"Service"

A DIGEST OF ELECTRONIC NEWS AND VIEWS

THIS magazine is designed to present students with current news and information affecting the field of Electronics. Articles dealing with general business subjects, which in many cases the student finds necessary for his complete success, will also be included. To enable readers to obtain original articles, details of the origin of any condensed matter will be quoted.

IN this, the January, 1948, issue of your magazine "Service", we are proud and happy to present to you the first instalment of a very important series of articles. For long the need has been felt for a special series of practical workshop lessons to cater for the needs of correspondence students in remote districts, and particularly those who are residing overseas. In the past that need has been well catered for, and undoubtedly will also be catered for in the future to a great extent, by the numerous kit sets which are available on the Australian market. However, present day material shortages will make this planned course of practical lessons, together with materials, a most desirable feature for many Australian students. Undoubtedly the great majority of A.R.C. students overseas will immediately wish to incorporate this new course with their regular series of lessons.

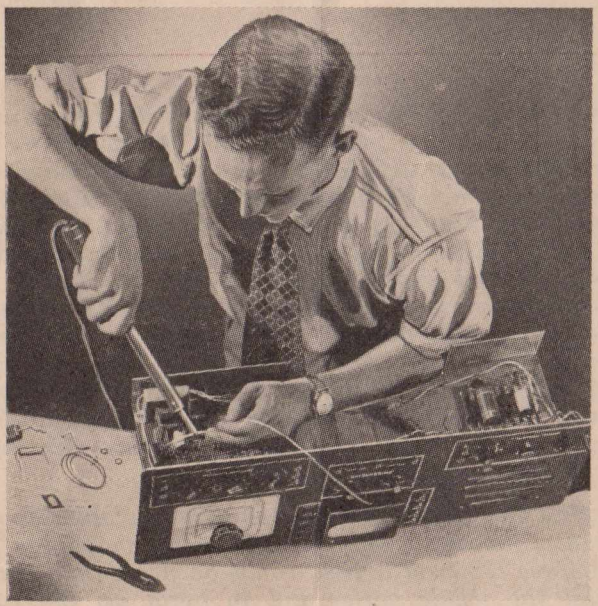
IN presenting the course to you, we also apologize for the delay it has caused to the production of your magazine "Service". However, before the first article could be presented, it was necessary to plan the whole series and to build up the considerable amount of experimental apparatus, and this all created unavoidable delay. However, from now on, the Engineering and Editorial staff of the College will be in a position to regularly produce "Service", including these practical lessons, and have the magazine forwarded to you regularly each month.

JANUARY, 1948

WHAT TO LOOK FOR IN THIS ISSUE

This monthly publication is produced by the
AUSTRALIAN RADIO COLLEGE PTY. LTD., 206 Broadway, N.S.W.

PRACTICAL RADIO COURSE



HOME PRACTICAL INSTRUCTION

LESSON No. 1.

AUSTRALIAN RADIO COLLEGE PTY. LTD.

HOME PRACTICAL INSTRUCTION

LESSON No. 1.

Radio is indeed a most fascinating and interesting subject to study. Whether it be studied with the object of obtaining a lucrative career in the radio industry, for the betterment of one's position, or merely to provide an entertaining hobby, it has an appeal to thousands. Perhaps this is due to the glamour associated with any thriving, young industry, developing at a rate faster than any other industry. Perhaps it is due to some of the achievements of radio in the past or the unlimited potentialities of radio in the future, but whatever the cause, it is hard to conceive any more fascinating or interesting subject to study.

Some students have the ability of absorbing knowledge readily from textbooks or printed lesson papers. Their minds are able to clearly grasp the subject they are studying from the printed text and illustrations, and many become just as proficient ultimately as others who are more favourably placed in obtaining extensive practical experience. There are some, however, who find it much easier to visualise the intricate actions which occur in radio apparatus and are able to more readily understand a written description of a particular radio component or circuit if they are able to handle actual radio parts, assemble them into practical working circuits and make the necessary tests and experiments to bear out in practice what is set down in a text.

