

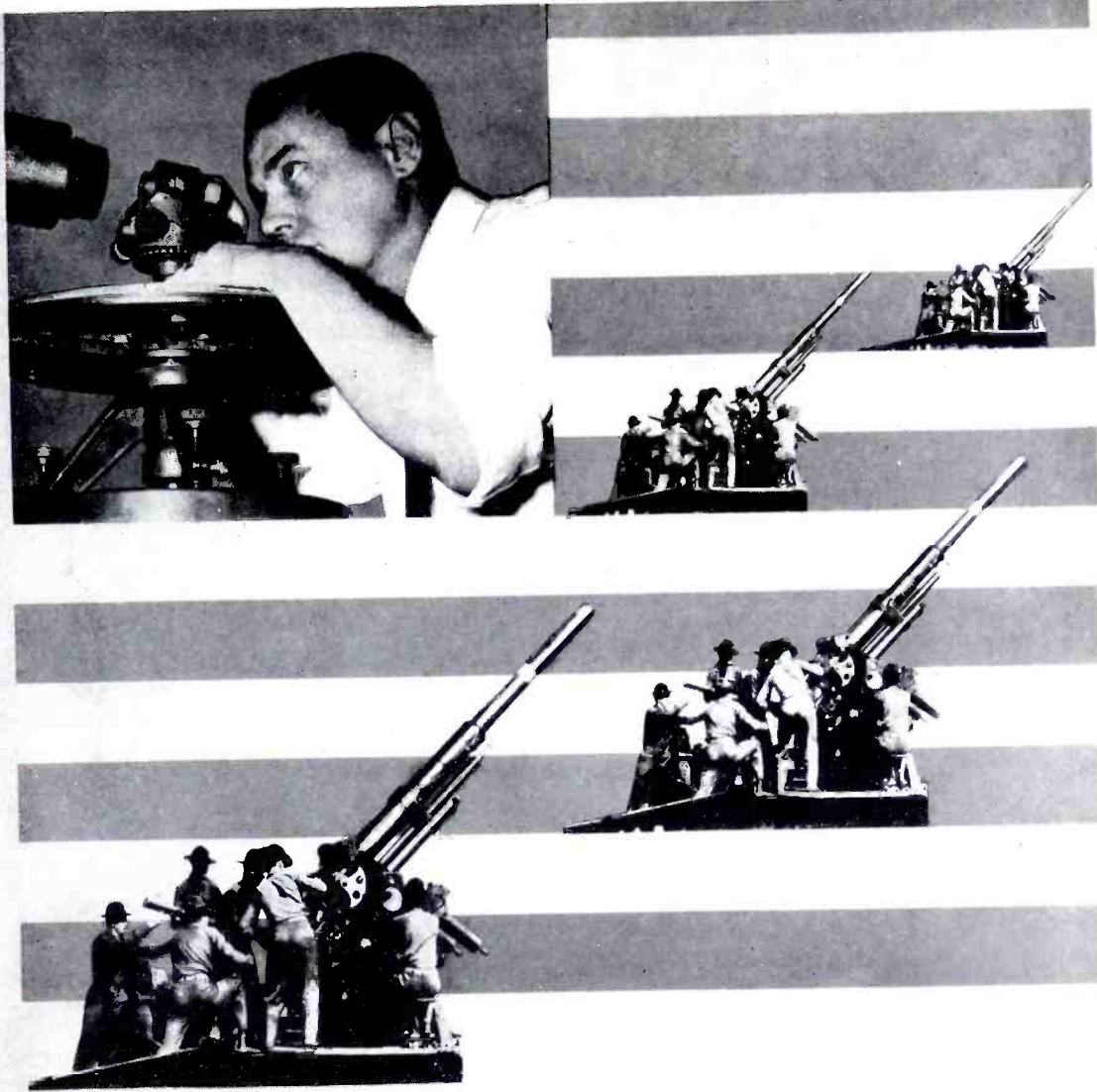
COMMUNICATIONS

**BROADCAST
RADIO RELAY**

**APCO
CONVENTION**

**NATIONAL
DEFENSE**

**AUGUST
1941**



KEEP 'EM ROLLING!



Briareus, Machinist?

With his hundred arms the mythical giant Briareus no doubt could have accomplished a great deal of work . . . say as a lathe operator. ¶There is no information, however, that Briareus was a brainy fellow and that he could skillfully employ any one of his hundred arms. ¶Here at Collins we believe that fine craftsmanship does not arise alone from good tools or keen workmen but is a result of the coordination of both. ¶Our factory, equipped with modern machine tools, utilizes nearly every process for the finished fabrication of transmitter materials.

Processing not satisfactorily procured from outside sources is done in our own plant; thus, we are able to control quality and to speed production. ¶Complementing our equipment is a large corps of highly skilled workmen who know how to use the tools to advantage. These men are instilled with the idea of doing the best possible job. They are inspired to have achieved the highest standard of craftsmanship.

COLLINS RADIO COMPANY
CEDAR RAPIDS, IOWA NEW YORK, N. Y.: 11 WEST 42 ST.

COMMUNICATIONS

AUGUST

1941

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RAY D. RETTENMEYER

Editor

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COVER ILLUSTRATION

"KEEP 'EM ROLLING!"—a poster of the Division of Information, Office for Emergency Management. We reproduce it here to emphasize the importance of the National Defense effort and as a salute to the radio industry for the splendid way in which it is contributing to this effort.

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• Comments •

ON August 8, the Defense Communications Board outlined nation-wide plans to use standard broadcast stations for air raid warnings and other messages, communique and announcements in the event of military emergency. The plans were made known by James Lawrence Fly, Chairman of the DCB and the FCC.

Present plans, under consideration by the DCB and the Office of Civilian Defense, are concerned with ways of linking broadcast stations to local defense centers for immediate receipt of local and regional messages. Also, a potential nation-wide supernetwork is said to be available for messages of national importance.

The DCB indicates that of some 880 stations, nearly 500 are already connected to the supernetwork by telephone lines; that an additional 132 have studios in cities served by the supernetwork, so that only local lines need be secured; and that 240 stations are located along the lines of the supernetwork and can be tapped in. Only 12 stations in the country are located away from regular program lines, but these can be hooked in by ordinary telephone interconnections.

It was found that certain rural areas are without reliable reception during daylight hours and during the summer months in the Southern States. Plans for providing reliable service in these areas are under consideration.

The DCB report indicates that reliability of transmission varies from station to station, but that a high degree of freedom from program interruptions can be attained. Thus 20 selected stations were found to be losing an average of less than 1½ minutes per week from all types of interruptions . . . a reliability of 99.982%.

Power failures account for about 50% of all program breaks, according to the DCB. Since continuous operation of the stations is essential, the Board has in progress means of continuing service while public power is shut off. It is estimated that 10% of all broadcast stations are now equipped with emergency gasoline or steam-driven power generators. A few other stations are served by two or more independent sources of public power. Studies are said to be under

(Please turn to page 32)

