THE SCANNER

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CONFIDENTIAL

THE "HOTTEST" LITTLE THING . . . . IN RADIO

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THE SCANNER

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PRINTED PRIMARILY FOR THE INFORMATION OF THE MEMBERS OF THE ENGINEERING DEPARTMENTS OF THE RCA MANUFACTURING COMPANY, INC.

Several articles of outstanding interest will be found in this issue. The Production Engineering Division have kindly provided a description of the technical features of our new line of home receivers. Next quarter we expect to supplement this with the story on our auto radios.

Since our previous issue, two conventions of the Institute of Radio Engineers have been held, one in the East and one on the West Coast, we include here brief summaries of the outstanding papers delivered at each. As in previous conventions of this society, the RCA engineers were well represented and presented many of the papers of greatest interest.

We are pleased to be able to present in this issue two articles which our Canadian plant has provided concerning the activities of the newly created Engineering Products group there. We believe these will be of interest to all our readers.

The series on Plastics which was begun in our previous issue is continued here with another of Mr. Creager's informative articles on that subject.

For the benefit of authors of technical papers, a study has been made of the editorial requirements of the principal periodicals in which we publish articles. The condensed results of this study are given in some of the loose-leaf sheets accompanying this issue. We believe those of our engineers who write technical articles will find it advantageous to retain this information in a convenient place for reference.

In This Issue

THE 1941 LINE OF INSTRUMENTS

By P. F. G. Holst
Production Engineering Division

In accordance with our Company Policy, the spring convention and the simultaneous introduction of the entire line of instruments has been eliminated. Instead, new models have been placed on the market at suitable intervals. At this time, the release of the 1941 line of instruments is complete and it may be of interest to study some of its principal features from an engineering point of view.

The design of the 1940 line was based on the prediction that consumer interest would center around small table receivers and portables in the lower price brackets and console radio-phonographs at higher cost. A study of the 1941 line will reveal that a further development of this trend is expected by our Sales Department.

The outstanding feature in all the new instruments is unquestionably the styling which is the result of a very close cooperation between the Sales, Styling, and Engineering Departments. Push-buttons, knobs, dials, and bezels are styled and located so that they blend better than ever with the cabinet designs.

All antenna circuits, with the exception of those used in the farm receivers, are designed to provide satisfactory reception without an outside antenna or ground under all but the most difficult receiving conditions. All push-button receivers use fixed tuned circuits for greater stability in station set-up, ease of operation, and accuracy of tuning.

Of special interest in this year's line of instruments is the almost exclusive use of tubes of the "preferred" types. The standardization which has been reached in this respect will be of benefit to all concerned. The tube manufacturing division will be able to concentrate their efforts on a smaller number of tubes, the customer will be able to obtain replacements more readily and at lower cost, and finally, the use of preferred tubes represents a large step towards the standardization of the instruments themselves.

All except a few Nippers and the portable receivers are approved by the Underwriters' Laboratories.

As far as value is concerned, a comparison with the 1940 line will show that considerable progress has been made.

Phonograph Combinations

In line with the trend described in the introduction, considerable attention has been paid to the development of a superior line of phonograph combinations. In planning these instruments the following points were considered to be of prime importance. First, the public have shown a decided preference for phonographs in which the low-frequency response is emphasized both in amplitude and power. Second, a good high-frequency response is desirable, provided it does not cause objectionable hiss. Third, the so-called record noise or pickup chatter is highly objectionable.

The improvement in the low register was effected by the re-design of a number of parts which heretofore have limited the low-frequency response. The response of the audio amplifier to these frequencies was raised, the cabinets were made more sturdy and the speakers were mounted solidly on their baffles. In addition, the output transformers were increased in size and power handling capacity. The rumble and acoustic howl resulting from the improved low-frequency response were overcome through the design of new rim-drive record players and a very careful treatment of the turntable spring suspension. The new and better record player, incidentally, can be manufactured at a much lower cost than the one it replaces.

A study was made of the hiss produced by the various types of records and it was found that the magnitude of the hiss increases sharply above 5000 cycles per second. Listening tests made at the same time indicated that the average consumer did not object to the elimination of the frequency range above 5000 cycles per second. As a result, it was decided to build phonograph speakers with a very sharp cut-off at 5000 cycles and a smooth response below this frequency. In these speakers, the low-frequency resonance was raised to fall between 70 and 80 cycles per second because the lower frequencies were found to be unimportant as far as the sound quality was concerned, but they did aggravate the rumble considerably.

Victrola V-205

It was considered desirable to find a substitute for the airtight lid seal used in the 1940 phonograph line. This lid seal was objectionable from a manufacturing point of view on account of the required close tolerances. This construction, therefore, has been replaced with a new lid seal which traps the high frequency components of the sound in two grooves of different. This construction permits more than 1/16 of an inch airgap between the lid and the cabinet without any detrimental effects. The sound is prevented from going through the turntable itself by means of a pan placed underneath the motor board.

The following console phonographs are being manufactured at this time.

V-170 is a 6 tube instrument with a single-ended output stage and six station buttons, housed in a modern-style cabinet.

V-200 is a 7 tube instrument with a low power push-pull output system and six station buttons, housed in an 18th Century lowboy.

V-201 represents the same circuit located in a different chassis. The treatment of the cabinet design is novel in that the record player is located directly over the radio chassis.

V-205 is a 9 tube instrument with full power push-pull output stage and 6 station buttons. The cabinet is modern in style.

V-405 represents the same instrument as the V-205 housed in a Sheraton cabinet.

V-300 uses 10 tubes and has a driven push-pull output stage operating a 15 inch speaker of new design. The receiver has a tuned r-f stage on all bands and a two stage i-f amplifier with variable selectivity. The audio circuit is provided with a high-pass filter which may be varied in three steps to serve as a low-frequency tone control, and the high-frequency response is terminated at 5000 cycles per second by means of a low-pass filter. The instrument is provided with a separate power supply.

V-301 is the same instrument as the V-300 except that it uses a record player with a larger motor. The cabinet is Chippendale.

V-302 is the same instrument as the V-301 housed in a cabinet of 18th Century design.

All of our console phonograph combinations have automatic record changers.

The following table model phonographs are in this year's line.

V-100 is a table type 5 tube phonograph combination designed for the lowest price bracket. Several interesting features are incorporated in this model. For example, the receiver power switch and the turntable switch are built into the record-radio switch, and that the r-f tubes are cut-off on phonograph connection, resulting in an increased power output.

V-102 is a table type 7 tube phonograph combination with 5 station buttons designed for a somewhat higher price bracket.

All our present line of electric phonograph combinations except the V-100 and V-102 have automatic record changers.

Home Recording Phonograph Combination

It was decided to re-introduce home recording on some of our phonograph combinations. This was done in the case of the V-200, V-205 and V-405 and the corresponding home recording models were placed on the market as VHR-202, VHR-207, and VHR-407. These new models present a vastly improved performance over the home recording models which were sold several years ago.

Numerous obstacles had to be overcome in order to produce these models. First of all a cutting head had to be located on our regular record changer and a more powerful motor substituted. The cutter and microphone had to be selected from the several makes available, and finally the audio amplifiers had to be modified to properly perform their new functions. Among these changes were the addition of a pre-amplifier stage for the microphone and the incorporation of a mixing circuit which permits the mixing of a local pickup with one coming over the air. It is of interest to note that these instruments may be used for re-recording if the user purchases one of our inexpensive record players. On the V-207 and the V-407, monitoring has been partly automatic through the addition of a contracter which counteracts unintentional changes in level at the microphone. A new type of non-combustible home recording blank has been made available by our record department and is used with these instruments.

Nippers

When considering the trends towards low priced merchandise it is not surprising that our Company produces a large number of small a-c/d-c receivers. Of recent designs, special attention should be paid to the concentration model 15X and its companion model, the Underwriters approved, 16X1. These radios represent, at this time, the best value it is possible to produce in this class of merchandise. The receiver provides reception of the broadcast band and one police band. The loudspeaker is of the permanent-magnet type, which conserves power and provides greater undistorted sound output. An interesting circuit is used to provide inexpensive and effective filtering of the power supply. The total rectified voltage is connected to a tap on the output transformer and an arrangement is provided which will cause the plate current for the output tube and the +B current for the remainder of the receiver to run in opposite directions through the windings of the output transformer primary. By properly proportioning the windings it is possible to cancel the hum appearing across the first filter capacitor so that only a fraction will appear across the speaker voice coil.

Nipper Model 15-X

For the first time in this class of receivers, an untuned radio-frequency stage has been used to provide greater sensitivity. The resulting 6 tube receiver employs one more tube than any other receiver in this price class and it is hoped that this "Nipper" will start a trend towards a greater number of tubes in small a-c/d-c receivers. The receiver is provided with a loop for self-contained operation, a 2 point tone control, and a phonograph plug for operation in conjunction with a record player. The cabinet with its large straight-line edge-lighted dial was selected as a prize winner by the New York World's Fair 1940 Gold-Seal Jury of Awards.

Another series of "Nippers" are the 46X21, 46X23, and 46X24, all of which use the same Underwriters approved chassis. The receivers

cover the broadcast and foreign entertainment bands. These receivers are, like the 15X, provided with permanent magnet speakers and the new hum backing circuit. A loop of customary design is provided for "A" band reception, while the "C" band uses a regular antenna coil with the "A" band loop connected to its high side, serving as a capacity pickup device.

The 46X21 and the 46X23 are housed in a bakelite and a wooden cabinet respectively. The 46X24 is provided with a wooden cabinet and has, in addition to the features incorporated in the two smaller receivers, provision for push-button operation on 5 stations.

Table Receivers

A group of table receivers, the 16T2, 16T3 and 16T4 have been placed on the market. All are 6 tube receivers provided with a single ended output stage which will deliver 4.5 watts of audio power to the speaker. These receivers are furthermore provided with an untuned radio-frequency stage.

Model 18-T

The 16T2 is an "A" and "C" band receiver housed in a pleasing wooden cabinet of the chest type. It is provided with loop antennas for both bands.

The 16T3 is essentially the same receiver as the 16T2 but housed in a slightly larger cabinet. Push-button tuning has been provided for 5 stations.

The 16T4 incorporated the addition of the "B" band and is provided with a still larger wooden cabinet.

The top of the table model line is the 18T. This receiver is housed in a cabinet of continental styling with a straight line slanted dial, which may be read from any angle. This receiver has been designed to provide satisfactory operation under the most adverse conditions of reception. It has tuned radio frequency amplification on all its three bands and it incorporates a push-pull output stage. It will therefore out-perform all but the most expensive console radios and phonograph combinations.

Console Radios

The least expensive console model is the 16K which uses the same chassis as the 16T3. It has, however, a 12" speaker in place of the 6" speaker used in the table model.

Model 111K

In a slightly higher price bracket is the Model 17K. This receiver uses 7 tubes and covers the "A", "B" and "C" bands. It is the lowest priced receiver which incorporates a new "C" band antenna circuit. Heretofore a loop similar to the standard "A" band loop has been used to provide self-contained "C" band reception. However, it was found difficult to insure line-up with such a loop both in the factory and in the field. The new antenna circuit consists of a short antenna located within the cabinet. The impedance of this wire is matched to the primary of an ordinary "C" band antenna coil. Preliminary field experience indicates that this circuit is preferable whenever the cabinet is of sufficient size to permit its use.

A further step up is provided with the 9 tube receiver, Model 19K. This receiver has in addition to a push-pull output stage, electric tuning on 6 stations and a rotatable loop. The receiver covers the "A", "B" and "C" bands.

In a still higher price class will be found the 10 tube Model 110K. This receiver is housed in a beautiful cabinet of modern style. It incorporates a rotatable loop, parallel push-pull output stage, and one spread band - the 31 meter band. The band indicator as well as an indicator for the position of the tone control is located in the dial.

The top of the line is the 11 tube 111K which in addition to all previous features mentioned for the consoles, incorporates a magic eye and a tuned r-f stage.

Farm Radios

Receivers in this classification are, as a general rule, operated in locations where the signal strength is very low and consequently every effort has been made to obtain as much sensitivity as possible. The means by which this has been achieved include high-gain antenna transformers and i-f transformers with a higher L/C ratio than have been used heretofore in broadcast receivers. For the same reason loops and other self-contained antenna devices have not been incorporated in these receivers.

Economy of operation is another important performance characteristic for battery receivers and has been achieved through the use of low-drain tubes and a "Battery Saver" switch. This circuit permits the customer to over-bias the output tube and thereby reduce its plate current whenever full output power is not required. The "RCA Victor Economy Blinker" insures the user against leaving the receiver "on" unintentionally.

All RCA Victor Farm Radios may be converted to 110 volts a-c operation by means of a CV-40 converter and they may be used with an R-103-S spring wound record player as a radio-phonograph.

The 14BT1, 14BT2 and 14BK all use the same 4 tube chassis housed in different cabinets. These receivers cover the "A" band and one police band. Both the 14BT1 and 14BT2 are of the table type, but while the brown bakelite cabinet used for the 14BT1 requires that the batteries must be located externally, ample battery space has been provided in the walnut cabinet used for the 14BT2. The 14BK is housed in a walnut console cabinet.

Pick-Me-Ups

The 15BP pick-me-up may be obtained in six different carrying cases, all designed to house the same chassis, speaker, and batteries. It has been found through actual field experience that it is of prime importance to make the sensitivity as good as possible for this type of receivers and nothing has been neglected to achieve superior performance in this respect.

It has also been found through our experience with earlier models that portable receivers have found considerable use within the home. There are two objections to this use. First, most portables are styled to look like a piece of luggage; a styling which makes these receivers fit poorly within the home. Second, battery power is much more expensive than ordinary house current. Both of these objections have been overcome in the present line of portable receivers. Two of these receivers, the 15BP1 and the 15BP6, are styled to harmonize with ordinary room furnishings and they may be used as portable receivers when housed in a carrying case. The four remaining models are of standard pick-me-up styling but the 15BP2 and 15BP3 are covered with fabric and the 15BP4 and 15BP5 are covered with leatherette.

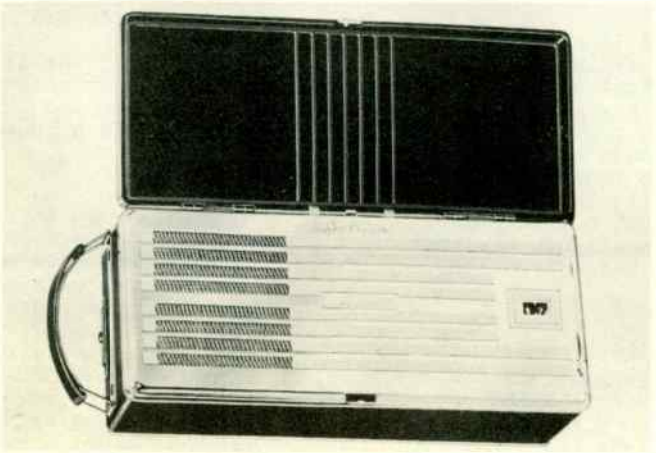
All portables of the 15BP series are designed to operate on 110 volts a-c or d-c as well as on batteries, with the "on-off" switch selecting the desired type of operation. The

"Pick-Me-Up" Model 15BP-6

power cord is concealed in the back of the receiver when not in use.

The BP-10 Personal Radio represents a radical departure from the conventional design of portable receivers. As the name implies, the receiver is designed to occupy a minimum of space without sacrificing required performance. How well this has been achieved will be seen from the measurements of the complete receiver, which are 3 x 3-3/4 x 9 inches. This result was first reached after new and smaller component parts were obtained for all circuit elements. Radiotron produced a new line of miniature battery tubes. A new small 67-1/2 volt layer built battery was developed and built by one of the battery manufacturers to provide "B" power. The i-f transformers are of a new type, in which iron powder forms a complete magnetic path around the coils. This design permits adequate performance with very small space requirements. It would require too much space to describe in detail the numerous obstacles which had to be overcome in order to produce this receiver. It is interesting to note, however, that the overwhelming customer response has amply justified the expenditure of time and money used in designing this receiver.

It has been impossible within the space allotted for this article to describe in detail all the features or even all the receivers which our Company is offering for sale at this time. Those who may desire further information are referred to the pamphlet, "Announcing the New 1941 RCA Victor Radios and Radio Phonographs" which is available in the Display Room.



Personal Radio Model BP-10

INSTITUTE OF RADIO ENGINEERS

FIFTEENTH ANNUAL CONVENTION

June 27, 28, and 29, 1940

Hotel Statler Boston, Massachusetts

This convention was held at the Hotel Statler in Boston. At the close the registration was announced as 1007. As usual, exhibits of component parts, test equipment, etc., were held in the ballroom foyer. Most of the technical sessions were held in the ballroom of the hotel. The chief exception to this was on Friday when the large number of available papers necessitated running simultaneous meetings in both morning and afternoon. The morning sessions were on "Vacuum Tubes and General" (in the ballroom) and "Measurements" (in the Georgian Room). In the afternoon the session in the ballroom was on "Aircraft Radio", while that in the Georgian Room was on "Vacuum Tubes".

The editors wish to acknowledge with thanks the assistance of J. S. Donal, Jr., D. B. Langmuir, and A. K. Wing or Harrison, who kindly provided accounts of some of the papers.

Annual Banquet

At the banquet on Friday evening in addition to presenting the Institute Medal of Honor and the Liebmann Memorial Prize, certificates were presented to newly elected Fellows of the Institute. We are happy to report that Mr. E. W. Engstrom was one of those to receive the grade of Fellow. We know of no one who better merits the honor and to him go our congratulations.

Trips

On Thursday afternoon various trips were available to those attending the Convention. The two of chief interest to engineers were: First, the General Radio Company plant and Harvard University laboratories; and, second, the Hygrade Sylvania plant and U.S. Coast Guard Air Base.

Those going to the General Radio Company's plant were shown the various laboratories as well as their manufacturing departments. Several things of interest were noted. The almost complete lack of safety guards around punch presses, circular saws, etc., in the machine shops and manufacturing departments was very noticeable. Presumably the management trusts in the higher intelligence of their relatively highly skilled employees to avoid accidents. In their sealed condensers, resistors, etc., a small quantity of silicon gel is sealed in each case with the unit to maintain the unit and the space inside the case in a moisture free condition.

At Harvard University a demonstration of high-fidelity sound recording was followed by visits to laboratories in which work on supersonics, u-h-f measurements, measurement of the velocity of light by the use of u-h-f, Ionosphere measuring equipment (for South African eclipse expedition - October, 1940), and the Harvard Cyclotron were described and in some cases demonstrated.

