

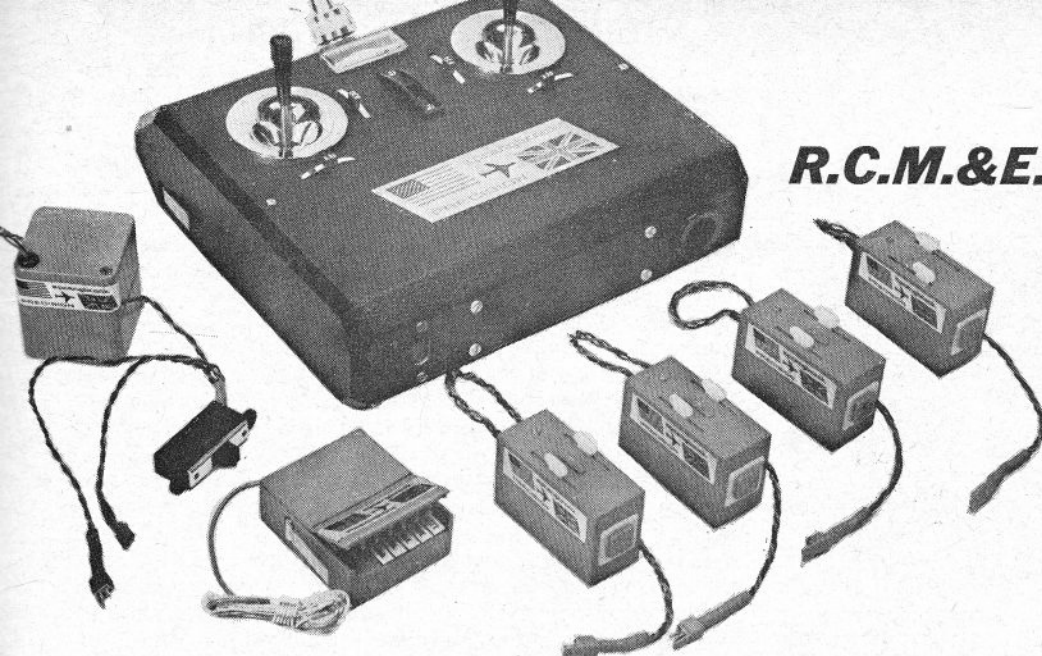
R.C.M.&E. TEST REPORT

SPRENGBROOK

SERIES 73

& PROFESSIONAL

SERIES



YOU'VE either got, or you haven't got style.' So goes the song and in the case of the *Sprengbrook Series 73* and complementary *Professional Series* system, it certainly does stand out a mile. Certainly no one can deny the elegant appearance of the pleasantly-styled Sprengbrook transmitter in its black vinyl cladding and red-coloured components of its neat, airborne system.

It is a long time since we tested a Sprengbrook R/C system, January '69 to be exact. Since that time the Sprengbrook line has been completely revised, the line now comprising the four- and six-function Sprengbrook Series 73, plus their 'Professional' system, the latter basically the same electronically and mechanically, while offering some useful additional features such as seven-function capability (great for scale), retracting undercarriage switch and an unusual and novel built-in frequency selector system.

Transmitter

The case of the Sprengbrook transmitter measures $7\frac{3}{8} \times 6\frac{3}{4} \times 2$ in. and is made up of a basic vinyl clad, folded metal centre frame flanked by moulded side cheeks. Distinctively styled with chamfered edges around the sides, bottom and top, the complete unit is slim, and with aerial fully extended ready for operation, balances well in the hands. The black case is pleasantly contrasted with the chrome deposited stick unit front bezels, trim levers and auxiliary controls.

Control layout is virtually standard for transmitters today with two dual-axis Sprengbrook stick units placed left and right in the top half of the case offering good, precise control 'feel'. The stick units have moulded end caps which friction fit onto the stick stems. The Nylon caps are long and provide a very good range of stick length adjustment achieved by simply moving the caps up and down the metal stems. A meter to monitor output and battery state is positioned at top centre on the case while below this is the

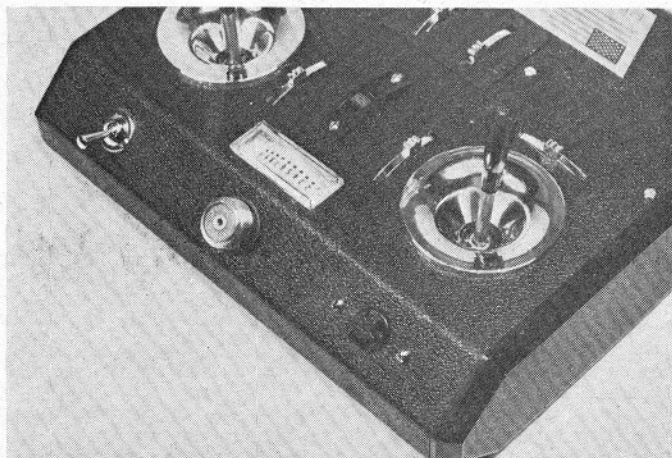
on/off switch, clearly marked 'on' and 'off'. It is a nice change to see the switch position legibly marked in this way. There can be no excuses for mistake here!

