APRIL 1962

RADIO CONTROL MODELS & ELECTRONICS

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War on Gremlins

465 Mc/s Feature

'Creep' an R/C 'Thing'

Tx Power Converter

Vibration Indicator

APRIL 1962

RADIO CONTROL MODELS & ELECTRONICS

VOLUME 3 NUMBER 4

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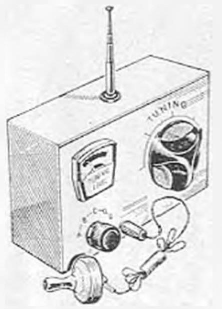

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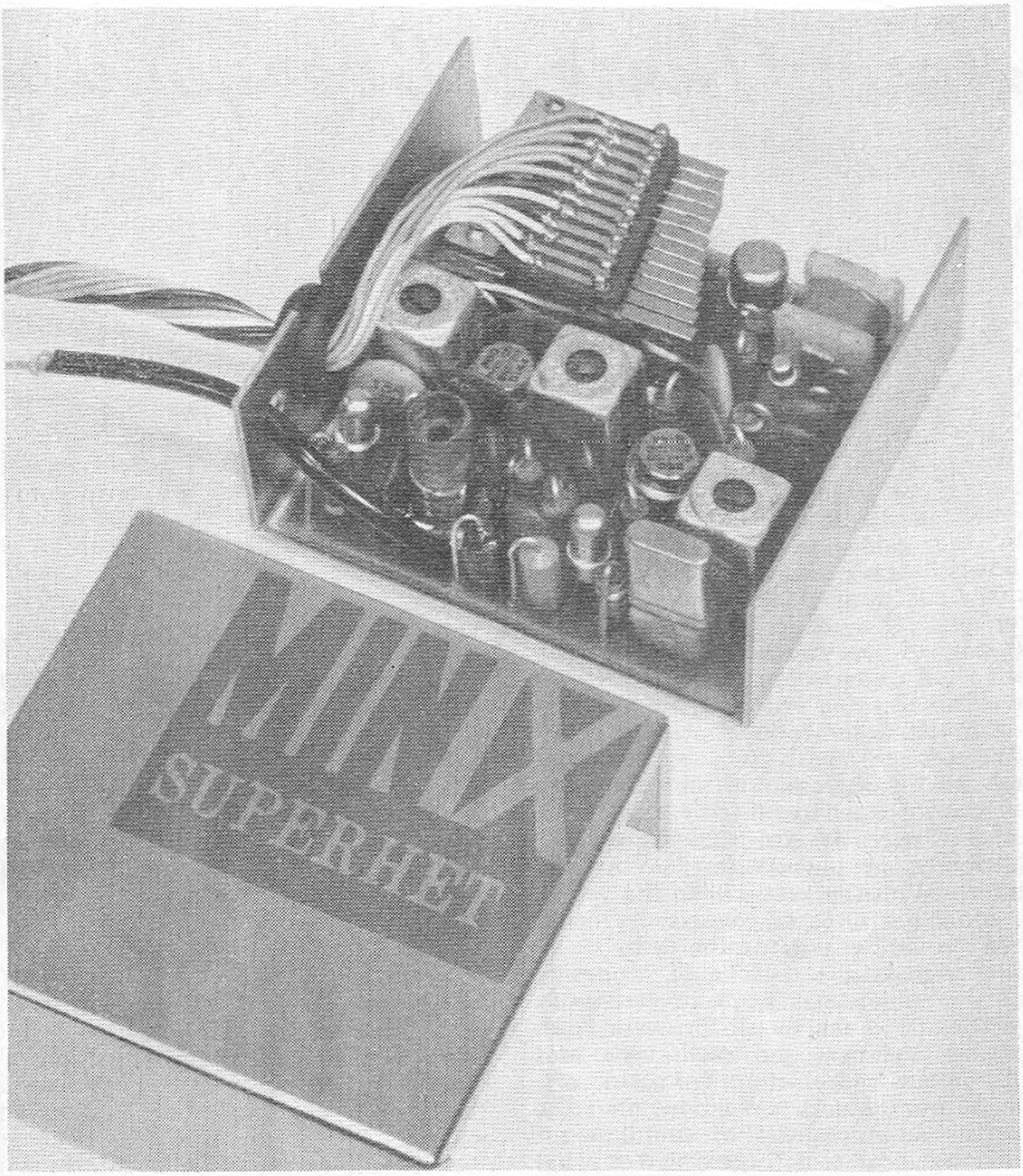
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Here, There & Everywhere

Overture and Beginners Please

A CALL well known in theatrical circles which we feel may be applied to *R.C.M. & E.*, its readers and its contributors. The increasing number of modellers starting radio these days means that your favourite magazine must take a swing in the direction likely to give the most help to those who are in most need.

We must therefore make our overtures *to* our beginners in the hope that as their experience increases they will join the ranks of our more expert followers. Our plea is directed at our worthy contributors, that means you, the average R/C modeller in the local club. not only to give the newcomer a leg-up but to tell us how you did it. We must then pass on the valuable information to a much wider following.

We for our part are now doing a large share of research into the *easy* way but in order to be truly representative, it is necessary for you, the reader/contributor to have a fair say in the matter. With the best will in the world, we could not hope to cover every detail when providing gen for the tyro.

Never make the mistake of supposing that the subject has been covered once and for all. Each month brings a fresh crop of beginners and each day's post bag contains more letters from this section of our readers. We hope that the theorists and designers of simultaneous full house gear will forgive us for what may seem to be repetition of elementary advice.

Far be it from us to back pedal on interesting technical articles, but the majority of readers are not yet followers of the highly theoretical. In like manner those who have many years of flying and boating behind them are still split into a very small contest group and a vast proportion of sport flyers or those who just like messing about *with* boats.

A humorous comment appeared in a reader's letter the other day wherein he sought the advice of experts. a class which he informs us is known in his locality as X-spurts; X being equal to nothing and a spurt=a drip under pressure. He didn't mean it, honest.

New Look

Our new easy to spot cover will we hope mean an instantly recognised end to the search for your copy of *R.C.M. & E.*

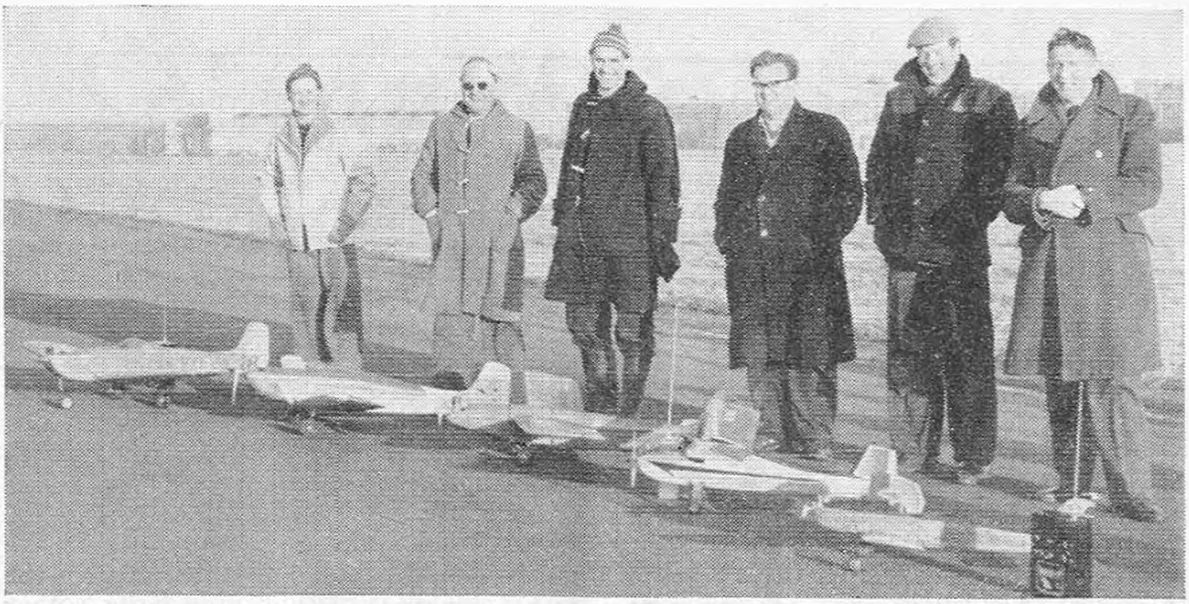
In keeping with our policy for the encouragement of bright new ideas, we have enlisted the help of a Graphic Art student/modeller Jack Purcell to design this and the next few covers.

Our Model Photographs

Jean Konicheff of Algeria sent us this photograph of his "Heliomastre" which seems to bear slight Uproar design tendencies and is powered by a Merco 35. The radio equipment is E.D. eight-channel. It is interesting to hear gen and see photographs from followers of the hobby who may be dotted around the globe.

Now, back home we have a nice club line up from the Bristol R/C Model Aircraft Club which was taken at R.A.F.

Jean Konchief's "Heliomastre"; rather more dihedral than an "Uproar" and a more closely faired nose. A nice workmanlike layout.



Bristol R/C M.A.C. line up (left to right) : Roy Norris and Astro Hog, John Mardon, Astro Hog again, Mike Barnett, John Reynolds and Gee-String, Bill Bellinger and own design high wing model, and Cyril Needham with own design low wing model.

Hullavington. Duffles, gloves and/or blue hands being the official wear on this 14th of January.

Rainbow

We have been asked by the author of the article describing this little R/C doll to mention the fact that D. N. Beany, H. J. Craig, and V. D. Brooker played a sizeable part in the production of the model. Messrs. Beany and Craig are technical assistants in the research department of one of our leading aircraft companies. Vic Brooker now retired from industry, continues to plug on with electronics at home. It took him just four days to wire up the complete and complex system of relays and control mechanism.

Derek Beany and Harry Craig spent two weeks perfecting the arm mechanism, which as readers will remember, gave two distinct motions to fore and upper arm. This required a separate model to prove the linkage design. The complete design and manufacture of the doll and its mechanical parts had to be executed in only two months.

Two More Dates

Leeds Model Boat Society will be holding an open Regatta on May 20th on the Upper Lake, Roundhay Park, Leeds, 1 p.m. to 7 p.m. R/C Steering and R/C Speed. Entrance fee 2/6d. inc. We suggest you write to the following address for entry forms. Mr. A. A. Midwinter, 1 Talbot View, St. Michael's Lane, Leeds 4. *Mid*winter? Let us hope that the May 20th weather is not influenced and that steering and speed enthusiasts will turn up in force. Now over to Birmingham where Valley Parkway Association (Birmingham I.R.C.M.S. and Bournville Model Yacht and Power Boat Club) will hold an open Regatta at Valley Pool, Bournville, on Whit Monday, June 11th, commencing 11 a.m. This event will be mainly for Radio Control with a straight steering course, no hydroplanes. For further details in Radio Control in the Birmingham Area please contact Mr. D. Vokins, 13 Vincent Avenue, Stratford-on-Avon, telephone number Stratford-on-Avon 3364, the Secretary, Birmingham Group I.R.C.M.S.

New R/C Service

Well-known modeller, Eric Falkner, a Galloping Ghost enthusiast who is a qualified electronic and mechanical engineer has formed a business known as "Radio Control Specialists" and is now available to cater for the R/C man's precise requirements.

He hopes to be able to offer the first British commercial proportional fullhouse system which is now being developed with Peter Lovegrove. We wish him every success in this venture.

Gremlin War '62

DOWN WITH THE GREMLINS . . . LET'S HAVE R/C . . . TROUBLE-FREE

WE propose in this series of articles to seek out and destroy as many of the mystery faults that assail an apparently foolproof model. Call them gremlins if you will, for such is their elusive nature and their ability to bring wrath and frustration upon the innocent modeller. One starts radio control in all good faith hoping it will be a nice easy, safe and restful way of operating otherwise free flying or free running models. Those who are successful may sometimes be dubbed as disciples of Lady Luck or budding Einsteins.

Of course, the gremlin strikes when least expected and adopts many cunning disguises so the poor modeller may be hot on the trail of some other ether jamming operator, when in fact a small interference shaped gremlin is hiding under his own servo. We hope to show the exact shape and colour of these trouble makers in a series of articles written specially for the beginner.

Vibration

One of the greatest hazards to the successful operation of an apparently foolproof set of equipment is provided in large measure by the vibration gremlin; he may be identified in several forms, his general shape having the dimensions amplitude, direction and frequency. He is usually the product of an unbalanced power unit although as we shall show later several quite different sources of vibration combined do produce rather similar effects, so one must carefully identify the source of vibration before attempting to control its effect.

Vibration Producers

A number of off-balance reciprocatory and rotary components are to be found in model internal combustion motors. This is in no way intended as a criticism of their design; some motors are more prone to vibration than others; diesels by virtue of their higher compression ratio. but some motors which are not tuned to run smoothly.

In this case the direction of force produced by vibration tends to be rather more elliptical than circular with the major axis through the centre line of the cylinder, the "shape" may be seen in Fig. 1 and is dependent upon the reaction and any slight unbalance in the piston/cylinder assembly and the rotary motion which may be accentuated by an off-balance airscrew. Naturally, such vibration will produce a predominantly vertical motion to the airframe or hull whereas a "sidewinder" (motor laid on its side) installation will produce a predominantly sideways motion.

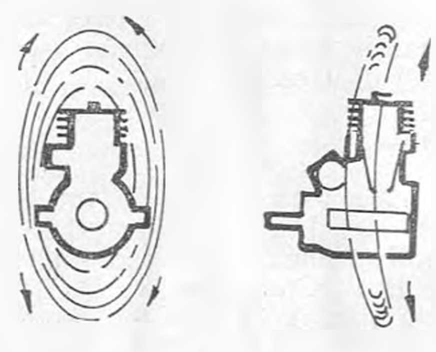
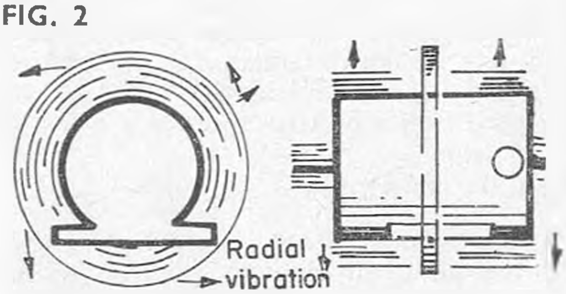


FIG. 1 Elliptical Vibration.

Electric motors, if off balance, though a less often encountered failing, usually provide a rotary force about the axis of the armature and their degree of vibration or amplitude is hardly likely to be sufficient to produce harmful results.

Fig. 2 shows the general direction of the vibration.

FIG. 2



Other Sources of Vibration

Having mentioned the fact that an airscrew can produce vibration it would be as well to study the effects of a defective propeller on a boat; Fig. 3a shows the forces set up and their effect on the shaft. It would be seen that whilst a mere fact of a heavy blade will produce a radial vibration similar to that in an electric motor; a blade of

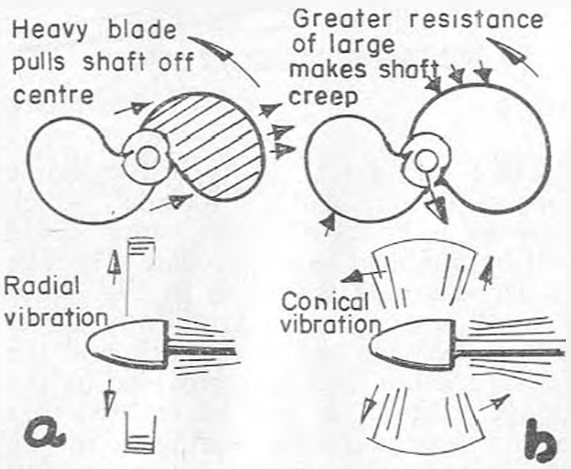


FIG. 3

greater resistance, i.e. one of higher pitch than the other for greater area even if no heavier will result in a dynamically unbalanced set up as in 3b. This results in a conical (not *comical*) movement of the shaft.

In the case of vehicles an additional form of vibration may be induced by its passage over rough ground if inadequate suspension is incorporated. Fig. 4 shows that most vibration is vertical with a

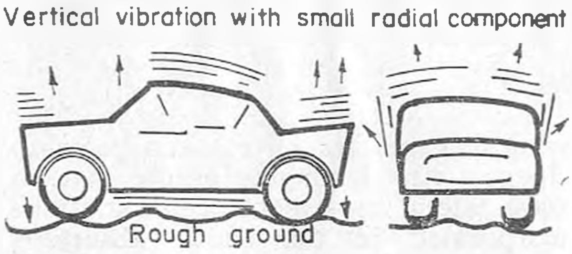


FIG. 4

certain amount of "rock and roll". Naturally the form of propulsion and any degree of off-balance in the wheels must be taken into consideration.

Damping

There are several forms of damping which may be employed to reduce the vibration at its source. Naturally the best method would seem to be one in

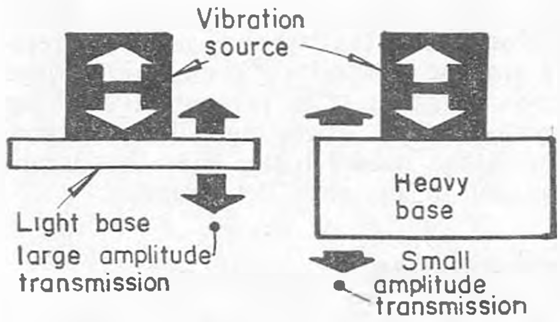


FIG. 5

which the motor itself was made to run more smoothly, i.e. by adding a heavy flywheel or airscrew. Where such a procedure is impracticable one must resort to mass damping (see Fig. 5). It should be obvious that when the source of vibration, such as the motor, is securely fixed to the base, that base will add to the mass of the supposedly fixed part of the motor, the crankcase in this instance. Now the smaller total percentage of moving parts will have less effects and the amplitude of the base will be smaller as a result.

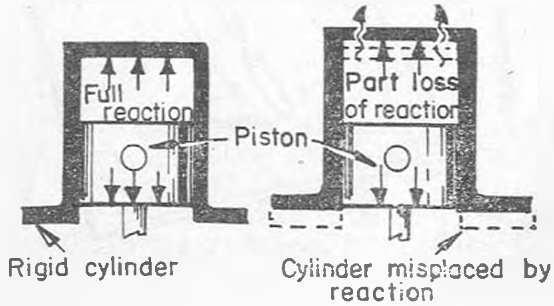
A belief held in some circles is that a loosely mounted motor loses a certain amount of power due to vibration, this may be due to friction in addition to reaction in Fig. 6.

Now before you begin to wonder what all this has to do with radio we must explain that to know the nature of the beast is an essential part of the cure for the vibration gremlin. One can then plan the successful isolation of valuable equipment from any excess vibration that remains after all balancing and damping methods have been applied. Now read on . . .

Model Mass

As we have seen from Fig. 5, for a given engine size or amount of vibration production, the greater the mass of the model, then the more natural damp-

FIG. 6



ing will occur. A point not often appreciated is that when a model is resting on the ground or even held in the hands extra mass is present, everything seems to be operating nicely, right; launch the model bang, goes the damping and in marches the gremlin.

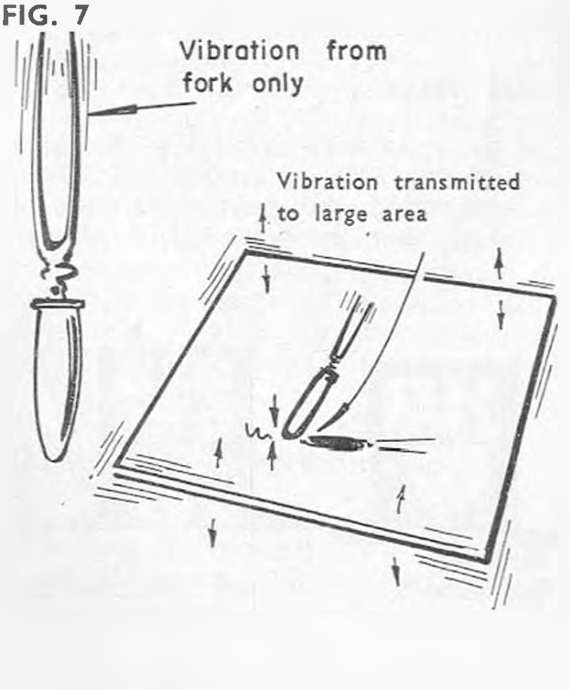
Transmission

We will deal principally with aircraft as being of lighter construction and using motors which forego the luxury of extra flywheel damping. Suppose one strikes a tuning fork as in Fig. 7 and places it on a light sounding board, then the board will vibrate with the fork. Much the same thing happens with a model aeroplane when the engine is running, that is to say, the vibration is transmitted down the bearers to the airframe and any equipment fitted *to* the airframe receives the full "benefit" of this vibration.