At the conclusion of each afternoon tour the opportunity was offered to visit some of the laboratories of the Massachusetts Institute of Technology. Several outstanding items of interest were seen there. One was a large power control panel which could be set up to imitate a complete city power circuit distribution system involving five power house supplies with complete freedom of load and phase of all parts of the system so that actual operating field conditions could be easily duplicated and studied. The Harvard mechanical wave analyzer was shown. However, of even greater interest was a new and similar, though much expanded, device in which electronic circuits were substituted for the mechanical gears and shafts of the older unit. In the new device the problems are to be set up by means of a series of telephone dials and a punched paper tape. The device, which consisted of five telephone racks about 30-feet long and 10-feet high, each filled with equipment of various sorts, was said to be about half finished. It was said to employ several hundred tubes when complete. (SALES DEPT. TAKE NOTICE)

After the tour of the laboratories, a popular lecture on "Microwaves - Present and Future" was presented by W. L. Barrow and Staff of M.I.T. This was very interesting and was accompanied by numerous demonstrations to illustrate the lecturer's remarks. Excellent planning and the injection of frequent amusing situations and slides kept the mixed audience awake and in a very good humor.

Technical Sessions

Of the 46 technical papers presented at the convention, RCA engineers contributed 13, or 28%, and of these the RCAM engineers were authors or joint authors of 8, or 17%. The papers presented by RCA Manufacturing Company engineers are listed in the session in which they were presented. Summaries, however, are omitted since copies of these papers are available in Camden or Harrison.

Thursday A.M.

The Convention was opened on Thursday morning at 10:00 A.M. with a brief address by L. C. F. Horle, the President of the Institute. He was followed by H. B. Martin of the Radiomarine Corporation of America who gave a paper on "Marine Radiotelephone Design" which described various telephone transmitters and receivers for use on ships and on shore stations which communicate with them. The use of dial systems to enable a transmitter to call a ship station was briefly discussed and photographs of various power transmitters were shown.

R. N. Harmon of Westinghouse gave a paper

entitled "50 Kilowatt Air-Cooled Broadcast Transmitters". He pointed out that the large air-cooled tubes used in this transmitter would be discussed in more detail in another paper later in this Convention. The author first showed by a series of old photographs the progress of Westinghouse transmission equipment from the first transmitter in Dr. Conrad's house through various other locations and increases in power up to the present KDKA transmitter. One of the main features emphasized for the latest design was the air cooling of the large tubes and photographs of these tubes in their air cooling fittings were shown. The transmitter uses high level modulation with a "Class C" last stage. The modulation system uses "Class B" with inverse feedback. Another feature of this transmitter was the use of metal rectifiers for all rectifiers except the main power stage supply. The author also went into some detail on the fuseless protective system used throughout the transmitter and the control system used.

R. A. Lynn and B. F. Fredendall of NBC presented a paper on "RCA-NBC Orthacoustic Recording". It was stated that most broadcasting stations made about 20% of their revenue on sales of transcriptions. The problems of scratch and rumble were discussed. The former is a problem at the high frequency end of the audible range while the latter lies in the low frequency range. Attenuation of both ends of the range would therefore reduce these troubles but at the expense of the musical fidelity. By pre-emphasizing the two ends of the range it is then possible by an appropriate degree of attenuation at both ends during reproduction to retain the musical fidelity and improve the signal-to-noise ratio. It was pointed out that pre-emphasis of the ends did not require over-cutting at these frequencies since the energy level at the parts of the range emphasized were sufficiently low compared with the center of the range so that no over-cutting was needed at the degree of emphasis used. Characteristic curves of the pre-amphasis used were shown.

The authors discussed the transfer loss resulting from change of groove radius as the center of the record is approached and argued against trying to overcome this by a compensation network to raise highs. Their investigation shows that the loss is due to the wave front in the high frequencies at small radius being so steep as to make it impossible for the needle to track. Attempts to compensate this, therefore, merely result in producing more noticeable distortion. The only solution is to stop the recording at a sufficient diameter. It was also stated that different types of reproducer compensation were required by different record materials.

A paper on "Instrument Production" was presented by E. H. Locke of the General Radio Company. It was pointed out that this company, in its manufacturing procedure does not use production line methods even though some parts of the equipment bear a definite resemblance to receiver chassis. Hand work by relatively skilled operators is used almost entirely. As a result of this, the average wage for this company's employees is about $2,000.00 per year as compared with out $1100.00 which has been given as the average for the radio industry. The men doing actual manufacturing work are instructed never to make any changes as a result of verbal instructions from a member of the Engineering Department. A change can only be made through a regular procedure set up through the drafting department and the supervisor of the manufacturing group making the item in question. Their production takes about 4 or 5 months after receipt of a Sales Department order until instruments are available to sell. In slack times they make up inventory on items that move reasonably rapidly at peak sales periods. In the winter of 1931-32 and again in 1937-38 they had a slow period during which all employees stopped working for a short time. They do this rather than let any employees so since they are thus able to keep their organization intact.

Friday A.M. "Vacuum Tubes and General"

E. W. Schafer and E. R. Jervis of the National Union Radio Corporation presented a paper entitled "Available High-Mutual-Conductance Tubes".

A sheet containing characteristic data of the tubes under discussion was passed to the audience and is reproduced here. The principal points brought out by the speaker were as follows:

CHART OF TUBE CHARACTERISTICS

	If	Ec1 Ec2 Ep	Gm	Eg1 C0	Ib	Ic2	Rp	Cin	Cout	Cgp	Gm/Ib	Gm/Ct	Gm/C1	Gm/Cb	K-G1 SPACE
7A7-6SK7	.300	-1.5,100,250	2300	-35.0	12.0	3.1	.53	6.0	7.0	.003	192	177	383	329	.012"
6SK7GT		(-3,100,250	2000	-35.0	9.2	2.4	.80)								
6AC7/1852	.450	-1.5,100,250	6000	-4.5	4.4	1.1	1.4	11.0	5.0	.015	1365	375	500	1200	.005"
		(-2,150,300)	9000	-6(-12)	10.0	2.5	.75)								
7G7/1232	.450	-1.5,100,250	5600	-6.0	7.4	2.4	.90	9.0	7.0	.005	755	350	620	800	.008"
		(-2,100,250)	4500	-6.0	6.0	2.0	.80)								
7L7	.300	-1.5,100,250	3100	-6.0	4.5	1.5	1.0	8.0	6.5	.010	690	214	388	476	.008"
6SE7GT	.300	-1.5,100,250	3100	-6.0	4.5	1.5	.60	9.0	9.5	.0035	690	166	342	324	.008"
7H7	.300	-1.5,100,250	3370	-18.0	6.1	1.7	1.2	8.0	7.0	.005	548	225	420	480	.008"
		(-2,150,250	3500	-27.0	9.0	2.5	1.0)								
6SD7GT	.300	-1.5,100,250	3820	-15.5	6.8	2.3	1.7	8.5	7.8	.0035	560	233	444	490	.008"
		(-2,100,250	3600	-15.5	6.0	1.9	1.0)								
6AB7/1853	.450	-1.5,100,250	2850	-8.5	3.4	.9	1.35	8.0	5.0	.015	840	220	365	560	.009"
		(-3,200,300	5000	-25.0	12.5	3.2	.70)								
6S6GT	.450	-1.5,100,250	5200	-35.0	15.0	3.5	.37	7.0	6.4	.010	347	388	742	810	.008"
		(-2,100,250	4000	-35.0	13.0	3.0	.35)								

From the table it will be seen that the 7A7 - 6SK7 - 6SK7GT series are suitable for tuned r-f applications, while 6AC7/1852 serve for untuned r-f. The 7G7/1232 series were introduced as a compromise on Gm and cathode-grid spacing.

Since the second and third series of the table were not suitable for series operation, they were modified in the 7L7 - 6SE7GT series to give as high a Gm as possible with a 0.300" cathode. The low plate current of the 7L7 contributed toward low noise but the sharp cut-off is a handicap in loop operation. With spacing still about 0.008", the 6SD7GT gives a 15 volt cut-off with a Gm of 3000-3500 at 6 Ma.

The 6S6GT series is for untuned r-f loop operation, with output capacitance (with shield) of only 5.3 μμf.

For television and FM applications, the above list serves, in general, but gain is limited by the ratio of Gm to capacitance and by grid loading. The 1852 is best, in general, but the 0.005" cathode-grid spacing is a manufacturing handicap. The other tubes are all right for broad band work as regards the Gm/capacitance ratio. For FM, cost considerations may demand wider spacings and lower capacitance tubes.

Hiss as a function of Gm/plate current and screen current/plate current is not yet a leading manufacturing consideration. Ultimately, additional aligned grids may have to be used.

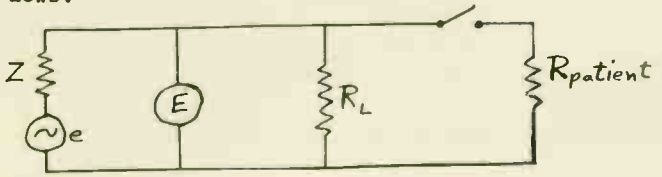
As to the future, it must be admitted that high Gm tubes are not now commercially available, the difficulty being in the cathode-grid spacing. Although space-charge grids are still being worked on, they may not be the solution. At the moment we rather look to further refinements of the present moderate spacing tubes.

The next paper was on "An Ultra-High-Frequency Dosemeter-Diatherm" by J. D. Kraus and R. W. Teed, University of Michigan.

The subject of diathermy is of interest to engineers because of the radio problems presented. Diathermy apparatus usually consists of a simple self-excited oscillator designed to deliver r-f energy to a patient rather than to an antenna. There are two drawbacks to the present equipment: First, the only indication of dosage has been the subjective response of the patient as to whether he feels warm or not and patients vary widely in their tolerance; Second, more power is usually radiated than is transferred to the patient and this results in a power loss and in radio interference. The "Dosemeter-Diatherm" is designed to correct these conditions.

In the older apparatus, tuning to resonance is done in the main cabinet rather far from the patient, resulting in long (1/4 to 1/2 λ) resonant leads, forming a dipole antenna which radiates well in spite of the load resistance. In the new apparatus the tuning is carried out in a separate unit close to the patient, the lines beyond the tuning point having a length not greater than 0.05 λ and a spacing not more than 0.03 λ at 7 meters.

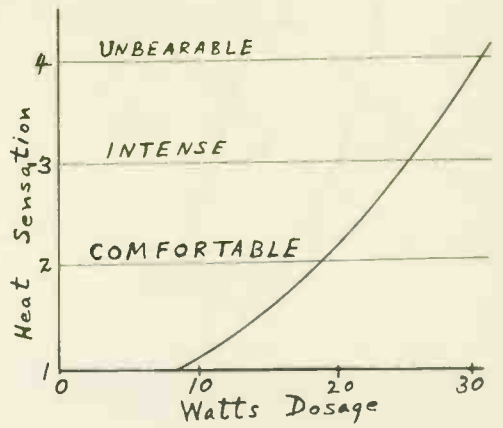
The dosage is metered close to the patient. Schematically, the measuring circuit is as follows:



The watts of dosage are given by the relation

$$W_p = \frac{E_2 \left(\frac{Y_2}{Y_1} E_1 - E_2 \right)}{R_L}$$

in which a calorimeter is substituted for the patient and the resonant voltages are read with and without the calorimeter in circuit. In application of the device, the meter reads dosage in watts after it is set to zero without the patient.



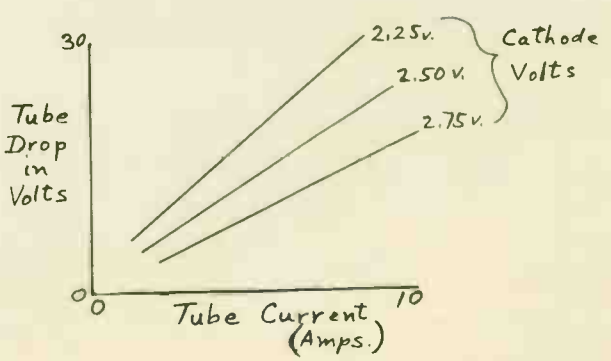
The patient's subjective sensation was found to bear the above relation to the dosage in watts. It has been found that using the reaction of the patient alone, the dosage is accurate to only about 200 to 300 percent, while with the Dosemeter the dosage can be controlled to within 10%. Another point of considerable interest is the claim that this apparatus gives very low radio interference.

The next paper was entitled "Sparking of Oxide-Coated-Cathodes in Mercury-Vapor-Filled Tubes" by J. W. McNall of the Westinghouse Electric & Manufacturing Company, Bloomfield, N. J.

The usual methods of investigation of cathode-sparking are not reliable because of the resulting cathode heating and cathode-sparking which throws doubt on the value of the tube-drop/tube-current curves.

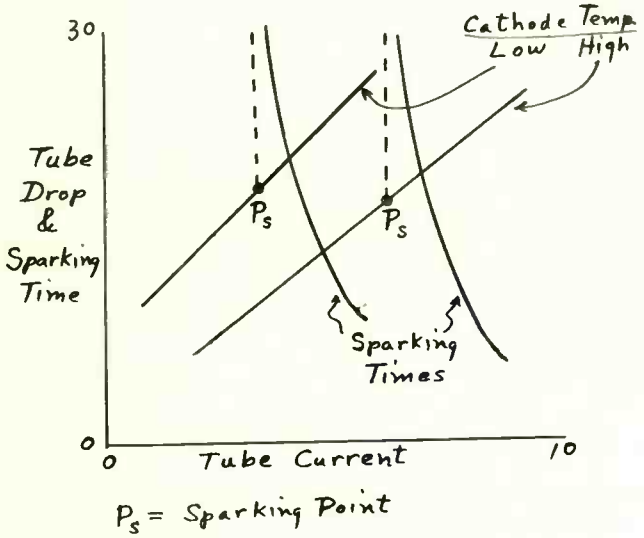
A circuit has been developed which gives a square wave of current to eliminate cathode heating. With this circuit the characteristic curve is a straight line rather than a curve of quite variable slope.

For different cathode temperatures, a representative set of curves would be as shown below, the higher cathode temperature giving the least change in drop as the tube current is varied.



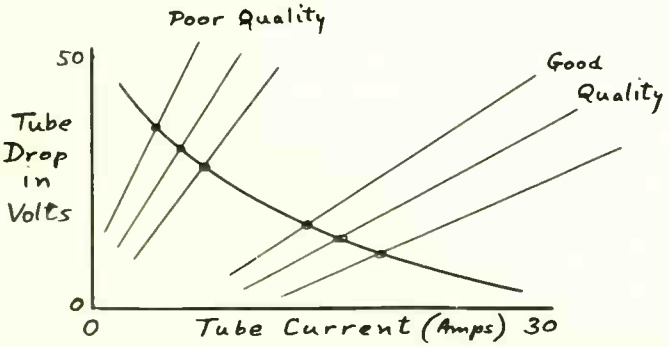
In corresponding manner, cathodes of better quality give lower slopes, and those of poorer quality give higher slopes.

At higher tube currents, sparking starts, followed rapidly by cathode disintegration. The time of sparking was measured on an oscillograph, and the relation of sparking time to tube current and tube drop are shown below.



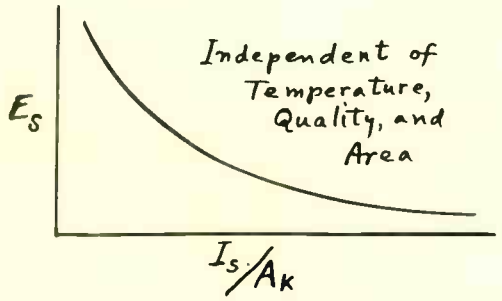
Thus, the higher the cathode temperature, the higher the sparking current but the lower the tube drop at the sparking point. The variation with quality was in the same direction as that with cathode temperature.

The following curve connects the sparking points for two different quality cathodes operated each at three different temperatures.



The heavy curve is independent of temperature and quality, i.e., a cathode of intermediate quality would have its sparking points lying on this same curve.

If the abscissa is made sparking current per unit area, it is found that the curve is likewise independent of area, as follows:



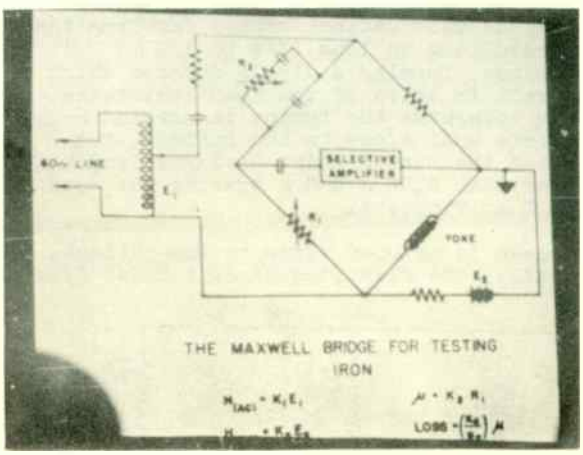
The shift of the lines with higher cathode temperature would be expected due to (a) increase in field emission due to lowered work function and (b) increase in coating conductivity with temperature. However, since the sparking voltage is a function only of I_s/A_K, it means that all cathode areas are contributing equally, a result which is surprising since the sparking would be expected to localize at a point. Hence, no gradual localization of current is indicated, but rather a sudden shift to a single point, as in the transition from a glow to an arc.

Two of the papers during this session were presented by RCAM engineers. These were "Centimeter-Wave-Detector Measurements and Performance" by E. G. Linder and R. A. Braden of Camden (copy of paper available in E. T. Dickey's office), and "A New Ultra-High-Frequency Tetrode and Its Use in a 1-Kilowatt Television Sound Transmitter" by A. K. Wing, of Harrison and J. E. Young of Camden (copies of paper available in offices of R. S. Burnap and E. T. Dickey).

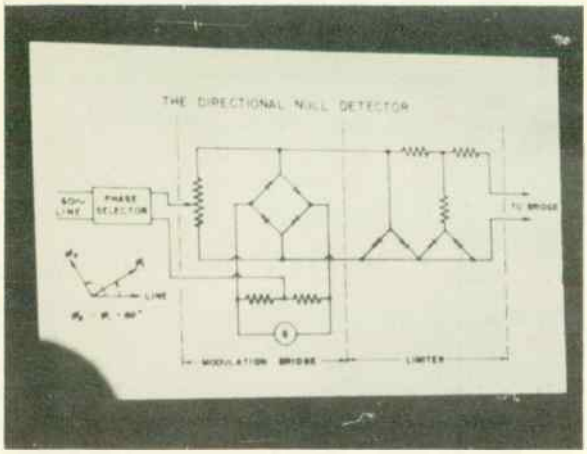
Friday A.M. "Measurements"

The session on measurements was started by P. S. Christaldi of the Allen B. Du Mont Laboratories, Inc., who gave a paper on "Recent Advances in the Design of Cathode-Ray Oscillographs". The author pointed out the need for instruments of more diversified usefulness which has resulted from the greater variety of tests for which these devices are now being employed. A 5-inch oscillograph was described in which the tube employed an accelerating third anode, thus permitting the use of low deflecting power while at the same time retaining good screen brilliancy. Various improvements in the ease of operating the entire instrument were described. In the discussion following the paper, Dr. Cook brought out by questions a fact which had been left uncertain by the author's remarks, i.e., the tube did not give any greater detail than any existing tube of the same size.