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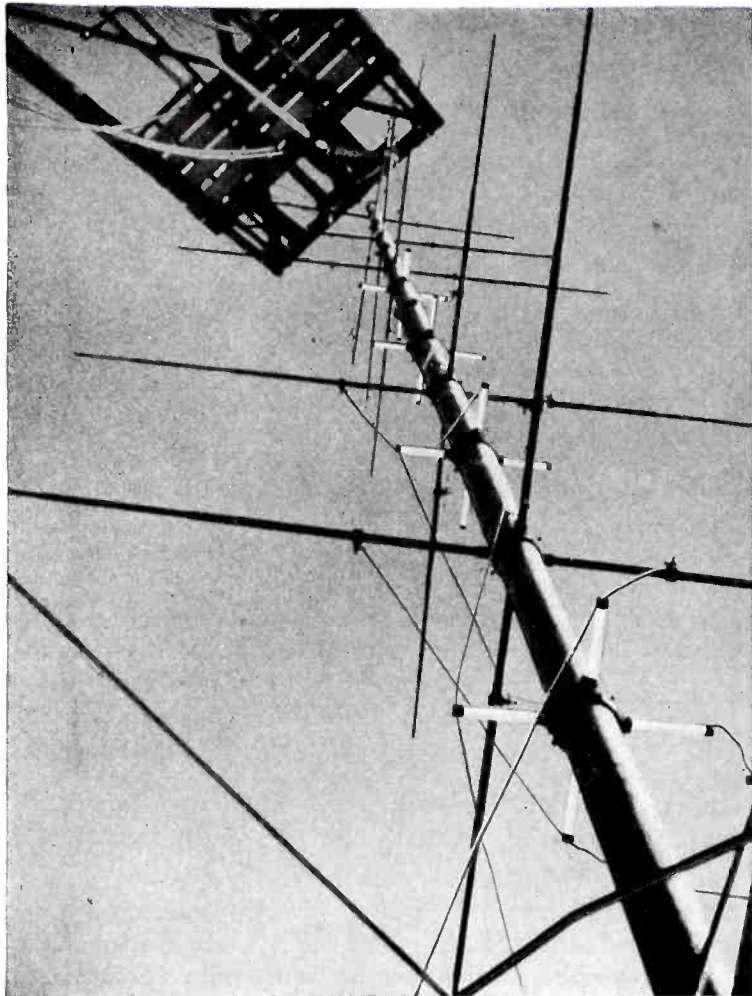
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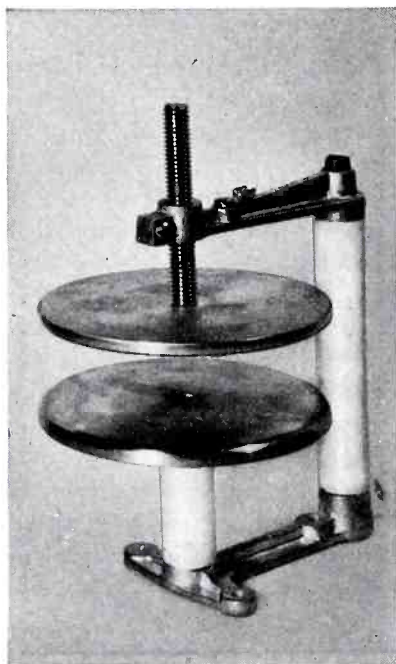
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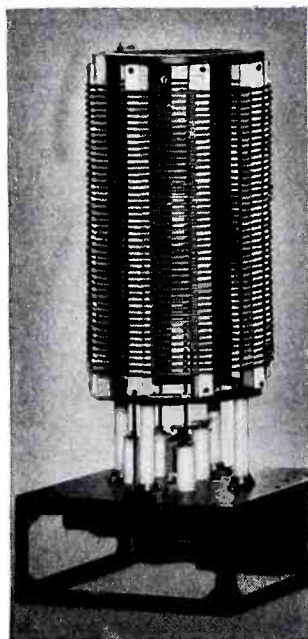


(Above) OUTSTANDING ADVANCE in radio engineering has been the development of FM. Isolantite*, with its outstanding mechanical, thermal, and electrical properties which make it ideal for ultra-high frequency service, has been identified with this important development ever since its beginning. Photo shows Isolantite stand-off insulators on one of the turnstiles of Major E. H. Armstrong's experimental station W2XMN at Alpine, N. J.

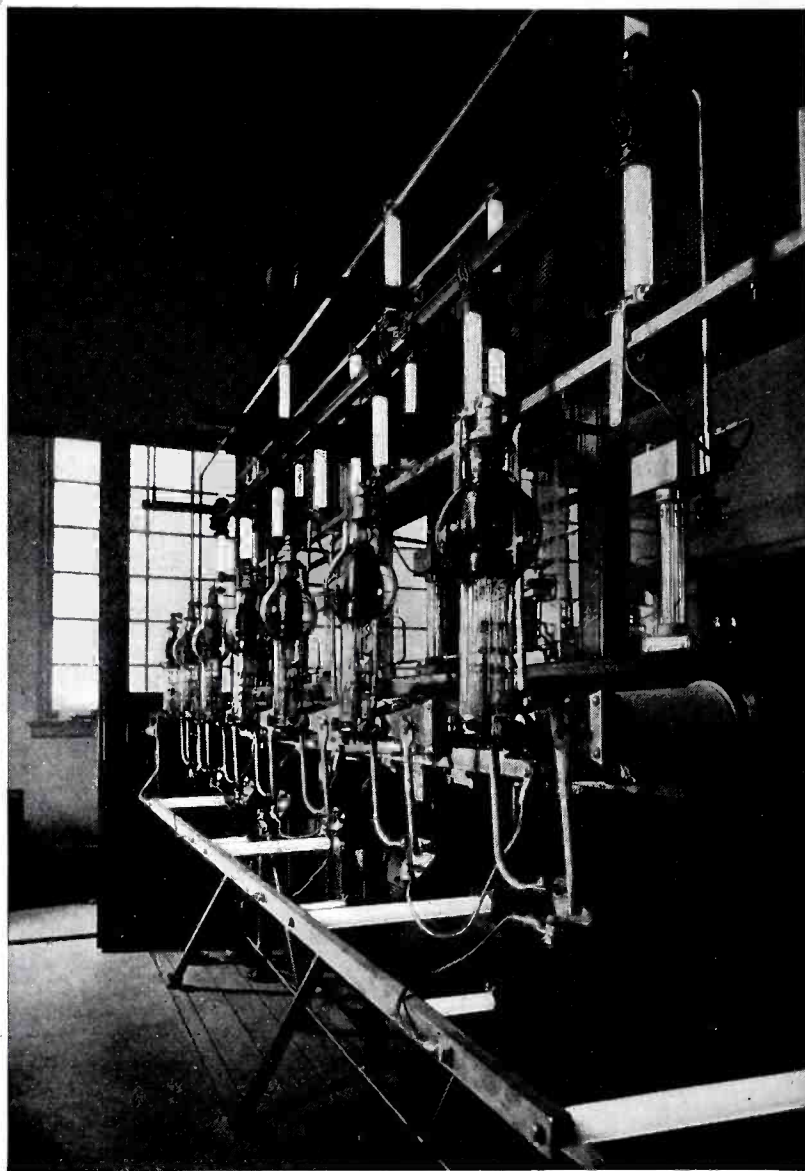
(Below) IN THIS INDUCTION Coil Assembly, made by Collins Radio, Isolantite bar inductance supports and stand-off insulators contribute to ruggedness of design and reduction in power losses. Accuracy of size and location of winding slots is an outstanding advantage of large Isolantite inductance bars and makes for improved electrical design and mechanical assembly.



(Above) HIGH STRENGTH and mechanical precision of Isolantite are utilized to good advantage in the design of this air-gap condenser built by National Company, Inc. Isolantite insulation is the choice of many of the leading manufacturers of all types of condensers, and of other component parts of communications equipment. If special insulator designs are needed they can frequently be produced economically.



INSULATION HIGHLIGHTS



(Above) HIGH-VOLTAGE RECTIFYING UNITS make liberal use of Isolantite, because of its high mechanical strength and low power losses. Unit shown forms part of the 50 KW transmitting unit built by Western Electric for Station WHAS, Louisville.

*Registered trade-name for the products of Isolantite, Inc.

ISOLANTITE

CERAMIC INSULATORS

ISOLANTITE, INC. FACTORY: BELLEVILLE, NEW JERSEY
SALES OFFICES: 233 BROADWAY, NEW YORK, N. Y.