Motor Isolation

A number of models employ a very successful method of isolating the motor from the airframe. This system does of course permit the motor and bearer unit to vibrate quite fiercely, but on its own. This is where some mass damping is helpful; by making the bearer unit and nose block as solid as possible and as heavy as design considerations will permit, some degree of mass *damping* will occur, leaving less vibration to be *isolated* in the connection between the

FIG. 7



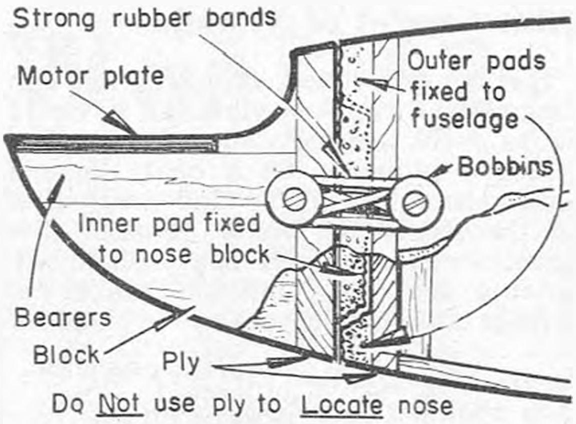


FIG. 8

fuselage and nose. A typical example appears in our A.P.S. "Rohma" which employs a knock-off nose which could well be modified to incorporate a sponge rubber damping spacer as in Fig. 8. It is most important to avoid any direct contact between the nose block and the fuselage, other than that provided by the sponge rubber. It will be realised that to add sponge rubber springing in the fore and aft direction and retain wooden locating blocks or dowels is defeating the main object of the experiment; the vibration will simply travel down this part into the fuselage offsetting most of

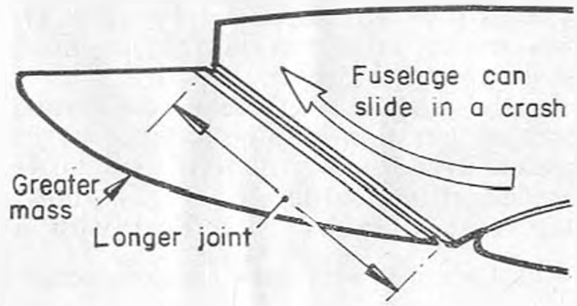


FIG. 9

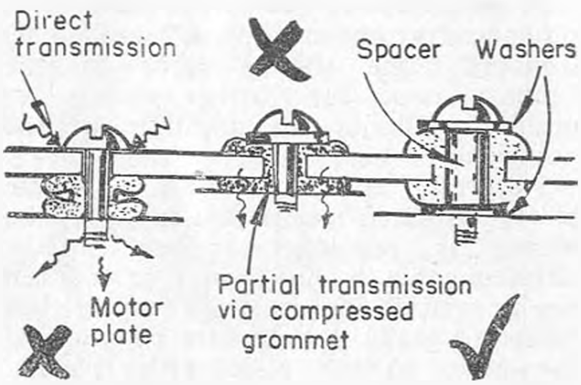
the advantages we have taken pains to achieve. Any keying to ensure that no excess lateral movement occurs must be incorporated in the shock absorbing material itself. The success or otherwise of this system depends largely upon practical tests with the motor it is intended to use by mounting it in a rough mock up of the nose unit with its damping spacer. In certain cases a particular motor will provide violent vibration at certain revs. if the nose unit becomes resonant. Alternative versions of this "free front end" may be seen in Fig. 9 which is an improvement wherein the joint at fuselage is much longer, there is a greater mass in the nose block, both factors contribute to a more stable yet resilient arrangement and the oblique angle of the joint permits the fuselage to slide clear during a crash. The latest R/C model to join the *Aeromodeller* Plans Service; "Blister" employs a spring mounted nose block to afford some degree of crash resistance if not vibration damping.

Boats are usually of sufficient mass to aid motor damping, in fact the water itself may give additional help in this respect.

Isolation Plates

The following system may be used as a motor mount or indeed as a fixing method for equipment itself. The same precaution should be taken when mounting motors by this method to avoid resonant effects in the final installation. An advantage of this method is that with very little trouble. the plate to which the motor is normally fitted may be given varying degrees of resiliance. Fig. 10 shows two ways of how not to do it (far too often seen in equipment installations) and the really effective method on the *right*. It will be seen that a spacer is incorporated in between two washers so that the mounting bolt which passes through the centre may be tightened up without compressing the grommet too much. Study Fig. 11 for details of this grommet and spacer combination. By filing the spacer tube to a shorter length one can compress the grommet, which be of reasonably soft rubber, a little more in order to give harder springing (one must not have the motor finding its own side thrust as the grommets take up the slack). Naturally diesel fuel is likely to affect the grommets and soften them after a while, although the effects will be considerably less when a glow plug motor is chosen as a power unit.

FIG. 10



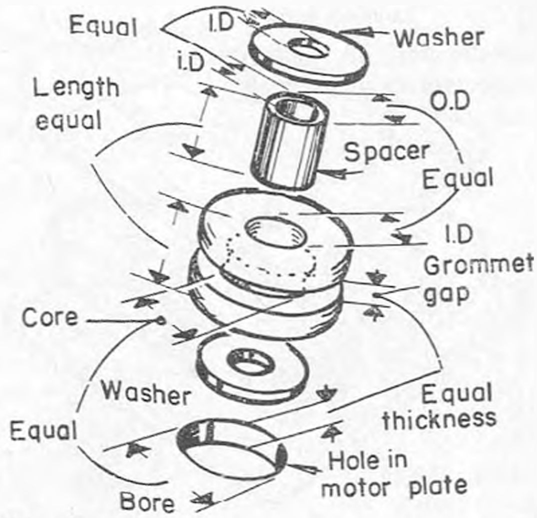


FIG. 11

The Effects on an Airframe

The effect of vibration on an airframe should be well known to the free-flight enthusiast and the wear which takes place on a control linkage is only too apparent to the control line flyer. Combine these into one unit and one has the difficulties associated with a radio controlled airframe.

Mechanical wear and tear on the actual structure due to high speed flexing of its members and actual wear due to component parts rubbing (as in a wing and tail seatings) combined with fatigue on metal components to reduce their structural strength and accurate fit. Naturally, if we are successful in reducing vibration at its source, then we shall reduce these unwanted effects on the airframe. The choice of engine and airscrew has quite a bearing on the subject and the precise formulae for smooth operation can only be found by trial and error. The use of a *vibration indicator* or monitor can go a long way towards detecting an improvement or otherwise of the power installation; a suitable instrument is described on page 172.

Linkages

Pushrods linking the control horn to the servos, torque rods linking rudder to actuator and in some cases throttle cables will transmit airframe vibration back to the equipment even if the latter is resiliently mounted, so it will be

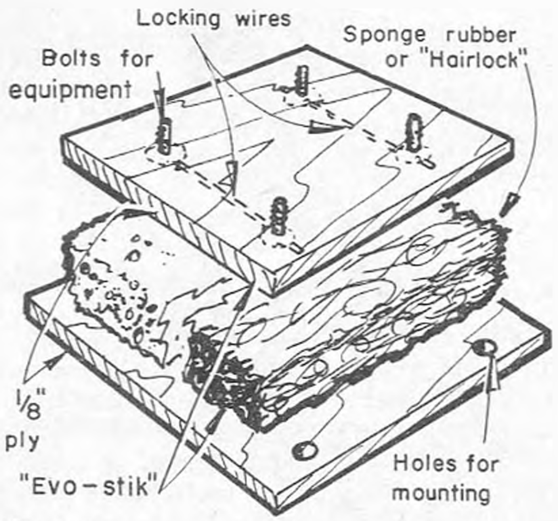


FIG. 12

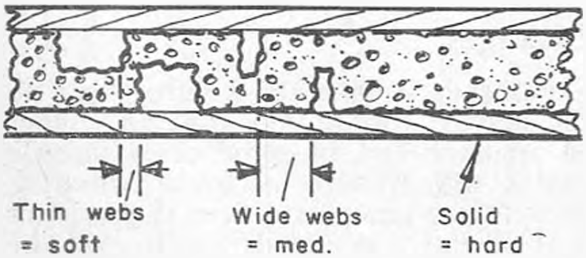
obvious that a reduction of vibration is more profitable than attempts to damp the equipment within the airframe. Such procedure is, unfortunately, not always possible or practical, so we must resort to an efficient form of isolation.

Isolation Technique

A similar but much softer form of "suspension" may be employed as an equipment mount to that described earlier for motors. One must bear in mind the necessity of providing springing in the *appropriate* direction; fore and aft float is to be avoided, whereas good damping in the direction of the vibration is of paramount importance.

Take the typical example of a servo; end float will cause the control surface to move off neutral with disastrous results. Yet if no isolation is provided, mechanical wear and fatigue will affect the servo. Even greater precautions must be taken with relays and reedbanks, for if vibration is allowed to get through to such units, intermittent and spurious operation will result. This applies both to single and multi where relays are employed, the reedbank itself

FIG. 13



being on the receiver is afforded a certain amount of mass damping although in these days of lighter receivers such damping is of a much lower order. Relayless equipment is still, of course, affected by unwanted vibration reaching the reeds.

Isolation Mountings

Where equipment is mounted on a plate such as that in the Sweetman version of the "Voltswagen" seen in the installation gen on page 15 of our January, 1962, issue, then the whole plate may be mounted as shown in Fig. 12. Sponge rubber or "Hairlok" may be used in a series of pads or sliced into grooves as in Fig. 13. It

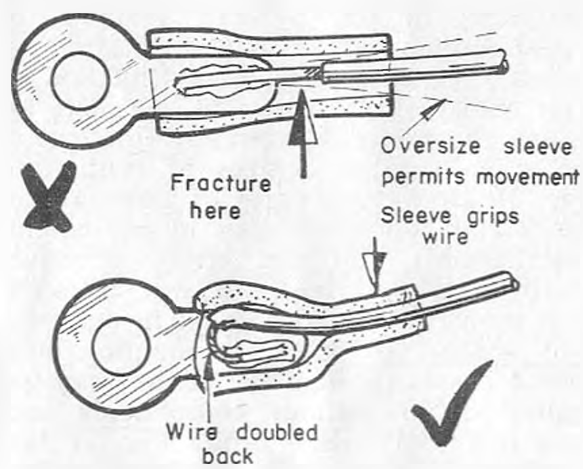


FIG. 14

will be seen that the more dense the sandwich, the harder the suspension and the more vibration is likely to be transmitted. Here again some form of end float restricter is necessary as the servos are mounted on the same panel. Blocks of hardwood faced with a rubber cut from an old inner tube placed so that they press against each end of the panel should provide the necessary stops.

Further precautions may be taken, such as mounting the servos themselves on special grommet units as supplied by Bonners. One should refer to the January issue for further details on multi installation in addition to the points noted here.

Naturally, the fact that a complete plate is isolated means that much of the wiring is protected against fatigue, although this is no excuse to slacken one's precautions in this respect but rather to make doubly sure by securing the wires to the plate with Evostik.

Fig. 14 shows right and wrong ways of terminating wires.

The suspension required for servos being slightly more rigid than that for receivers necessitates the use of additional extra soft padding round the receiver which would then be carried in a box at one end of the plate.

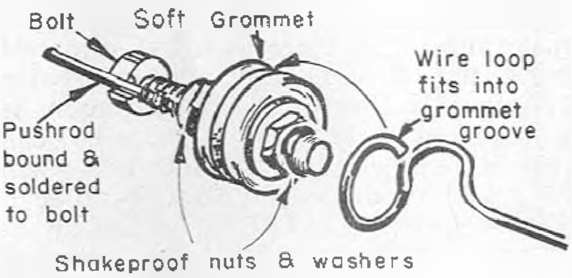
Linkage Isolation

In order to afford some measure of damping between a torque rod which may be vibrating and the servo, the little gimmick shown in Fig. 15 may be fitted to the wire part which engages in the servo output lever or the control horn. This is simply a form of adjuster with a soft rubber grommet incorporated between two ends of the linkage. It will be seen that by tightening the nuts which should be of the shake proof variety, the grommet is squeezed to provide a tighter grip on the wire loop fitted into the groove of the grommet. We now have an efficient form of shock absorber and a fine adjustment for neutral in the same unit, with the added advantage that the degree of damping is adjustable.

Linkage Vibration

Care should be taken to avoid what is known as a *resonant* vibration in push rods and torque rods; these may vibrate violently at certain engine r.p.m., in fact they have been known to fracture as a result whilst in the air. This may occur when the length and weight of the push rod respond to certain frequencies which virtually turn it into a vibrating reed. In fact, it is possible to arrange a visual indication of the vibration present in the model by fitting a piece of piano wire, clamped at one end, to the fuselage. Try to avoid a resonant length by checking the wire on the motor in similar manner to the reed type tachometers ("Revspot", etc.). Naturally, if the length is resonant a false indication will be given. The better policy is, of course, to make a simple vibration detector as previously mentioned.

FIG. 15



Mechanical Wear

Even though damping and isolation techniques may be applied, some of the effects of vibration may be felt in the actual mechanical wear on moving parts such as hinges, control horn to push rod joints, bearings on escapements and servos and on the wipers of switching systems. Servos are taken care of by the previous methods but hinges and push rod ends, bellcrank connections in aileron linkages, etc., may be improved by fitting biasing springs to hold the wire against one side of the hole, so that any vibration is restricted to half the bearing surface and reduced by virtue of the increased damping. A number of control line models have employed this arrangement successfully, and such an arrangement is shown in Fig. 16.

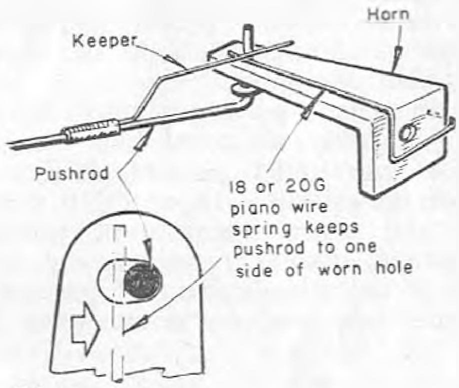


FIG. 16

Creep

Vibration will also produce what is known as creep. This has the effect of moving the controls off centre and causing sequential motorised servos to run onto the next position. Happily a number of servos are free from such effects but it is as well to bear in mind the fact that another source of trouble may be experienced in this respect.

Generally

It is hoped that the foregoing notes have helped to illustrate the problem and that reader may install his next set of equipment in such a way that the vibration gremlin is well and truly locked out. Next month we shall deal with the effects of G on equipment.

★

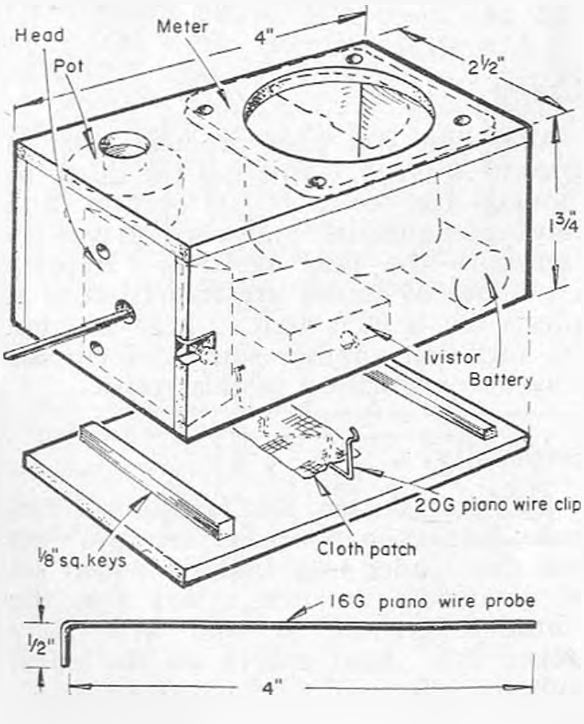
Break that Shake

With a useful vibration indicator

By PETER HOLLAND

If you are a neat and tidy reader you will probably have come across an article on the previous pages dealing with the vibration gremlin and noted that when installing radio in a model, it is better to have a previous knowledge of the conditions likely to be imposed upon that equipment.

In this case we are dealing with vibration, naturally we must find out what type of vibration is present, its direction and its amplitude. In order to cut out trial and error methods of installing equipment involving testing and modifying, a better indication of precautionary methods needed can be given if it is possible to monitor vibration in an airframe. This is possible without going so far as to make a flight, with the possibility of slightly more vibration being present than will be safely taken by the equipment.



Method of Measurement

Low frequency vibration can be observed by watching the poor little components in the installation literally quivering, higher frequency may sometimes be detected by placing the tips of the fingers lightly on the gear. This gives an indication that considerable vibration is getting through to the equipment. Now it is possible that less vibration will still be harmful, so we need some means of comparing the amount of vibration during our efforts to reduce its effect. It is too much to hope that one's fingers can detect a sufficient change in amplitude so some form of electronic measuring device is indicated.

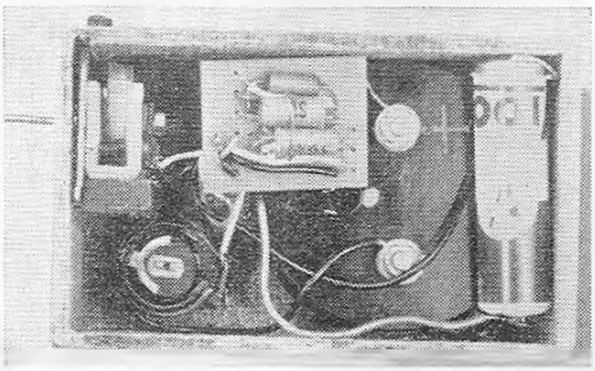
Naturally, the more simple the instrument the easier it will be to produce. Furthermore, some reasonable standards must be applied in order to achieve a fairly accurate comparison between different instruments. For this reason, the unit described here was designed to make use of no more than five principle parts, that is, if one includes an Ivistor as one. The heart of the instrument is a magnetic gramophone pick-up head that was relegated to the junk box when 78 r.p.m. equipment took a back seat. The original was a G.E.C. unit of about 2K coil resistance. Connected through a standard Ivistor, the gain provided is more than adequate to swing an 0-5 milliammeter to full scale deflection. A pot. is included in the circuit in order to tame the instrument down when being used to measure the vibration of large amplitude. By the way, amplitude means the distance through which anything subjected to vibration moves in the course of that vibration, in other words a ball bounced gently on the ground may be said to be of small amplitude whereas one bounced hard rises further and is an example of large amplitude.

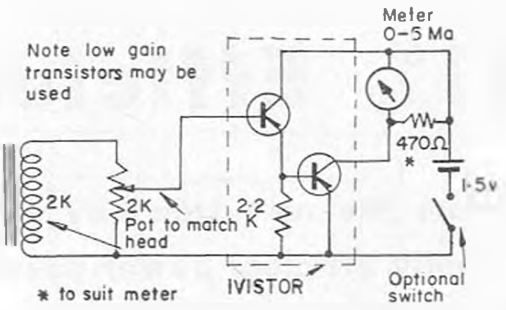
The frequency (speed) is also indicated on the instrument and it would require a more sophisticated piece of circuitry to separate the two. As the effect on the equipment is brought about by a combination of frequency and amplitude, it seemed unnecessary to go to such pains in the design.

Hook-up

It is advisable to procure a suitable pick-up head and meter before making the case. Selection of the head should not be too difficult and a test may be carried out simply by holding the pick-up head in the hand with a 3 in. length of 16G piano wire inserted in place of a needle. When wired up to the meter via an Ivistor it should be possible to get full scale deflection from vibration approximately $\frac{1}{32}$nd amplitude of a 1,000 r.p.m. or so. How does one test a tester? The prototype was tried out with a vibration *producer* no. Not a further complication; simply a TG18 motor with a small off balance Meccano gear on its shaft. This gubbins is strapped onto a piece of $\frac{1}{2}$ in. x 1 in. balsa about 9 in. long and fed from a 4.5v. battery via a variable resistance.

Below : View with the back removed; pick-up head top left.





Typical Circuit

Construction

Having established that the components work satisfactorily, a simple case from $\frac{1}{8}$ in. hardboard, ply or even hard balsa may be made, a circular cut-out for the meter and a hole for the pot. in the top panel. The pick-up head is screwed to one end so that the normal sideways movement of this armature is now up and down when viewed from the front panel. That is to say, if a gramophone needle was inserted and the box placed with its side towards the centre of a gramophone turntable the pick-up head would be in its original position. Do not try to use this as a level indicator on the best record player! This being one reason why the vibration producer was made.

The photographs indicate clearly the position of the components and the battery. No switch has been provided for this half pencell as it was felt that leakage would be so small as to warrant its use unnecessary. There is plenty of room in the original case for a push switch if required. The Ivistor should be wrapped with several layers of Sellotape to provide insulation and a pad of sponge plastic laid in the bottom of the case to retain the battery.

Readers may have their own ideas for construction of the case itself and the dimensions given in the illustration are for guidance only. An improvement in sensitivity may be made by shortening the length of the probe. This has the effect of increasing the amplitude of the armature for a given amplitude of input vibration. It is not advisable to lengthen the probe as this will not only desensitise the unit due to flexibility, but one may find that the longer wire has a resonance which will give a false reading.

[Continued on page 189]

81% Efficiency Converter

Follow the new trend by using a really efficient power converter on the Tx. Cheap batteries, no bother . . .

G. HIGGINS

shows how it is done.

