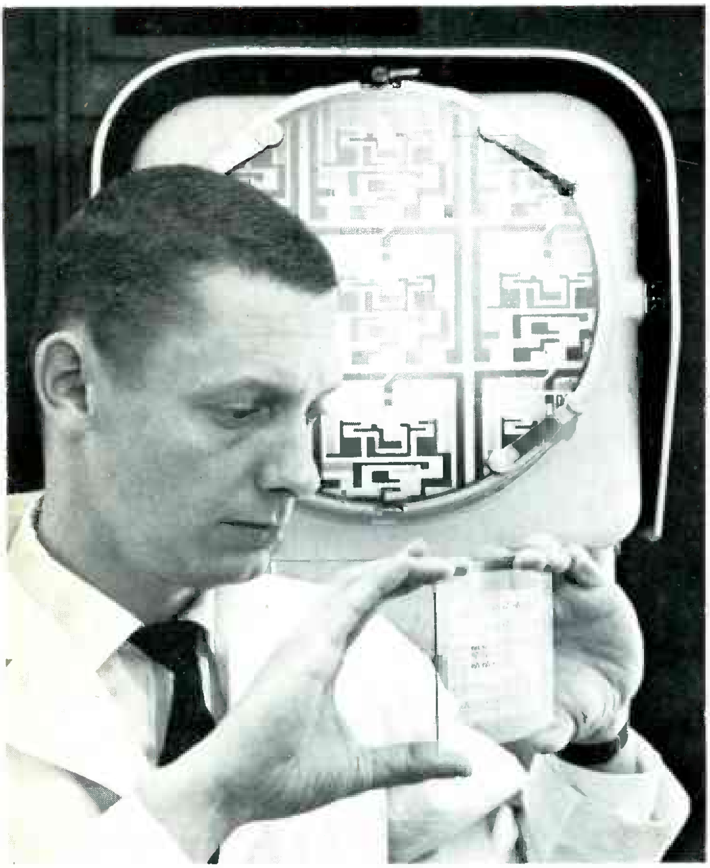
nri journal

JUNE/JULY 1963



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- MAG AMPS
- POWER FAILURE/ RESTORATION ALARM
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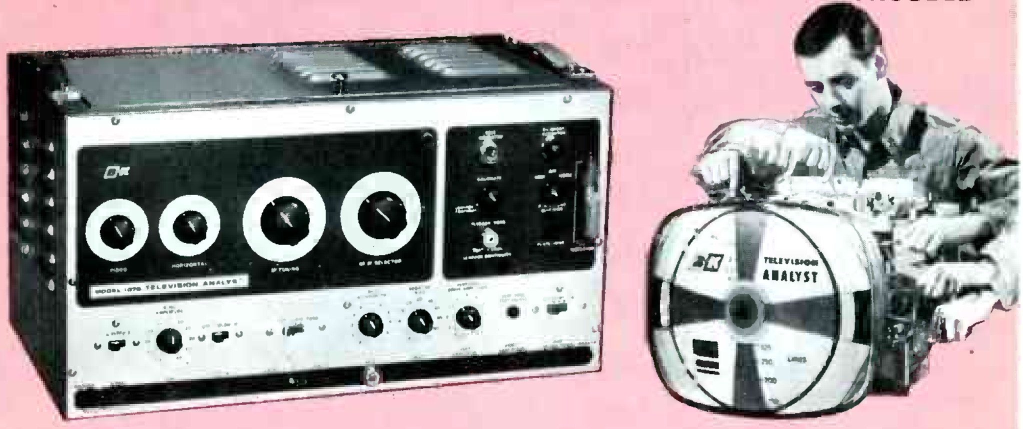

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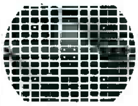

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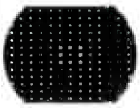

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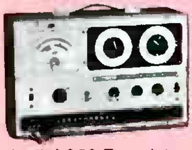

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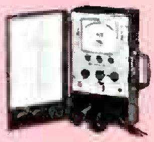

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2

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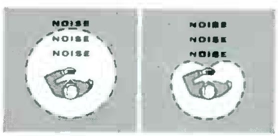

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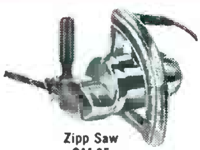
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NRI news

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An
Editorial

OUR NEW LOOK and TITLE

You have just received your first copy of NRI Journal. It is called a "pilot" issue by the printers and is published in advance of its first regular monthly schedule which begins with the October issue. The Journal replaces NRI News published every other month (6 times per year) for many years.

The Journal has been designed to meet the needs of both our students and graduates for an improved publication to supplement their training and to keep them up-to-date on electronic developments.

We have engaged the services of qualified writers who are specialists in radio-TV servicing, communications, industrial electronics, audio, and other related subjects. They will give you the benefit of their experience and show how to be successful technicians in our electronics industry.

They will explain the latest servicing techniques and shortcuts so that you can save time on your calls and make more money. The Journal will include popular "How to" construction articles on electronic equipment that is both useful and educational.

We will accept a limited amount of advertising from manufacturers and suppliers of products and services you will use in your chosen job. You will note that we have added extra pages to accommodate these future advertisers.

The August - September issue of the Journal will be printed (same as previous NRI News) so that you will not miss any issue to which you are entitled.

Please remember - NRI Journal will be published MONTHLY beginning with the OCTOBER issue and be printed in color the same as this special preview copy.

The Journal is YOUR magazine and we will welcome your comments and suggestions.

O. R.

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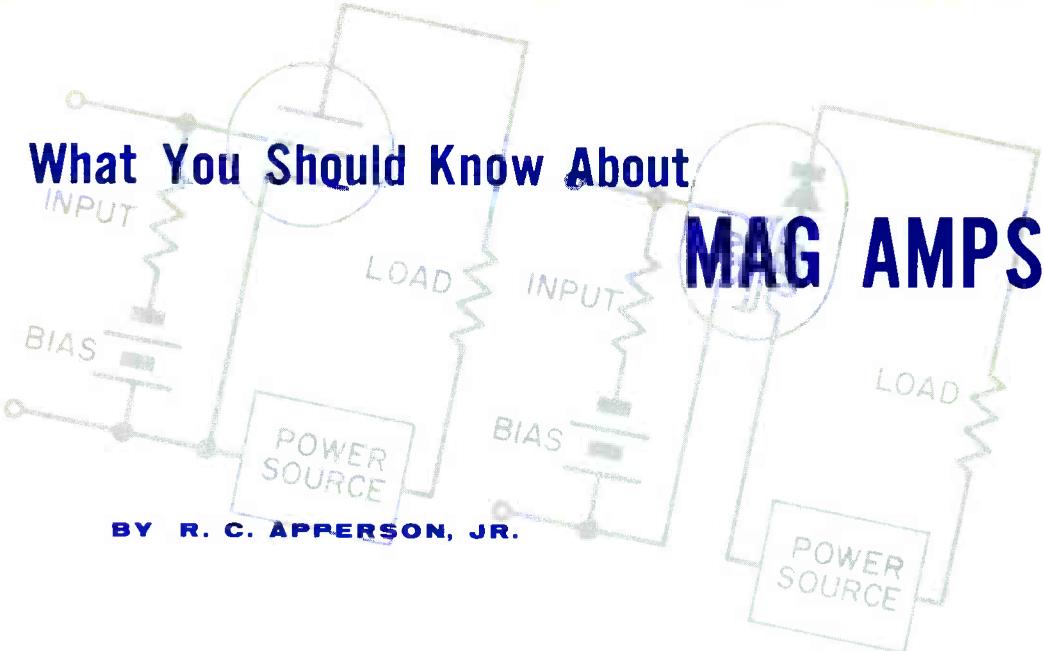
What You Should Know About MAG AMPS



BY R. C. APPERSON, JR.

In quest of a trouble-free efficient device to replace the vacuum tube, which had a high failure rate, our enemy during World War II seized upon an American invention and spent millions developing it. Adolph Hitler's scientists and engineers evidently felt that the magnetic amplifier was a good replacement for vacuum tube circuitry, since mag amps were used in some very critical applications. They were found in stabilizers, servos, and the fire control systems of their finest warships.

The use of the device crossed the ocean again and contracts were let to exploit the use of mag amps in such high speed applications as digital computers and pulse forming circuits, memory and scanning devices for radio, radar and sonar equipment. Later we will look at the practical applications, but now, let us see what the magnetic amplifier is.

FUNDAMENTALS OF THE MAG AMP

Defined as a variable impedance control device, the mag amp is simply another type of valve, such as the vacuum tube and the transistor. It is, basically, a saturable core reactor. Power is varied by placing the mag amp in series with the load to be controlled, just as in the case of the transistor or vacuum tube (see Fig. 1). By varying the impedance of the controlling device with a signal, much like the grid swing on a tube, the power to the load is controlled.

The heart of the magnetic amplifier is the core of its saturation characteristics. The impedance of the device is varied by saturating the core and, gain is derived because of the rectangular hysteris loop, which became more readily obtained with the advent of the ferrite core.

In Fig. 2, we see a simple variable reactor. As the iron bar is moved in and out of the coil, we know that the inductance goes through a prominent change. Consider the instant the iron is completely in the coil, the impedance to current flow is very high and most of the

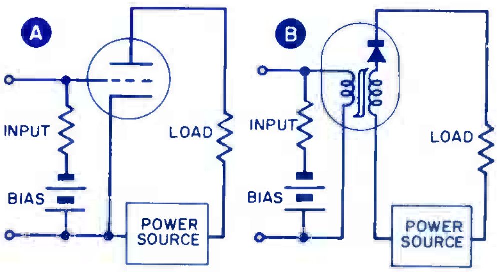


FIG. 1. Comparison of vacuum tube circuit, A, and magnetic amplifier circuit, B.

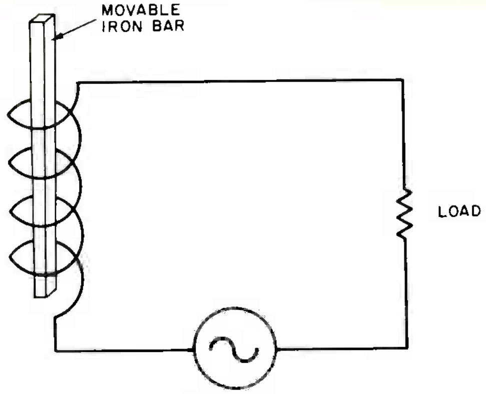


FIG. 2. How muscle power is converted to electrical power.

voltage is dropped across the coil. As the iron moves out slowly, the voltage starts increasing across the load, since the impedance to current flow is decreasing. Simply by moving the bar, we control the power delivered to the load. If the load were a motor capable of several horsepower, by expending very little power in moving the bar we could control a large quantity of power. This is a crude magnetic amplifier.

Let's go one step further. In Fig. 3, we have two windings on a core. One is a control winding and the other is the load winding. Now, instead of the bar, we turn the pot in the control circuit and saturate the core with direct current. As the direct current increases, the core effectiveness decreases, and the coil in the load winding becomes very close to an air core coil which has practically no impedance except the resistance of the wire itself. This device would be an inefficient amplifier since the ampere turns of the control winding must be greater than the ampere turns of the load winding by the number of turns required to saturate the core. We can beat this by using the circuit shown in Fig. 4. A rectifier is added to assist the control winding so we have DC flowing in the load winding as well, aiding in the work required to saturate the core. Accordingly, much less power is required to control the load, so now we have an amplifier that will compete with the tube and transistor. The amplifier in Fig. 4 can be improved upon, since it is basic and only for illustrative purposes.

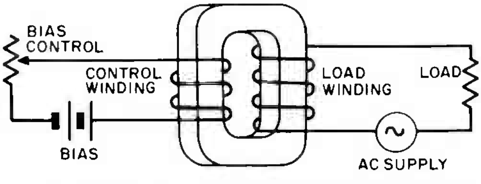


FIG. 3. Saturation of core replaces mechanical movement of bar.

We have faults in our basic amplifier. We can readily point one out by referring to a half wave rectifier power supply. We know that it is inefficient as compared to a full wave or bridge rectifier. Also, because of transformer action, we would get power loss due to that which would be generated back into the control circuit. A look at Fig. 5(A) will readily explain how to overcome these two problems. We now have a high gain, efficient amplifier of practical design. We see, first of all, that we have two windings in the load circuit, wound in an opposing manner. This neutralizes any transformer action, since two waves will appear across the control winding 180 degrees out of phase, and the net voltage will be zero. Another diode rectifier is added, both halves of the cycle are now used and a smoother more efficient waveform is delivered to the load. By adding two more diodes (Fig. 5B), we have power for a DC load.

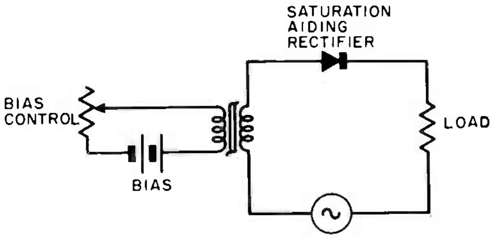


FIG. 4. Rectifier helps saturation.