On the six-function version of the Series 73 system and on the Professional Series an auxiliary control panel, carrying two non-centring auxiliary control levels, is placed lower centre in the case. Charging input socket, and output to the receiver power pack are both positioned in the case bottom.

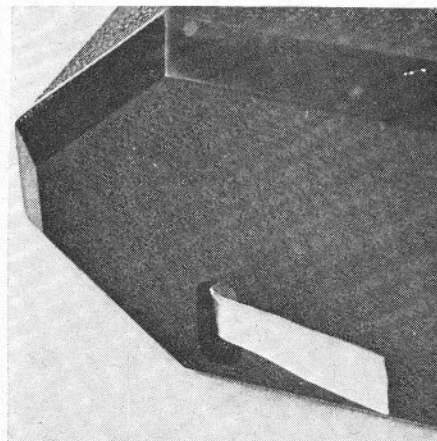
In the case top bevelled edge is the aerial connector, which in this case is a good quality, low loss, screw-on type UHF connector, once used by virtually all brands of R/C gear but now discarded by most. Sprengbrook are to be complimented for retaining it. The aerial itself is an excellent, robust stainless steel type, and angled at approximately 45 degrees to the vertical – the best arrangement to avoid signal 'dead spots' that tend to occur when a model is in line with the tip of the aerial. In the case of the Professional Series Tx, the aerial socket is flanked (left or right, depending on preference) by a two-position toggle switch for controlling a retracting undercarriage function.

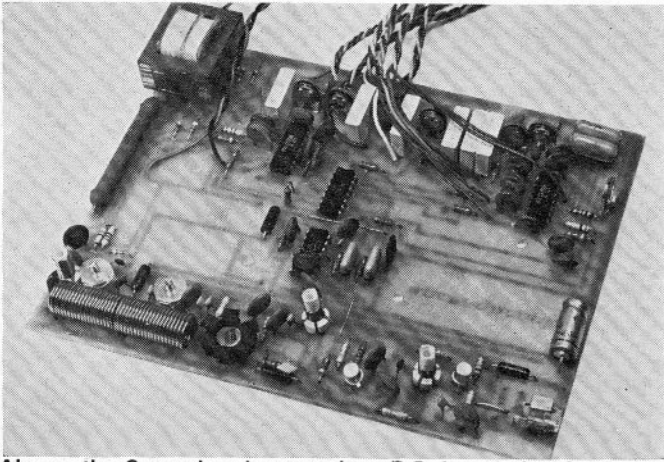
Frequency interchangeability is also available. In the case of the Series 73 system, a plug-in crystal is provided, inserted into a socket through an aperture in the left side cheek, while on the Professional Series a 'dial-a-matic' three-position rotary frequency selector is provided, linked to three crystals soldered into the P.C. board. This latter is a particularly neat little feature which helps to avoid most of the 'human element' problems associated with plug-in crystals. The frequency dial is easy and a quick way to change frequency and the three frequency positions are numbered, albeit in very tiny size print which might well be duplicated in larger size with transfer numerals around the periphery of the rotary switch, just for safety's sake.

Access to the internals is via a rear face panel which removes to reveal the high standard of soldering work which one would expect. The P.C. board is good quality glass epoxy and compo-

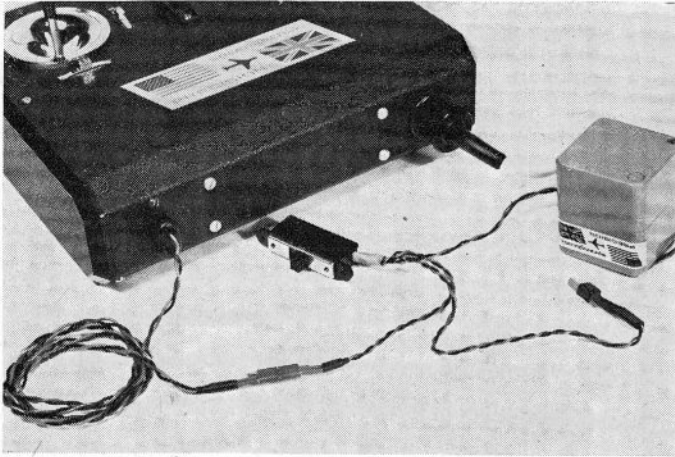


Left: Sprengbrook Professional Series transmitter showing the retract switch and the rotary frequency selector dial on the front face edge with the angled aerial socket. Right: plug-in crystal installation on the Series 73 transmitter.