WSM'S RELAY TRANSMITTER

• A 300-mc studio-to-transmitter radio link

IN order to add further reliability to the program service rendered to the public by station WSM, a 300-mega-cycle radio circuit has been installed to operate between the studio and the transmitter. It is often the case with broadcast stations that all available wire lines between the studio and transmitter are routed along the same highway. This makes it possible for a single accident such as a broken pole or a fallen tree to interrupt all service between these points. An emergency radio circuit entirely independent of the telephone lines is the obvious solution if interruptionless service is to be maintained.

A block diagram of the system installed in 1937 by WSM is shown in Fig. 1.

To obtain an optical path which is necessary for satisfactory operation at the frequencies available for this type of service it was necessary to make use of the 878-foot vertical radiator used by the 650-kc, 50-kw WSM transmitter. Fig. 2 shows a contour map of the vicinity of the station. A cross-section plotted from this map shows the necessity for height at the receiving location.

The transmitter is located in the pent house of the National Life and Accident Insurance Company building in Nashville, and is operated automatically and controlled from the master control room of the studio located in the same building.

In this transmitter a mechanically rigid solid copper quarter-wave transmission line having the length of its inner conductor held constant by means of an invar rod is connected in the grid circuit of a 316 "turnip" tube which is used as a master oscillator. The oscillator is operated at the carrier frequency and is loosely coupled to the grids of two 316 tubes connected as a neutralized push-pull amplifier. This power amplifier delivers 15 watts of 300-mc energy to the antenna and is modulated in its plate circuit by four 6L6's. A balanced shielded transmission line connects the

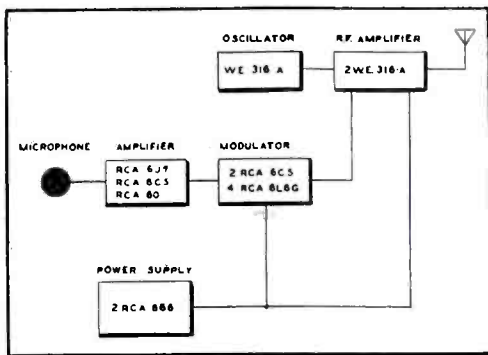
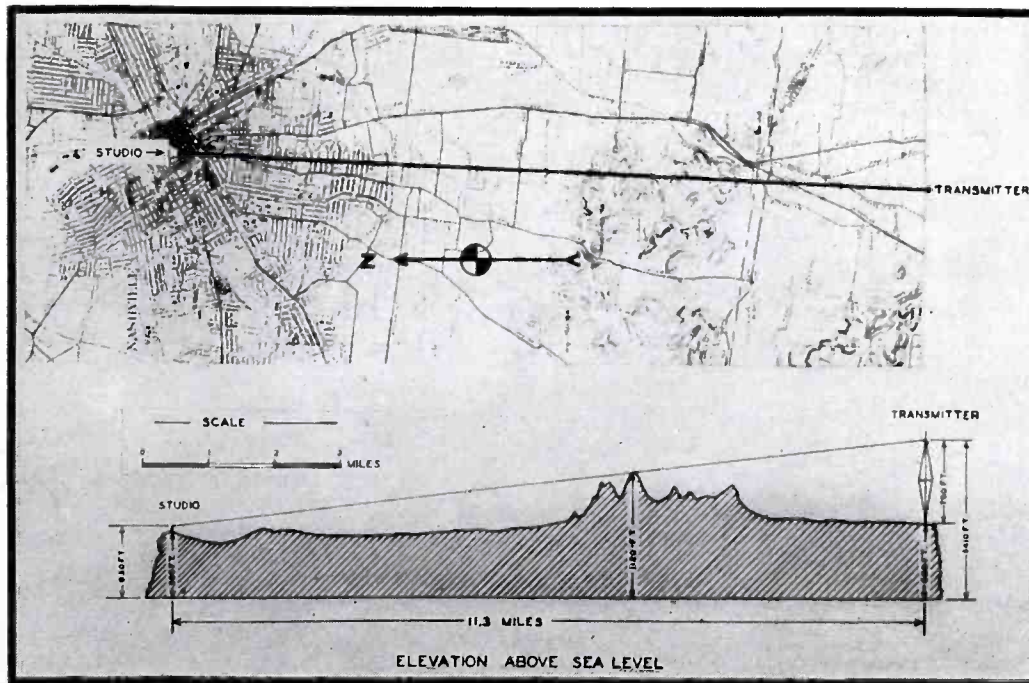


Fig. 1. Block diagram of 300-mc transmitter.

transmitter to its antenna which is mounted on the roof of the building about 70 feet above the surrounding terrain.

The antenna consists of 24 half-wave elements stacked in four columns of six elements each. Twelve of these units are end fed so as to form six center-fed, full-wave antennae. The remaining twelve radiators are mounted a quarter wavelength behind and are excited parasitically. Each antenna is separated from the adjacent antenna by one-half

Fig. 2. Transmission path of 300-mc radio link.



wavelength and from its reflector by a quarter wavelength. This forms a unidirectional broadside array which has a gain of about 16 db over a single antenna. A drawing of the complete antenna system is shown in Fig. 3.

A similar array is used at the receiving end. As was previously mentioned, it was necessary to locate this antenna about 750 feet above the ground at the base of the pole atop the 878-foot WSM vertical radiator. The signal from the antenna is brought down the tower by a 3-inch concentric transmission line which connects it with the receiver located in the tuning house at the base of the tower.

300-MC Transmission Line & Filter

This array has an impedance of approximately 150 ohms. At the receiving end it is matched by a pair of 75-ohm $\frac{3}{8}$ -inch concentric transmission lines. These lines have their sheaths connected together and thus present an impedance of 150 ohms between their inner conductors, and form a balanced shielded line.

In order to match this balanced line

to the single-ended main transmission line running down the tower, a quarter-wave matching section was inserted in the main line an odd number of quarter wavelengths from the top. This matching section consists of a copper cylinder 0.85 inch in diameter and ten inches long mounted coaxially with and connected to the center conductor of the main transmission line. This section has a characteristic impedance of 75 ohms and therefore presents an impedance of 37.5 ohms at one end when the other is connected to 150 ohms. Since the lower end of this section is connected directly to the main line which has an impedance of 150 ohms, it appears as 37.5 ohms at its upper terminals and properly matches the two 75-ohm lines from the antenna when they are connected in parallel. The remainder of the main line is then short-circuited an odd number of quarter waves above this point and presents an extremely high impedance which can be ignored.

The two inner conductors of the 75-ohm lines must carry currents which are 180 degrees out of phase. To achieve this condition they are connected to points one-half wavelength or 180 degrees apart on the inner conductor of the main line. The intervening half wavelength acts as a 1:1 transformer and effectively connects the two lines in parallel as far as impedance is concerned, yet 180 degrees apart in time phase.

The construction of the main transmission line represents a departure from ordinary practice. For this line a



Fig. 5-B. Photograph of 300-mc receiver.

3-inch copper gutter downspout is used as a sheath while the inner conductor is a number 6 wire insulated and supported with mycalex discs. This line is brought into the tuning house at the base of the tower with its sheath connected directly to the 650-kc, 50-kw antenna lead-in.

The problem of separating the 300-mc from the 650-kc is complicated by the fact that the 650-kc voltage may be as high as 10,000 volts above ground.

