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ON OUR COVER

J.B. Straughn, who is otherwise known as "Father" Straughn to hundreds of NRI students and graduates, wears yet another hat and becomes "Father Christmas" for our cover picture, with the reminder that maybe Santa would like a CONAR Kit to work on, too. For other gift suggestions keyed to course status, see "Something For The Girls", on Pages 16-18, and turn to the center-fold insert of your NRI Journal for details and prices. You'll find CONAR order blanks on Pages 17 and 18 of this issue.

The Development of the Vacuum Tube as an Oscillator

If the frequently asked questions are any indicator, the use of the vacuum tube as an oscillator seems to cause undue puzzlement. It is hoped that this article will go a long way toward the clarification of this matter, both for beginners and graduates who like new slants on old circuits.

BY J. B. STRAUGHN

AFTER THE PERFECTION of the three-electrode vacuum-tube amplifier the possibility of generating continuous waves (cw) became apparent. For years it had been possible to produce radio waves that would easily span the distance between widely separated transmitting and receiving antennas. But these radio waves were crude things and the only way to transmit information was to periodically interrupt the transmission into segments. The length of the segment and the repetition rate was used to represent letters in the alphabet. For example, a short burst of transmission followed by a longer one (.-) represented the letter A, and so on. In other words, what we had was a telegraph system without wires; hence the early name "wireless."

However, Bell had already invented the telephone and so the dream of broadcasting words and music without wires dangled like a carrot in front of every experimenter. It was known that the sound pressure changes produced by words and music could be transformed into equivalent electrical variations with a microphone and could be changed back into the original sounds by crude "speakers." These electrical sound signals were found to be ac which varied, both in frequency and amplitude, corresponding to the pitch and loudness of the original sounds. They were given the name "audio," meaning that the frequencies were within the range of human ears.

The signals traveling from transmitter to receiving antenna were far too high to be heard, but it was apparent that if the high frequency signal could be made to carry the audio signal, the audio could be stripped off at the receiver. One way to do this would be to make the carrier vary in strength and in frequency at the audio rate. For example, if we had a 100,000-cycle carrier and a 1000-cycle audio signal we should be able to make the carrier frequency vary 1000 times a second from 101,000 to 999,000 cycles, and also vary in strength just as did the 1000-cycle signal. There was one great big stumbling block. Carrier signals varied all by themselves, both in frequency and amplitude (strength)! This problem was attacked by the American inventor, Armstrong, with the following results:

> What was needed was a carrier whose frequency and amplitude normally remained constant unless purposely varied. At the time most transmitters were of the spark gap type shown in Fig. 1.

In this system, the distance between the elements forming the spark gap is adjusted so the supply voltage is not quite large enough to cause an arc-over or spark. When turned on, C charges through L and energy is stored in the magnetic field around L. When the charging current starts to taper off, the field around L collapses and the resulting voltage

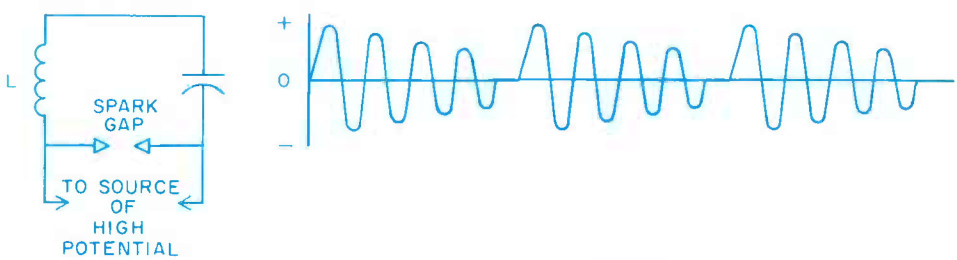

Figure 1.

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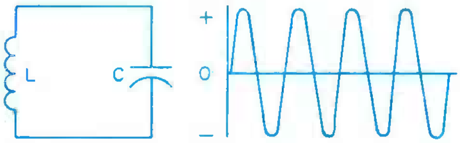

Figure 2.

across L, added to that stored in C, is enough to break down the air in the spark gap. The result is a visual spark and a loud snap. However, the circuit between L and C has been completed and energy is transferred back and forth between the coil and capacitor. A damped wave is formed, as shown, whose amplitude gradually decreases until the spark disappears and then the process is repeated. The frequency roughly is determined by the capacity of C and the inductance of L. A damped wave train (a series of damped waves) of this sort is of no value as a carrier of voice or music. We described it to bring out the important point, that once a resonant circuit starts to oscillate it will continue to do so until all the stored energy is used up in the form of heat. Suppose in the damped wave in Fig. 1 we gave a little extra shove (a burst of energy) right at the top of the first positive cycle and each succeeding half cycle. The circuit would then continue to oscillate. There would be no damping or change in frequency and we would have the desired type of carrier, producing a signal as shown in Fig. 2.

The question remains as to how we will get oscillation started in the resonant circuit and how we will reinforce it. We have the tube which will amplify, and a resonant circuit, as shown in Fig. 3A.

How can we put them together? Let's start out with the resonant circuit in the grid circuit as shown in Fig. 3B.

When we first turn this circuit on we will get a sudden flow of grid current which will start L-C to oscillate and we will have an enlarged duplicate across RL. However, everything then stops because the grid current no longer changes and we have just one damped wave -- not even a train or succession of them! But we do have a larger damped wave across RL. If we could feed some of this signal back to L-C so it would reinforce the damped wave, our problem would be solved.

You will recall from your studies of tubes that if a cathode resistor is used for bias, feedback of amplified signal into the grid-cathode circuit occurs. However, this feedback opposes rather than aids the input signal - exactly opposite to the effect we want.

Speaking of bias, we will need to provide this in the oscillator circuit, because without bias the plate current can get high enough to damage the tube. You will also remember the grid capacitor - grid resistor bias which works from the applied signal, so let's put this in, as shown in Fig. 3C. We expect to get a healthy signal across L-C and this, when rectified by the grid cathode, will take care of the bias. Also, plate current will only flow on the tips of the applied signal, which is just when we need reinforcement. Now, how can we get this current to put back energy into the L-C circuit? One way would be to couple the plate current inductively to L, as shown in Fig. 3D.

We will find that this circuit will oscillate continuously and produce continuous waves across L and C. However, the direction of current flow through L_1 is important. If we reverse the connections at A and B no oscillation will occur because the voltage induced into L from L_1 will oppose rather than aid the oscillation in L-C. The development of the oscillator led almost at once to the broadcasting of speech and music, since it was a simple matter to modulate the high frequency carrier by audio signals and recover the modulation at the receiver. With the advent of the vacuum tube oscillator a rash of inventions resulted in an effort to get around Armstrong's patents. However, the final results showed that signals could be fed back from the output to the input in only two ways, inductively, as described, and electrostatically through a capacitor.

It became apparent at once that a signal fed back from the cathode could serve just as

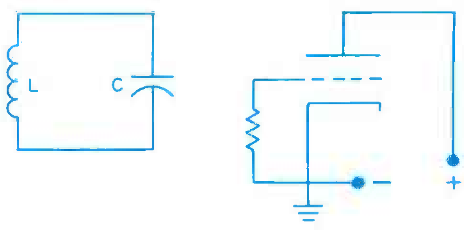

Figure 3A.

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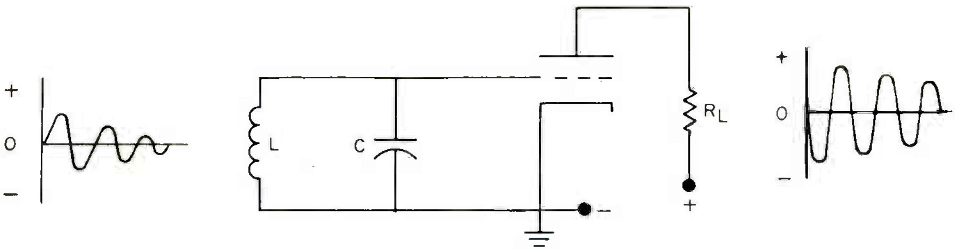

Figure 3B.

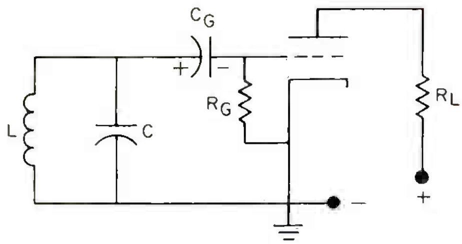

Figure 3C. The polarity of the dc voltage due to grid - cathode rectification is shown across capacitor C_G.

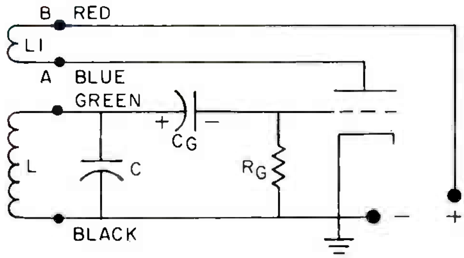

Figure 3D.

well as a signal fed back from the plate. The two circuits are shown for comparison purposes in Fig. 4.

The circuit in Fig. 4B has the two coils connecting to a common ground point (the chassis). This suggests that a center-tapped coil could be used. Let's develop this schematically in Fig. 5.

We do not generally try to show the direction of the windings in a schematic since the coils are wound on the form in the same direction. The manner in which the connections are made is the important thing. In our coil the green and red ends are the finish of the windings, and the blue and black are the start. The connection necessary, as shown at Fig. 5B (A and B are the same) shows that L_2 is connected to be backwards from L_1. Fig. 5B is not too satisfactory since what we want to do is tap the tuned coil. The changed circuit is shown in Fig. 5C. Here L_1 and L_2 are wound in the same direction, unlike Fig. 5B. To get Fig. 5C to work we connect the black and red leads together, making a single continuous coil. This is a less expensive coil to make than the one in Fig. 5A and there are only three terminals. The entire coil is tuned by capacitor C_1.

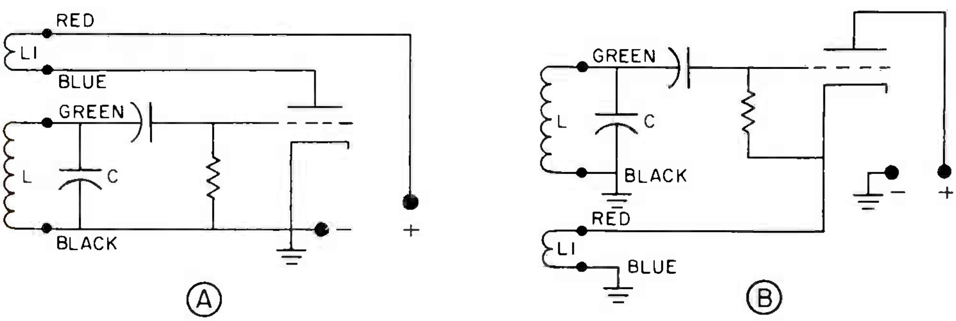

Figure 4. Plate feedback is shown at A; cathode feedback, at B.

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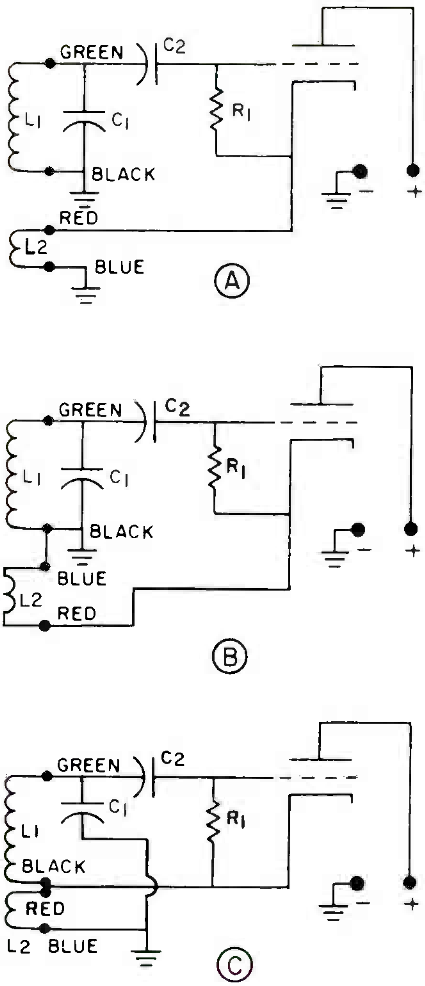

Figure 5.