Many people, especially those in remote locations, are handicapped in not having ready access to radio parts and test instruments with which to experiment. It is with the needs of these enthusiasts in mind that a practical instruction kit has been evolved especially to cater for them, to provide a means for carrying out hundreds of interesting experiments and which will ultimately make possible the construction of an extremely efficient and useful set of radio servicing apparatus.

The kit of equipment described is fundamentally intended to be used in conjunction with the Australian Radio College course of Radio Service Engineering. This course deals thoroughly with the principles of radio and electricity, performance of the various stages in radio receivers and efficient systematic service technique. For this reason, some reference is contained in these practical instruction papers, which accompany the kits of parts, to the lesson papers contained in the Radio Service Engineering Course. These references are intended only to amplify the descriptions contained in the

practical instruction papers accompanying the practical material kit. These instruction booklets are clearly set out, explained in simple language and profusely illustrated to enable the student to carry out a large number of experiments with every kit he receives. This course may therefore be considered to be complete in itself, the cross-references to the lessons of the A.R.C. course merely serving to provide additional and amplified descriptions of the actions being explained.

As a practical instruction kit will be of particular interest to those in outlying areas where electric power supplies are rarely available, it has been decided to base it principally upon battery operated equipment; and the necessary batteries for operating amplifiers, receivers, test instruments and so on, constructed throughout the course of training, are included with the kit. This makes the course completely universal so that it can be used with equal efficiency in any area regardless of whether or not electric power is available.

Every student taking up a course of radio training desires ultimately to become proficient in adjusting new receivers and locating faults in defective receivers and for this class of work needs some testing instruments. The most essential testing instruments are a multimeter for checking voltages, currents and resistances in radio apparatus: a test oscillator for providing radio frequency signals for testing receivers and a signal tracer for rapidly and efficiently locating defects in faulty receivers. This practical course of training has been very carefully planned to provide a variety of radio parts which may be assembled in many combinations to provide instructive practical training throughout the course and yet, towards the completion of the course of training, the parts can be grouped in such a fashion that they form an efficient multimeter, a modulated radio frequency test oscillator and a 3-valve signal tracer. Thus, the student on the completion of his course becomes the proud possessor of one of the most modern test outfits possible; which will enable him to make practical use of the knowledge he has gained throughout his training period.

You will receive nine big parcels of radio parts at regular intervals throughout the course of training. Each of these parcels enables a large number of individual experiments to be carried out. Each parcel is accompanied by a carefully prepared instruction booklet which explains in full detail the experiments to be conducted with the kit supplied, tests to be made and examples of the principles examined in actual radio apparatus. Each component part supplied in the parcel is clearly labelled so that no difficulty will be experienced in

recognising it or applying it in the correct manner.

Parcels themselves do not all contain goods of equal monetary value. This is necessary because some of the parcels, to make them complete and versatile, contain quite a lot of expensive components. To enable the student to build up credit for these expensive parcels the preceding one may not contain goods of quite as much value. For example, the first parcel contains a soldering outfit, a quantity of wire, solder, flux, resistance panel, insulation tape, and a soldering iron to enable the student to become proficient at soldering. The monetary value of this first parcel is somewhat below the average value and this enables the second parcel to contain some more costly items such as a high quality permanent magnet moving coil meter, fitted in an attractive plastic case and provided with a universal scale. This will eventually become a complete multimeter.

As most people have a few simple tools available no tools have been included in the kits with the exception of a small soldering iron which can be heated over a fire or stove of any kind. The other necessary tools are something with which to cut wire, e.g. an old pair of scissors or a knife, a pair of pliers, a file or sheet of emery cloth for keeping the soldering iron clean and a small and large screwdriver. The metal chassis frames provided for the assembly of experimental units are furnished complete with all necessary mounting holes already cut in so that other tools are not essential although they may prove handy if available.