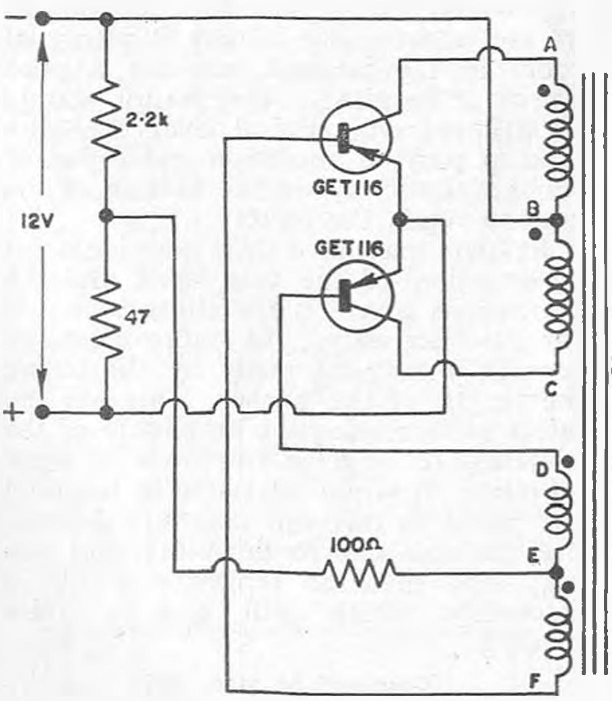
ANY form of D.C. to D.C. voltage converter must incorporate some form of switching device to convert the input D.C. voltage to an alternating voltage in order that a step-up (or down) transformer may be used. Prior to the use of transistors in this application a very commonly used switch was the "vibrator" as used in many car radios. As readers are probably aware this device suffers from the usual contact troubles and is relatively inefficient due to its moving parts.

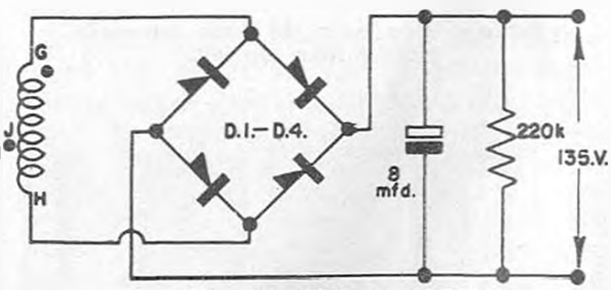
If transistors are used as switches to replace the vibrator these troubles disappear and the only remaining causes of inefficiency are in the inevitable transformer and rectifier system. Using modern semi-conductor rectifiers and with care in the design of the transformer an efficiency of 80% or more can be achieved. The unit to be described has in fact a full load efficiency of 81%.

Fig. 1 shows the circuit of a simple converter using two transistors in a push-pull arrangement. The transformer primary windings are connected with the collectors of the transistors which are switched by feedback windings connected to their bases. The output voltage is obtained across a third winding and is rectified and smoothed by the four diodes D1—D4 and condenser C1. It is essential to use full-wave rectification as the converter must be loaded on both half cycles of its oscillation.

Mode of Operation

The mode of operation is as follows: When a voltage is applied to the circuit one of the transistors will, due to minor variations of components, tend to conduct more than the other. The collector current of this transistor will increase and this change in turn induces voltages in the feedback windings which switch this transistor "on" and the other "off". This effect is accumulative and in a very short space of time one transistor is "bottomed" (fully on) and the other is hard "off". The full





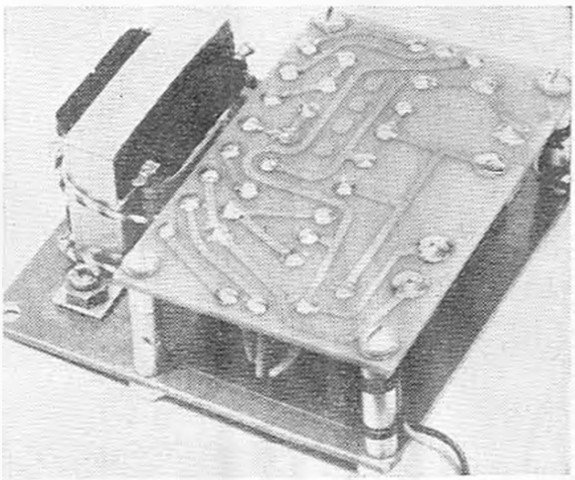
D.1.– D.4. GD10 or SX643
● Indicates Start of Windings.

FIG. 1

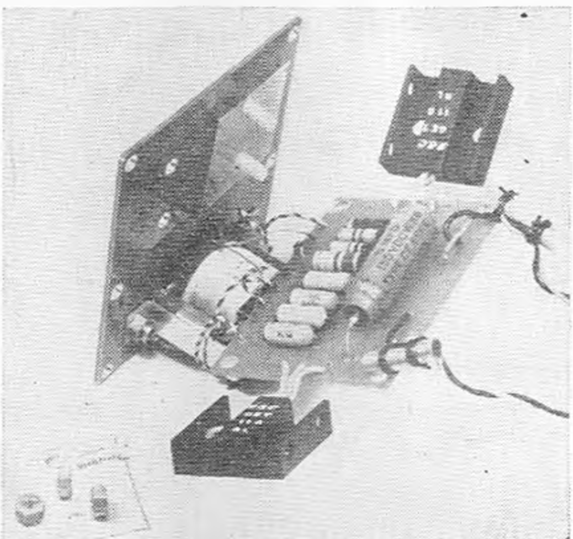
supply voltage is now applied to one half of the primary winding (less about 0.5v. which is the transistor bottoming voltage), this action having taken around 50μ seconds to complete.

The rate of rise of current in the primary winding will now be limited only by the primary inductance of the transformer. This rate will initially be constant giving rise to a constant output and feedback voltage. When the current has increased sufficiently the transformer core will begin to saturate, the primary inductance will decrease and also the primary current will tend to increase more rapidly. At this point the feedback voltage collapses (as there is no further change of flux in the core) and the transistor is returned to the "off" condition.

The over swing of the transformer will bring the other transistor into conduction and the cycle will be repeated.



Ultra neat construction shows well in these photographs.



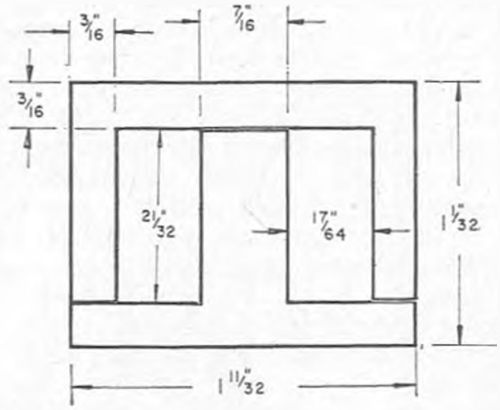


FIG. 2

Construction of the Unit

With the possible exception of the transformer no difficulty should arise in the construction of the unit. The transformer will therefore be discussed first. It is most important that the core be as specified and to aid readers who may have a suitable Government surplus transformer the lamination dimensions are shown in Fig. 2. This should be of .004 mu-metal which is usually sprayed with pink lacquer for identification purposes. Thicker laminations may be used but a reduced efficiency must be expected. The lamination stack is $\frac{5}{16}$ in. thick.

Winding details are given in Table 1. It will be noted that the two secondary windings are bifilar wound. This is achieved by laying two wires side by side and winding as one (as described in the December issue).

To minimise the effects of inter-winding capacities the output winding has been split into two parts with the other windings in between. The marking off starts and finishes must be accurately observed.

TABLE I

Start	Finish	Size	Turns
G	J	38g	382
D	E	38g	9
E	F	38g	9
A	B	28g	65 Bifilar
B	C	28g	65 Wound
J	H	38g	382

Transformer Winding Details.

In Order, From Core Out.

The base plate is shown in Fig. 3, this is of $\frac{1}{16}$ in. aluminium or copper and acts as a heat sink for the transistors. The holes should be de-burred carefully to avoid possible damage to the mica insulation of the transistors.

Figs. 4 and 5 show details of the printed circuit board and the positions of the components on it. Several articles have already appeared in past issues of *R.C.M. & E.* on the subject of making and wiring these and any constructor still in doubt is advised to refer to these.

Start the assembly by mounting the transistors on the base plate. The GET 116 transistors were chosen because of their fairly high (1 A) peak current rating and small size. They are supplied with a mica insulating plate and two nylon 4 BA screws which are used to insulate the body of the transistor from the base plate. The nylon screws are fairly

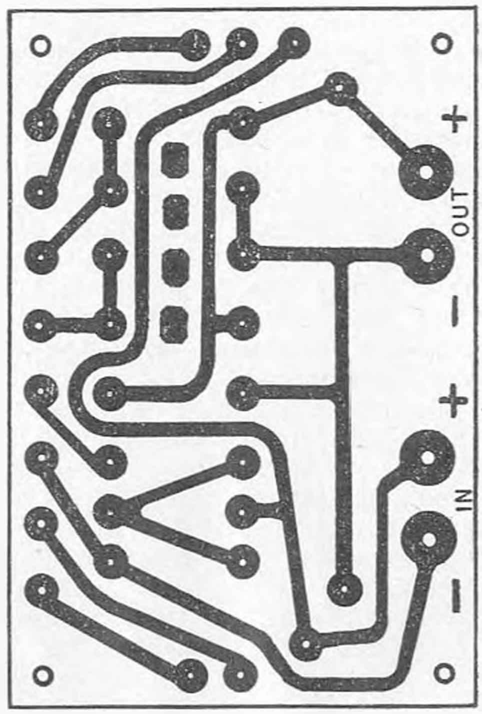
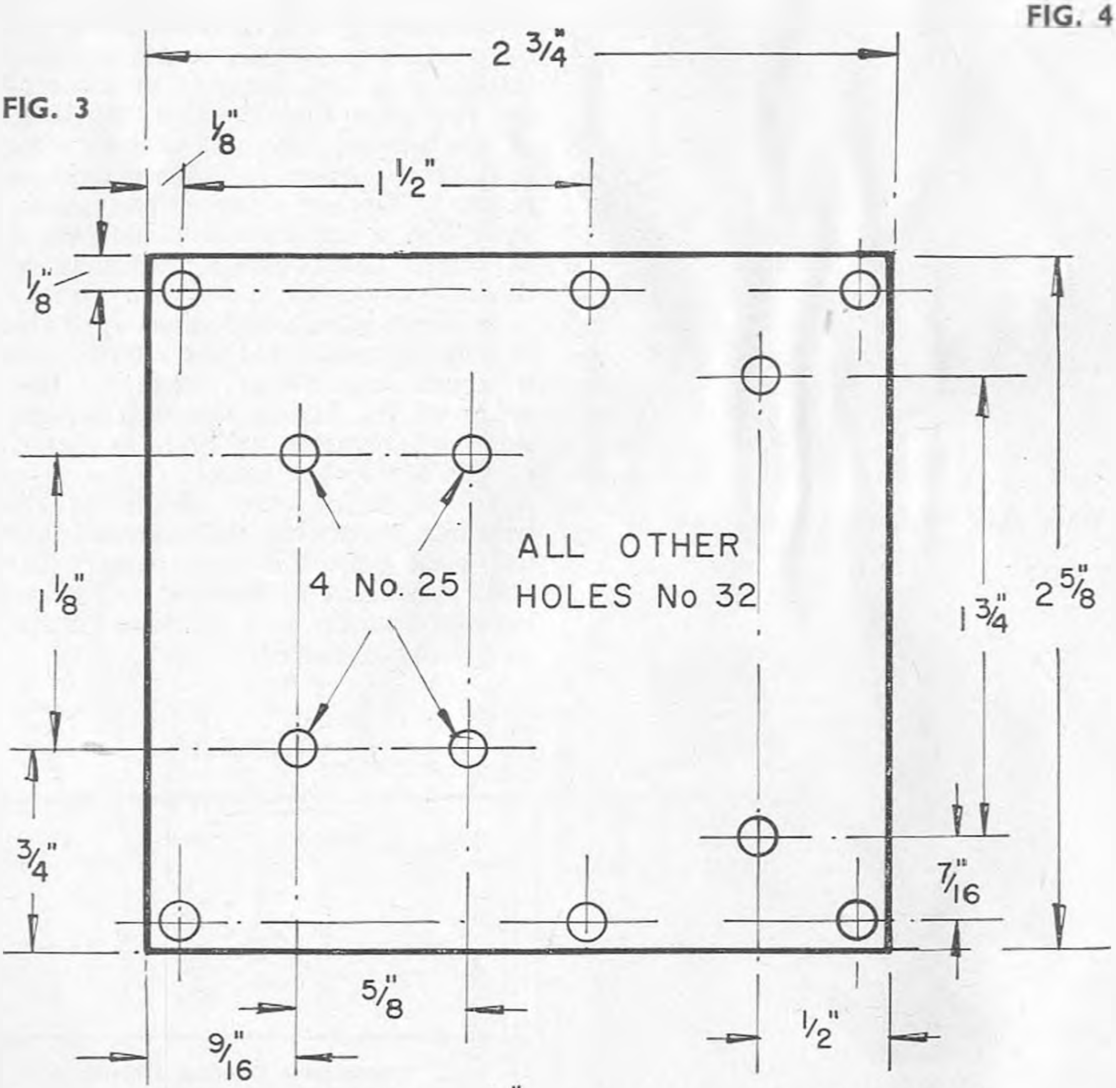


FIG. 4

FIG. 3



BASE PLATE 1/16" ALUMN. OR COPPER

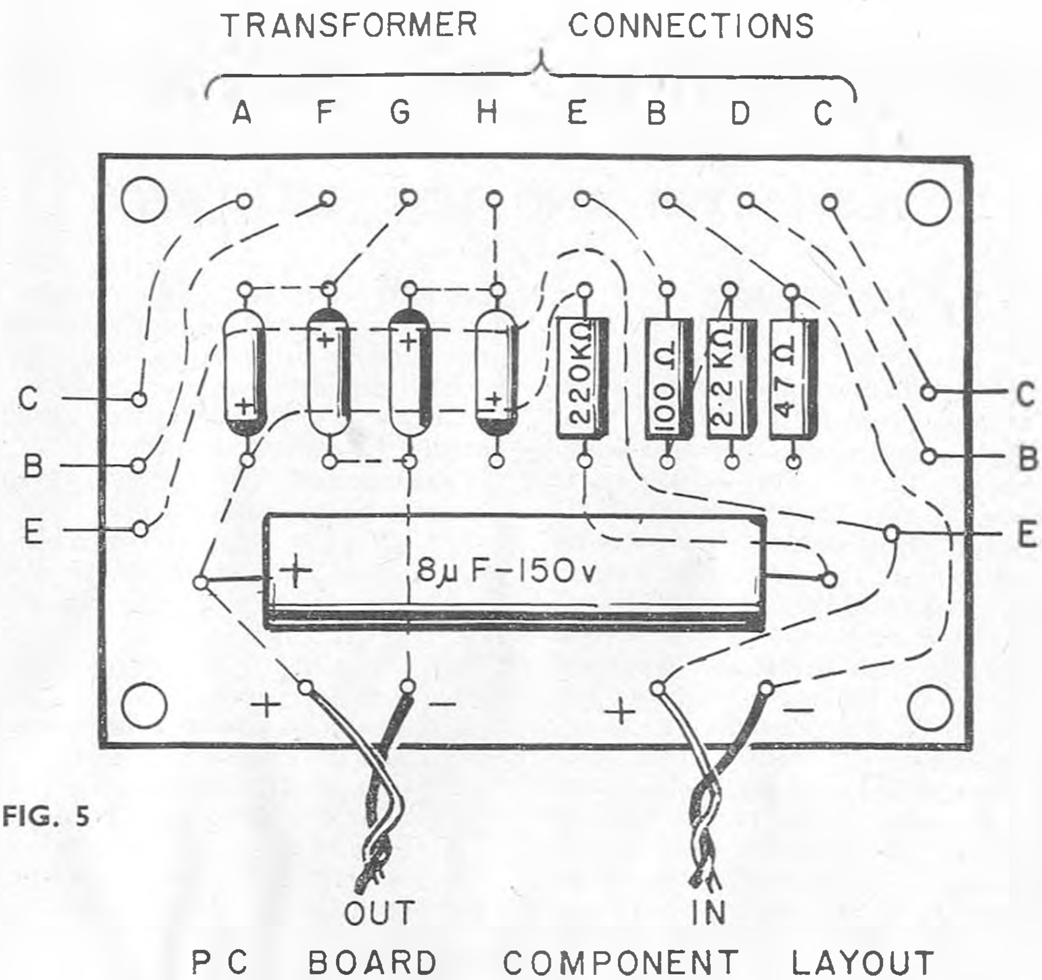


FIG. 5

strong but avoid over-tightening.

The printed circuit board is mounted in position, as seen in the photograph using 6 BA bolts and spacing bushes.

The transistor leads may now be connected to the printed circuit board and the interconnections to the transformer can be made. Great care should be taken to ensure that the transformer windings are correctly phased.

The unit is intended to be run from three 4.5v. flat batteries and with these it will occupy the same space as the two 67½v. H.T. batteries used in most transmitters. The output voltage on load should be 130v.-135v. with fairly new batteries. A 12v. car battery may be used if convenient.

Certain transmitters require a supply of only 90v. and in these cases the unit may be used in conjunction with a 90v. gas filled stabiliser tube to provide an extremely stable supply. A suitable circuit is shown in Fig. 6.

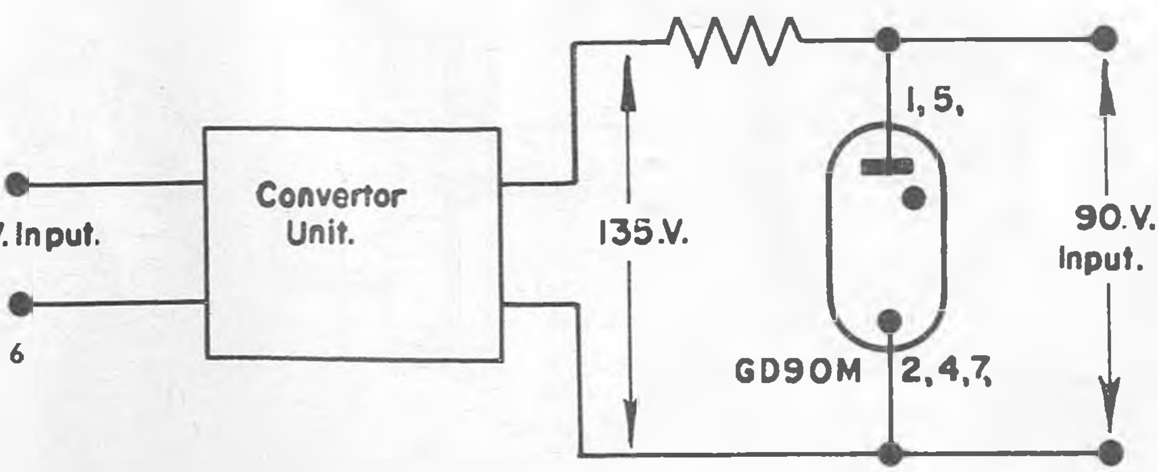


FIG. 6

Introduction to 465 mc/s

A WAVEMETER AND TEST OSCILLATOR

By H. BRUNT

ONE of the first requirements when considering using the U.H.F. frequency is the finding of that frequency in the U.H.F. Band. This is not quite as simple as it may first appear, particularly when making one's first approach of this part of the radio frequency spectrum. The following article is based on notes made originally in the course of experiments with the Radio Amateur Band starting at 420 mc/s. But as the instrument to be described has a coverage of approximately 410—480 mc/s it was considered that it would be quite adequate for use in the model control section of the U.H.F. Band. Before proceeding further it is as well to mention that, where care of construction and accuracy are important at 27 mc/s when making test and measuring gear; at 465 mc/s these things are of *paramount importance* if accuracies of even 1% are to be achieved and maintained. The type and form of tuned circuit used for the wavemeter described here, will no doubt, be unusual to most of the model control fraternity. So for the record and those interested, it is referred to in the U.H.F. Radio Amateur Field as a "semi-butterfly" type circuit, a name which reveals its origin from the "butterfly" circuit. Both circuits being a combination of both variable capacitor and variable inductance, thus giving a wide frequency range. More exact functions are detailed later under the heading Circuit Operation.

Construction: The following materials will be required:—

- A 7 pf. maximum variable capacitor. *See note below.
- A length of copper strip or sheet $\frac{1}{64}$ in. thick.
- A quantity of $\frac{1}{8}$ in. and $\frac{1}{4}$ in. thick Perspex sheet.
- A short length of $\frac{1}{4}$ in. diam. Ebonite or Tufnol rod.
- 1 $\frac{1}{4}$ in. shaft coupler.
- 1 Dial. 1 Knob and $\frac{1}{2}$ doz. 6BA x $\frac{1}{2}$ in. Csk. *Brass* screws.

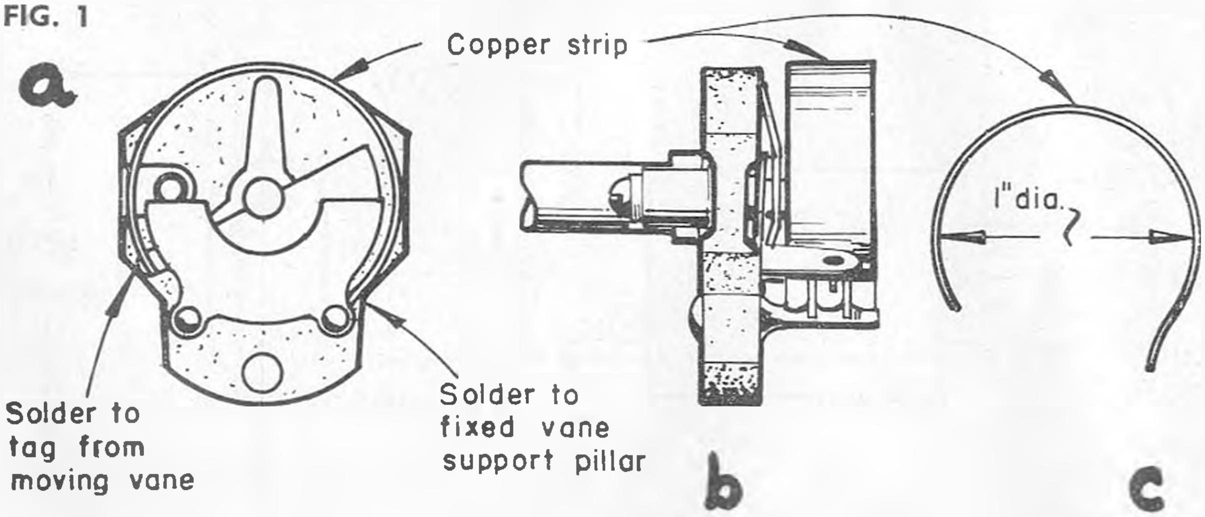
*[*It is essential that the capacitor to be used should have BRASS plates. Also the capacity will be 7 pf. max. when ready for assembly.]*

First ensure that the capacitor has the requisite number of vanes as per Fig. 1b if not remove surplus plates. The 7 pf. capacitor should have two fixed and one moving vanes.