A filter utilizing lengths of concentric transmission line as its circuit elements is connected so as to introduce approximately 120-db attenuation to

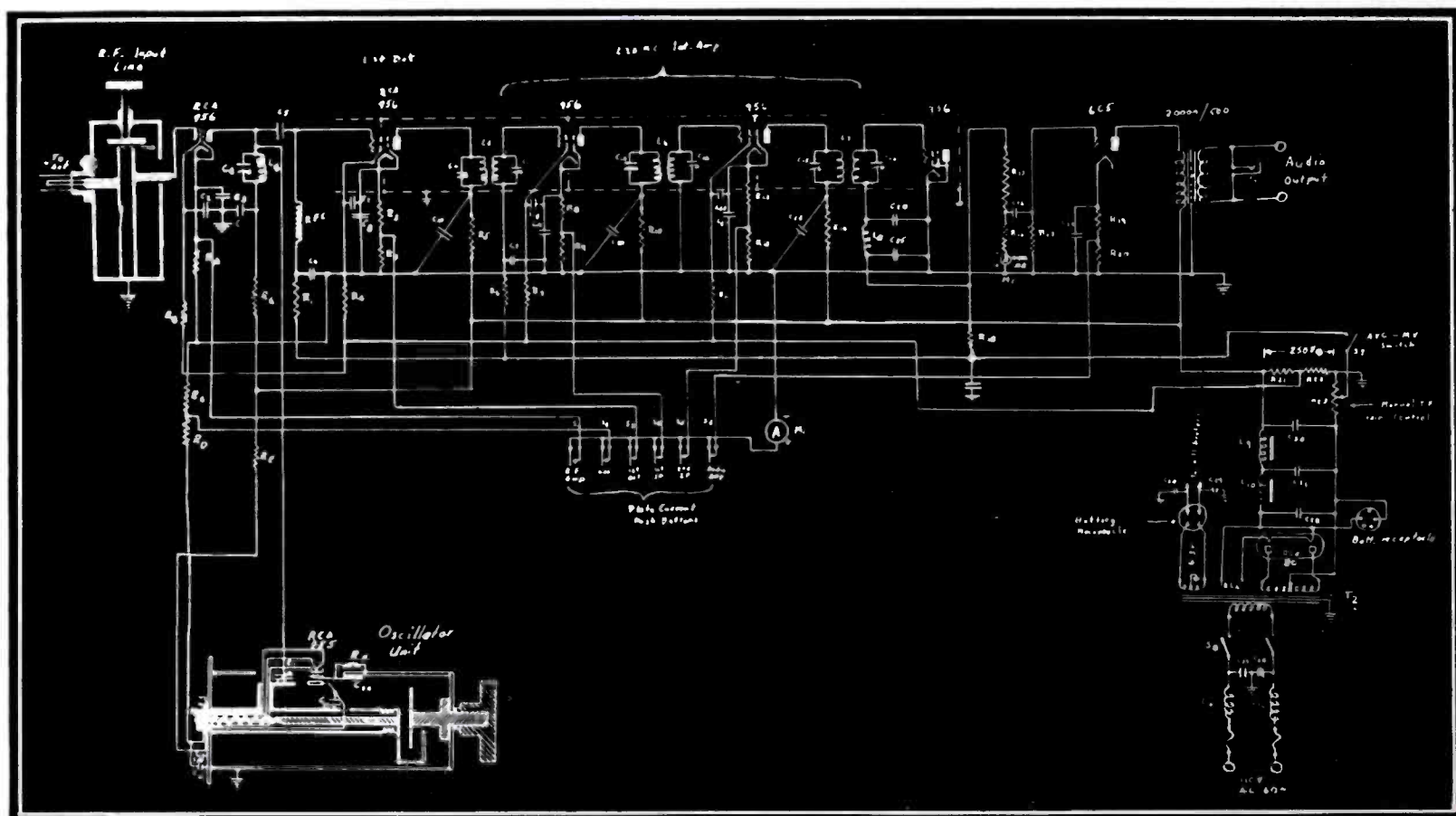
650-kc currents and afford insulation up to 40 kilovolts. This unit is shown in Fig. 4-A and its equivalent electrical circuit is given in Fig. 4-B.

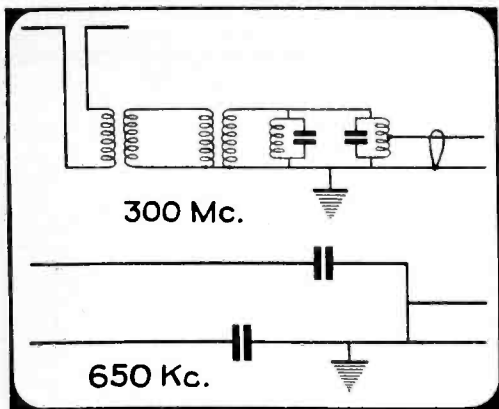
The first element of this filter consists of a short-circuited quarter-wave section connected in shunt with the line. Such an element offers a high impedance to the 300-mc currents, but appears as a small fraction of an ohm at 650-kc, since a quarter wave at 300-mc is only about ten inches of conductor. Thus, any 650-kc potential which might exist between the inner and outer conductor of the line is greatly reduced.

The outer sheath which must remain at a high potential above ground for frequencies near 650 kc is brought to ground potential for 300 mc by the use of a quarter-wave open-circuit section. This section is made by surrounding a quarter-wave length of the sheath of the three-inch transmission line with a grounded copper cylinder six inches in diameter. The center conductor is continued into this larger and grounded cylinder and at the same time is changed in diameter so as to have the same characteristic impedance with the six-inch sheath as it had with the three-inch pipe.

The system has thus been converted into a 150-ohm line with its outer conductor 6 inches in diameter and at ground potential. The inner conductor is, however, still at a high potential above ground at 650 kc. In order that the 300-mc energy can be introduced without danger into its receiver the inner conductor is surrounded by a quarter-wave three-inch grounded pipe,

Fig. 5-A. Circuit diagram of 300-mc receiver.

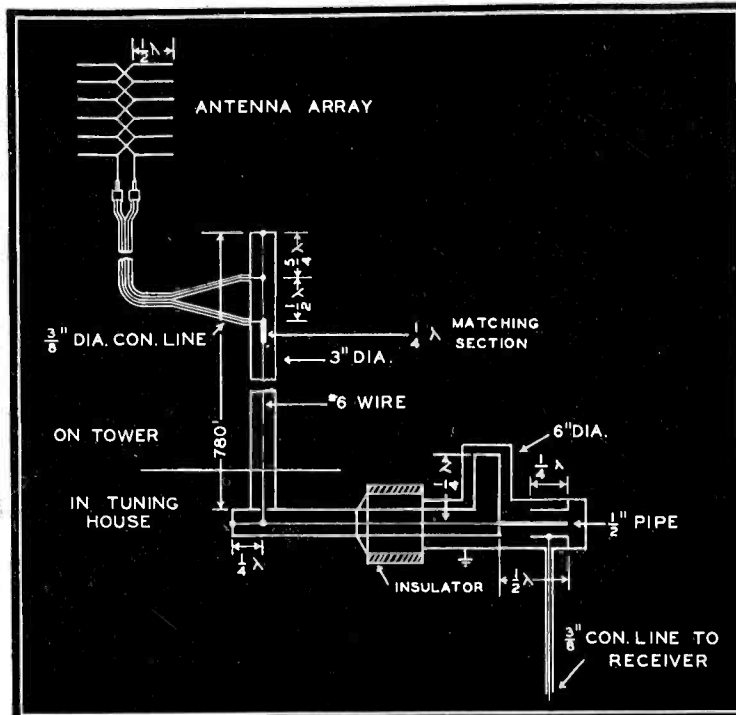




(Left) Fig. 4-B. Electrical equivalent of filter.

(Right) Fig. 4-A. The 300-mc transmission line and 650-kc filter.

(Below) Fig. 3. The 300-360 megacycle antenna array.



thereby forming another open-circuit quarter-wavelength line which would normally present a very low impedance between the inner conductor and the three-inch pipe. Since one end of this three-inch pipe is connected directly to the outer six-inch sheath, its open end would normally appear to be at a high impedance above the outer six-inch sheath, or ground for 300-mc currents. However, a $\frac{3}{8}$ -inch, 75-ohm line to the receiver is tapped on to this quarter-wave three-inch line at such a position that the end of this line no longer presents a high impedance to ground, but appears as an impedance of 150 ohms and properly terminates the main transmission line.