LIST OF KITS CONSTRUCTED.

To give some indication of the flexibility and wide variety of experiments which may be carried out the following list, of units constructed during the course of training, is provided. This list merely indicates some of the work and a few of the units which are constructed and it should be borne in mind that on each of these units there are many experiments which may be conducted so that the extent of practical training is very great.

Soldering instruction.
Wire splices and joining.
Insulation.
Aerial construction.
Fault location with voltmeter.
Continuity tester, for testing radio and electrical parts and circuits.
Coil winding.
Ohmmeter.
Multimeter.
Output meter.
Valve testing.
Valve Curves.
Valve amplifiers.
1 valve receiver.
2 valve receiver.
Radio frequency oscillator.
Audio frequency oscillator.
Morse code practice oscillator.
Modulated radio frequency oscillator.

3 valve T.R.F. receiver.
Vacuum tube voltmeter, for D.C.
Vacuum tube voltmeter, for A.C.
Class A, B and C amplifiers.
Inverse feedback.
Push-pull amplifier.
Condenser tester.
Signal tracer.

The experience gained from the construction of units such as those listed above will not only promote a clearer understanding in the student's mind of the basic principles and theory of operation of the equipment but it will also breed a feeling of confidence so that on completing the course the student will not only be the possessor of a sound technical training, but will also be thoroughly equipped and confident to carry out radio receiver construction or repairing work.

KIT 1. SOLDERING OUTFIT.

A radio receiver constructed without the use of soldered connections would be entirely impracticable. Even though it may perhaps be coaxed into working at first, before very long crackles and noises would interfere with reception and the receiver would soon become inoperative. It is essential for all the connections in a radio receiver to be soldered and consequently one of the first essentials is for you to learn the art of soldering efficiently and quickly.

The reason for the widespread use of solder in radio receiver construction is the fact that the amount of electricity which will flow in any circuit is dependent upon the resistance of the paths through which it has to flow. Most metals have a fairly low resistance and if their surfaces are perfectly clean merely clamping them together will initially cause a low resistance path so that normal values of current can pass through the connection. However, all metals in contact with the air, will eventually have a film of oxide formed on their surface. This oxide, in the case of iron, is called rust. Other metals also have a film which is not always as apparent as in the case of rust on iron, but nevertheless exists to some degree. The oxide films on metals are normally fairly good insulators of electricity and consequently would increase considerably the resistance to the path of electricity and reduce the current to a lower than the correct value. Eventually, the thickness of the oxide film may become so great, as the result of moisture in the atmosphere that in a radio circuit it may completely prevent current from flowing. This may happen even though the oxide film may only be a fraction of a thousandth of an inch in thickness and hardly noticeable to the eye.

The use of soldered connections is not so important in high voltage circuits such as those used for electric power and lighting because the high volt-

ages used are strong enough to cause any oxide film to break through and for the current then to be able to flow directly from one metal surface to the other. With receivers, however, some of the signal voltages are only a few thousands or even millionths of a volt in strength and these low voltages are not enough to drive electric current through an oxide film of any appreciable thickness. The film will form even on pieces of metal which are fairly tightly clamped together due to air getting in between the surfaces and corroding them. One certain way of assuring a permanent connection of low resistance between two pieces of metal is to exclude any possibility of air reaching the surfaces across which the current has to flow and at the same time bridging the gap between the two pieces of metal with a third metal, solder, which is itself a good electrical conductor.

Solder is not a very strong metal and consequently should not be relied upon where a great deal of mechanical strength is required. It is always preferable to make a strong mechanical joint before the solder is applied. This can often be achieved by carefully twisting together two wires to be joined or, where a wire is to be connected to a solder lug the wire can sometimes be passed through a hole in the solder lug as shown in Figure 2.

