price 55/- each, special snip price 12/6 plus 2/- postage and insurance.

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2N1747	25/-	OA5	5/-	OC76	5/-
2N1748	10/-	OA10	6/-	OC77	7/-
AC107	9/-	OA47	8/-	OC78	5/-
AC127	9/-	OA70	2/-	OC78D	5/-
AC171	8/6	OA79	2/6	OC81	5/-
AC176	8/6	OA81	2/6	OC81D	5/-
AC179	8/6	OA85	8/-	OC82	5/-
AC190	6/6	OA90	2/6	OC83	5/-
AC192	6/6	OA91	2/6	OC84	5/-
AC192	8/6	OA200	3/3	OC139	8/6
AF114	7/-	OC202	4/3	OC140	18/6
AF116	8/6	OC29	10/-	OC170	6/-
AF117	5/-	OC23	17/6	OC171	6/-
AF118	12/6	OC24	22/6	OC200	9/-
AF130	17/6	OC28	7/6	OC201	12/6
AF186	18/6	OC28	15/-	OC202	18/6
AF212	15/-	OC29	17/6	OC203	12/6
AF221	15/-	OC35	18/6	OC271	18/6
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## See in the dark INFRA-RED BINOCULARS

These infra red binoculars when fed from a high voltage source will enable objects to be seen in the dark, providing the objects are in the rays of an infra-red beam. Each eye tube contains a complete optical lens system as well as the infra-red cell. These optical systems can be used as lens for T.V. cameras—light cell, etc. (details supplied). The binoculars form part of the Army night driving (Tabby) equipment. They are unused and believed to be in good working order, but sold without a guarantee. Price £2.17.6 plus 10/- carriage and insurance. Handbook 2/6.



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## SUMMER SALE BARGAINS UNLIMITED

**MINIATURE RELAYS** with removable covers. Very sensitive (will close on only 20 ma). Coil resistance 10,000 ohms—contacts are three sets: triple set for change over pair to open circuit and the third pair to close circuit—perfect order unused (removed from equipment), 7/8 each.

**MAINS TRANSFORMER.** Upright mounting with primary tapped 200, 220, 240 v. H.T. secondary is 200-0-250 v at 100 ma and it has two L.T. secondaries of 6.3 v. 13 amp.—unused (removed from equipment), 15/- plus 3/6 post and insurance.

**MULLARD SILICON RECTIFIERS.** 350 v. 100 ma. Removed from unused equipment, perfect. Ref. BY100, 4/8 each.

**REED SWITCHES.** A pair of contacts sealed into a glass tube. When a magnet comes close the contacts close immediately and the circuit is switched. For burglar alarms on doors or windows—moving displays for advertising—rev. or batch counting—relay circuits. New and perfect, price 15/8 each.

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**MINIATURE PICK-UP.** For pop-records—this is made by Comocord—has a crystal cartridge and long play sapphire stylus—offered for less than the wholesale price of the stylus only—namely 3/8 each or 38/- doz.

**SYNCHRONOUS METER MOTOR.** This is self starting and has a cog coded spindle—add a train of gears and you have a clock or hours elapsed meter, or it would drive a little fan to keep equipment cool or similar job. Brand new and perfect, 6/8 each, 54/- per doz.

**RELAY SWITCHES.** These enable micro switches, delicate thermostats or other low current devices to control up to 30 amps.—ideal to switch thermal storage heaters—motors, etc., made by the famous A.E.I. group these are listed at £25 each—you can buy it if you hurry at a very keen price of 39/6 each and we will include diagrams and data. Mounted on handle approximately 5 x 3in. deep.

**MAINS FROM CAR BATTERY** Rotary generators 12 v. input, 240 v. output, 110 ma. £2, 330 ma. £5, plus 6/- post.

**H.R.O. POWER PACK.** Suitable 240 or 115 volt input, gives 250 v. H.T. and 6.3 v. L.T. Unused but sealed and less rectifier valve, 19/6, plus 6/6 post.

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**6.3 v. HEATER TRANSFORMERS,** 1 amp., 5/6.