Instead of coupling the output to the input by means of passing cathode or plate current through a coil inductively coupled to the L-C tank circuit, let's investigate the possibility of feeding back signal voltage from either the plate or cathode into the tank. In the inductive method we used a feedback coil as shown in Fig. 6A or fed the signal through a part of the tank coil, as shown in Fig. 6B. How can we feed a signal back through a capacitor? Let's draw some circuits and look them over.

In Fig. 7A suppose the plate current is increasing. This calls for a positive voltage on the grid. The increase in plate current makes the cathode positive and C_2 charges up to the polarity shown, electrons flowing from ground, through L and into C_2. The end of C_1 connected to C_2 is at the same potential, negative, so electrons flow out of the other side of C_1 and through R_g. This puts a negative voltage on the grid when we wanted a positive voltage so Fig. 7A won't oscillate. Look at Fig. 7B. We know that the signals at the plate and grid are 180° out of phase so any signals fed back here will not produce oscillation. These two circuits are no good for our purpose.

Looking at Figs. 6A and 6B, again we note that we are not feeding the signal to both L and C and that we are feeding it to only a part of L. Since we now want to use capacitive feedback it seems logical to feed the signal to C alone; but how can we do this, since L and C are in parallel? The only thing to do is to use two series-connected capacitors in place of C and feed the signal to the junction of the two capacitors. If C requires a value of 250 μμf for tuning purposes, two 500 μμf capacitors in series would give the desired capacity of 250 μμf. Figs. 7C and 7D show how this may be done.

In Fig. 7C a sudden increase in plate current again calls for a positive grid voltage and again results in a positive cathode. Both C_1 and C_2 charge up, C_1 charging through L slowly. When the plate current increase tends to stop, L discharges into C_1 through C_2. The polarity across C_1 is such that it drives

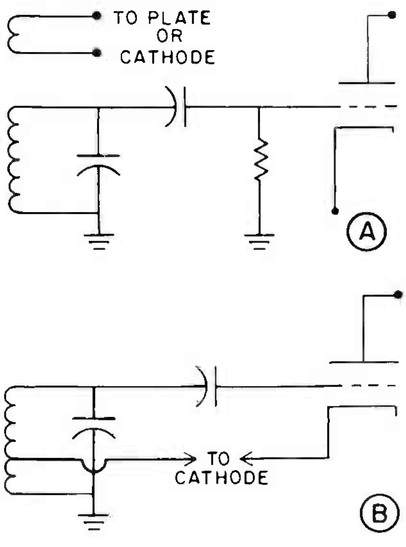

Figure 6.

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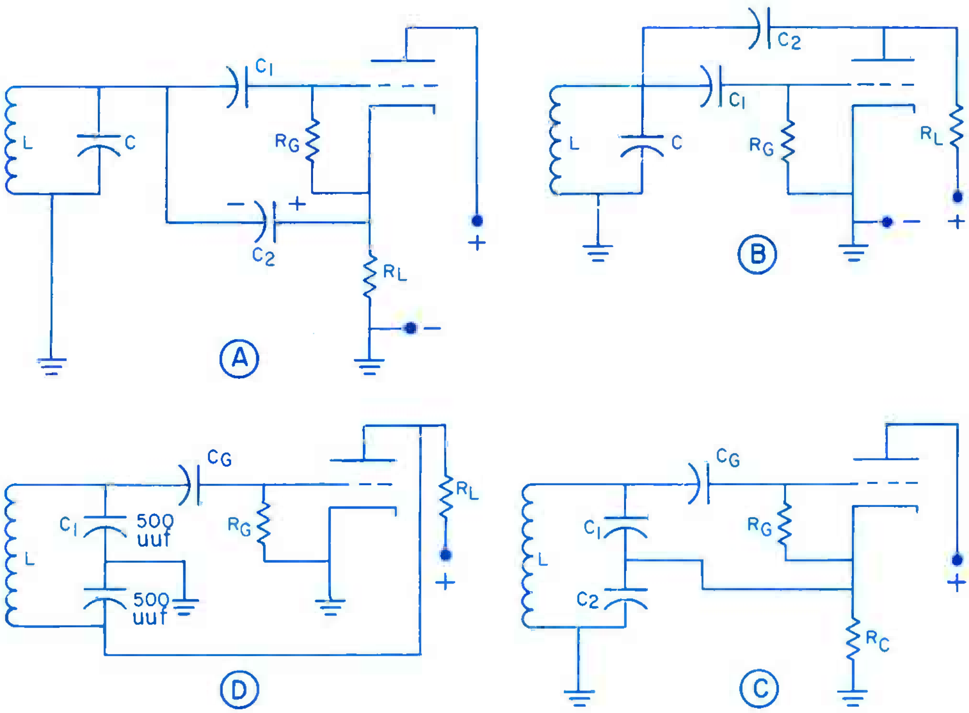

Figure 7.

the grid positive, which is what is needed to sustain oscillation. Note the difference in feedback in Figs. 7C and 7D. This compares to the feedback differences required in Figs. 4A and 4B.

The Multivibrator. In all the oscillator circuits so far considered we have depended on an L-C circuit for frequency determination and to insure the production of a sine wave signal. L-C circuits are always used in trans-

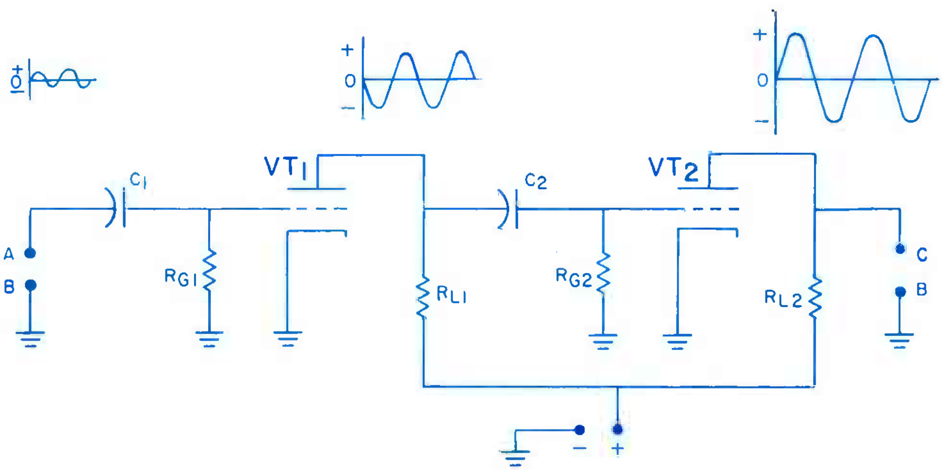

Figure 8.

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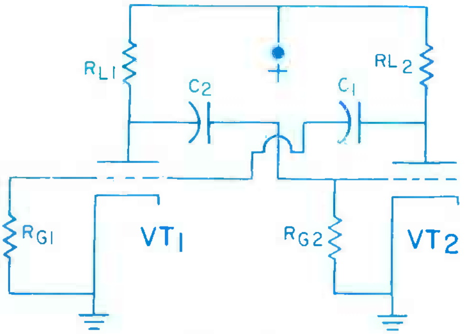

Figure 9.

mitter oscillators and in the oscillators of superheterodyne receivers. Sine waves can be produced without an L-C tank, but the circuit is more complex and more suited for audio rather than rf work. In many cases an odd waveshape such as a pulse, sawtooth, or a square wave may be desired. Then what is referred to as a multivibrator type oscillator is used. The term "multivibrator" means that many signals are produced at the same time, and such is always the case when the output is not a pure sine wave. A sawtooth wave, for example, can be broken down into many signals, the sum of which is the sawtooth. However, technicians are concerned more with the circuit which produces the desired signal rather than a mathematical analysis of the signal.

So far you have learned that for an oscillator to work, energy of the right phase must be fed from the output to the input. Perhaps you have noticed that where a public-address system is used to give coverage to a large gathering, a howl will occur if the volume is turned up too high. This is a form of oscillation because some of the amplified sound signal from the loudspeaker gets back to the microphone. It follows, therefore, that if the output of an amplifier is fed back to the input with the right phase, oscillation will take place.

A typical amplifier is shown in Fig. 8. This is a two-stage amplifier consisting of tubes VT_1 and VT_2. The input is A-B and the output is C-B. Suppose a positive-going signal is fed into A-B. The tube will invert the signal

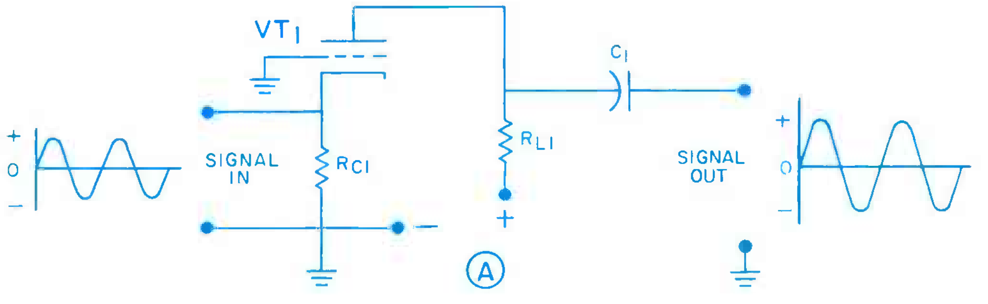

Figure 10A. With the grounded grid circuit there is gain but no phase reversal.

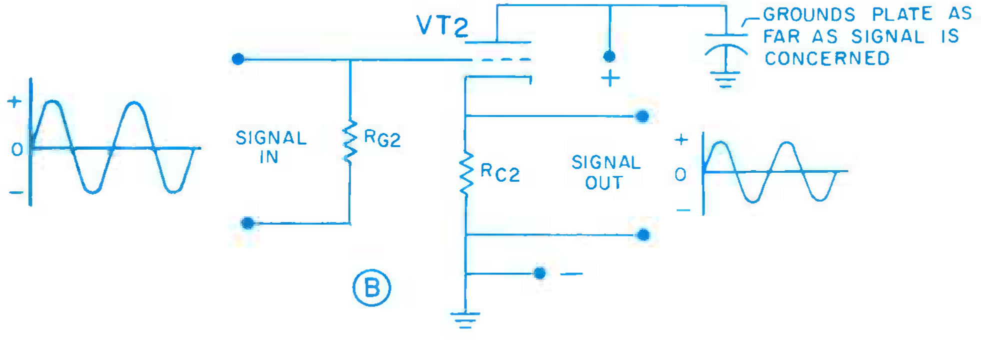

Figure 10B. Grounded plate circuit gives gain less than 1 but with no phase reversal.

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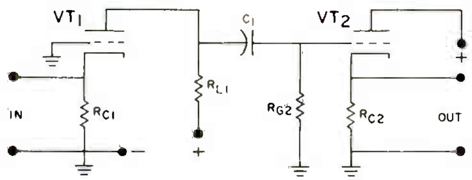

Figure 11. Although the gain of VT_2 is less than 1, the output signal of VT_2 is greater than the input signal of VT_1 because of the gain in VT_1.

and it will be negative-going at the plate of VT_1. This negative-going signal fed to the grid of VT_2 through C_2 will be amplified by VT_2, and at the plate of VT_2 we will have a positive-going signal like that at A-B, only much larger. The phase is right, so if we connect points C and A together, feedback which results in oscillation will occur. Redrawing Fig. 8 as so connected we come up with Fig. 9, a standard plate-coupled multivibrator, which should be familiar from your regular lessons.