Next manufacture Perspex parts as shown in Figs. 2a, b and c. Care should be taken to ensure capacitor mounting holes coincide with the fixing of the particular capacitor to be used.

Now prepare the inductance; this is

FIG. 1



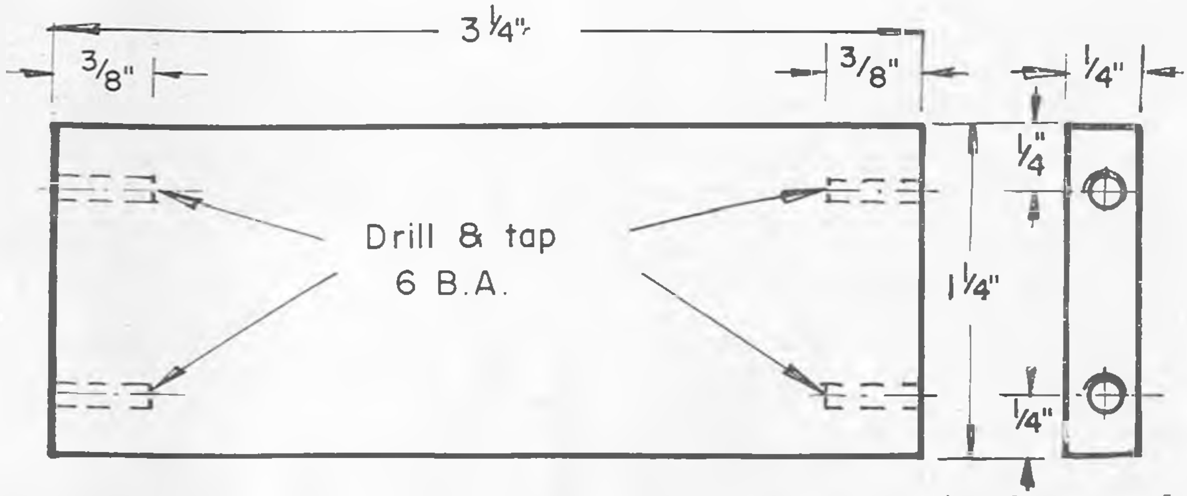
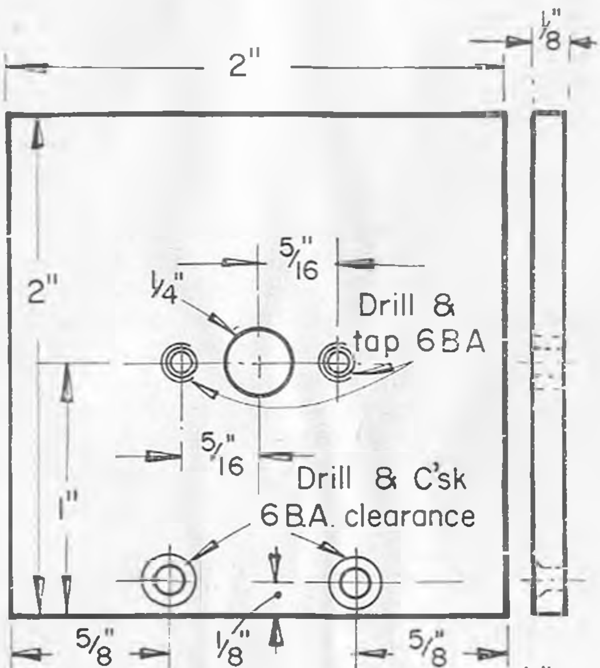
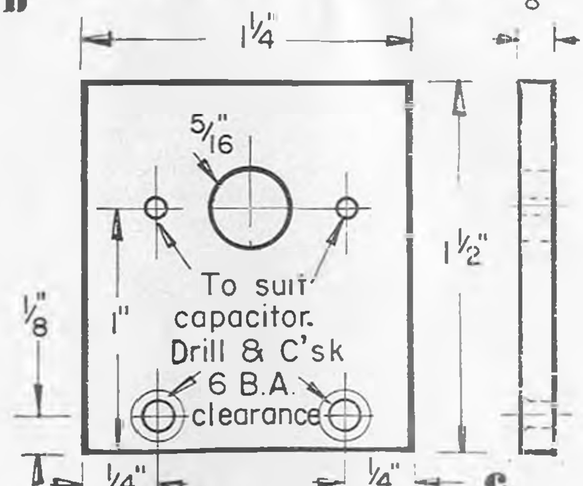


FIG. 2a



b



c

made by cutting a strip of copper $\frac{5}{16}$ in. wide x $2\frac{1}{4}$ in. long, from the $\frac{1}{64}$ in. strip or sheet. The strip so produced should now be bent round a 1 in. diam. mandrel (a piece of 1 in. O.D. tubing will suffice for this purpose) to form a loop as shown in Fig. 1c.

The following operation is most important, the soldering of the loop to the capacitor, a sound joint must be the aim, using as little solder as possible. *WARNING!* Do not use corrosive flux! From Figs. 1a and 1b it will be seen that one end of the loop is soldered to the moving vane (some capacitors may have the tag in a different position to that shown in Figs. 1a and 1b, this will necessitate a slight modification to remedy the trouble but it is quite simple and will be easily apparent), the other end of the loop is soldered to one of the supporting pillars of the fixed vanes. When completed, the loop should be clear all round on the inside by $\frac{1}{16}$ in. from the moving vane. All that remains now is to assemble the unit as detailed in Fig. 3, the $\frac{1}{4}$ in. diam. rod being cut to the required length. The reason for having such an extension spindle on the unit is to reduce to a minimum any "hand capacity" effects. Should a higher frequency coverage be required at the H.F. end (with some loss at the L.F. end) of the band the inductance may be reduced by replacing the existing copper strip by a wider strip (i.e. a strip $\frac{3}{8}$ in. or $\frac{7}{16}$ in. wide) this gives the same effect as is obtained by paralleling inductances, e.g. a single turn strip $\frac{5}{8}$ in. wide has approximately half the inductance of a strip $\frac{5}{16}$ in. wide.

Circuit Operation

The principle of operation of "semi-butterfly" type circuits is described below.

When the capacitor vanes are fully meshed we get maximum capacity and maximum inductance and therefore tune the unit to the L.F. end of the frequency range of the instrument; but when we set the capacitor to give minimum capacity, we also reduce the value of the inductance like a brass slug or core, this is the reason for specifying a capacitor with brass vanes.

Note.—When an iron dust core is inserted in a coil the inductance is increased, but a brass core causes the inductance to decrease in value. Thus minimum capacity and minimum inductance coincide, therefore tuning the unit to the H.F. end of its range.

It is this mode of operation which gives the circuit its wide frequency coverage.

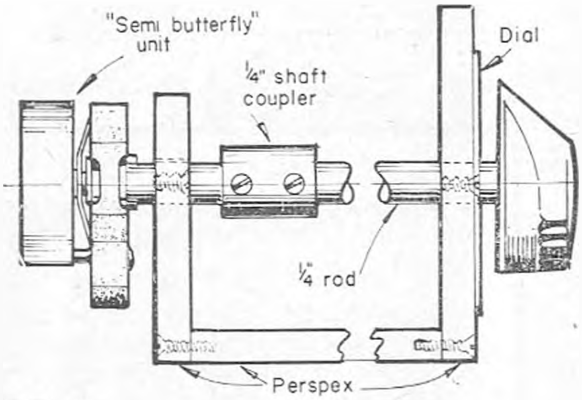


FIG. 3

Calibration

Although the object of the wavemeter is to provide a more portable and easily operated instrument for frequency measurement, unless the constructor has a colleague from whom he can borrow means of calibration, i.e. Lecher Lines and/or a calibrated oscillator, then these items will need making up for this purpose, it will assist here by referring to Figs. 4a and b for a suitable oscillator and Figs. 5a, b and c for Loop Lamp and Lecher Lines, these drawings should be adequate for most people as the construction is quite simple, also a rule (preferably one made of wood or plastic) calibrated in cm's and mm's. Before proceeding with the calibration it is as well to ensure that all unwanted metallic objects are removed from the scene of operations. I had a most unfortunate experience with my first tests at U.H.F., which caused my oscillator to almost stop working at one part of its frequency coverage, the fault proved to be due to a screwdriver, left close to the tuned circuit, this screwdriver was found to be $\lambda/4$ ($\frac{1}{4}$ wavelength) in length and was absorbing most of the R.F. energy at the frequency concerned. Also it is as well to remember that such loading and overcoupling of wavemeters, etc. can "pull" the oscillator off frequency. Now to the actual operation. The oscillator is switched on, the loop lamp loosely coupled so that the bulb gives a dull yellow glow, now couple even more loosely the loop from the "lecher lines"; next, starting with the shorting bar at the loop or shorted end of the lines, now slowly move the bar along the lines until a point is found where the lamp dips in brilliance, we will call this point A (see Fig. 5c) and a suitable pencil mark should be made for reference. The bar is now slid further along until a second dip in brilliance occurs, we will call this point B, and a second pencil mark is made for reference. We now uncouple the lines from the oscillator, and substitute our wave-meter and tune for a dip in brilliance of the loop lamp, this will give the point on the dial which coincides with the measurements on the Lecher Lines. The distance between points A and B on the lines equal $\lambda/2$ ($\frac{1}{2}$ wavelength) the frequency may be had by applying the following formula.

$$\text{Frequency in mc/s} = \frac{15{,}000}{\text{Distance between A and B in cm's.}}$$

The frequency thus found should be marked on the wavemeter dial or graph (the graph should be of dial reading of wave-meter, plotted against frequency in mc/s). The oscillator tuning is now moved and the process repeated till sufficient calibration has been obtained. A better and more sensitive indication of resonance may be obtained by inserting at point X in the oscillator grid circuit, a suitable m.A. meter (see Fig. 4a). The loop lamp is not now used, in place of the lamp we now have a meter that dips at resonance. Further the coupling between the oscillator and the measuring devices can now be greatly reduced—thus enhancing accuracy—such that even at 3—4 inches between oscillator tuned circuit and measuring devices, a good dip is obtained on the meter. With care an

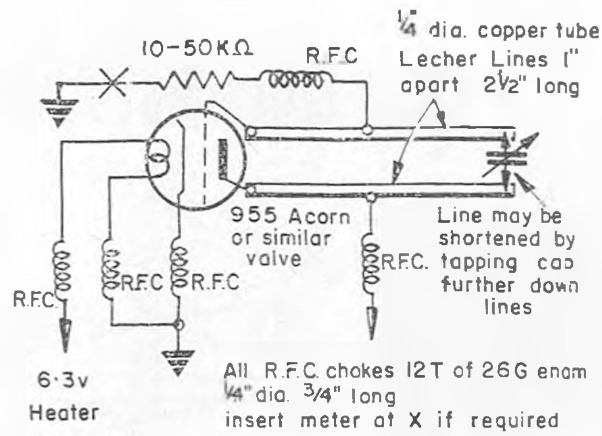


FIG. 4a

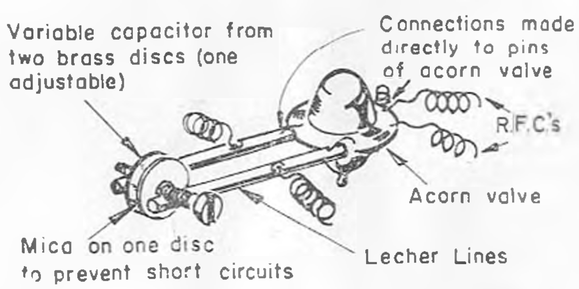


FIG. 4b

accuracy of 1% can be achieved, but it is essential when taking readings with "lecher lines" that the coupling is not varied while adjusting the shorting bar.

Note.—With a meter in the grid circuit the oscillator is working as a "Grid Dip Meter", an instrument some readers may have used or at least heard of.

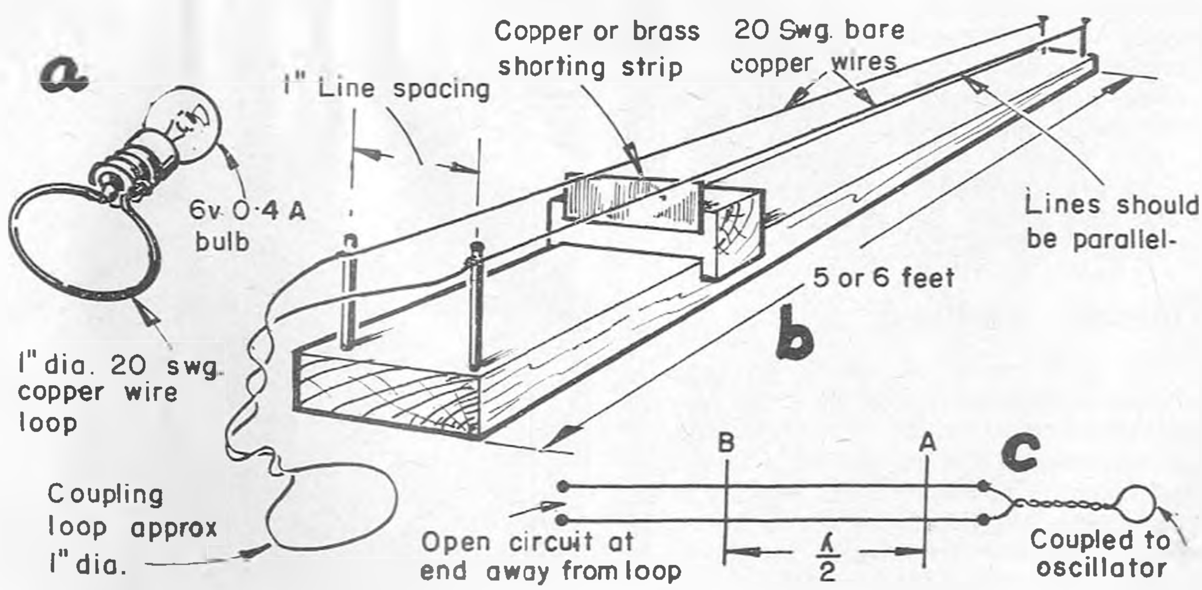
Application Notes

Although most radio control fans will no doubt be already familiar with the use of the absorption wavemeter as a test instrument, it is felt that a brief review of the main uses of the instrument will not be out of place. The primary function of the instrument is the checking or locating a frequency within certain limits. It is also useful to ensure that the correct harmonic has been selected when multiplying frequencies in a transmitter. Further, the instrument can be used to give a good indication of receiver sensitivity, see Gadgets and Gimmickry, November, 1961, issue of *R.C.M. & E.*, page 559 and Fig. 2. Above all, for U.H.F. work a small absorption wavemeter and loop lamp are far more portable than Lecher Lines and much easier to operate

Conclusion

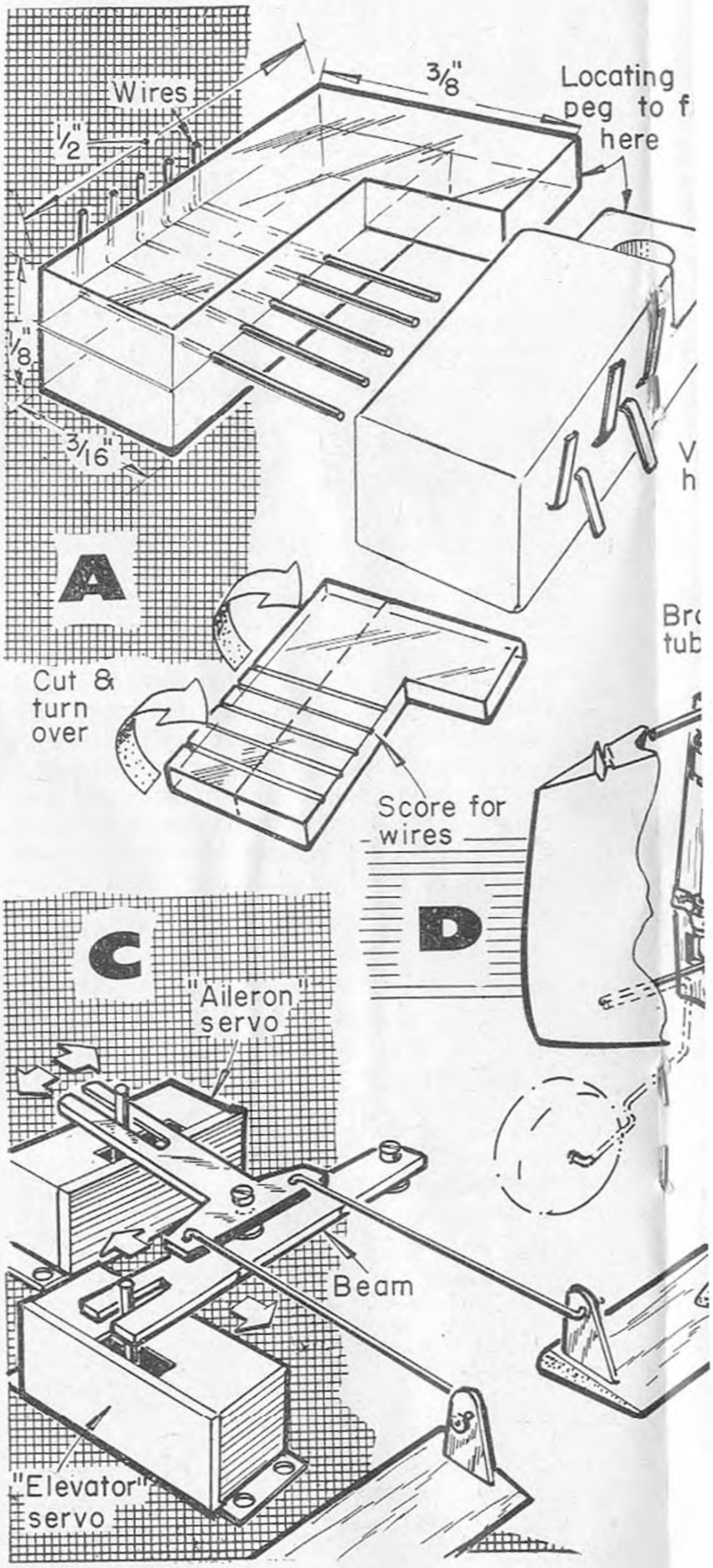
Before concluding it is worthwhile mentioning that the "semi-butterfly" type tuning circuit could and in fact has been, quite easily used in low power U.H.F. oscillators. In fact I see no reason why it should not be applied to Rxs. of the super-regen. type and even superhets. The unit is more compact and easier to adjust than line type tuned circuits, it is also mechanically stable, without being excessively heavy, further it is very little more bulky than circuits used for tuning at 27 mc/s. I have little doubt most model control enthusiasts wishing to use the U.H.F. band will give the "semi-butterfly" a try. Those who do will not be disappointed.

FIG. 5



A FEATURE FOR THE EXPERIMENTER, COMPRISING IDEAS AND TIPS FOR ALL TYPES OF RADIO CONTROL APPLICATIONS.

Gadgets and



ALL set for another session of gargets and gimmickry? Right, here we go again; we are glad to see more bright ideas in our "in" tray. With the flying and boating season rapidly approaching, we are doing our best to provide tips for that brand new installation.

Boat gimmicks seem to be in the minority. Whilst a number of the gadgets would apply equally to aircraft or boats we are still short of material for power boats and would welcome gadget contributions on this theme.

Miniature Plugs

J. Hall supplied us with a sketch for this sub-miniature socket with a clever locating lug for use with standard five-way miniature valve holders of the flat type as shown in illustration **A.** Take two pieces of $\frac{1}{16}$ in. Perspex cut to the dimensions shown and grooved to receive five tinned copper wires. These grooves should line up exactly with the holes in the valve holder. The wires must be a tight fit in their grooves, so we would recommend one to insert the wires in the valve holder and scribe the grooves in the Perspex using them as a template. We would suggest this is done before final cutting of the Perspex so that the grooves line up when the two halves are cemented together with Perspex cement or chloroform.

