EDITORIAL

"Peace On Earth---Good Will To Men"

With the chill of winter in the air and Christmas just a few days away we all feel the exuberance of holiday spirit and the festivity which always comes with the Yuletide season. At this particular time we have reason to be more happy than usual and the occasion to celebrate considerably more than Christmas would ordinarily dictate. On every quarter, from the captains of industry down to the common laborer, we hear the report of better times. Our dynamic president has proved his worth and shown us that our faith was not misplaced. Under his guidance the country is already on the road to industrial recovery and general faith in the American people has been restored.

Christmas is the time of year when we all feel a little more kindly toward our fellow men. Also it is just before we begin a new year and all of us make many resolutions which we really intend to carry out faithfully. However, it is safe to say that a large majority of such resolutions made in good faith are usually violated the first few days of the new year and by the end of the first month most of them are entirely forgotten.

As a new experiment in New Year’s resolutions let us resolve, first of all, to make fewer, more important resolutions and really live up to them. Let us resolve to give a little more effort to performing our everyday work and doing our job well, regardless of what it may be. Let us resolve to never let a day pass without doing some unselfish service to our industry, our employer, employee, association, country or some worthy cause. Also, let us resolve to never allow a day to pass without advancing our knowledge in some way, by study, experience, or intellectually profitable contact of some kind.

Of course, we must assume inherent honesty and a desire to be fair and square in all our dealings, to be a quality which need not be bolstered up by New Year’s resolutions.

Whatever our resolutions for the New Year, let’s definitely resolve to rigidly observe them and endeavor to make this old world a little better for our efforts by next Christmas. A kindly word and friendly interest is often times the difference between happiness and despair to some one of our associates. These overtures of friendship take so little effort that we should resolve to maintain and evidence an attitude of “Peace on Earth---Good Will to Men” not only during the last week of 1933 and the first week of 1934, but for all time.
**THE AMBITIONS AND PURPOSES OF THE CERTIFIED RADIO TECHNICIAN’S ASSN.**

The radio technician or serviceman, as he is more generally called, has from the very inception of the radio industry, been deemed a necessary evil. It was only after several years of the most intensive demand from technicians in all parts of the country that manufacturers of radio receivers have finally come to realize that it is to their best interests to supply service information to any but dead technicians, who too often, than not threw what little there was supplied in the waste basket. Because the technician was a docile animal, didn’t stop to consider the value of his services or the cost of his training, the cost of keeping his testing and mental equipment up to date or that he might by growing old or lose the power to bring in the bare necessities of life he has been the prey of this most chaotic or shall I say, erratic industry. Individually we have from time to time averted to the tide of short-sighted selfishness but the lone wolf however heroic his stand, seldom escapes from his adversaries with a whole skin.

The events of the past few weeks have shown conclusively that the radio has Arrived, but the question remains, how shall it be used, and when we arrive at a plan for a true and efficient protective service for the public, we may answer by specialists in the particular field involved. We have an employment committee, which is actively working to secure for the members of this Association all the available employment in this field. We have in the course of this developmental work many other services of like nature which will of great benefit not only to the members of this organization, but to the radio industry and the public.

All these things and many more are available to the man who supports his organization, morally and financially, which would be very difficult or impossible, for the lone wolf to procure.

**THE FIVE METER BAND**

By J. J. GLAUBER

Chief Engineer, Arcturus Radio Tube Company

**HISTORY**

It is an interesting fact that the use of ultra-short waves is now being developed. For years the term "short-waves" was more correct term, because of their short range. At one time all wave-lengths below about 200 meters were despised because of the supposedly rapid absorption and consequent uselessness for long distance transmission. Then came the great discovery that, under certain conditions, short waves made long distance transmission possible with an expenditure of power ridiculously small compared with that which had been found necessary for reliable long-wave transmission. Now a new phase is developing as the result of the discovery that for wavelengths below 10 meters the waves which travel over the earth’s surface are rapidly damped out, while those which are radiated upward into space do not return again to earth. They are thus admirably suited for those cases in which it is required to broadcast over a limited area, and to limit reception strictly to that area; the latter condition may arise from reasons of secrecy or from the desire to avoid interference in regions outside the limited area. The distinctive characteristic of their use has been mastered to the same extent as that of longer waves, ultra-short waves will occupy a special place in radio activities and extremely useful niche of their own in the field of radio communication.

Waves below 6 meters in length have for convenience been termed "ultra-short." Often these “ultra-short” waves are said to be quasi-optical. The designation quasi-optical refers to the fact that the waves carry their energy in points within sight of the transmitting aerial, the words “within sight” being interpreted in a geometrical sense.

In the production of ultra-short waves, Heinrich Hertz was probably the first with his classical experiments carried out in the years 1880-90 on waves of two or three meters in length. In this work and in that of his contemporaries, the greatest limitation was placed on the problem and demonstrated the various properties of the waves, spark discharge oscillators were employed with gaseous tubes, various types of spark gaps and damped oscillographs. Following the application of this work to practical wireless communication, the spark transmitter was developed to a high degree on the longer wavelengths, of from 100 meters upwards. One of the most recent applications of damped waves of a few meters wavelength is the rotating beam transmitter described by C. T. Ball and E. M. K. of the Institute of Electrical Engineers of 1922, Vol. 60. Using a wavelength of about 6 meters, this transmitter was located at the focal line of a cylindrical parabolic reflector, the whole system being rotated continuously to enable ships to radio signals. Of recent years also, the spark transmitter has been developed as a means of generating extremely short waves in an attempt to link up the electromagnetic spectrum with that of the infra-red.

After the classical work of Hertz and his successors in the production of damped waves of a few meters wavelength, the period of nearly thirty years elapsed before it became possible to produce, even on a laboratory scale, undamped oscillations of the very high frequency corresponding to this small wavelength. This phase of the science had, in fact, to await the practical development of the thermionic valve.