Above, the Sprengbrook transmitter P.C. board showing layout of components including the charger with its small step-down transformer. This is the seven-function unit. Below: the charging harness.



ponents are quite thinly spread around. Further disassembly revealed the use of Alan Bradley pots on the dual-axis stick units.

Receivers

The receivers used with both the Series 73 and 'Pro.' systems are acceptably small by any standards. The four-function unit size $2\frac{1}{16} \times 1\frac{1}{4} \times \frac{1}{8}$ in., in red-moulded case uses a single P.C. board for both R.F. and decoder circuit, while the six-function Series 73 and Professional System receivers' size $2\frac{1}{16} \times 1\frac{1}{4} \times 1\frac{1}{16}$ in., employ a double-deck P.C. board arrangement.

Outputs to the servos, and the power input are handled via a novel block connector into which the servos and power pack plug, is mounted at one end of the P.C. board. The case lid of the receiver doubles as a locking device for the servo connectors. The hinged flap at one end of the case lid has small 'teeth' moulded in which grip the connectors when the lid is shut, thereby preventing the servo connectors from withdrawing accidentally.

A plug-in crystal arrangement is employed in the Series 73 system, the crystal being inserted through the side of the case while, on the Professional Series receiver, the 3-frequency 'dial-a-matic' system with built-in crystal bank and rotary dial selector is applied. The selector dial is wired to fly leads and can be mounted on to a fuselage side exactly as per an on/off switch for easy accessibility.

Servos

With either Sprengbrook system, you get a choice of servos. The standard Sprengbrook servo unit is their Micro-loc servo, size $2\frac{1}{16} \times 1\frac{1}{16} \times \frac{1}{8}$ in., which features dual linear output drive. This is a really well-made unit, featuring neutral adjustment from an external screw in the case top. Adjustment is a simple matter, using a small screwdriver.

The Sprengbrook Micro-loc installation system discards the more usual servo mounting lugs for spring metal mounting clips.

The servos then key into these clips and can be quickly extracted for installation in another model using another set of clips already fitted. Three types of clip are available, a single, upright clip and a dual, upright servo clip, both for fuselage installations, while a single servo sidewinder clip serves for aileron installations.

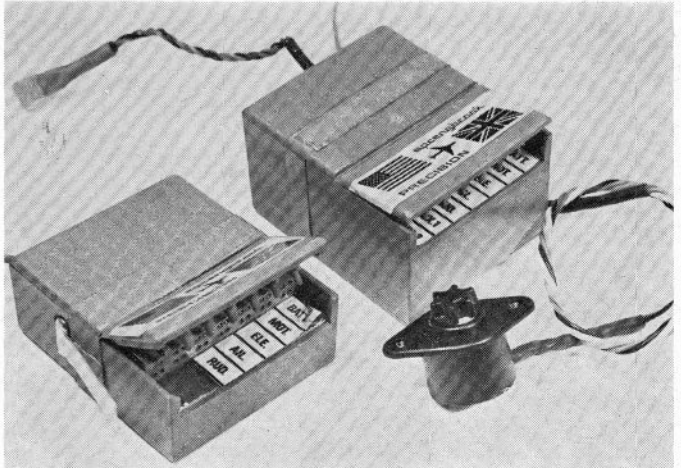
Also available is the Sprengbrook Mini-Servo, a really tiny unit, size $1\frac{1}{2} \times 1\frac{1}{8} \times \frac{1}{4}$ in., with rotary-type output drive. This has normal mounting lugs and is available with servo mounting tray to suit fuselage and wing installations. This servo also provides for external neutral adjustment, achieved by removing the output drive disc and using a screwdriver to turn the metal centre peg on the output gear.

Using three wire bridge amplifier circuits, both servo types have very fast travel times and produce excellent power. Neutrals are very 'tight' indeed and there is only the tiniest hint of slop in the gear trains. Servo connectors are tiny, three-pin ITT-Cannon solderless types, with moulded tongues to achieve polarisation and to prevent inserting into the receiver connector block incorrectly. The pins are gold plated, and lead connections are crimped into the plugs in place of the more usual soldering.

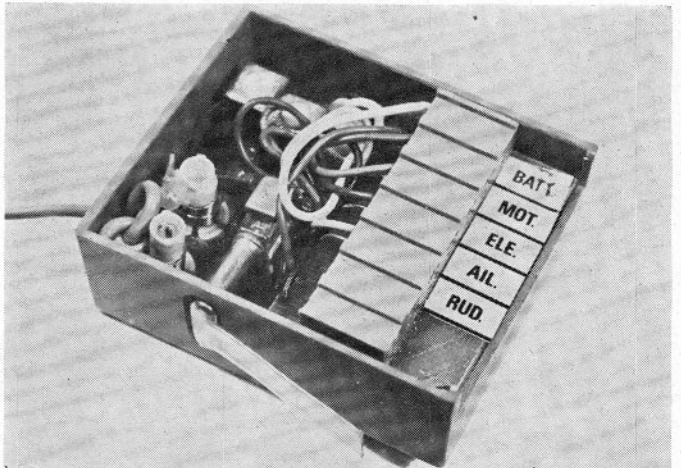
General system appraisal

Having examined the Sprengbrook Series 73 and Professional systems in detail, one is left to make an overall appraisal of the systems.