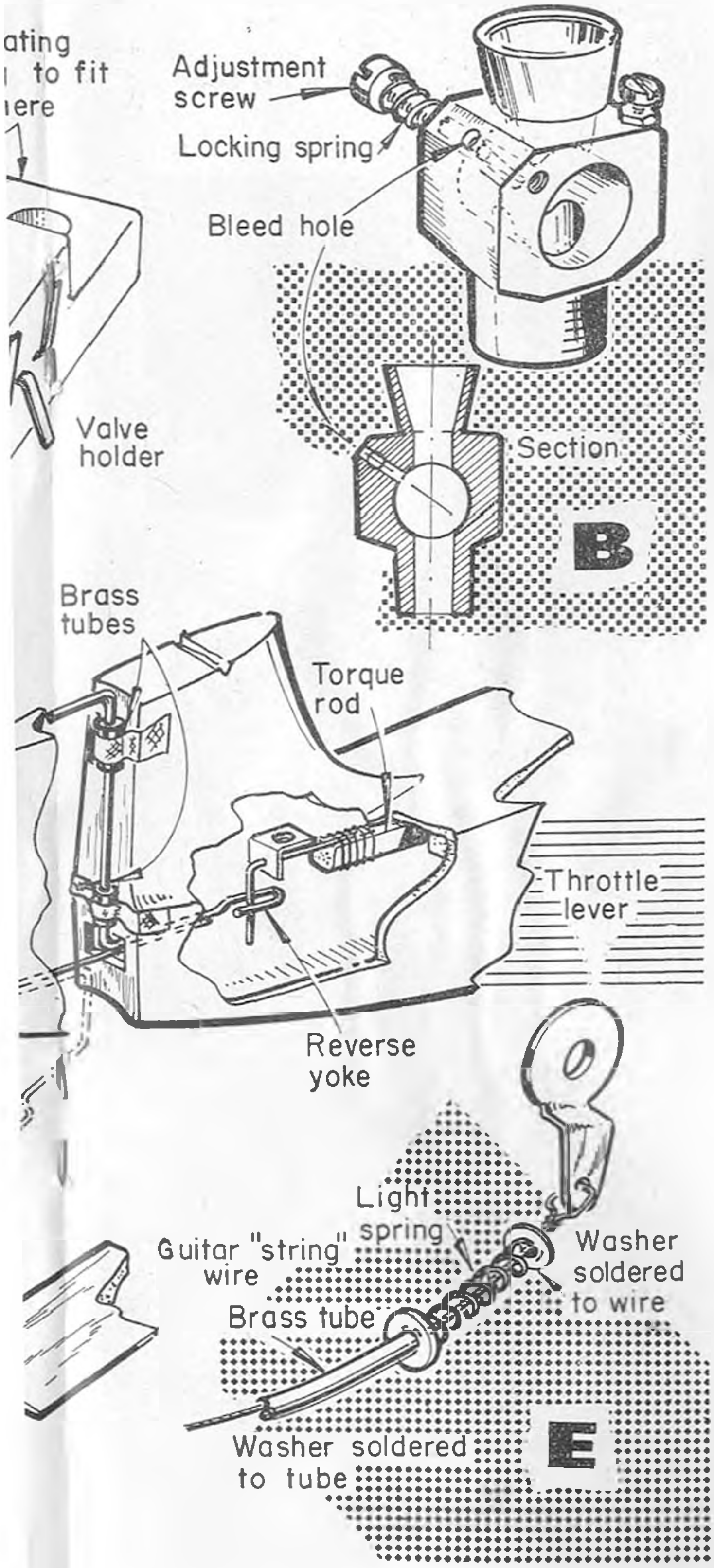
The approximate size of the whole unit (plug *and* socket) need only be 1 in. x $\frac{1}{2}$ in. x $\frac{1}{8}$ in. and providing the leads are suitably anchored, should make a good connector for servo harnesses, test sockets, etc.

Variable Air-bleed

The well known K. & B. 45 throttle is sometimes modified to give the correct low speed mixture by filing the top of the opening in the barrel on a trial and error basis. The error side usually costs one a new barrel. In sketch **B** Maynard Hill shows how to modify the body to fit a proper trim valve so that the mix-

ıd Gimmickry

We invite readers to submit their Gimmicks for publication. All we need is a clear description and a rough sketch, we do the artwork for those selected and you get paid !



ture may be varied while the motor is running.

Procedure is to drill across the upper rear corner of the throttle body with a No. 50 drill. This is then tapped for a suitable fine thread ⅜ in. screw. Now file the body at 45° on this corner so that a further hole, again with a 50 drill, may be made at an angle of 45° down into the barrel. Make sure that any burrs so made have been removed and insert a compression spring under the head of the screw so that it is locked against vibration.

The screw is now turned so that it partly blocks the air-bleed hole. Now all that remains is to run the motor up and find the correct setting for tick-over.

Elevon Linkage

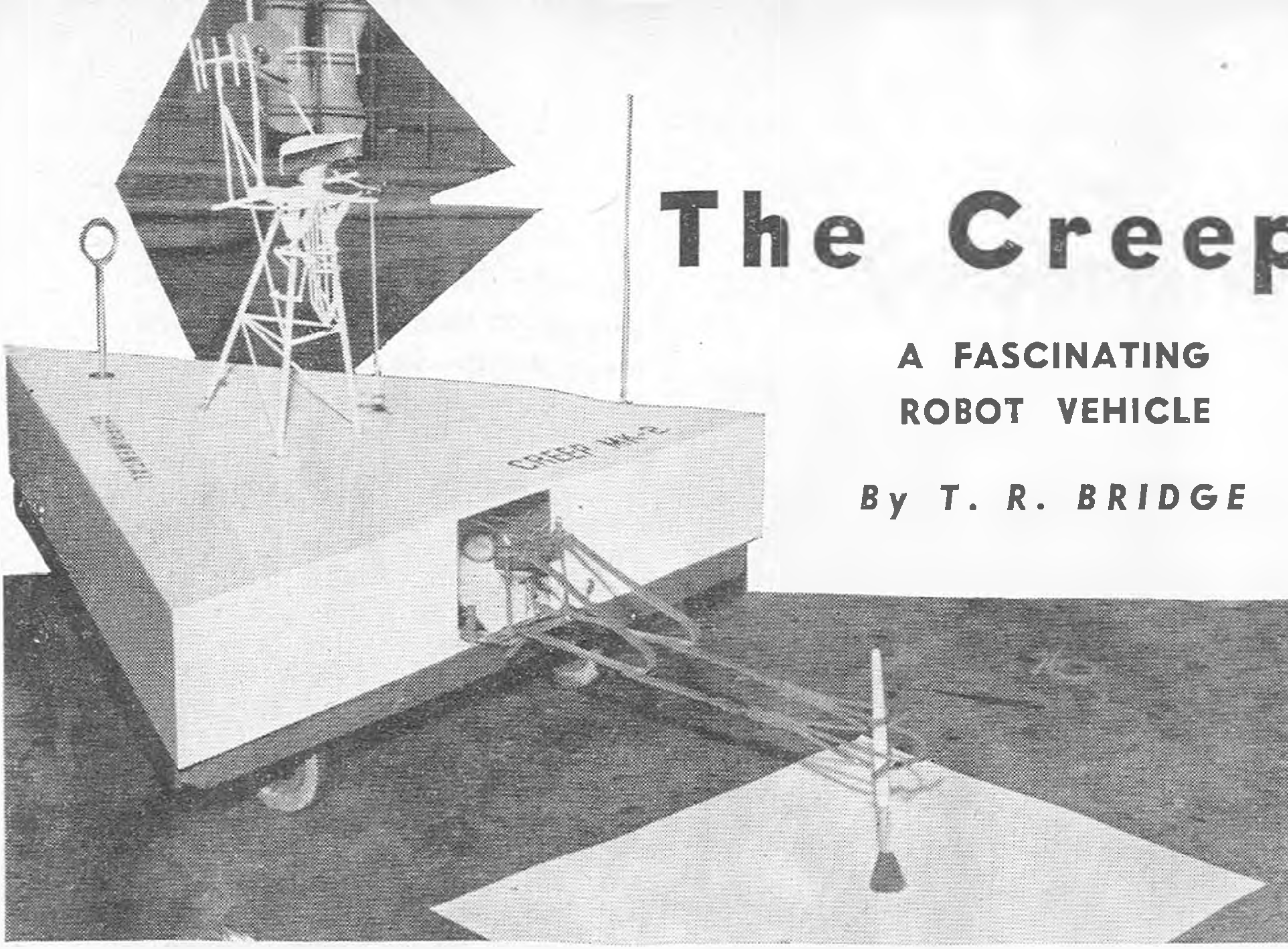
A variant on the clever elevon linkage appearing in February *R.C.M. & E.* is shown here and was extracted from "Modelarz". Sketch **C** shows how the beam operated by the "elevator" servo swings the slotted "aileron" bell crank fore and aft. Rolling motion is produced by transverse motion of the pin of the "aileron" servo in the bellcrank slot.

Scale Rudder Link

Sketch **D** should be self-explanatory and shows the method devised by M. Emery for scale models where external linkage would be an undesirable feature. It should be noted that the fuselage must be fairly wide at the rear to accommodate the reversed yoke.

Throttle Cable

B. Wardlow's cable operated throttle in sketch **E** uses thin brass tubing as an "outer" and a guitar string as the inner cable, a light compression spring keeps the wire tight and provides the return action, this arrangement should reduce conducted vibration and move throttle to slow if linkage fails.



The Creep

A FASCINATING ROBOT VEHICLE

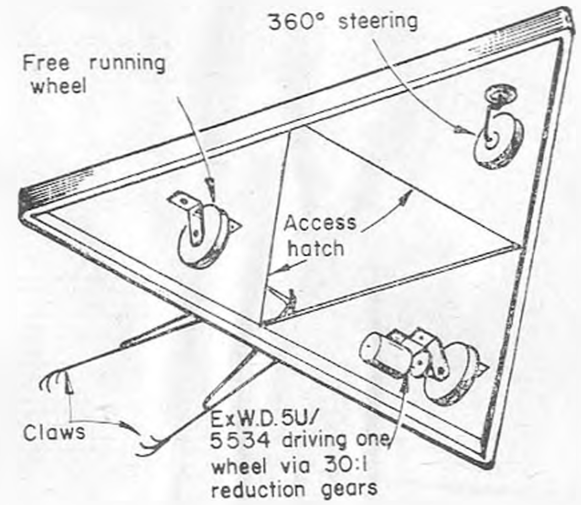
By T. R. BRIDGE

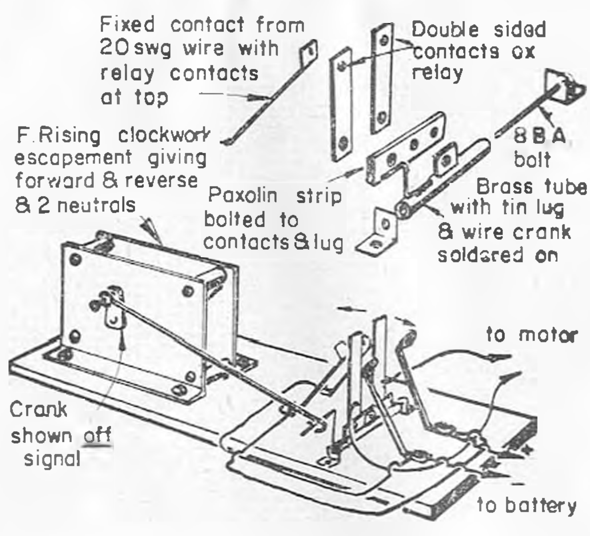
THE "Creep" is a three-wheeled vehicle with one drive wheel, one free running and one steering through 360°. This obviates the necessity for limit switches or over-run devices and makes it very manoeuvrable, full lock takes about three seconds.

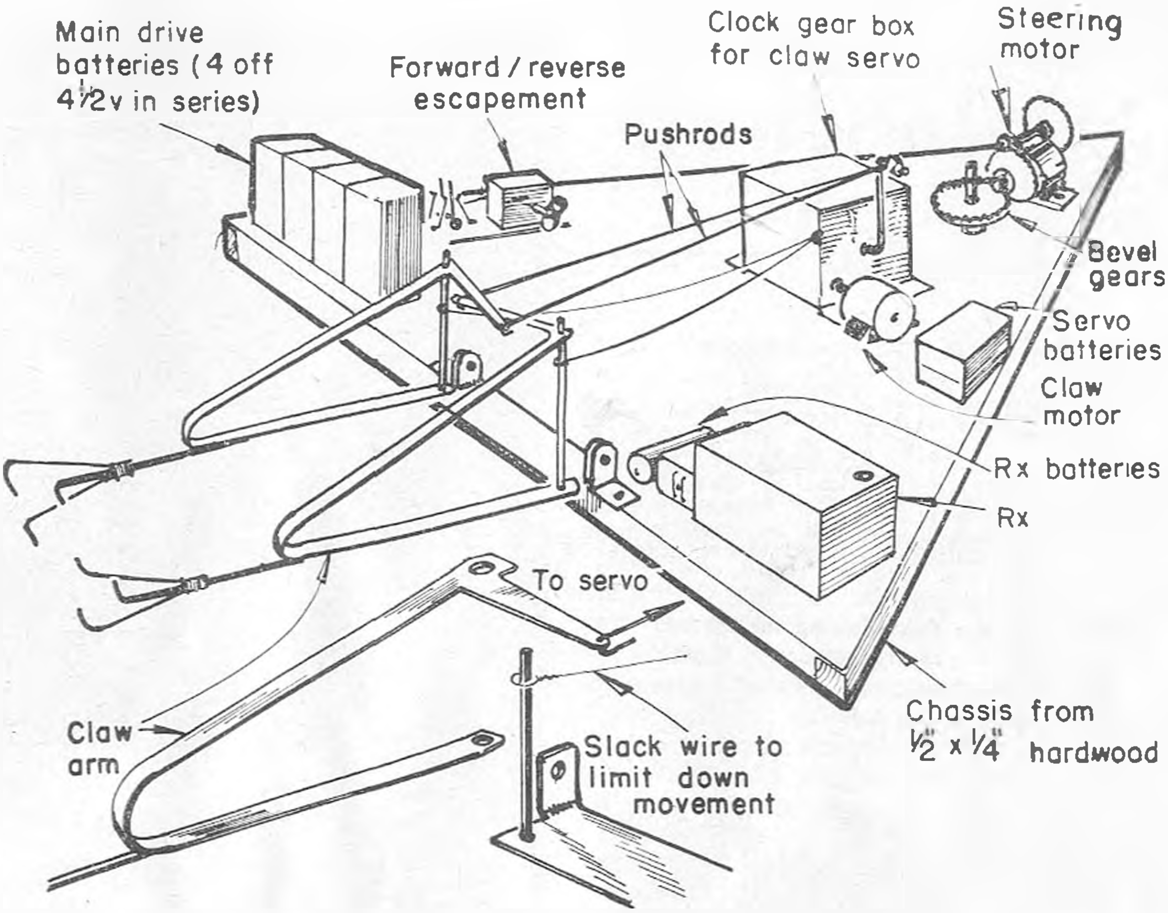
Forward, Stop and Reverse functions are controlled by a F.R. clockwork escapement operating D.P. changeover contacts, feeding the drive motor, an ex-W.D.5V/5534.

The chassis is fitted with a pair of claws that can grip and lift objects. The arrangement of the claws can be seen from the drawings, only one servo is used for closing-opening-lifting and lowering; the arrangement of the grip levers is such that they are first drawn together, then when this movement is arrested by the object being handled, the jib rises automatically. Another advantage of the system is that heavy objects are gripped more than light ones.

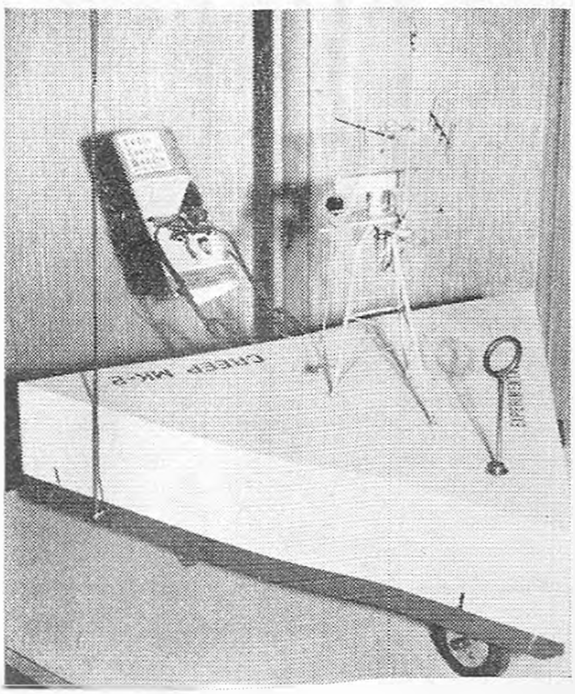
The cover of the "Creep" is made from ⅛ in ply, and the mast unit may be recognised as being taken from a *M.M.* Plans Vosper R.T.T.L., the "Radar scanner" and masthead light work on three channels of the E.D. Black Prince 8 receiver.



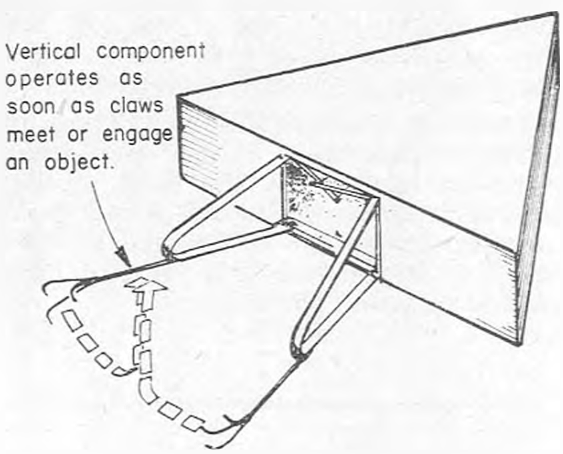




Heading picture shows "Creep" the artist at work. Below: "Reading" R.C.M. & E. . . . Diagrams on opposite page show the wheel positions and drive with the reverse actuator switch below. Right-hand diagram indicates the action of the claws.



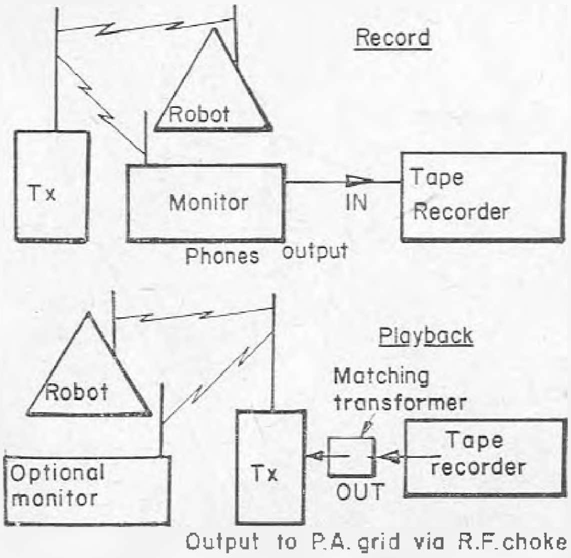
General Installation

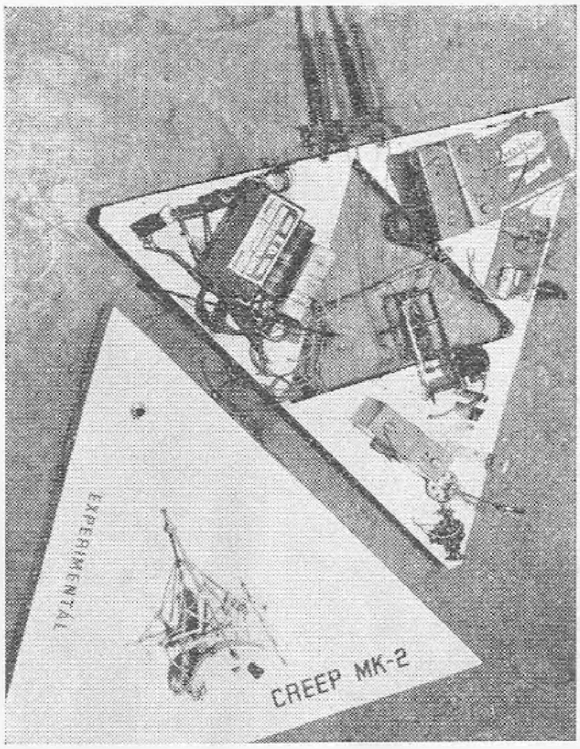


One of the most interesting things from the public point of view is the facility to record a programme and then send the "Creep" through the programme without manual control.

The system is to record the tones on a tape recorder. direct from a signals receiver monitor, and then play the tones from the tape recorder back into the modified Black Prince transmitter.

For this purpose, the transmitter was fitted with a jack socket which feeds the



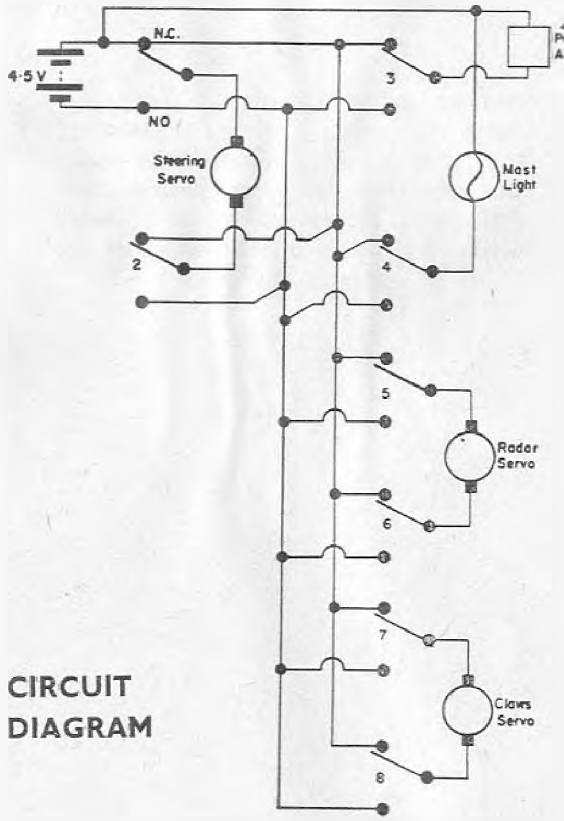


Above : Radio link showing the method of using a tape recorder. Right : Plan view shows the "works" with circuit below.

grid of the P.A. valve. It was found necessary to do this via an R.F. choke to prevent the R.F. leaking to earth.