When considering generally the use of the wave for the generation of oscillations of extremely high frequencies, it is evident that the thermionic tube will set an upper limit to the frequency obtainable. For if the plate of the tube is connected by the grid circuit, the frequency is determined by the inductance of the loop so formed and the capacity between the elements. By the use of grid of many investigators have reduced the inter-element capacity to such an extent as to enable them to obtain oscillations of frequencies up to nearly 300 megacycles per second, corresponding to a wavelength of 1 meter. If attempts are made to extend this process, a second limitation is soon reached, which is determined by the time of travel of the electrons from filament to plate inside the tube. In the wave generated by the tube must be greater than this time in order that the current through the tube may respond rapidly to instantaneous changes in the plate.

Going back to the more usual method of producing oscillations by the use of a vacuum tube with coupling, W. C. White described in 1916 a circuit arrangement which gave satisfactory operation at 50 megacycles. Three years later, Guttman and
Pad design is not particularly difficult, but at least it involves a little slide-rule computation, and therefore most people seem desirable to collect in one place and to do without them when they really need pads which contain constants they cannot find in their notebooks. Since notebook data has a most distressing habit of getting lost just when it is most needed, it has seemed desirable to place a fairly complete table of resistor values for all the pads in common use; hence the present effusion.

A few words about the choice of a pad for a given purpose may not be out of place here. For working into a high-impedance device such as the grid of a tube it is usually O.K. to use a potentiometer, which is the simplest form of pad. Here $R + R = Z_1$ (see below for diagrams and notations) and since this sum is constant only one switch arm and set of contacts will be needed if the pad is to be variable. For two impedances where it is not necessary that the impedance looking back into the pad output terminals shall equal the load impedance (probably the common case) we can use an H-pad. Here the equation given above no longer holds, and if the pad is to be variable we must use a double set of switch points, though the two switch arms are connected together. Finally, when the pad output impedance must match the load impedance, as in two-way mixers and other cases of symmetrical T-pads; the design of the pads in such cases is discussed later.

All of the pads in Table 1 are computed for 500-ohm lines. Pads for other characteristics can be computed very easily from the values given, by multiplying all of the resistances by the ratio of the desired impedances to the 500 ohms.

For example, suppose that a symmetrical pad is desired which will give 10 db loss in a 200 ohm line. 200/500 = 0.4; from the table we find that a 10 db 500 ohm T-pad has two series resistances of 250 ohms each and a shunt resistance of 35 ohms. Multiplied by 0.4 we get 104 ohms for the series arms and 141 ohms for the shunt arm.

No values have been given for H-pads, since they may be easily derived from the corresponding T-pads. The procedure is to halve each series resistor and to put the other half in the opposite leg; if it is desired to ground the electrical center the shunt resistor must be center-tapped. As an example, if the 200 ohm 10 db pad of the previous paragraph is to be used in a balanced line with the center grounded it will take the form of an H-pad each of whose four series arms is 52 ohms and whose shunt arm is composed of two 70.5 ohm resistors in series with their common point grounded.

Table 1. 500 Ohm Pads

<table>
<thead>
<tr>
<th>Loss, db</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>54.5</td>
<td>44</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>108</td>
<td>86</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>145</td>
<td>1162</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>185</td>
<td>1155</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>219</td>
<td>643</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>259</td>
<td>50</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>273</td>
<td>405</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>301</td>
<td>23</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>324</td>
<td>23</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>359</td>
<td>197</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>399</td>
<td>197</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>435</td>
<td>134</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>441</td>
<td>22</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>461</td>
<td>119</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>473</td>
<td>119</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>483</td>
<td>119</td>
<td>57.3</td>
<td>2160</td>
<td></td>
</tr>
</tbody>
</table>

(Continued on page 15)
FREQUENCY PROBLEMS IN TELEVISION

BY W. SCOTT HALL, JR., Engineer E. B. Dunn Co.

Among questions concerning television most frequently asked by technicians are the following two: the answers to which are closely related:

1. Why do television signals tune so broad?
2. Why aren't more lines used for television pictures?

The latter question usually follows an explanation of the fact that basically, the greater the number of lines used the better the pictorial detail will be and also the more complex the picture which is being transmitted can be. One detailed (but interesting, we hope) explanation will answer both questions.

Let us examine the method by which the modulation frequencies of television signals are determined. Figure 1 represents a simple constant object consisting of alternate black and white stripes painted on cardboard which we will assume is to be televised by a ten line scanner at the rate of ten frames per second. Line 1 is scanned first, followed consecutively by lines 2, 3, 4, 5, 6, 7, 8, 9, 10, then the section is repeated. The standard method of scanning is from left to right and from top to bottom consecutively.

The scanning beam in this example thus travels across one line in 1-100 of a second. Inasmuch as it takes one complete change from a dark to a light area (or the opposite) to create one cycle of current in the photo electric cell, then for each line scanned on this object there are six complete changes from dark to light areas giving rise to 6 cycles and in the entire object. With ten line scanning there would be 60 cycles per picture frame and at the rate of 10 frames per second the frequency would be 600 cycles per second. If there were half as many stripes the beam itself could be faithfully reproduced. The term aspect ratio is explained later in this article.

It has been found that for practical results the smallest number of lines that can be used to successfully televise a persons face with satisfactory definition is about 40 to 50 lines. To simulate motion smoothly it is necessary to have, in single spiral scanning systems, at least 15 frames per second. With a triple spiral system a few less frames per second can be used, approximately 12½ or 2½ per second less.

The number of lines will determine (and is equal to) the number of pictorial elements in the height of the picture. If the picture or field of view, was square it would be the same number, picture elements wide and the product of the two would give the total number of pictorial elements or units of light and dark area in the picture. The American Television Broadcasters have adopted as standard the same picture height to width ratio as a single frame of standard motion picture film which is 5 units high to 6 units wide. This is called the aspect ratio of the picture. If a picture is 45 lines high it will be 120 picture units, 45 wide or 54 elements wide. The product of these two figures 45x54 then gives 2430 which is the number of pictorial elements in the 45 line picture assuming standard aspect ratio.