We like both Sprengbrook systems very much indeed. The transmitter is elegant and balances well in the hands. The stick unit has a pleasant feel while the trim controls are smooth, with sufficient friction to hold position. We also liked the positive



The four and seven-function receivers showing the top flap connector retainer and rotary frequency selector of larger seven-function Professional Series receiver.



The four-function Series 73 receiver in case with top removed to reveal the connector block, crystal holder and component layout. The plug-in crystal has a nice long tag for easy handling.

ratchet action applied to the throttle function, perhaps the very best yet experienced, and we also liked the on/off switch guard – always a sensible, practical feature.

The receiver is small, and with its clever connector block arrangement is another plus for the system.

Not every system offers choice of servo types and in the case of the Sprengbrook, the types do differ sufficiently to make the choice have practical meaning, a feature which makes this system all the more attractive.

Standard of workmanship throughout is really good, in fact it would be impractical to demand better. Assembly is neat and soldering work excellent. Offering, as it does, a really elegant-looking system and good technical performance to match, it is not surprising that the latest Sprengbrook system is enjoying popularity among modellers throughout the U.K.

TECHNICAL ANALYSIS By Rex Boyer

Since the basic circuitry for both the Sprengbrook Series 73 and their Professional Series are similar this technical analysis applies to both systems, with comments on individualities where appropriate.

Transmitter

Commencing our investigation as usual where the signal begins, we found both *Series 73* and *Professional System* transmitters to be unquestionably one of the most sophisticated we have seen in our long series of tests.

The Radio Frequency (R.F.) section is comprised of a crystal (xtal) oscillator (with three switched crystals in the Professional

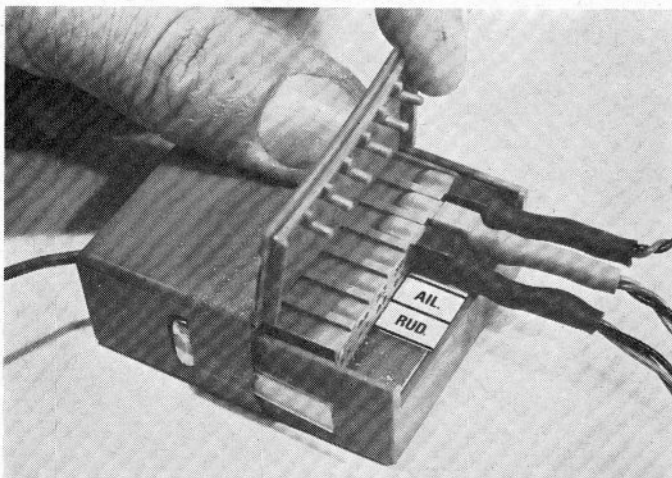
system) capacitively coupled to a buffer/modulation stage. The modulated R.F. signal is then inductively coupled to the Power Amplifier (P.A.) transistor. Replacing the common single π (Pi) output circuitry is a *double π* network, the output from which is fed to the loading coil of the aerial.

It is indeed gratifying to see such R.F. sophistication in a circuit, and this manufacturer is certainly to be complimented in going to such lengths to achieve a really 'clean' output, in which the first harmonic is virtually non-existent. The loading coil, incidentally, does not really take full advantage of all that the circuit has to offer. To achieve this, the coil would be too large for the Tx. case. In any event, there is more than adequate output by any standards the relatively high current drain ensures a particularly high output available to the aerial.

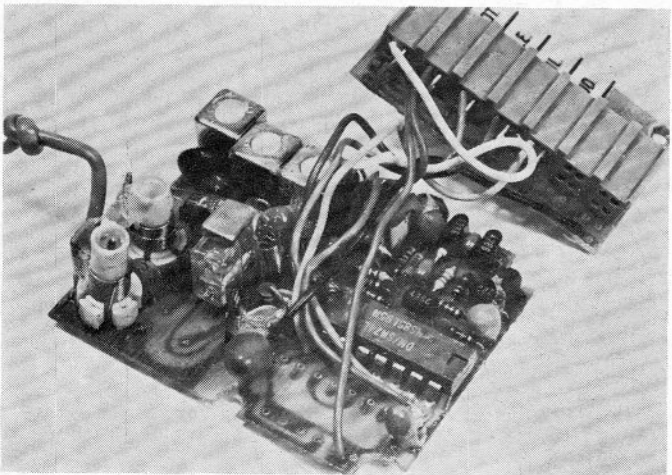
The Logic part of the circuit involves four I.C.s. The multi-vibrator clock generator is formed from an RCA 3086 I.C. (which is simply an I.C. full of transistors) in which some of the circuitry, unused by the multi-vib., is used for the first three half-shot pulse generators. On the four-function Series 73 system, the remaining pulse is derived from a discrete component half-shot circuit. While, in the seven-function Professional unit, the remaining pulses are formed by a second RCA 3086. Outputs from the pulse generators are fed to a *Motorola MC 719* I.C. and an *MC 717* chip, where they are gated together to provide the necessary R.F. off-pulses at the end of each command pulse.