During the exhibition, demonstrations were given by the "Creep" building toy bricks, carrying objects, large and small, and helping with the flying of "Pee Wee" powered R.T.P. models; acting in the capacity of head fuel fetcher!

Later in the exhibition we had the "Creep" painting. Whilst the results were abstract to say the least, it drew a very large crowd to watch it dipping a brush first in the water then a colour and then move over to a sheet of paper pinned down on the floor.



CIRCUIT DIAGRAM

"I've keyed but nothing happens!"

Coupled Controls

By R. H. WARRING

PART 2

Elevator

What the coupled aileron-rudder system lacks is elevator control, which is virtually essential to utilise aileron control fully and effectively. The scheme was originally devised for dual-proportional systems giving proportional rudder and elevator (but no aileron) in order to increase their scope (with the addition of aileron) and make them more directly comparable with complete 'bang-bang' multi systems. With proportional rudder and elevator, coupled aileron-rudder works extremely well. Using another proportional actuator paralleled to the rudder actuator, aileron movement is also proportional enabling roll and turn rate to be varied at will—with proportional elevator movement available to compensate for deviations due to 'opposite' rudder action during certain parts of manoeuvres.

If it works with dual proportional it should work nearly as well—if not equally well—with *six*-channel 'bang-bang' multi. This represents a saving of two channels (but not the additional aileron servo) to give a performance comparable with eight-channel operation. In fact, on any system where rudder *and* elevator controls are available on a practical scale, paralleling aileron with rudder *should* improve the performance and scope of control.

Kick Elevator

No other coupling of main flying controls is practical, except for rudder-elevator coupling for single-channel. Since rudder, as a turn control, causes the nose of the aircraft to drop, compensating 'up' elevator is really called for. Direct mechanical coupling between the rudder linkage and an elevator yoke is relatively easy to arrange to 'kick' the elevator to 'up' position whenever a rudder position is selected. This is one of the most obvious—and earliest—'coupled' systems tried. For various reasons it appears almost to have been forgotten.

Certainly it does not provide a complete answer to dropping the nose on turns, but it can be beneficial with sufficient 'cut and try' technique to establish the right balance of elevator area and trip movement to suit a particular design and trim. It should also make a more under-elevated trim possible with the advantage that on coming out of a turn with some excess speed the elevator drops back to neutral to help hold the nose down and kill the characteristic 'single-channel zoom'

COUPLED MAIN CONTROLS

Receiver	Coupled Controls (Main Control First)	Method of Coupling	Remarks
3-Channel	Rudder—Aileron	Paralleled Servo	Limited gain
4-Channel	Rudder—Aileron	Paralleled Servo	Could be advantageous using other two channels for elevator
6-Channel	Rudder—Aileron	Paralleled Servo	Almost equivalent to 8-channel control

COUPLED SINGLE - CHANNEL CONTROLS

Coupled Controls (Main Control First)	Main Control Actuator	Method of Coupling	Possibilities
Rudder—Tailwheel Steering	Escapement Servo	Mechanical Link Mechanical Link	Not Recommended Satisfactory
Rudder—Nosewheel Steering	Escapement Servo	— Mechanical Link	Not Suitable Satisfactory
Rudder—Aileron	Escapement Servo	Additional Servo Switched by Escapement Paralleled Servo	Some Improvement in Turn and Roll characteristics But Several limitations Poor Low Speed handling characteristics
Rudder—Elevator (Trip 'Up')	Escapement Servo	— Mechanical Link	Not Suitable Advantage for turning but not all manoeuvres
Engine Speed*—Brakes	Escapement Servo	— Mechanical Link	Not Recommended Satisfactory (Work off 'Slow' Engine)
Engine Speed*—Flaps	Escapement Servo	— Mechanical Link	Not Recommended Little Advantage, if any

**Utilising Secondary Actuator Operated via 'Quick-Blip' on Primary Compound Actuator.*

COUPLED DUAL - PROPORTIONAL SYSTEMS

Coupled Controls (Main Control First)	Method of Coupling	Remarks
Rudder—Aileron	Paralleled Proportional Servo	Distinct advantages Possible Rudder movement may be reduced. Overall improvement in manoeuvrability
Rudder—Steering	Mechanical Link	Satisfactory Provided Servo is Protected from Shock Loads
Engine Speed*—Brakes	Mechanical Link	Satisfactory (Work off 'Slow' Engine)

**Utilising Secondary Actuator Operated via 'Quick-Blip' or similar Selective Switching.*

usually associated with recovery. In certain other manoeuvres, though, it may be distinctly unhelpful to have 'up' elevator automatically applied with rudder.

Coupled rudder-elevator 'trip' is not practical with escapements. The additional load on the escapement motor may well cause the system to bind—probably the main reason why earlier coupled rudder-elevator controls were largely unsuccessful. With suitable single-channel compound servos now available, however, it is a different matter. The system may well prove worthwhile for 'sports' models and scale designs used with single-channel equipment.

Further data on coupled systems and their possibilities are summarised in the tables. These are not necessarily exhaustive but cover most possibilities.

Almost any actuator will do the job but if you are using quick blip for engine control you may have to suppress the spark at the quick blip contacts. Also it might be necessary to de-sensitise the receiver to eliminate interference and this should be done as explained by the makers.

We have not listed coupled systems applied to single-channel proportional due to lack of practical experience in this field, but coupled rudder-aileron with proportional rudder control would appear to have the same limitations as with normal single-channel (lack of elevator control); and single-channel dual-proportional systems probably too temperamental to tamper with anyway.

BREAK THAT SHAKE

[Continued from page 173]

Using the Instrument

One of the advantages of this type of instrument is the fact that the direction of the vibration can be ascertained simply by resting the probe so that a reading is taken from first the top then the side and finally the end of the equipment whilst this is being subjected to a constant vibration. The highest reading being the point facing the line of maximum amplitude, i.e. a high reading on the top indicates vertical vibration, whereas on the side lateral vibration as produced by a sidewinder motor. It is unlikely that a very high reading will be taken from the end unless the general level of vibration is severe.

It is most important that the hooked end of the probe is placed on the gear being tested. Contact further up the probe will give too high a reading, it should be remembered that a reading is always taken up and down relative to the front of the instrument when viewing the meter. It is possible to take spot checks on the field even after the equipment has been successfully installed in a correctly damped and isolated manner. One can then see if the motor is producing more vibration than it should or that the equipment has become ineffectively supported. Interesting comparisons may be made between different models to find out just why Joe's super foolproof system does not work and Fred's "lashup" does.

When selecting new equipment it may be placed on a board and subjected to vibration by means of the little TG18 motor and weight, or similar clean and quiet vibration producer in order to check the equipment's ability to withstand this form of abuse. Simply take test readings with the indicator and note the effects of the equipment under operation. By varying the weight or degree of off-balance and the speed of the motor (via a variable resistance) one can simulate the low to middle range for vibration frequency likely to be encountered in the model.

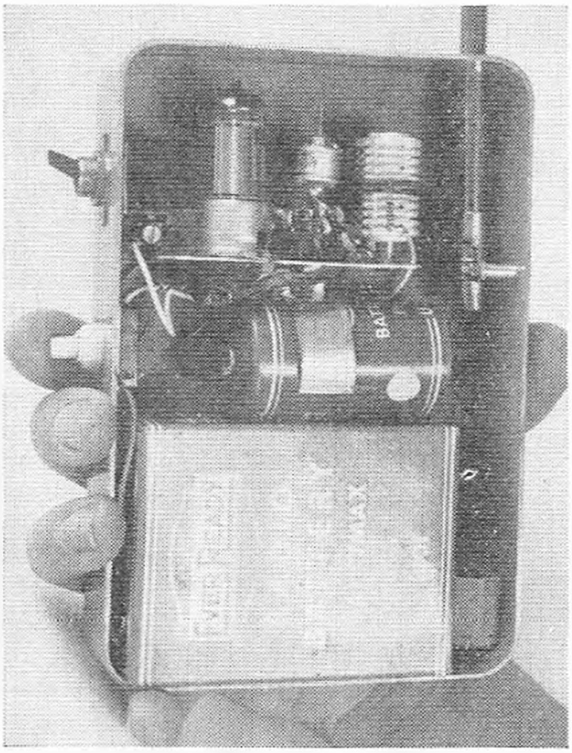
ARE YOU LICENCED ?

Just in case newcomers to Radio Control are not aware of it — you need a licence for operating remote control equipment. No tests, just fill in a form and pay £1 for five years cover. Application form and full particulars from Radio Branch, Radio & Accommodation Dept., G.P.O. Headquarters, London, E.C.1.

Tiny Tx.

F. G. RAYER

Describes a miniature carrier wave transmitter . . . the essence of simplicity, build one tonight



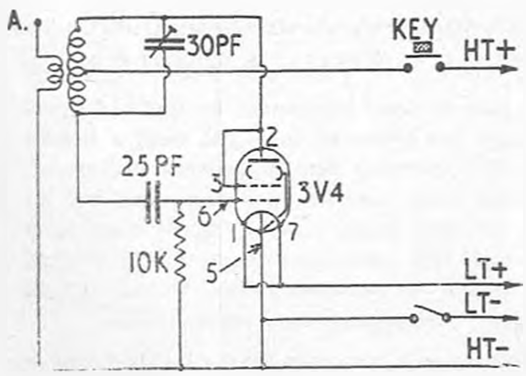
Above : Half a dozen principal components, batteries and a box; result : one transmitter . . . Now just look at the circuit in Fig. 1 and put those parts on your shopping list.

THIS transmitter uses one of the simplest possible circuits, and may be used to control 27 mc/s home-constructed or commercial made continuous wave type receivers. The whole transmitter, with batteries, is of such a size that it can be held in one hand, and it is fitted with an extending rod aerial, which can be telescoped into the case.

The direct current input to the valve is approximately ½ watt. This places the transmitter in the small power class, and it is not intended for use with aircraft, which could easily fly out of range. But it is suitable for models controlled at short range—boats on small ponds, land models used indoors or in the garden, etc. It is impossible to state a maximum range, as this depends so much on the sensitivity of the receiver, and the care with which receiver and relay are adjusted. It is, of course, also satisfactory for the short range testing of models which will later be controlled at greater range, by means of a more powerful transmitter.

Fig. 1 shows the circuit, which is of usual type. Filament consumption is only 0.1a. from a 1½v. battery. Any 1½v. battery can be used, but a single U.2 cell is convenient. With such cells, the brass cap is positive.

FIG. 1



For H.T., a 67½v. battery such as the B101 is satisfactory. A 90v. battery could be used instead, if space is available. Current consumption at 67½v. is about 10 m.A.

The containing case shown is a "lunch box" which may be obtained cheaply at popular stores. This is plastic, and approximately 4½ in. x 7 in. x 1⅝ in., when the lid is in position. It will accommodate the U2 and B101 batteries in the positions shown. The box can be left in its original transparent state, or painted on the inside.

Construction Details

The transmitter is built upon a piece of aluminium about 3 in. x 1 in. with a ½ in. flange. This flange is bolted to a sheet of thin paxolin or other insulating material, cut to such a size that it will lie inside the case. Countersunk 6BA bolts may be used. A metal clip to hold the U2 cell is held by an extra nut to a bolt passing through the paxolin.

Connections and components are shown in Fig. 2. The coil has 11 turns of 20 s.w.g. tinned copper wire, on a ¾ in. diameter ribbed former, turns

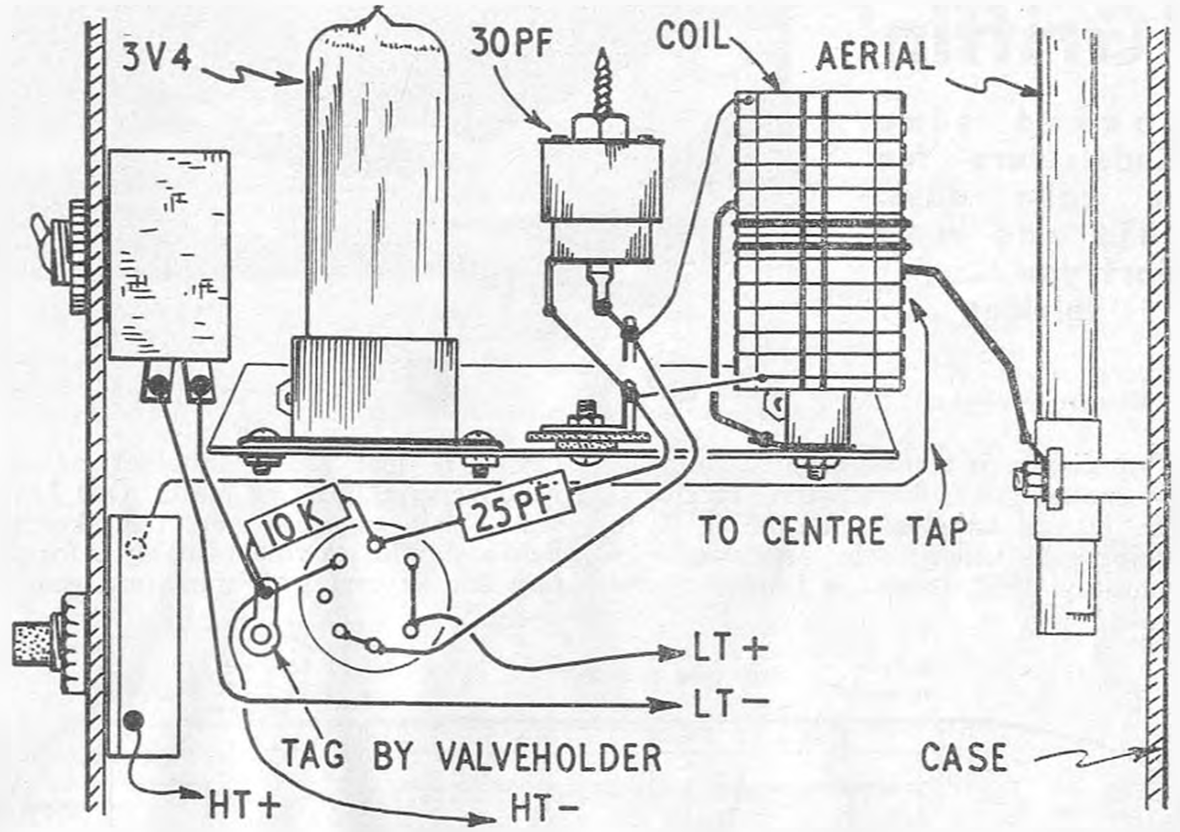


FIG. 2

being spaced at about 10 per inch. A lead is soldered to the middle of the centre turn, to form the centre tap, and goes to the H.T. circuit keying switch.

The aerial coupling coil consists of two turns of insulated wire round the centre of the coil. One end of this winding is soldered to a tag in contact with the aluminium bracket, and the other end goes to the aerial. The coil should be spaced a little clear of the aluminium, as in Fig. 2.

A two-way tag strip, with both tags insulated from the aluminium, is bolted near the coil. The outer ends of the coil go to these tags. The 30pF. air-spaced beehive trimmer is soldered directly to the tags, so that it is across the coil.

Fig. 2 shows the underside of the valve-holder, so that tag connections can be seen. The tag is held by one of the bolts securing the valve-holder, and is thus in contact with the aluminium bracket.

Thin flex is used for battery leads, and suitable clips or studs can be employed for H.T. With a dry cell for L.T., leads may be attached with a touch of solder. Or the card case can be taken from the cell, so that the clip mentioned forms the negative connection. A further small bracket, bolted to the paxolin, would then act as positive, the brass cap of the cell bearing upon it.

When wiring is complete except for the switches and aerial, the transmitter is inserted in the case. The filament switch is near the valve, and the H.T. switch is level with the U2 cell. The H.T. switch completes the circuit when depressed.

The aerial is of the type which closes up to about 6½ in. and it is attached to the side of the case by two 6BA bolts, with spacers. It extends through a hole in the top of the case. When the aerial is not required, it is pushed right down into the case. When in use, it is fully withdrawn, including the largest section, which would otherwise remain near the B101 battery and user's hand. A small block of wood or other packing keeps the B101 battery to the left of the case, as shown.

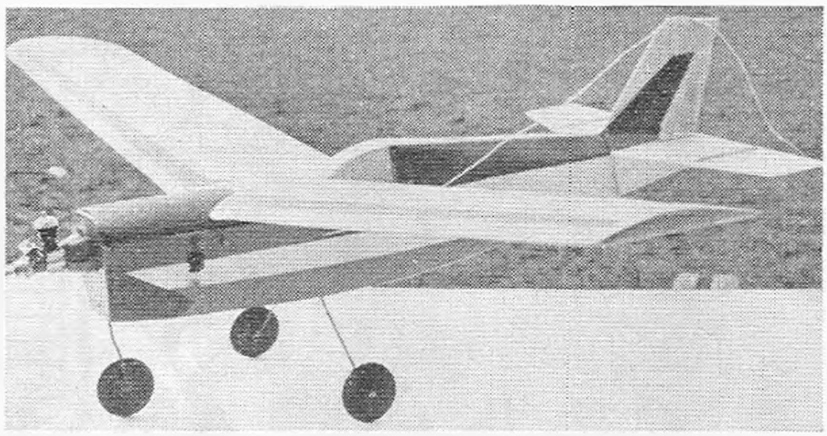
Testing and Tuning

The transmitter can be initially tested for oscillation by making a loop of insulated wire roughly 1 in. in diameter, and soldering a 6v. 0.06a. bulb to this

[Continued on page 204]

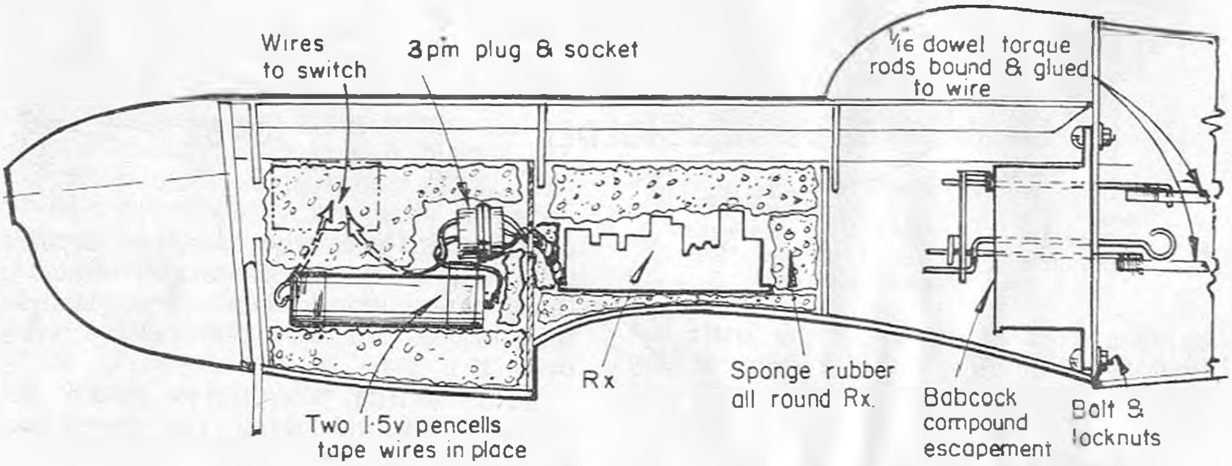
'Griffin'

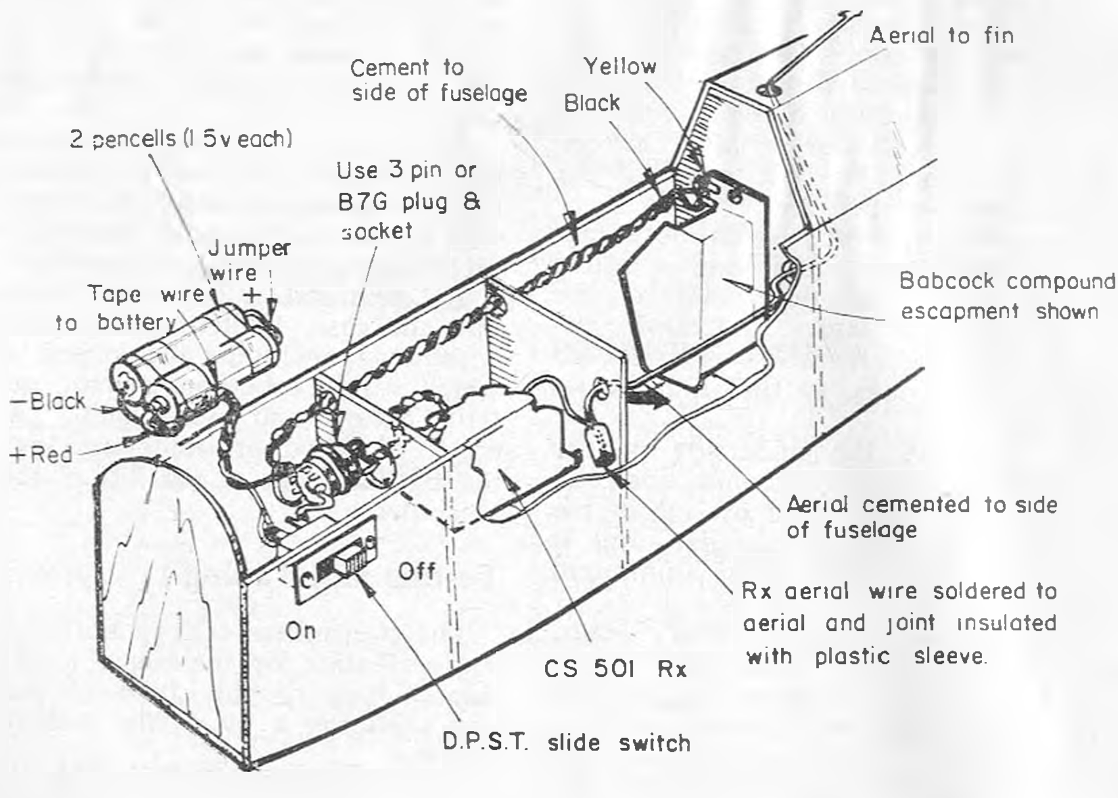
Pocket size models are fun on calm days. This one may start you thinking . . .