H. W. Lamson of the General Radio Company gave a paper on "A Method of Measuring the Magnetic Properties of Small Samples of Transformer Laminations". A feature of the arrangement was the fact that much smaller samples of iron were needed than in other methods previously employed. A single lamination could be employed if desired. The test setup used was shown. In it, the major reluctance of the magnetic path was arranged to occur in the sample under test. A highly selective amplifier was provided for the balance measurement in order to avoid trouble from harmonics. The bridge circuit used was as shown below.

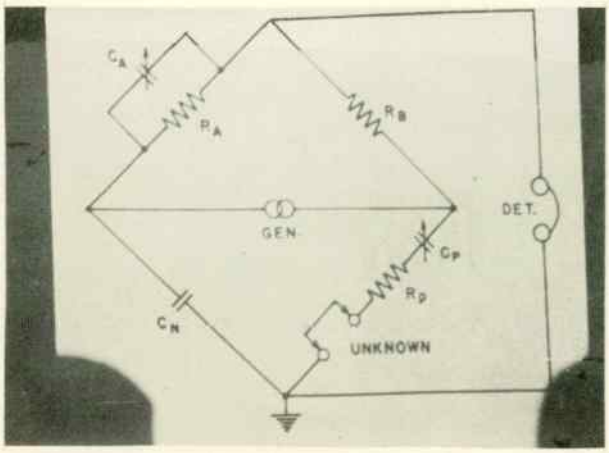


In this bridge, R_1 is arranged to read permeability directly while the iron losses are given by R_2. To be thus direct reading, the bridge presupposes a certain size of sample. A d-c magnetizing current can be supplied to the yoke if desired. A special directional null detector circuit was also provided as shown below.



By use of this circuit, a zero center galvanometer will give an indication, by its direction of reading, of which way the voltage is out of phase in the bridge. The phase angle setting is different for the permeability and loss readings. By the use of copper oxide rectifiers as limiters, the detector is given a pseudo-logarithmic characteristic, thus eliminating the necessity for an adjustable shunt on the galvanometer. Because of its great sensitivity, the bridge is capable of making measurements at very small values of magnetization, i.e., values of less than 1 millioerstead have been used.

The next paper was by D. B. Sinclair of the General Radio Company and was entitled "A Radio-Frequency Bridge for Measurements up to 30 Megacycles". The usual problems of null methods for such measurements, involving shielded transformers, inductive free variable resistors, etc., were discussed. For measurements at low impedance and high frequency the bridge was considered best by the author and a substitution method was employed. Fixed resistors were used instead of the variable type. Balance was obtained by means of variable capacitors. The circuit used is shown below:



Special triple shielding was used over C_p. The type and value of resistor R_A was not very important. The dielectric loss and inductance value of C_A, however, was very important. Resistive components up to 1000 ohms can be measured with this bridge directly on an approximately logarithmic dial of the capacitor with an accuracy of 1% $\pm$0.1 ohm. This reading is independent of frequency up to about 4 megacycles and beyond this the proper correction can be applied. The correction varies for different values of resistance. The reactance dial is calibrated directly in ohms at 1 megacycle. Values at other frequencies are obtained by dividing by the frequency in megacycles.

F. Hamburger, Jr. and C. F. Miller of Johns Hopkins University presented a paper on "The Measurement of Coil Reactance in the 100 Megacycle Region". Measurement technique involving use of a transmission line with the unknown reactance at its end was described for measurements at frequencies of about 100 Mc. Distributed capacitance of single layer solenoids was shown to be considerably reduced by skin and proximity effects.

The next two papers were by Camden engineers and were as follows: "A New Electron Microscope" by L. Marton, M. C. Banca and J. F. Bender, and "Stable Power Supplies for the Electron Microscope" by A. W. Vance. Copies of these papers are available in E. T. Dickey's office for review by anyone who wishes to see them.

Friday P.M. "Aircraft"

A discussion of "Aircraft Antennas" was given by G. L. Haller of the War Department Aircraft Radio Laboratory, Dayton, Ohio. The paper covered antennas for use between 2 and 20 Mc - particularly with regard to transmitter use. The importance of choosing the best kind of wire was pointed out and copper-clad steel was mentioned as having distinct advantages. The problem of antenna icing had been investigated and a certain critical angle (about 15° to 20°) to the normal had been found which gave thinner and more brittle ice formation. Certain advantages of the trailing wire antenna were mentioned and it was pointed out that it operated best with a weight at the end since this caused a portion of the wire to assume a practically vertical position, giving a more nearly circular radiation pattern. The facility with which the trailing wire antenna can be tuned by adjustment of its length facilitates feeding it from a transmission line in cases where several frequencies are used in operation. This gives this antenna an advantage over the fixed type which cannot be easily so used. A sketch of a new mechanical device for automatically adjusting the antenna length was shown by slides.

A wooden structure 50 feet high used for making aircraft antenna measurements was described and shown in a slide.

H. K. Morgan presented a paper entitled "Rain and Snow Static" which he said he preferred to retitle "Q = CE". He presented some rather novel theories of the reasons for the occurance of rain and snow static as experienced by planes. These involved a consideration of the circulating path of changed rain particles due to convection air currents in clouds with consequent change of height above ground. It was stated that this would result in increased potential charge on the particle as a result of decreased capacitance to ground. In the later discussion H. A. Wheeler raised the question of whether a change from 1000 ft.

to 5000 ft. above the earth would appreciably affect the capacitance between a raindrop and the earth. The author, however, said he felt that considering all the drops in a cloud of large area, they would act as a mass rather than as individual particles for purposes of his considerations.

According to the author's theory, a plane flying through rain or other charged particles gets charged up to the potential of the surrounding particles and then losses some of the charge by corona discharge and it is this discharge primarily which causes interference. Shielded loops and discharge wires were the best known ways of reducing the effect of this static. The discharge wire has a characteristic which makes it give off interference at the lower frequencies and thus the shielded loop was considered the best protection for that range. For the high frequency ranges, however, the discharge wire system was best. It was made up with a piece of carbon saturated rope (to introduce resistance in the current path) followed by the discharge wire. Sudden discharges of heavy current were thus prevented.

Marcel Wallace presented a paper on "Panoramic Reception". This involves the simultaneous reception of all signals in a given band and having them appear as individual deflections on the screen of a cathode ray tube. All can be made to appear at once by synchronizing the receiver sweep tuning with the horizontal sweep of the tube. The sweep is repeated at a rate sufficiently high to produce the equivalent of a continuous non-flickering pattern to the eye. About 25 to 60 sweeps per second are used. Vertical amplitudes of the various signal indications are made logarithmically proportional to their intensities. The receiver used in a demonstration which accompanied the paper covered a band of 1.5 Mc. Possible uses of the system include comparison of signal strengths, for monitoring purposes where several bands must be covered, for observations and adjustments of transmitters such as television and FM types. The scheme can also be used for aviation navigation purposes since by keeping the difference in height the same for the deflections of two beam transmitters, an off beam course with respect to the two may be followed.

The next paper was by D. G. C. Luck on "Radio Navigation and the Omnidirectional Radio Range". This was accompanied with animated motion pictures explaining the operation of the range signals and a demonstration using a large scale indicator dial and map to show how the range is used for navigation. A copy of the paper is available in E. T. Dickey's office for review by anyone who wishes to see it.

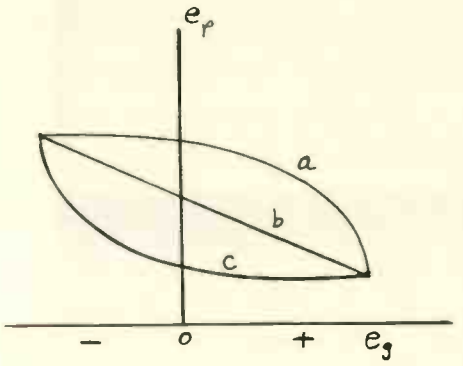
Friday P.M. "Vacuum Tubes"

The vacuum tube series started with a paper on "Optimum Conditions for the Operation of a Class C Amplifier" by E. L. Chaffee of Harvard University.

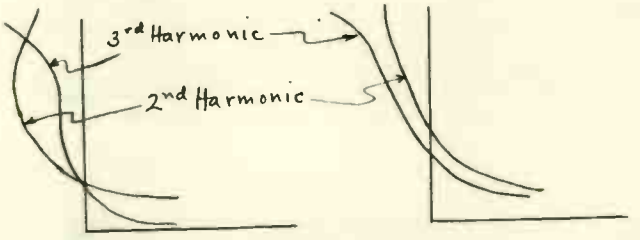
From the constant current types of characteristic plots, contours of constant plate loss, driving power, power output, and grid swing were derived. From these contours the optimum operating conditions for output or driving power could be read.

In the discussion which followed the paper the question of the usefulness of the method was raised. Several favored the method of approximate calculation worked out by Wagner. Care would be necessary to make sure that an average tube was used.

The next paper was by R. I. Sarbacher of Harvard University on "Power Tube Performance as Influenced by Harmonic Voltage". The use of harmonic voltages to improve operation efficiency was first described by D. C. Prince. Various paths of operation on a plot of constant current tube characteristics were investigated. (The ordinates of the plot are interchanged from the conventional constant current curves.)



Path "b" is the normal one. Path "a" is preferable for the grid since the grid dissipation is lessened. Path "c" is preferable for the plate since the plate loss is decreased. This latter path is most desirable since the driving power is not seriously increased and the efficiency is best. It has been found that introducing 2nd or 3rd harmonic voltage in the grid or plate circuits alters the normal characteristic to approximate this curve. The results obtained are sketched below. The harmonic voltage is obtained from a separate source - it cannot be supplied from a resonant circuit.



Harmonic voltage introduced in grid circuit

Harmonic voltage introduced in plate circuit

Several circuits were shown for introducing the desired voltage. Curves of efficiency against the amount of introduced harmonic voltage were shown. Overall efficiency depended, of course, upon the efficiency with which the harmonic was produced. With 50% efficiency for 3rd harmonic generation, considerable improvement in overall efficiency is possible, with a maximum efficiency obtained at one certain value of harmonic voltage.

Next a paper on "High-Efficiency Frequency Doublers" was presented by J. E. Sheperd of Harvard University. The conventional doubler circuit was discussed. A solution of the ex-

pression for plate current indicates that the path of operation on the eg - ep plane is parabolic. Fourier analysis for square and cosine pulses indicated a maximum efficiency of 42% for the square and 70% for the cosine.

Oscillograms of current pulses indicate a shape between the two, and in practice efficiencies between the two are obtained, i.e., approximately 50%.

The effect of bias and grid swing on power output, power input, efficiency, driving power, and power gain were considered. The addition of 3rd or 4th harmonic in grid or plate circuit increased efficiency. Slides were shown of the effect of this voltage on the operating path. Oscillograms of the wave form obtained when the harmonic power added was varied were given. The harmonic power required is much smaller when it is added in the grid circuit.

In one case, measured experimentally, 50% 3rd harmonic voltage added in the grid circuit enabled a plate efficiency of 85% to be obtained at decreased driving power and increased power gain.

The next paper was on "Space-Charge Relations in Triodes and the Characteristic Surface of Large Vacuum Tubes" by E. L. Chaffee, Harvard University.

This paper outlined a new mode of representation of the characteristics of vacuum tubes which is especially applicable to large triodes in the region of positive grid swing. The method is based upon the fact, established experimentally and theoretically, that the plate, grid, and total currents vary as the 3/2 power of the plate voltage along lines of constant $L = e_{g_o}/e_{p_o}$, where e_{g_o} and e_{p_o} are the total instantaneous grid and plate voltages, respectively, measured from a displaced origin. Each current can then be expressed in the form $i = A e_p^{3/2} (i + \mu L)^{3/2} F(L)$. When A and F (L) are known the entire system of static curves for one of the three currents can then be expressed by two curves, one for $A e_p^{3/2}$, and one for F (L).

Since F (L) can be determined at low voltages and the above equation used for extrapolation, it is possible to determine static characteristics by a few measurements at low power.

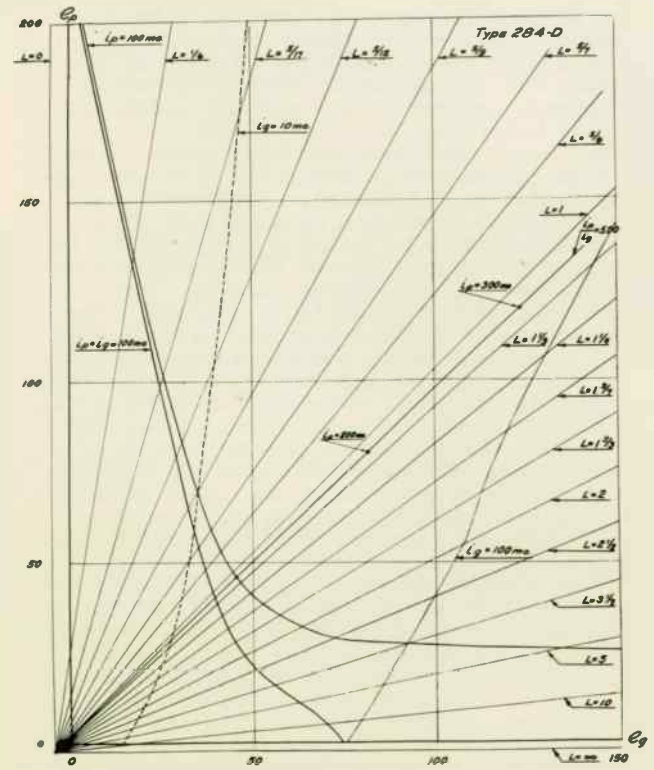
J. E. Mouromtseff of the Westinghouse Bloomfield plant presented a paper on "Water and Forced-air Cooling of Vacuum Tubes with External Anodes".

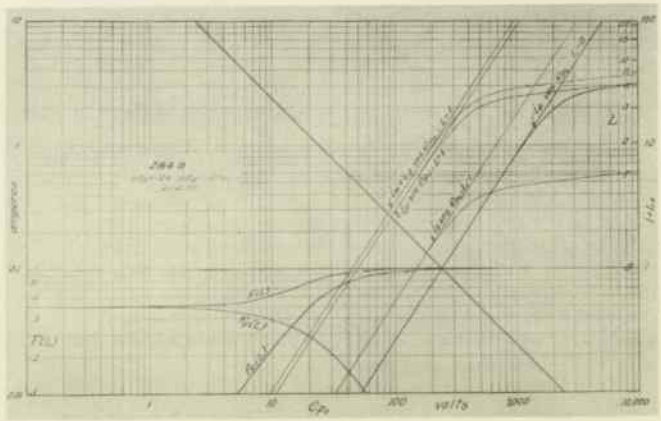
From heat engineering it is known that heat transfer to a fluid depends upon the physical constants of the fluid, its velocity, and the dimensions of the channel in which it flows. The rate of heat transfer is given by the expression

$$h = .024 \frac{K}{D} \left(\frac{V \rho D}{m}\right)^{0.8} \left(\frac{m D_p}{K}\right)^{0.4}$$

where

K = Thermal conductivity of the fluid
D = Equivalent hydraulic diameter of the channel
V = Fluid velocity
ρ = Fluid density
m = Fluid viscosity
C_p = Specific heat of the fluid





Curves showing data for a triode represented in the manner described by Chaffee. Δe_p and Δe_g are the displacements of the origin. $L_o = \mu L$. The scale of abscissae for F (L) is located at the upper right, and translation should be made using the solid black straight line as indicated by the dotted lines.

Turbulent flow is necessary for satisfactory heat transfer. This is usually measured by the Reynolds number which is the expression with the exponent 0.8 in the above formula. In general the Reynolds number should exceed 4000 for turbulent flow. The total cooling is proportional to the cooling area, the temperature difference between surface and fluid, and the rate of heat transfer. The rate of heat transfer as a function of fluid temperature was shown for several fluids. For water it decreases with temperature; for alcohol and prestone it is lower than for water and decreases also; for air it is much lower than for water but more constant. Consequently, the cooling surface must be much larger for air cooling than water cooling.

The most important factor is the anode temperature. For tin solder this must not exceed 160° to 170° C. For cadmium solder a temperature of 230° C is safe and experience has shown that this is practicable for the tube life. Copper is the most usual material for use in air coolers. Aluminum is difficult to fabricate and due to its poorer heat conductivity results in larger structures.

The air velocity must be high enough to give turbulent flow but not too high or excessive noise or back pressure will result. The power necessary in the blower increases as the cube of the air velocity. A flow of 800 or 900 cm./sec is the minimum for air. Most of the heat drop between anode and air occurs between the cooling fins and the air.

The design is determined by the permissible size, the power to be dissipated, and the air flow considerations noted. The core of the cooler must be large enough to receive the tube anode. Theory indicates that the design is optimum for a given outside diameter and with a given fin thickness and spacing at the core, when the core diameter is 1/2 the outside diameter. The axial length of the cooler is determined by the anode length. The outside edges of the fins are not uniformly effective; i.e., there is a maximum width of fin in the radial direction beyond which it is not economical to increase them. This width depends upon the air velocity and the fin thickness. For fins 1/16" thick it is about 3"; for 1/32" fins about 2". Similarly the ends of the cooler beyond the hot portion of the anode are effective for only a certain length, and a maximum useful length results.

Increasing air velocity does not give a proportional increase in cooling capacity.

Coolers of the slotted type as compared with the finned type are less efficient.

Slides were shown of several designs illustrating the temperature distribution in both radial and axial directions as well as the variation of permissible power dissipation (for a given maximum temperature at the anode) and maximum temperature at a given dissipation as a function of air flow.

The next paper was by J. E. Mouromtseff and W. G. Moran of Westinghouse - Bloomfield - on the subject "Large Air-cooled Tubes in 50 Kilowatt Transmitters".

The history of air cooling was briefly traced. Air must replace water as a cooling medium on its merits rather than as a fad. In early transmitters the use of tubes which could be changed quickly was necessary because of poorer tube quality. Better tube quality has allowed use to be made of larger coolers.

The design of the cooler for the 893 tube was discussed. The first decision which had to be made was with reference to the overall size. From this size the core diameter, fin thickness, and spacing were determined, using the radiator design methods outlined in the preceding paper, and from considerations of strength and appearance.