The need for the two additional diodes points out one basic difference between the mag amp and the tube or transistor. We need an AC supply since we cannot control DC. This can be seen easily since we are really dealing with a choke and we know that DC doesn't care about X_L, (except for sudden current changes); it is only affected by ohmic resistance. With this as a consideration, when using the mag amp as an audio amplifier, the supply frequency should be above the audio range. This limits its use in this capacity, since the generation of a supply frequency in this range is an added task which most applications would not warrant. Now,

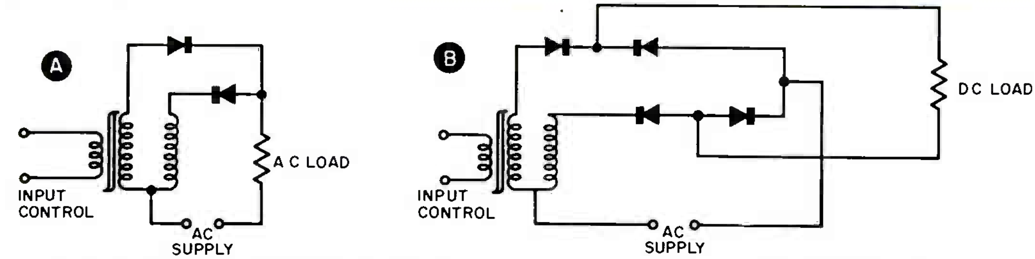


FIG. 5. (A) Opposing windings with 2 diodes improves efficiency. (B) Addition of 2 more diodes converts AC for a DC load.

let's see what the magnetic amplifier can be used for practically.

APPLICATIONS FOR THE MAG AMP

Due to a slow response time, the mag amp promised nothing in the high frequency circuitry fields until cores were developed which increased the response time to a point where megacycle operation was feasible. It has now been used for wave shaping, gating, counting and generation of pulses with rep rates up to 500 kc, but it is still a basically slow device.

Although the transistor has taken the lead in the computer field, the mag amp has been used in flip-flop circuits such as square wave, and in one-shot and free-running multivibrators.

To prove a point, a commercial broadcast receiver manufacturer built a receiver using the mag amp in the RF-IF and audio portions, using a transistor as the oscillator and diodes as detectors. This is not a feasible application, since nothing is gained by the use of the mag amp over the transistor or tube, but it is a point of interest in passing.

The most useful and practical application for the magnetic amplifier is in servo systems. Fig. 6 compares a thyratron controller to a mag amp controller. Here, the advantage is dependability. The mag amp can be depended upon for much longer life than the thyratron, and will give a little more positive control.

Wherever large loads are to be controlled with a minimum of input power expended, you can use the magnetic amplifier.

ADVANTAGES AND DISADVANTAGES

Every device has two sides. Now we'll see the good and bad features of the magnetic amplifier.

Being a transformer type device, they are rugged and their life is usually governed by the kind of rectifier used in their construction. They are stable as far as power supply variations are concerned. Since they have no cathode or

(Continued on Page 28)

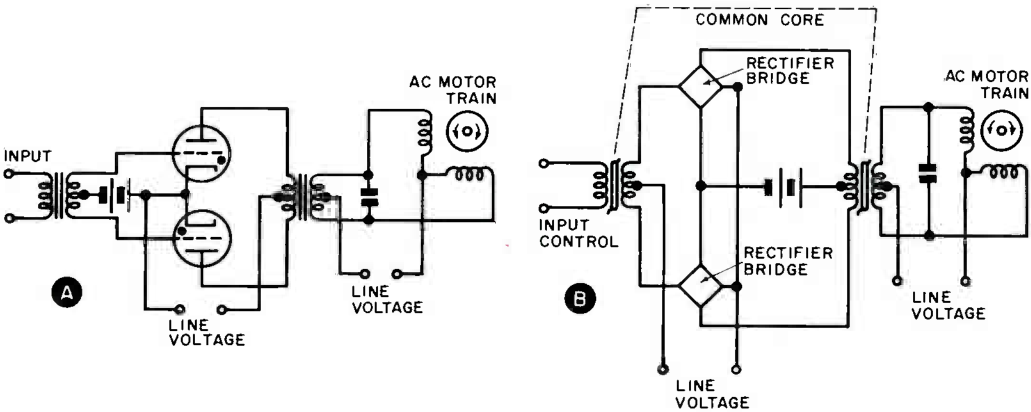


FIG. 6. (A) Conventional thyratron controller. (B) Magnetic amplifier controller.

BUILD THIS

Power Failure/Restoration Alarm

By William L. Blair

Has your boss given you the final warning that, "If you're late once again I'll fire you"? Are you tired of missing important appointments or events? Or do you perhaps own an electric freezer in which a valuable quantity of food might spoil if the power were to be interrupted for a period of time without your being aware of it?

Then you will be interested in this simple alarm system. It will sound off with a gentle "BUZZ" to let you know the next time there is a power failure in your area. Your best electric clock won't kid you into thinking there's plenty of time before you should be on your way. Day or night, this alarm will tell you immediately when there is an interruption in your electric service, and then, with a simple flip of a switch, it will be armed to give another signal when power is restored.

Whether or not you feel that such a gadget might be of value to have around the house, it might prove interesting to see how one could set out to tackle the job of designing a piece of equipment to do a particular thing.

As a starter, it is essential to formulate, mentally at least, just what the problem is. In our present case, it is simply to design a device which will give an audible signal whenever there is a power failure in your particular area. Since the creation of sound suggests the use of some sort of electro-mechanical system, it would be most practical, perhaps, to begin along those lines.

A second consideration is usually economy and availability. With these two in mind, what could be better than an ordinary door buzzer? Since the problem requires the sound in the event of a power failure, it is a necessity that a self-contained energy source be included. That dictates the use of a battery. Now, all that remains is to add a control which will not permit the buzzer to sound as long as power lines are active but which will turn it on in the event of power failure.

Another electro-mechanical device suggests itself. A relay should be just the ticket. Here is a device which makes contact by the application of current and is returned to a normal state (open contact) by spring tension when the current flow ceases. Normally, contacts are provided in many different possible combinations but so far our system requires only one set of contacts which close when the relay is deactivated. One accepted schematic symbol for such a relay, K1, is shown in Fig. 1. The dashed line running through the coil and ending on the pole of the switch signifies that the pole is attracted toward the magnet when current is flowing through the windings.

If a DC voltage is applied to the relay

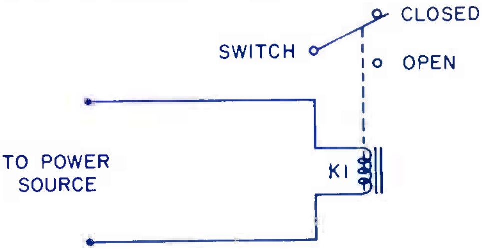


FIG. 1. Schematic representation of a relay.

coil, the resultant current flow creates an electromagnet which attracts the iron in the switch pole. However, our power mains are, for the most part, AC power sources and it will be realized that the current through the coil will successively flow in one direction, drop to zero, flow in the opposite direction, drop to zero, repeating indefinitely at the rate of 60 times per second. This means that, unless something is done to correct it, the switch pole will first be attracted and then be released 120 times per second, and the resultant chattering noise will become very undesirable.

However, something can and has been done to overcome this difficulty. A heavy piece of "D" shaped copper is attached to the core of commercial AC

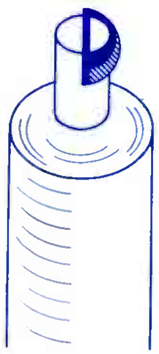


FIG. 2. AC relay magnet showing heavy metal "D" shaped band on one pole end.

electromagnets as shown in Fig. 2. Now, as the field off the end of the magnet core starts to collapse, when the current falls toward zero, the lines of force induce in this loop of heavy wire a current which opposes the collapse. That is, the current is in such a direction as to produce a field which adds to that which is collapsing. The result is that the field off the half pole which is enclosed by the copper loop does not reach zero as soon as the field off the unenclosed half. By the time the lagging field does fall to zero, the other has begun to build up as the coil current flows in the opposite direction. What has been accomplished by this is the creation of some field strength throughout the entire cycle of the current. Thus, the switch is held open as long as voltage is applied. The relay most suitable, then, for our system is one rated for 15V AC so that it may be operated directly from the power lines.

Fig. 3 shows the power failure alarm at its present stage of design. It will be noticed that the buzzer is simply another relay with its switch contacts wired so that it will continually interrupt the current flow through the coil just as the switch pole is pulled toward the magnet. Since no "D" shaped band is fastened to the magnet pole, the buzzer would make plenty of noise on AC even without interruption contacts. However, such contacts are necessary in our case since we intend to operate if from a DC (battery) source. As a side experiment, one could easily make a buzzer from the relay described earlier simply by wiring it similarly to the door buzzer in Fig. 3.

This circuit will do the job we originally set up for it. However, now that we have these parts we can rightly ask if there isn't a way in which the unit could be made more useful. The first thought could be to add a switch so that the unit could be armed to give a signal when power is restored. Obviously, this means that the switch must disconnect the buzzer from the battery and connect it so that it receives power from the power lines when they become activated once again. Here we must remember that door buzzers operate normally on about 6 volts (the size of the battery in Fig. 3). If we were to connect the buzzer directly across the power lines, we could expect about one "buzz" followed by a cloud of smoke!

This means that a 6.3 volt filament transformer, or its equivalent, must be inserted in the circuit between the power lines and the buzzer. A little thought should produce a circuit similar to Fig. 4 to incorporate these additions.

The power failure/restoration alarm is now a reality, on paper at least, but it

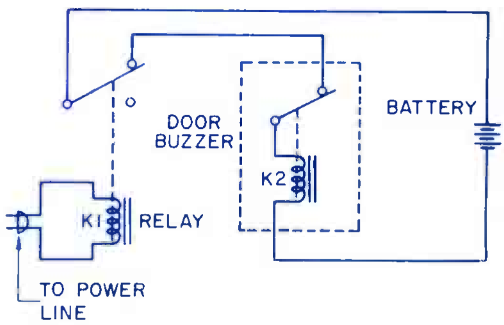


FIG. 3. Preliminary design 1 of the Alarm.

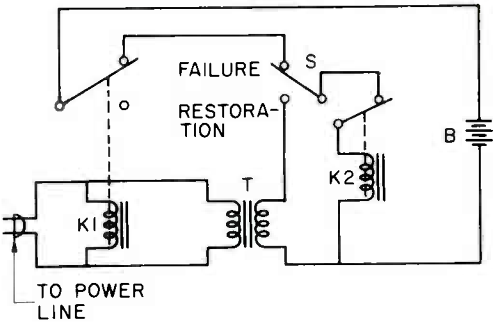


FIG. 4. Preliminary design 2 of the Alarm.

still has a serious fault. If one were to leave it attached to the power mains while away from home, a power failure of more than a few minutes would permit the buzzer to drain the current capacity of the battery completely. Therefore, an "Off" position for switch S would be desirable so that one could easily disarm the buzzer during absence from home. Such already in the circuit, the easiest addition is a 6 volt pilot lamp. Including it in the circuit is not quite as simple, for the schematic in Fig. 4 shows that the relay will return to its initial state as soon as the power is restored. This means that a pilot light would be on before and after a power failure and consequently be of no value toward our desired end.

There is yet a possibility, however. Consider that the relay is not energized until a push button is depressed momentarily. The energized relay then bypasses the push button through its own contacts and remains energized after the push button is released, through its "self-holding" contacts.

Now the alarm is armed initially by a push button but will not be rearmed after a power failure. Fig. 5 shows the changes required and corresponds to the actual

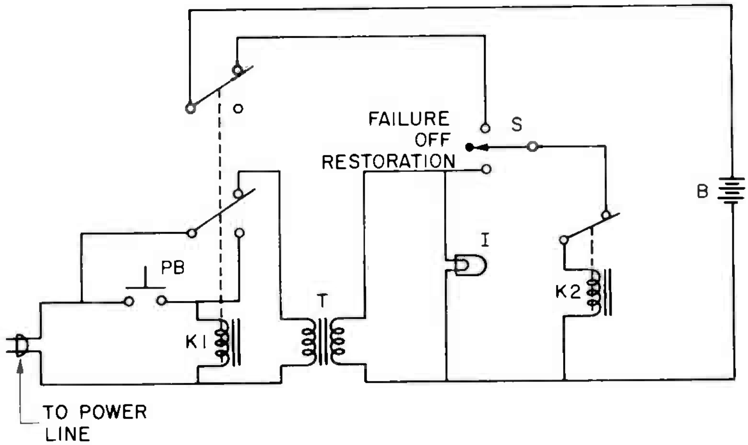


FIG. 5. Final schematic diagram of the Power Failure Restoration Alarm.