The frequency of operation is determined by the length of time it takes C_1 and C_2 to charge and discharge. This is governed not only by their capacity but also by the values of R_{g1} and R_{g2}, as R_{L1} and R_{L2} are too small to have a noticeable effect on the series resistance in either circuit. The signal may be taken off either grid or plate and, by changing the resistor and capacitor values, various wave shapes may be produced.

Looking at Fig. 8 you see that both VT_1 and VT_2 are connected as grounded cathode amplifiers. You know that we also have a grounded grid (Fig. 10A) and grounded plate (Fig. 10B) type amplifiers. Notice in the grounded grid the signal is applied to the cathode and removed from the plate, while in the grounded plate the signal is applied to the grid and is taken from the cathode.

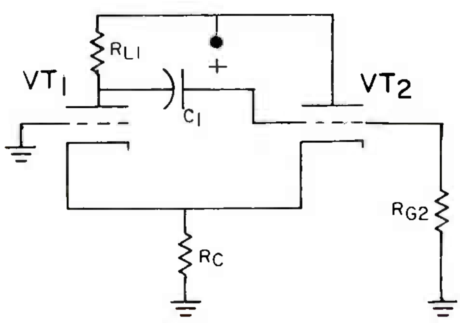

Figure 12. Basic cathode coupled multivibrator. The frequency of operation is determined by C_1 and R_{G2}, R_{L1} being so small compared to R_{G2} as to have little or no effect on the frequency.

Can we connect the input and output of these amplifiers together to form a multivibrator? It is easy to see that C_1 should connect to the grid of VT_2. Also the cathode resistor of VT_1 is its input resistance, while the cathode of VT_2 is its output resistance. Suppose we connect the cathodes together and use a single resistor common to both. First, however, let's look at the amplifiers together as they are in Fig. 11 to see if they are phased right.

If we apply a positive-going signal to R_{C1} a positive signal will be developed at the plate of VT_1 and applied to the grid of VT_2. This

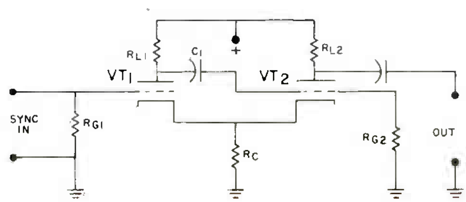

Figure 13. Typical cathode coupled multivibrator found in many electronic devices.

will result in a positive-going signal at the cathode of VT_2, so the output circuit of VT_2 is in phase with the input of VT_1. The circuit will, therefore, work if wired as shown in Fig. 12 and reasonable values are used.

Since a common cathode resistor is used to couple the input of VT_1 to the output of VT_2 the circuit is aptly called a cathode-coupled multivibrator. A more usual version is shown in Fig. 13. The grid resistor of VT_1 is used so pulses may be injected at this point to sync the oscillator with some particular frequency, near its normal frequency. The plate load of VT_2 is provided for signal take-off purposes. However, with either or both R_{g1} and R_{L2} shorted the circuit will oscillate.

It is hoped that the above explanations of some basic oscillator circuits will be helpful to students and of interest to graduates who like to get a new slant on old circuits.

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VIDEO SWEEP MODULATION FOR COLOR ALIGNMENT

By ART WIDMANN

MOST TECHNICIANS ARE AWARE that alignment of a color television receiver is more critical than in a black-and-white receiver. One obvious alignment point is the traps that remove the sound signal from the video. If sound is not properly trapped out, an annoying 920 kc beat pattern is visible in the color picture. Also, you know that the color receiver must have good alignment for use in fringe areas if you expect to get a usable color picture. Poor alignment can also produce color picture defects that are not obviously due to misalignment.

Improper color circuit alignment can result in loss of color, color smear, or incorrect hues. Loss of color or insufficient color due to misalignment is the result of gross misalignment. When you have an adequate station signal, the circuits must be quite far out of alignment to lose color. This condition will almost never develop in a receiver which has been operating normally before failure. Alignment settings just do not drift that much. The trouble is more likely due to a circuit defect.

Color smear and displacement of the color information into the wrong areas in the picture will usually be caused by improper bandwidth of the circuits passing the color signal. Incorrect bandwidth introduces an incorrect time delay that displaces the color information to the wrong areas in the picture.

Conventional sweep-alignment technique will show the passband of the circuits and any apparent errors can be corrected. Bear in mind that circuit defects other than misalignment can cause color smear and color displacement. A shorted delay line and poor high or low frequency response are examples. However, in this article we are concerned only with color alignment problems.

Incorrect hues can be caused by color signal path misalignment. This misalignment may cause a phase shift of some color sidebands producing incorrect hues. Or, portions of the color signal receive incorrect amplification, again producing incorrect hues.

This type of misalignment can be observed by viewing a color bar generator pattern. The trouble shows up as changes of hue within a solid bar of color. For example, a normally blue bar may fade off into red in one part of the bar.

Let's review the process that the color signal goes through in a typical color receiver. This will enable us to point out how misalignment affects the color signal and will show the need for special alignment techniques to align the color receiver.

Much the same effect can be produced by misadjusting fine tuning. If not too pronounced, this kind of misadjustment may go unnoticed while viewing a color program. The quality of the reproduced picture suffers, or the viewer may find trouble getting what he thinks to be correct tint control setting.

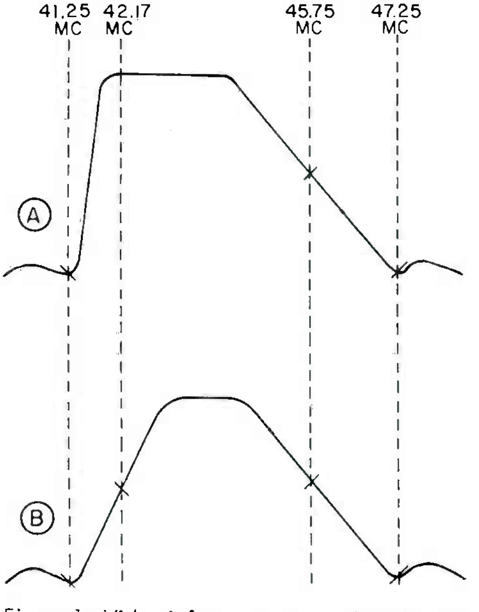

Figure 1. Video i-f response curve for a broadband receiver (A) and for a narrow-band receiver (B).

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As you recall, color information is transmitted on a color subcarrier that lies within the 6mc band of frequencies allotted to the TV station. The color subcarrier signal lies 3.58mc above the picture carrier while the sound carrier lies 4.5mc above the picture carrier. When this rf station signal is converted by the mixer stage in the tuner, the frequencies are inverted. The lineup of the signals in the video i-f amplifier are shown in Fig. 1. The sound carrier is at 41.25mc, the color subcarrier at 42.17mc, while the picture carrier lies at 45.75mc.

Fig. 1A shows the video i-f response curve for a broad-band color TV receiver. Notice that the leading skirt of the response curve rises sharply from the sound trap so that the color subcarrier lies on the flat top of the curve. The color subcarrier sidebands above and below 42.17mc receives equal amplification when passing through this video i-f amplifier. Four or more stages of video i-f are usually required to obtain a response curve like this.

Most modern receivers have a narrow-band i-f response similar to that shown in Fig. 1B. Notice that the color subcarrier lies at about the 50% point on the leading slope of the video i-f response curve. The color subcarrier sidebands above and below 42.17mc will not receive equal amplification in this arrangement. The unequal amplification can be compensated for by shaping the response curve of the color i-f amplifier.

The original 3.58 mc color subcarrier with its sidebands is reconstructed in the video detector. The video i-f color subcarrier (42.17mc) heterodynes with the 45.75mc picture carrier, producing the 3.58mc difference frequency. This explanation is somewhat simplified. As you recall, the 3.58mc subcarrier is suppressed at the transmitter. Only the subcarrier sidebands are actually transmitted.

So the color signals recovered after the video detector are actually sidebands above and below 3.58mc. The 3.58mc color subcarrier frequency is reinserted at the color demodulator in the color receiver.

The color signals recovered at the video detector are applied to the bandpass amplifier. The circuits of the bandpass amplifier are tuned to accept only a narrow band of frequencies above and below 3.58mc. Most

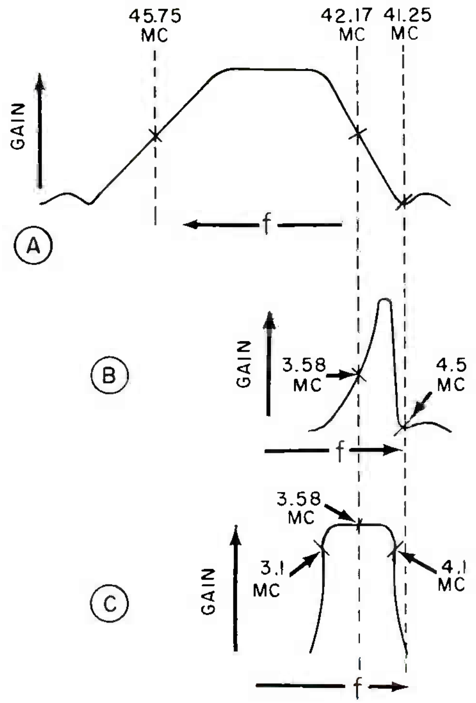

FIG. 2. The color i-f response (B) is shaped to compensate for the unequal response above and below 42.17mc in the video i-f response (A) to produce a flat-topped overall color sideband signal response (C).

modern color receivers pass about 500 to 700 kc above and below 3.58mc. The color information outside these limits is fine color detail that the eye cannot resolve at normal viewing distances, so nothing essential is lost.

Fig. 2 shows how the response of the color i-f amplifier (bandpass amplifier) is shaped to get equal amplification for the upper and lower color sidebands. In Fig. 2A the video i-f response is drawn with the frequency decreasing left-to-right. This is necessary to allow for the reversal of color sideband frequencies in the heterodyning process of the video detector. That is, sidebands below 3.58mc are above 42.17mc when they are in the video i-f amplifier. These lower sidebands receive greater amplification in the video i-f amplifier than the upper sidebands that lie between 42.17mc.

Therefore the response curve of the bandpass amplifier is shaped as shown in Fig. 2B. The rising slope of the bandpass amplifier curve

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just compensates for the falling slope of the response curve in the video i-f amplifier. The resultant overall response curve is shown in Fig. 2C. Thus the sidebands above and below 3.58mc receive equal amplification and, after demodulation, can produce true colors.

Need For New Alignment Techniques

Theoretically, one should be able to align the video i-f amplifier and the bandpass amplifier separately to get the resultant flat response curve shown in Fig. 2C. In practice, this is almost impossible. Not only the slope of the curve must be matched accurately, but also the relative gain of the amplifiers must be correct to produce a resultant flat response.

One other factor is not taken into account at all when you align the circuit separately. This is the response of the video detector circuit to the signal in the 3.58mc range. In normal alignment procedures, the video i-f amplifier response curve is a dc voltage level that recurs at a 60-cycle sweep rate. No other video signals in the 0-4mc range are present.

As you know, the 3.58mc color signals are produced in the video detector and the detector circuit, particularly the detector filter, will affect these signals. The filter will not respond uniformly to the range of signals contained in the color sidebands.

To properly evaluate the receiver response to color signals, an alignment method is needed that will show an overall response curve for all the circuits from the input of the i-f amplifier through the bandpass amplifier. To do this, it is necessary to produce a controlled signal similar to the signal produced by a color TV station.