For the KDKA transmitter it was found that 2 - 893 tubes would be satisfactory for the modulator but that they would not be large enough for the power amplifier. Two 898 tubes would be too large for either position. Consequently it was decided to use 4 - 893's in the P.A. position and by running them more lightly to improve their life expectancy.

From the required air flow of 1800 cubic ft. per minute for a dissipation of 30 kw per tube (total dissipation), the blower requirements can be computed. The cross sectional area of the air path through the cooler is 2135 sq. cm.

An 893R tube was exhibited.

Saturday A.M.

The Saturday morning session was devoted to Television. The first paper was by C. D. Kentner of Camden on "A Portable Television Transmitter". A copy of this paper is available in E. T. Dickey's office for review by those interested. The next speaker was W. H. Hickok of Harrison who presented a paper on "Small Iconoscopes of Recent Design". A copy of this paper is available in R. S. Burnap's office for review by interested parties.

S. W. Stanton of Allen B. Du Mont Laboratories, Inc., presented a paper by T. T. Goldsmith, R. L. Campbell and himself on "A New Method of Synchronization for Television Systems".

The author discussed differences between the present RMA synchronizing system which employs a weak synchronization circuit at the receiver, and the system Du Mont proposed in which entire control of the picture synchronization is maintained at the transmitter. Their proposed horizontal synchronizing pulse is much like that of RMA and is separated from the signal by amplitude difference. Their vertical impulse is also separated by amplitude difference but instead of being a longer pulse is a burst of r-f signal of the same amplitude as the horizontal synchronizing pulses. Easy separation by tuned circuits is claimed. The author pointed out the danger with such a system of possibly burning the kinescope screen if the signal stopped and stated that circuits were provided in their receivers to deflect the spot off the screen in such cases. They call their system the r-f vertical-synchronizing-signal system. It was stated that an easy switching from one system to the other could be made at the receiver during the time when signals using both systems might be on the air.

In the discussion which followed, the speaker admitted that at 10 frames per second the flicker trouble would be bad. On the question of use of 24 frames the author stated that he preferred 15 or 30 frames. He did not seem worried about possible jerky motion at low frame speeds. He stated that his company had a screen fluorescent material which retained full brilliancy over the time required for one frame and then suddenly dropped brilliancy to zero. Great surprise - not to say incredulity - on the part of the audience greeted this. The only problem remaining to be worked out

with this material was stated to be one of fluorescent color.

During the discussion, it was brought out that the authors felt the r-f impulses for best synchronizing action should have a frequency of about 1/2 Mc. H. A. Wheeler suggested the use of FM for the vertical impulse of the Du Mont system. Another party pointed out that the lack of a united engineering front regarding transmission standards had "called down coals of fire" from the FCC on the industry. He argued for the engineers to work together on the problem of standards so that those outside would see a more united industry.

A paper by J. S. Donal, Jr. and D. B. Langmuir of Radiotron on "A Type of Light Valve for Television Reproduction", was next presented. Copies of this are available in the offices of R. S. Burnap and E. T. Dickey for review by those interested.

A paper on "Television Radio Relaying" by F. H. Kroger, Bertram Trevor, and J. E. Smith of R.C.A. Communications was the next one presented. This paper reviewed development of a television radio relaying system by RCA. The development comprised setting up an experimental system by means of which television programs from the Empire State building in New York City were delivered to Riverhead, Long Island, through radio repeating stations near Hauppauge and Rocky Point. The repeating was done without demodulating and remodulating in the repeater equipment. Radio carrier frequencies between 450 and 500 megacycles were employed in the radio links. The carrier waves were modulated in frequency by the vision-modulating currents. The paper reviewed some of the problems involved in designing television relaying networks for distributing programs to television broadcast stations and discussed means for solving these problems. Some of the test equipment used in these developments was described.

A paper on "High Oscillator Stability Without Crystals" by S. W. Seeley and E. I. Anderson of the RCA License Laboratories was presented and illustrated by a demonstration showing the very high degree of frequency stability obtainable using the precautions discussed in the paper. It was pointed out that the most important factor influencing oscillator frequency was humidity. This was stated to be even more important than temperature. By proper choice of materials, however, the effects of humidity can be practically eliminated. Next in importance is temperature. The chief variation here comes from the circuit inductance. By the use of a copper-plated wire whose base material had temperature characteristics like Invar steel, the affect of temperature on inductance values was reduced to negligibility. The circuits used were high in capacitances and low in inductance. Other points of importance were the avoidance of flexing of the chassis and strains in the wiring.

Saturday P.M.

The technical session Saturday afternoon was devoted entirely to frequency modulation. The first paper was by Dale Pollack on the subject "Interference Between Stations in Frequency-Phase Modulation". The results of a study of interference between stations were given. The author also discussed the theory of the disturbance reducing properties of frequency-phase modulation. Some measurement data were also given and the optimum deviation ratio with respect to interference between stations was discussed.

The next paper was by S. Goodman of the G.E. Co. on the subject "Interference Between Two Frequency Modulated Stations". The author started out by announcing that the preceding speaker had presented his paper. Apparently the two papers were as similar in text material as their titles would indicate. In what discussion he did give, the author added little to what Pollack had said.

The next paper was by J. F. Morrison of the Bell Laboratories on "A New Broadcast Transmitter Circuit Design for Frequency Modulation"*. The author first discussed the limitations of the FM generation methods used so far, i.e., compensated phase modulation and direct frequency modulation. While each has certain desirable characteristics, it also has limitations. In the compensated phase-modulation scheme there is difficulty in maintaining the carrier frequency, even when a crystal is used in the original low frequency oscillator, because of the large multiplication ratio used. In a direct FM system, such as that using a reactance control tube, there is great likelihood of carrier-frequency variations because of inherent characteristics of the type of oscillator used with such a system. Methods of automatic frequency control can be applied to such systems but the author pointed out a number of practical difficulties with such arrangements, among which is the difficulty of selecting the carrier under wide band conditions. Frequency division is used by the author to provide a mean frequency component of good amplitude. This frequency is modulated by a standard crystal reference frequency to produce two-phase beat currents. These currents are applied to a synchronous motor which controls a variable condenser in the high frequency modulated-oscillator circuit. The latter is thus automatically held on frequency. Stability of the order of 0.0025 percent is claimed using this system.

The next paper was on "Frequency-Modulation-Systems Characteristics" by M. L. Levy of Stromberg-Carlson. The author discussed signal-to-noise ratios and compared receivers using four deviation systems from the standpoint of signal-to-noise and other characteristics. Various types of measurements for FM receivers were discussed.

A paper was presented by R. F. Guy and R. M. Morris of NBC on the "NBC Field Test of Frequency Modulation". This was accompanied with a demonstration. Unfortunately, the time consomed by some of the less interesting and less important papers which preceded it, prevented this paper from being given adequate time for a proper presentation of the large amount of useful data it contained. The setup for the 1939-40 field tests was described briefly and curves were shown of the effect of the various types of modulation and of various deviation ratios. It was emphasized that to get best results from FM it was necessary to have sufficient gain in the receiver ahead of the limiter to provide proper operation of the latter. Demonstration records were played in which a desired and an undesired signal had been recorded simultaneously. The following ratios of undesired to desired signals were used: 6/1, 1/1, 1/6, 1/12.

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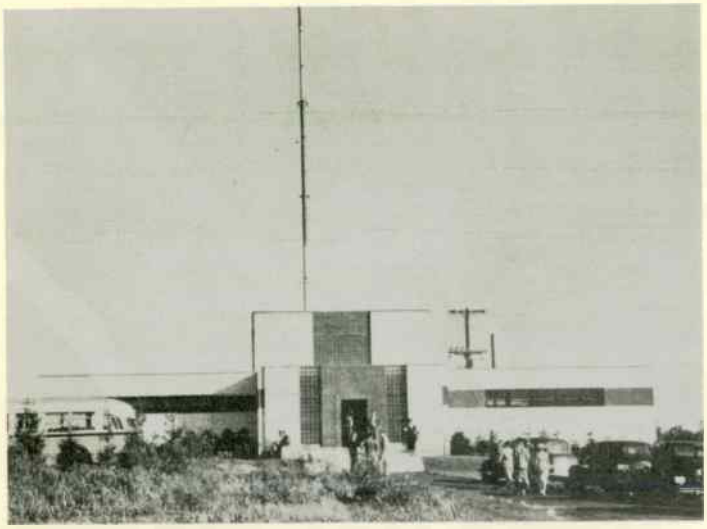
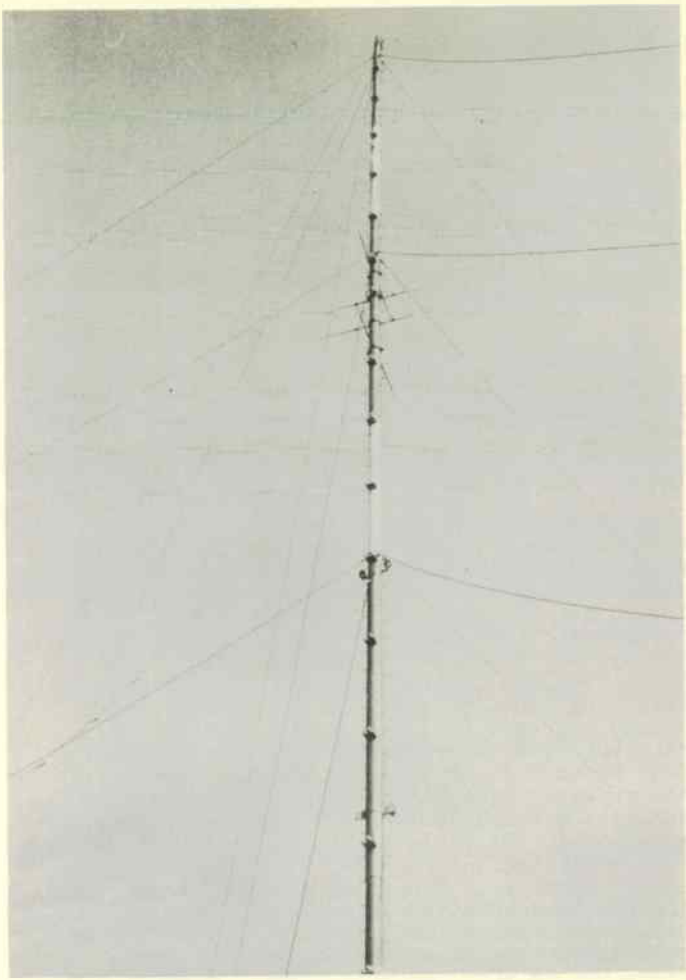
*A copy of this paper is available in the Camden Library.



This paper was followed with a demonstration by E. H. Armstrong and P. A. De Mars of the reception in Boston from the Yankee Network 50 kw FM station at Paxton, Mass. At the conclusion of the demonstration a bus trip to this station was available for those desiring to see it. The station was at a distance of 46 miles from Boston. Following the inspection of the station, a buffet supper, etc., was served.

A view of the front of the station is shown as well as a shot taken up the mast. The double crossed dipole radiators will be seen part way up the mast. The mast was originally about two-hundred feet higher but ice and a storm last winter broke off a considerable portion of the top. At that time the radiators were installed at their present location as a temporary measure and have never been changed.



Pacific Coast Convention

Institute of Radio Engineers

AUGUST 28, 29, 30, 1940

AMBASSADOR HOTEL **LOS ANGELES, CALIF.**

For the fourth year the Pacific Coast Sections of the I.R.E. joined in arranging for a convention. This year it was held in Los Angeles. Our thanks for the following summaries of the outstanding papers presented there go to Mr. G. L. Beers who presented a paper at the convention and attended the technical sessions.

"Ultra-High-Frequency Tubes" by A. V. Haeff, RCA Manufacturing Company, Inc., Harrison, N. J. A copy of this paper is available both in Harrison and Camden for those who may be interested in this subject.

"Rectilinear Electron Flow in Beams" by J. R. Pierce, Bell Telephone Laboratories. Pierce gave a theoretical discussion of the possibility of obtaining rectilinear electron flow according to space-charge equations for parallel planes and concentric cylinders and spheres in the form of beams surrounded by charge-free space. To obtain the rectilinear electron flow the cathode and beam are enclosed by electrodes in the form of equipotentials which were obtained from solutions of Laplace's equation which matched the space-charge equations in potential and gradient over plane, cylindrical, or conical surfaces along the lines of flow.

"Propagation of Electromagnetic Waves Inside a Cylindrical Metal Tube and Along Other Types of Guides" by C. P. Hsu, California Institute of Technology. This paper included a mathematical treatment of the propagation of electromagnetic waves inside cylindrical metal tubes. From this treatment Hsu concluded that the attenuation of the electromagnetic wave inside a metal tube could be made approximately

the same as that along a coaxial cable. The cylindrical metal tube, however, had the following disadvantages:

1. Sharp bends must be avoided.
2. It is difficult to maintain the ideal contour for the tube.
3. No efficient means or receiving arrangement for terminating the tube has been devised.

"Distortion Measurements by Fundamental-Suppression Methods" by W. R. Hewlett and David Packard, Hewlett-Packard Company, Palo Alto, California. The paper was presented by Mr. Hewlett. He discussed two methods of suppressing the fundamental to measure distortion. In the first method a filter was used to reject the fundamental. The filter was designed for a specific frequency. A cathode-ray oscilloscope was used to measure and analyze the distortion components. The second method made use of a synchronized local oscillator and a resistance bridge for balancing out the fundamental. Mr. Hewlett stated that this system had the advantage that it could be used to cover the entire audio-frequency range. The local oscillator was provided with a vernier tuning control to enable proper phase adjustment of the local oscillator voltage. The use of an rms. type meter for reading the percentage of distortion was suggested.

"Measurements of Noise and Vibration" by H. H. Scott, General Radio Company. This paper was essentially a sales talk on the new General Radio noise and vibration meters. He stressed the point of having a constant percentage selectivity in the measuring equipment. He discussed various industrial applications of the equipment in reducing noise and minimizing vibration.

"Design and Test of Sound Equipment by the Intermodulation Method" by J. R. Hilliard, Metro-Goldwyn-Mayer Studios. Mr. Hilliard discussed both the single-frequency and two-frequency methods of measuring distortion. He expressed the opinion that the two-frequency method, in which the sum and difference frequencies are measured, gave results which were more consistent and more representative of the performance obtained under actual operating conditions.

"Mutual Acoustic Impedance in Multiple Speaker Systems" by H. S. Knowles, Jensen Radio Manufacturing Company. In this paper Mr. Knowles discussed the mutual or interaction impedance between multiple loudspeakers. He concluded that at low frequencies twice the radiation resistance is obtained with a two-speaker system. He recommended that the speakers be placed as close together as possible and stated that the best phasing between speakers is obtained when the total sound energy in the enclosure is a maximum.

"Frequency Modulation" by E. H. Armstrong, Columbia University. Major Armstrong covered substantially the same subject matter which was discussed in the frequency modulation paper which he presented at the S.M.P.E. convention in Atlantic City.

"Performance Characteristics of Frequency Modulation in Ultra-High-Frequency Sound Broadcasting" by R. F. Guy, National Broadcasting Company. This paper was substantially the same as the one Mr. Guy presented at the I.R.E. Convention in Boston.

"Proposal for Reduction of Polarization Errors in Loop Direction Finders" by F. E. Terman, Stanford University, and J. M. Pettit, University of California. In the introduction to this paper Mr. Pettit discussed the "night effect" error in radio compass work which results from the horizontally polarized component of the sky wave being picked up by the horizontal elements of the loop. The Adcock antenna overcomes this limitation but is not suitable for many applications. Mr. Pettit proposed the use of an auxiliary antenna in fixed relationship to a conventional multi-turn loop and a simple network by which a voltage from the antenna would be used to cancel the horizontally polarized component intercepted by the loop. A mathematical analysis of the nine variables involved in the system showed that when the earth has a high reflection coefficient the horizontal dipole antenna, mounted on the main loop, is capable of providing complete or nearly complete neutralization of the horizontal pickup, with no tuning required other than an initial adjustment.

"Radio Direction Finding for Meterological Balloons at 1.67 Meters" by L. C. Yuan and S. S. Mackeown, California Institute of Technology. The direction finding receiver described by M. Yuan employed an Adcock antenna which could be rotated about both a horizontal and a vertical axis. Rotating the antenna about the horizontal axis converted it into an horizontal-H antenna and the vertical angle of the incoming wave could be determined. Rotating the antenna about the vertical axis made it possible to measure the horizontal angle. An accuracy of 1/2 degree was claimed for the system. Deviations from true directions were noted on several occasions. These errors were caused by irregularities in the contour and conductivity of the ground at the receiving location. The receiver employed was a superheterodyne and used a resistance-coupled intermediate-frequency amplifier.

"Vacuum Tubes in Chemical Research" by C. J. Penther and D. J. Pompeo, Shell Development Company, Emeryville, Calif. Mr. Penther described several electronic devices used in chemical research and primarily applicable to the oil industry. The first device described was a thyratron-controlled system for maintaining the temperature of a solution at any desired temperature to within a fraction of a degree. The next device described was an engine-pressure indicator which used a polished metal diaphragm in the cylinder head. A spot of light was reflected from the diaphragm to a photo-electric cell. Changes in pressure within the cylinder resulted in a deflection of the spot of light along an aperture used with the photo-cell and a corresponding variation in the current in the photo-cell circuit. A third device which Mr. Penther described was a timing device to be used in place of a stop watch. A thermostatically controlled tuning fork was used as a constant-frequency source to obtain impulses so that small increments of time could be measured.

"Some Notes on Linear and Grid-Modulated Radio-Frequency Amplifiers" by F. E. Terman, Stanford University, and R. R. Buss, Heintz and Kaufman, Ltd. Mr. Buss described a feedback arrangement applicable to both types of radio-frequency amplifiers in which a sample of the modulation obtained from the output is compared with a sample of the modulation obtained from the input and the difference between the two modulations is applied as a modulating voltage in the proper polarity to cancel noise and distortion appearing in the output.

"RCA Portable Television Pickup Equipment"

by G. L. Beers, RCA Manufacturing Company, Inc., Camden, N. J. Same paper as given at the S.M.P.E. Convention in Atlantic City.

"Portable Television Broadcasting" by H. R. Lubcke, Don Lee Broadcasting System. Mr. Lubcke gave essentially the same information which he covered in his paper at the S.M.P.E. Convention in Atlantic City.