Each half of the logic train is provided with a preset pot for setting up, as also is the clock generator. It was pleasing to find high-quality capacitors in the half shots, so there should be no stability problems with this circuit.

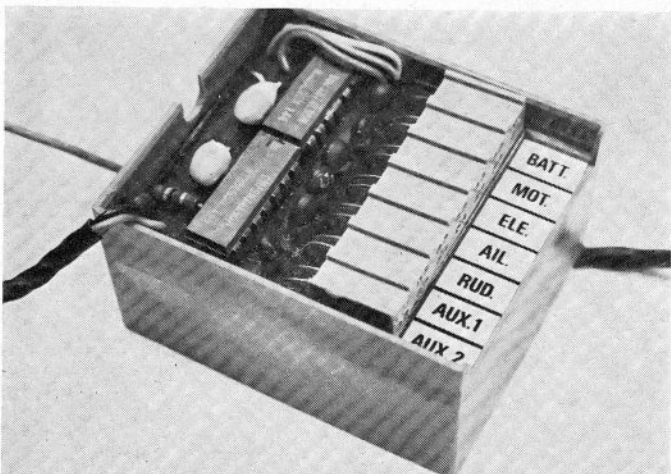
Unusual practice in the transmitter is the incorporation of the



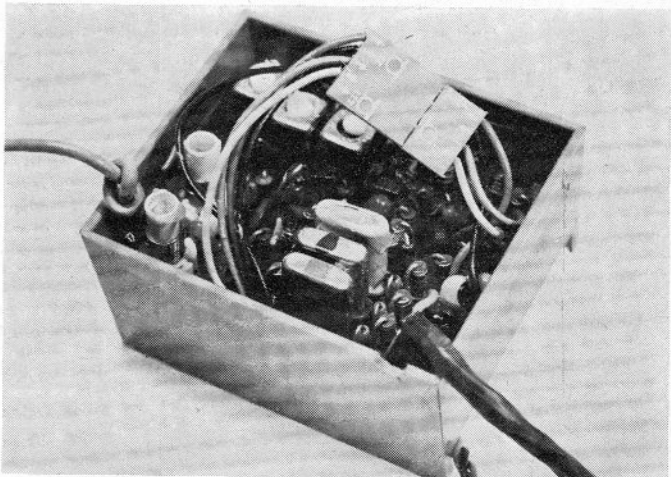
The four-function Series 73 receiver showing the top cover flap which folds back to allow insertion of the servo and power pack connectors in the receiver block. Note the 'teeth' which grip the connectors when the flap is replaced.



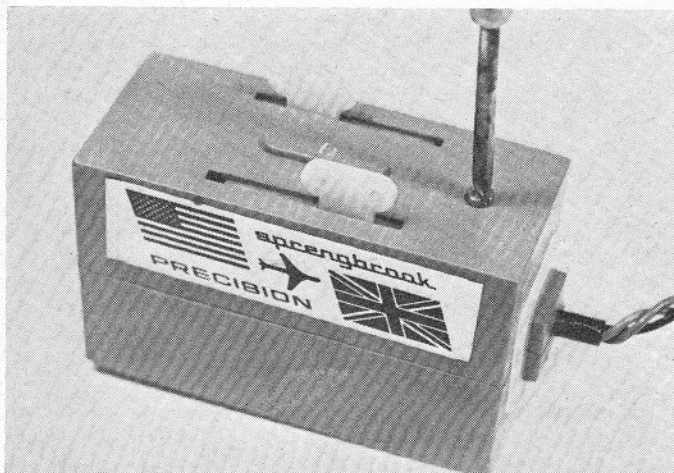
The P.C. board of the four-function Series 73 system is here completely removed from its case.