## ARDENTE HEARING AID

If not wanted as hearing aid these could be the basis of radio control units—pocket transmitter—staff locators, etc. They are beautifully made little units and they contain many subsidiaries parts including crystal microphone, on/off switch—volume control with on/off switch—inter-stage transformer—Mullard valves types DL 66 and DF 64 (2 of). All parts in good order, in fact hearing aids believed to be in working order but not guaranteed so—complete in plastic case with pocket clip only 27/8 (tearphone not included).

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# detached particles

JOHN VALENCE

## JUST A DREAM

One's heart must go out to Lord Robens and his fellow members of the National Coal Board. With courage and imagination they embarked upon a vast programme of modernisation, calling in all the resources of modern technology. This planning reached a grand climax in the completion of the showpiece colliery at Bevercotes in Nottinghamshire. Twelve months ago the National Coal Board unveiled this, the first remotely controlled mine in the world, with electronically guided and controlled machinery.

What an inspiring picture this presented: here was one of the oldest industries of all—notorious for the severity of its working conditions—boldly deciding to take a gigantic step forward into the 21st century. A shining example for other industries to follow. A glimpse of the future, when all unpleasant and arduous toil would be undertaken by machines with man merely there to supervise their operation.

So we thought. Alas, this remains but a dream.

For some inexplicable reason, the mineworkers seem unappreciative of the new white-coated role they are being offered. A few million pounds worth of equipment including complex electronic installations lies entombed 3,000 feet below the surface, unused, at Bevercotes. The coal that might have been won during these past 12 months is estimated at about a million tons.

## OFF THE BEAT?

Computers, infra-red devices, radio, and closed circuit television are some of the electronic aids now being mobilised for action in the campaign against the mounting crime wave.

Will this extended use of science and technology result ultimately in the disappearance from our streets of the "bobby"? I would not myself have thought this at all likely. But no less an authority than the Secretary General of Interpol, M. Jean Nepote,

believes this to be so. By 1975, he forecasts, policemen will have vanished from the streets in Britain and their function will have been taken over by television cameras!

Such a state of affairs can hardly be contemplated. Just consider, for one thing, our guests from overseas. Whatever will they do when they want to be directed to say—The Tower, or wish to know when the Changing of the Guard ceremony takes place. And, in particular, let us consider those members of the fair sex one sees in the busy streets of the Capital gazing admiringly upwards into the face of an ever helpful bobby. They surely will find little recompense in the glassy eye of a television camera—even if it is part of an all knowing robot with a computer fed encyclopaedic mind.

## RELIABLE SERVICE

The radio and television rental system is hardly known in the U.S.A., where it is limited to such institutions as schools and hospitals. This is in sharp contrast to our own country, where the rental system is becoming increasingly popular with the general public. When colour arrives in Britain (all being well—end of 1967) it is predicted that at least 80 per cent of colour receivers in private homes will be hired on the rental basis. This at any rate was the view put forward by Mr. Robinson, Chairman of Radio Rentals Limited, when announcing a tie up between his firm and The Radio Corporation of America for the production of colour tubes in Britain.

Apart from the very real financial aspect, I suspect that the swing over to rental as opposed to private ownership has been greatly encouraged by the public's suspicion of the "servicing" fraternity. Perhaps this Cinderella of the radio and television trade could learn something from its counterpart in the U.S.A. Over there the private listener or viewer is dependent on the serviceman or "troubleshooter" and, one presumes, has no qualms about calling him in.

## ALL-TALKING INSTRUMENTATION

The motorist has benefited very considerably from electronic developments. As readers of this magazine will know quite well, there are a variety of devices designed to assist the driver or to safeguard his vehicle. Nevertheless, what we have seen so far is apparently just the beginning.

For example, the Ford people, I understand, are developing "audio" speedometers and petrol and oil gauges. Miniature tape machines will give pre-recorded warning messages as the needle reaches a danger mark. The idea is to relieve the motorist of the necessity of frequently glancing at the dashboard instruments. I suggest that automatic muting of the car radio when the audio warning comes up is a vital adjunct to such a scheme.