PARTS LIST

PB	SPST Push Button, Push to Make	T	Filament Transformer, 6.3 Volt at 1 amp. (Stancor No. P-6134)
K1	DPDT Relay, 115V AC Coil (Potter and Brumfield No. KR11A, SU11A, or 327)	I	Indicator Lamp, 6.3V
K2	6 Volt Door Buzzer	S	Toggle Switch, SPDT, Center Off

B Dry Cell Battery, 1.5 - 6 Volts

switches are available from most radio supply houses as single pole, double throw (SPDT), center "Off" switches. In this case it would be desirable to incorporate an indicating device, preferably silent, which would indicate whether or not power had been off during your absence. Since a 6.3 volt transformer is alarm which was finally built and which is pictured in Fig. 6.

Push button, PB, switch, S, and indicator light, I, are mounted on the front of the box. The relay, K1, and buzzer, K2, are mounted from the top of the box and the

(Continued on Page 35)

AF POWER AMPLIFIERS

A DISCUSSION OF BASIC REQUIREMENTS

BY E. B. BEACH

When audio enthusiasts get together the conversation invariably turns to a discussion of the performance of their stereo systems. What's the response? How much power per channel? What are the distortion ratings?

Notice the concern for POWER, DISTORTION and FREQUENCY RESPONSE. While all components of an audio system determine to some extent its overall distortion and frequency response, it is the power amplifier which is the largest limiting factor in the whole chain. Power amplifiers, or basic amplifiers if you prefer, have for this reason received the most attention of audio design engineers.

In this article we shall investigate briefly the role played by the power amplifier in reproducing high fidelity sound. We shall take a close look at the requirements, both real and imagined, of power amplifiers and see how present circuits meet, or fail to meet, these requirements.

WANTED: HERCULES

At first glance it would appear that what we ask the power amplifier to do would give even Hercules a rough time of it. Here are a few of the jobs assigned to the power amplifier:

1. Raise an electrical signal from a level of .1 vrms - 1 vrms to a high enough level to drive a loudspeaker to full orchestral output (80 - 88 db as measured by a sound level meter).
2. Maintain uniform output over the range of frequencies from 20 cps to 20,000 cps minimum.
3. Introduce no more than 1% total harmonic distortion.
4. Produce less than 1% intermodulation distortion.
5. Deliver electrical power to a complex load that varies in magnitude from less than 16 ohms to well over 800 ohms.

If this isn't a job for Hercules, what is?

POWER Let's take a look at the overall picture of the power amplifier's job rather than at each requirement separately. Since the primary job is that of producing electrical power, we will be dealing with power rather than with voltage and will use db and power rather than volts.

It is generally agreed that about 80 db is the maximum acoustical level required to reproduce loud orchestra passages. This level corresponds to about .4 watt of ACOUSTICAL power. That is, in order to reproduce loud orchestra passages the loudspeaker must deliver .4 watt of sound power. This doesn't sound like a great deal of power, but the loudspeaker, in addition to some other nasty traits, is grossly inefficient in converting electrical power to sound power.

For example, the efficiency of present dynamic speaker systems ranges from 2% to 45% with 4% being about "average". This means that only 4% of the electrical power fed to the loudspeaker is converted to useful sound power. To get the required

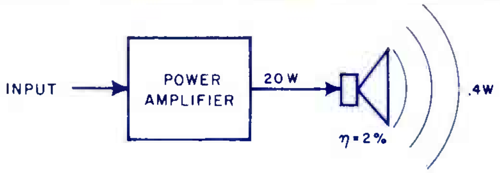


FIG. 1. Power output needed to produce .4 acoustical watt.

minimum of .4 watt of acoustical power, from the 2% efficient loudspeaker would thus require 20 watts of electrical power from the amplifier as shown in Fig. 1.

The signal from the pre-amplifier that drives the power amplifier is usually in the vicinity of .1V to 1V. If the input impedance of the power amplifier is around half a megohm, the power input is .02 microwatt to 2 microwatts for a .1V to 1V input signal. With the assumed output conditions noted above, the amplifier must have a power gain of about 90 db to produce 20 watts from a .02 microwatt input. Even without considering distortion and bandwidth this is a fairly large demand to make of a power amplifier.

Today a power output of 20 watts is considered by many people to be inadequate. WHY it is considered inadequate is anyone's guess. In the average living room, using a low efficiency speaker system, 20 watts will produce enough sound to make even the neighbors uncomfortable.

The argument is put forth in defense of higher power that with multiple speaker installations the extra power is needed to drive the added speakers. However the fact remains that a TOTAL acoustical power of .4 watt is all that is really necessary. This does not mean .4 watt treble power, .4 watt mid-range power and .4 watt bass power, but .4 watt TOTAL power. The mid-range and low range speakers will require the largest amount of power. The treble requires the least. Even considering added losses and lowest efficiency crossovers, not more than 5 or 6 additional watts of electrical power should be needed.

For stereo, the same line of reasoning seems to be used by manufacturers and their customers -- if 20 watts was adequate for monaural high fidelity reproduction, then 40 watts is a minimum for stereo, or 20 watts per channel.

Here again, the TOTAL sound power needed is only .4 watt for comfortable listening. Seldom is one channel of a stereo operated alone, representing full left or full right. Instead there is sound reproduction at all times from both channels. Thus it would seem that rather than needing twice the power, we should be able to get along with half the power (10 watts for each channel) as indicated in Fig. 2.

DISTORTION

The real problem, however, is not how much power to produce, but how to obtain this power without introducing distortion. Large output power calls for large driving voltages and, in developing large drive voltages distortion nearly always is produced.

The two types of distortion of greatest concern are harmonic distortion and intermodulation distortion. Of the two, intermodulation distortion is least tolerated by listeners. Intermodulation distortion occurs when two or more frequencies are mixed in a non-linear circuit producing dissonant beats harmonically unrelated to any of the original frequencies. Fig. 3 shows intermodulation distortion produced when mixing 60 cps and 1000 cps. Tones tend to sound shrill, brassy and strident. The same effect can be noticed when two people attempt to whistle the same tune together. Minor differences in pitch (frequency) mix in your ear (which is non-linear acousti-

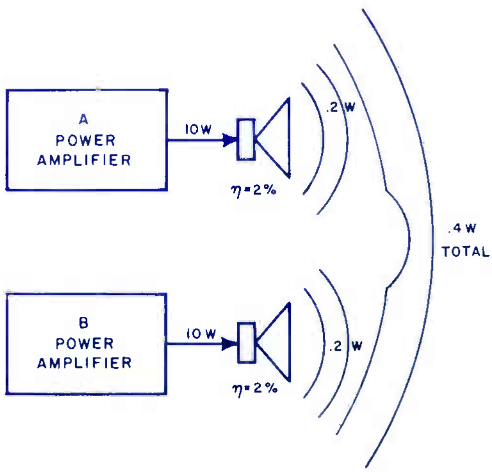


FIG. 2. Stereo acoustical power.

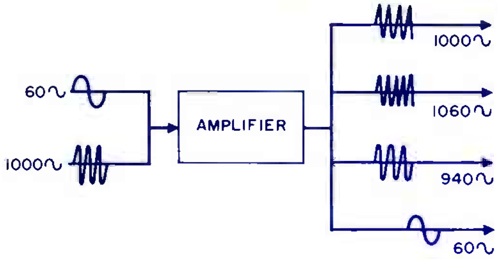


FIG. 3. Intermodulation distortion.

cally) to produce unpleasant intermodulation products.

Harmonic distortion is of two types, even and odd. Again the ear tends to be much more tolerant of even harmonic distortion. In fact, listening tests have shown that as much as 10% even harmonic distortion will go unnoticed by most listeners while 2% odd harmonic distortion is not only noticeable but also objectionable.

The same non-linearity of circuit elements (usually vacuum tubes) that produces intermodulation distortion also produces harmonic distortion. Thus, it would appear reasonable that to keep distortion to a minimum we must have good linearity. Unfortunately, vacuum tube characteristics are inherently non-linear and there is little that can be done about it. Confining operation to small regions of the tube curve will give maximum linearity. However, it would be impossible to develop any power with such operation.

Fortunately there is something that can be done about distortion produced within the power amplifier, as discussed in the next section.

NEGATIVE FEEDBACK

Overall negative feedback can be added to a well designed amplifier to:

(1) reduce distortion generated within the power amplifier
(2) broaden the bandwidth
(3) reduce output impedance.

Unfortunately, too many designers rely on negative feedback as a cure-all for a poorly designed amplifier. When applied judiciously, however, to a well designed stable power amplifier there can be a significant reduction in distortion, gain in bandwidth and reduction in output impedance.

REDUCING DISTORTION

Fig. 4 is a block diagram of a power amplifier. I is the clean input signal and 0 is the output wave that has considerable second harmonic distortion indicated by one peak being flattened and the other peaked. A part of the output, F, exactly out of phase with the input, is added to the input to produce a signal intput I' which is thus "pre-distorted" so the amplifier distorts I' to produce 0', the desired output waveshape.

In theory, if 20 db feedback is applied, the distortion produced in the amplifier will be reduced by a factor of 1/10. For example, if the amplifier had 5% distortion without feedback, 20 db feedback would reduce this figure to .5% - a very reasonable figure.

Everything is not roses, however. 20 db feedback will also reduce the input signal, I', by a factor of 1/10. This means that if we are to obtain 20 watts output we must increase the input voltage 10 times from .1V to 1V. This throws a burden on the pre-amplifier since it must now supply an undistorted signal of 1V instead of .1V to the power amplifier. Calling for this large an increase means the pre-amplifier must be more carefully designed.

STABILITY

The greatest problem with negative feedback is insuring that the feedback signal is truly out of phase with the input signal. At extremely high and extremely low frequencies the power amplifier exhibits

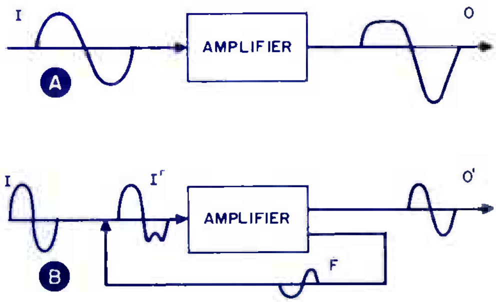


FIG. 4. Amplifier with harmonic distortion (A). Corrected with negative feedback (B).

phase shift which can make the feedback reinforce, rather than cancel distortion at certain frequencies. In this event the amplifier becomes unstable and may break into oscillation, as shown in Fig. 5.

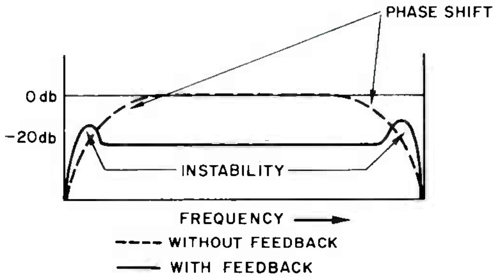


FIG. 5. Effects of feedback.

It is usually necessary to use a frequency selective feedback circuit that will have a phase shift that will exactly cancel the amplifier phase shift. This is sometimes aided by additional phase shifting components added within the amplifier for further stability.

Thus, it would appear that negative feedback, while not a cure-all, can significantly improve a power amplifier if it is used wisely.

AMPLIFIER CIRCUITS

Nearly all vacuum tube amplifiers use push-pull beam tetrodes in the output stage. This arrangement has proven to be the most efficient in producing large amounts of output power, but is not always the best when it comes to considerations of distortion. However, most designers prefer push-pull beam tetrodes and rely on feedback to bring distortion within bounds.

Push-pull circuits are preferred because:

1. Even harmonic distortion cancels
2. More power output is possible than with the same tubes operated in parallel
3. Low frequency response is improved because of higher available inductance of output transformer primary winding.