Video Sweep Modulation

A special alignment technique called video sweep modulation (abbreviated VSM) has been devised to check the overall response of the color signal path in a color receiver. In this system you generate an i-f signal modulated by the color sideband frequencies. This modulation is recovered by the video detector and is applied to the bandpass amplifier. At the output of the bandpass amplifier you are able to view a response curve that accurately shows the response of the i-f amplifier, video detector, and the bandpass amplifier. In effect, it duplicates the situation the receiver experiences in handling color signals from a TV station.

Fig. 3 shows a block diagram of the VSM alignment system. An accurate signal generator is adjusted to produce a 45.75mc signal. A sweep generator is adjusted to produce a swept signal of about 3mc wide, centered at 3.58mc. These two signals are heterodyned together in a modulator. As you know, the heterodyne process produced four signals -- the two original signals plus the sum and the difference of the two original signals. The output from the modulator is applied to the mixer stage in the receiver tuner being aligned. Since the mixer stage is effectively the input section of the i-f amplifier, it will accept only those frequencies in the i-f range. The 2 - 5mc signal is well below the passband of the i-f amplifier. The sum frequencies are above the i-f bandpass. So the i-f amplifier accepts the 45.75mc signals and the difference signals that fall in the passband. These signals are amplified by the i-f amplifier and applied to the video detector.

In the video detector, the 45.75mc signal beats with the difference signal (43.75mc to 40.75-mc) reconstructing the 2-5mc swept signal. Actually, four signals are again present as a result of the heterodyning process in the detector. The 45.75mc and the 40.75 to 43.75mc are filtered out by the detector filter. Likewise the sum of these two signals is a very high frequency signal that is filtered out. The remaining 2-5mc difference signal is amplified by the first video amplifier and applied to the bandpass amplifier.

The response curve is viewed by connecting a demodulator probe to the output of the bandpass amplifier and feeding the demodulated signal to the vertical amplifier of an oscilloscope. The horizontal deflection of the scope is driven by the sweep rate from the sweep generator. The sample response curve shown in Fig. 3 has a fairly flat response from 3.08-mc to 4.08mc. This curve shows that the color sidebands above and below 3.58mc will receive equal amplification.

Observe that the amplitude and shape of the response curve in Fig. 3 is determined by the i-f amplifier circuits, video detector, the first video amplifier, and the bandpass amplifier. If any of these circuits distort the color sideband signals, the distortion will show up on the response curve. For example, suppose the filter circuit in the video detec-

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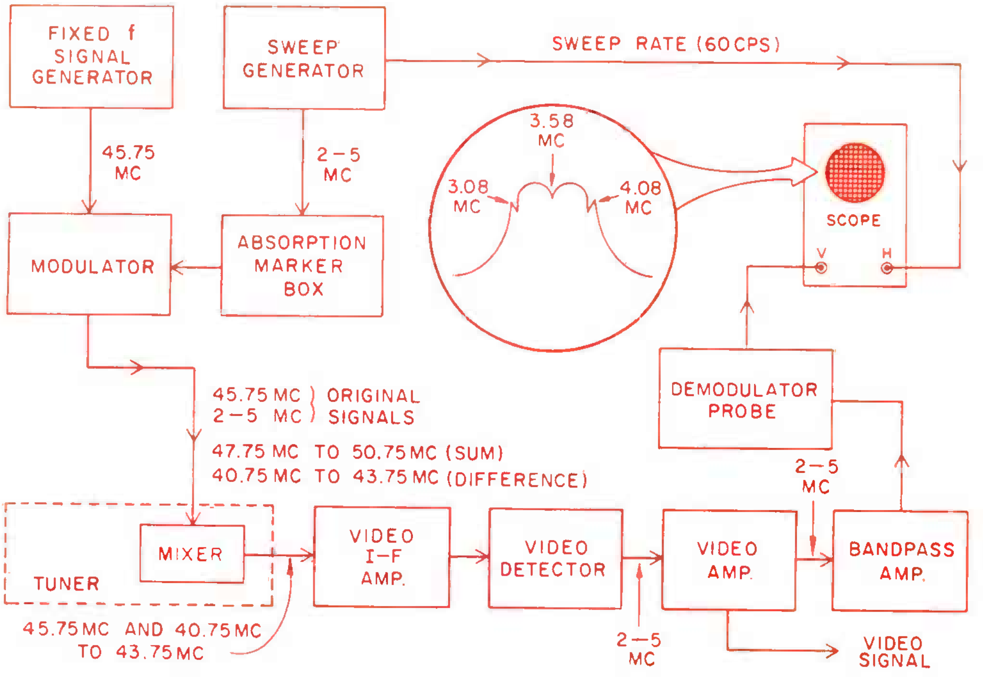

Figure 3. Video Sweep Modulation alignment system shown in block form.

tor attenuates high frequency video signals. This would result in reduced amplitude of the higher frequencies (near 4.08mc) of the swept signal. As a result, the response curve would slope down at the high end, indicating insufficient amplification of the upper color sidebands. If the attenuation is not too great, it can be corrected by adjusting the tuned circuits in the bandpass amplifier.

Video Sweep Modulation alignment is used as an overall alignment check after the individual circuits have been aligned. Before you use VSM you would perform the usual video i-f amplifier alignment. Also most receiver alignment procedures will call for separate alignment of the bandpass amplifier. This may be either sweep alignment or peak alignment of the tuned circuits in the bandpass amplifier. If the i-f circuits are properly aligned and only touch-up alignment of the bandpass amplifier is needed, you can go directly to the Video Sweep Modulation alignment.

How To Set Up For VSM

It's always been my experience that a certain amount of trial and error is required in setting up for any alignment procedure. VSM is no exception. Since you work with two generator signals the problems are increased. In general, the same care and precautions apply to VSM that apply to sweep alignment of the i-f amplifier of any receiver. Let's run through the setup for the VSM on a typical color receiver. We will assume that the i-f amplifier has been properly aligned and that the bandpass amplifier is in approximate alignment.

Set the receiver on the bench in a position where you can conveniently reach the bandpass amplifier adjustments and where you can locate your alignment equipment close to the receiver. Some receivers can be aligned in the cabinet but in most cases it is necessary to remove the chassis.

If you are working with a transformerless set, be sure to use an isolation transformer between the receiver and the power line. This is important for personal safety and to prevent possible damage to your test equipment. With two generators, a scope, a bias supply, and a vtvm connected to a receiver, it is easy to get ground connections interchanged, which could be dangerous in a transformer-

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less receiver. An isolation transformer lets you work in complete safety.

Disable The Horizontal Section

Disable the horizontal output stage of the receiver. This removes the danger of the high voltage supply and prevents horizontal spikes from obscuring your scope trace. In some sets you can remove the horizontal output tube. Usually you can disconnect the cathode connection to the horizontal output tube. In most sets it is unsafe to just remove the plate cap because the screen will draw excessive current and damage the output tube.

It will be necessary to load the B+ line to compensate for the current normally drawn by the horizontal section of the receiver. Service literature for your receiver usually recommends a resistor of suitable size and wattage. The dummy load resistor may range from 10K ohm at 5 watts to 2K ohm at 100 watts. The resistor should draw approximately the same current as the horizontal section of the receiver.

A valid test to see if the dummy load resistor is doing its job is to measure B+ with the set operating normally and then measure B+ with the dummy load in place and the horizontal section disabled. The two readings should be within 5 to 10 volts of each other.

Apply Proper Bias

Apply suitable bias voltages to the tuner rf stage, the i-f amplifier, the color killer, and the bandpass amplifier. The tuner rf stage should be biased beyond cut-off by a large negative voltage (-15 volts) applied to the tuner AGC line. This will prevent interference signals from entering the front end. The i-f AGC line should be grounded or a specified value of bias should be applied. The bias specified, usually -1 to -3 volts, operates the tubes at their normal bias.

The color killer stage must be disabled so that the signals can get through the bandpass amplifier. In some sets the threshold control can be adjusted to disable the killer. In other cases a large negative bias (-15 volts) must be applied to the grid of the killer stage. A suitable bias must be applied to the bandpass amplifier in some receivers. The bias will be of such a value as to operate the tube at its normal value.

You will need more than one bias box, or a bias box with taps to supply all the bias points for some alignment set-ups. You can make a voltage divider network to supply the low-voltage bias. This enables you to supply two or more bias points from a single bias box.

The Alignment Equipment

The fixed frequency signal generator used to supply the 45.75mc frequencies must be accurate. When this signal is injected into the i-f amplifier, its frequency must be accurate so it will fall on the proper point on the i-f response curve. This is the same point that is occupied by the picture carrier when a TV station is properly tuned into the receiver. A crystal-controlled or crystal-calibrated marker generator is suitable. The rf output amplitude must be adjustable with an available maximum output of about .1 volt.

The Video Sweep Generator must be capable of producing a constant amplitude swept signal in the 2 to 5mc range. Some alignment procedures may call for a zero to 5mc sweep. However, only those frequencies about 1.5mc either side of 3.58mc can possibly get through the bandpass amplifier. So a video sweep generator with a sweep 3mc wide that can be centered at 3.58mc is entirely adequate.

An absorption marker box can be used at the output of the video sweep generator. Absorption markers are simply high Q-tuned circuits that absorb some rf energy at a particular frequency. This produces a notch or dip in the alignment curve to mark desired frequencies. At video frequencies, markers produced by "beating" two signals together produce very broad pips of markers. While absorption markers are more convenient, the other type can be used.

The scope used to view the response curve in VSM alignment does not have any special requirements. The response curve is essentially varying dc that recurs at a 60-cycle sweep rate, so high-frequency response is not necessary. Almost any service type scope is adequate; a dc type scope is not required. The horizontal input to the scope must be connected to the sweep output from the sweep generator. This synchronizes the scope trace with the swept output of the sweep generator.

You can construct your own modulator. Fig. 4 shows a schematic diagram of the modulator circuit. The resistor network at the gen-

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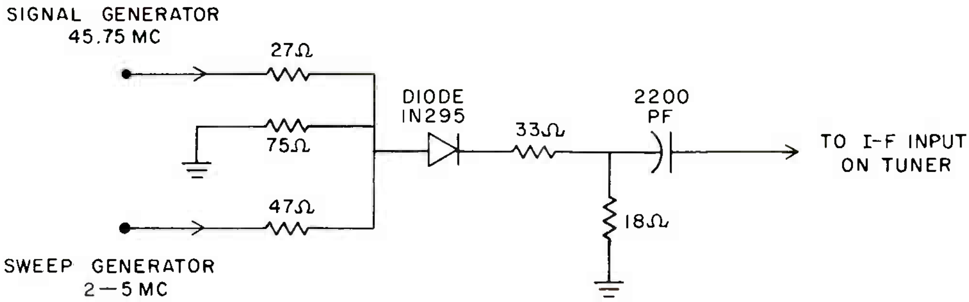

Figure 4. Schematic diagram of Modulator.

erator connections provides isolation between the generators and a suitable impedance match to the diode. The heterodyning or mixing action takes place in the diode. While a 1N295 is shown, any good video detector diode is suitable. The signals resulting from mixing are coupled through the disc ceramic 2200pf capacitor to a test point on the tuner. For rf signals, disc ceramics are more suitable than tubular capacitors.

Examine the tuner schematic of the set you are aligning. It will usually designate a suitable test point for injecting the i-f signal. Test point will bring the signal into the grid of the mixer stage. This provides isolation between the applied signal and the tuned i-f circuits that are in the plate of the mixer stage. Incidentally, the output voltage from the modulator is too low to radiate into a floating shield on the mixer tube, so use the test point.

It is convenient to build up the circuit in Fig. 4 by simply soldering the components together. Keep the leads short, but spread the components out enough so the finished unit can be soldered in place on the tuner. By soldering to the tuner you get good electrical connections. Then connect the fixed frequency generator input and the Sweep Generator input to their respective resistors. Be sure to use good ground connections from the generator cables to the tuner chassis. Use a demodulator probe on the oscilloscope or build up a suitable detector circuit. As previously explained, the output from the bandpass amplifier is a video frequency signal that must be amplitude demodulated before it can be viewed as a response curve on the scope. The output is usually taken from the secondary winding of the bandpass transformer in the color receiver. In some sets it may be more convenient to pick up the signal at the grid of one of the color demodulators.