In a 60 line picture we have 60 ele-

THE "FIVE METER BAND"
(Continued from page 5)

Touly described experiments, made with an ordinary type of tube then available, in which the wavelength was reduced to 3 meters, and by the use of a special low inter-element capacity type of tube this was lowered to 2 meters.

In a paper published in 1920, Southworth made a brief analysis of the general form of the circuit of an oscillating tube and drew attention to the necessity of substituting for lumped inductances circuits having distributed inductance and capacity if successful operation at wavelengths below 10 meters is to be obtained.

In 1924, R. Mesny described the results of investigations on short waves carried out in the French Laboratory for Military Radio Telegraphy. Mesny has given particular attention to the balanced two-tube type of circuit which was described by Eccles and Jordan in Radio Review, 1919. With this arrangement wavelengths as short as 1.5 meters were obtained with low power transmitters, and experiments were carried out using voice modulation of such waves. The circuits used by most amateurs today on 5 meters is an exact duplicate of that described by Eccles and Jordan. Using the super-regenerative type of receiving circuit, these experimenters succeeded in communicating by voice over a distance of 160 miles between mountain peaks in the Alps. When the same experiment was attempted along flat ground the distance of satisfactory transmission was reduced to 1.5 to 2 miles, thus illustrating the serious absorption effect of the earth for very short waves.

An interesting extension of the symmetrical two-tube oscillating circuit above was provided by Danilewsky in 1923. He used a single five element tube containing two grids and two plates. Oscillations of a few meters wavelength were produced.

Prominent among the more recent experimenters on the subject of ultra-short wave work, may be mentioned that carried out in Japan. Ueda has investigated in some detail the behavior of aerials and reflectors for use in beam transmission, while Yagi has carried out various experiments on wavelengths below 5 meters to show the effect of the earth in attenuating the waves, and of the directive properties of systems of inductively excited aerials and reflector wires.

(Continued in next issue)
The Electrolysis of an Oscillator and Detector

BY CONTESTANT NO. 1

The electron coupled oscillator and detector is the latest improvement in combined detector and oscillator circuits. It has all the advantages of the older types, the saving of space and more even coupling over the wave band; independent control over the individual circuits possible and intercoupling and interlocking effects are eliminated. No load is placed on the oscillator by this method with greater stability the result.

The usual methods of combining detectors and oscillators is to use capacitive and reactive coupling between the oscillator and detector circuits. The grid and plates being used for both oscillator and detector circuits; with the new system, separate elements are used. A simple electron coupled mixing tube may be considered as a detector tube into which the modulating frequency is impressed, and the plate which is the common cathode, the first grid and anode being between the cathode and the elements of the detector portion of the tube. The two extra elements, the grid and the anode grid, form the elements for the oscillator and being between the cathode and the elements of the detector circuit, modulate the space current in an electron-coupled manner.

The tubes used for electron-coupled mixers are called Pentagrid Converters. The two important models being the 2A7 and 6A7, identical except for the filament voltages which are 2.5 and 6.3 volts respectively. Two of these tubes use seven elements in their construction; they are the filament for heating the cathode, the common cathode, the first grid and anode grid which make up the oscillator; the screen grids for shielding the control grid, the control grid between the screen grids upon which the incoming frequency is impressed, and the plate which is the output for the modulated signal.

These tubes when built into a circuit must be thoroughly shielded; the capacity in the output or plate circuit of this tube should be large enough to limit the output voltage built up across this circuit in order to prevent degenerative effects. It should be at least 50 uuf.

It is very interesting to note how the great flexibility obtainable with this type of tube, a great many different circuits and combinations are possible. The following is a circuit adaptable for this tube which works very well.

Circuit Constants

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.1 Microfarad</td>
</tr>
<tr>
<td>C1</td>
<td>200 Micro-Microfarads</td>
</tr>
<tr>
<td>R</td>
<td>250 Ohms Approx.</td>
</tr>
<tr>
<td>R1</td>
<td>10000-25000 Ohms, when Screen voltage=50</td>
</tr>
<tr>
<td>25000-50000 Ohms, when Screen voltage=75</td>
<td></td>
</tr>
<tr>
<td>50000-100000 Ohms, when Screen voltage=100</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>20000 Ohms (approx.) Voltage Reducing Resistor, When Anode Grid Supply Voltage Exceeds 200 volts</td>
</tr>
</tbody>
</table>

**EDUCATIONAL COURSE CONDUCTED BY R. G. LEITNER**

Mr. R. G. Leitner, under the auspices of the National Union Tube Company, has conducted a very valuable course of lectures at the Union test laboratory. The lectures have given detailed information for the construction of semi-precision laboratory testing and measuring equipment for the service laboratory and experimenter. These lectures held in conjunction with the meetings of the Certified Radio Technicians Association, have been attended by quite large numbers of technicians and everyone attending has voiced approval of the series. Mr. Leitner is to be congratulated for the systematic and natural attack of underlying theory which has made it possible for the man with little or no technical training to grasp the fundamentals of radio servicing and attendant problems.

The National Union Tube Company, who has made it possible for Mr. Leitner to bring his lectures to the radio technicians of Southern California, indicate the possibility of continuing the series indefinitely if sufficient interest is evidenced. The lack of interest is certainly no problem so we may very probably have the pleasure of attending more of these interesting meetings after Christmas. Thank you! Mr. Leitner and National Union!
A MODERN ANALIZER FOR MODERN RADIO
BY CONTESTANT NO. 3

In the following article is an analizer which combines flexibility and simplicity of operation and still is within the limits of size and standard parts.

The panel is 7 by 10 inches and the case 10 × 13 1/2 × 3/4 inches inside which leaves space for all cables and batteries. Referring to the diagram, there are four pin jacks on the left side. The two top ones are for output voltmeter connections. A triple pole double throw jack switch, S1, switches to either A.C. or D.C. A shunt, R1, is thrown in on D.C., giving the same calibration on either A.C. or D.C.

