

R.C.M. & E. TEST REPORT No. 1

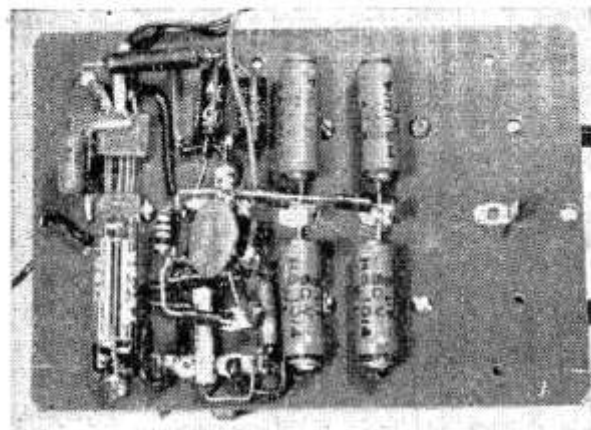
E.D. Black Prince & Black Arrow

Equipment reviewed is considered under aspects of electrical testing carried out by F. C. Judd, A.Inst.E., and from the model operator's point of view by T. H. Ives. This splitting of reports will, we believe, enable us to provide readers with the best possible appraisal of new products.

BOTH the transmitter and receiver are entirely new developments in reed control using modern electronics techniques, new Mullard type transistors and miniature components. The complete equipment comprises a very compact hand held transmitter and a light-weight reed receiver, both of which are available for 4, 6 or 8 channel operation. This part of a combined review is concerned with electrical testing and performance only; I will deal with the transmitter and receiver separately.

The 'Black Prince' Transmitter

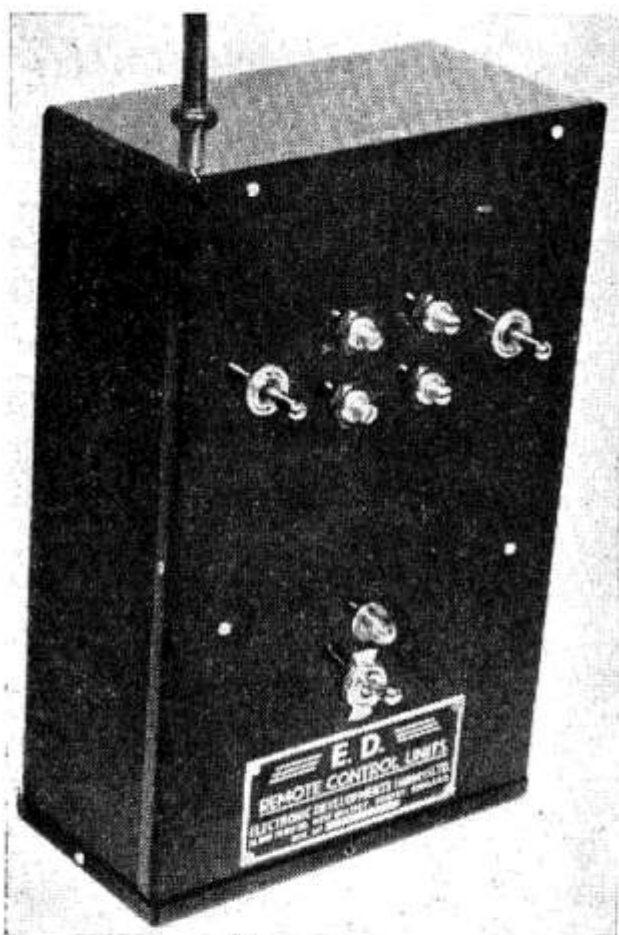
The model submitted for review has a black anodised finished case which being of aluminium helps considerably in keeping weight to a minimum. Construction generally is robust and I was particularly impressed with the chassis which is shaped to comfortably accom-



Above: Receiver with top removed. Note that eight reeds are installed on this four channel unit though four only in use. Below: Underside of the unit.

modate all the transmitter components and valves, and at the same time is rigid enough to prevent trouble from frequency shift due to movement of the transmitter and oscillator tuning coils. The size of the transmitter makes it convenient to carry in one hand whilst operation of the controls is carried out with the other. The aerial is also of quite unique construction being telescopic from 10 in. to its fully extended length of 5 ft. Loaded to resonance by an internal series inductance, this type of aerial is fully efficient, such losses as there are being very small indeed when compared with a full quarter wavelength aerial of 8 ft. 6 ins.