If you do not have a demodulator probe for your scope, build the detector circuit shown in Fig. 5. Use disc ceramic capacitors and any good video detector diode. It is usually convenient to "tack" solder the detector circuit into the receiver. Then use a direct connection from the output of the detector circuit to the vertical input of the scope. A shielded input scope lead is all right but avoid using an isolation probe. The isolation resistance attenuates the amplitude of your available signal, so you have to turn up the

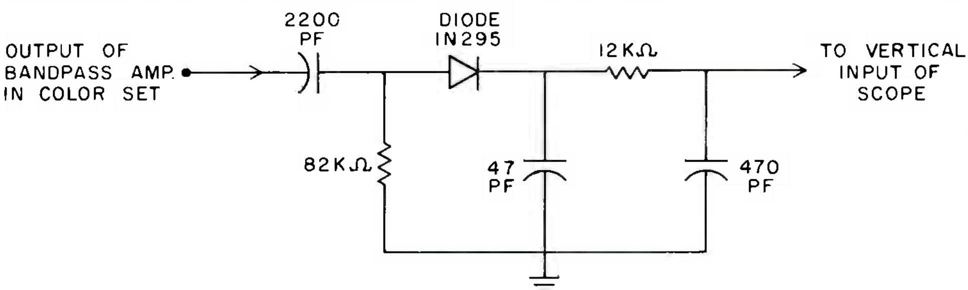

Figure 5. Detector circuit for demodulating the swept signal.

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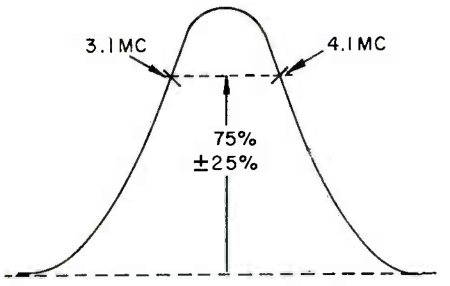

Figure 6. VSM response curve for a typical color receiver.

gain of the scope. As a result your trace will not be as smooth as when you use a direct connection. Provide a good ground connection between the receiver chassis and the scope.

Check your setup carefully and allow the signal generator and receiver to warmup. Fifteen minutes is usually long enough to assure stable operation of the generator and receiver circuits.

Evaluate The Response Curve

Getting a usable response curve in VSM alignment requires careful adjustment of the 45.75mc generator signal. If you have difficulty getting a response curve, change the amplitude of the generator output. It may be too high or too low. As a starter, turn the sweep generator output to minimum. Measure the dc voltage at the output of the video detector as you adjust the amplitude of the 45.75mc generator output.

Observe if the amount of detected voltage varies with the generator signal amplitude. If it does, it indicates that the signal is getting through the i-f amplifier. Adjust the generator output to produce about 2 volts at the video detector. Next, adjust the amplitude of the sweep generator rf output and observe the scope trace. Adjust the vertical gain of your scope to produce a convenient size curve.

Identify marker positions on the response curve. If you are using a video marker box, kill each marker separately while observing the response curve to locate the position of each marker. The 3.58mc oscillator in the color receiver will usually provide a marker pip on the trace. Enough energy from the 3.58mc oscillator leaks into the bandpass circuits so it mixes with the swept signal. At the point on the curve where the swept signal equals the frequency of the oscillator, a marker pip is formed. You can definitely identify this pip by temporarily killing the 3.58mc oscillator. Shunt a .01mfd capacitor from the crystal to ground to kill the oscillator and see if the pip disappears.

(See conclusion of article on Page 19.)

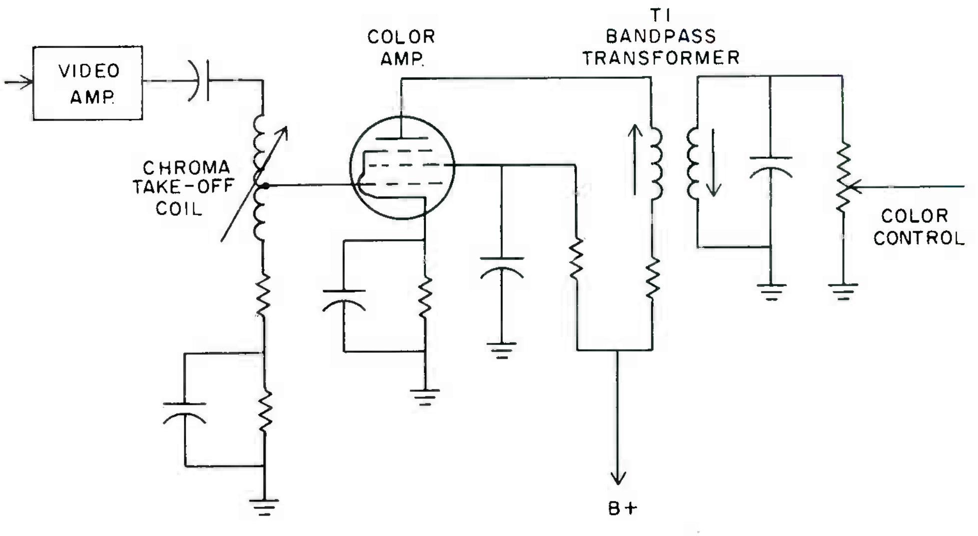

Figure 7. Bandpass amplifier circuits of a typical color receiver.

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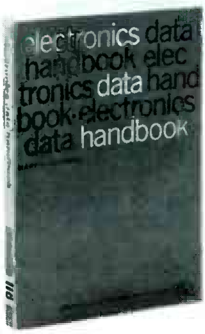

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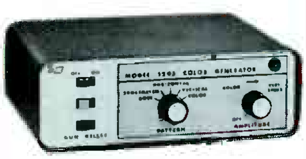

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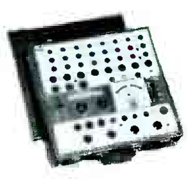

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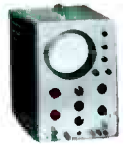

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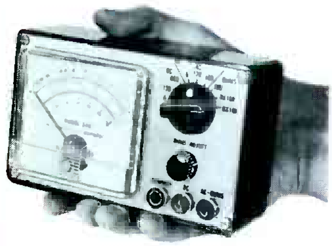

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☐ EASY PAYMENT PLAN (10% Deposit)

Quantity	Model	Name of Item	Price Each	Total

If you live in Washington, D.C., add 3% sales tax. All prices are net, F.O.B. Washington, D.C.

TOTAL

ON TIME PAYMENT ORDERS please be sure to complete the Easy Payment Plan credit information form on the reverse side of this page and include 10% down payment with your order.

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If he has reached lesson 20, he has his Voltmeter, which comes as part of his course. At this point he'd welcome a handsome cabinet for it, or the accessory high-voltage probe.

A TRACER, RC TESTER, OR CADDY?

AT LESSON 23, he's a candidate for a CONAR Signal Tracer, Signal Generator, or R-C Tester. At lesson 27, a tube caddy is a handy item; and at lesson 35, he'll find a 3/8-inch electric drill a valuable addition to his growing tool kit.

A Transistor Power Supply would be welcome if he has reached the lesson 39 mark, and for those who have reached lesson 42, the CONAR Oscilloscope would make a gift that will keep on giving for many years to come.

PARTS KIT, ANALYST ARE HANDY

AT LESSON 50 the CONAR kit of replacement parts would come in handy, and at lesson 54 we'd recommend a B and K TV Analyst.
And that's it for the struggling student.
"But he has already graduated." you say.

All right. How about the unusual Dynaquad Touch Control Lamp? Or the fascinating CONAR Audiocolor? We'd also recommend the CONAR 300 Stereo System, which gives a truly amazing performance and at a low price, too.

JUNIOR WILL LIKE AIE KIT

AND HERE'S A SUGGESTION for the budding junior technician in the family. It's the Adventures In Electronics Kit, which contains more than 100 top-quality parts and projects that cover a seemingly endless variety of activities.

Got some ideas? Fine. Now all you have to do is turn to the CONAR catalog.
Your Christmas shopping problems are solved.
EASY, WASN'T IT?

CONAR EASY PAYMENT PLAN

SO

Note: Easy payment contracts cannot be accepted from persons under 21 years of age. If you are under 21, have this sheet filled in by a person of legal age and regularly employed.

Enclosed is a down payment of $________ on the equipment I have listed on the reverse side. Beginning 30 days from the date of shipment I will pay you $________ each month until the total payment price is paid. You will retain title of this equipment until this amount is fully paid. If I do not make the payments as agreed, you may declare the entire unpaid balance immediately due and payable, or at your option, repossess the equipment. Your acceptance of this will be effected by your shipment to me of the equipment I have listed.

Date ________________ Your written signature ________________

CREDIT APPLICATION

Print Full Name ________________ Age ______

Home Address ________________

City & State ________________ How long at this address? ______

Previous Address ________________

City & State ________________ How long at this address? ______

Present Employer __________ Position __________ Monthly Income ______

Business Address ________________ How Long Employed? ______

If in business for self, what business? __________ How Long? ______

Bank Account with ________________ Savings ☐ Checking ☐

CREDIT REFERENCE (Give 2 Merchants, Firms or Finance Companies with whom you have or have had accounts.

Credit Acct. with __________ (Name) __________ (Address) Highest Credit ______

Credit Acct. with __________ (Name) __________ (Address) Highest Credit ______

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VIDEO SWEEP MODULATION FOR COLOR ALIGNMENT (Cont. from Page 15.)

Test your response curve for overload distortion. You should be able to change the amplitude of the response curve without changing the shape by varying the amplitudes of the signals from the signal generators. If the shape changes, you are probably overloading some circuit through which the signal passes. In general, you should work with the smallest signal possible from the signal generators and use the gain of the scope to get the desired height of the response curve. Use this test again after you have made any adjustments to the circuits. The response curve is not valid if it changes shape with small changes in signal amplitude.

Adjust the tuned circuits and bandpass amplifiers to obtain the desired response curve. Fig. 6 shows a VSM response curve for a typical color receiver. As you can see, the bandpass amplifier provides only approximately equal response to sidebands about 500kc above and below 3.58mc. Before you make an adjustment identify the coil or transformer by using the schematic diagram or pictures in the service literature for your receiver. As you move the adjustment, observe what part of the response curve is affected. Make each adjustment for maximum amplitude of the response curve, and then readjust it to get the desired bandwidth.

Best results are usually obtained by going over the adjustment several times. Bandpass amplifier circuits of a typical color receiver are shown in Fig. 7. Three adjustment points are provided - the chroma take-off coil, the primary winding and the secondary winding of the bandpass transformer. In most receivers of this type, the primary winding adjustment tunes the high end of the curve, the secondary winding adjustment tunes the low end of the curve. The chroma take off coil fills in the center of the curve and adjusts the top of the final response curve.

VSM alignment can be used as a trouble-shooting technique. Look for adjustments that fail to produce a change in the response curve. For example, suppose the chroma take-off coil of the bandpass amplifier has shorted turns. Moving its core will produce little or no change in the shape or amplitude of the response curve. You may be able to misadjust the bandpass transformer and approach the desired curve. Or you may find that when you get the necessary bandwidth, the middle of the curve sags. In any case the key to locating the faulty part is the lack of change when you move the adjustment.

Summary

Alignment is more critical for the reception of color than for black-and-white pictures. Like black-and-white receivers, color sets seldom get out of alignment. However, alignment procedures are always a useful tool for dealing with difficult servicing problems in the signal path circuits. Signal path circuits from the front end through the video detector require the same alignment techniques for both color and black-and-white.