Five voltage ranges (10, 50, 250, 500 and 1000) cover all needs and are adaptable to the scale with which the meter is equipped. A tap switch, S9, selects the desired range. The multipliers are on the taps and connected in series.

The two center jacks, with switch, S1, in the D.C. position are continuity and resistance. For meter protection a switch, S7, is provided. The meter is open until the plug is inserted into the plot, the eighth to the grid clip and the ninth to the set ground with a battery clip.

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Two button switches, S3, in the grid, and S4, in the control grid circuit, are for grid swing test. A ten point tap switch, S10, provides reading of the voltage to any element. A triple throw single pole toggle switch, S5, allows any reading to be taken to either filament, cathode or ground.

The current meter, a 10 milliammeter, is equipped. A tap switch, S8, returns the meter to the 10 mill scale.

TSP, a four prong socket for rectifiers, TSP, a 4-5-6 prong socket and T3, a 7-7 prong socket are connected to the radio through a nine wire cable, seven to the plug, the eighth to the grid clip and the ninth to the set ground with a battery clip.

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The panel is 7 by 10 inches and the case 10 × 13 1/2 × 3/4 inches inside which leaves space for all cables and batteries. Referring to the diagram, there are four pin jacks on the left side. The two top ones are for output voltmeter connections. A triple pole double throw jack switch, S1, switches to either A.C. or D.C. A shunt, R1, is thrown in on D.C., giving the same calibration on either A.C. or D.C.

Five voltage ranges (10, 50, 250, 500 and 1000) cover all needs and are adaptable to the scale with which the meter is equipped. A tap switch, S9, selects the desired range. The multipliers are on the taps and connected in series.

The two center jacks, with switch, S1, in the D.C. position are continuity and resistance. For meter protection a switch, S7, is provided; the meter is open until the plug is inserted into the plot, the eighth to the grid clip and the ninth to the set ground with a battery clip.

Two button switches, S3, in the grid, and S4, in the control grid circuit, are for grid swing test. A ten point tap switch, S10, provides reading of the voltage to any element. A triple throw single pole toggle switch, S5, allows any reading to be taken to either filament, cathode or ground.

For meter protection a switch, S7, is provided; the meter is open until the plug is inserted into the plot, the eighth to the grid clip and the ninth to the set ground with a battery clip.
FREQUENCY PROBLEMS

IN TELEVISION

(Continued from page 8)

In the 80 line pictures, which are being broadcast in Los Angeles by the Don Lee Broadcasting System, the picture is 80 elements high x 96 elements wide or composed of 7680 pictorial elements. In the 45 line pictures the number of elements is doubled, giving over three times the detail obtainable in the 45 line pictures. In fact the following rule always holds true: If the number of lines used in the picture is doubled then the number of pictorial elements is squared thus giving a corresponding increase in the fineness of detail in the picture.

To convey a concrete idea of the aim of television research, may it be said here, that to have television pictures with the same effectiveness of detail as home movies, it will be necessary to employ in the neighborhood of 24 frames per second in scanning the picture. On this point nearly all of the country's foremost television engineers are agreed. At this point in the discussion the logical question is, Why not use more lines? We will now endeavor to answer this question by finding out to what extent our modulation frequencies change with a change in the number of lines.

Except on ultra short waves the channels assigned for television use are 100 kilocycles wide which will allow modulation frequencies up to 50,000 cycles either side of the carrier frequency.

In the 45 line pictures we have 2430 pictorial elements and if it takes two or more pictorial elements to create one cycle of current this gives a possible maximum of 1215 cycles per frame and at the rate of fifteen pictures per second this gives 18,225 cycles per second as the highest modulation frequency we can use in the 45 line pictures. Inasmuch as the broadness of the frequency response of television receiver will be determined by the highest modulation frequency we can now see why television signals are so broad.

Among some of the problems to be overcome are:

1. Obtaining photoelectric cells or other light to current translating mediums which will faithfully respond to light changes having a frequency range from practically nothing to several million cycles per second.

2. Properly modulating a carrier frequency with this enormous band of modulation frequencies.

3. Reception, amplification and demodulation of this wide band of frequencies.

4. Obtaining a light source for the receiver scanning system which will respond faithfully to the same wide band of frequencies.

Doubling the non-mechanical system of scanning for both transmission and reception will eventually be used in which the scanning beam will be some practically inertialess and lagless at extremely high speeds and electrons similar to cathode rays.

With the 60 line pictures there are 4320 elements or 2160 cycles per frame and inasmuch as all television broadcasters utilizing 60 lines have standardized on 20 frames per second this gives a top modulation frequency of 43,200 cycles which is still within the allowable frequency limit.

80 line pictures are composed of 7680 pictorial elements or 3840 cycles per frame and at 15 frames per second, which is the speed at which they are shown at the present time, the highest modulation frequency is 57,600 cycles per second. It is necessary to suppress all frequencies above 50,000 cycles on the standard 109 or 140 meter television channels when such a large number of lines are used. However, at the present time successful reproduction or detection of ultra short waves will still present some difficulties so the gain is not so apparent as might be expected.

As closing the simple let us see what frequencies arise in the scanning of a 400 line picture. Thus we are shown a little more than a head view can be shown with the same detail.

PAD DESIGN TABLES

(Continued from page 6)

The formulae from which all the resistance given above may be computed are fairly simple, but this is not the case for pads which must work between dissimilar impedances. Since we now have two variables instead of one, i.e., both attenuation and impedance ratio, any reasonably complete table would be very bulky—besides requiring much more time for computation than I care to spend. So I have tabulated values for a few of the most useful pads of this type and have added a table of coefficients for which are probably the simplest of the several equivalent design formulae for this case. Anyway, if you're too lazy to substitute in a simple formula you don't need an impedance matching pad very much.

The rule given above for changing a T- to an H-pad holds here also, though care should be taken to keep the same resistances in the proper legs; i.e., the two input series resistances should be equal and also in the two output legs.