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ENGINEERING FACILITIES OF THE ENGINEERING PRODUCTS DIVISION RCA VICTOR COMPANY LIMITED, MONTREAL

By E. A. Laport
Manager of Engineering & Development
Engineering Products Division

In December 1938, the first steps were taken by the RCA Victor Company Limited for the permanent establishment of an Engineering Products Division with design and development facilities and manufacturing department, located in Montreal. This was brought about by the growing market in Canada for engineering products custom-made to Government specifications. Previous to that time it had been possible, to a certain extent, to sell Camden-made products on an export basis and to partially fabricate and assemble in Canada, Camden-made components as was done in 1938-39 on two 50D, 50 KW broadcast transmitters. Engineering products sales on an export basis were extremely difficult in view of the existence of two major Canadian manufacturers with development, design, and manufacturing capabilities of a formidable nature. The situation was resolved into a definite program of future activity when the Canadian Government called for tenders for substantial quantities of radio equipment for the Royal Canadian Air Force late in 1938, which had to be supplied by Canadian manufacturers, developed to meet very exacting specifications.

Since that time the Engineering Products Division to be described in this and an accompanying article has been organized, planned, constructed, and put into active operation. An article by Mr. J. P. Donovan in this issue describes the manufacturing department. Another in a future issue by Mr. J. M. Brian of the Engineering and Development Department will go into detail concerning the development of our facilities for testing equipment at high and very low temperatures and various humidities.

It was necessary to provide a new building to house the Engineering Products Division since the plant, though large, was utilized to the utmost for the manufacture of the regular line of home receivers, cabinets, records, Victrolas, and combinations, as well as numerous other regular merchandise items. Ground was broken in July 1939 and by October a modern building was ready for occupancy.

The space was laid out on the coordinated-unit plan where all departments from sales to shipping are together in the same building, where all may know one another and understand all phases of the special apparatus business. This type of close-knit organization, based on the Camden model, was readily worked out because all the departments were starting from scratch and were obliged to provide their own facilities independently of the rest of the plant. It also made it easy to comply with the Government requirements regarding restriction of admittance to the zones where Government work was being done.

The building contains 16,000 sq. ft. of floor space on two floors. The allocation of space to the various departments is shown in Fig. 1. The building is of reinforced concrete construction with sections of glass brick wall

General View of the RCA Victor Company, Ltd.'s Plant in Montreal. The Engineering Products Division Occupies the New 2-story Building in the Foreground

and steel frame factory windows. The windows are translucent, composed of double glass with spun glass fibres between. All partitions are on temporary framework. Offices and laboratories are flored with heavy linoleum. The heating is by means of steam radiator-blower units located near the ceilings.

The Engineering and Development Department consists of an office and two laboratories, all connecting, located on the second floor. The office has desks for 9 engineers and a stenographer, six fluorescent-lighted drafting positions, of which four are regularly used, a fireproof tracing vault, correspondence and record-print files, large book cabinet, and a blackboard 3 ft. by 9 ft. The space for the office and drafting room is 21 ft. by 42 ft. The main

Section of Engineering Department, Engineering Products Division

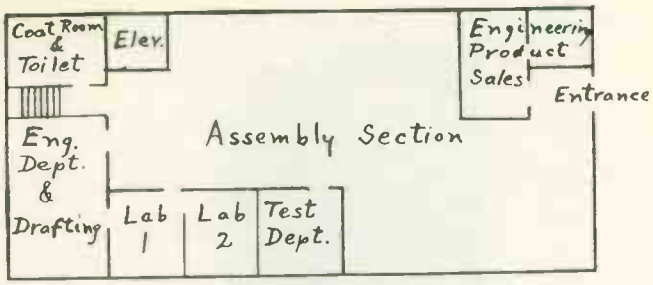


Fig. 1. Layout of 2nd Floor
Engineering Products Bldg. #17
Montreal

entrance is from the assembly section of the shop and the other door opens into the first laboratory.

Draftsmen are equipped with drafting machines of latest design. The efficiency of these drafting machines has been proven to the point where they are considered indispensable as a fixture in a modern drafting room. The speed of delineation is fully double that using tee-square and triangle, and the accuracy and neatness are superior. It is felt that these instruments paid for themselves in 4 to 6 months' use. The fluorescent lamps over each drafting table provide 50-60 ft. candles of uniform illumination essentially shadow-free.

Two laboratories, each 21 ft. square, suffice for the present requirements. These are equipped with all essential instruments and equipment for the development of medium power transmitters for frequencies as high as 100 megacycles. Suitable power circuits for the present range of our work are provided in both 60 cycles and 25 cycles. A 10 kva 1 phase 25 cycle power plant has been installed on the first floor to provide the 25-cycle source to test all equipment intended for use in the 25-cycle regions of Ontario, which normally comprises 40% of the Canadian market.

Laboratory #2 with Development Model of the Fan-Marker Transmitter in the Foreground

Aside from broadcasting, the major purchaser of engineering products is the Canadian Government. Even in broadcasting, it may be said that the principal purchaser is also the Government, since the Canadian Broadcasting Corporation is a direct Government subsidiary like the Canadian National Railways and the Trans-Canada Airlines. The CBC has purchased two 50D transmitters and one 5DX transmitter. The Depart-

Laboratory #1 with the Developmental Model of the General Purpose Communications Transmitter in the Center

ment of Transport, in providing the airways facilities for the Dominion, is a large purchaser of radio equipment. For this Department we have developed and manufactured 11 complete dual-transmitter, cone-of-silence marker equipments, including the antenna systems, and also 6 complete fan-marker equipments. The former are 10-watt 75 Mc equipments and the latter 100-watt 75 Mc equipments. Both are dual transmitters with provisions for automatic transfer to the second transmitter in the event that the carrier level or the modulation level drops more than 5% below normal. The performance of these equipments is identical to that specified by CAA, but of new designs which are more economical than those specified by CAA. This is the first important u-h-f work to be done in Canada and the results have been satisfactory. For the time being, at least, RCA Victor is in a leading position in u-h-f transmission in Canada.

Cone-of-Silence Marker Transmitter

A project of special interest is the 300 watt general communication transmitter. This equipment was successfully developed to unusually difficult specifications, involving substantial problems in mechanical as well as electrical design. Sectional construction has been carried out in the extreme in this transmitter to excellent advantage. The transmitter is made up of 8 major assemblies which are wired and tested before entering the final assembly, and each of these in turn comprises from 3 to 7 minor assemblies wired and pretested. Thus, while the equipment is complicated, the method of completely demountable sections provides unusual accessibility, interchangeability, and simplified manufacture. It may be of interest to state that there was not a single misfit in the entire assembly in production, even though manufacture proceeded very largely in parallel with development from preliminary releases.

For the purpose of testing this equipment under the specifications, it was necessary to provide a temperature-humidity chamber in which the complete transmitter could be subjected to temperatures from -40° C to 60° C, and to humidities in excess of 95%. As a separate engineering project, a large chamber was built and successfully operated. For separate use in the study of temperature characteristics of small components and assemblies and for the production adjustment of automatic temperature compensation of master oscillator units, it was necessary also to design and build a smaller unit which could be closely and rapidly controlled over great temperature differentials. Mr. Brian will describe this equipment in a later article, together with equipment for measuring frequency drift.

Entirely aside from the apparatus standpoint, starting a new Engineering Products Division gave an opportunity to incorporate a new streamlined system as well as new buildings, machines, and equipment. One interesting matter of system is that of identifying all stages of a job, from proposition to instruction book, with one basic number. For instance, we receive a request to tender on some apparatus. Serially we assign a proposition number, say Prop. 131. With this as a basis, the following numbering system is developed:

Proposition	
This becomes Project	Prop. 131 Descriptive Spec. TE-131 is issued.
Drawings marked: First Made for	Proj. 131 (if we are the successful bidder).
Engineering Notices released as	Proj. 131
	EN 131-1 (serially numbered thereafter).

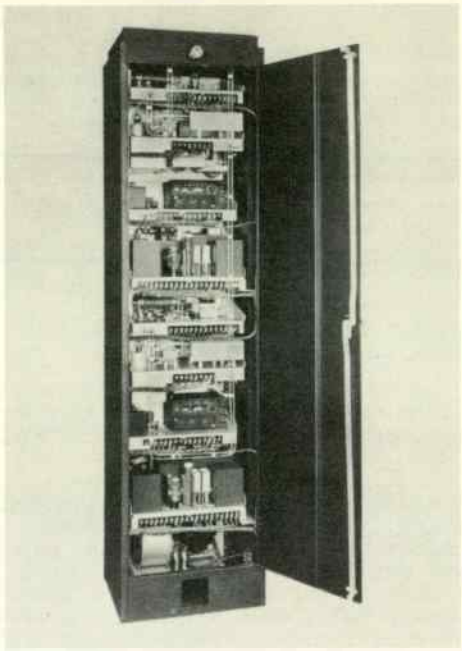
If there is an electrical contractor's installation job involved, such as for a broadcasting station, there is issued

Electrical Installation Spec.	EI-131
Then there is the instruction book	IB-131
Photographs are numbered	P-131-1, 2, 3, etc. serially
Equipment becomes known as	Type 131 (unless previously identified otherwise)
Final Engineering report becomes	ER-131

Thus everything relating to a job in all its phases is identified with one number and is filed in one place. The only place where a cross-indexing of numbers becomes necessary is when there is a repeat order for identical equipment.

Since the organization of the Engineering Products Division in 1939, the following projects have been developed and manufactured in the Montreal plant:

34 - 300-watt General Communication transmitters (several more are in production)
11 - 10-watt 75 Mc Cone-of-Silence Marker transmitters
6 - 80-watt 75 Mc Fan-Marker transmitters
5 - 10-watt 75 Mc transmitters for Trans-Canada Airlines
1 - 63 Mc 4-course Radio Range antenna system
1 - 50-D 50 Kw Broadcast transmitter (CBK)
1 - Portable 10-watt 75 Mc transmitting equipment with special antennas for cone-of-silence and fan-marker duties
2 - 5-DX 5 Kw Broadcast transmitters (partial manufacture, assembly, wiring and installation). (CBM and CKAC)
2 - 1-G 1 Kw Broadcast transmitters (CKGW and CJKL)
2 - Broadcast Directive Antenna designs (CHML and CKNX)
Development of all the basic units for a system of integrated broadcast speech-input equipment.



Rear View Showing Internal Assembly of The Cone-of-Silence Marker Transmitter

Installation of 2 - 50- D transmitters (CBA and CBK)
1 - Set of Speech input equipment for station CBM
5 - Airport Traffic Control Transmitters
10 - 5-channel Airport Communication Receivers
Also, during this period, 41 propositions of various types have been worked up.
11 - Improved Cone-of-Silence Marker antennas (new design now being developed to overcome some of the short-comings of the standard CAA design)

The personnel of the Engineering and Development Department is as follows:

E. A. Laport	-	Manager
S. E. Currier	-	Assistant Manager
J. M. Brian	-	Engineer
J. W. Sanborn	-	"
O. L. Britney	-	"
J. H. Pratt	-	"
J. E. Jackson	-	"
V. E. Isaac	-	"
F. R. Quance	-	"
J. M. Conroy	-	Supervisor of Inspection and Test
G. Holiday	-	Secretary
J. E. Hebert	-	Chief Draftsman
L. Kahne	-	Draftsman
G. E. Perks	-	Draftsmen
W. J. Ahearn	-	"
W. R. Casian	-	Laboratory Assistant

This department reports to J. L. McMurray, Manager of the Engineering Products Division, who reports to E. C. Grimley, President of the RCA Victor Company Limited.

It is desired to acknowledge the willing advice and suggestions of many individuals of the Headquarters staff in Camden, whose knowledge and experience frequently assists us with problems of all sorts. Their continued aid from time to time is taken for granted and it is hoped that some of the Canadian developments may merit use in Camden in the future.

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ENGINEERING PRODUCTS MANUFACTURE IN CANADA

By John P. Donovan
In Charge of Special Apparatus Mfg.
RCA Victor Co., Ltd., Montreal, Canada

There are many problems to the operation of any manufacturing organization but these are multiplied many times when a manufacturing unit is in the making, which is the condition we have in Montreal.

Our first problem in organizing was to determine the type of equipment we were to manufacture, the amount of business we anticipated handling, and the necessary tool equipment and floor space required to carry on this activity. This was accomplished by preparing some estimates on items of equipment that were representative of the equipment we could manufacture with a reasonable investment for machine tools, and converting this estimate into terms of man-hours for the various operations to be performed in building such apparatus. Consideration was also given to normal expansion of facilities as increase of business might warrant.

A tentative organization was made up of members drafted from Radio Manufacturing. Organization plans were patterned after the Special Apparatus Division at Camden, wherein all the phases of manufacturing, purchasing, processing, stock keeping, etc., are reporting directly to the department head. This had proved to be a very workable plan for obtaining immediate action on current problems.

The training of personnel to prepare estimates for new business was necessary even before we had begun to function as a manufacturing organization. This was difficult when you consider we had no record of past performances that would serve as a guide of what we might expect in the way of shop efficiency with the limited equipment available.

Processing and time study offered practically the same problems as estimating, but here we were able to apply many of the standard shop practices and time standards used in the Special Apparatus Division at Camden that would apply to our machine equipment.

Purchasing of materials for Engineering Products also required the training of personnel. Here, new domestic sources of supply had to be located on as many of the materials as possible and contacts had to be made with all vendors of materials imported from the United States. The purchasing group is located in the Manufacturing Department with the process and material ordering section. This has also proven to be helpful in speeding the purchase and follow up of materials. A better understanding of manufacturing requirements is also obtained by the Purchasing Department. Here schedules are made and discussed and the Purchasing Department plays a very important part in it.

Portion of the Machine Section of the Engineering Products Division of the Montreal Plant

Supervision also plays a very important part of our scheduling and naturally the supervisors are interested in seeing that these schedules are met.

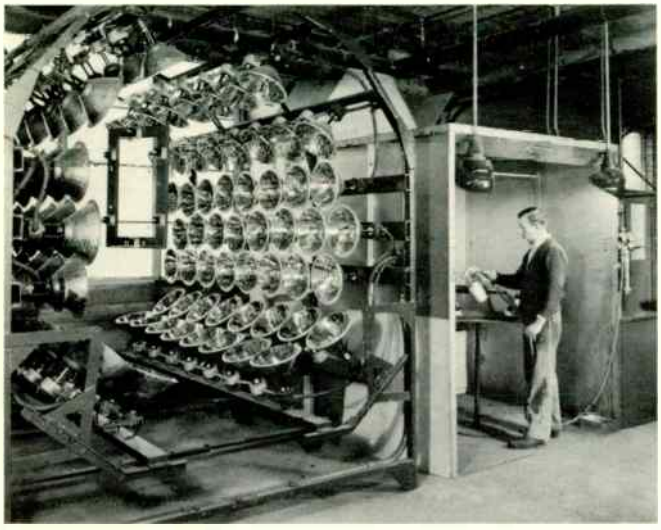
This is all possible in a small organization such as we have. It also makes each one of our organization feel he plays an important part in the operation of the department.

Manufacturing operations on Engineering Products were started in October 1939. We immediately established a Quality Division for incoming materials, fabricated parts and units. At the present time one hundred percent inspection is applied to all material and parts going into the manufacture of our equipment. This insures a high standard of production which is so important to any manufacturer and particularly so where we are invading a field that our competitors have held for some time. Quality has steadily improved so that now all our operators know exactly what is required of them and make every effort to set up and produce in exact accordance with drawings. This has also reduced the amount of individual supervision.

For machine equipment we have a Sheet Metal Department equipped with an eight-foot power

shear and large power brake for cabinet and frame work. For punch press parts, ten kick presses and three power presses ranging in size from fifteen to fifty tons, are available.

A welding section is located close to the punch press operations. We have facilities for spot, arc, and gas welding and miscellaneous portable tools for grinding, sanding, etc., of welded assemblies.

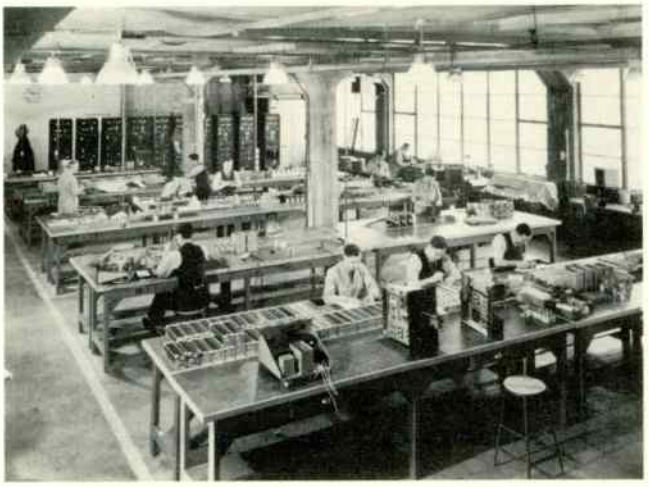


The Infra-Red Drying Oven and the Spray-Booth here shown constitute the modern finishing section of the Engineering Products Division, Montreal Plant

The main machine tool equipment consists of three milling machines, two horizontal and one vertical, two B & S one-inch capacity screw machines, surface grinder, shaper, three engine lathes, bench lathe, several multiple spindle drill presses, miscellaneous saws and a pantograph engraving machine. For finishing, we have a modern type spray booth having a water curtain on back apron to prevent the accumulation of spray material on booth walls. Fumes are also filtered through this water curtain reducing the fire hazard to a minimum. The oven equipment used employs infra-red rays as a medium of drying and baking. The unit consists of an adjustable frame on which are mounted one hundred and twelve, twelve-inch diameter gold-plated reflectors. The heating elements used are two hundred and fifty watt drying lamps. Baking of finishes is accomplished in about thirty to forty percent of the time required in the usual type ovens. It also has another desirable feature for our production. Small quantities of parts can be baked without any preliminary heating of the oven. A flick of the switch and the oven is ready for baking, and on completion of baking, it can be immediately turned off.

Assembly operations (sub and final) are carried on at present in an area of four thousand square feet. Approximately thirty employees are required to carry on operations when working at normal rate. A view of one section of the department is shown below.

The organizing, setting up, and starting of machine operations had to be done in a very short space of time. We were obligated by commitments to produce equipment in a specified time. This was accomplished with a reasonable degree of satisfaction. Delivery dates were



Portion of the Assembly Section, Engineering Products Division, Montreal Plant. A row of completed Cone-of-Silence Marker transmitters for use on the Department of Transport's Canadian airways can be seen in the background

met, but it required the expending of much effort to make up for our period of training before we reached a reasonable degree of efficiency. At the present time, operations have been in progress seven months. Plans are now being made for additional expansion. We hope that before the year has gone we shall be able to report that we are in a better position competitively and our scope of manufacture has been expanded to a point where we are recognized to be the leading manufacturer of Special Engineering Radio products in Canada.