In the color receiver, the bandpass amplifier response must be matched to the combined response of the video i-f amplifier and the video detector. To view this overall response, it is necessary to employ a Video Sweep Modulation alignment technique. Practice the VSM alignment procedure on a properly operating set so you will be ready to use it on those puzzling jobs, where you are not sure but you have a gnawing feeling that alignment is at fault.

An English affiliate of the Ford Motor Company has come out with a remote-controlled tractor which one day may be driven by a robot. The system has a wide variety of potential applications, ranging from hauling logs over ice-covered rivers to handling radioactive materials from atomic power stations. It can handle up to 28 functions simultaneously: starting or stopping the tractor, shifting gears through three forward speeds and two reverse speeds, turning its lights on and off, speeding up and slowing down, and cutting the power take-off in and out. Operating range extends from 10 feet to 200 yards.

Share Your Holiday Joy!

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Fight tuberculosis
and other
respiratory diseases.

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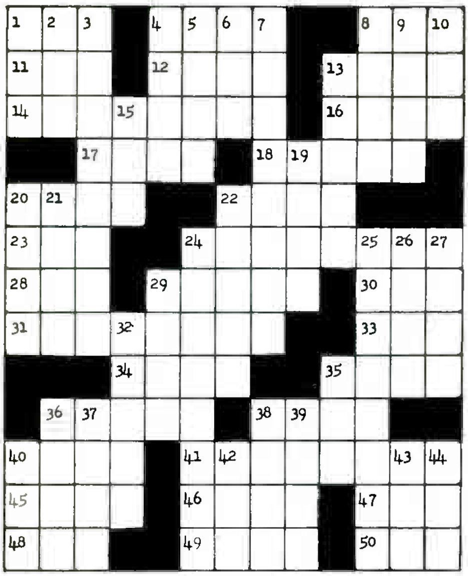
ELECTRONICS CROSSWORD PUZZLE



Solution on Page 32.

By James R. Kimsey

ACROSS

1. Metal top on tube.
4. Amateur radio operators (slang).
8. Place of research.
11. Fruit drink.
12. To revise and prepare for publication.
13. Sensitive to pain from pressure.
14. To vary the amplitude, frequency, or phase of an oscillation.
16. A number of turns of wire shaped to offer resistance to alternating current.
17. Glimpse.
18. South American animal resembling a camel.
20. To sit for an artist.
22. Prearrange.
23. Abbreviation for aerial.
24. A type of tape used chiefly to hold rubber-tape insulation in place.
28. Large electronics manufacturer.
29. Choice or select.
30. Our favorite electronics school.
31. To transmit or receive an image by television (phonetic).
33. Low, marshy land.
34. Mature; ready for reaping.
35. Opposite of voltage drop.
36. One of two equal parts of anything (2 wds).
38. Foreboding.
40. Mineral springs.
41. A small microphone worn around the neck.
45. Present.
46. Uttered by mouth.
47. Part of the foot.
48. Before.
49. Animal skin.
50. Finish of a winding.

DOWN

1. A rotating part used to transfer motion from one direction to another.
2. Fuss or trouble.
3. Blanking pulse.
4. When stuck on a kit you need ____ .
5. Twenty-four hours (2 wds).
6. Fingerless glove.
7. Resembling a star in shape.
8. Weaving machine.
9. Operatic solo.
10. Unit for the logarithmic expression of ratios of power, voltage, or current.
13. Meager.
15. Utilize.
19. To make a neat cable.
20. A capacitor, a coil or a resistor.
21. At one time.
22. Something offered or striven for in competition or in contests of chance.
24. A device having two stable states and two input terminals, each of which corresponds with one of the two states (2 wds).
25. A type of detector.
26. Crude metals.
27. Three squared.
29. Wicked and bad.
32. To remove previously recorded information.
35. A unit of reluctance.
36. One who imitates.
37. Rabbit.
38. Egg-shaped.
39. Grain used in brewing.
40. Her.
42. Exist.
43. Division of time.
44. An electron gun in a three-gun color picture tube.

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BY STEVE BAILEY

DEAR STEVE:

In technical articles lately the symbols "KHZ" and "MHZ" are being used. What do these mean?

L.E.B., Fla.

"HZ" stands for cycles and is derived from the name Hertz, who first discovered electromagnetic radiation. "KHZ" means kilocycles, while "MHZ" represents megacycles. Thus, the broadcast band extends from 550 KHZ to 1600 KHZ, or 1.6 MHZ.

DEAR STEVE:

I have often seen the term "loading" used, but I do not know exactly what it means. Could you tell me, using an example?

M.L., Iowa

First of all, you should remember a term frequently used in relationship to various circuits. This term is "load" and means something that is connected to a circuit that will consume power.

Keeping this definition in mind, it follows that the word "loading" means that something is drawing current and power from the circuit. For example, a meter can load a circuit that has a resistance connected in series with it. The way it does this is to alter the circuit characteristics so that the amount of power and current consumed will be changed. If the voltage is measured across a part whose resistance is equal to the resistance of the voltmeter, the voltmeter may serve as a parallel resistance and reduce the total resistance of this part of the circuit. When this happens, the current through the complete circuit increases. Because of the higher current, the voltage drop across the series resistance will increase. This means that the voltage drop across the part under test will decrease to a value lower than it was before the meter was connected across it. Of course, the meter reading would be inaccurate.

This can best be avoided with the use of a meter with a high sensitivity rating. For example, a meter with a sensitivity of 20,000 ohms-per-volt would not load a circuit as much as one with a rating of only 1000 ohms-per-volt.

DEAR STEVE:

At this time, I am studying Lesson 21BB. Question 2 refers to "rms" voltage. Could you tell me what this is?

R.R., Calif.

The term "rms" voltage should not confuse you -- it is the very same thing as effective voltage. If you recall, an effective ac voltage is one that will cause an ac current to flow that will produce the same heating effect as the equivalent amount of direct current. The term "rms" means the very same thing.

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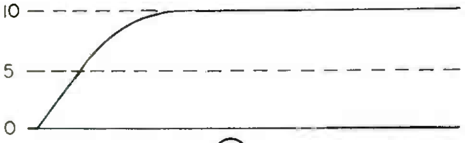
Also, you should keep in mind that ac measurements taken with a service type voltmeter are expressed as effective or rms values unless otherwise stated. This was first discussed on Page 15 of Lesson 2BB.

DEAR STEVE:

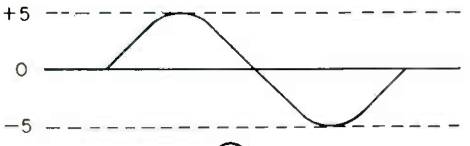
What is a pulsating dc voltage? I am presently studying Lesson 3BB.

M.R., Ala.

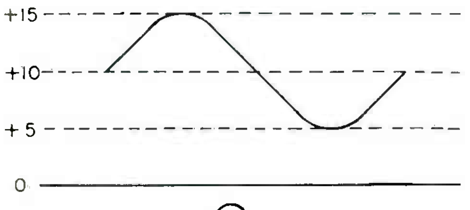
A pulsating dc voltage is one that contains an ac component or part, as well as a dc component. It contains characteristics of both.



(A)



(B)



(C)

Fig. A illustrates a typical dc voltage. Notice that it begins at zero and rises to a maximum constant value. Fig. B shows a typical ac voltage. It begins at zero and rises to a maximum positive value, returns to zero, reaches a maximum negative value, and returns to zero again.

Now if these voltages were combined, they would appear as in Fig. C. Notice that we still have the ac sine wave, but it is on the positive side of zero. If we have a dc voltage of 10 volts and a maximum ac voltage of 5 volts, the ac and dc voltages will add during half the cycle and oppose during the other. Thus when they add we will have a total of +15 volts and a total of +5 volts when they oppose.

From this we can see that a pulsating dc voltage exhibits the characteristics of both ac and dc. It resembles dc in that it never changes polarity and it resembles ac in that it varies. As a matter of interest, we could actually measure the separate components with a vacuum tube voltmeter.

DEAR STEVE:

What does the word "impedance" mean?

T.K., Miss.

Impedance is the total opposition a circuit will offer to the flow of ac through it. This opposition can take the form of resistance, inductive reactance, capacitive reactance, or any combination of the three.

The formula for determining the impedance of a circuit containing a resistance and a reactance is

$$Z = \sqrt{R^2 + X^2}$$

R represents resistance and X can represent either inductive reactance or capacitive reactance.

When you have all three in the circuit, the formula is changed to

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

To use this formula, you find the difference between the two reactances and square it. Then add the result of this step to the square of the resistance, and find the square root of the sum.

Impedance, like resistance, is expressed in ohms.

DEAR STEVE:

I am having trouble remembering the voltage and current relationship in a coil and in a capacitor. Can you help me with this?

M.B., Va.

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One popular way of remembering the voltage and current relationships in coils and capacitors is to memorize the simple phrase, "Eli the Iceman". This is a novel way of expressing what might otherwise be a stiff, technical concept.

In this phrase, notice the first word "Eli." Each of these letters stands for the electronic symbols for voltage (E), inductance (L), and current (I). Also, notice that the "E" comes before the "I". Thus in an inductive (L) circuit, the voltage (E) leads the current (I).

The second major part of this phrase is "ice". Again, the middle letter "C" represents the component involved, "capacity". However, the "I" comes before the "E" in this case. Therefore, in a capacitive (C) circuit, the current (I) leads the voltage (E).

DEAR STEVE:

Lesson 7BB (Page 11) states that at high frequencies it take a smaller change in capacity to cause a change in frequency than it does at low frequencies. Could you tell me why this is so?

B.R., Penna.

When we tune towards the high frequency end of the broadcast band the tuning capacity is reduced to a very small value. Here slight changes in capacity will cause a relatively large change in total circuit capacity and hence a large change in frequency. For example, if the minimum capacity of the tuning capacity is 10 μμf, rearrangement of the circuit leads might increase the capacity to as much as 15 μμf. This is a large percentage change and will result in a large frequency change.

At the low frequency end of the broadcast band the tuning capacity value might normally be 350 μμf. Here a change of 5μμf would have little effect on the total capacity and hence little effect on the resonant frequency.

DEAR STEVE:

Why is the oscillator signal in a radio set always above the frequency of the incoming signal by the value of the i-f frequency?

M.E., Texas

The broadcast band extends from 550 kc to 1600 kc. This frequency coverage is obtained by changing either the capacity or inductance in the tuning circuits of the receiver. This particular coverage is used because a frequency change of 3 to 1 is the maximum practical value. For example, 3 times the lowest frequency (550 kc) is 1650 kc and therefore 1600 kc is chosen as the upper limit of the broadcast band.

The frequency of the local oscillator in a superheterodyne receiver always differs from the incoming signal by the i-f frequency. As far as mixing is concerned the local oscillator may be higher or lower than the signal to be received. As an example, to see the frequency range which the local oscillator might cover if operated below or above the incoming signal, let's consider a receiver with an i-f of 450 kc. To operate the oscillator above the incoming signals in the broadcast band we find:

$$\begin{array}{r} 550 \text{ kc} \\ +\ 450 \text{ kc} \\ \hline 1000 \text{ kc} \end{array} \qquad \begin{array}{r} 1600 \text{ kc} \\ +\ 450 \text{ kc} \\ \hline 2050 \text{ kc} \end{array}$$

So the local oscillator must tune continuously from 1000 kc to 2050 kc. This is a frequency change of about 2 to 1 which can be obtained with ease.

Now if we wanted the oscillator to operate below the frequency of the incoming signal we find:

$$\begin{array}{r} 550 \text{ kc} \\ -\ 450 \text{ kc} \\ \hline 100 \text{ kc} \end{array} \qquad \begin{array}{r} 1600 \text{ kc} \\ -\ 450 \text{ kc} \\ \hline 1150 \text{ kc} \end{array}$$

So here the oscillator would have to tune from 100 kc to 1150 kc, which is a frequency change greater than 10 to 1. Such frequency coverage cannot be readily obtained. For this reason the oscillator in a broadcast receiver is always designed to work above the frequency of the incoming signal.