The *Black Prince* is designed to operate from two Ever Ready B101 batteries (67.5v. each) for H.T. and 1 AD4 (1.5v.) for L.T. and employs a circuit which is not widely used for radio control but is actually one of the most economical arrangements for obtaining good frequency stability and maximum efficiency. Two working valves are used, the DL 94 as a self-excited oscillator, this has both anode and grid tuning, resulting in a very efficient circuit. The DK 96 valve is used, as a tone generator and used in conjunction with a high Q Ferroxcube coil thus ensuring complete stabilisation of the generated



tones, each of which is selected by biased switches on the front panel.

Performance Tests

The model sent for review was a four channel version and was tested first with recommended H.T. supply (total 135v. from two Ever Ready B101 batteries) and then with the H.T. voltage reduced to 90v. The frequency stability at 27 Mc/s is good and remained so even with reduced H.T. and as the transmitter is pre-tuned at the factory the only operating frequency adjustment to be carried out is that of tuning the receiver. The waveform of the tone generator was examined and on each range a nearly squarewave signal is applied as modulation voltage to the grid of the power amplifier. Although the voltage output from the transmitter is too low to examine properly on the Y plates of an oscilloscope there was in fact just sufficient to show that the modulation is about the 100% mark; so the maximum possible low frequency signal is available at the reed unit.

Other tests included those of checking the frequency separation between tones. Each tone control covers about

100 c.p.s. so that the range of each channel overlaps the next, and by choosing an approximate mid-setting for the highest tone, each of the others may be set accordingly. None of the settings are critical and once adjusted there is ample separation between operating frequencies to obviate both drift and inter-action between channels. Having set all four reeds to work entirely independently the operating frequencies were measured as follows:—

No. 1	...	...	480 c.p.s.
No. 2	...	...	430 c.p.s.
No. 3	...	...	412 c.p.s.
No. 4	...	...	390 c.p.s.

The relays pulled in solidly at within ± 5 c.p.s. of the frequencies above and over a long running period a check on the highest frequency proved it to be within ± 1 c.p.s. of the original setting. This is extremely good for a self-generating L.F. oscillator and since the frequency separation required by the reeds is approximately 22, 28 and 50 c.p.s., between channels 4 and 3, 3 and 2 and 2 and 1 respectively, there should be absolutely no inter-action between them whatsoever.

General

Current consumption is 10ma. for carrier only and 12ma. when modulation is applied (at full H.T. voltage). This is comparatively low so that a fair life should be obtained from the recommended B101 batteries. The transmitter was tested at 90v. H.T. and still continued to function satisfactorily from an electrical point of view. L.T. consumption at 1.5v. is only 75ma. The weight of the transmitter is 5 lbs. complete with batteries and its dimensions are $9\frac{3}{4}$ in. \times $6\frac{1}{4}$ in. wide and $3\frac{1}{8}$ in. deep. The layout of the transmitter is such that battery changing is simple and can be done without disturbing the transmitter.

My only criticism and at the same time a suggestion, is that special lock nuts, known as 'pot-locks' should be fitted to the tone controls to prevent accidental shift for although these controls are slotted for screwdriver adjustment, they can be turned easily with the fingers. Each of the channel selectors are spring biased so that they return to the off position when released and are arranged to move up and down for channels 3 and 4 and right or left for channels 1 and 2. Suggested applica-

tions are as follows: Channel 1—right rudder, channel 2—left rudder, channel 3—up elevator, channel 4—down elevator. Alternatively channels 3 and 4 could be used for engine control, etc.