If no hole is provided in the solder lug, it may be possible to

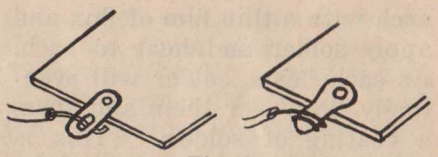


Fig. 2.

wind the wire once or twice around the solder lug before solder is applied. After this has been carried out, the application of solder will fill any spaces between the two wires or the wire and lug and will assure a permanent and lasting connection of low resistance between them.

Solder will only "wet" a surface of metal which is perfectly clean and free from any oxide coating. Therefore, the first principle of soldering is that both surfaces to be joined must be thoroughly clean, any oxide film being removed from them. A substance called "flux" should then be coated on the surfaces to be joined so that when heat is applied the flux will melt and the liquid will remain over the hot surfaces to prevent air from coming in contact with them and forming a new oxide film. Solder is also applied and when the two surfaces to be joined have each reached a temperature higher than the melting temperature of solder, the solder will flow onto them and will coat them both. A film of solder will link them together and this will assure an efficient connection.

An alternative, slightly different method of soldering, is to clean the surfaces of each piece of metal separately, coat

each with a thin film of flux and apply solder and heat to each. As each heats, solder will eventually flow over them and form a coating of solder. This is known as "tinning" a surface. The two pieces to be joined are then brought together and heat again applied until the two lots of solder melt and merge into one. On removal of the heat the solder will solidify and hold the two surfaces together.

SOLDER.

Solder is a metal consisting of a mixture of tin and lead. The most suitable type of solder for radio work is composed of 50% tin and 50% lead. This solder, when heated, starts to become soft at a temperature of 358 degrees F. and becomes really fluid at 415 degrees F. At any temperatures higher than this, it flows quite readily. Due to the high cost and shortage of tin there is a tendency nowadays to use solder composed of 40% tin and 60% lead. This solder also becomes soft at a temperature of 358 degrees F. but does not really melt and become fluid until it is heated to 460 degrees. On cooling, it remains quite liquid until its temperature drops to 460 degrees and it then becomes plastic or soft until it cools to 358 degrees and then it finally sets hard at temperatures below this. Although not quite as good as 50-50 solder it is nevertheless quite satisfactory for radio work.

FLUX.

Previously it was mentioned that it is essential for both materials to be joined to be thoroughly cleaned before any attempt is made to solder them. This is necessary to remove any oxide film. After the surfaces have been cleaned, the application of heat from a soldering iron would immediately tend to form a new oxide film before the surfaces became hot enough for solder to flow on them. To prevent this new oxide film from forming, a flux is employed. There are a number of different fluxes which may be used in soldering although for radio purposes resin or some of the special non-corrosive soldering pastes are generally used. The purpose of a flux is to melt as soon as heat is applied, and form a film over the surface of the metal. Thus air is excluded and an oxide film cannot reform. As the temperature of the surfaces increases, the flux boils and commences to evaporate. When solder is applied, it penetrates through the film of flux and flows over the surface of the metal. Meanwhile the continued application of heat evaporates most of the flux so that by the time the process of soldering is complete there should be little, if any, flux remaining.

A little practice will soon indicate the correct amount of flux to employ. If too little is used, it will all evaporate before the objects have reached a sufficiently high temperature

for solder to flow over them and the solder will not adhere efficiently to the surfaces. If too much flux is employed, it will not all be evaporated during the process of soldering and the surplus, having melted, will flow over the surface of the materials and will not only look untidy but on cooling will form a sticky mass to which dust will later adhere with the possibility of an electrical breakdown or fault developing due to electricity escaping through the dust. You should aim to use just sufficient soldering flux so that it is all evaporated by the time the process of soldering is completed. If you misjudge, and use too much, then any surplus should be removed with a cloth dampened with methylated spirits or alcohol.