Further attenuation of the 650-kc energy is also obtained at this point since the line to the receiver is actually tapped across about three inches of conductor which appears in the neighborhood of 75 ohms at 300 mc, but acts as a practical short circuit at 650 kc.

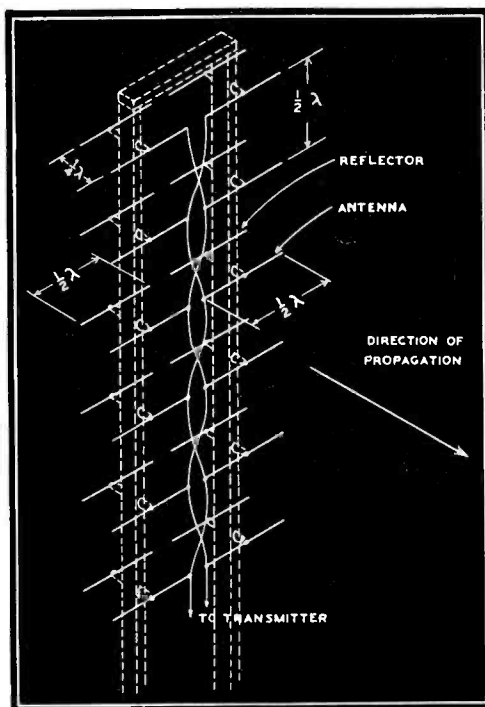
The Receiver

The receiver employs the superheterodyne circuit preceded by a single stage of tuned-radio-frequency amplification. The intermediate frequency is 23.5 mc. Acorn tubes are used throughout with the exception of the rectifier and a single stage of audio-frequency amplification.

A high impedance is obtained in the first tuned circuit by utilizing a short-circuited quarter-wave line, the resonant frequency of which can be varied over a small range by means of a variable capacity between the end of the line and the grounded case.

Stability is assured in the oscillator circuit by means of a concentric line having an invar rod controlling the length of the inner conductor. This line is similar in construction to the one employed in the oscillator stage of the transmitter. A schematic diagram (A) and photograph (B) of the receiver are shown in Fig. 5.

Since pre-emphasis of the high audio frequencies is employed at the transmitter it is necessary to equalize the receiver output in order to obtain a flat frequency characteristic. After equaliza-



tion the receiver output is connected through a 600-ohm telephone line to a jack on the panel of the speech-amplifier equipment board in the transmitter control room. When this jack is patched into an alternate transmitter input jack, a key switch can be used for changing instantaneously from a wire line to the radio circuit.

The overall frequency characteristic and noise level of the system compares favorably with an open-wire line. During thunder storms, when occasional "hits" are experienced on the wire line, the radio loop is definitely superior.

Although experience has proven this system to be entirely satisfactory, a frequency-modulated system will probably give a comparable signal-to-noise ratio with a less elaborate antenna system. For this reason a low-power frequency-modulated system is being installed at the present time and will be described in another article.

INDUCTANCE OF TWO PARALLEL WIRES

(Nomogram on page 6)

By T. S. E. THOMAS

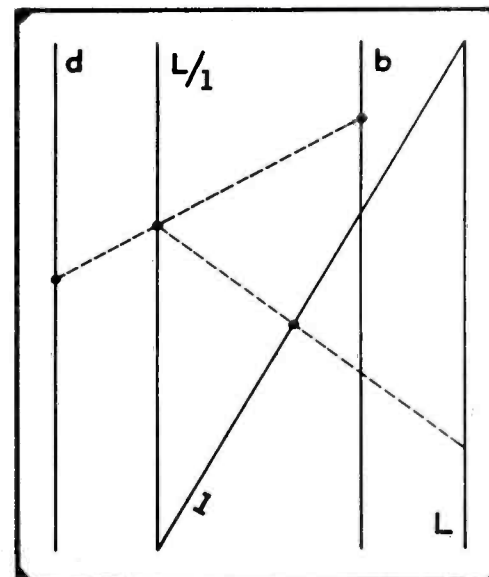
IN radio-frequency engineering it is sometimes necessary to know the inductance of a pair of parallel leads such as the feeder to an aerial or the connections to a condenser or inductance coil.

The high-frequency inductance of two parallel wires is given by

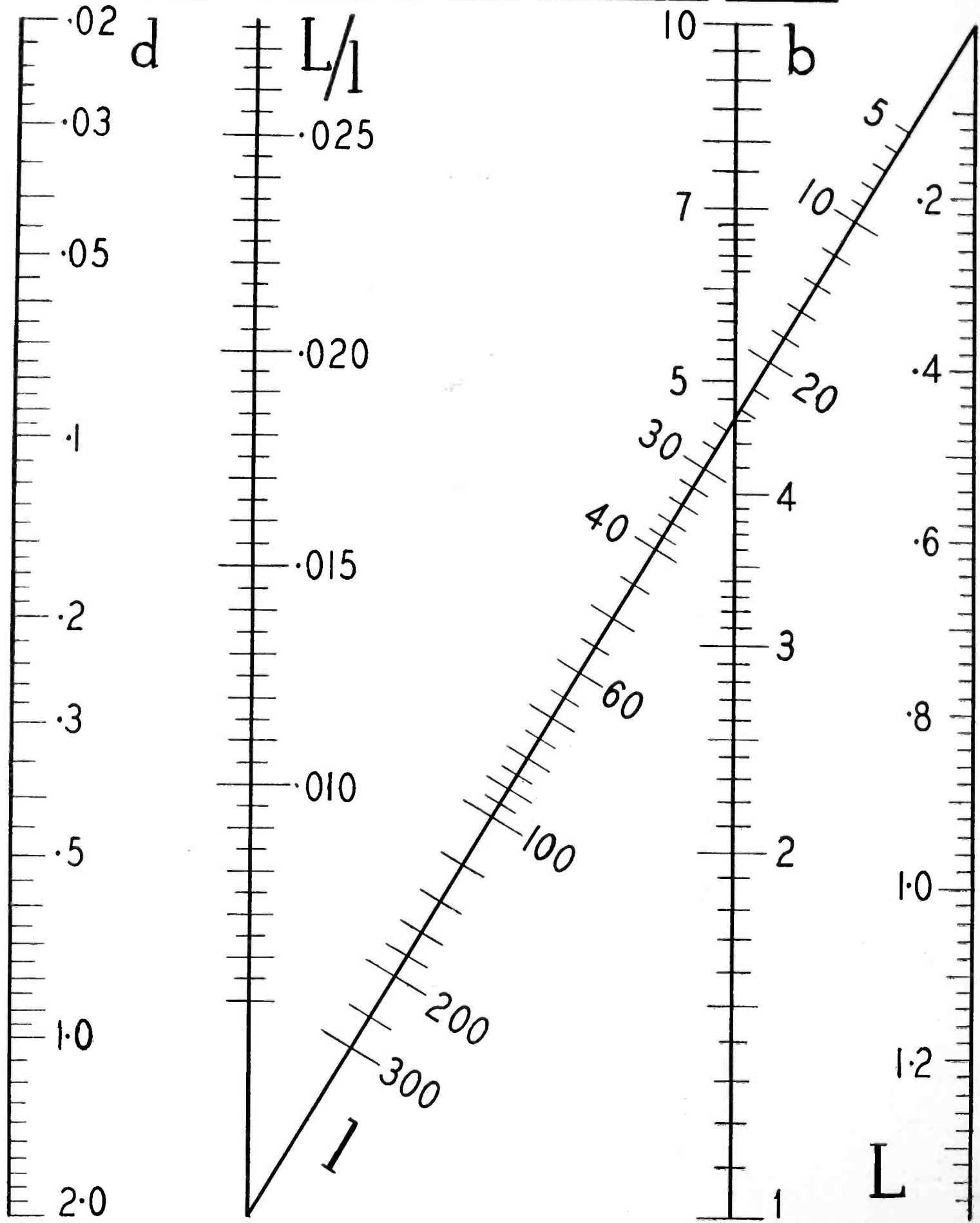
$$L = 0.004 l \log_e 2 b/d \text{ microhenry.}$$

where l is the length, d the diameter (circular section) and b the distance between centers, all dimensions being in centimeters. The formula does not take into account the effect of the end connections and it also becomes inaccurate when the wires are almost in contact.