To change the characteristic impedance will also work, but only if the required values is to be an input to output impedance ratio as the prototype. Thus a 200 to 20 ohm pad could be made up by taking a 500 to 50 ohm pad of the required attenuation and multiplying all of the resistance by 0.4, but a 200 to 50 ohm pad could not because the impedance ratio is not the same in the two cases.

It should be noted that there is a minimum possible loss for which this type of pad can be constructed, which depends on the impedance ratio. This loss varies from zero for a ratio of 1.0 to infinite loss for ratio zero, being 4.7 db for 0.75, 7.65 for 0.5, 11.4 for 0.25, 15.80 for 0.1, etc. For this reason some of the pads in Table II, are labeled "impossible," since their losses are less than the minimum corresponding to their impedance ratios.

In conclusion, although all values have been given in three figures in the above tables it is not necessary to hold the actual values of the resistors used in a very high accuracy except in special cases. An error of 5 per cent in one resistor will cause an impedance mismatching of not more than that amount—usually less—and a loss variation of only half a db. Most commercial wire-wound resistors and many carbons and lattenes are sufficiently close for all practical purposes. So go to it with any blue bottle and if you want more dope of this kind I'll try to furnish it.
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QUESTIONS AND ANSWERS

Q. In what respect are litz coils superior to coils wound with solid wire?

A. Assuming coils of a size and inductance suitable for use in a receiver, tests have shown that the RF resistance of litz coils is less at the lower BC frequencies and higher at the higher BC frequencies than similar coils wound with solid wire. This greatly facilitates the design of litz coils having the desirable constant gain characteristic across the BC band. Outside the BC band, solid wire is superior for short wave coils while litz is better for IF coils due to lower RF resistance under the respective conditions.

Q. Is there any way a 0-1 DC millimeter can be made more sensitive?

A. Since the sensitivity of a d'Arsonval type meter depends upon the strength of the permanent field magnet, the torque of the springs, and the amper-turns in the moving coil, there is nothing that one who is not a skilled meter expert can do to increase the sensitivity unless by chance the meter happens to have an internal shunt. In that case removal of the shunt would increase the sensitivity.

Q. How much will the voltage be raised by substituting a 5Z3 for an 807?

A. 20 to 30 volts may usually be expected, depending upon the load and the design of the pack.

Q. Why do high grade signal generators (oscillators) use tube modulation rather than self-modulation?

A. Self-modulation necessitates the use of a grid condenser and leak. This introduction of resistance to the grid circuit broadens the tuning of that circuit and therefore the signal. A separate tube modulator has the additional advantage that the percentage and frequency of modulation may be controlled at will.

LOCAL DESIGN ENGINEER PROMISES ARTICLE FOR "TECHNICIAN"

Mr. Louis B. Brittain, chief engineer of the Herbert H. Horn Co., manufacturers of Tiffany-Tone radio, has promised to prepare an article of exceptional interest to appear in these pages in the near future. The Herbert Horn Company has announced a new 7 tube all-wave receiver designed by Mr. Brittain which is definite proof that Southern California is capable of producing radio equipment which is on a par with any other section of the country.

A MODERN ANALYZER

(Continued from page 12)

switch is closed. Further protection is through the use of fuses, P₁, and P₂, in the meter circuits.

Switch S₆ is used to read the current of either plate of a rectifier tube. To read the voltage on both plates place the tube in TS'. From plate to ground gives A.C. volts applied to plate. From filament to ground gives D.C. out, put volts of the tube.

The cable wires are numbered from one to nine corresponding to the numbers on the sockets and selector switch with the exception of points 7, 8, and 9 on the selector switch. No. 8 on the switch is the grid cap, 7 is the off position, 9 the position for continuity and resistance, and 10 the position for output voltmeter.

Details of construction, etc., may be obtained from the author.

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Comparison Between Class “A” and “B” Amplification

By A. A. Simon

A'. When $V'$ is a class "A" stage, $T'$ is a voltage transformer.
(a) The current in the secondary of $T'$ is negligible because the grids of $V'$ never swing positive.
(b) Thus the size of wire for this secondary is as small as is practical to wind.

$R_s = \frac{Pc}{Ig} - E_s = 0 = \infty$

A'. When $V'$ is a class "B" stage, $T'$ is an impedance matching transformer and $V'$ is a power amplifier stage.
(a) The current in the secondary of $T'$ has a definite value, depending upon the time of excursion of the grid swing while it has a positive potential.
(b) The wire used on the secondary of $T'$ must be heavy enough to safely carry the grid current pulses.
(c) The turns ratio of the impedance matching transformer is:

$$T = \frac{N_s}{N_p} = \frac{V_p}{R_p}$$

B'. In a class "A" stage of push-pull, the normal D. C. plate currents flowing in the plate circuit of each tube set up flux in the core of the transformer $T'$ which are equal but of opposite polarity thereby neutralizing each other. Hence, since the possibility of core saturation is greatly reduced a small core may be used for $T'$.

B'. In a class "B" stage of push-push, the normal D. C. plate current is zero, if the grids are not excited. When the grids are excited, as shown below, a pulse of plate current flows for alternate half cycles, in the plate circuit of each tube. Since these pulses of plate current of each tube do not flow during the same half cycle each current will set up a strong D. C. field necessitating the use of a large core for $T'$ in order to minimize the possibility of core saturation.

C. As was pointed out, the D. C. plate current remains practically constant in a class "A" push-pull stage regardless of volume input (grid excitation). However, in a class "B" push-push stage the plate current increases with volume input, so the speaker field cannot be used in the plate supply circuit because its high resistance would cause fluctuations in B+ voltage as the plate current varied.