Resin, while being fairly effective in preventing the formation of an oxide film during the soldering process, is not very active in removing any corrosion or film which has not been thoroughly removed by prior scraping, filing or cleaning of the metal. For this reason, resin is only suitable as a flux on work that has been previously cleaned efficiently. Some of the soldering pastes available are more effective in their cleaning action than resin and have the property of removing to some degree small amounts of corrosion or film on surfaces so that in many instances, especially in the case of tinned copper wire, no previous scraping or cleaning is necessary unless the wire is badly corroded. However, most of these patent fluxes are slightly corrosive and therefore should never be used for soldering extremely fine wires in radio apparatus such as the wires on tuning coils or transformer windings. For these purposes it is advisable to use resin only but for the thicker wires in a radio set and for general soldering, soldering pastes are usually quite effective.

For soldering large sheets of metal it is sometimes preferable to use a liquid known as "zinc chloride". This is manufactured by dissolving the metal zinc in hydrochloric acid until no more zinc will dissolve. The remaining fluid is then suitable as a soldering flux for use on most metals with the exception of aluminium, zinc and galvanised iron. For galvanised iron or zinc a dilute solution of hydrochloric acid, sometimes called spirits of salts, should be used. There is no really effective flux for aluminium and consequently it is almost impossible to satisfactorily solder aluminium. Zinc chloride and hydrochloric acid are of course corrosive, and should never be used in the wiring of a radio receiver. They are only suitable for joining together large sheets of material. If they are used in the construction of a radio set, after a period of time the thin wires will be corroded completely through.

Because of the suitability of resin as a flux for radio work,

most solder used for radio is supplied in the form of a thick wire or rather, a tube with a centre core of resin. Where two clean bright surfaces are to be joined, some of this solder can be applied either by transferring a drop with the iron to the surfaces to be soldered or by applying the end of the wire solder to the joint and melting some of the solder and resin contained in it onto the material with the hot iron. In this case, the resin and solder will flow together over the surface of the metal.

Where any difficulty is experienced in making the solder adhere, or where the surfaces are not perfectly clean, it is advisable to use a little soldering paste or some other form of flux in addition to the resin contained in the solder.

SOUND ON PAPER

Made Possible by New Magnetic Coating

(From "SCIENTIFIC AMERICAN")

After many false starts, magnetic recordings of voices, favorite radio programmes, and messages for mailing to distant points are being made available on a new medium—a paper tape coated by a printing process with a thin film of magnetic material.

The development of the paper tape technique for home and office use is an outgrowth of forward strides made during the war in magnetic recording on a thin steel wire. The paper tape is about 0.003 inch thick and comes on a reel like that used on eight-millimeter home movie equipment. It passes from a supply reel to a take-up reel through a magnetic recording head. The latter is supplied with electrical energy by an electronic amplifier similar to those used on present-day home recording instruments. Variations of the sound-modulated electrical energy are transformed by the head into magnetic variations in the paper coating. The sounds to be recorded can be taken from a radio programme or picked up by a microphone supplied with the instrument.

One of the advantages of the paper tape is that it can be cut at any point and a portion of the tape deleted. This permits the user to edit out unwanted portions of a radio programme; for example, commercial announcements. Splicing of the cut ends of tape is easily accomplished with an adhesive. Recordings can also be magnetically erased, in full or in part; this permits re-recording

of new programmes or sound, or adding material between wanted portions. The tape is expected to have a useful life in excess of that of the usual disc recordings. The first model of the paper-tape magnetic recording instrument, a product of The Brush Development Company, will be about the size of a table-top radio and is planned to be an accessory to the present home radio receiver. Each full reel of paper tape will accommodate a half hour of recorded material and can be rewound in less than a minute. Operation is quite simple and requires no more technical skill than that needed for loading a movie camera. Business dictation machines are also contemplated.