This is not to say that single-ended circuits cannot be used in high fidelity amplifiers. Indeed, low cost, low power circuits using single-ended output (such as CONAR 300) are used that have good per-

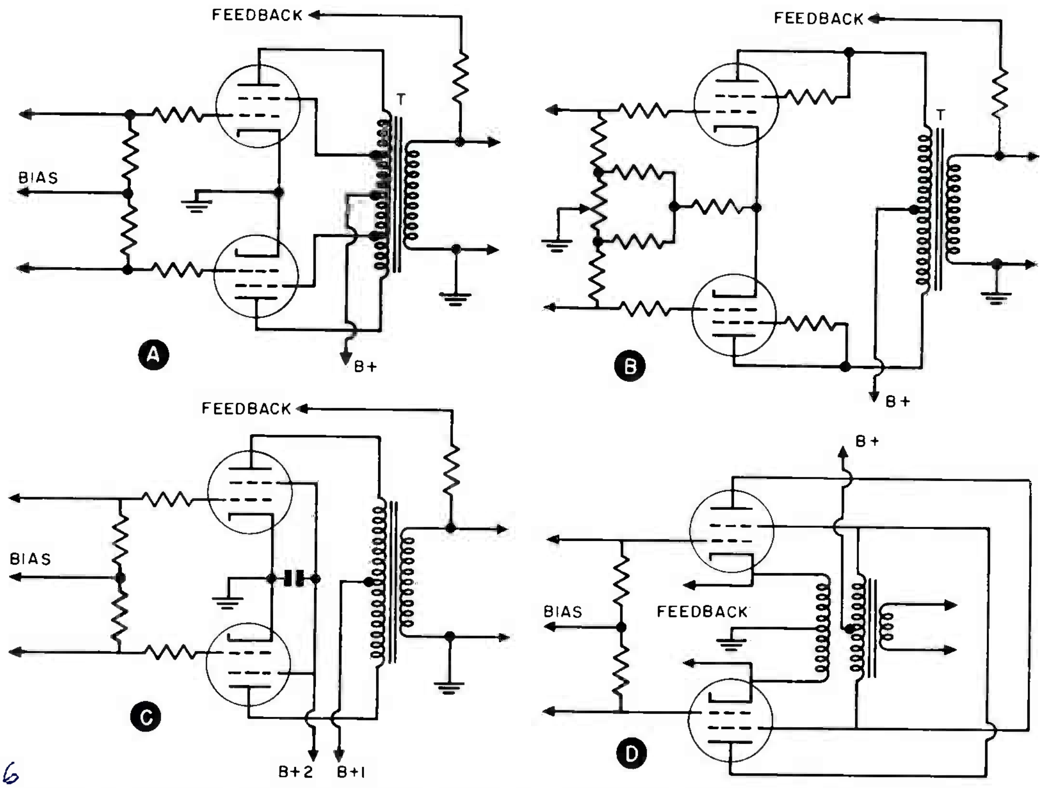


FIG. 6. Ultra linear, (A), Williamson, (B), Pentode, (C), and McIntosh, (D), output stages.

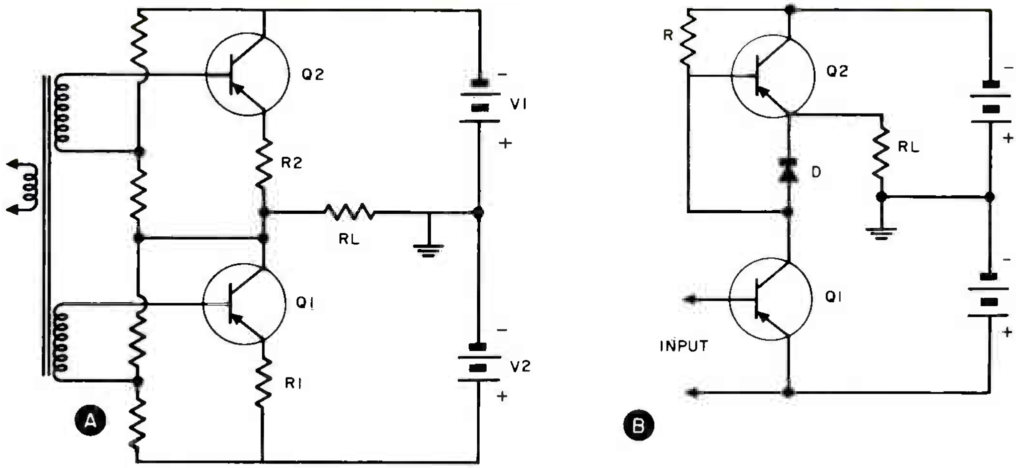


FIG. 7. Symmetrical, (A), and non-symmetrical, (B), transistor output stages.

formance. This is possible, however, only because new tube types have been developed and core materials are now available that provide good response from output transformers.

OUTPUT STAGE

Nearly all power output stages operate two tubes in push-pull class AB. Transistor amplifiers use a bridge arrangement that operates class B or extended class AB. All power amplifiers use some degree of overall negative feedback for performance improvement. Starting from this point let's look at some typical output stages.

Fig. 6 shows the four most common output stages. 6A is the Ultra Linear or tapped-screen circuit. 6B is the triode Williamson configuration. 6C is a straight pentode circuit and 6D is the McIntosh unity-coupled circuit.

Nearly all modern amplifiers use the straight pentode circuit of 6C or the tapped screen circuit of 6A. The reason for this, especially in stereo, is one of simple economy. These circuits are by far the simplest to design and build and can provide considerable output power with little input. At the same time, overall negative feedback is added to provide better performance. Either fixed bias (in high power circuits) or cathode bias (for low and medium power circuits) may be used with either of these circuits.

The Williamson amplifier has by far the best performance of any of the simple circuits. However, it has fallen into relative disfavor since it requires rather large driving voltages and with present tube types can supply only relatively low power output (20W). It is still, however, one of the best SOUNDING amplifiers.

The McIntosh circuit operates class B and can supply upwards of 50 watts of good clean audio power using ordinary 6L6 tubes. The cross-coupled screen circuits provide a measure of positive feedback to raise power output while the bifilar wound split primary winding in the cathode circuits supplies a large amount of local negative feedback to smooth out the response.

Fig. 7 shows two representative transistor circuits. 7A is the more conservative single ended push-pull arrangement while 7B is a rather unusual very high power output circuit.

Notice that 7A is a symmetrical circuit that uses a driver transformer but no output transformer. The driver transformer serves two functions. First, it supplies a small amount of needed gain. Second, it allows each transistor to be driven correctly between base and emitter. R1 and R2 are positive temperature coefficient resistors used as stabilizing resistors as well as fuses in the event of an accidental short circuit of the output terminals. Well-regulated supply voltages must be used, especially when two amplifiers are powered by one supply, since the power supplies form one half of the output bridge circuit.

(Continued on Page 27)

UHF - Coming On Strong!

THE REBIRTH OF THE UHF SPECTRUM MAY REVOLUTIONIZE AMERICA'S TV VIEWING HABITS

BY LON CANTOR

Would you like to see better and more varied TV programming? So would the Federal Communications Commission. Cognizant of the fact that some major United States cities have only one TV channel and many only two, the Federal Communications Commission has moved decisively to insure that more TV channels come on the air.

There is virtually no more room for needed new channels in the VHF spectrum. Therefore, the Commission feels that the answer is UHF. Yet, UHF has seldom been able to compete successfully with VHF, simply because most people do not have TV sets capable of receiving UHF. To solve this problem, The Federal Government has passed a law requiring that all TV receivers manufactured after 1964 be equipped with UHF tuners.

Enactment of this law has already caused a tremendous upsurge in UHF. New channels are rushing on the air. Because there is so much more room in UHF, channels can operate to meet the needs of minority groups.

Channel 41 in Texas and Channel 34 in Los Angeles are excellent examples of ethnic programming. They fill the needs of the Spanish-speaking populations of these areas, showing bull-fights, Spanish dances, musicals and even soap operas.

Channel 14 in Washington, D. C. caters exclusively to the Negro population, featuring top Negro stars. A group of Texans is attempting to establish a network of UHF channels serving businessmen with daytime stock reports and other business information. Channel 31 in New York City meets a variety of minority-group needs, from doctor and firemen training, to programs directed toward rehabilitation of the handicapped, to complete UN coverage.

UHF is also ideal for educational and religious purposes. The giant MPATI (Midwest Program on Airborne Television Instruction) program covers six states over UHF Channels 72 and 76. And there are already ground-based UHF

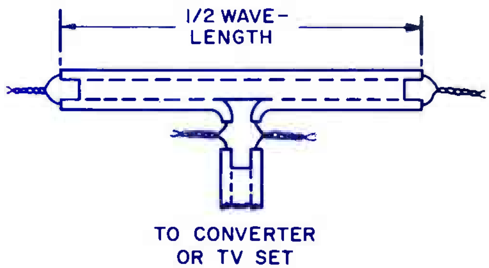


FIG. 1. Indoor UHF antenna made of 300 ohm twinlead. Half wavelength at center of UHF spectrum is about 8-1/2 inches long.

ETV channels in 17 of the 50 states. Religious UHF channels are operating in Michigan and Virginia, with a channel in Massachusetts soon to come on the air.

HOW DO UHF AND VHF DIFFER?

VHF includes channels 2 through 13, covering frequencies from 54 megacycles to 216 megacycles. There are 70 UHF channels, 14 through 53, covering 470 megacycles through 890 megacycles. Each channel occupies a 6 mc band. The 70 UHF channels run consecutively, with no gaps or guard bands in between.

Since the lowest UHF channel is telecast at more than twice the frequency of the highest VHF channel, there are marked differences in propagation problems. Because higher frequencies refuse to follow the curvature of the earth, UHF is more limited to line of sight distances than VHF. Also, UHF signals tend to be more easily absorbed by hills, buildings and other obstacles. Yet in New York City, probably the worst possible area for UHF, the FCC found that UHF reception was not significantly inferior to VHF.

Outdoors, the median signal measured at Channel 31 was 98 dbu (0 dbu is equal to 1000 microvolts of signal across 75 ohms). The median signal measured at Channel 2 was only 91 dbu. Indoors, however, the Channel 31 signal was reduced to 71 dbu compared with 73 dbu at Channel 2. This is because "building losses" are higher at UHF, pointing out the need for more outdoor antennas.

UHF has been found to have several marked superiorities over VHF. The most important is that it is far less susceptible to man-made noises, such as electric razors, motors, etc. Most of these devices generate frequencies that fall into the VHF band, but leave the UHF spectrum clear.

HOW TO RECEIVE UHF

Within about 30 miles of the transmitter, UHF acts pretty much like VHF. For areas less than 15 miles out, an ordinary VHF rabbit ear generally does the job. Slightly farther away, a special indoor UHF antenna may be required. What's the difference between a UHF and a VHF antenna? Primarily, size. Because UHF frequencies are higher, wave lengths are shorter, therefore UHF antennas can be considerably smaller.

A number of indoor UHF antennas have recently appeared on the market, but it's a simple matter to make your own.

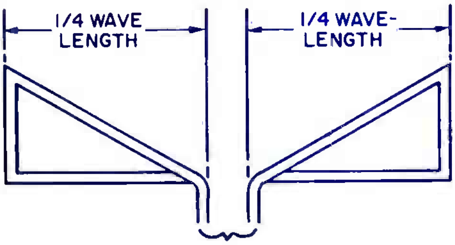


FIG. 2. Indoor UHF antenna made of No. 14 wire.

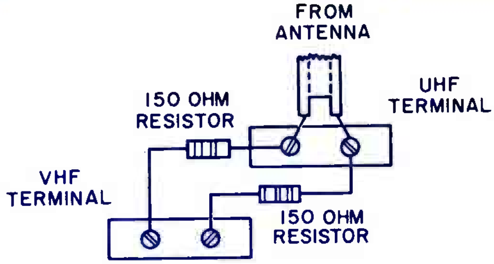


FIG. 3. Two 150 ohm resistors used to split UHF/VHF signals.

Just remember that the wavelength of the center of the UHF band is 17.4 inches long. ($\lambda = 3 \times 10^8/.0254$ frequency $= 3 \times 10^8/.0254 \times 650$ mc $= 17.4$ inches)

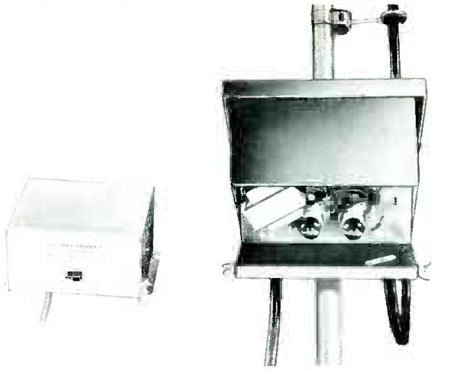
With this in mind, it's easy enough to make the halfwave and quarter-wave sections shown in Figs. 1 and 2 respectively.

Performance of these homemade UHF antennas, or any of the commercial units, is roughly equal to that of VHF rabbit ears. But antenna orientation is even more important. You may find that reception is completely unacceptable with the antenna on top of the TV set, yet get excellent pictures by moving the antenna to another corner of the room. Careful "probing" of the room by moving the antenna about and watching the effect on the picture will often produce pictures far superior to those obtainable over VHF channels using a rabbit ear.

Since "building losses" at UHF are higher than at VHF however, more outdoor antennas will be required. Generally speaking, an outdoor antenna is recommended for any installation more than 20 miles out.

However, your present outdoor VHF antenna will often do a good job for UHF, too. Try it before you invest in a separate UHF antenna. If it works, though, you'll have to find some way of splitting the signal. There are two ways of doing this:

1. Use two 150 ohm resistors as shown in Fig. 3. The disadvantage of this method is that the resistors attenuate the signal and there is no frequency discrimination. Therefore, this is not recommended in weak signal areas.



Courtesy Blonder-Tongue Laboratories, Inc.

FIG. 4. A mast-mounted pre-amplifier.

2. Use a commercial UHF-VHF splitter as shown in Fig. 4. Units of this type are frequency selective, they send only VHF signals to one output, and only UHF signals to the other output. Signal loss is less than one decibel.

Farther away from the UHF station, a separate UHF outdoor antenna will be required. A UHF Double V is the least expensive type (about $4 to $6). Bow-tie antennas with reflectors (about $6 to $8) do a very good job and can be stacked for more gain. UHF yagis are also available (about $15 to $20). For very difficult UHF reception areas, a mast-mounted UHF preamplifier such as that shown in Fig. 4. may be required. These units are rather expensive, but they make all the difference between good pictures and none at all.