Also, the internal resistance of the rectifier tube and its plate supply secondary of the power transformer, and all filter chokes, must be kept low in order to get the best possible regulation from the pack.
Radio in all places is a factor which not only gives joy to living, but has now gone so far as to be a vital commodity to every family and every person. In Mexico and countries south of the Rio Grande, the Latin Americans are not behind in accepting this wonder, the art of electronics. Conditions in these countries are slightly behind, the reason being, of course, the lack of sufficient expert radio talent and modern research laboratories. The ones that are installed are those owned by government or municipal authorities and they are for the sole purpose of developing naval radio beacons and weather radio stations. Only a few military bases are at the present experimenting with the popular five meter band for super-short wave telephone communication.

An outline of the status of the short wave amateur in Latin America is worth mentioning. Countless are the instances where radio amateurs rendered public service and emergency relief in moments of distress, and have proved that they are capable even if they are handicapped by the lack of advanced equipment. One proof is that here in Los Angeles there is a continuous stream of letters to our manufacturers and even retailers inquiring about parts, kits, data and installations on short wave equipment. Down there they are just beginning to feel the epidemic caused by the fatal sting of the "radio bug."

Spanish Radio Language

Technical literature in the Spanish language for the radio man is also lacking. There was in Mexico City about a year ago, a distributor who attempted a monthly radio journal. It was said to be exclusively for radio but a couple of pages of cooking recipes were added! Here in the United States several eastern factories are printing good pamphlets and data sheets in Spanish explaining their products, to supply the demands. When speaking of literature there comes to my mind a letter I once received. To translate all technical terms used in radio to the Spanish language has been rather difficult for they already have different electrical denominations which they have incorporated into the English radio terms and names. Just recently I received from a friend an interesting letter wherein he described the functioning of a duo-valve tube and believe me it was sort of concentrated—brief—in his entire paper not once did he mention English for his theory or notes on the tube elements.

The sales and market for American radio products in Latin America is, in my estimation, about even with the European products. There is a considerable variation in the international money exchanges but leaving the money value aside, the radio parts and broadcast receivers from the United States have more acceptance and there is a growing demand for them. Outside of "B" batteries, "A" cells and a very few cabinets everything else is imported into Mexico. Then, too, I want to say that if you happen to live in a town that is not one of the five largest in Mexico, and your radio goes on the "blink" you would have to send it by railroad to Mexico City and the charges are 15 pesos for examination only, parts and labor extra. Popular standard midgets run around 150 pesos and I won't try to make you believe what a new twenty record automatic panatrope costs (or a sixteen tube all-wave super with umpteen outstanding features described in nine syllable words.—Editor).

Season's greetings to all members of the Certified Radio Technicians Associations and I hope that there will be a closer bond of understanding between our radio minded Americas for the advancement of radio.
NEW CITY OF LOS ANGELES
ORDINANCES RELATING TO
ELECTRIC REFRIGERATION

You should familiarize yourself with ordinances No. 68,490, 69,856, 73,173 and 73,174, all of which have an important bearing on the sale, installation, repair and sale and alterations to Electric Refrigerators.

Very quietly and mysteriously, these laws of Los Angeles were introduced and made operative through the selfish wish of some unknown parties.

In brief—every individual, firm or corporation selling, installing and servicing refrigerators, is regulated under these ordinances, and according to same is obliged to register with the Board of Building & Safety Commissioners, and be issued by said Board a Certificate as a "Refrigeration Contractor."

The annual fee for such license is $25.00 and is renewable on July 1st of each year. At the present time, no examination is being made to establish the qualifications, ability or technical experience of each applicant, but it is promised that the next renewal date of July 1st, 1934, every applicant will be obliged to take a rigid examination (similar to that before the next renewal date of July 1st, 1934, every applicant will be obliged to take a rigid examination (similar to that before the next renewal date of July 1st, 1934, every applicant will be obliged to take a rigid examination (similar to that before the next renewal date of July 1st).

In addition, every registration will have to provide a $1,000 bond, payable to the City of Los Angeles, to cover any possible infractions of existing ordinances. This looks like a fine way to raise money for our City, for which they do it.

This seems to be along the lines of eliminating only the small and financially weak operator and to favor the big and rich organizations. However, the weakness seems to be along the lines of insufficient examination of every applicant to determine his knowledge and ability to do efficient and qualified work.

If the chisler and faker who has a screw driver and plier and thinks he is a mechanic or refrigerator engineer, but actually has quite insufficient knowledge, was to be removed from business circulation, because he could not pass a rigid examination, this would reduce accidents, hazards, damages, etc. In the manner operated now, any man, firm or corporation may register and be licensed if he can provide sufficient money to cover the fees.

Whether this is all wrong or right, we now have these laws and you are effectually bound by them. The Building Department of the Building & Safety Commission in the City Hall, register and be licensed and bonded, if, in your service, you come under the regulations.

—J. V. VALFOYLE.

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SERVICE KINKS

A very successful condenser tester may
be constructed by placing a tenth watt neon bulb in series with a D. C. voltage and touching the ends of the test prods to the condenser under test. If the condenser is good the neon will glow while the condenser is taking a charge and go out when the condenser is fully charged. The light should not glow again if prods are touched again to the condenser within 10 to 20 seconds. If the neon should glow after 10 seconds the condenser is leaky, and should be discarded. A 250,000 ohm resistor is connected in parallel with the neon bulb. This tester is for paper condensers only. If properly constructed it is a very useful instrument to have on the bench.

Roy K. Tate.

When you come across a baffling case of interference at night causing a loud buzzing in the radio like a buzz-saw or powerful motor, drown out all signals and which diminishes or vanishes when the antenna is disconnected, it may be a defective electric lamp. A simple test to determine this is to unscrew all the lighted lamps while the radio is playing. When one is found which when unscrewed will cause the noise to cease it is obviously the offending member. The lamps may appear O. K. but I have found several cases of severe interference which were traced to defective light bulbs.

—L. K.

Early model Peter Pans: If volume is low remove the 47 tube and if it is possible to hear KFJ, KJH, check the filter condensers for open-circuit.

—J. E. SCHINDLER.