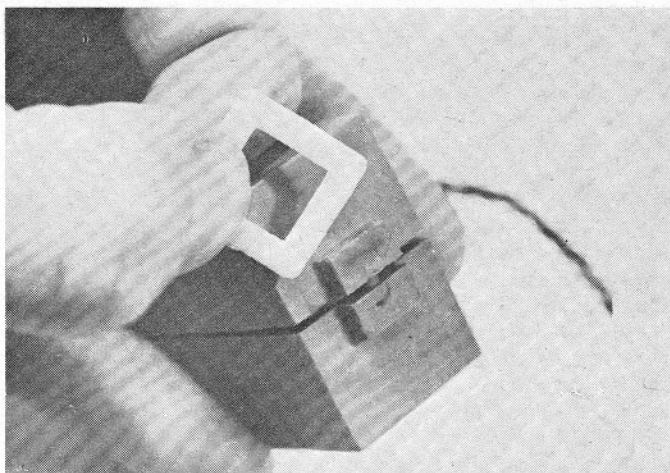
The seven-function Professional Series receiver features separate P.C. boards for R.F. and decoder circuits, latter of which is seen here; note the two I.C. chips and convenient identification of each function on the connector block.



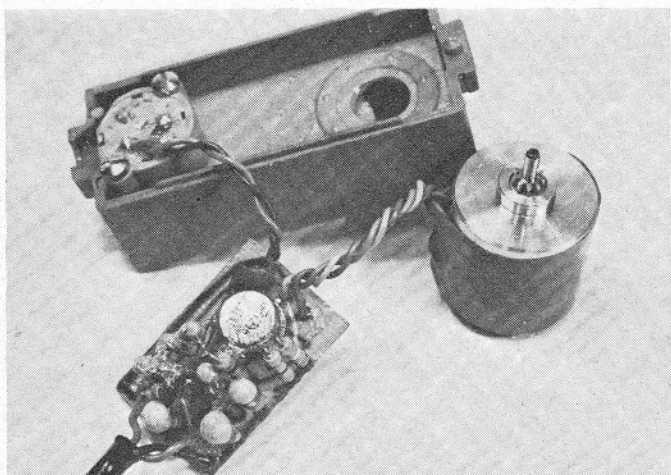
The Professional Series seven-function receiver showing the R.F. P.C. board. Note the three crystals soldered to the P.C.



Sprenghrook's standard Micro-Loc servo unit features two linear output drive take-offs which are opposite acting. Has no conventional lugs.



The Micro-Loc servo case is held together by small circlips which fit over the mounting clip keys moulded into the case ends.



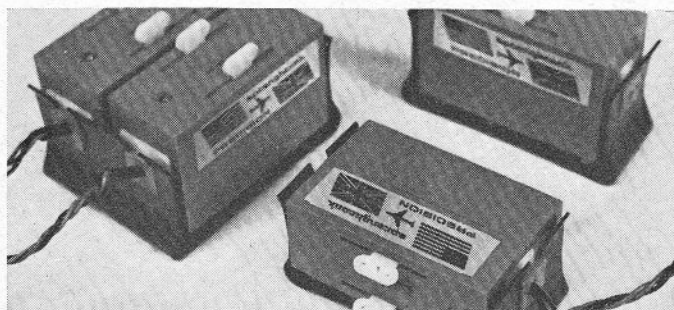
The standard Micro-Loc servo disassembled to show the I.C. servo amplifier circuit board, cermet-type pot and motor. Gear train is sealed in.

charger circuitry and transformer on the Tx. P.C. board. This does make for a 'complete' system and gets rid of some loose wires. The charger output socket to the receiver power pack could, perhaps, be better – a small point in an otherwise very high-quality effort. Power for the transmitter is derived from a 9.6v 55mAH Ever Ready nickel cadmium battery pack.

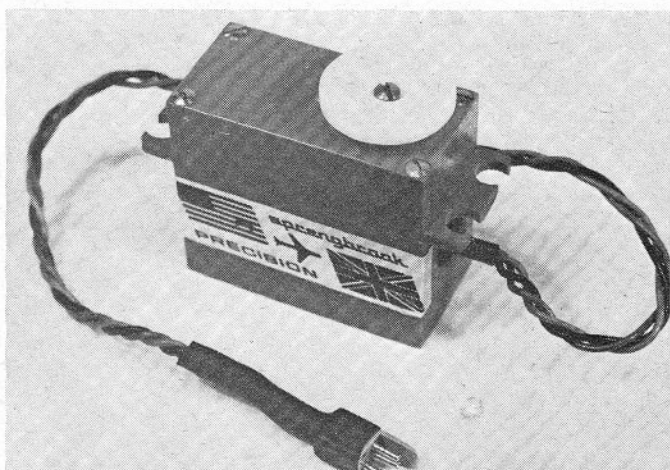
Receiver

Receiver circuitry is sound and conventional, employing a double-tuned R.F. section, feeding a mixer stage. A separate R.F.C.-type crystal oscillator is employed and in the case of the Professional system there are three crystals mounted on the board, selection of which is achieved by external rotary switch.

Two stages of I.F. amplification are employed, the output from the I.F. being rectified and shaped before passing to the sync. detector and other relevant circuitry.



Sprenghrook Micro-Loc servos fitted into variety of purpose-made mounting clips. At left is dual upright, in background single upright, and in foreground aileron sidewinder mount.