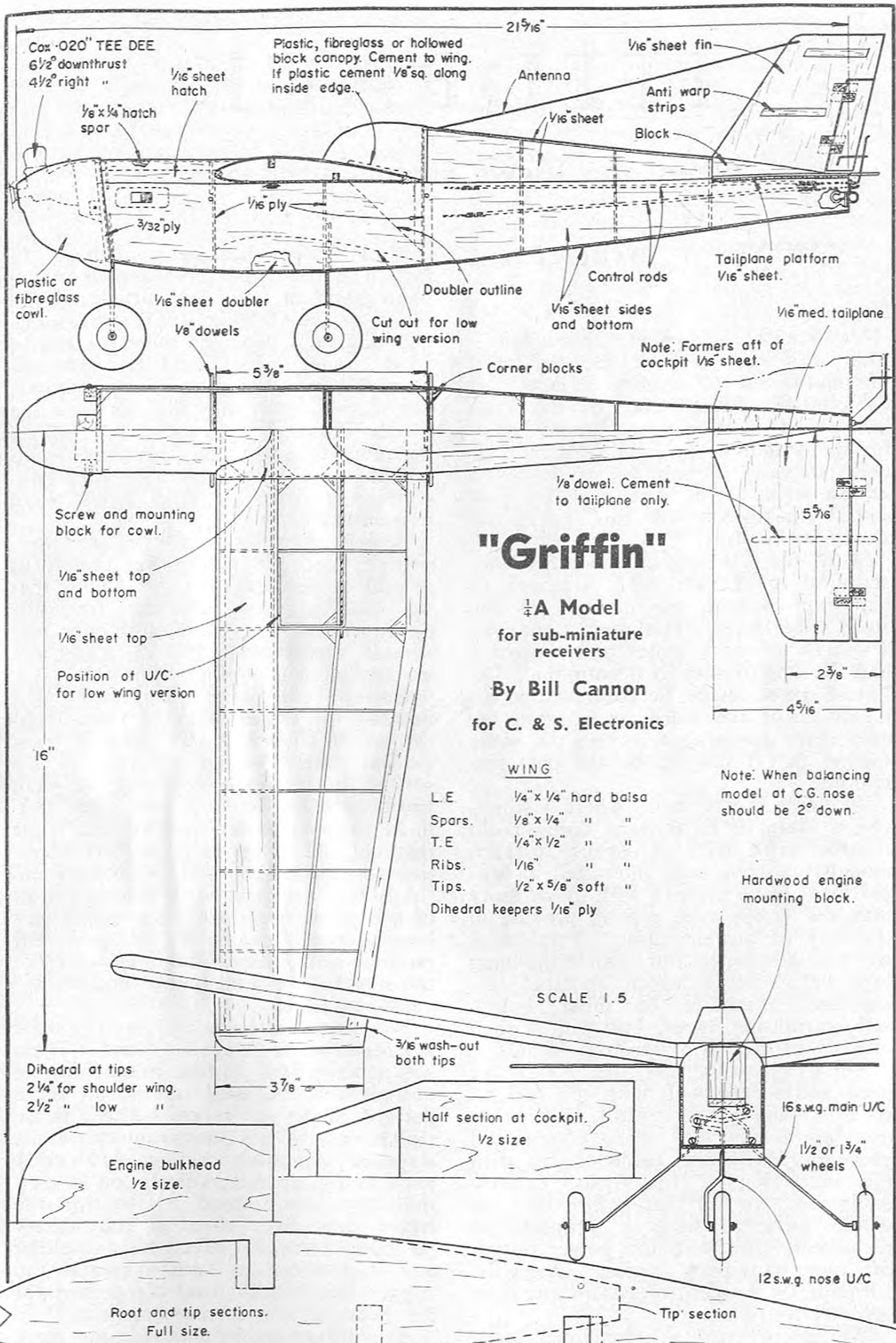


Picture shows R. H. Warring's version.

THE Griffin is a neat little 32 in. span model for sub-miniature receivers. The plan is supplied with the C. & S. equipment which was reviewed in February. 1962. issue. A feature of the design is that either shoulder or low wing versions may be built. Our 1/5th scale plan opposite and the sketches below should provide valuable information for anyone with miniature gear.







"Griffin"

¼A Model
for sub-miniature receivers

By Bill Cannon

for C. & S. Electronics

WING

L.E.	¼" x ¼" hard balsa
Spars.	1/8" x ¼" " "
T.E.	¼" x ½" " "
Ribs.	1/16" " "
Tips.	½" x 5/8" soft "
Dihedral keepers	1/16" ply

FEEDBACK

News and Views From Our Readers

MONEY'S WORTH

Dear Sir,

You must have been clairvoyant—what else can account for the most fascinating bit of reading I have just completed? Either that, or the fates have been plotting across many miles for many months to produce a remarkable telepathy in your series on Servo Development. I'm sure that by now some explanation of this paragraph would be helpful!

Well, for Christmas, I had my subscription to *R.C.M. & E.* renewed (it had expired with the delivery of the April 1961 issue). This week I received a bundle of back issues and tonight I had the opportunity to devour them. As I read the series on Servo Development it was as if the words were from my own diary covering work on the same subject that I did during the past few months.

At the N.A.S.A. labs., where I supervise a shop of technicians doing radio control work with aerospace research models, we have been interested in proportional servo systems with much more than the hobby type motors provide in the way of power output. Previously, we had developed our own bang-bang type of actuators, which operated like standard Duramite or other hobby self-neutralising types, but with torque outputs of five and ten foot-pounds.

These actuators had the power we need and served well with the full on or off (bang-bang) control systems in use, but during 1961 when commercial proportional systems came of age with the marketing of the Space Control equipment, we felt that before long we would have to have a proportional servomechanism with the power output of our bang-bang types: otherwise, adoption of the control system might be severely restricted.

We already had a commercial servo available which we earlier thought would be suitable when a proportional control system became available. In fact, it is the same servo shown in the photograph in your lead article of the series, in the October, 1961, issue! We had bought a batch of these for use in wind tunnel models and had adapted them for bang-bang use in our outdoor test models. But they did not have the torque required and the complications in rebuilding the transistorised servo amplifier for greater wattage and substituting a more powerful motor were objectionable.

Power handling was the trouble—with a 12 or 28 volt power supply at several amperes current, we found that we had a most efficient transistor destroyer and after several months and several wastebaskets full of transistors we looked for another approach.

Hobby experience suggested that bucking the trend might be more fruitful, so we tried relays in place of transistors! Here we got results. In the process of servo development, we went through, step by step, the path outlined in your series, but all the while ignorant of the series or of any literature on the subject that might be helpful. One fact may be of interest; most of this effort was done on a technician's level—several engineers followed our progress with interest but they were not too hopeful concerning the "backwards" approach.

We were fortunate in having some Micropositioner relays on hand. These will operate on a few microamps of current and we used one to switch a pair of Sigma 4F relays. The Sigmas, which only a few years ago were the standard American hobby R/C relay and which operated nicely on a few milliamps, were used to control the heavy duty D.C. motor. The Micropositioner was in effect our amplifier and it provided us with a simple and rugged electromechanical component for the heart of the servomechanism.

As your series emphasised, the main problem encountered was in damping. Velocity damping, provided by the back

E.M.F. of the motor was almost good enough. But with the big motor, the inertia was high and more damping than we liked seemed to be needed. A trick here was used (and about the only one not covered in your articles!) that did the job and it could be used because we *did* have relays to work with. By proper hookup of the relay contacts, we were able to apply dynamic braking to the motor whenever the control relays dropped out. This braking, by shorting out the motor terminals, stopped the armature within a few revolutions and stopped the coasting. Braking, together with velocity damping, made the big motor behave as we wanted it to.

Accidentally, we ended up with a self-oscillating servo. It was a good thing and we liked it, but we didn't know why it worked until your January, 1962, issue explained it! Perhaps it's a good thing the subscription expired—by not knowing all the information you had published, we were not prejudiced during the servo experiments and we learned first hand all the points that were covered with more emphasis than might have been gathered from the printed word alone.

Please pass on my thanks and appreciation to D. W. Allen and H. Cuckson for their excellent series. I hope they have more material on the subject. For instance, equivalent transistor circuitry to complement the valve amplifier information would be helpful.

I have dug in at home and am in the drudgery of model building again, in order to have something to fly when the weather improves. Currently, I am involved in putting together Don Brown's Dee Bee IV (2nd place at our nationals) which is about the best proportional control plane design to come along yet.

My T.T.P.W. is being converted to Don Hewes' control system which appears to be the next logical development of Walt Good's brain child. Don has dispensed with all the relays in the system (transmitter and receiver) except a pair in the receiver used only for fail-safe and engine control. Instead of pulsing, the system's tone is varied smoothly between 100 and 500 cycles for rate control and the mark-space is also varied smoothly between 60/40 and 40/60 for width control.

Only one multivibrator is used in the transmitter instead of the former three and it modulates the amplifier grid directly. In the model, feedback servos are used and are of the Space Control type. Micro-Mo motors are used and provide powerful yet low drain servo action with perfectly smooth yet fast response.

Don has put in about two years developing the system and I hope to help him out by proving that other T.T.P.W. systems can be converted similarly without much trouble. He has been flying the system occasionally during the past year and we hope that with another system in the air any de-bugging" will be speeded up.

Joe Block should also be mentioned here. He is the other half of the "we" referred to in my description of the Servo Development. Joe did most of the work on variations of the basic servo to find the extremes of each experiment and to adapt the servo for use with different motors and damping methods. His work took the servo out of the breadboard stage and made it a practical device.

If you are interested in more of this type of discussion, I'll be glad to correspond again. Best regards for '62.

JOHN WORTH.

U.S.A.

LAND'S END

Dear Sir,

Having just built the U.K. receiver, I thought I might assist in saving a few worry lines appearing on the faces of some of your readers.

We found that when the receiver was built as shown in the instructions, the relay (a bleep), would not pull out even after a suggested mod. When our meter showed the current drop to the relay pull out figure, the relay simply chattered like mad.

We had up to this time taken everything else for granted, but further examination of the P.C. showed that we were getting an additional negative connection via the screw seating the relay. As I could see no necessity for this we cut through the offending part of the P.C. and all our troubles ceased.

This is a really good receiver, range, current rise, etc. being all that could be desired.

Many thanks to *R.C.M. & E.* which I read from cover to cover. (Though being a novice I do not always understand.)

L. R. ORRISS.

New Equipment

THE LATEST DEVELOPMENTS

New Servos

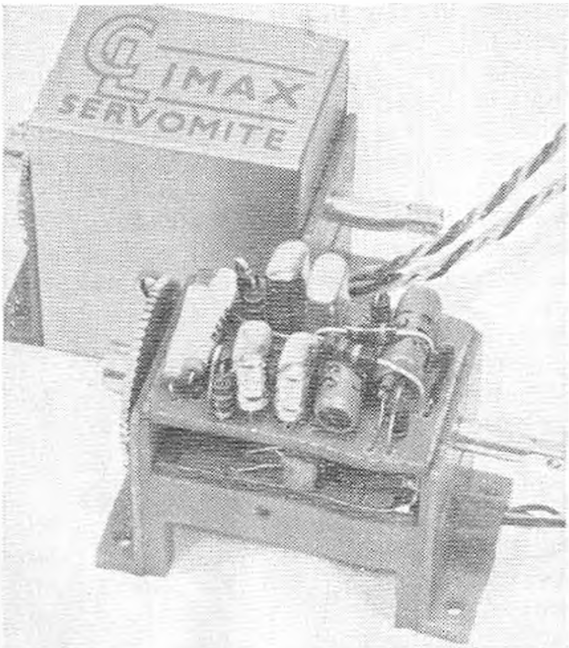
R.E.P. distribute a compact little multi servo using the microperm motor geared in one stage to a lead screw output which carries a set of silver wire wipers running on the usual P.C. switching panel. A relayless version using a slightly higher case is also available.

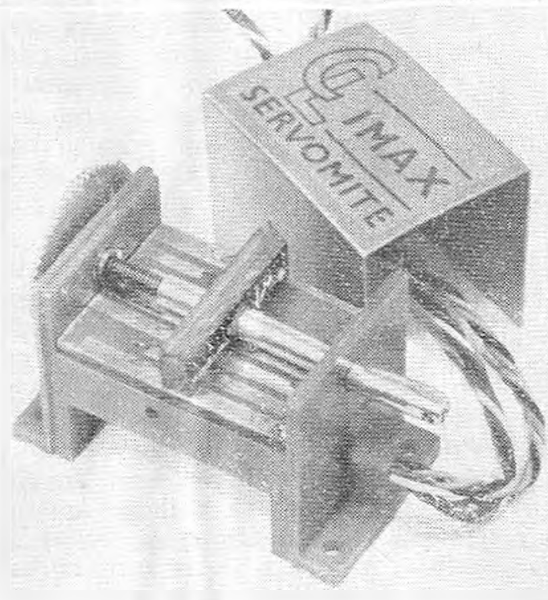
From the same manufacturer we have a new tuned filter two tone outfit known as the "Twin Tripple", comprising transmitter. receiver and two rubber driven escapements; one compound the other "bang-bang". A third escapement for motor may be operated from the compound via an electronically timed quick blip on one channel. This new principle of using two tones to provide sequential rudder and sequential elevator results in a somewhat lighter installation at a very competitive price. A new single and a new multi receiver teamed with new styled transmitters give R.E.P. a new electronic look. All the receivers including a superhet (which is supplied to order) are now fully transistorised and work from a P.P.3 or similar 9v. supply. We shall be reviewing these units in the very near future. Prices are as follows:—

Climax Servo. Basic Price 59/8d.
Relayless Version, £7/18/4d.
Twin Triple System. Complete Transmitter, Receiver and two escapements, £26.19.4d.
The New Quadratone. Complete Tx. and Rx. with Relays not including Servos, £32.19.2d.
Sextone, ditto, £35.18.11d.
Octone, ditto, £50.6.7d.
Decatone, ditto, £59.18.6d.

Relayless versions are of a lower price, for example, the Decatone Receiver is £17.1.6d. the reduction being proportionate to the number of relays saved.

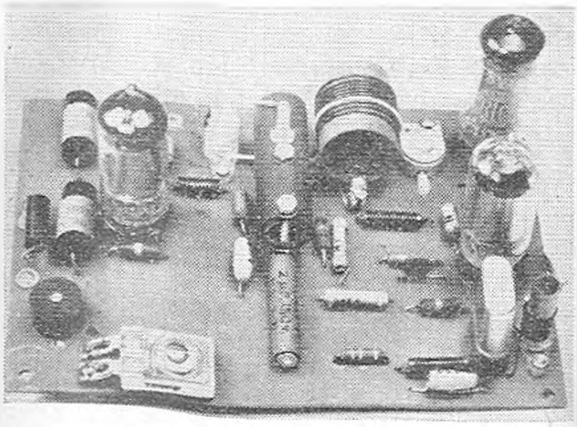
A completely redesigned reedbank with hard plastic reed and contact carriers is available at the new low price of 50/- for replacement or O/D Rxs.





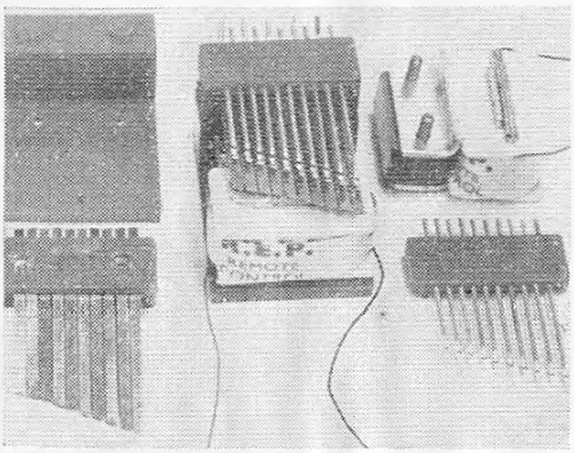
Above : Top picture shows the R.E.P./ Climax servo with amplifier, lower view, this time of the standard type reveals the switch panel and wipers.

Below : The transmitter panel from the "Twin-Triple" system.

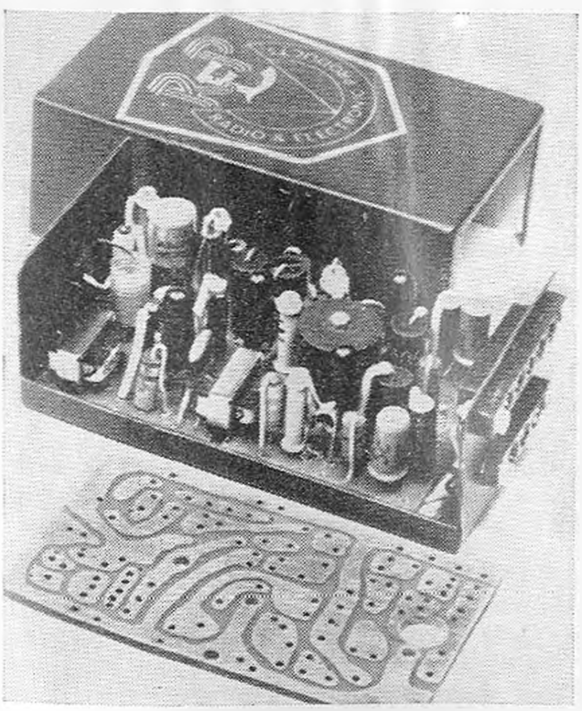


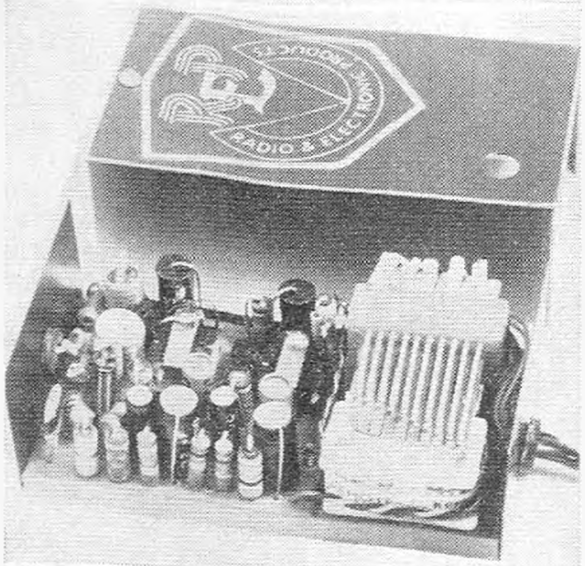
Grundig Joins the Movement

The Graupner Company present a new set of equipment by Grundig; basically four-channel, one may add a further stage to the transmitter to provide eight tones with a modulation range of between 800 and 6,000 c.p.s. at approximately 220 milliwatts and is temperature stable between —10° and +55° C. The transmitter appears to be all-transistor operating on eight 1.5v. cells and is enclosed in an attractive red high impact Polystyrene case. To change to eight-channel one merely plugs in a second unit, in fact the whole system is connected via plugs and sockets, the receiver is of matchbox size

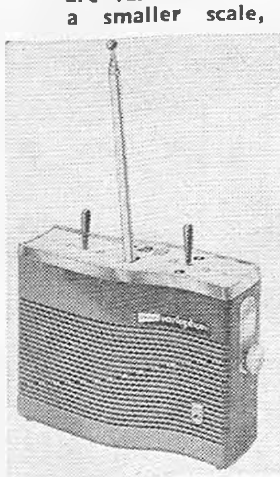


Above : The new R.E.P. reed bank and its component parts. Below : The "Twin-Triple" receiver and its P.C. board.





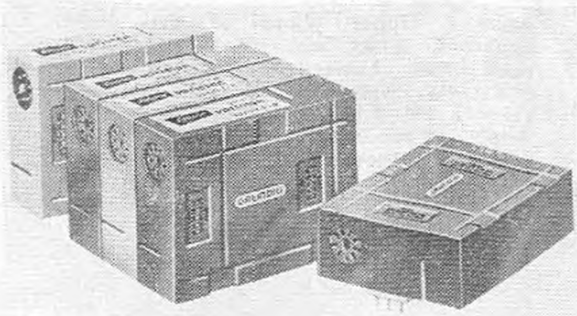
Above : Upper photo of the single superhet, which can drive a separate reed bank. Lower shows the standard Multi Rx, with 10-reed bank. Below : (right) the R.E.P. Tx., for the "Twin-Triple" filter outfit. This case is now standard, although key levers or buttons are varied to suit the system. Left, to a smaller scale, the Grundig 8 Tx.