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MOLDED PLASTICS*

By F. L. Creager
Supt. Tool Shops

The materials encompassed by this term may be broken down into two broad groups. Based on their reactions to heat and pressure, we have so-called "thermosetting" as differentiated from "thermoplastic" materials. Thermosetting materials are usually produced by the polymerization of the resin employed and the result is an infusible solid unaffected by subsequent heating up to the charring point. Conversely, thermoplastics may be readily deformed upon subsequent re-heating after the initial molding cycle.

In production, the molding technique also varies materially. Direct compression molding is generally employed for thermosetting materials although so-called transfer molding is gradually coming to the front. More recently extrusion has been commercially accomplished. Various sections such as railings, etc., have been produced in both straight and curved lengths. In compression molding, due to the longer time cycle involved, multiple cavity molds are employed to step up production.

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*No attempt will be made at this time to cover the entire subject field. The data herein have been restricted to apply to the materials common to the radio industry and more particularly to those employed by RCAM.

Thermoplastic materials are generally injection molded, permitting relatively high production rates from a smaller number of mold cavities.

It is important to note that compression molding entails loading cold, or at best pre-heated compound into open heated molds. The molds are then closed and after a predetermined curing time has elapsed, are opened and the finished part ejected, usually while still hot.

Transfer molding consists of pre-heating a measured charge of compound in a chamber from which it is ejected as a plastic mass into a closed, heated mold. The flow is such that slender inserts, etc., may be readily employed in situations which would be prohibited when straight compression molding is used. After proper curing, mold and transfer chamber are discharged and the cycle repeated.

Injection molding consists of pre-heating the charge as it is being compressed in a noznle and injecting same as a plastic mass into a closed chilled mold. The work is then ejected after which the cycle is repeated.

Thermosetting molding compounds common to our industry embrace two general types, the phenolics and the ureas. The phenolics are more popularly known under the generic term "bakelite". They are essentially synthetic resinoids resulting from the polymerization of phenol and formaldehyde under heat and pressure. Usually, they are loaded with wood flour, although they are employed sometimes without fillers as well as with paper, cloth, mica, etc.

Parts molded from this type of material (with wood flour filler) present a solid infusible mass with the following general characteristics:

Good	Fair
Molding quality	Dielectric Strength
Solvent Resistance	Machineability
Cold Flow Resistance	Color possibilities
Water Resistance	
Heat Resistance	
Distortion under Heat	
Dimension changes with age	**Bad**
Tensile Strength	Power Factor
Compressive Strength	Color Fastness
Hardness	Impact Strength (In Regular Grades)
Nearly non-burning	

The cost of black or brown in this material approaches 12 cents per lb. Colored compounds will approximately double this figure, making it cheaper in many cases to lacquer-color the lower cost compounds.

Inasmuch as the unit cost is largely influenced by production speed (pieces per mold per man), it is the practice to eject finished parts from the mold while they are still hot. Where dimensions and changes must be held to reasonable accuracy, the work is supported after ejection from the mold on so-called "chill blocks", until it approximates room temperature. Since the material is seldom fully polymerized as molded, there is a possibility that slight dimensional changes will occur with time. The dimensions may be fixed by longer cure of the part and/or subsequent over bake. The attendant unit cost increase, which may attain the order of 100%, can only be justified on critical parts where assembly alignment, etc., must be maintained. Special purpose materials compounded to accent certain characteristics are available at increased costs. These include medium and high impact strength compounds, low shrinkage compounds employed where relatively large inserts are used, low power factor (silk and mica loaded) compounds, etc.

Mottles or admixtures of two or more colored compounds in various ratios are available to simulate walnut, mahogany, marble, etc. When specified for large areas such as cabinets, etc., final decision on the material employed should be reserved until several cabinets have been molded since flow lines modify the pattern to such an extent as to occasionally radically change the expected pattern. Both the color ratios and the granule or chip size can be varied to control the final pattern within reasonable limits.

Urea-formaldehyde compounds are also thermosetting and likewise compression molded. They are more expensive (approximately 29 to 35 cents per pound) than the average phenolics, hence their use has been restricted to fields where the stability of the lighter pastel colors and light diffusion characteristics of this material justify their employment. Their moisture absorption is higher than that of the phenolics. They are somewhat more difficult to control in compounding and molding. Some trouble with finished parts may be encountered due to changing atmospheric conditions and an accelerated aging test is recommended before approval.

Cold Flow of Molded Plastic Materials

So-called "cold flow" or movement under continued pressure at room temperature varies materially with different basic compounds and to a lesser extent with different types of the same compound. The following table covers recent findings of the Bell Telephone Laboratories on this subject:

Material	% Cold Flow
Ebony Asbestor	0.2
Phenol Plastics	0.4
Urea Plastics	0.4 to 7.0
Cast Phenolics	10.0
Hard Rubber	0.5 to 8.0
Vinyl Plastics	1.0 to 32
Acrylic Resins	1.0 to 50
Polystyrol	2.0 to 22
Cellulose Acetate Plastics	2.0 to 64
Benzyl Cellulose	76.

The above figures were obtained as the percentage decrease in height of a 1/2" cube held for 24 hours at 120° F. between parallel plates under a load of 1000# (4000# P.S. 1). The great variation shown for thermoplastics is largely due to difference in plasticizers, the higher the percentage of plasticizer, added to obtain greater flow at molding temperature, the greater the cold flow.

With the higher displacements increase in specimen contact areas tends, by reducing unit pressure, to vitiate the readings somewhat; however, they are acceptable up to 15%.

Moist atmospheres may double the cold flow characteristics of the harder (low plasticizer content) cellulose acetates with slightly less effects on the softer compositions. The lower moisture absorption of the butyrates is reflected in less increase of cold flow with humid atmospheres.

Lesser amounts of plasticizer, with corresponding increase in molding flow temperature, result in material gains in all physicals and a large drop in cold flow, however, with some decrease in impact strength.

When thermoplastics are specified, particular attention should be paid to strengthening sections subject to flow by increasing cross section or the use of a channel or rib. All contacting parts should be studied that low

unit pressures are maintained by the use of large areas, washer-headed screws, etc. The use of metal inserts is sometimes necessary to distribute the stresses over larger areas.

Note: Abrupt changes in section (ribs, etc.) must be carefully watched as shrinkage hollows on the opposite face of the part wall may be expected.

--ooOoo--

SERENDIPITY*

Pasteur had a true understanding of the mental processes of discoverers and inventors when he stated: "Chance favors the mind that is prepared." It is more than a truism that discoveries are made almost exclusively by workers who are keenly searching for an objective. Occasionally the objective may be a bit hazy and at other times the searcher finds not what he seeks directly but something in its place that may be even more valuable, yet the discovery made is nevertheless an object attained by a search. A special name has been coined for discoveries that differ from what one goes out for; they are instances of "serendipity--the gift of finding valuable or agreeable things not sought for".

The term serendipity was recently revived by Dr. W. B. Cannon of the Harvard Medical School in an address reported in the "Scientific Monthly", entitled "The Role of Chance in Discovery". The word was apparently first used by Horace Walpole, in 1754, in a letter to his friend Horace Mann, which alluded to an old fairy tale about the "Three Princes of Serendip" (an old name for Ceylon), who, as they traveled about, "were always making discoveries, by accident or sagacity, of things they were not in quest of".

In Dr. Cannon's own field of physiology many serendipitous discoveries have been and still are being made, but always by trained discoverers. The keen physiologist Galvani discovered that frogs' legs suspended by copper wires from the railing of a balcony twitched strangely whenever the free ends touched the iron of the rails as the legs swung in the breeze. By a group of such observations, followed through by study, electricity was gradually brought before the modern mind, via frogs' legs, batteries, static electric generators, Leyden jars, magnets, etc. Very recently, another variant of Galvani's observation of the influence of electricity on nerves is coming to the fore, and nobody yet knows how far physiology and therapy may advance through "brain waves" and other associations between electricity and the body. Research on the influence of various external conditions on cell-division in eggs led in a roundabout way to the cold therapy which is now being tested as a human cancer treatment.

Archimedes' discovery of the concept of specific gravity is well known. Nobel's discovery of dynamite was also an example of serendipity, as was the finding of the first aniline dye by the boy Perkin, while he was trying to synthesize quinine. One of the most notable chance discoveries was that of America by the navigator, Columbus.

Serendipity is more characteristic of the pioneer than of later workers in any line, but can always occur. Our well-known earth now perhaps affords few opportunities for chance discovery in a geographical way. However, there should continue to be many occasions for the manifestation of serendipity in the developing world of science and industry for a long time to come.

This article was submitted for comment to Dr. Willis R. Whitney, as one of the users and appreciators of the term serendipity. A part of his reply may be of general interest: "In every individual's stock of knowledge (his conscious and subconscious assets) there lie the peculiar items or records of all his former thoughts. They are permanent records. Some of these may 'pop out' or 'come to mind' when a novel or unexpected event crosses his mental threshold. Some sort of catalysis has taken place. This all indicates dependence of the gift of serendipity upon the total (even forgotten) knowledge and training of the individual. This gives us all a continuing reason for learning more wherever we are."

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*Reprinted from "Industrial Bulletin of Arthur D. Little, Inc.", July, 1940.

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July 1, 1940

Due to the unsettled conditions abroad, Mr. B. Gardner's headquarters have been transferred to New York.

Mr. Gardner will continue to have responsibility for the operation of the London Company, and will also continue to be responsible for a number of commercial negotiations in the foreign field, which, also of necessity, have had to be transferred to New York.

Mr. Gardner will be located in the RCA Building, 30 Rockefeller Plaza, New York. Your wholehearted cooperation with Mr. Gardner will be appreciated.

F. R. Deakins
Vice President

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July 8, 1940

The apparatus business of the Company has been expanding for some time.

In order to prepare for further expansion and meet the problems incident to the changing character of our business, both at home and abroad, the following organization changes are effective as of this date:

Mr. J. L. Schwank is transferred to the office of F. R. Deakins.

Mr. Mead Brunet is made manager of the Engineering Products Division, and as such will be responsible for the management of the Washington Office.

The Commercial Sound Department will be made a separate division with Mr. George Ewald, manager - reporting to F. R. Deakins.

F. R. Deakins
Vice President

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N O T I C E

To allow for concentration and specialization in automobile radio activities both from an engineering and a commercial viewpoint, Mr. F. X. Rettenmeyer has been chosen to give his entire time to the subject, starting Monday, August 12. Therefore, all matters concerning automobile engineering, and commercial-engineering matters should be referred to him directly or to Mr. J. C. Smith who will continue to supervise the activity as assistant to Mr. Rettenmeyer.

Mr. D. D. Cole will direct all engineering activities associated with Domestic, Brand and Export home receivers in the Production Engineering Division.

Mr. K. A. Chittick will become assistant to Mr. Cole, and will continue to be responsible for engineering activities associated with Domestic home receiver items.

E. J. KELLY
Manufacturing Administration

8/20/40

RCA TECHNICAL PRESS

Effective September 1, 1940, the name of the RCA Institutes Technical Press will be changed to the RCA Technical Press. Headquarters of the Press will be in the RCA Department of Information, 30 Rockefeller Plaza, under the management of Ernest S. Colling.

The RCA Technical Press will continue to publish RCA's quarterly engineering journal, the RCA REVIEW, and other technical books and papers. The Board of Editors of the REVIEW will be the same as in the past, under the chairmanship of Charles J. Pannill, President of the Radiomarine Corporation of America and RCA Institutes.

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RCA INDIANAPOLIS PLANT
EXPANSION IS ANNOUNCED

New Building to Increase Manufacturing Space Substantially

Plans have been completed for enlarging our plant at Indianapolis, Ind., by the addition of one building unit of 100,000 square feet of space, the first of a total of some 400,000 square feet which the Company will need to meet requirements under the National Defense Program for products now manufactured at Indianapolis. The new building will be rushed to completion so that it may be in service by January 1, 1941.

Announcement of the plant expansion was made public by Mayor Reginald H. Sullivan of Indianapolis, immediately following RCA's acquisition of 15 acres of land adjoining the present factory. At the present time 1500 persons are employed at Indianapolis, and it is expected that this number will be increased to 2500 employees when the new unit is placed in operation.

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SENSATIONAL NEW PRICES
SET FOR VICTOR RECORDS

Entire Red Seal and Black Label Catalogs Included in Reductions Running as High as 50 Percent

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Sensational new established prices for Victor Red Seal and Victor Black Label records of all classifications, running from one-half to one-third lower than former prices, were announced about the middle of August.

Twelve-inch Red Seal records, formerly priced at $2.00 and $1.50, now sell for $1.00 (with proportionate reductions in the prices of album sets); 10-inch Red Seal records, formerly priced at $1.50 and $1.00, are now 75¢; 12-inch Black Label Classics, which achieved a tremendous sale at $1.00, are now 75¢; the 75¢ Victor Black Label 10-inch popular records are now 50¢.

These new established prices have already produced an unprecedented jump in retail sales throughout the country, with dollar volume of Red Seal sales alone reported from more than double to nearly seven times greater since the mid-August price changes. Public enthusiasm created by the new prices has literally turned

the record business "upside down". The demand is not alone for the 1,000 or so 'standard' records and album sets, but also for usually slow-selling records which have been in the Victor Catalog for years.

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RCA FELLOWSHIP

A Fellowship for the investigation of biological problems with the electron microscope recently developed in our research laboratories has been established in the National Research Council through funds provided by the RCA Manufacturing Company.

In considering candidates for the RCA Fellowship, the National Research Council will give preference to "versatile young men of United States citizenship, who have sound training in micro-biology, a doctor's degree (Ph.D. or M.D.), and a record of original work". The RCA Fellowship is for the year 1940-41 and will carry a stipendium of $3000. The work will be carried on at the research laboratory of RCA at Camden, N. J.

The selection will be made by a distinguished committee of scientists of the National Research Council, headed by Dr. Stuart Mudd, of the University of Pennsylvania's School of Medicine, as Chairman. The Committee will also act in an advisory capacity to the Fellow. The other members of the committee are Dr. M. Demerec, Station of Experimental Evolution, Carnegie Institution of Washington; Dr. J. H. Kempton, United States Bureau of Plant Industry; Dr. C. W. Metz, Department of Embryology, Carnegie Institution of Washington; Dr. W. M. Stanley, Rockefeller Institute for Medical Research; Dr. Caryl P. Haskins, Haskins Laboratories; and Dr. V. K. Zworykin, RCA Research Laboratory.

Our purpose in establishing the RCA Fellowship in the National Research Council is twofold. First, to help further pioneering research on biological problems that may lead to new conquests in man's continual battle against disease. Second, to develop the best technique for obtaining the fullest benefits of this miraculous new instrument which is now available to research workers in all fields.

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RCA VICTROLA SERIES SHOWN TO DISTRIBUTORS

New Instruments Pre-viewed at Chicago and Atlantic City Meetings

A complete series of RCA Victrola instruments, including a new type of home entertainment instrument which combines radio and phonograph reproduction, and simplified facilities for making phonograph recordings in the home, was given pre-view showings for RCA Victor distributors from all parts of the country during the week of July 8. Several hundred wholesalers and members of their staffs from the middle and far West attended a two-day session in Chicago's Palmer House on Monday and Tuesday of that week. Those from the East met on Saturday and the following Monday at Haddon Hall, Atlantic City.

The interesting technical features of our new line of instruments will be found described elsewhere in this issue.

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TELEVISION AT REPUBLICAN CONVENTION

Political history shaped in Philadelphia by the Republican National Convention provided the background for an important chapter of communication history written by television engineers and the largest single installation of television receivers ever assembled in one spot.

The vast seating capacity of the Convention Hall was further increased by the installation of 60 television receivers in the Exhibition Hall of the Commercial Museum to take the sights and sounds of the convention outside the walls of the Hall for an additional audience of nearly 2000 persons.

RCA Victor engineers installed the sixty receivers in such a manner that 30 or more viewers could be accommodated by each. The instruments were connected by coaxial cable to the television cameras mounted on an especially built balcony only 75 feet from the rostrum in the Convention Hall, from which they carried two-hour programs morning, afternoon, and evening. There was no admission charge for visitors to the Exhibition Hall. There were also about five additional receivers set up for the press in various locations, one being in the Pennsylvania Club.

The proximity of the cameras to the rostrum actually gave the television viewers in the Commercial Museum a better view of the proceedings than was enjoyed by most of the spectators in the Hall itself. The installation in the Commercial Museum marks the first time that television has been called upon to increase the seating capacity of an auditorium. Public address facilities for overflow crowds are commonplace, but enabling persons outside a hall to see as well as hear the proceedings is unprecedented.

In addition, a comprehensive television plan was worked out by NBC for televiewers in the New York area. Daily sight as well as sound programs were broadcast to New York from the convention floor, transmission between the cities being accomplished by coaxial cable.

A temporary television studio was constructed in the Convention Hall where important personages were interviewed and programs other than those originating from the floor were presented.

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NEW RCA FIELD FORCE TO SELL POLICE RADIO

Sales engineers and service experts assigned to cover every section of the country are included in a new field force organized to merchandise RCA police radio and emergency communication equipment. Heretofore, such equipment sales have been handled by a field organization responsible for the sale of various other RCA products as well.

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POPULAR MUSIC VERSUS THE CLASSICS

Mr. and Mrs. Average American and Family seem to prefer serious music to "swing" or popular tunes, at least when they are able to hear the classics in their proper settings.

This was made known as the initial results were published of a survey made at the RCA Exhibit at the New York World's Fair, of requests for recorded music received in the building's Record Music Room. More than 1,200

requests for selections are made on the average day and about 200 selections are played during the 14 hours the lounge is open daily. During the first month of the Fair 83½ per cent of the requests were for serious music and only 16½ per cent for "swing" and popular numbers.

The Paul Robeson recording of "Ballad for Americans" is by far the most popular music requested. So many requests for it are received that it has had to be placed on a regular schedule. It is played on weekdays at 1:00, 4:00 and 8:00 p.m. On Saturday, Sundays and holidays requests for the number are so great that it sometimes has to be played hourly to satisfy the demand.

It was soon discovered that visitors to the Music Room did not like to mix their music. If they came in to hear a symphony, they were not satisfied to sit and listen to a swing band instead. To remedy this, "swing" and popular music is scheduled at two periods a day - from 10:00 to 12:00 a.m. and from 6:00 to 7:00 p.m.

The survey represents a cross section of the country since visitors from every state in the union, as well as from many foreign countries, have registered their requests. All age groups and both sexes are represented, but a predominant number of requests are made by young people.

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ENGLISH BUY MORE PHOTOPHONE SOUND

Shipments of RCA Photophone motion picture sound reproducing equipments to England during the first half of 1940 were approximately 57 percent greater than for the same period of last year despite the economic dislocations caused by the war.