A keen home salesman in Dallas, Texas, uses his mobile radio to save time. He puts signs outside sale houses inviting people to look around. Inside each house he puts a sign by the phone: "I am in the area in my mobile-equipped car. If you wish details about this house, please call me at..."

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GRADUATES EARN NRI HONORS PROGRAM AWARDS

In the tradition of NRI's pursuit of excellence in training, the following graduates who earned NRI electronics diplomas in August, 1966, also earned unusual recognition under the NRI Honors Program. On the basis of their grades, these graduates distinguished themselves by earning the right to honors listed below and to the appropriate CERTIFICATE OF DISTINCTION in addition to their regular NRI Diploma. This distinction is made part of their permanent NRI records.

WITH HIGHEST HONORS

Richard J. Holcer
Silver Spring, Md.

Jack Hyder, Jr.
APO San Francisco

Gordon M. Kincheloe
APO New York

Donald A. McCullough
Seattle, Wash.

John C. McMullen
APO San Francisco

Voyde D. Oldson
Gunnison, Colo.

Ray E. Ruff
Marshall, Texas

John W. Rupp
APO New York

Robert E. Wade
Claude, Texas

WITH HIGH HONORS

William Anderson
Lincoln, Mo.

George W. August
South Ozone Park, N. Y.

Dale Bennett
Baker, Oregon

Edward A. Bepko, Jr.
Atwater, Calif.

Francois Dube
Ottawa, Canada

W. C. Gaylord
Fayetteville, Ark.

William W. Hill
Suffolk, Va.

Joseph H. S. Hoag
Bethesda, Md.

Peter D. Hoagland
Oreland, Pa.

Donald R. Johnson
Lafayette, La.

John Kratz
Hawthorne, Calif.

Joseph N. Kubani
Utica, Mich.

Eric Kutzner
Trenton, Ont., Canada

Arthur T. Lawhorn, Jr.
Washington, D. C.

Clarence W. Laye
Clemson, S. C.

H. J. Lewis
Halifax, N. S., Canada

J. D. Mantle
Painesville, Ohio

Richard G. Masoka
Sterling, Va.

Cornice McLaughlin
Dallas, Tex.

Frank Orsini
Leamington, Ont., Canada

William C. Parker
Hannibal, N. Y.

Dane L. Rodman
APO New York

Harry D. Rowe
White Stone, Va.

Russell R. Schefke
Utica, Mich.

William O. Steele III
West Linn, Ore.

Vincent J. Svehla
Baltimore, Md.

Walter W. Timmers
Salisbury, Md.

Robert M. Volk
Union, N. J.

Frank Walther
Portland, Ore.

WITH HONORS

Thomas D. Bailey
Tallahassee, Fla.

Herman Bakker
Holland, Mich.

George M. Barrows
North Springfield, Vt.

Frank H. Baxter
Connellsville, Pa.

Thomas J. Bergeron
Thibodaux, La.

Trentino Bonafede
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Bruce Davidson
Minot, N. Dak.

Wilmer B. Duvall
Phoenix, Ariz.

Salvatore Ferraro
Scranton, Pa.

Neldon A. Hanson
Nephi, Utah

E. S. Higginbotham
Richmond, Va.

Russell E. Keith
Pawnee, Okla.

Adolph Lepper
Jefferson City, Mo.

B. H. Marshall
Shreveport, La.

Ronnie Mercer
Shreveport, La.

Jack B. Merritt
Lexington, N. C.

Jesse J. McNeice
Redondo Beach, Calif.

Lynn E. Pickle
Petaluma, Calif.

Garland M. Puckett
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Herbert A. Randall
Cheshire, Mass.

Joseph E. Rosch
Meriden, Conn.

Earl F. Schneider
Lehighton, Pa.

Dr. R. J. Sibilsky
Jackson, Mich.

Dr. Francisco N. Tamolang
New Haven, Conn.

John D. Verkerk
Flin Flon, Man., Canada

Gerald R. Wark
Dexter, Maine

Clifton N. Yeager
Imperial, Mo.

HAVE A FIRST-CLASS RADIOTELEPHONE LICENSE? A FIRST-CLASS JOB MAY BE WAITING FOR YOU NOW

From time to time we receive inquiries from prospective employers about hiring NRI graduates for work in broadcasting, mobile radio communications, commercial transcontinental communications systems, marine radio, aircraft radio, radar, and other fields.

ALL THESE JOBS REQUIRE A FIRST-CLASS RADIOTELEPHONE LICENSE.

Do you have the required license and would you be interested in these jobs? If so, write a short note to that effect and address it to Ted Rose, National Radio Institute, 3939 Wisconsin Avenue N.W., Washington, D.C. 20016. In answering employers about these jobs hereafter we will include your name among the NRI men they may contact.

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NRI GRADUATES

Where They Are, What They Do

His Only Regret: He Didn't Start With NRI Sooner

Graduate Robert Belew, shown with his TV and radio service wagon, enrolled in the NRI radio and television servicing course in 1956. The reasons? "As a hobby and to occupy myself." Mr. Belew retired at the age of 65 and liked the course so much that he then enrolled in the professional TV servicing course. Now 73 years old, Mr. Belew is an NRI graduate who is "still going strong." His only regret? "That I did not enroll ten years sooner."

GRADUATE ROBERT BELEW
4553 Valley Boulevard
Los Angeles, California 90032

Operates Service Shop On World Famous Chinatown Street

"I highly recommend your Radio-TV Servicing course to anyone who wants a better income with a business of his own. Thanks to your course I have been able to fix sets other TV men could not. I service TV, Color TV, HiFi, tape recorders, record changers, and auto radios. At first I had my doubts whether any school could teach electronics thru the mail. But you and your fine staff have proved it many times over through your successful graduates. I have my shop at the address below. In 1965 our sales alone were over $5,000 worth at cost. I have been very successful thanks to NRI."

GRADUATE BRIAN CHIN
50B Mulberry St.
New York, N. Y.

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Middle-Aged Graduate Finds TV Servicing "Out of This World"

"Within ten months from my enrollment with NRI, a whole new world opened to me. Being well into middle age, this has meant a great deal. A part-time TV servicing business is growing for me and will soon become my full-time pursuit.

"Having spent most of my life in a dull, fruitless job, Electronics is just out of this world to me. I enjoy every moment of it, and the daily challenges keep me trying to learn more and more.

"All this I owe to NRI and your wonderful staff for the help and encouragement they gave me. (And still do when I ask for it!) My recommendation goes to anyone interested in Electronics."

GRADUATE HENRY W. BAUMANN
27 Hamilton Ave.
Brentwood, N. Y.

Does Acceptance Testing Of Beacon Units, Part-Time Servicing

"I am working for Keltec Industries, as a junior Engineer for Quality Assurance. My job deals with workmanship and acceptance testing of beacon units for missiles. The course helped me in better understanding and use of the many kinds of test equipment. My salary is approximately $7000 a year. In addition I have repaired numerous radios, TV's, tape recorders and record players. All my customers were extremely satisfied and call me back when other troubles occur."

GRADUATE CLARENCE L. ENNIS
7908 Telegraph Road
Alexandria, Va.

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EMPLOYMENT OPPORTUNITIES

The following firms have requested that they be listed as continuing prospective employers of NRI graduates in the designated capacities:

VANITY FAIR
P. O. Box 111 Monroe Mills
Monroeville, Alabama 36460
Challenging, long-term opportunity in expanding Research and Development Dept. for two or three electronics technicians who can adapt technical training to business-industry needs. Vanity Fair is a nylon lingerie and foundation garment industry with a growth equal to a plant a year for the past 10 years. Seven plants located within 100-mile radius of Monroeville, clean, wide-awake town of 5,000, which is 90 miles north of Pensacola, Fla., and 100 miles southwest of Montgomery. Adhere to policy of promotion from within. Write George Heard, Director of Industrial Relations.

CHESAPEAKE AND OHIO RAILROAD CO.
409 11th St., Huntington, West Virginia
Needs technicians for electronics maintenance on railroad. Must have 2nd class license or better. Openings in Ill., Mich., Ky., and Va.

RADIATION SERVICE COMPANY
9342 Fraser St., Silver Spring, Md.
Needs Communications Technician with 1st class FCC license to train in Baltimore. No experience necessary. Pays $80 - $125 wkly. Car furnished.

SIMPSON ELECTRIC COMPANY
5200 Kinzie St., Chicago, Ill. 60644
Openings for technicians, design and development engineers, electro-mechanical and production engineers. Write: W. F. Jones.

NRI Graduate Wants To Hire Another

Charles L. Hays, operator of the TV-Radio Fix-it Shop at 5004 N. Palafox St., Pensacola, Fla. 32505, since his graduation from NRI in 1962, would like to employ another graduate with black-and-white and color Television servicing experience. Write to Charles L. Hays at the above address.

GENERAL ELECTRIC COMPANY, Appliance Park 6-221, Louisville, Ky. 40225 has openings available throughout U.S.A. with good pay, excellent working conditions, full benefit package. Specialized on-the-job training provided. Consult local telephone directory for factory service operations, or write to above address for location to District Product Service Manager nearest you.

NEPTUNE BROADCASTING COMPANY, 300 North 7th St., Steubenville, Ohio, is seeking men with radio training and/or experience for jobs in Ohio, Pennsylvania, and West Virginia.

RCA DET Division has openings for electronics technicians. Contact Mr. Townsend, RCA DET Div., Front and Cooper Sts., Camden, N. J.

SUN ELECTRIC CORP., 5708B Frederick Ave., Rockville, Md., is looking for electronics technicians.

PARKINSON ELECTRONICS
1008 Houston, Levelland, Texas
Needs radio technician experienced in transistors; television technician capable of management; two-way radio technician experienced in mobile and base station repair and installation.

PAGE AIRWAYS, AVIONICS DIVISION
Washington National Airport
Washington, D. C.
Needs technician with second-class license to train for work in communications and navigational equipment; also has opening for man trained in solid state repair work. Send resume to James R. Tracey.

RCA SERVICE COMPANY, Camden, N. J. Needs TV Servicemen at most RCA Service Factory Service Branches. Technical School training essential prefer B/W and Color Service experience. Apply at RCA Branch nearest you, consult Yellow Pages or write to D. A. Giordano, Mgr., Employment, RCA Service Co., Cherry Hill, N. J.

SACRAMENTO ARMY DEPOT
Sacramento, California
At moment needs 120 radio technicians.

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Alumni News

Howard Tate .... President
Joseph Bradley ..... Vice President
Edward Bednarz ..... Vice President
Isaiah Randolph .... Vice President
F. Earl Oliver ..... Vice President
Theodore E. Rose Executive Sec.

EUGENE DE CAUSSIN BECOMES NEW NRIAA PRESIDENT

IT IS A PLEASURE to announce that the NRIAA President-Elect for 1967 is Eugene de Caussin of Los Angeles.

The voting was fairly heavy. It is a tribute to F. Earl Oliver, his opponent, that he, Oliver, polled proportionately as many votes as he did in view of the heavy vote for de Caussin from the West. Having gone through and won many elections himself, as President and Vice President of the NRIAA, Oliver knows what it is both to lose and to win an election.

Three of the current Vice-Presidents, Joseph Bradley, Edward Bednarz, and Isaiah Randolph, were re-elected. Harvey Morris of Philadelphia, a staunch supporter of the Philadelphia-Camden Chapter who served three terms as a Vice-President in the early fifties, was again elected to a Vice-Presidency. Congratulations, gentlemen!

Eugene de Caussin made quite an impressive record in industry, mostly as an engineer and designer. Beginning approximately 35 years ago as a draftsman with the White Motor Company of Cleveland, he progressed to Chief Engineer, Principal Engineering Draftsman, Tool Engineer, Chief Tool and Design Engineer, and Consultant Engineer with such companies as the Covered Wagon Company, Mount Clemens, Mich,; Rock Island Arsenal, Rock Island, Ill.; Continental Motors, Detroit; Willys Motors, Kaiser Electronics Division, Arlington, Va.; and other companies of similar caliber.