Instructions for operating are supplied although I would suggest these include a little more information in simplified style for the non-technical user. E.D. equipment is well known to all radio control enthusiasts and knowing something of their products and of the care that goes into design and production I have no doubt that the *Black Prince* multi-channel R/C transmitter will prove itself a thoroughly reliable unit and enjoy the same prestige as does all E.D. equipment in the field of Radio Control.

The 'Black Arrow' Receiver

Although designed for use with the *Black Prince* transmitter I see no reason why this receiver should not work efficiently with any well constructed multi-channel transmitter. It was, however, tested in conjunction with the E.D.4 channel tone modulated *Black Prince* transmitter and gave a remarkably good account of itself.

Firstly, considering its compactness and lightweight (8 ozs.) the construction of the receiver is robust and it is completely protected against shock and the intrusion of water or oil spray, etc. The reed unit relays the receiver components and transistor are all assembled on a strong bakelite chassis that is locked within the lower half of the receiver case which, like the transmitter, is black anodised finished. Layout is tidy and components are all securely fixed. The leads from each set of relay contacts are brought out ready for connection to servo units, each being clearly labelled and colour coded. Instructions include diagrams for the battery and relay connections as well as full information on installation, tuning and the various other adjustments required.

General

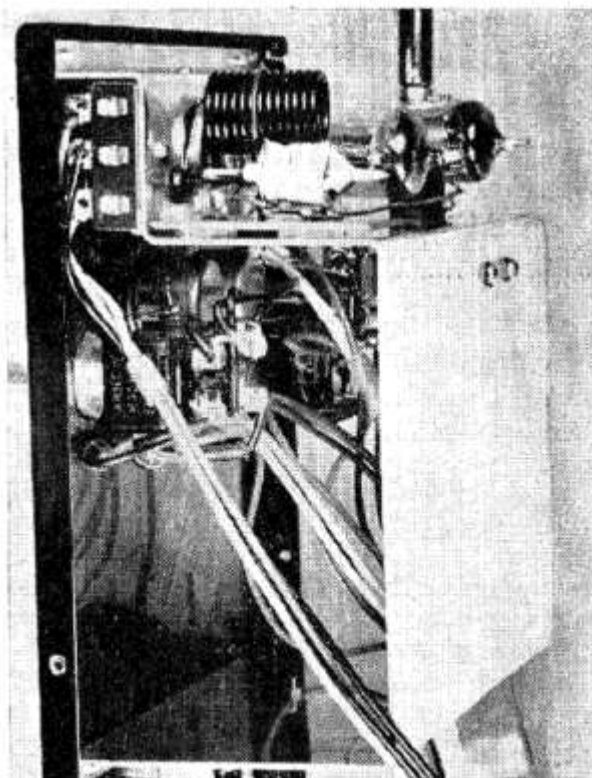
The *Black Arrow* sent for review was a four channel version but there was space on the chassis for two additional relays whilst the reed unit fitted was an eight channel unit. The receiver

operates from a 30v. H.T. supply and since current consumption is only 1ma. when receiving carrier only, small hearing aid batteries should give good service where requirements demand extra lightweight. Idling current is 1.5ma. (no carrier) and consumption when tone is being received goes up to 5ma.

The circuitry is based on latest type Mullard transistors (OC75) and uses a Hivac XFY34 sub-miniature valve as quench oscillator/detector. The two transistors are operated as low frequency amplifiers and develop some 22 volts r.m.s. of signal into the reed unit. Transformer coupling is used between transistors and temperature stabilisation ensures steady non-drift operation. Tuning requires the aid of a milli-ammeter but is otherwise a simple function.