UHF CONVERSION

Of the approximately 55 million TV sets

FIG. 5. Typical set mounted UHF converter.

in use today, only about 10% are equipped to receive UHF. People who buy new sets will have no problem, but what about all the other sets? A VHF only set can be converted to receive UHF signals in either of two ways. In some sets, a UHF strip can be inserted in place of an unused VHF channel strip. Generally, this must be done by an experienced technician. Another disadvantage is that this method only equips the set to watch one UHF channel.

A UHF converter, however, such as that shown in Fig. 5, can adapt any TV set to receive all UHF Channels. It simply uses a tunable oscillator to convert the incoming UHF signal to VHF Channel 5 or 6.

TIPS ON INSTALLATION

The biggest difference between a VHF and UHF installation is the lead-in wire. The higher the frequency, the greater the loss

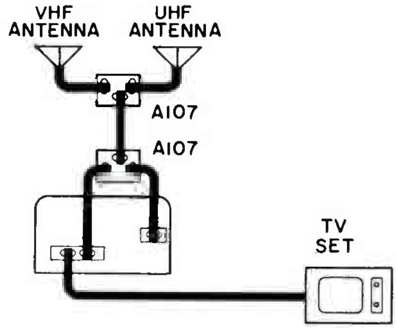


FIG. 6. Two frequency selective couplers used to utilize single downlead.

caused by lead-in wire. At UHF frequencies, this can be a severe problem. Therefore, it is important to use a good lead-in wire and to run it carefully.

Don't use ordinary 300 ohm flat twin lead outdoors for UHF. It works all right when dry, but signal attenuation can increase by up to 6 times when twin lead is wet or dirty.

Hollow tubular twin lead has been used extensively for UHF installation, but if it becomes filled with water, losses can be very high. If you use hollow tubular twin lead be sure to run it so that no ends opening into the hollow center face upward. Also, punch little weep holes where

(Continued on Page 26)

Homemade Connectors for Improved BREADBOARDING

By Elliot McCready

Back in the old days, when vacuum tubes and other moderately high-voltage devices were the stock-in-trade of the experimenter, some sort of chassis or breadboard was a necessity. You just didn't haywire transformers, chokes, filter condensers and tube sockets together. Not if you had any respect for your components and fingers, you didn't. As transistors and other semiconductor

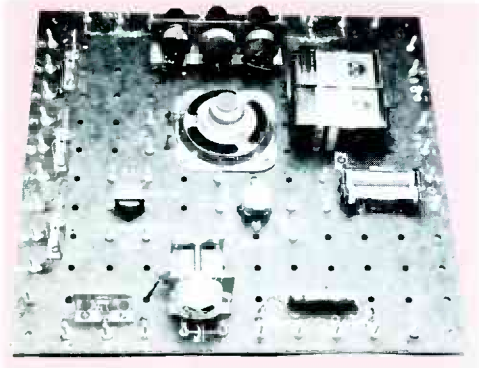


FIG. 1. The completed breadboard.

devices became available I, for one, almost forgot about the breadboard, at least for the simpler circuits. Complex circuitry was built up on those handy little punched phenolic boards that are almost universally available.

The point at which a simple circuit ceases to be simple is rather vague, however, as I discovered recently when I burnt up an expensive tunnel diode - or rather, gravity burnt up this tunnel diode. A precariously-balanced test clip fell and the resulting short circuit pumped several amperes through the diode, effectively converting it to a resistor.

This little tragedy emphasized a basic law of electronics: Any loose wires which can float around and short against other wires will, eventually, do just that.

Now, there are three ways to go about building up an experimental circuit: First, you can haywire the thing together,

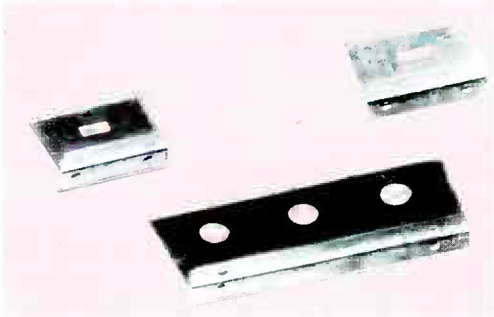


FIG. 2. Aluminum socket and potentiometer brackets.

using test leads and bits of scrap wire. I have determined to avoid this method in the future. Second, you can securely mount and solder all components to a circuit board. This method isn't too feasible because of the time and labor involved in mounting, soldering, and especially unsoldering the parts. Heat damage and lead breakage are also major problems with this method. Third, you can breadboard the circuit. The breadboarding method seemed to me to be the ideal solution, and I remembered seeing a good example not too long ago. It was part of a kit furnished with an extension course put out by Publications and Non-Resident

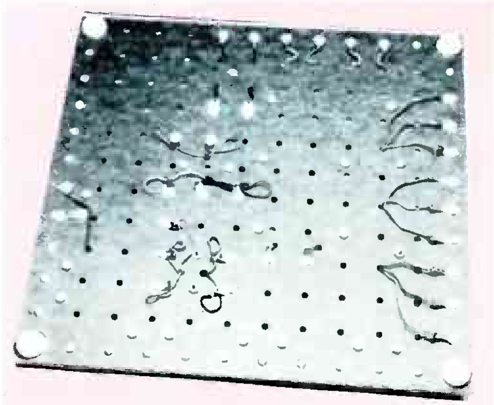


FIG. 3. Underside of breadboard, showing rubber feet and wiring.

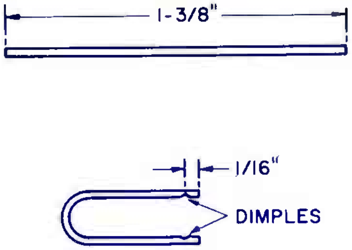


FIG. 4. Construction of the hairpin loop connector.

Instruction Division of the Federal Aviation Agency Training Center at Oklahoma City, Oklahoma.*

This breadboard consisted of a masonite pegboard base upon which all sorts of components were mounted. Connections were made by means of various-length leads terminated in small hairpin loops of wire which snapped securely over plated terminals mounted at the edge of the pegboard base. Resistors, capacitors and diodes, also terminated in these hairpin loops, were furnished, and any number of circuits could be wired almost as fast as one could read the schematic. Best of all, disassembly was accomplished in a matter of seconds, for all leads could be removed from the terminals with a slight tug.

The School advised me that, while they had developed the kit, the wire loops and terminals were supplied by a company which did not sell to individuals. However, they were kind enough to send me some samples which I found could be easily duplicated with tinned hookup wire and ordinary plated bolts.

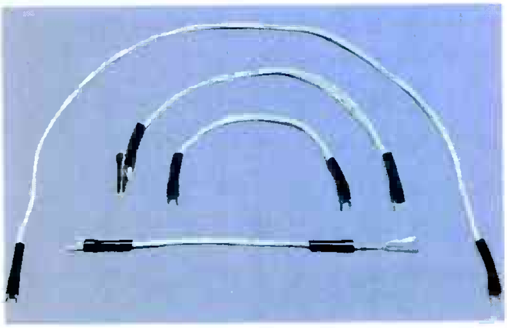


FIG. 5. Various types of connectors, bottom connector with spaghetti stripped back.

*The FAA School provides free extension study courses to many government agencies. If you are a civil service employee, look into it!

Construction

The basic breadboard consists of a 12-inch square piece of 1/8 inch masonite pegboard (Fig. 1) upon which all major components are mounted. The type of work you are interested in will determine the components to be mounted. My breadboard incorporates several transistor sockets and potentiometers mounted on home-made aluminum brackets (Fig. 2), as well as interstage transformers, batteries, a loop antenna and variable capacitor. If you are interested in industrial work you will probably want a relay or two.

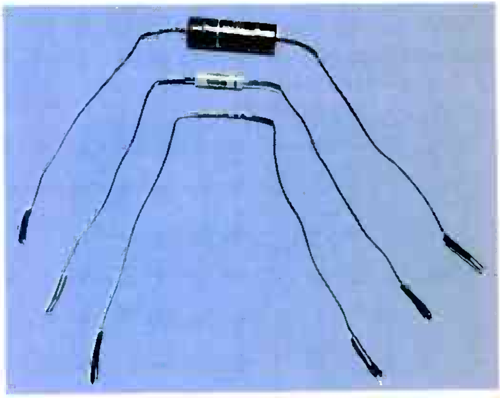


FIG. 6. Capacitors and resistor terminated with leads and loops.

Four rubber feet mounted at each corner of the underside of the pegboard provide clearance for the under-chassis wiring (Fig. 3). The terminals to which all component leads are wired are 3/4 inch 6-32 plated bolts. Mount terminals around the edge of the board and leave a few of them disconnected to serve as tie points. If possible, terminate all components to terminals near the edge of the board, as connections are much more easily made from the outside. A rough schematic of the component, painted between the appropriate terminals (Fig. 1), makes identification of the terminals easy.

Next, make up the connector loops from number 16 tinned copper hookup wire. Straighten a length of wire by stretching it slightly and cut it into 1-3/8 inch lengths. Now bend each length of wire into

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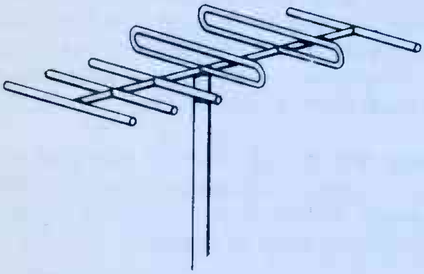
THAR'S GOLD IN THE ATTIC!

ATTIC ANTENNA INSTALLATIONS



By Walter S. Andarlese

The TV serviceman could write a small book listing the various cliches and stock comments continually heard while dealing with his customers over the past fifteen years. Fantastically enough, many of these sayings are repeated almost word for word, although originating from many different and isolated sources. Probably heading the list would be the classic statement invariably heard before the technician could get within two feet of the ailing set: "It must be a tube".

Another gem, frequently expressed during the early years of television, was the customer's prediction: "The old time radios used to need outside aerials and now they're in the sets. It won't be long before televisions have 'em in their cabinets too". No doubt, this was wishful thinking on the customer's part because of the expense and inconvenience involved with outside antenna installations. Admittedly, there are in operation today many favorably situated sets performing with maximum quality on their factory installed cabinet antennas (for example: the simple wire dipoles, metallic bow-ties and others strung within the wooden cabinets or across their backboards). The modern portable TV, too, performs quite well with its single telescopic whip or rabbit ears mounted on top, but a noticeable improvement in overall operation usually results when a higher gain antenna is substituted. It is fairly safe to assume, and increased activity in UHF will insure the assumption, that the remotely installed higher gain antenna will be with us for quite some time to come.

When considering the variety of different antenna setups currently available, their individual merits and their weaknesses, much can be said for the use of attic antennas. In many ways, the attic installed antenna is the next best thing to a cabinet contained antenna (disregarding for the moment, reception quality). Once installed, it is completely hidden and will last almost indefinitely. Add to this its low initial (and often final) cost. Only the antenna lead anchoring the TV set to a fixed location reminds the owner that his set lacks a built-in antenna. With the heavy console or table model, even this limitation is quickly forgotten.

The benefits of attic antenna installation are manifold, for both the customer and the installer. For the customer, the replacement of his weather-beaten outside type is a periodic nuisance. Also, the roof top antenna is no longer a status symbol. Many homeowners feel the outside installation is a lightning and wind hazard. Some housewives consider the indoor "rabbit ears" antenna unsightly for their living rooms and most viewers are constantly annoyed with the "touchiness" of these and other set top antennas, especially in medium and low signal strength areas.

For the installer, if he is an all-around technician, attic installations might represent a flexible "filler" to his normal work load of outside installations, service calls and shop work. Adverse weather and darkness are no barriers. Scheduling for attic installation jobs, unlike chassis servicing, can be safely put off until a time convenient to the installer. The dangers of falling from great heights or accidental contact with nearby power lines which are so inherent in outside installations are also eliminated. Moneywise, many likely customers, possibly unaware of the desirability of having antennas put under the roof, remain a potential source of extra profitable business.

In theory, an antenna designed for outside installation would operate somewhat less efficiently beneath a roof due to its restricted height and the unavoidable proximity of interference radiating house wiring and other objects. However, many innovations and improvements introduced since the beginning of television have almost completely nullified the effects of these disadvantages, even in moderate fringe areas. Increased transmitting power and tower heights have long since been made. Strides made in high gain antenna design and increased tuner sensitivity have been tremendous.