Just prior to his graduation from NRI in September 1958, de Caussin began doing service work in his spare time. In February 1961, he established his shop in Los Angeles and still operates it. He has been Chairman of the Los Angeles Chapter continuously for the last half-dozen years and has given much

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of his time and energy to the welfare of the Chapter.

He has four children, two boys and two girls, who live in Michigan. The girls are married and between them he has 13 grandchildren (latest count), some of which he has never seen. He met his present wife (Frances), in Washington, D. C. She is an employee of the Federal Government with the General Services Administration in Los Angeles. She has been very helpful to him both in running his business and in the social part of the meetings of the Los Angeles Chapter. Both Mr. and Mrs. de Caussin are interested and active in photography but his hours and his work at the shop do not leave him much time to pursue this or any other hobby.

Current President Howard Tate's term of office will expire on December 31. Eugene de Caussin's term will begin the next day, January 1. Our congratulations to you, Gene!

DEMONSTRATION BOARD ENHANCES SPRINGFIELD LECTURES

SPRINGFIELD (MASS.) CHAPTER was sorry to lose Arnold Wilder, who moved to North Carolina with the firm with which he is employed. He was one of the most valuable and active members of the Chapter, always gave unstintingly of his knowledge and experience to help the other members. While we are sorry to lose you, Arnold, we nevertheless wish you luck and happiness in your new home.

The Chapter has received its Transistor Radio Demonstration Board. Secretary Brother Bernard Frey put it together and says it works well. He is preparing lectures to help the members in transistor TV work and plans to use film strips and sound tapes, donated by Larry Black to accompany them. The Demonstration Board will be helpful in training the members.

PHILADELPHIA-CAMDEN CHAPTER ANTICIPATES NEW MEMBERS

PHILADELPHIA-CAMDEN CHAPTER started the new season with the admittance of new member, Joseph Madigan, a student from Siklerville, N. J. Welcome to the Chapter, Joe! Judging by past performance, the Chapter will undoubtedly swell its ranks with many more new members this season.

A note of misfortune has to be injected here. George Dolnick, former Chapter Librarian, has had to give up his service work due to his health. We are sorry, George, and know how lost you will be for a while without your service work.

The members were particularly pleased and proud of guest speaker Joseph Springer, Jr. Secretary Jules Cohen took special pleasure in signing up both father and son as new members back in 1958. Joe Jr. continued his education, is now an Electrical Engineer with the Philco Corporation and is doing very well. He has even patented a few inventions and designed a device to attach to the CONAR Model 250 Oscilloscope for checking transistors. It was on this that he lectured to the Chapter. He did a very thorough job; his talk and demonstration were excellent. The members hope Joe will come back again soon. We have written Jules Cohen for further details of the attachment so that we may present them in a forthcoming issue of the NRI Journal.

Arrangements were made with a field representative from the Philco Corporation for a lecture and demonstration on Philco Color Television receivers. This pleased Chairman John Pirrung to no end. He had just bought a Philco Color TV set.

PITTSBURGH VIEWS FILM ON MASTER ANTENNA SYSTEMS

PITTSBURGH CHAPTER featured Mr. Thomas Dapra as a guest speaker. He is Manager of the Radio Parts Company, a large parts distributor in Pittsburgh. Mr. Dapra spoke on Master Antenna Systems and showed a very informative film on the subject. Chapter Member Tony Jox won a tube caddy presented by the Radio Parts Company.

A Motorola representative was scheduled to demonstrate the new Motorola hybrid Television at the following meeting.

SAN ANTONIO ALAMO ENJOYS SLIDE-TAPE LECTURES

SAN ANTONIO ALAMO CHAPTER showed two films. One was "Ideas", a 15-minute color-sound film which was presented by Sylvania. It dealt with color TV and related electronic subjects. The other film was called "This is Photofact", a 45-minute slide-type presentation from Howard S. Sams -- a very informa-

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tive film on how to use Photofact for the greatest benefit.

At the next meeting Sam Stinebaugh and Robert Bonge, both part-time Radio-TV Service Technicians, teamed up to put on a demonstration of the oscilloscope and the B and K Television Analyzer. This was a fine demonstration.

The newest member to be admitted to the Chapter is Romulo Rabago. Our congratulations to you, Romulo!

SAN FRANCISCO STUDIES TRANSISTOR AMPLIFICATIONS

SAN FRANCISCO CHAPTER'S Art Ragsdale delivered a talk on and made a blackboard schematic diagram of the first phase of dc amplification using a transistor. At the next meeting he planned to discuss the second phase of this project using ac in connection with transistor amplification.

In Memoriam

Since the last issue of the Journal we have received word that the following members of the Alumni Association have passed away. We extend the sympathy of the Alumni Association to their families.

Mr. Walter J. Cummings, Vista, Calif.

Mr. L. W. Henley, Richmond, Va.

Mr. Hubert A. Bond, Norwood, N. Y.

Mr. Patrick J. Grady, Buffalo, N. Y.

Mr. James J. Newbeck, New York City.

Mr. Owen C. Scott, Clearwater, S. C.

Mr. Raymond F. Pugsley, Mystic, Conn.

NBC TOURS WITH ULTRA-MODERN MOBILE UNIT

WASHINGTON, D. C. --- On display here recently in the metropolitan area has been the National Broadcasting Company's new ultra-modern, three-vehicle, color television mobile unit. It took almost a year for construction, and cost $1,500,000.

The new color mobile unit is similar to one NBC completed a year ago, but has added facilities and advancements. Each of the 40-foot tractor-trailers is designed for a specific function, the camera trailer carrying all movable equipment such as cameras, cables, and tripods, which when unloaded can be converted to a compact television studio; the control or production trailer, a mobile control room in which production personnel, such as the program director, technical director and audio engineers operate; and the third trailer housing technical equipment required for the pickup and transmission of color, including the color video control center as well as the color tape facilities.

Included in the operating facilities with the three trailers are five color cameras, a black-and-white insert camera, pulse generator and distribution equipment, color tape recorders capable of "instant reply" for football and basketball coverage, a stop-motion recorder, a video switching system accommodating 20 different inputs from cameras and remote lines, and chroma key facilities.

Also included are special effects equipment making possible mixtures of two or more cameras by a lap dissolve or a wide variety of special horizontal and vertical wipe configurations; title insert facilities to position a title any place within a picture; and superlock, a method to synchronize one camera to any incoming remote signal.

"This new color television complex is the most modern and most versatile mobile television facility ever constructed," according to William Trevarthen, NBC's Vice President of Operations and Engineering. "Like most other NBC mobile units, it can handle virtually every type of remote broadcast, but unlike most other mobile units it has the asset of size which enables it to be a large portable television studio."

The unit's control area has 33 black and white monitors, seven color monitors, and built-in control panel facilities for the technical director, production director and assistant. In addition, the control and equipment trailers have thermostat-regulated air conditioning, ventilation and heat facilities, and all are equipped with permanent telephone communications.

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DIRECTORY OF ALUMNI CHAPTERS

DETROIT CHAPTER meets 8:00 P. M., 2nd Friday of each month, St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Mich., VI-14972.

FLINT (SAGINAW VALLEY) CHAPTER meets 8:00 P. M., 2nd Wednesday of each month at Andrew Jobbagy's Shop, G-5507 S. Saginaw Rd., Flint. Chairman: Clyde Morrissett, 514 Gorton Ct., Flint, Michigan., OW. 4-6867.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER meets 7:30 P. M., 2nd Thursday of each month at George Fulk's Radio-TV Service Shop, Boonsboro, Md. Chairman: Robert McHenry, RR2, Kearneysville, W. Va. 25430.

LOS ANGELES CHAPTER meets 8:00 P. M., 2nd and last Saturday of each month, 4912 Fountain Ave., L. A. Chairman: Eugene DeCaussin, 4912 Fountain Ave., L. A., NO 4-3455.

MINNEAPOLIS-ST PAUL (TWIN CITIES) CHAPTER meets 8:00 P. M., 2nd Thursday of each month, at the homes of its members. Chairman: Edwin Rolf, Grasston, Minn.

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: John Schumott, 1778 Madison Ave., NYC. 722-4748.

NORTH JERSEY CHAPTER meets 8:00 P.M., last Friday of each month, Washington and Kearny Ave., Kearny, N. J. Chairman: George Schopmeier, 935-C River Rd., New Milford, N. J.

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: Joseph Burnelis, 2268 Whited St., Pittsburgh, Pa.

SAN ANTONIO ALAMO CHAPTER meets 7:00 P. M., 4th Friday of each month, Beethoven Home, 422 Pereida, San Antonio. Chairman: Sam Stinebaugh, 318 Early Trail, San Antonio, Texas.

SAN FRANCISCO CHAPTER meets 8:00 P.M., 2nd Wednesday of each month, 1259 Evans Ave., San Francisco. Chairman: Isiah Randolph, 523 Ivy St., San Francisco, Calif.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8:00 P. M., last Wednesday of each month at home of John Alves, 57 Allen Blvd, Swansea, Mass. Chairman: Daniel DeJesus, 125 Bluefield St., New Bedford, Mass.

SPRINGFIELD (MASS.) CHAPTER meets 7:00 P. M., last Saturday of each month at shop of Norman Charest, 74 Redfern St., Springfield, Mass. Chairman: Joseph Gaze, 68 Worthen St., W. Springfield, Mass.

1 C	2 A	3 P	■	4 H	5 A	6 M	7 S	■	■	8 L	9 A	10 B
11 A	D	E	■	12 E	D	I	T	■	13 S	O	R	E
14 M	O	D	15 U	L	A	T	E	■	16 C	O	I	L
■	■	17 E	S	P	Y	■	18 L	19 L	A	M	A	■
20 P	21 O	S	E	■	■	22 P	L	A	N	■	■	■
23 A	N	T	■	■	24 F	R	I	C	T	25 I	26 O	27 N
28 R	C	A	■	29 E	L	I	T	E	■	30 N	R	I
31 T	E	L	32 E	V	I	Z	E	■	■	33 F	E	N
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45 H	E	R	E	■	46 O	R	A	L	■	47 T	O	E
48 E	R	E	■	■	49 P	E	L	T	■	50 E	N	D

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6AB4, 6AC7, 6AF4, 6AG5, 6AG7, 6AH4GT, 6AH6, 6AK5, 6AL5, 6AL7, 6AM8, 6AN8, 6AQ5, 6AQ6, GAQ7GT, 6AR5, 6AS5, 6AT6, 6AT8, 6AU4GT, 6AU5GT, 6AU6, 6AU8, 6AV5GT, 6AV6, 6AW8, 6AX4GT, 6AX5GT, 6B8, 6BA6, 6BC5, 6BC8, 6BD6, 6BE6, 6BF5, 6BF6, 6BG6G, 6BH6, 6BJ6, 6BK5, 6BK7, 6BL7GT, 6BN6, 6BQ6GT, 6BQ7, 5BY5G, 6BZ6

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6W6GT, 6X4, 6X5, 6X8, 6Y6G, 7A4/XXL, 7A5, 7A6, 7A7, 7A8, 7B4, 7B5, 7B6, 7B7, 7B8, 7C4, 7C5, 7C6, 7C7, 7E6, 7E7, 7F7

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2N1136A, 2N1136B, 2N1137, 2N1137A, 2N1137B, 2N1138/A/B, 2N1245, 2N1246, 2N1291, 2N1293, 2N1297, 2SB25, 2SB26, AR5, AR6, AR8, AR9, DS503, DS520, ET-6, CT-1124, CT1124B, MN25, MN29, SYL-109, WTVPwr25, WTVPwr12, WTVPwr6, WTV89Pwr, WTV199Pwr

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