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Some months ago while working out some special problems in sound recording a dependable audio oscillator became absolutely necessary to the progress of the work in hand. Previous to this time I had spent several months on the design of audio oscillators of various types (straight audio oscillators, beat-frequency oscillators and dynamos with temperature control were all discarded because of inherent shortcomings.) True, some of these faults would be of no consequence in the ordinary uses for which an oscillator is required but for the work in which it was to be used in audio generators was required. Absolute frequency stability was the first essential. Minimum harmonic content was the second and a reasonably flat curve was the third consideration. Coupled with these characteristics it was necessary to be able to vary the frequency with reasonable ease from the lowest to the highest frequency and as both time and money were getting short not too much of either could be spent on any part of the problem. In the midst of my dilemma it became necessary to run a curve on a Carrier oscillator which we were using. While Mr. Carrier was running a calibration curve on the microphone I became attracted to his audio oscillator and asked for the circuit diagram. I publish this article with the permission and cooperation of Mr. O. B. Carrier, of the Carrier Microphone Company of Inglewood. This oscillator is the result of long and trying research on his part and I take no credit for any of the design but I have made some changes which made it better for my own particular problems.

It is suggested that it be built strictly according to the circuit diagram first and that the changes be made later if any are found necessary. The builder will save much time in the construction of this oscillator if he will use the transformers specified as they have been chosen for their characteristics and while I am not so bold as to say that only transformers which may be used neither Mr. Carrier nor myself have found any others which quite suit the requirements. A second hint is that to begin with, no attempt should be made to operate this oscillator with alternating current. For some work this may be desirable, but if the output is to be used for any kind of measurements this is definitely prohibited as the slightest amount of hum will throw off the measurements. To introduce beats which destroy the wave form and cause harmonics which render measurements valueless.

A small but important point which made the entire range easy to cover with two revolutions of the dial is that true, one is one more revolution of the dial than is required with a beat-frequency oscillator but the wave form and the absence of harmonics more than offset this and to anyone who has used the ordinary audio oscillator with fixed condensers for variation of the frequency the ease of operation of this oscillator is at once apparent.

The main frequency control is a 700,000 ohm potentiometer the frequency is varied from the lowest point up to the middle range in one revolution of this control and the switch is then thrown to the high side of the range covered by starting with the control as at first. The variable condenser acts as a fine adjustment on the high frequencies. By using a potentiometer from which the stop has been removed and mounting the change-over switch near the main control it no longer becomes necessary to return the potentiometer to zero through the entire arc and an auxiliary lever may be mounted on the shaft to throw the switch from low to high and vice versa so that the entire range is swept with two revolutions of the dial.

Another precaution is that no change should be made in the method of obtaining bias on the tubes. The bias voltage is developed in the series filament resistor in the negative side of the filament. Needless to say the condensers used must be of the best non-inductive type and it is recommended that they be tested for leakage in series with 250 volts of well filtered direct current and a neon lamp. Discard any condenser which shows even the slightest glow after the charging flash.

The operation is as follows: With the filament at 2 volts and the 0-5 milliammeter indicating oscillation the frequency should be very low when the R500 transformer is in the circuit and there is a minimum of the 700,000 ohm resistor in the circuit. On the low side variable condenser will make no difference if the 700,000 ohm resistor is now turned to maximum the frequency will rise to about 3000 cycles. To cover the high range the 111A transformer is switched in with the variable at zero and no resistance in the main control, the frequency should start at nearly the same point as before. On the other transformer left off. The resistance is now turned to full position. About 2000 cycles will be added to the range by adding the capacity of the variable condenser. If there is a gap between the two ranges this may be closed by adding capacity across 1 and 4 on the 111A transformer. If, on the other hand, the ranges overlap, capacity added across G and P on the R500 transformer will remedy the difficulty. The output curve may be flattened by a tone control in the plate of the amplifier as it will be found that the highs are more powerful if the proper precautions are taken to eliminate stray capacities.

In a subsequent issue the method of calibration and a direct reading frequency meter for audio frequencies will be given.
ARCTURUS TUBES USED IN STRATOSPHERE FLIGHT

From Radio Press, Newark, N. J.

In the history-making ascent into the cosmic region by Lt. Com. T. W. C. Settle and Major C. L. Fordney, Arcturus Tubes were used in the stratosphere-cosmic ray meters. This extremely sensitive equipment was used in making important measurements miles above this earth, an area practically unknown to scientists.

On Arcturus Tubes, manufactured by the Arcturus Radio Tube Company, Newark, N. J., depended the success of these intricate observations. It is believed that a record for altitude performance of radio tubes was established in this flight, as well as a record for altitude—a tribute to the precision and efficiency of radio tubes as manufactured today.

REPLACEMENT PRICE LIST

Mr. Eddie Frietas, on behalf of A. E. Ravenroost, presented the members and guests of the CRT at the regular meeting Monday, December 4, with copies of list price quotations for all standard replacement parts such as condensers, resistors, and voltage dividers.

ARCTURUS TUBES USED

Elsewhere in this issue you will find a brief account of the aims and purposes of this association and various accounts of our activities. We solicit members who are actively engaged in technical radio pursuits and who are interested in assisting themselves, through cooperating with others, to rise above the treacherous lowlands of the oft-mentioned depression and advance the radio art as a profession, and themselves as technicians. You are cordially invited to attend our meetings and instructive lectures and learn more of our efforts to progress through concerted action and united strength.

By calling any of the directors of the Association whose phone numbers are found in this issue, you may determine the location, time, and attractions of our next meeting.

NEW INTERFERENCE ASSOCIATION FORMED

Since the dissolution of the Radio Music Trades Association, the work of the interference department has been valiantly carried on under the direction of Mr. Grimes with Mr. J. V. Guilfoyle acting as unpaid secretary. The entire expense of carrying on this work has been borne by the various public utilities, and the least that we members of the radio industry can do, is to support morally and financially this work which benefits not only the radio trade but the entire listening public.