One major obstacle will prevent successful attic antenna installations in some homes. This would be the incompatible construction of the dwelling. For a successful home installation, two requirements must be satisfied. First of all, a location must exist for placement of the antenna. Obviously, this would be the attic, the vacant eaves area next to an attic bedroom, or if no attic exists, possibly the ceiling of an unused room or even the basement ceiling in strong signal areas. Secondly, a feasible method must be available for connecting the remotely situated antenna and the television receiver in its selected location. The most desirable method here would be to keep the twin lead entirely hidden within the walls for its travel to the TV set. The next best method would be the exposed placement of the twin lead outside the walls and/or along the baseboards. In this case, a very neat and highly unnoticeable job could be done using the CLEAR type 300 ohm line. Actually, a combination of hidden and exposed wiring might work out well. A least desirable method would be to bring the twin lead out through a vent in the attic and run it down the outside of the house, using conventional standoff insulators, to a wall or window feed-thru located near the TV set inside. Doing this would partially defeat the advantages of having an inside antenna as deterioration of the lead would necessitate its replacement from time to time.

Using the two previously mentioned requirements as a guide, a prospective attic antenna job could be classified in one of the following three ways:

1. Impossible

   (no attic space or possible antenna location of any kind available, a house built of reinforced concrete, or any factor that would render a proposed installation futile).

2. Time consuming but profitable.

3. Fast and highly profitable.

As an example of how a few basic ideas and techniques can be coupled with modern home construction to yield results in the third category above, the following procedure will be described in detail. It depicts a working and highly profitable method of antenna installation procedure that is currently being utilized by the author. Although it does not cover every possible aspect in the realm of various high profit techniques in use today, its specific hints and ideas should prove helpful in many different situations.

Houses such as the ranch type, Cape Cod, and others of similar construction are unique in that they usually have an unimproved attic above, and a basement or crawl-space below the main living area. This type of design readily permits the easy placement of the TV antenna in the unoccupied attic and the quick hidden placement of the 300 ohm twin lead going to the TV set. No time consuming "fishing" of the twin lead inside the walls between attic and basement is usually

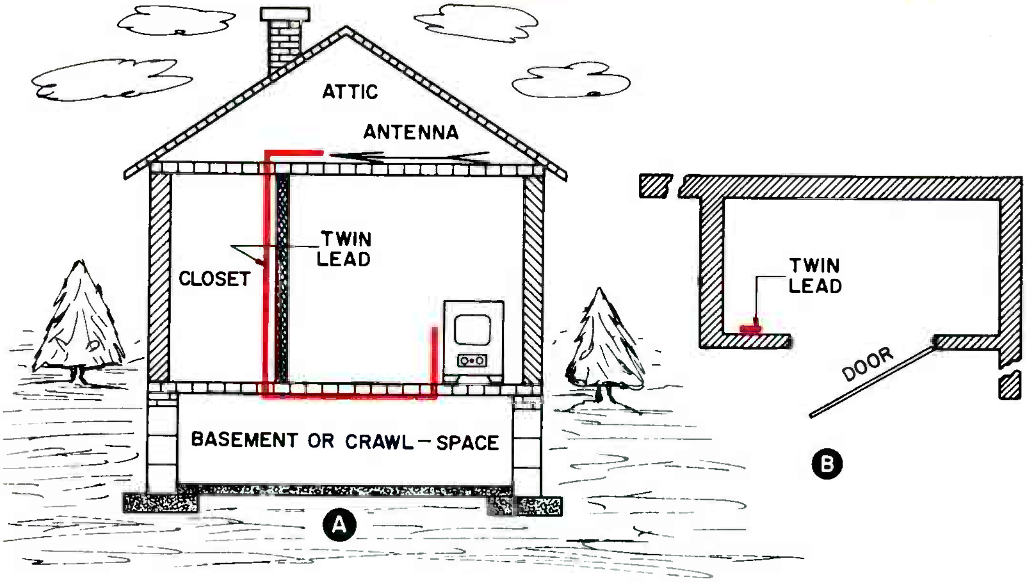


FIG. 1. A, Bringing the lead down to the TV set. B, Top view of closet.

necessary. The trick of getting the lead secretly from the attic to the television set down below is due to the advantageous construction of the CLOTHES CLOSETS in these homes. The diagrams, Fig. 1, show how a tiny rectangular hole (made by drilling two adjacent 1/4" holes) in the closet ceiling and another in the closet floor will permit easy travel for the twin lead as it leaves the attic. The wire hides BEHIND the narrow FORWARD WALL of the closet, enters the basement and follows along or across the basement ceiling joists to an area just beneath the TV set (the set can be located in practically any desired room in the house). A third hole in the floor behind the set permits final connection to the set above.

Certain split-level homes and virtually any other type having the attic-closet-basement arrangement described are equally adaptable to this rapid mode of installation.

Cape Cod dwellings will often have their attics "finished-off" with an extra bedroom. Usually, ample space remains under the otherwise unusable side eaves for easy antenna placement.

In some localities, the aforementioned homes are built on concrete slabs (with the elimination of the basement or crawl-space). Also, some that have basements might have their ceilings covered over. This is a minor problem if the set is to be located in a room with an attic topped closet. A small exposed hole in the baseboard just outside the closet will will permit entry for the lead and its neatly tacked placement along the baseboard to a point immediately behind the TV set. As previously mentioned, clear twin lead can be used here to reduce its conspicuousness.

Two story homes with an attic above, can also employ the above technique on the second floor.

As for the antenna itself, many of the (flat lying) outdoor types do an equally fine job in the attic. The conventional "double-vee" is flat, offers good gain, and can be purchased in quantity for under $2.00 apiece. The more expensive but higher gain types can be profitably employed in weak signal or fringe areas if necessary. The three dimensional antenna designs, such as the conical, do not lie flat. They can also be used if mounted on a pole (a sawed-off broomstick, for example) suspended from the rafters.

The pricing of the job centers mainly around the cost of the antenna itself. Unlike the outside roof installation, the only other components required are 40 feet or less of 300 ohm twin lead (which would not run over a dollar) and a few pennies worth of insulated tacks for lead dressing. One fixed price could safely be advertised. A typical careful installation could be performed by one man in an hour and a half or in less than half that time by two men. Using the "double-vee" as suggested above could result in a profit of $12.00 (before labor costs) when a standard charge of only $15.00 is quoted!

Perhaps the actual procurement of installation jobs is the most difficult phase of the whole operation. It will be found that most jobs can be secured by the technician on his routine home TV service calls. If he keeps a watchful eye on his visits for a likely customer, a friendly and informal sales message can result in numerous job orders. As many set owners are not aware of the benefits of owning attic antennas, other forms of advertising might bring in little response. A housing development having a preponderance of ramblers, Cape Cods, or splits however, offers many possibilities.

The only tools required (in addition to those found in the standard TV repair kit) are the following:

- 1/4" electric drill (with drill assortment.
- 12 foot extension cord
- 110V extension or "trouble" light

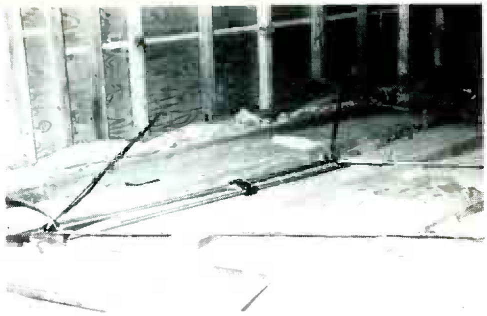


FIG. 2. The assembled antenna need only be oriented.

- carpenter's hammer
- (on occasion) 6 foot step ladder (the customer usually has one) for ceiling attic entrances

One last but important bit of advice. When gingerly stepping about in the customer's attic, the installer must make doubly sure that he steps squarely, each time, on a ceiling joist. A worthwhile accessory tool for the installer (for kneeling or sitting while assembling, connecting up, orientating the antenna) would be a 35 inch length of 1" × 12" board (see Fig. 2). This board would be so placed as to straddle the joists. Failure of the installer to place all of his weight on this board and/or the joists might wipe out the profits of more than one job. BE CAREFUL not to put your foot through the customer's ceiling as it won't hold your weight!

UHF (Cont. from P. 20)
the cable bends and at its lowest point to allow any water that does get in to escape.

The best type of wire for UHF, however, is the new heavy duty polyfoam type, such as Belden 8325, Amphenol 214-105, or RCA 933014.

You can run UHF lead-in much as you would VHF lead-in, but there are lot of important don'ts:

DON'T tape the lead-in wire to the mast. Use insulated standoffs.

DON'T crimp the standoff around the lead-in.

Use the type of standoff that does not encircle the lead with metal.

DON'T run cable parallel to or close to any metal.

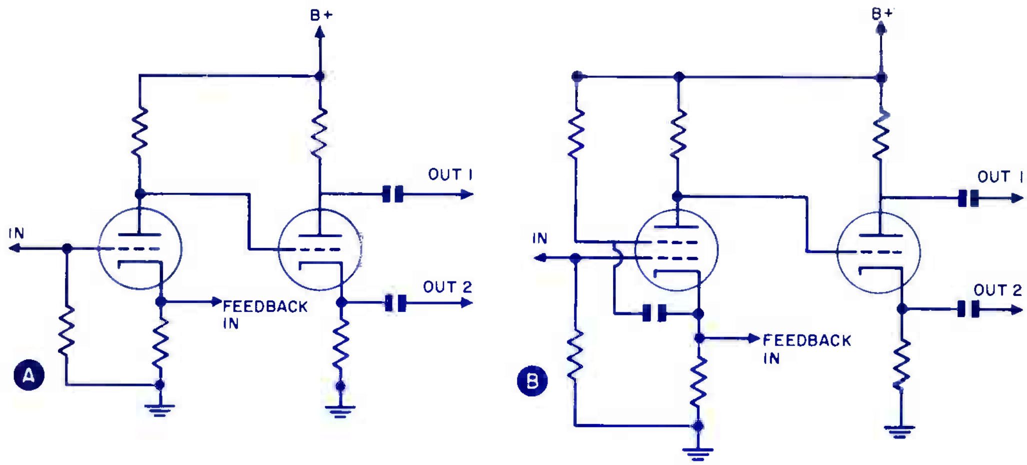
DON'T splice the cable.

DON'T make the cable any longer than necessary.

DON'T leave a coil of cable behind the TV.

If you are using two separate outdoor antennas, one for UHF and one for VHF, you may still prefer to use a single lead-in cable. This can be done with two of the UHF to VHF couplers as shown in Fig. 6. One coupler combines the UHF and VHF signals into a single line, and the other splits the signals to separate the lines again.

A UHF installation is different from, but not necessarily more difficult than, a VHF installation. And in time, UHF will definitely increase the variety and perhaps even the quality of our TV fare.



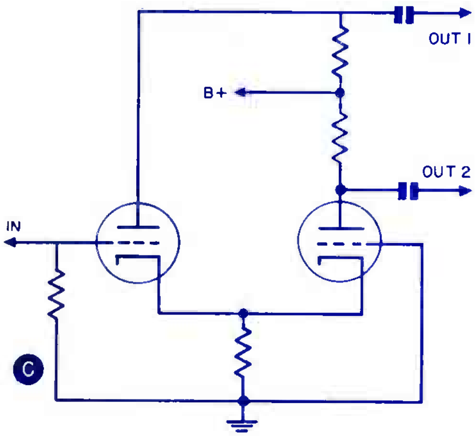


FIG. 8. Phase inverters. Dual triode, split load (A); pentode-triode split load (B); cathode coupled (C).

Fig. 7B is an unusual arrangement and is very non-symmetrical. Notice that only the lower transistor receives an input signal from the driver stage. The diode D conducts when Q1 is driven negative and Q2 is cut off because of the emitter voltage developed across RL. When the input swings positive, Q1 is cutoff and D stops conducting. Q2 becomes forward biased by R and passes current through RL. With this arrangement none of the positive input waveshape controls the current of Q2 through RL which causes considerable distortion since Q2 is merely turned on and off. However, by using negative feedback in the amount of 70 db this extreme distortion is brought somewhat within reason.

While it would seem at first glance that transistors would be ideally suited for the low impedance, high power output stage, in truth they find more application in the low level pre-amplifier stages. This is mainly because of the delicacy required in handling power circuits to guard against damaging transients, sustained high frequency input and short circuit output conditions.

DRIVERS

The remainder of power amplifier circuitry is taken up with driver circuits and power supplies. The latter are in all ways conventional and straight forward except when high power class AB amplifiers are used that demand electronic regulation of both the high voltage and bias supplies.

Vacuum tube drivers most commonly used are shown in Fig. 8. 8A shows a triode amplifier directly coupled to a split-load phase inverter. This circuit is popular where only moderate push-pull output voltages are needed. The circuit of 8B is used where additional gain is required.

Another popular arrangement is the cathode-coupled phase inverter of 8C. This phase inverter is not self-balancing as are the circuits of 8A and 8B and may require additional amplification to drive large power tubes to full output.

While there are many other driver and power output circuits, these cited above account for the majority of the presently used circuits. Table I gives a comparison of the several amplifiers discussed above.

CIRCUIT	SINEWAVE POWER OUTPUT	%TOTAL HARMONIC DISTORTION	%INTER-MODULATION DISTORTION	FREQUENCY RESPONSE
6A	25W	0.9	0.82	20-20KC ± 1.5DB
6B	14W	0.045	0.35	10-20KC ± .2DB
6C	30W	1.4	3.0	20-20KC ± 1.5DB
6D	50W	0.3	0.6	20-30KC ± 0DB
7A	20W	1.0	2.0	20-20KC ± 1.0DB
7B	80W	N/A	N/A	15-45KC ± .1DB

TABLE I. Performance of typical power amplifiers.