Performance Tests

The receiver is fitted with a flexible aerial, which from the tests appears quite long enough for all practical purposes. Tuning is not critical owing to the broad band characteristics of the super-regenerative detector and no trouble was experienced in getting the reeds to respond to the four tones from the transmitter. Various tests were made to determine the frequency tolerance required by the reeds (see paragraph on transmitter) and the entire receiver was tested at reduced H.T. (22v.) from which



Above, left: Handsome and handy case in black anodised alloy whence comes series name of "Black". On right: A view inside the compact unit which allows ample battery stowage.

it continued to function perfectly.

The reliable operation of this receiver is undoubtedly due to the nature of the tone signals fed into the reed unit. These signals are nearly squarewaves when transmitted but once received are re-shaped with a fast leading and trailing edge, thus ensuring maximum and rapid movement of the reeds. Various tests were applied to check continuous function of both reeds and relays and a time test revealed that tone frequency drift is no more than ± 1 c.p.s. over a period of 10 minutes continuous operation. Intermittent operation over a period of one hour showed that the tone circuits remained completely stable and almost drift free. Frequency need only be maintained within ± 5 c.p.s. which is more than sufficient for reliable function.

Like its associated transmitter the *Black Arrow* receiver should gain prestige for reliability which surely is of prime importance in any R/C equipment. The working range tests for this equipment must be left to the reviewer who is to test both transmitter and receiver from a more practical point of view, e.g. in a working model. I have no reason to believe that other than a really good performance will be the result of the next stage of testing, for if both units perform successfully during these trials, the manufacturers should be proud of having designed them and potential purchasers will be assured of many hours of trouble-free multi-channel radio control.

MODELLERS' REPORT

The units were tested under conditions which could be expected to obtain in normal use for model work. A servo was connected and all batteries included. (TX.: 2 Ever Ready B101, 1 ditto, AD4; RX.: HT.B123 LT. U 10.)

Transmitter

This was found to be well up to standard as technical report indicates.

At $67\frac{1}{2}$ volts H.T. (i.e. half the recommended value) satisfactory operation of the reeds was possible at reasonable range. It is not recommended, however, that R/C operation should be attempted at such low voltage but is an indication of the reliability of the instrument. At this point the neon voltage indicator did not glow and a more precise adjustment of the reed frequency was found to be desirable.

The H.T. current consumption is quite low and a reasonably long life can be expected from the batteries without any falling off in efficiency.

Receiver

This was found to be very sensitive in operation. Was quite easy to install and very little adjustment was necessary to obtain satisfactory operation. Again the remarks in the technical review are fully endorsed but some minor criticisms arise on points which the manufacturers are modifying in production models. This being so there is no doubt that the units represent one of the finest at present obtainable.

It is recommended that care is taken in installation and use. All R/C equipment needs such care and these units are no exception.

Range with the aerial fully extended was found to be:—At 135 volts ground range exceeded $\frac{1}{4}$ mile with full aerial, and retracted 125 yards.

Points noted are listed below.

- (1) A certain amount of feedback was present in the RX. and if the H.T. battery falls, the internal resistance can cause excessive feedback to such an extent that operation of the reeds is not possible. In a severe case "motor boating" could arise. This applies also if phones are connected in the H.T. lead.
- (2) The inclusion of a capacitor of from 2 to 4 mfc. across the H.T. line completely cured the trouble and response was improved.
- (3) It was found that the relays as set by the makers operated at a current which appeared to be low. Adjustment of the spring tension is very limited and should not normally be attempted by the user. The makers are arranging for correct contact pressure during assembly.
- (4) Relay contacts are not suppressed.
- (5) The reed pots. on the transmitter need some protection (e.g. a cover plate or locking arrangement).
- (6) The channel switches are a little stiff.
- (7) Flexible leads to the TX. and RX. are not anchored and frequent movement in use might cause fracture at the point of connection.

Subject to attention to the points mentioned the two units can be recommended with every confidence.

[N.B. Circuits not available for publication.]