Talking of car radio, the practice of driving along with the accompaniment of broadcast entertainment is so widespread now that it will doubtless surprise many younger readers to learn that the introduction of this amenity was fiercely opposed in some quarters in the early days as being a dangerous distraction. But, paradoxically, it was soon proved that a radio programme can help keep the driver alert, particularly on long solitary journeys.



# Readout—

## A SELECTION FROM OUR POSTBAG

### Where has all the fuzz gone?

Sir—I have completed making the *Fuzz Box* described in the July issue, but have not obtained fully successful results with it.

On connecting up and plucking the guitar string softly, only a very small output can be obtained (far softer than without the fuzz box connected). However, on plucking the guitar string fairly hard, a very loud (much amplified above normal level, i.e. without the fuzz box) fuzzed note is obtained. This is satisfactory, except for the fact that this note lasts only for a few seconds on the bass notes, and even shorter on the treble notes. This, however, I suspect is due to the guitar's lack of sustain on the treble notes) before suddenly cutting out and reverting to the "tinny" output, as before. Just before cutting out, a crackle also appears, with the fuzz. Thus, it seems that whether the unit fuzzes or not is dependent upon the input supplied by the guitar.

In the unit which I constructed I was not able to obtain the correct values for all the components. But, since the margins of error are fairly small, I am not sure whether or not the fault can be traced to any of these.

S. F. Bywaters,  
Hornchurch,  
Essex.

*Slight modifications may be necessary so as to make the fuzz box match the particular guitar output specification. The clipping stage preceded by the pre-amp has a definite minimum threshold input level which can be varied by changing the value of R3, altering the gain of TR2, or trying a different diode as D1. Any signal lower than the minimum trigger input level will not be reproduced at all. The circuit will give an illusion of sustaining the signal because, providing the input signal is over the threshold level, the output signal is always at the same level until cut-off point is reached, when the input level falls below threshold. The true sustain effect is not only unobtainable but also undesirable. If any such unit gave a sustain effect then any note played would carry on to give a cataclysmic discord if the next note was played soon after.—M. S-R.*

### The Roding Boys' Society

This radio and electronics group for boys has changed the Headquarters location, and the meetings are now held in Waltham Forest, London, E.17.

An expansion of the activities should now take place with the new facilities available to us.

Meetings will continue on Tuesday evenings, plus special activities on Saturdays.

Boys who are especially keen on radio/electronics are particularly welcome to visit the new Centre. If you are interested please contact:—

Ron Marchant,  
154, Essex Rd.,  
London, E.10.

### CAN YOU HELP?

Letters for inclusion under this heading should be as brief as possible. Replies should be made direct to the readers concerned.

Sir—I have been trying to obtain some early issues, Nos. 1 to 10, but have had no luck. I wonder if any of your readers can help? I will, of course, pay the postal rates and charges.

B. Toffoli, 18, Farnley Street, Mt. Lawley, Perth, Western Australia.

Sir—I am interested in purchasing back number 1 to 12 of volume 1 and February 1966 at cost plus postage.

A. Balsillie, Science Dept., Williamwood High School, Seres Road, Clarkston, By Glasgow.

Sir—Can any reader supply me with all back copies for volume 1 as well as numbers 1 to 4 of volume 2?

O. W. Griffiths, P.O. Box 13504, Sinoville, Pretoria, South Africa.

Sir—Can anyone supply me with the first four copies of Practical Electronics? I would pay full price for these to complete my collection.

D. R. Fairbrother, Averill House, King's College, Otahuhu, Auckland, New Zealand.

Sir—Could any of your readers supply me with volume 1 complete with blueprints, etc?

J. A. Daykin, 14, The Avenue, Churchdown, Glos.

Back numbers are usually very quickly exhausted. We strongly advise all our readers that a standing order be placed with their newsagent to avoid any future disappointment.

### Noise from the quiet sun

Sir—I read with interest the article on *Radio Astronomy* by C. B. Sibley in the August edition.