On December 6, 1933 the Radio Trades Engineering Association was formed into a permanent organization with Mr. Juneau of the Broadcaster’s Association, as president, Mr. Panter of the Bureau of Power and Light, as vice-president, and Mr. Grimes, the chief engineer of the organization, also holding the office of secretary-treasurer.

With the millions of electrical appliances such as vacuum cleaners, heating pads, traffic signals, diathermy machines, neon signs, and others, in use today, radio reception would be practically impossible without some agency for the tracking down and elimination of so-called “man-made” static.

It behooves us as technicians whose livelihood is directly dependent upon the ability of the listener-in to receive satisfactory performance from his radio receiving set, to aid in every manner possible, Mr. Grimes and his assistants in clearing up such interference as develops from time to time. We can best accomplish this, first, by seeing to it that every receiving set with which we come in contact is properly installed with a good ground and an outside antenna which should be kept as far as possible from surrounding objects. Secondly, we can cooperate in this work by first making absolutely certain that a complaint of interference is received, that the source of the noise is not in the set itself. This can best be accomplished by taking a small portable superheterodyne receiver, known to be in good condition, into the house from which the complaint was received, and noting if the same noise is also present in the output of this instrument. Lastly, a log showing the approximate time and duration of the interfering noise should be obtained from the customer extending over a period of several days.

If this information is then relayed to Mr. Grimes, it will save much time and money for the Radio Trades Engineering Association, and this is of vital importance at this time of economic stress.

The foregoing precautions will eliminate the many needless calls which have been made by the engineers of the association in the past to homes where interference was reported and which upon analysis proved to be receiver trouble.

Each branch of the radio industry is represented upon the board of directors of the Radio Trades Engineering Association and, as your President, represent the technicians branch, and inasmuch as it is impossible for us to support this work financially at this time, the least we can do is support it by lightening the work of the engineers whenever possible, and by helping publicize to the trade and to the public the efforts of the Association.

A. PAUL, Jr.
President CRT

(As a result of Mr. Paul’s ten years experience as an engineer with Western Electric, he is particularly well qualified to assist in shaping the destinies of this Association. It is indeed fortunate for everyone concerned that Mr. Paul is a member of the Board of Directors of the Radio Trades Engineering Association.—Editor.)

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THANKS

We are indebted to Mr. Thomas B. Pritchard, Southern California distributor of Arcturus Tubes, for the splendid article, "The Five Meter Band," a three part technical treatise on this absorbing subject which begins in this issue. The article was especially prepared and written for the "TECHNICIAN" by Mr. J. J. Glauber, chief engineer of the Arcturus Tube Company, at the request of Mr. Pritchard.

Mr. Pritchard has been and is one of our most earnest supporters in word, act and spirit. We wish to express our sincere appreciation of his kind cooperation and support.

NOTICE TO ADVERTISERS AND THEIR PATRONS

Beginning with this issue each advertiser will be furnished with suitable cards to display in the proper places which will signify that the holder of the card has advertised in the "TECHNICIAN" for the month shown on the card. Advertisers will place these cards in their windows and on their counters. Technicians are urged to patronize only those firms whose advertisements appear in these pages. These men are soliciting your business and are supporting your efforts to progress—it is only fair to reciprocate by giving your business exclusively to those who evidence a willingness to help us.

YULETIDE GREETINGS TO OUR ADVERTISERS

On behalf of the membership of the Certified Radio Technicians Association, the officers and Board of Directors and the editor of the "TECHNICIAN" wish to take this opportunity to express our best wishes for a Merry Christmas and a very successful and prosperous year to come. We sincerely appreciate your support in word and act in the past and we shall make every effort to deserve your continued cooperation during the years to come and the attendant progress in the radio field.

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INDEX

Aims and Purpose of the Certified Radio Technician's Association..Page 4

"Five Meter Band"..................Page 5

By J. J. Glauber

Pad Design Tables ..................Page 6

Frequency Problems in Television Page 8

By W. Scott Hall, Jr.

The Electron Coupled Oscillator and Detector ..................Page 10

By Contestant No. 1

Tracking of Variable Condensers ..................Page 11

By Contestant No. 2

The Modern Analyzer for Modern Radio ..................Page 12

By Contestant No. 3

A New Year's Message from your President ..................Page 13

Technical Questions and Answers ..................Page 19

Comparison Between Class "A" and "B" Amplification ..................Page 20

By A. A. Simon

Notice to Contributors ..................Page 21

Radio Conditions in Mexico........Page 23

By Luis Lopez Romero

New Ordinances on Electric Refrigeration ..................Page 24

Service Kinks and Pet Equipment ..................Page 25

An Audio Oscillator ..................Page 26

By John A. Orme

New Interference Association Formed ........Page 29

For Sale—

We have a few 60 cycle 900 R.P.M. synchronizing Television Motors on hand. Made expressly for Don Lee reception. Price very reasonable. Phone or write to E. B. Dunn Co., 3948 Halfdaile Ave., Los Angeles. University 4938.

Wanted—

Used 203A, 866, 2000 volt condensers, 10A and 15 henry 300 mil. chokes. Box X-1, c/o the "TECHNICIAN."

Cash paid for stamp collections. H. I. O'Brien, 1348 E. Colorado Boulevard, Glendale.

Precision Laboratory measuring equipment. Box X-2, c/o The "TECHNICIAN."

Three foot trumpets and dynamic units, new or used. Box X-3, c/o The "TECHNICIAN."

Weston model 301 0-10 amperemeter and decade resistance box. Fox and Racon Dynamic Horn Units. Norman B. Neely, ALbany 1628.

For Sale or Trade—

One Weston 0-4 A.C. Voltmeter, like new. One Weston 0-19 D.C. Milliammeter. Roy K. Tate.


Weston Model 301 meters—0-15 voltmeter, 0-30 milliammeter, 0-1.5 milliammeter (multi-scale). Norman B. Neely, ALbany 1628.

Readrite analyzer for sale or trade. H. I. O'Brien, 1348 E. Colorado Blvd., Glendale.