MAG AMPS (Cont. from P. 9)
junction to be bothered by temperature changes, they are affected very little by heat. An overload can be carried as easily as an equivalent transformer would handle it.

The mag amp has greater efficiency with equivalent gain than vacuum tube circuits. Also, there is definite isolation between the input and output circuits, very little possibility of interaction between input and output exists.

The device can be hermetically sealed and can become an integral part of the equipment; this adds to the ruggedness of the mag amp. Also, for most applications, they are relatively small for the power they can handle.

These are a few of the things in favor of the mag amp, now let's look at the bad features.

The mag amp will always be limited by time constant as compared to the tube or transistor. It will always shoulder the muscle jobs while the other two do the fast work. We can say that the device is frequency limited, due to core and winding effects as suffered in all transformer devices.

The size of the unit as compared to the transistor is large and the cost is greater, but if one sacrifices cost for durability, the mag amp will still outshine the vacuum tube in many applications.

SUMMING UP

You won't find the mag amp in a television set or a hi fi, but you can expect to bump into the fellow if you have any dealings in the radar or control fields. You can find a close relative in the newer sweep generators using an Increductor in the sweep circuit. When you go to a movie and the lights dim slowly, that's a saturable reactor doing the job.

The magnetic amplifier definitely has its place in the family of control valve devices. Although you may never use one or have the opportunity to work with one, it's nice to know that they do exist and are working for us every day in this increasing age of automation.

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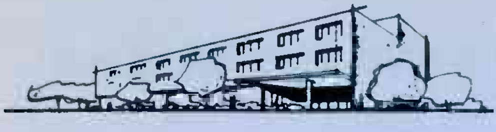
NRI ALUMNI NEWS



DETROIT CHAPTER considered it an evening well spent to repair the amplifier system for St. Andrews Hall where its meetings are held. Just prior to this, many of the members attended a demonstration of FM stereo and color TV servicing given by the Hickok Test Instrument Company and the Radio-Specialties Company, a local electronic supplier.

Earl Oliver brought in a new type miniature Sincore oscilloscope and John Karpolski an old Raytheorn television set that was giving him trouble in the horizontal oscillator circuits. Between waveform readings and voltage readings with the new scope, Oliver and Karpolski discovered and repaired the trouble in about an hour. The Chapter has had several such demonstrations recently and the members thoroughly enjoy them.

On the next meeting night, instead of holding the regular meeting, members toured the transmitter of Radio Station WJR at Riverview (with studios in Detroit). This is a 50,000-watt clear channel AM station. The tour was conducted by Mr. Robert Steiger, Engineer on duty, who pointed out many of the things it takes to operate a transmitter of this type. Chapter members are indebted to Mr. Steiger for such a fascinating and enlightening tour, also to Mr. Ross Calloway, Director of Public Relations, and Mr. Andrew Friedenthal, Chief Engineer.

FLINT (SAGINAW VALLEY) CHAPTER at one meeting concentrated on FM stereo and multiplex. Chairman Andy Jobbagy introduced three different FM stereo sets with built-in multiplex units and compared them with other sets. Henry Hubbard then introduced his Sweet Sixteen speaker which he built himself and compared it with other types of speakers.

The subsequent meeting was devoted entirely to trouble shooting. There were two sets, a Muntz television receiver and an RCA table radio, which were really puzzlers. These kept the members busy the whole evening.

The Chapter members were guests at the Philco Technirama 63 program at Saginaw. Philco demonstrated the newest color circuit, also multiplex FM alignment and the latest trouble shooting and repair techniques for printed circuit panels. Quick solution to perplexing Philco service problems were also demonstrated. George Martin won the first door prize, a 3-inch Philco oscilloscope.

Following are the new officers for the current year: Andrew Jobbagy, Chairman; Clyde Morrissette, Vice Chairman; Henry Hubbard, Secretary; James Windom, Treasurer; William Jones, Executive Committee on Opportunity, also Information Director; Art Clapp, Sgt. at Arms and Communications Director; Robert Poli, George Martin, Gilbert Harris, Educational Committee; Donald Darbee, Publicity Director; and Paul Crippen, Program Director.

The Chapter is pleased to report three new members: Donald Darbee of Caro, Robert Newell and Kenneth Melbourn from Port Huron. Congratulations, gentlemen!

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER Program Chairman George Fulks gave a demonstration of aligning a TV receiver with a scope and signal generator and marker generator. This demonstration was so extensive and was of such interest that George had to carry it over into the next meeting.

The officers elected to serve the chapter for 1963 are: Francis Lyons, Chairman; Harry Straub, Vice Chairman; Harold Rosenberger, Secretary; Howard Sheeler, Corresponding Secretary and

Treasurer; and George Fulks, Program Chairman. Our best wishes to these officers!

LOS ANGELES CHAPTER last winter planned for this summer to use some slides which Chairman Gene DeCaussin prepared to project on to a screen -- showing the various stages of TV circuitry -- for use along with discussions of defects and remedies at meetings. The slides were completed soon thereafter and are now being used to good advantage.

The Chapter recently accepted Joe Whalen and Charles Hall as members. Congratulations to you, gentlemen!

MINNEAPOLIS-ST. PAUL (TWIN CITY) Chapter members were questioned early in the season by John Berka, National President of the NRIAA for 1963, as to what they are interested in and what they have been doing in the past year in radio and television. As a result of this questioning the Chapter leaders are in a better position to plan talks, demonstrations and other programs for the next season beginning in the fall.

The newly elected officers for the year are Paul Donatell, Chairman; Walt Berbee, Vice-Chairman; John Babcock, Secretary; George Dixon, Treasurer; and Melvin Menk, Sergeant at Arms. The new officers were inducted into office by Ted Rose, Executive Secretary of the NRIAA, on the occasion of his annual visit to the Chapter together with Mr. J. B. Straughn, NRI Chief of Consultation Service. A few of the Chapter members entertained the two visitors with dinner at the Lexington Restaurant.

NEW ORLEANS CHAPTER continues to feature its TV "Clinic" at its meetings. The clinic consists of demonstrating television receivers' ills, diagnosing them and finding short cuts to repairing them.

The Chapter has been pleased recently to welcome four new members. They are Frank Ryder, Harold Williams, and Henry Carter, all of the New Orleans area, and Howard Ragland, of Raceland. National Headquarters bids you welcome to the Chapter, gentlemen!

The Chapter would like to take this opportunity to mention that students and graduates from other towns and cities near New Orleans will be welcomed at the meetings, as in the case of Howard Ragland.

NEW YORK CITY CHAPTER'S Joseph Orsini and Alvah Bonham brought in two defunct TV sets for analysis and repair. The sets were examined and restored to order under the direction of Chairman Spitzer, assisted by Jim Eaddy, Aracelio Nieves, and Joseph Orsini. The program resulted in some very instructive sessions in diagnosing TV troubles as they appear on the screen of the Chapter's rigged set. This gives an excellent opportunity for discussion by all members regarding the symptoms likely to be shown on the screen for a given ailment, and the best method for pinpointing the problem.

Through Albert Bimstein the Chapter purchased a Mercury Tube Testing Adapter to test all the latest tubes on the Chapter's old tester, which has also been updated with a new chart.

Three new members have been admitted: Wilfred Grant, Arieh Soherman, and Christian Wyntuin. Welcome to the Chapter, gentlemen.

A number of discussions have been held on such matters as how to establish oneself with jobbers as a professional, and the pros and cons of a licensing law for radio-TV technicians.

Jim Eaddy has added something more to the list of things that make him invaluable to the Chapter by starting a series of talks on the use of the oscilloscope as a measuring instrument, signal tracer and troubleshooter. He is being assisted in this project by Secretary Joe Bradley.

PHILADELPHIA-CAMDEN CHAPTER members were again guests of the General Electric Company at what GE labelled "An Evening Of Electronic Service Training." This evening was arranged exclusively for members of the Chapter. GE's George Reid, District Manager, Products Service, and George Walker, Specialist, Products Service, conducted the meeting at the GE auditorium. The guests received the very latest information on circuitry design and troubleshooting procedures on GE television, color television, and hi-fi sets. Door prizes and literature were furnished the members as well as a tasty buffet supper. This was only one of several such evenings that GE has held for the Chapter. The members are always very enthusiastic about them and attendance at these evenings are understandably high.

As we go to press, Bill Heath of Westinghouse was scheduled as a guest speaker at a forthcoming meeting. He is also highly favored by the members and is, in fact, an honorary member of the Chapter.

Unusual as it may seem, the Chapter reports only one new member at this time. He is Edwin Gifford of Bridgeton, N. J. Glad to number you among the membership, Ed!

PITTSBURGH CHAPTER at one meeting featured a question-and-answer session conducted by Chairman Tom Schnader. Discussions of this kind, in which so many of the members take part, are always fruitful.

At the next meeting Howard Tate and Bill Lundy gave an excellent demonstration on how to use an oscilloscope. Many of the members at the meeting remarked that they saw things done with a scope that they had never before thought could be done.

The newest member to join the Chapter is Harry Stewart. Welcome, Harry!

SAN ANTONIO ALAMO CHAPTER admitted two new members to its ranks. They are Adolph Herrera and Anastacio Lerma. Our congratulations to you, gentlemen!

Chapter member John Noll delivered a talk on tuner repair and Jess DeLao on horizontal section servicing.

When a special speaker is not scheduled for a meeting, the Chapter usually holds a general discussion about some phase of radio-television servicing. This is popular with the members, who feel they always gain a lot of useful information from these discussions and exchanges of experiences.

SAN FRANCISCO CHAPTER members were enthusiastic about a presentation and demonstration by Art Ragsdale. His subject was AGC circuits. Art went so thoroughly into the subject and the members were so interested in it that he had to devote two meetings to the topic. At the first meeting Art demonstrated the general nature of AGC systems and the principles on which they operate. He illustrated his talk with blackboard schematic diagrams of a simple AGC system in a TV receiver. He used a signal generator and the picture tube for troubleshooting through the rf and i-f circuits. At the second meeting he drew block diagrams of AGC circuits, basic type, amplified type and keyed AGC system. He stressed the importance of feedback in the three circuits. These talks and demonstrations by Art Ragsdale are always popular with the members.

Another member of the Chapter, Ross Alexander, delivered an excellent talk on the vacuum tube voltmeter. He based his discussion on the article "Servicing The Vacuum Tube Voltmeter" by Andrew Belski of the NRI Staff, which appeared in the December-January issue of the NRI News.

Since the last report of new members four more have been accepted for membership: Harold Jenkins, Glenn Totten, Eusebio Ramirez, and Ramiro Barragan. These gentlemen are very welcome.

SOUTHEASTERN MASSACHUSETTS CHAPTER members made a searching and critical examination into the Chapter's programs. As a result, the majority of the members voted to continue with the present type of program in which a TV set is brought in with an unusual fault or "tough dog" and the members, led by two volunteers, use various methods to find the trouble. It was the consensus of opinion that most members seemed to derive the greatest help and practical benefit from this type of program.

The latest member to join the Chapter is Jacintho Vieira. A warm welcome to you, Jacintho!

SPRINGFIELD (MASS.) CHAPTER reports that attendance at its meetings has shown an increase of 25% since the beginning of 1963. This is a real worthwhile achievement.

The feature at two meetings was John Parks' demonstration of how to use the scope in repairing a TV receiver. During the demonstration he used his Model 250 Oscilloscope that he purchased in kit form from NRI.

TEACHERS WANTED . . . . to assist NRI with counsel and guidance in a new program of in-school instruction in electronics. If you are an NRI graduate who is presently teaching industrial or vocational arts in a school system we want to hear from you. Please write to Mr. Dale R. Fox, Director of Information, NRI, 3939 Wisconsin Ave., N. W., Washington 16, D. C. and let him know who you are and where you are teaching. Mr. Fox has a 'thank you' gift for your time and trouble.

Directory of Local Chapters

Local chapters of the NRI Alumni Association cordially welcome visits from all NRI students and graduates as guests or prospective members. For more information contact the Chairman of the chapter you would like to visit or consider joining.

CHICAGO CHAPTER meets 8:00 P.M., 2nd and 4th Wednesday of each month, 666 Lake Shore Dr., West Entrance, 33rd Floor, Chicago. Chairman: Frank Dominski, 2646 W. Potomac, Chicago, Ill.

DETROIT CHAPTER meets 8:00 P.M., 2nd and 4th Friday of each month. St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Mich., VI-1-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 8:00 P.M., 2nd Wednesday of each month at Chairman Andrew Jobbagy's Shop, G-5507 S. Saginaw Rd., Flint, Mich., OW 46773.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER meets 7:30 P.M., 2nd Thursday of each month at the YMCA in Hagerstown, Md. Chairman: Francis Lyons, 2239 Beverly Dr., Hagerstown, Md. Reg 9-8280.