The increase is attributed to the blackouts and war strain, which have made the entertainment provided by the cinema more important to the English than ever before.

It is interesting to note that RCA Photophone sound recording apparatus is playing an increasingly important part in the production of British pictures while at the same time gaining steadily with American studios. During the first half of 1940, 65 percent of all British pictures were recorded on RCA Photophone equipment. This compares with only 40 percent for the same period of 1939. The next most popular recording equipment is currently being used on only about 10 percent of the new movies.

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BUILT-IN RCA RADIO IS FEATURE OF PIPER COUPE

The Piper Aircraft Corporation and the RCA Manufacturing Company have completed arrangements for the installation of two-way RCA radio equipment in the famed two-place Piper Coupe at the former Company's Lockhaven, Pa. factory. Transmitting and receiving equipment and a new type of antenna reel system are supplied with the fast-selling Coupes for $466.25.

The custom-fitted radio installation is on display in a Piper Coupe in the RCA Exhibit at the New York World's Fair.

The Coupes may also be purchased with factory-installed radio receivers alone, or with a receiver equipped with a radio range filter which enables the pilot to listen to range signals, voice broadcasts, or both together.

The complete two-way equipment includes the RCA AVR-15A receiver, Model AVT-15A 7½-watt transmitter, and Model AVA-41 Antenna Reel System. All three units have CAA type certification. The range is over 100 miles under ordinary conditions, satisfying CAA requirements for instrument flight.

The Civil Aeronautics Authority recently purchased twelve of these planes, equipped with RCA two-way radio.

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RCA VICTOR RELEASES HOME RECORDER DISCS

RCA Victor has introduced a new home recording blank to distributors, the RCA Victor Phonogram, designed to attract the profitable new market created by the widespread sale of home recording instruments.

The Phonogram is a six-and-a-half inch disc retailing at $1.05 per package of seven. Its features include a fully flexible paper core, slow-burning shavings, extremely low surface noise, and exceptionally fine tone quality and volume. The disc is finished in a rich blue with a buff label which takes both ink and pencil.

Available with the discs are envelopes of heavy cardboard-backed, draft paper with cover ruled for addresses. For sale at nominal cost, the envelopes are almost a necessity for sending recorded messages through the mails.

--ooOoo--

We received the following notices of new arrivals from the Special Apparatus Engineering group. We are sorry that due to the fact that The Scanner comes out quarterly, some of these are quite late in getting into print. However, this does not dim our pleasure in printing them and we feel confident the proud fathers are still beaming.

Pamela Jane Brokaw arrived at the C. A. Brokaws' on April 28. She weighed 6 lbs. - 4 ozs. on arrival.

Mr. and Mrs. E. P. Gertsch announce the arrival on July 6 of Paul Robert Gertsch. Paul weighed 6 lbs. - 1 oz.

On May 5 Anne Susan Tucker arrived at the home of Mr. and Mrs. Tucker weighing 7 lbs. - 11½ ozs.

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HOME-RUN HALTS HITLESS HURLING

A record of pitching 31 scoreless innings was ended on Saturday, August 17, when it was announced that Miss Edith R. "Teddy" Langmuir had found "Lefty" Leverenz' offerings to her liking and had slammed a homer over the pennant in deep centerfield.

Realizing the futility of holding forth against such a powerful opponent, "Lefty" has persuaded "Teddy" to join him as a lifetime battery, signalizing harmonious teamwork typical of the RCA Family.

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Congratulations to Thomas T. Eaton (General Research Section) on his marriage on July 27

to Miss Maurine M. Wilson of Oaklyn, N. J. The ceremony took place at 4:00 P.M. in St. Mary's Episcopal Church of Haddon Heights. Mr. and Mrs. Eaton are now at home at 409 Crest Avenue, Haddon Heights, N. J.

Miss Sarah B. Miller of Jermyn, Penna., and David H. Cunningham (Home & Auto Receiver Section) were married on August 17. Miss Miller is a graduate of Cornell University and Mr. Cunningham is a graduate of the University of Missouri. Mr. and Mrs. Cunningham are at home at 322 Estaugh Avenue, Haddonfield, N. J.

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Our congratulations to W. A. Hargraves (Engineering General Research) on his marriage on August 16 to Miss Gerda Geiringer.

Best wishes to Eunice M. Byers (Sound Engineering Section) on her marriage on August 17 to Ralph C. Huttich. The ceremony took place at 7:00 o'clock in the evening in the Wyoming Avenue Baptist Church, Philadelphia.

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TRANSFERS AND ADDITIONS TO THE ENGINEERING DIVISIONS

Radiotron Division

Additions

Oliver Fulton	Student Engineer in Development Shop

Transfers

L. Pensak	Development Shop to Research
C. Eddison	Chemical Research Section to Camden

Victor Division

Additions

H. Barnaby	Sound Engineering
E. Deckman	Drafting
C. H. James, Jr.	Blueprint
R. A. Ritter	Drafting
E. C. Rodriquez	Blueprint

Transfers

S. W. Child	Engr. Adm. to Special Apparatus
W. P. Dutton	Television Projects to RCAM Washington
R. H. Heacock	Sound Engineering to New Products
F. L. Creager	General Research to Home & Auto Receivers
W. M. Perkins	General Research to RCAM, Detroit
C. W. Ellinwood	Engr. Adm. to Special Apparatus
F. A. Nester	Student Course to General Engineering
M. Richmond	Special Apparatus to General Engineering

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New Equipment Recently Marketed

Model	List Price	Description
		Personal Radio
BP-10	$20.00	Personal radio 3" x 3-3/4" x 9" case - self-contained batteries - loop operation - price includes batteries.
		Nippers
45X1	$ 9.95	5 tube a-c/d-c - plastic case - range 540-1720 kc.
10X	$14.95	5 tube a-c/d-c - plastic case - range 540-1720 kc.
15X	$16.95	6 tube a-c/d-c - Continental style plastic case - range 540-1720 kc - loop antenna - untuned r-f stage.
16X2	$19.95	6 tube a-c/d-c - plastic case - ranges 540-1720 kc - loop antenna - untuned r-f stage.
		Victrolas
V-100	$29.95	5 tube table model - wood case - self-starting motor - range 540-1600 kc - loop antenna.
V-102	$59.95	7 tube table model - wood case - self-starting motor - range 540-1600 kc - loop antenna - 5 push buttons.
V-170	$89.95	6 tube console - ranges 540-1560 and 5800-18000 - 2 loop antennas - 6 push buttons - automatic record changer.
V-200	$99.95	7 tube lowboy - other features similar to V-170.
V-201	$115.00	Similar features to V-200 but in console instead of lowboy cabinet.
V-205	$150.00	9 tube console - tone guard around lid - rotatable loop - ranges 540-1560, 1550-4000 and 5800-18000 kc - r-f stage.
V-405	$180.00	Lowboy having features similar to V-205.
V-300	$225.00	10 tube lowboy - ranges similar to V-405 plus spread band on 31 meter band - 8 push buttons - tuned r-f stage.
V-301	$275.00	Similar to V-300 except for cabinet which is Chippendale.
V-302	$300.00	Similar to V-300 except for cabinet which is 18th Century design.
VHR-202	$150.00	8 tube lowboy similar in ranges and features to V-200 and with addition of home recording.
VHR-207	$200.00	10 tube lowboy similar in ranges and features to V-205 and with addition of home recording.
VHR-407	$230.00	10 tube lowboy similar in ranges and features to V-405 and with addition of home recording.

Radiotron Division

LR-123 - Review of Work Done on the Spectrograph, H. T. Swanson - 12/14/39.

LR-125 - Status of Age Hardening of Nipron Wire on December 15, 1939 - S. Umbreit - 12/28/39.

LR-126 - Some Factors Affecting the Choice of Lenses for Television Cameras, H. B. Devore and Harley Iams - 1/8/40.

LR-127 - Application of Transparent Evaporated Films, R. B. Janes - 1/16/40.

LR-128 - Deflection and Impedance of Electron Beams at High Frequencies in the Presence of a Magnetic Field, L. Malter - 1/17/40.

LR-129 - Simple Methods for Checking R-f Distortion or Cross Modulation of Screen Grid Amplifier Tubes - E. W. Herold - 2/6/40.

LR-130 - A Mechanical Model for the Motion of Electrons in a Magnetic Field, Albert Rose - 2/14/40.

LR-131 - Focus Modulation on Slit-aperture Iconoscopes, O. H. Schade - 3/5/40.

LR-132 - Variation of Quality of Annealing of Glass with Rate of Cooling, C. A. Jacoby - 3/15/40.

LR-133 - The type A-5010 High Transconductance Double Triode, E. W. Herold - 3/26/40.

LR-134 - Construction and Design of a Video Generator and Video Amplifiers, O. H. Schade - 5/1/40.

LR-135 - The "Acid Process" for the Production of Luminescent Zinc Sulphide, D. R. Hale - 6/20/40.

LR-136 - The Improvement of Production Exhaust Equipment for Cathode-ray Tube Manufacture, J. K. Burton, L. B. Headrick and W. H. Painter - 6/24/40.

LM-60 - Notes on the Application of the 6SA7 to a Three Band a-c/d-c Receiver, W. A. Harris - 12/13/39.

LM-63 - Memorandum on the Power Requirements of Candoluminescent Screens, J. M. Stinchfield - 1/2/40.

LM-64 - Cathode Grid Leakage in Kinescopes, W. H. Painter - 12/27/39.

LM-65 - The Properties of Tantalum-tungsten Alloy, D. B. Langmuir and L. Malter - 1/4/40.

LM-66 - Memorandum on Electron Penetration, J. M. Stinchfield - 1/15/40.

LM-67 - Observations on 6SA7 Microphonics in a Frequency Modulation Receiver, W. A. Harris and E. C. Peet - 1/22/40.

LM-69 - Glasses for Beading Tungsten to Seal to Pyrex, John Gallup - 2/7/40.

LM-70 - 6SA7, 6J5, and 6J5-GT as Ultra-High Frequency Oscillators, W. A. Harris - 2/27/40

LM-71 - 6H6: Receiver tests on Tube with New Center shield, J. T. Cimorelli - 2/9/40.

LM-72 - Hearing Aid, H. F. Hafker - 2/29/40.

LM-73 - A Revised Circuit for D-C Restoring in Television Receivers with Kinescopes Having Grid Leakage, E. W. Herold - 3/7/40.

LM-74 - Input Conductance and Effect of Humidity Types 6SK7 and 6D6, W. A. Harris - 4/5/40.

LM-75 - Blocking Tests on Type 6SA7, W. A. Harris - 3/20/40.

LM-76 - Cathode Ray Tube Activation and Degassing Temperatures for Cathode and Control Grid, A. D. Power and L. B. Headrick - 3/27/40.

LM-79 - Improvement in Annealing Type GT Stems, C. A. Jacoby - 4/30/40.

LM-80 - Oscillation Occurring in Pushpull Circuit Using the 6AD7G and 6F6-G, E. C. Peet - 4/22/40.

LM-81 - Effect of Contact Potential on Diode Detector Sensitivity, R. L. Kelly - 4/30/40.

LM-83 - Measurement of Ion Spot in Kinescope by Means of Diffusion, T. B. Perkins - 5/10/40.

LM-86 - Oscillation limits of Gaseous Relaxation Oscillators, E. C. Peet - 7/22/40.

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Victor Division

A record of the subject content of our Library has been sent to the Library of Congress, Washington, D. C. for use in the National Defense Program. From the standpoint of subject content our Library stands at the top of radio libraries in business and industry.

Note: The Engineering Library is now retaining a file of slides with an index to authors and subjects. All slides sent to the Library in the future will be indexed.

Technical Reports

TR-493 - Miniature I-f Transformers, R. L. Harvey - 6/30/40.

TR-494 - Influence of Phase Delay Characteristic of the Intermediate Frequency Amplifier of a Television Receiver on the Picture Quality, G. L. Fredendall - 4/24/40.

TR-495 - Sound Trap for Phonograph Pickup Noise, H. F. Olson - 6/7/40.

TR-496 - Distortion in Variable Width Sound Processing, J. O. Baker - 6/3/40.

TR-497 - Circular Types of Electrically Focused Electron Multipliers, J. Rajchman and E. G. Ramberg - 6/10/40.

TR-498 - Harmonic Distortion in Variable Width Sound Processing, J. O. Baker - 6/6/40.

TR-499 - A Comparison of Vertical and Horizontally Polarized Waves at u-h-f, G. H. Brown - 6/19/40.

TR-500 - Broadcast Receiver with New Station Selecting Means and Remote Loop and Speaker, W. M. Perkins - 6/21/40.

TR-801 - A Rotary Beam Antenna for Use in the 10 and 20 Meter Amateur Bands, G. H. Brown and J. Epstein - 7/1/40.

TR-802 - Discussion on a Degree of Consistency Required in a Power Supply for a Magnetic Electron Microscope, J. Hillier - 8/1/40.

TR-803 - A New Noise Reducing Input Circuit for Television Camera Amplifier, A. V. Bedford and A. C. Schroeder - 7/19/40.

Engineering Memorandums

EM-2194 - Manufacture of RCA Recording Systems, H. P. Billings - 6/1/40.

EM-2195 - Shot Noise of an Electron Multiplier when Operated on a High Frequency Voltage Supply, J. Rajchman and E. G. Ramberg - 6/10/40.

EM-2196 - Phonograph Record Reproduction with Photoelectric Pickup, H. E. Roys - 6/27/40.

EM-2197 - A Discussion of the FCC Rules and Standards of Good Engineering Practice Relating to Rating of FM Transmitters, R. D. Duncan, Jr. - 7/12/40.

EM-2198 - Polythene, a Thermoplastic Having Useful Dielectric Properties, E. G. McAllister - 7/26/40.

EM-2199 - Second Detector for Use in Television Receivers, R. S. Holmes and G. L. Grundmann - 7/25/40.

EM-2200 - Multiplex aural and Facsimile Operation with FM... Comments on FCC Rules Relating to the Same, R. D. Duncan - 7/30/40.

EM-2201 - Optimum Damping for the Rotary Stabilizer, H. E. Roys - 8/12/40.

RCA Radiotron Publications

Application Note #106 - Application note on the RCA miniature tubes.

Application Note #107 - A miniature tube hearing-aid amplifier for use with an air-conduction earpiece.

Reprint - L. C. Waller - An Efficient u-h-f Unit for the Amateur Television Transmitter.

Translations

F-18 - Diplex - a modern radio-telegraph system, P. J. Noizeux, H. Kraehenbuehl, B. Novics. Trans. by RCA-C Traffic Dept. 2/21/40.

G-85 - Recording and reproduction of the long playing record, H. Alquist. Trans. by H. E. Paschon from reprint of Radio-Mentor, Berlin.

Books

The Anglo-American Yearbook. Lond. Amer. Chamber of Commerce, 1940.

Delmonte, J. - Plastics in engineering... Cleveland, Penton, 1940.

Klemperer, O. - Einfuhrung in die elektronik; die experimental physik des freien elektrons im lichte der klassischen theorie und der wellenmechanik. Berlin, Springer, 1933.

Krumbhaar, W. - The chemistry of synthetic surface coatings, N. Y. Reinhold, 1937.

Lohr, Lenox R. - Television broadcasting: production, economics, technique. N. Y. McGraw, 1940.

Meyer, Erwin - Electro-acoustics. Lond. Bell, 1939.

Mumford, Lewis - Technics and civilization. N. Y. Harcourt, c1934.

Olson, Harry F. - Elements of acoustical engineering. N. Y., Van Nostrand, 1940.

Physical Society - Reports on progress in physics... Lond. Physical Society, 1940.

Porterfield, John, ed. - We present television. N. Y. Norton, c1940.

President's Resch. Committee on Social Trends - Recent social trends in the United States. Report of the President's research committee on social trends. N. Y. Whittlesey, c1934.

Rider, John F. - Frequency modulation.

The Statesman's Yearbook. 1940, Lond. Macmillan, 1940.

Swigert, Arthur M. - The story of superfinish ...Detroit, Lynn, c1940.

U.S. Dept. of Commerce - Commerce Yearbook. Washington, Govt. Printing Office. 1927, 1929. (Library has 1926- V. 2 and 1928 - V. 1.)

U.S. Dept. of Commerce - Foreign Commerce Yearbook. Wash. Govt. Printing Office, 1939. (Library has 1938)

Wood, R. W. - ...Researches in physical optics. N. Y. Columbia, 1919.

The World Almanac and book of facts, 1940.

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Papers Approved for Presentation or Publication

Title	Author	
Radiotron Division		
A Type of Light Valve for Television Reproduction	J. S. Donal & D. B. Langmuir	I.R.E. Convention in Boston
Small Iconoscopes of Recent Design	W. H. Hickok	I.R.E. Convention in Boston
A New Ultra-High-Frequency Tetrode and Its Use in a 1-Kw Television Sound Transmitter	A. K. Wing & J. E. Young	I.R.E. Convention in Boston
Application of Diodes, Triodes, and Pentodes to Radio Receivers	K. S. Jackson	Philadelphia Radio Servicemen's Association
An Efficient u-h-f Unit for the Amateur Television Transmitter	L. C. Waller	QST
Victor Division		
Electrons Extend the Range	V. K. Zworykin	Electrical Engineering
An Electron Microscope for the Research Laboratory	V. K. Zworykin	Science
An Ultra-High Frequency Antenna of Simple Construction (The RCA - MI-7823 Antenna)	G. H. Brown & J. Epstein	Communications
The Electron Microscope	V. K. Zworykin	Broadcast News
Centimeter Wave Detector Measurements and Performance	E. G. Linder & R. A. Braden	I.R.E. Convention in Boston
Stable Power Supplies for Electron Microscope	A. W. Vance	I.R.E. Convention in Boston
Radio Navigation and the Omnidirectional Radio Range	D. G. C. Luck	I.R.E. Convention in Boston
A Portable Television Transmitter	C. D. Kentner	I.R.E. Convention in Boston.
A New Electron Microscope	L. Marton, M. C. Banca & J. F. Bender	I.R.E. Convention in Boston
Low-Reactance, High-Frequency Resistors	G. H. Brown & J. W. Conklin	Electronics
A Vestigial Side-Band Filter for Use with a Television Transmitter	G. H. Brown	RCA Review
A Comparison of Vertically and Horizontally Polarized Waves at Ultra-High Frequencies	G. H. Brown	Electronics

Patent Department News

The following basic patent, under which we are licensed, is noted as a matter of considerable interest. Although filed about 20 years ago it was tied up in interference with a Langevin application of French origin, and Nicolson has recently won the interference.