The method of using this nomogram (page 6) is shown in diagram below. There are two alignments: the first gives the relation between L/l , 1 and d ; the second the relation between L , 1 and L/l .



INDUCTANCE OF TWO PARALLEL WIRES



1941 Conference

ASSOCIATED POLICE COMMUNICATION OFFICERS

• *September 10, 11, 12 & 13*

• *Oakland, California*

By CAPT. J. M. WHERRITT

Missouri State Highway Patrol

Editor, APCO Bulletin

THE 1941 APCO Conference will be held in Oakland, California, September 10, 11, 12, and 13. Mr. C. B. McMurphy, radio technician for the Alameda County, California, Sheriff's Office, is Conference chairman and is planning one of the most interesting sessions in APCO history. The Northern California Police Communication Officers' Association, a very active organization, will act as hosts for the Conference. Edward A. Maeschner, of the Berkeley Police Department, is president of the N. C. P. C. O. A., and Russell J. Woollum, Alameda County Sheriff's Office, is secretary-treasurer. Mr. Frank Winters, San Francisco Police Department, is chairman of the board of directors.

This eighth annual conference of the organization will be the first held on the west coast. Naturally, a great many police communication officers will attend who have not heretofore been associated with the cooperative venture which numbers among its members the most active men in police communication circles in the middle western, southern and eastern sections of the country. It is expected that much advantage will accrue from the influx of new blood into the association. The west coast has long been noted for its progressive and efficient communications activities. One of the first police radio stations was set up in a west coast city.

This year the most pressing problem to confront police communication officers is that of national defense. More and more the police departments all over the country, state, county, and municipal, are being called upon to combat subversive activities and to cooperate with federal departments, including Army, Navy and FBI, in insuring rapid development of our defense production. Under these circumstances it is naturally imperative that unflinching, efficient communication facilities are developed for all police agencies. The installation of many new state, city, and



county police radio systems is an indication of the acknowledgement on the part of police officials of the need for better communication systems.

At the present writing the state of Connecticut is operating more than 300 mobile units equipped with two-way radio and the state of Delaware is at present engaged in the installation of a similar system that will permit statewide two-way communication on a par with that now in service in our larger municipalities. Along with this development of radio for communication with mobile units of police departments has gone the tremendous increase in intercity and interstate police communication. The eastern teletype system has been recently expanded to include new contacts and the facilities for rapid interchange of information inside the system have been also more efficiently arranged. As new state and municipal radio systems go into service, as a general rule they include adequate equipment for intercity radiotelegraph and teletype communication. In general, states along the eastern seaboard, being more densely populated, have come to rely on teletype for intercity exchange of police information. States to the west have

naturally chosen radiotelegraph, due to the fact that longer distances between communication points are involved. Usually the regular radio operator personnel can easily take care of the added traffic resulting from radiotelegraph communication. Thus the cooperation among departments results in toll-free exchange of police messages throughout most of the middle western and southern part of the country.

Members of APCO are proud of the progress that has been made since the founding of the organization in 1935. A great deal of valuable interdepartment police cooperation has resulted from the work of the organization that would not have otherwise been brought about. The exchange of ideas between police communication officers and manufacturers of commercial equipment has resulted in a number of developments of tremendous value to law enforcement. As in all other activities which include membership widely scattered throughout the nation, the personal contacts and discussions have been extremely valuable.

At the Oakland Conference it is hoped that arrangements can be made that will result in more favorable assignment of frequencies by the Federal Communications Commission for police and fire department communication. Frequency assignments have not kept up with the phenomenal increase in number of police departments using radio. This lack of frequency assignments has not been due to an unsympathetic attitude on the part of the Federal Communications Commission, but rather to the fact that the number of channels available for assignment to all services is distinctly limited. In addition to these other problems, police department representatives must compete before the commission with highly-paid lawyers and engineers retained by commercial organizations who make use of such frequency assignments for private (APCO—continued on page 35)

CRYSTAL ELEMENTS

By A. L. WILLIAMS & A. W. DUFFIELD

The Brush Development Co.

• *The development and applications of crystal elements*

IN the past few years, Rochelle salt crystal products* have been widely accepted in the fields of sound recording and reproduction, communications, broadcasting and public address. The most generally used are the crystal microphone, earphone, phonograph record cutter and phonograph pickup. Many of these crystal products are now found in the home and school, as well as the studio and auditorium. While crystal loudspeakers have not been put to great use in the past, present trends indicate a potential market, particularly in small portable radio receivers. The miniature crystal insert phone also shows promise for pocket-type radio receivers.

Crystal products have also found considerable use in the fields of industry, science and medicine. Most notable of these are the direct inking oscillograph, the surfacer analyzer, and various other crystal instruments, such as vibration pickups, fluid pressure pickups, water-leak detectors, heart beat pickups, watch tick pickups, reflecting-type galvanometers, etc. The direct inking oscillograph and surface analyzer have found a place in the present defense program: the former for recording vibration and noise in engines and machinery, dynamic strains in structures, relay and automatic switch timing, pressure changes in fluid lines, etc.; the latter for recording the smoothness of highly finished aircraft and automobile engine parts in millionths of an inch.

Other applications of Rochelle salt crystals extend to the business office where they have been employed in dictating machines, inter-office communication systems, paging systems and "one hour per side" disc recording equipment, for use in airline dispatch or governmental purposes. In the "hard of hearing" field a very large proportion of all wearable hearing aids use crystal microphones and insert earphones.

All of these products have been made

*The raw material Rochelle salt is produced as a by-product in the manufacture of wines.

commercially possible through the extensive research and development work accomplished in the past few years which has resulted in a highly improved method of growing and fabricating Rochelle salt crystal elements. This was preceded by more than a century of experimental work by many well-known scientists who provided us with many of the laws and constants regarding piezo-electric substances.

Piezo-electricity, or pressure electricity, as exhibited in Rochelle salt crystals, is said to have been known as early as 1780. In 1833 measurements of this effect were made in various substances; and during the latter part of the 19th century, the Curies determined the voltage generated along various crystal axes as well as the constants of many piezo-electric substances. Rochelle salt was found considerably more active than any other materials being 1000 times more active than quartz. From the work of the Curies, it was determined that the potential generated in a piezo-electric crystal is proportional to the pressure. Furthermore, if a substance produced a voltage under pressure, then in accordance with the law of conservation of energy, the converse effect is also true, i. e., a voltage applied to a piezo-electric crystal will produce a motion proportional to the applied voltage.

Practically all of the work accomplished in the development of Rochelle salt crystals during this period was concerned with single plate crystals. This work brought to light many serious difficulties in applying Rochelle salt crystals commercially. Outstanding among these were saturation, hysteresis, wide variations in piezo-electric performance of the crystal at different temperatures, and the fact that different crystals produced different results at identical temperatures. Another serious difficulty in applying Rochelle salt crystals commercially was the fact that these crystals are not found in a natural state such as quartz, but have to be grown artificially.

The above difficulties have been prac-

tically overcome in present day Rochelle salt crystals through the introduction of the "Bimorph" crystal element and the accurately controlled processes developed for its fabrication.

Briefly, the "Bimorph" crystal element consists of two plates of Rochelle salt cemented together in such a manner that, upon the application of an electrical charge, one plate expands while the other contracts, causing a bending or twisting of the whole unit.