LOS ANGELES CHAPTER meets 8:00 P.M., 2nd and last Saturday of each month, 5938 Sunset Blvd., L. A. Chairman: Eugene DeCaussin, 5870 Franklin Ave., Apt. 203, Hollywood, Calif., HO 5-2356.

MINNEAPOLIS-ST. PAUL (TWIN CITIES) CHAPTER meets 8:00 P.M., 2nd Thursday of each month, Walt Berbee's Radio-TV Shop, 915 St. Clair St., St. Paul. Chairman: Paul Donatell, 1645 Sherwood Ave., St. Paul, Minn., PR 4-6495.

NEW ORLEANS CHAPTER meets 8:00 P.M., 2nd Tuesday of each month at Galjour's TV, 809 N. Broad St., New Orleans, La. Chairman: Herman Blackford, 5301 Tchoupitoulas St., New Orleans, La.

NEW YORK CITY CHAPTER meets 8:30 P.M., 1st and 3rd Thursday of each month, St. Marks Community Center, 12 St. Marks Pl., New York City. Chairman: David Spitzer, 2052 81st St., Brooklyn, N.Y., CL 6-6564.

PHILADELPHIA-CAMDEN CHAPTER meets 8:00 P.M., 2nd and 4th Monday of each month, K of C Hall, Tulip and Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore Ave., Philadelphia, Pa.

PITTSBURGH CHAPTER meets 8:00 P.M., 1st Thursday of each month, 436 Forbes Ave., Pittsburgh. Chairman: Thomas Schnader, RD 3, Irwin, Pa., 731-8327.

SAN ANTONIO ALAMO CHAPTER meets 7:30 P.M. 3rd Tuesday of each month, Sam Stinebaugh's TV Shop, 318 Early Trail, San Antonio, GE 3-3188. Chairman: Jesse De Lao, 606 Knotty Knoll, San Antonio, Texas.

SAN FRANCISCO CHAPTER meets 8:00 P.M., 1st Wednesday of each month, 147 Albion St., San Francisco. Chairman: Peter Salvotti, 2534 Great Hwy., San Francisco, Calif.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8:00 P.M., last Wednesday of each month, home of John Alves, 57 Allen Blvd., Swansea, Mass. Chairman: James Donnelly, 30 Lyon St., Fall River, Mass. OS 2-5371.

SPRINGFIELD (MASS.) CHAPTER meets 7:00 P.M., 1st and 3rd Saturday of each month at shop of Norman Charest, 74 Redfern St., Springfield, Mass. Chairman: Steven Chomyn, Powder Mill Rd., Southwich, Mass.

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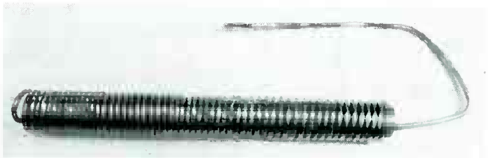
BREADBOARDING (Cont. from P. 22)

a hairpin loop using a nail a little smaller than a 6-32 bolt as a pivot. Next, move the nail so it is gripped about 1/16 of an inch from the open end of the loop and compress the wire and nail in a vise until two small dimples are left on the inside of the loop (Fig. 4). Remove the nail, straighten the ends of the wire, if necessary, and adjust the size of the loop so it will grip a 6-32 bolt. There is enough spring in the wire so the loop may be attached and removed from the terminals any number of times without losing tension.

Now make up your connectors in various lengths as shown in Fig. 5. Most connectors are terminated in a hairpin loop at each end with a short length of spaghetti slipped over the upper end of the loop as shown. Make up a few connectors with a loop at one end and a miniature alligator clip at the other; this type of connector is handy for connecting odd components into the circuit. Finally, terminate a number of standard-size capacitors, resistors, diodes and whatever other components you desire with leads and loops (Fig. 6).

I have used this breadboard for some time now and have found it to be just about the handiest item on the bench. Any variety of circuits can be set up quickly and safely, and disassembled in a very short time. Also, each terminal will accomodate up to four connectors, which cannot be said for a lot of the more readily available terminals and connectors.

A HANDY SOLDER DISPENSER



By coiling a length of solder on a piece of 3/8 inch diameter thin walled metal tubing, and threading the free end of the coil through one side to the other as shown above, a very handy solder holder can be made. The solder is always available and more can be had simply by pulling on the free end. The tube is also a convenient holder while soldering. I. M.

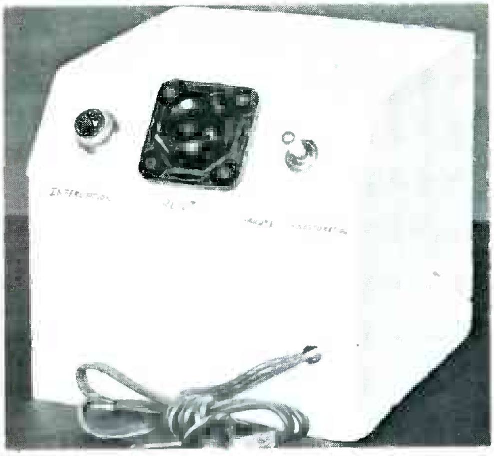


FIG. 6. Front view of the POWER FAILURE/ RESTORATION ALARM.

filament transformer, T, on the side so that battery, B, fits easily beneath the other parts. The battery shown is 4-1/2 volts, but even a single 1-1/2 volt size D flashlight cell will work equally well. In fact, the buzzer gives out a much more gentle sound at the lower voltage and might be more desirable as a night alarm! It is wise to test the battery under load at least once a month by disconnecting the line cord momentarily and noting the buzzer activity, so that you will be certain of an alarm when a true power failure occurs.

Operation of the alarm is simple. Set switch, S, in the "Off" position, plug in the power cord, depress the push button, PB, and throw S to "Failure". The unit is now set to sound the buzzer any time the power is interrupted. In the event of such an interruption, simply throw S to "Restoration" and the unit is now set to indicate audibly when the power is on again. If you are leaving your home, throw S to "Off" and when you return if the indicator light is out, all is well, but if it is on, better check your electric clocks, refrigerator and freezer, for the power has been off sometime while you were away.

Designing the alarm was't difficult, was it? Then, next time you hear someone say, "I wish they would make a gadget to....", why not take a crack at design? You might even come up with an idea that "pays off"!

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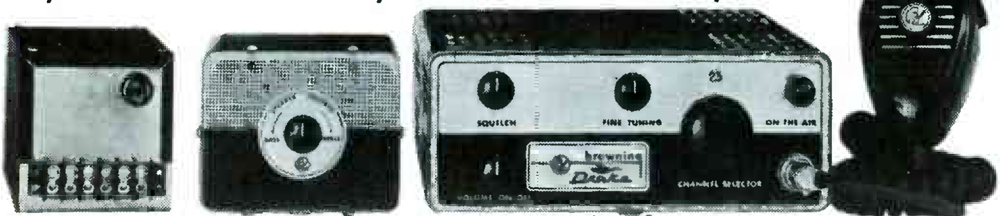

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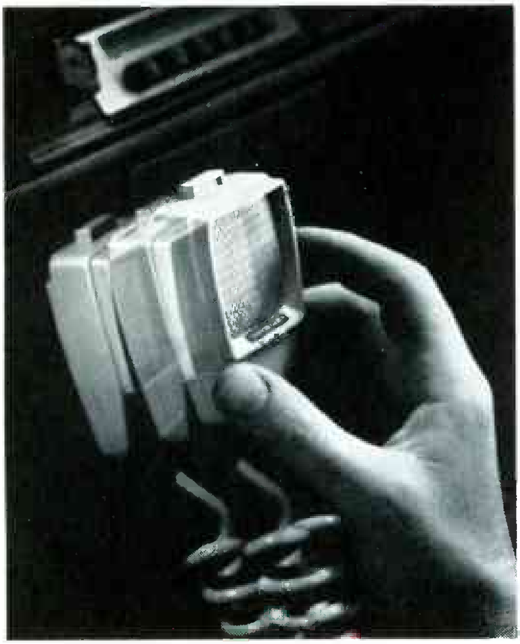

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Responsible for this boon to those who rely on CB or mobile communication, from car or truck, is an important Sonotone development called "Magnet Mount." A heavy duty magnet on the back of Sonotone Ceramike mobile communications Models "CM-30M" and "CM-31M" lets you place the mike almost anywhere on or around the dashboard. Further, Magnet Mount eliminates the need to drill holes for dashboard mounting brackets.
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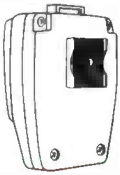

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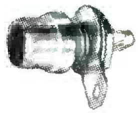

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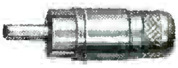

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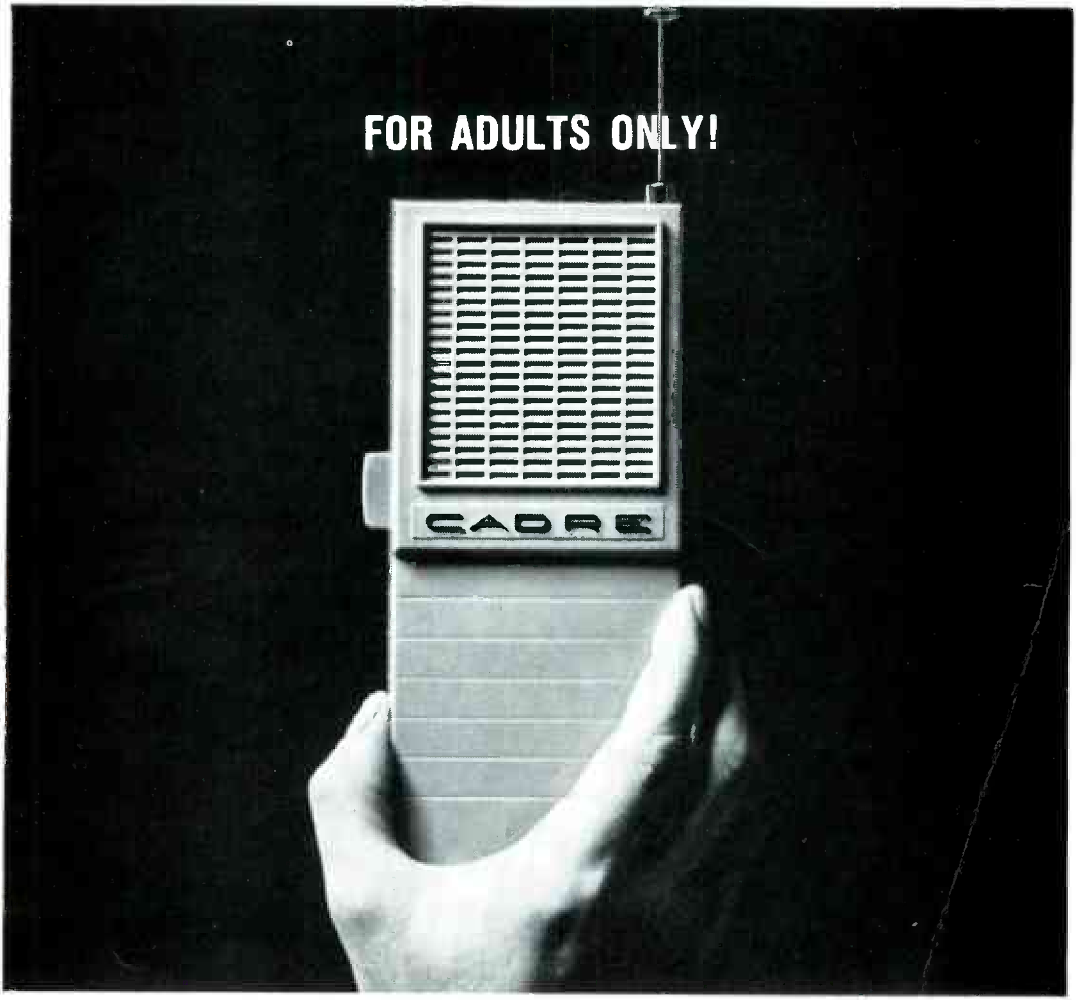

NEW CADRE C-75 CB TRANSCEIVER

The new Cadre C-75 1.5-watt, 2-channel transceiver is 15 times too powerful for youngsters (under 18 years of age) to operate, according to FCC regulations. Clearly, it's not a toy. It's designed for serious CBers who need 'big set' performance that can be used conveniently anywhere.

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The C-75 has all the portable conveniences you'd want, too: operates on alkaline or mercury penlite cells (8-hour rechargeable nickel-cadmium battery available); earphone and antenna jacks; built-in retractable antenna; jack for base operation while recharging.

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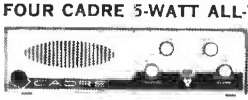

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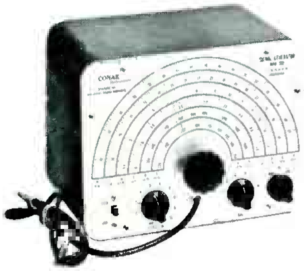

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