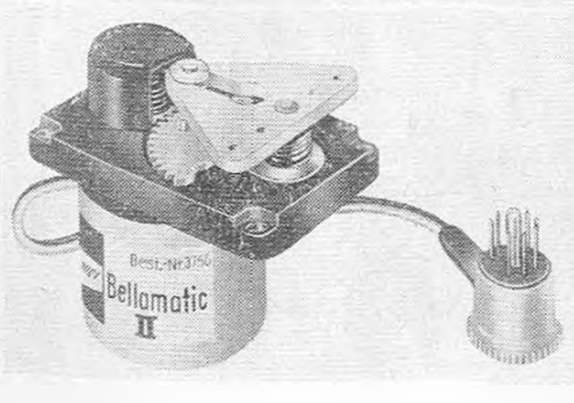


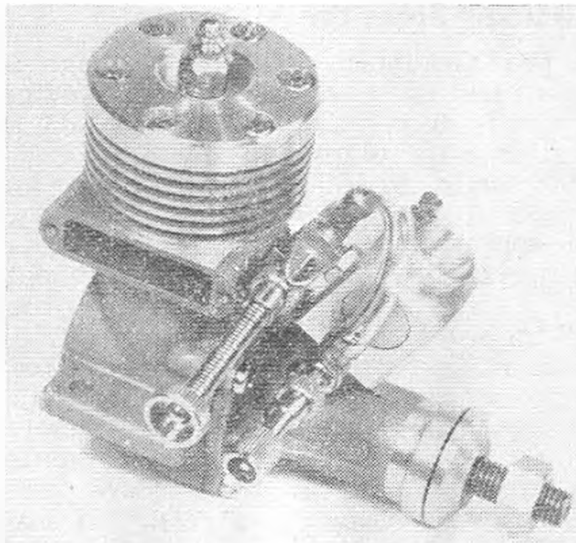
and split into five units. A clever arranegment of mechanical keying prevents incorrect connections. The first unit comprises an all-transistorised superhet, which is also temperature stabilised, into which is plugged a stack of relay units which provide an output via eight-pin sockets to each servo (Bellamatic or Duomatic). Each pair of channels employ relay switching via Grundig miniature relays via gold contacts with high contact pressure, everything is completely enclosed in the colour coded plastic cases. The colour of each two-channel block corresponding to a similar colour on the transmitter control sticks which may be operated simultaneously.

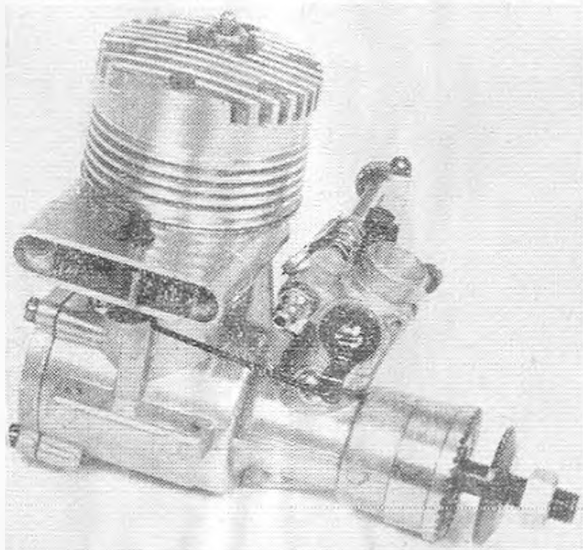
A set of DEACs in two packs come ready wired with the appropriate taps

Below : Matchbox gives an idea of the size of the Grundig/Graupner filter units and Rx. Bottom photo to a larger scale the new Bellamatic Mk. 2. Right : The new Enya 45 top and O.S. 49 below. Note the "Gate" type exhaust closure on the latter. The Enya does not need any exhaust restricting system.









and switch terminating in a socket into which the receiver plugs.

A New Bellamatic 2

The latest addition to the range of servos is the Bellamatic 2 using a Micro T03 motor with additional gearing for high output power. It is shown fitted with an eight-pin plug for connection to the Grundig relay blocks.

First of the new 49's

Fresh from Japan, yet to receive B.H.P. test, come the O.S. and Enya both of which feature entirely new throttle systems and plain pistons.

Enya uses twin spray bars each with its own needle, and a barrel throttle with additional slow running adjustment.

Ed. Johnson's plugs and sockets were mis-named "Space Control" in the heading last month. We offer our apologies to Ed. and retailers of Space Control radio control gear.

A 1, 2, 3, 4 Keying Box

For use with cascade escapements

By Peter Lovegrove, B.Sc.

BASICALLY, a Mighty Midget is used, with a rattler fitted to the armature as described in *R.C.M. & E.* June, 1960, page 91.

A two-side printed circuit disc is fitted to the low-speed shaft with cut-out sections as shown. These switch the motor and transmitter for the requisite signal depending on which way the joy-stick is moved.

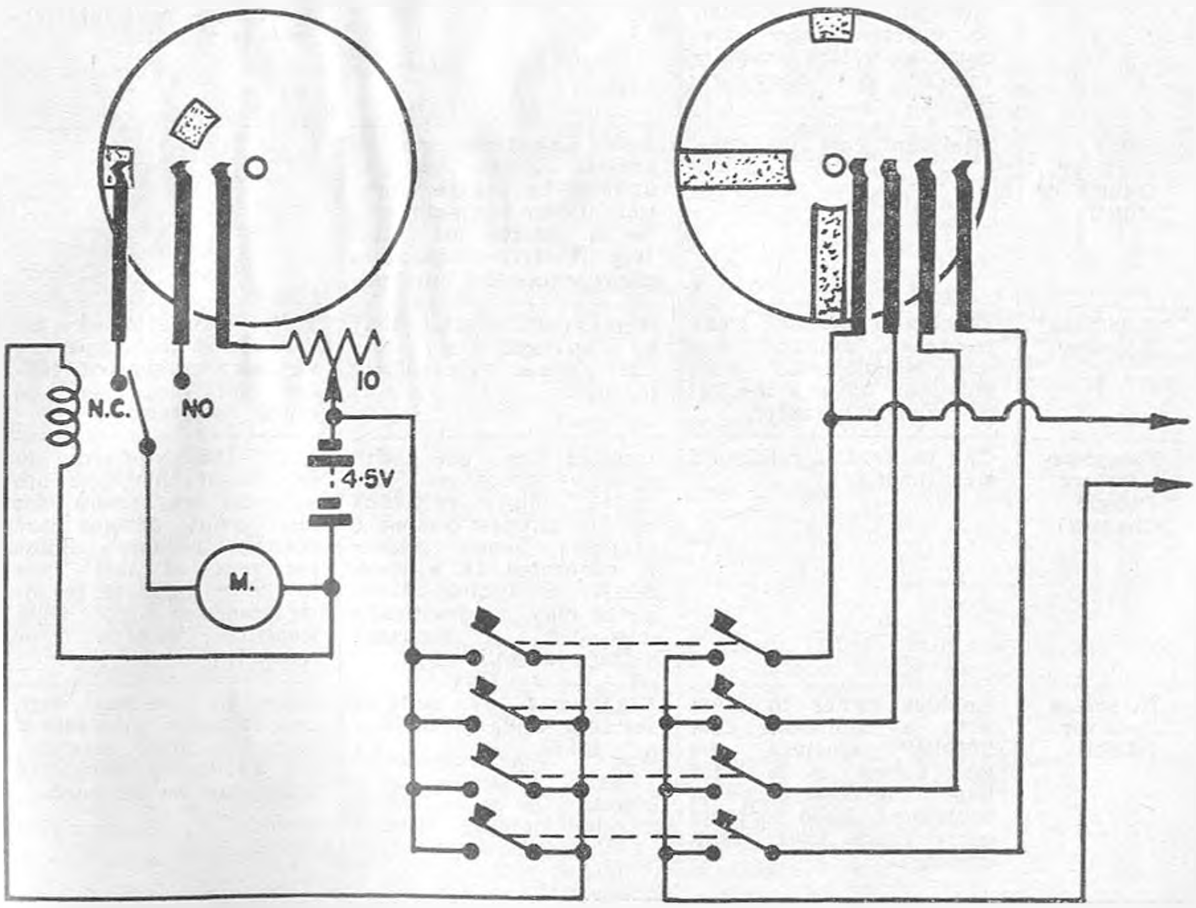
If we look at this in a slightly less confused (Fig. 1) circuit form it is simple, viz.

The joystick pushes onto one of four two-pole push-button switches. One pole of each switch is in parallel with the others so that any direction of motion of the stick pulls in the relay and makes the motor rotate about 340° on the low-speed shaft, i.e. until the bare patch on the disc stops it. Then when the stick is released the motor goes on 20° to "off". The tone is simultaneously switched on with the motor but different buttons connect through different brushes on the reverse face of the printed circuit disc, and the tone may be broken one, two or three times before being held "on" at the 340° position. When the motor goes on to neutral, as it were, because the button is released, via the joystick, the tone also ceases because the buttons are all "off".

The joystick can be one of the "Ripmax" type already fitted with the two-pole push-buttons. The relay is any type which works on 3-4½v. say, for example, Siemens 50 + 50 ohms.

FIG. 1

Note the separate keying switches for each function. The Tx. connections are to the right.



Equipment Selection

Tabulated by

R. H. WARRING

WHAT are the advantages of a tone receiver compared with a carrier wave type? Why is a two-valve transmitter claimed to be better than a single valve circuit? Should I choose relayless or a relay type receiver? What is the most inexpensive way of building up 'multi', step by step? These, and dozens more questions like them, are problems every radio control modeller faces at one time or another in choosing new equipment.

The accompanying tables have been specially prepared as an Equipment Guide, summarising the advantages and disadvantages of different types of transmitters and receivers; and the applications of standard types of actuators. It has been restricted to coverage of commercial equipment commonly available in this country and does not include the more sophisticated proportional control systems.

RECEIVERS (GENERAL)

Type	Advantage(s)	Disadvantage(s)	Remarks
Super-regenerative	Standard Type.	Very broad tuning, therefore susceptible to interference.	Some circuits are critical and have dubious performance.
Super-heterodyne	Virtually free from interference. More than one transmitter receiver combinations can be operated simultaneously on different 'spot' frequencies. High stability (should not need re-tuning).	Much higher cost. Needs specialised knowledge and equipment to align and tune.	Extra cost is justified for "simultaneous" radio control of different models, or where freedom from local interference is required.
Relay Receiver (Single or Multi)	Minimum cost for type.	Relay adjustment may be critical. Relay may be affected by engine vibration. Relay contacts may be a source of fault (e.g. if dirty or made to carry excessive current).	
Relayless Receiver	Eliminates possible relay troubles. Minimum size and weight may need only one battery for receiver and actuator.	Higher cost. Battery may be over-rated (very short life) unless accumulator is used.	Fully transistorised receivers of this type are virtually crashproof (except for reed bank on multi receivers).
Relayless Receiver (Single Channel)	Can be used in minimum size models.	Limited to use with specific actuators. No 'quick blip' switching possible on most compound actuators unless receiver is connected to a slave relay. Switching transistor may be drastically over-rated (excessive voltage drop).	Fully transistorised receivers of this type are virtually crashproof. Not all circuit designs are entirely reliable. Some receivers of this type are very sensitive to interference (e.g. from electric motors, or 'noise').
Relayless Receiver (Multi)	Enables owner to start with a minimum cost "Multi" receiver and add servos at a later date to increase scope of equipment. Reed contacts carry much lower peak currents.	High cost of suitable servos and transistor amplifiers.	Operation can start with two channels (one servo) and add more services, via additional servos as these can be afforded.

RECEIVERS (SPECIFIC)

Type of Receiver	Advantage(s)	Disadvantage(s)	Remarks
Single Channel (Carrier)—			
Single Hard Valve	Minimum cost.	Very broad tuning, susceptible to interference. Stability tends to be critical, needs good relay.	Typically a "current fall" receiver draining a high standing current.
Single 'Soft' Valve	Smaller size and weight.	Tends to vary in characteristics, not particularly reliable.	Not now used.
Twin Hard Valve	More favourable current change makes relay selection and adjustment less critical.	Increased weight and size.	Current rise characteristics.
Hard valve plus soft valve	Smaller size and weight.	Unreliable.	Current rise characteristics.
All transistor relay	Smaller size and weight. Minimum battery requirements.	Very few examples designed or made for carrier wave operation.	Most fully transistorised receivers are of the tone type, operated by a tone transmitter.
All transistor relayless	Smallest size and weight. Minimum battery requirements.		
Single Channel (Tone)—			
Single Valve	Minimum cost.	Stability tends to be critical. Needs good relay.	Current rise on receipt of tone signal.
Valve detector plus transistor amplification (i) Relay (ii) Relayless	Standard form less susceptible to interference. Greater range with hand-held teransmitters.	Higher cost some designs may need 'matching' tone transmitter for best performance.	The most reliable type among smaller H.T. batteries to be used.
All transistor (i) Relay (ii) Relayless	Minimum size and weight. Minimum battery requirements. Greater range with hand-held transmitters.	Higher cost. Stability largely determined by circuit design. Performance may be dependent on optimum transistor selection.	Single battery for receiver. Separate actuator battery suitable for any actuator. May employ single 3-9 volt battery for receiver and actuator.
Multi channel (Reed)—			
(i) Relay Receiver	Standard well developed circuits available of high reliability.	Bulky and heavy. Reeds and/or reeds may be affected by engine vibration. Reed contacts may be over-rated if high servo battery used, leading to burning or welding.	Relay requirements are not critical but a good relay design is required (one relay per channel) will operate any type of actuator.
(ii) Relayless	Compact, light weight. Reed contacts carry relatively low peak currents.	Needs transistor amplifier for each servo, increasing servo cost. Reeds may be affected by engine vibration.	Must be used with suitable matching servos.
Multi Channel (Tone Filter)—			
(i) Relay Receiver	Eliminates reed contacts as source of trouble.	Bulky and heavy. Usually limited in number of separate channels available.	Will operate any type of actuator.
(ii) Relayless	Virtually shockproof and unaffected by vibration. Better separation of adjacent channels possible (compared with reeds).	Expensive. Needs expensive servos. Usually limited in number of separate channels available. Usually heavier than comparable reed receiver.	Must be used with suitable servos.

ACTUATORS

Actuator	Action	Power	Used with	Application(s) Aircraft	Boats
Simple Escapement.	2-position self-neutralising.	Rubber strip.	Single channel or one channel of multi-channel.	Rudder *or* engine speed changeover (used as secondary escapement).	Rudder on small, light boats only.
	4-position non-neutralising.	Rubber strip.	Single channel or one channel of multi-channel.	Secondary escapement for 3-position throttle.	——
	2-position self-neutralising.	Clockwork.	Single channel or one channel of multi-channel.	Secondary escapement for engine speed changeover.	Secondary escapement for engine speed changeover.
	4-position non-neutralising.	Clockwork.	Single channel or one channel of multi-channel.	Secondary escapement for 3-position throttle.	Secondary escapement for 3-position throttle *or* 4-position sequence switcher.
Compound Escapement.	R and L *plus* 'third position'.	Rubber strip.	Single channel or one channel of multi-channel.	Rudder *plus* engine speed (via secondary escapement) *or* rudder *plus* trip elevator.	Sequence selection of 3 non-critical services (not including rudder).
	R and L *plus* 'quick blip'.	Rubber strip.	Single channel or one channel of multi-channel.	Rudder *plus* engine speed (via secondary escapement).	——
	R and L *plus* 'quick blip' *plus* 'third position'.	Rubber strip.	Single channel or one channel of multi-channel.	Rudder *plus* engine speed (via secondary escapement) *plus* trip elevator.	——
Simple Servo (Single Channel).	2-position self-neutralising.	Electric Motor	Single channel or one channel of multi-channel.	Rudder *or* engine speed changeover (used as secondary actuator).	Rudder.
	4-position non-neutralising.	Electric Motor	Single channel or one channel of multi-channel.	Secondary actuator for 3-position throttle.	Sequence switching of non-critical services or motor speed.
Compound Servo (Single Channel).	2-position self-neutralising *plus* one additional switching action.	Electric Motor	Single channel or one channel of multi-channel.	Rudder *plus* engine speed.	Rudder plus selective switching of one additional service.
Compound Servo (Single Channel).	2-position self-neutralising *plus* more than one additional switching aerion.	Electric Motor	Single channel or one channel of multi-channel.	——	Rudder plus selective switching of one or more additional services.
Proportional Servo (Single Channel).	Proportional L or R, self-neutralising.	Electric Motor	Proportional transmitter signalling.	Rudder.	Rudder.
	Proportional L or R. no neutral.	Electric Motor	Proportional transmitter signalling.	——	Rudder (but not on high speed craft).
Progressive Servo (Multi Channel).	Progressive R or L not self-neutralising.	Electric Motor	Two channels or Multi equipment.	Engine speed or elevator trim.	Engine speed.
Multi Servo (Bang-Bang).	Push-pull self-neutralising.	Electric Motor	Two channels or Multi equipment.	Rudder (1 servo). Elevators (1 servo). Ailerons (1 servo).	Rudder (1 servo). Sail adjustment on yachts (1 servo).

It is advisable to check that a receiver and transmitter are matched, not only in type but in the case of some receivers, that the modulation depth provided by the transmitter is sufficiently deep to provide satisfactory operation. Furthermore, some compound escapement may require a *very short* " quick blip " to which some Rx. are unable to respond without suitable modification.

TRANSMITTERS

Type	Advantage(s)	Disadvantage(s)	Remarks
Single Valve	Minimum cost and simplest circuit.	Critical operating point. Likely to be affected by hand capacity proximity to ground, relative position of keying load, etc.	
Two Valve	More stable operation less liable to frequency drift.	Slightly less efficient (i.e. less power output for given power input).	Most suitable circuit for tone trasmitters.
All transistor	Minimum size and weight; Minimum battery requirements; Minimum operating cost.	Comparatively new and thus not fully proven by 'field' experience. May have low power output (low range).	Makes the lightest and smallest hand-held transmitter.
Crystal Controlled	Stable signal frequency improved performance at range.	Higher cost.	Essential with superhet receivers.
Ground Based	High output power possible. Long aerial possible for maximum range. Best for carrier receivers.	Large and heavy due to bulk, not always suitable for aircraft 'multi' controls.	Normally used with separate keying load.
Hand-held	Light and portable. Eliminates need for separate carrying load.	Reduced range short battery life telescopic aerial not particularly efficient.	Standard with most tone receivers. Standard for multi-channel. Used with carrier receivers may need loading coil.

Query Column

WE ANSWER QUERIES THROUGH THIS COLUMN EACH MONTH, AND WELCOME GENERAL INTEREST PROBLEMS. AT THE MOMENT WE CANNOT UNDERTAKE TO ANSWER QUERIES THROUGH THE POST, NOR SHOULD SETS BE SENT TO US UNLESS SPECIFICALLY REQUESTED.

I HAVE built a "Transmutone" Rx., as published in January, 1958, "Aeromodeller", for a three-reed bank. Is it possible to use "Ivistor" electric relays on a reed bank and if so how does one connect them up?

If the above is not possible is it possible to use "Transmutone" as a S/C Rx. with "Ivistor"?

B. S., LANCS.

The "Ivistor" relay eliminator will only switch one way and is not suitable therefore for reed work. We shall be publishing a circuit of a balanced transistor servo switcher later on and this is quite suitable for reed work. For obvious reasons we cannot anticipate the published article.

I HAVE a printed circuit Tx. coupled with a "Transmutone" Modulator, as described in a previous issue of the "Aeromodeller". I am contemplating building the "U.K." Tone Receiver, as described in "R.C.M. & E.", but note that this receiver requires 100 modulation transmitted signal. Will the Modulation Unit as mentioned fulfill this requirement? K.B., YORKS.

The transmitter you have should work quite well with the "U.K." tone receiver, ideally the mark-space ratio should be 50/50, this is rarely the case with a blocking oscillator like the "Transmutone" but satisfactory results should be obtained in spite of this.

If you wish to get the ideal modulation try reducing the time constant of the grid circuit by making the associated resistor and capacitor of gradually lower values (check that the current through the transformer and valve does not exceed rated values) and at the same time increase the value of the capacitor across the transformer to get the desired frequency. Careful cut and try here can get the desired result but access to an oscilloscope is necessary to check progress.

TINY TX. [Continued from page 191]

loop. With batteries connected, the filament switch on, and the H.T. switch closed. this bulb should light with fair brilliance, when the loop is brought near the transmitter coil.

If the bulb does not light, check wiring and H.T. battery connections for correct polarity. Test that about 0.1a. filament current flows, with a meter, or observe that the filament glows red, in darkness or away from the light. If it does not, check L.T. cell, wiring to it, or contact between cell and brackets, if soldered connections are not used here.

When the bulb lights, the transmitter may be tuned into the 27 mc/s band, by rotating the trimmer, and observing the tuning point on a calibrated wavemeter or bulb meter. If necessary, a wavemeter or bulb meter can be calibrated by tuning it to the signal obtained from a transmitter already set within the band. The wavemeter tuning is then left untouched, and the home-made transmitter is tuned for maximum indication on the wavemeter.

Final tuning should be with the aerial rod fully extended. The transmitter can be held in the right hand, and in this position one finger will come upon the H.T. switch button. The hand should be fairly low down, level with the B101 battery, and clear of the aerial fixing bolts.

ERRATA

We must apologise for the following errors which appeared in "Transistor Testing" last month:—

In Fig. 1; M3 should be 0.250μA. VR1 should be 25K. Checking Super Alpha pairs: Y is varied between R2 and VR2, x between R1 and VR1. Page 145, line 22: Should read (μA). Blocks a and b were transposed.

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