Although magnetic recording offers many novel features, it cannot be expected that the conventional disc-type records will be replaced by reels of paper or wire. Disc records are pressed from a master in a matter of seconds in mass production. So far, no similar method of reproducing magnetically recorded reels is even on the horizon. Each reel of wire or coated paper tape would have to run through the recording head to receive the proper magnetizing effect; time alone is a considerable factor in this operation. For special programmes, business records and dictation, and similar purposes, however, magnetic recording offers many advantages.

ELECTRONIC SORTERS REJECT BAD BEANS

Electronic sorters have met the test of practical service, and 1,000 of them in the U.S. and Canada are picking the bad out of 700 tons a day of beans, peanuts, coffee, seed corn, and even potatoes.

One bean at a time is fed mechanically through these Electric Sorting Machine Co. units. Light from a lamp is reflected by the bean through the lens to a partial mirror, which reflects half of the light through a red filter to a red-sensitive phototube and transmits half to a second mirror which reflects it through a green filter to a green-sensitive phototube. The outputs of the phototubes are amplified and fed to the deflection plates of a cathode-ray tube to control the horizontal and vertical sweeps of the electron beam. A bad bean throws the beam outside of a partial mask on the cathore-ray tube face to actuate a third phototube that operates a rejector mechanism to throw out the bean.

—Electrical World

"Are you the man who saved my little boy from drowning?"
"Yes."
"Well, where's his cap?"

A.R.C. TRADING POST

A free Buy - Exchange - Sell Service for A.R.C. Students

FOR SALE.—Springtime Portable in excellent condition, ready to operate; £23 or nearest offer.

S. Copine, Box 157, Mareeba, N. Qld.

FOR SALE.—1K5-3 valve set, less cabinet and batteries. Valves new. Price £8. Will exchange for 3 or 4 valve electric set.

R. Jasprizza, "Cherry Hill", Cowra Rd., Young, N.S.W.

FOR SALE. — Supertester, checks all radio components, perfect condition. £28/10/- new, will sell for £22/10/- or reasonable offer.

R. O'Toole, Cnr. Canterbury Rd. and Broadway, Punchbowl. (Sundays only).

FOR SALE. — "The Radio Amateur's Handbook". (Special Defence Edition) 5/-.

V. G. Bruce, 391 Canterbury Rd., Surrey Hills, E10, Vic.

FOR SALE.—Velco F45 13 watt P.A. amplifier (P/P6V6's), including G'Phone motor, pick-up, and radio tuner. Best offer.

R. E. Jarvie, c/o Camp Staff, 113 R.G.H., Concord, N.S.W.

FOR SALE.—One Service Oscillator, new, batteries, described in R & H, April, 1947. £14 or near offer.

A. A. Lawrenz, Pinnacle, via Mackay, Qld.

FOR SALE.

AMATEUR THEATRE EQUIPMENT.

2 Hanns Gothez handfed projection Arc Lamps, complete with lamps, houses, and 5 inch mirrors. Also 2 A.C. Arc Transformers—240 V input, 25 V-80 Amp output. The lot, in good order—£50, or will sell transformers separate at £18 each.

F. W. Griffiths, Station St., Somerville.

FOR SALE.—Useful for experimenter—single gang condenser—hardly used 1P5GT, 19, 1Q5GT—Kingsley RF KC2 coil —the lot 40/-. Also BTH Magnetic Pick-up, almost new, 30/-.

B. Eneberg, 371 Military Rd., Largs Bay, S.A.

FOR SALE.—OK1 Mod. Osc. New condition. £7.

C. Cripps, 3 Almora St., Balmoral. LA 3366 during daytime.

Do you want to buy, sell or exchange something with a fellow student? If so, the College will gladly insert your advertisements free of charge on this page. Write carefully—or, better still, print your advertisement. Condense it to 30 words or less, and it must be confined to radio subjects. The College of course reserves the right to re-write advertisements as necessary, or to reject those that may not fit in with the spirit of this service.

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