In fabricating these "Bimorph" elements, the Rochelle salt crystals are first grown in large, clear homogeneous bars about 2' long. (For convenience, the crystal plants produce only one-half the natural Rochelle salt crystal bar. See Fig. 1-A). They are grown by very closely controlled and advanced methods of the ordinary "crystallization from solution" process. By means of unique fabricating methods, these large bars are first cut into slabs (See Fig. 1-B) and then into the small plates used in the final crystal elements.

The properties of these crystal plates may be expressed in terms of three axes: a, b, and c, as shown in Figs. 1-A and 1-B. The more common crystal plates are cut perpendicular to the a-axis because in Rochelle salt the electric effects along this axis are by far the most pronounced. The two fundamental a-cut plates used are the "expander" and "shear" plates, shown in Figs. 1-C and 1-D. It will be noted that the "expander" plate is cut at a 45-degree angle to the b and c axes, and the "shear" plate is cut with edges parallel to the b and c axes.

When a voltage of given polarity is applied to the two faces of each plate, the mechanical motions developed will be at 45 degrees to the b and c axes. This means that the "expander" plate of Fig. 1-C will increase its length and simultaneously decrease its width; these two actions reverse on change of polarity of the applied voltage. The cut of the "shear" plate of Fig. 1-D shows that a similar action occurs, but that expansions and contractions occur approxi-

mately along the diagonals of the plate instead of in directions parallel to the edges as in the case of the "expander" plate.

Two or more "expander" plates properly oriented with respect to each other are cemented together to form a "bender" element, and two or more "shear" plates properly oriented with respect to each other are cemented together to form a "twister" element. These names "bender" and "twister" have been selected since they indicate the resulting motion of the final element when an electrical potential is applied. Both "bender" and "twister" elements, because of their multiple plate construction, come under the classification of "Bimorphs." This construction practically eliminates the generally undesirable effects of saturation, hysteresis, and greatly reduces the effects of temperature on the sensitivity and impedance as exhibited in single-plate crystal elements. Such construction also permits more efficient size and shape, and makes possible an element with much higher sensitivity.

Fig 2 shows the method of constructing "bender" and "twister" "Bimorph" elements. Prior to the final assembly, the two faces of each crystal plate are milled smooth and graphite or foil electrodes are applied. Metal leads are connected to the electrodes, and the plates, after proper orientation, are bonded together with a cement. The electrodes are connected either in parallel or in series, depending on the application for which the final element is constructed. The parallel lead arrangement, however, is standard, and for this reason only this is shown in Fig. 2.

To insure maximum protection against deterioration under unusually dry or damp conditions of use, the assembled crystal element is finally coated with a specially prepared moisture-proof material.

The piezo-electric temperature limits of Rochelle salt crystals are from approximately minus 40 degrees to plus 130 degrees F. The greatest piezo-electric activity occurs at normal room temperature, 72 degrees F. Upon exposures to temperatures higher than 130 degrees F., the crystals lose their piezo-electric properties permanently. However, for practically all uses, this temperature is very seldom encountered. Temperature effects that are of major importance to the designer or user of crystal devices are the variations of the converse piezo-electric sensitivity and the dielectric constant with changes in temperature.

When the crystal element is used as a generator, the voltage developed for a given stress remains practically constant over the temperature range, provided that the load impedance for all

conditions is much higher than the crystal impedance. This generated voltage for all practical purposes is proportional to the applied stress. Temperature change will cause variations in the generated voltage only if the load impedance is comparable with or less than that of the crystal impedance, since the impedance of the crystal varies with changes in temperature, thus causing a variable voltage loss. The exact representation of the crystal element is somewhat complicated, but for most practical purposes the crystal impedance may be treated strictly as capacitive when used as a generator.

When the crystal elements are used as motors, the displacement or motion developed by the crystal elements is practically proportional to the applied voltage (neglecting any peaks or resonances) for those conditions where the crystal impedance is effectively larger than the load or driving impedance. The motional sensitivity of the crystal element produced by a given applied voltage will vary somewhat with change of temperature and for this reason should be given consideration in the design of all voltage-driven crystal devices. Where extreme accuracy of calibration is required, thermostatically-controlled heater elements have been used with crystal elements for temperature stabilization. In such devices, the temperatures are usually adjusted above those normally encountered (i.e., approximately 95 degrees F.)

APPLICATIONS OF CRYSTAL ELEMENTS

Microphones

Many of the microphones employed today for sound recording, public address, radio broadcasting and communications, employ Rochelle salt crystal elements. These microphones differ somewhat in frequency range and output depending on the specific application. For high-fidelity use and where output level is not too important, crystal microphones are available having uniform frequency responses up to 10,000 to 15,000 c-p-s. The latter types are of particular importance with frequency-modulated transmitters and for precision sound measurement work. For other specialized work, crystal microphones have been made extending into ultra-sonic frequencies.

Since piezo-electricity is a pressure and not a velocity phenomenon, there is practically no low-frequency cutoff. On open circuit, crystal microphones will respond to 1 c-p-s as well as 1000 c-p-s.

Crystal microphones have been of two general classifications, i. e., "sound cell" and diaphragm types. In the former, the sound pressures act on the crystals directly. In the latter, the sound pressures act on a diaphragm which actuates

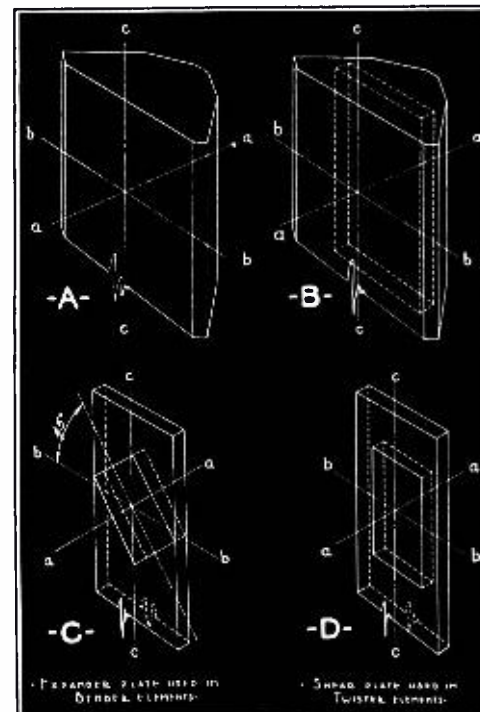


Fig. 1. Showing method of cutting crystals.

the crystal, and is therefore more sensitive.

In some microphones, the crystal element is operated in push-pull by means of two diaphragms. This arrangement provides exceptionally high output with high-fidelity response. Microphones employing metal diaphragms have been utilized which have the advantage that the crystal element is completely sealed-in, making it impervious to humidity and moisture. In one particular design, all viscous materials are eliminated with consequent reduction of the effect of temperature on response. The response in this design changes less than 1 db over a temperature range of from 30 to 120 degrees F.

One type of crystal microphone employs a "uniphase" principle which makes possible a cardioid unidirectivity in a single microphone element. In this principle, the sound acts on a diaphragm as well as indirectly (after phase shift) in an internal acoustic network. For sound incident to the front of the microphone, the direct and phase-shifted pressures are additive, while for sound incident to the rear of the microphone, the direct and phase-shifted pressures are subtractive. This principle is most useful in picking up sounds free from feedback or background noise.

Another type of crystal microphone offers a three-way directional pickup: unidirectional, providing a wide angle, front side pickup with reduction of sound from rear; bi-directional, providing front and back pickup with dead sides; and non-directional, full 360-degree pickup for group presentation, etc.