2,212,845
GENERATING AND TRANSMITTING ELECTRIC CURRENTS
Alexander M. Nicolson, New York, N. Y., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York
Original application April 10, 1918, Serial No. 227,802, now Patent No. 1,495,429, dated May 29, 1924. Divided and this application April 13, 1923, Serial No. 631,859
55 Claims. (Cl. 179—171.5)

1. An oscillating circuit comprising a piezoelectric device.

22. In a carrier wave signaling system, a piezoelectric device, an oscillator for energizing said device to cause the same to vibrate at the carrier

wave frequency, and means for modulating the vibration of said piezoelectric device.

...'''...

Mr. McQuate of our Patent Department has asked us to call the attention of our readers to the following:

"The RCA and RCAM Accounting Departments have informed me that they are greatly incon-

venienced by the failure of our engineer-inventors to cash the consideration checks which are issued to them for the assignment of U. S. and foreign applications to RCA, and have requested that we ask each inventor to promptly deposit any checks which may hereafter be issued to him."

...'''...

The following patents have recently been acquired by RCA.

2,029,282
Magnetic Circuit and Construction Thereof
Igor B. Serge, Rochester, N. Y.
Application April 13, 1935, Serial No. 16,261
7 Claims. (Cl. 179--117)

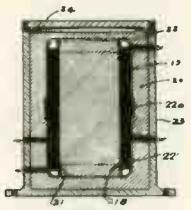
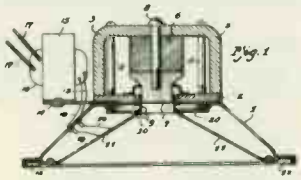


Fig. 5.

1. In a magnetic circuit for a transducer, a single relative short permanent magnet having a polar plane surface extending in a plane normal to the axis of the magnet and to the flux lines, a mild steel yoke attached to said magnet and including a mild steel pole plate having an opening therein concentric with the axis of said permanent magnet, a pole piece having a plane under surface extending normal to the axis of the pole piece and contacting with the polar plane surface of the magnet, said pole piece projecting into said opening and cooperating therewith to define an air gap between the pole piece and pole plate, said pole piece having a substantially homogeneous structure throughout its length but different flux concentrations.

2,143,811
Electromagnetic Core Construction and Method of Making Same
Elmer E. Wickersham, San Leandro, Calif.
Application March 29, 1933, Serial No. 663,298
4 Claims. (Cl. 175--21)



1. An electro-magnetic core comprising a body of native black sand including a large proportion of magnetite, and means for maintaining said magnetite in predetermined form.

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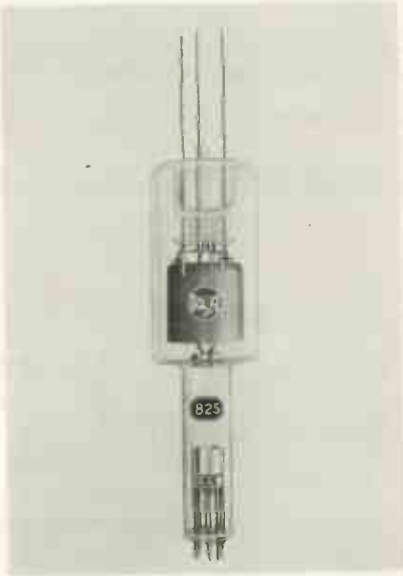
New Tube Data

Technical information has been issued on the following tubes and is available in the Library.

Type	Description
5W4-GT	High Vacuum Full Wave Rectifier - 350 v. and 100 ma.
825	Inductive Output Amplifier - 35 watts above 300 Mc.



827-R	Transmitting Beam Power Amplifier - Air Cooled - 800 watts up to 110 Mc.

880	Transmitting Triode - Water Cooled - 20 kw up to 25 Mc and at reduced output up to 100 Mc.
889-R	Transmitting Triode - Air Cooled - 5 kw up to 25 Mc and at reduced output up to 100 Mc.
893-R	Transmitting Triode - Air Cooled - 20 kw up to 5 Mc.
VR75-30	Voltage Regulator - Glow discharge type - 75 v. and 30 ma.

Application Notes No. 106 and 107 are also available discussing the miniature tubes 1R5, 1S4, 1S5 and 1T4. Sheets giving increased ratings for the 1R5, 1S4, and 1S5 are also available.

Recently Issued Patents Assigned to RCA

Issued June 4, 1940

Re. 21,473 - Receiving Means - R. W. George.

2,203,609 - Telegraph System with Repetition of the Signals - A. Bakker and H. C. A. van Duuren.

2,203,483 - Cathode Ray Tube - G. B. Banks.

2,203,191 - Sound Recording - G. L. Dimmick.

2,203,221 - Electron Discharge Device - J. L. H. Jonker and A. J. W. M. van Overbeek.

2,203,498 - Frequency Discriminating Network - W. R. Koch.

2,203,465 - Noise Reduction System - V. D. Landon.

2,203,468 - Regular for Time Delay Circuits - H. B. Martin.

2,203,634 - Television System - C. L. Richards.

2,203,582 - Tape Perforator - J. A. Spencer.

2,203,315 - Apparatus for Manufacturing Condenser Electrodes - W. L. L. Vivie.

2,203,481 - Concentric Lines and Circuits Therefor - P. D. Zottu.

Issued June 11, 1940

2,204,391 - Cathode for Electron Discharge Devices - Victor O. Allen.

2,203,857 - High Frequency Signal Responsive Control System - George L. Beers.

2,204,398 - Tuning Indicator System for Radio Receiving Apparatus and the Like - George L. Beers.

2,204,065 - Motor Driven Tuning System - H. H. Beizer and W. E. Newman.

2,203,811 - Radio Apparatus - Albert Blain.

2,204,175 - Antenna System - Philip S. Carter.

2,204,342 - Back-to-back Receiver - Murray G. Crosby.

2,203,722 - Television Receiver Circuit - C. C. Eaglesfield.

2,204,406 - Directional Antenna - Warren S. Eaton.

2,204,179 - Ultra-High Frequency Signal Generator - Ralph W. George.

2,203,820 - Electrical Signal Translating Apparatus - Emile C. Guedon.

2,204,250 - Television Transmitting Tube - Willard H. Hickok.

2,204,251 - Electrode for Television Tubes - Robert B. Janes.

2,204,086 - Radio Frequency Winding with Iron Core - Leone Kamenarovic.

2,203,871 - Radio Traffic Control - Winfield R. Koch.

2,204,089 - Noise Reduction System - Vernon D. Landon.

2,204,090 - Noise Rejecting Limiter System - Vernon D. Landon.

2,204,422 - Radio Signaling System - Arthur V. Loughren and Jerome C. Smith.

2,203,839 - Measurement of Dielectrics - Allan R. Ogilvie.

2,203,875 - Loudspeaker - Harry F. Olson.

2,204,052 - Directive Signaling - Walter van B. Roberts.

2,203,878 - Electrical Testing System - Albert L. Rosenberg.

2,203,879 - Sound Film Printer - L. T. Sachtleben.

2,203,750 - Measuring System - Jesse B. Sherman.

2,203,882 - Photoamplifier System - Henry Shore.

2,204,056 - Tuning Indicator Circuit - Fred B. Stone.

2,204,166 - Electric Condenser - George L. Usselman.

2,203,758 - Television System - Louis E. Q. Walker.

2,203,806 - Concentric Line - Lester J. Wolf.

2,203,807 - Radio Beam System - Irving Wolff.

Issued June 18, 1940

2,204,954 - Interference Rejection Circuit - E. I. Anderson and G. Mountjoy.

2,204,574 - Three Electrode Crystal Phase Modulation Receiver - M. G. Crosby.

2,204,575 - Phase Modulation Receiver - M. G. Crosby.

2,205,250 - Radio and Other High Frequency Feeder Arrangements - C. S. Franklin.

2,205,358 - Antenna - C. W. Hansell.

2,204,992 - Television Receiver - R. S. Holmes.

2,205,097 - Tuning Mechanism - G. B. Knos and A. Horowitz.

2,205,174 - Directional Antenna System - K. Posthumus.

2,204,702 - Piezoelectric Crystal Filter with Inductive Shunt - N. M. Rust.

2,205,069 - Thermionic Valve and Circuit - N. M. Rust and G. F. Brett.

2,205,233 - Oscillation Generation - J. van Slooten.

2,205,055 - Electric Discharge Device - V. K. Zworykin and L. Malter.

Issued June 25, 1940

2,205,847 - Crystal Filter - M. G. Crosby.

2,205,760 - Electronic Generator - D. J. Fewings.

2,205,880 - Modulation System - J. L. Finch.

2,205,762 - Variable Band Width Receiver - C. W. Hansell.

2,205,851 - Temperature Cycling - C. W. Hansell.

2,205,528 - Sound Reproduction - H. J. Hasbrouck, Jr.

2,205,500 - Electron Discharge Device - M. J. O. Strutt and P. H. J. A. Kleynen.

2,205,502 - Electron Discharge Tube - T. P. Tromp.

Issued July 2, 1940

2,206,072 - Arrangement for Mixing Two Frequencies in a Superheterodyne Receiver - Rene Barthelemy.

2,206,390 - Ultra High Frequency Radio Receiver - Wendell L. Carlson.

2,206,393 - Sound Recording Apparatus - Glenn L. Dimmick.

2,206,666 - Cathode Ray Tube - David W. Epstein.

2,206,400 - Ground Noise Reduction Shutter - Harold J. Hasbrouck, Jr.

2,206,636 - Phonograph Record - James H. Hunter.

2,206,504 - Electrode Support - Brice W. Kinyon.

2,206,637 - Direction Indicating Radio Receiver - Winfield R. Koch.

2,206,638 - Suppression of Interference - Winfield R. Koch.

2,206,509 - Radio Tube Manufacture - Ernest A. Lederer.

2,206,639 - Magnetron - Ernest G. Linder.

2,206,413 - Electron Device - Ioury G. Maloff.

2,206,415 - Making Electric Photomicrographs - Ladislaus Marton.

2,206,416 - Differential Electrical Meter - Richard E. Mathes.

2,206,511 - Electrode Support - K. M. McLaughlin and H. R. Seelen.

2,206,041 - Variable Tuned Transformer - H. A. Moore and J. B. Moore.

2,206,427 - Sound Reproducing Apparatus - John Preston.

2,206,123 - Power Supply Device - Herre Rinia A.J.H. van der Ven.

2,206,367 - Soundhead - Hyman I. Robinson.

2,206,645 - Monitoring Optical System for Sound Film Apparatus - L. T. Sachtleben.

2,206,682 - Transmitter - Harold J. H. Wassell.

2,206,683 - Ultra Short Wave Attenuator and Directive Device - Irving Wolff.

2,206,380 - Soundhead - A. G. Zimmerman.

2,206,381 - Film Magazine - A. G. Zimmerman.

2,206,654 - Television System - Vladimir K. Zworykin.

Issued July 9, 1940

2,207,503 - Electron Device - George B. Banks.

2,207,504 - Aerial System - Otto Bohm.

2,207,691 - Phase Modulation Receiver and Automatic Frequency Control - Murray G. Crosby.

2,207,243 - Volume Compression Device for Sound Reproducers - Glenn L. Dimmick.

2,207,244 - Direction Finder Correcting Loop - Benjamin L. Dolbear.

2,207,509 - Electrical Oscillation Generator - David J. Fewings.

2,207,510 - Television Receiver - Mark Flaherty and Ralph S. Holmes.

2,207,249 - Recording and Reproducing of Sound - Alfred N. Goldsmith.

2,207,055 - Switching Circuit - G. G. Goodling, Jr. and A. C. Stocker.

2,207,251 - Electric Motor - Emile C. Guedon.

2,207,540 - Frequency Comparison and Measurement - C. W. Hansell.

2,207,541 - Phase Modulation Receiver - C. W. Hansell.

2,206,963 - Recording and Reproduction of Electrical Impulses - E. W. Kellogg.

2,207,254 - Band Spread Tuning System - Paul F. G. Holst and L. R. Kirkwood.

2,207,259 - Voltage Regulating System - Winfield R. Koch.

2,207,267 - Radio Apparatus for Detecting Aircraft - D. L. Plaistowe.

2,207,498 - Modulation System - James Twatt.

2,207,499 - Cathode Ray Deflecting System - A. W. Vance.

2,207,389 - Cathode Ray Tube Deflecting Circuit - Karl R. Wendt.

121,427 - J. B. Suomala - Phonograph Record Player (design patent).

Issued July 16, 1940

2,207,775 - Television Receiver - A. V. Bedford.

2,207,777 - Cathode Ray Deflecting Device - A. Blain.

2,207,781 - Ultra-High Frequency Antenna - G. H. Brown.

2,207,783 - Temperature Compensated Capacitor - W. L. Carlson and R. L. Harvey.

2,207,705 - Hearing Aid Device - J. W. Cox.

2,207,796 - Band Pass Amplifier - G. L. Grundmann.

2,208,376 - Rotating Radio Beacon - D. G. C. Luck.

2,208,377 - Radio Direction Finding - D. G. C. Luck.

2,208,378 - Continuously Indicating Radio Compass - D. G. C. Luck.

2,208,379 - Radio Navigation Device - D. G. C. Luck.

2,207,933 - Tuned Ultra-High Frequency Amplifier - G. Mountjoy.

2,207,934 - Automatic Frequency Control System - G. Mountjoy.

2,207,821 - Sound Picture Apparatus - H. I. Robinson.

2,207,839 - Television Apparatus - W. A. Tolson.

2,207,905 - Automatic Volume Control - R. A. Weagant.

2,207,905 - Radio Detector - R. A. Weagant.

2,207,845 - Propagation of Waves in a Wave Guide - I. Wolff.

2,207,846 - Electronic Discharge Device - I. Wolff.

Issued July 23, 1940

2,208,920 - Cathode for Electron Discharge Devices - V. O. Allen.

2,208,623 - Electromechanical Servo Device - D. S. Bond.

2,209,191 - Radio Navigation Device - J. B. Dearing.

2,209,053 - Sound Recording Apparatus - G. L. Dimmick.

2,208,810 - Antenna System - M. Katzin.

2,208,733 - Directive Signaling - W. v. B. Roberts.

2,208,648 - Device for Measuring Torsional Vibration - H. J. Schrader.

2,208,692 - Active Metal Compound for Vacuum Tubes - D. H. Wamsley.

Issued July 30, 1940

2,209,510 - Modulated Carrier Wave Transmitter - N. H. Clough and E. Green.

2,209,923 - Magnetron - G. R. Kilgore.

2,209,582 - Optical Film Printing - E. Ross.

2,209,664 - Recording of Electrical Impulses - F. E. Runge.

2,209,541 - Modulation System - N. M. Rust.

2,209,708 - Cathode Manufacture - S. Umbreit.

Issued August 6, 1940

2,210,392 - Method of and Apparatus for Sound Recording - M. C. Batsel.

2,210,393 - Regulating System - R. A. Braden.

2,210,394 - Regulating System - R. A. Braden.

2,209,959 - Radio Receiving System - K. A. Chittick and M. C. Jones.

2,210,078 - Distortion Correction for Television Systems - L. B. Headrick.

2,210,406 - Frequency Determining Circuit - R. A. Henderson.

2,210,413 - Silencing and indicating device - M. C. Jones.

2,210,415 - Sound Collecting System - E. W. Kellogg.

2,210,487 - Wire Terminal Connector and Block - W. Kimmich.

2,209,982 - Oscillator Tuning System - L. R. Kirkwood.

2,210,087 - Synthesizing Luminescent Material - H. W. Leverenz.

2,210,491 - High Frequency Antenna - R. F. Lewis.

2,210,492 - High Voltage Generator - N. E. Lindenblad.

2,210,494 - Tuning Condenser for High Frequency Purposes - H. A. Moore.

2,210,425 - Automatic Tuning Control System - W. E. Newman.

2,210,379 - Band Spread Arrangement in Superheterodyne Receivers - D. Pasma.

2,210,384 - Electrical Filter Arrangement - N. M. Rust and J. D. Brailsford.

2,210,387 - Amplifier - R. M. Steere.

2,210,015 - Electron Oscillation Generator and Phase Modulator - G. L. Usselman.

2,210,050 - Electric Condenser - G. L. Usselman.

2,210,389 - Reliable Antenna System and Apparatus for Aircraft - W. D. Van Dyke.

2,210,390 - Amplifying System - P. Weathers.

2,210,518 - Electronic Oscillator Control Device - I. Wolff.

Issued August 13, 1940

2,211,091 - Superregenerative Magnetron Receiver - R. A. Braden.

2,211,404 - Impulse Modulated Magnetron Oscillator - R. A. Braden.

2,211,003 - Radio Signaling System - J. W. Conklin.

2,211,004 - Neutralizing System - J. W. Conklin.

2,211,325 - Oscillograph - R. H. George.

2,211,416 - Production of Sound Picture Records - A. N. Goldsmith.

2,211,653 - Card Holder - G. J. Halton.

2,211,010 - Thermionic Amplifier - C. E. Hallmark.

Issued August 20, 1940

2,212,139 - Piezoelectric Quartz Element - C. F. Baldwin and S. A. Bokovoy.

2,211,843 - Cathode Ray Tube - A. Bouwers.

2,211,844 - Cathode Ray Tube - G. F. Brett.

2,212,205 - Amplifier - G. Hepp.

2,212,206 - Electron Device - G. Holst and M. Wolf.

2,212,209 - Luminescent Material - H. W. Leverenz.

2,212,447 - Synchronism Correction for Telegraph Systems, R. E. Mathes.

2,211,860 - Electrical Wave Segregation Circuit - D. L. Plaistowe.

2,212,204 - Amplifier - G. Hepp.

Issued August 27, 1940

2,212,823 - Tensioning Device for Cord Drive - Jan Bulk.

2,213,177 - Television Transmitting Tube - H. A. Iams.

2,213,178 - Television Transmitting Tube and System - H. A. Iams.

2,213,179 - Television Transmitting Device - H. A. Iams.

2,213,175 - Television Transmitting Tube and System - H. A. Iams and A. Rose.

2,212,645 - Electron Tube - G. A. Morton.

2,212,648 - Synchronizing Pulse Generator - W. J. Poch.

2,213,176 - Television Transmitting Tube - A. Rose.

2,213,180 - Image Converter Tube - A. Rose.

2,213,173 - Television Transmitting Tube - A. Rose.

2,213,174 - Television Transmitting Tube - A. Rose.

2,213,172 - Electrode System - J. B. Sherman.

2,212,850 - Installation for Reducing Non-linear Distortion in Amplifier Systems - B. D. H. Tellegen and C. Henriquez.

2,212,851 - System for Amplifying Electrical Oscillations - A. Van der Ziel.

2,212,966 - Light Modulation System - J. N. Whitaker.

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