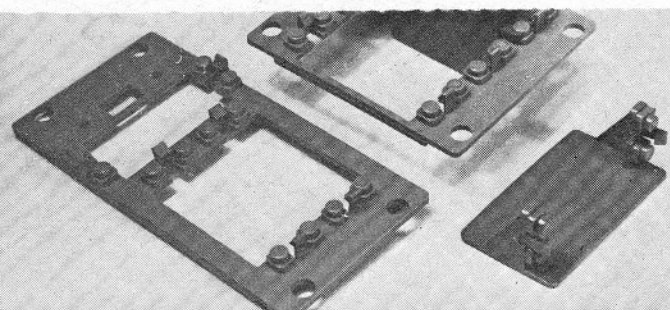
The Sprenghrook Mini servo is extremely compact, and features rotary output disc drive. Also has conventional end mounting lugs.

Decoding is achieved by the application of SN74L95 four-bit shift register I.C.s In the case of the six-function Series 73 and the Professional system there are two, offering a total capability of eight functions. The Sprenghrook system decoders all use low-power decoder I.C.s which maintain a satisfactorily low power consumption – a good technical point.

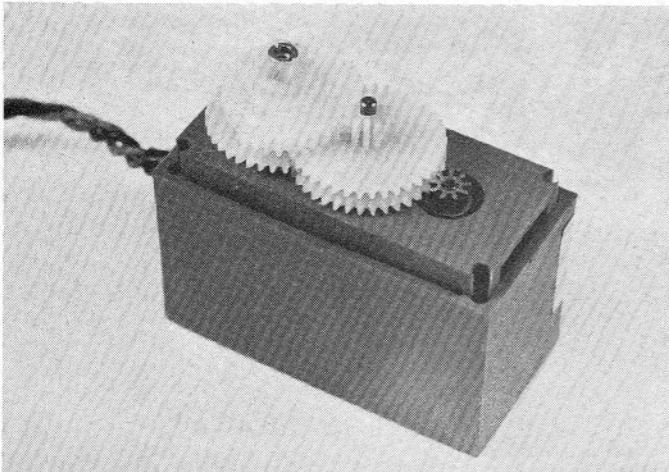
On the Professional series we noted the use of capacitors connected from each output of the shift register to -Ve supply. Manufacturer specification advises against such practice. This does not apply to the Series 73 unit.

Construction of the receiver is such that a rather novel form of case is employed in which the case lid is used to lock the output connectors from the servos and power pack which plug into the receiver output connector block, a sensible feature we thought.

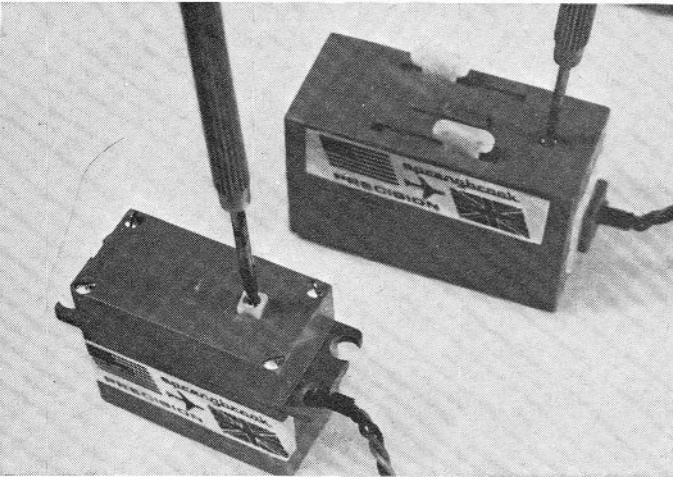
Output polarity from the decoder is +Ve, going with a level of the '1' state of some 3-4 volts.



For the Sprenghrook Mini-servos, these attractive nylon-moulded trays are available to suit variety of installation arrangements. Unit in left foreground features switch mounting position.



The Sprengbrock Mini-servo with case top removed to show the gear train. Output gear is thicker in minus teeth on part of arc to prevent over-travel.



Neutral position on both Micro-Loc and Mini-servos is adjustable externally, as demonstrated here. Simply use a small screwdriver to reset position.

Servos

It is no surprise to find the Sprengbrock servo amplifier circuit employing an integrated circuit. Such is, after all, the trend of the industry. The Sprengbrock circuit uses the Signetics WE 3141 I.C. chip which obviates the necessity for external transistors, although there are some 15 external resistors and capacitors, the latter being mostly of the high value tantalum type.

The principle of operation of this chip is conventional in that there is an internal reference monostable which is controlled by the feedback pot in the servo mechanics. The output of this monostable is compared with the incoming information and any difference is then amplified and processed such that it drives the servo motor in the appropriate direction to cancel out this difference.

As with contemporary I.C. servo amplifiers, the output to the motor is of the double pole change-over type (Bridge Amplifier), making use of an 11Ω motor and eliminating the battery centre tap.