I should like to point out that the detection of thermal noise from the quiet sun is not as easy to detect as the writer suggests. The block diagram (Fig. 4) shows a radiometer or full power system which is quite suitable for detecting large solar outbursts and should give good results during maximum sunspot activity.

Trying to detect the quiet sun with this system would be impossible as all forms of man made interference will be shown on the pen recorder. As a result it would be difficult to sort out genuine solar signals from the unwanted ones.

My main purpose of writing this is to prevent any would-be constructors becoming disappointed if their efforts failed, as I have constructed similar equipment without producing any results.

The type of equipment that could be used very successfully by the amateur with a garden of moderate size is the phase-switched interferometer. This system takes more time and effort but the results are most satisfying as I have found with my own equipment.

M. J. Hale,  
Secretary of the Radio  
Astronomy Section,  
The British  
Astronomical Association,  
London, S.E.9.

### "Pop" mandolin

Sir—Having read Colin Greig's letter in the August edition, I think that I ought to make one or two comments in reply.

The first is that the original instrument, the *Electronic Mandolin*, designed by S. Chisholm in the June edition was made originally with the idea of being highly amplified in a "pop" group. Also if it is to be used for this purpose a crystal microphone would be useless as the risk of "feedback" and the picking up of extraneous noises would be too great.

If a crystal pick-up is used the tone would be extremely "tinny" and tend to reproduce the upper register of the instrument more than the lower one.

G. K. Mitchell,  
Orpington,  
Kent.

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IN THIS MONTH'S ISSUE WITH THIS SPECIAL

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## PACK

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KIT M4 less case and deck (four track) but inc. valves, screws, wire, track switching, etc. £15.19.6

KIT M2 less case and deck (two track) but incl. valves, wire, screws, etc. £14.19.6

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No other system allows you to enlarge your installation stage by stage as Audiokits do. They comprise a wide range of very well made prefabricated transistorised units in which connections are standardised throughout and from which anything from a simple straight amplifier to an elaborate hi-fi stereo amplifier with FM tuner can be built. The Recordakit described above can be combined with your Audiokit assembly if you wish.

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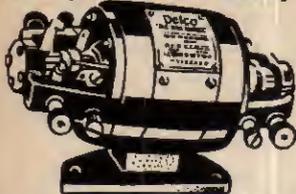
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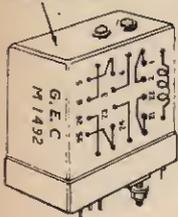


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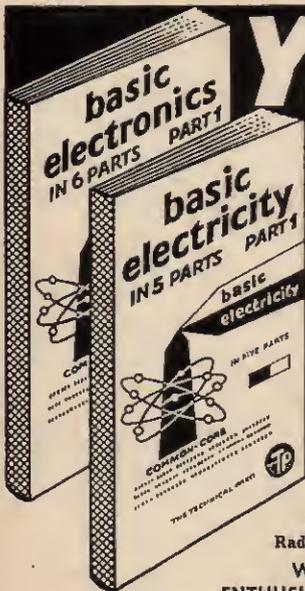
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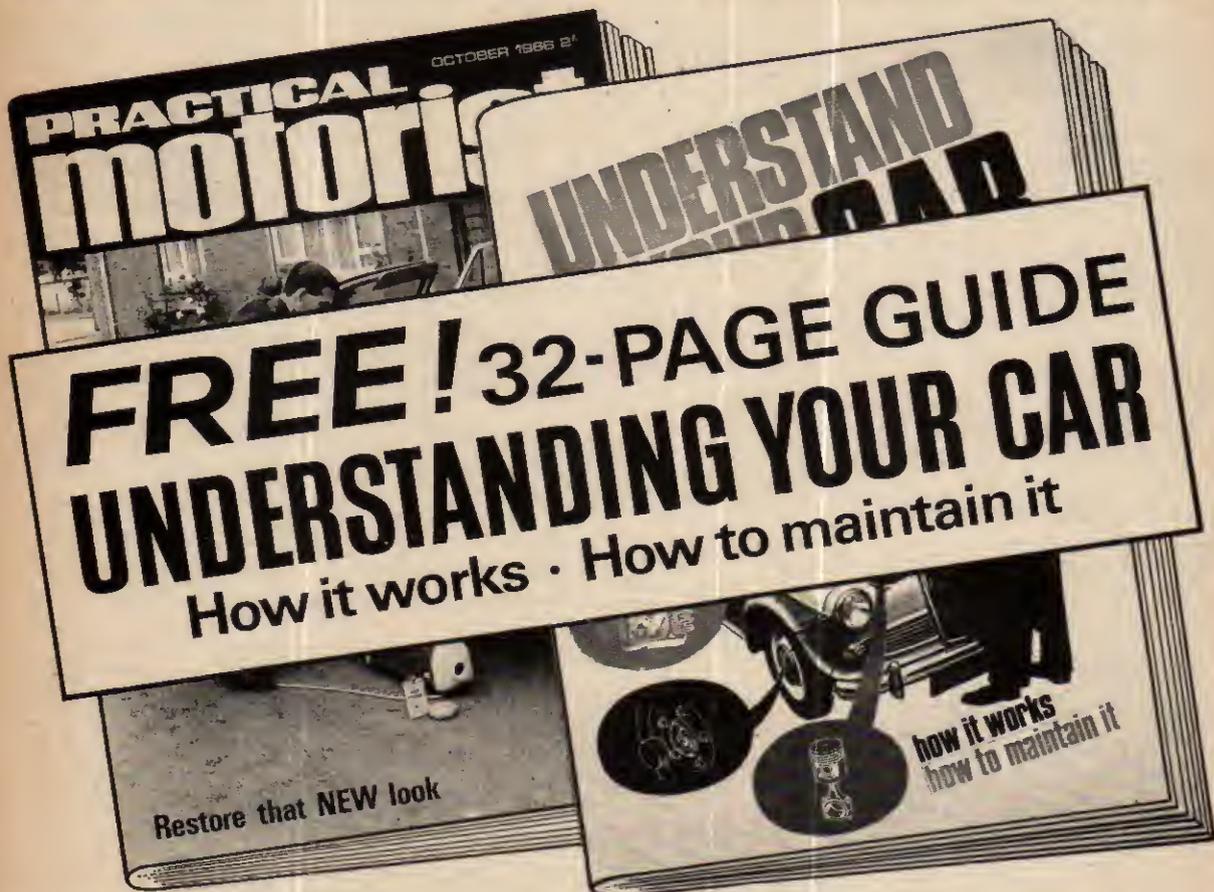
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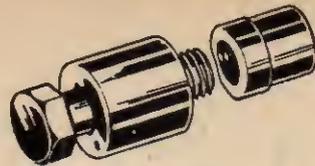
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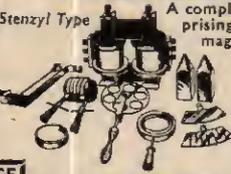
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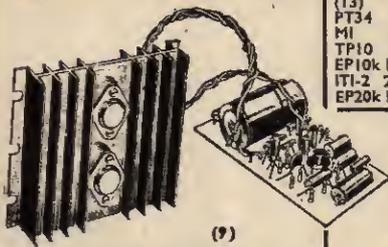
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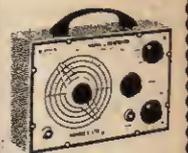
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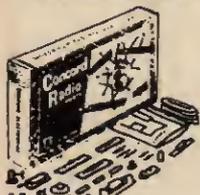
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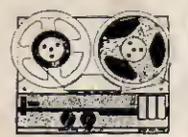
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(6)

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(4)

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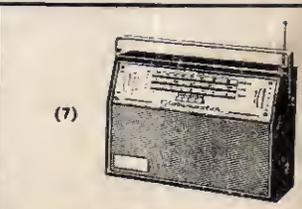


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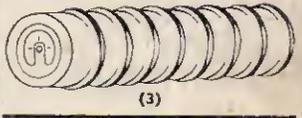
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(8)



(2)



(3)

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