We noted that the circuit provided little in the way of short circuit protection in the output circuit, although shorting is unlikely, due to the protection provided to the connector pins when the servo is plugged into the receiver connector block.

Further examination of the servo reveals the use of the now almost universally-accepted CTC feedback pot. Its application here is, however, unusual in that it is used as a two-wire variable resistor and not in the normal configuration as a potentiometer.

An external centring facility is provided with both types of servo mechanics. In the case of the larger, linear output type some care should be exercised when adjusting neutral positions to ensure that full deflection travel does not bring the output arm hard up against the end of the travel slot which stalls the motor.

Transmitter information signal timings

(all figures in milliseconds)

| Ch. | Function | Min. | Centre | Max. |
|-----|------------------|------|--------|------|
| 1 | Throttle | 1.0 | — | 2.0 |
| 2 | Elevator | 1.0 | 1.56 | 2.0 |
| 3 | Aileron | 1.0 | 1.56 | 2.05 |
| 4 | Rudder | 1.0 | 1.56 | 2.0 |
| 5 | Aux 1 | 0.95 | — | 2.1 |
| 6 | Aux 2 | 0.95 | — | 2.1 |
| 7 | Switch (retract) | 0.9 | — | 2.0 |

Tx current: 230mA (aerial up or down)

Battery pack: 9.6v nominal, 9.82v measured

Airborne pack current (Tx on)

Battery voltage: 4.8v nominal, 5.1v measured

Ever Ready 550mAH, nickel cadmium pack

| Receiver only | (10mA 4-channel) | Rx and 4 servos | 58mA |
|-----------------|------------------|-----------------|------|
| Rx and 1 servo | 32mA | Rx and 5 servos | 67mA |
| Rx and 2 servos | 41mA | Rx and 6 servos | 77mA |
| Rx and 3 servos | 50mA | Rx and 7 servos | 71mA |

Servo Response (all times are stop-to-stop)

| Load | Against load | Remarks | With load |
|-----------------|--------------|------------------|--------------------------|
| No Load (1 oz.) | 0.535 sec. | Slight overshoot | 0.512 sec. |
| 8 oz. | 0.575±0.1 | with load | Initial positional 0.5 |
| 1 lb. | 0.595±0.2 | error 1% | Initial positional 0.45 |
| 1 lb. 8 oz. | 0.610±0.375 | error 2.7% | Initial positional 0.475 |
| 2 lb. | 0.650±0.6 | error 4% | Initial positional 0.475 |
| 3 lb. | 0.625±0.462 | error 5% | Initial positional 0.45 |
| | | error 5.4% | |

Just stalled load 6 lb. 3½ oz.

Total Travel 0.45 in. Total Trim 0.15 in.

Comments

A close study of the test figures shows that the average servo current in the quiescent state with Tx on is 9mA, very low by contemporary standards for an I.C. servo amplifier.

The use of a low-power decoder chip also helps in the overall current drain figure for the airborne system. This is the lowest current drain I.C. system we have tested, and represents a commendable achievement.

The servo response tests produced somewhat erratic figures. In the no load state (i.e. with 1 oz.). The servo tended towards a slight overshoot when moving with the load, which disappeared when the load increased.

What did stand out was the response performance against the load in which instances, undershot tendencies were discovered. The figures show that the servo can get to within 5 per cent of the commanded position within normal time but takes further time to reach the true commanded position. It should be noted, however, that this state has no bearing on neutral position accuracy since the servo always seeks the neutral position in the 'with the load' state when used in a model, in which the aforementioned condition does not exist.

The servo is remarkable for its enormous power (comparatively speaking) and its ability not to slow down even at high loads. The stall load is over 6 lb. which should satisfy everyone. We would, however, like to see a less overdamped response characteristic.

Summing up then, a nicely engineered system. The standard model in particular gives very reasonable value for money.

Physical data

| Transmitter | Total airborne installation weights |
|--|--|
| Size: 7⅞ x 6⅜ x 2 in. | 4-channel with 4 micro-loc servos 14 oz. |
| Weight: 2⅜ lb. | 4-channel with 4 mini servos 11½ oz. |
| Aerial: Mins col-lapsed, 49 in. extnd. | 7-channel with 4 micro-loc servos 15 oz. |
| | 7-channel with 4 mini servos 12½ oz. |
| Receiver | |
| Size: 2⅞ x 1½ x 1⅞ in. (4-ch.) | Weight: 4-ch. — 1½ oz. |
| | 6-ch. — 2 oz. |
| | 7-ch. — 2½ oz. |
| Micro-Loc Servo | |
| Size: 2⅞ x 1⅞ x ⅞ in. | Weight: 1¾ oz. |
| Mini-servo | |
| Size: 1½ x 1⅞ x ⅜ in. | Weight: 1¼ oz. |