Rochelle salt crystals have also been used in contact microphones for crime

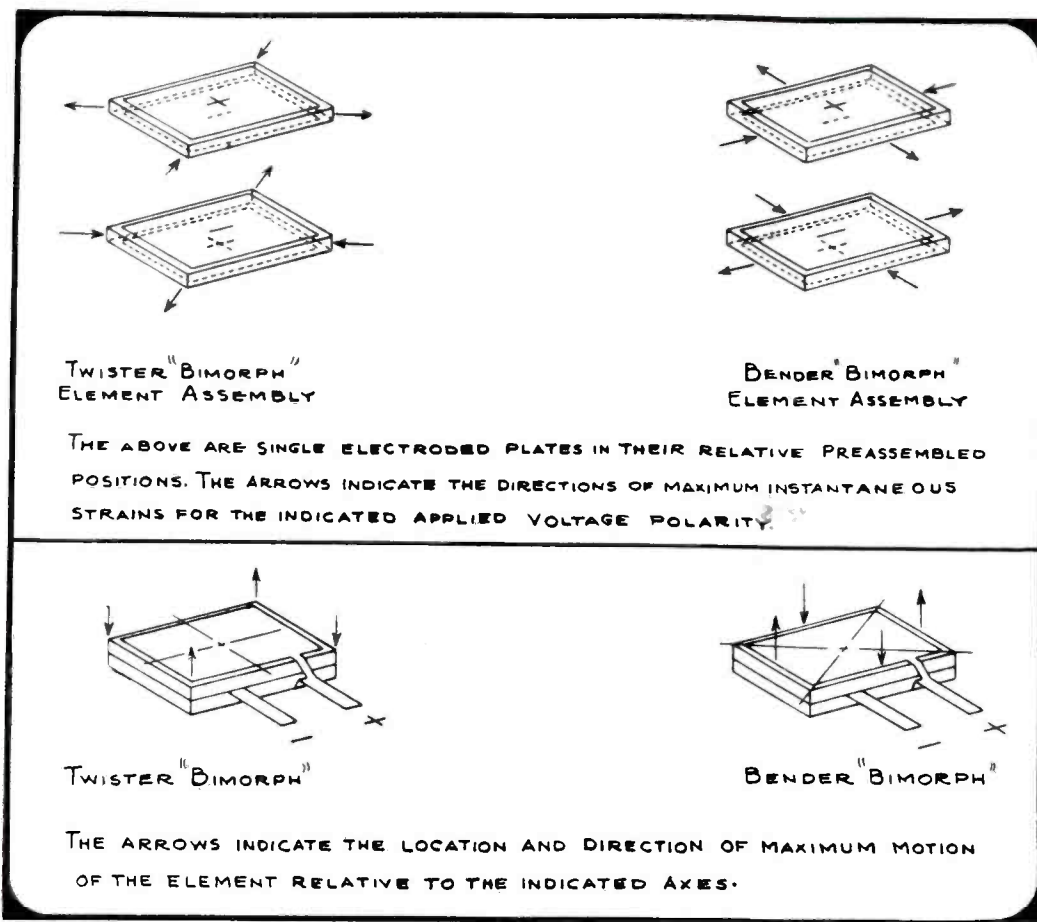


Fig. 2. Showing construction of "Bimorph" elements.

detection work, and reproducing musical instruments.

Earphones

Crystal earphones have been very popular for amateur and commercial radio communication use, group hearing aid installations, and general testing purposes. High-fidelity types, responding to frequencies up to 10,000 cycles per second, have been used for studio monitoring and audiometric measurements.

Their wide acceptance has been due primarily to their exceptionally good response and light weight. The former characteristic insures good articulation, so desirable for communication use, especially where hearing may otherwise be difficult because of extraneous noises, or vibration.

Miniature crystal insert earphones are also available for use with pocket-type radios for which there will probably be considerable demand in the near future. This type of earphone is being widely used today for wearable type hearing aids.

Loudspeakers

While dynamic type loudspeakers have been used in practically all cases in the past, shortage of certain materials required in their construction has recently created a considerable interest in crystal loudspeakers, especially for the small portable radio receivers. Two general types have been considered for this purpose, i.e., direct radiator and horn types. The performance of direct radiator loudspeakers having 7" or 8" cones compares favorably with good grade per-

manent-magnet dynamic loudspeakers now in current use. On the other hand, direct radiator crystal speakers having cone diameters of 4" or less have been found inadequate for radio receiver use, but have been employed in many cases for inter-communication purposes.

In the horn-type loudspeaker, a crystal drives a small paper cone located within a specially designed folded horn. The latter offers the necessary acoustic impedance to insure good frequency response with high output down to the cut off point of the horn. This type of crystal loudspeaker has been found somewhat superior in sensitivity to small permanent-magnet dynamic loudspeakers in current use.

Crystal pillow-type speakers are useful wherever it is desirable to listen to radio programs without disturbing others in the same room. This type of speaker consists essentially of a rather large direct-radiating crystal element mounted within a rubber jacket.

Phonograph Pickups

The great majority of the radio-phonograph combinations manufactured in this country during the past few years employ crystal phonograph pickups.

Within the last year, there has been a considerable and increasing use of a new type of crystal phonograph pickup. This pickup has a low inertia vibratory system of which a sapphire stylus usually forms a permanent part. This permits uniform response over a wide range

of frequencies (up to 10,000 c-p-s) with practically no distortion. When combined with the low stylus force (usually 30 grams), these features insure longer record life, and a considerable reduction in background and acoustic noise.

Disc Recorders

Crystal disc recorders are widely used today for home, school, studio and governmental applications. These are of two general types, the cutter and the embosser. In the former, the crystal actuates a stylus having a sharp chisel point which actually removes material from the record surface in forming the groove. This process permits a somewhat wider range of frequencies to be engraved in the record, and is used in those cases where high fidelity results are required.

In embossing, the crystal actuates a blunt stylus which actually pushes the material aside to form the groove in the record. Soft instantaneous materials such as nitrocellulose have produced best results for this work. The embossing method has been very popular lately in the recording of long-playing records at constant low linear speeds, especially when wide frequency range is not paramount.

For most critical recording work, such as electrical transcriptions, crystal cutters can be supplied with thermostatically-controlled heater elements for stabilization. These heaters automatically adjust the operating temperature of the recorder to approximately 95 degrees F., thus insuring that the sensitivity of the crystal and the properties of the damping material will not change with changes in room temperature. The sensitivity of crystal cutters without temperature stabilization will normally vary from 4 to 6 db in operating between 72 and 95 degrees F.

Direct Inking Oscillograph

An important instrument in the industrial field is the direct inking oscillograph. This instrument is designed for making instantaneous and permanent ink-on-paper records of low-frequency electrical alternations, surges, transient phenomena, relay timing, etc. When working from vibration pickups, it has been used for recording low-frequency noises and vibrations in airplane and automobile engines, electrical motors and generators, etc. When working from pressure pickups, it has been used for recording pulsating gas or liquid pressures in pipe lines, pressures in guns, etc.

The direct inking oscillograph has also been used for measuring strains in airplane propellers and wings, as well as the pressures exerted at the elec-

(CRYSTALS—continued on page 34)

ALERT RECEIVER

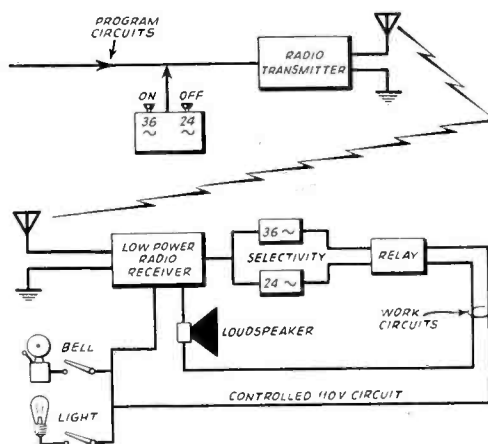
A special receiver which may be turned on and off automatically by means of sub-audible signals sent from a broadcast station.

A NEW Alert receiver* was recently demonstrated by the Radio Corporation of America. This receiver turns on automatically when it receives a special sub-audible signal from a broadcast station, rings a bell to summon listeners, and then shuts off when the all-clear signal is flashed.

The demonstration was conducted in the Administration Building at LaGuardia Airport. David Sarnoff, president of the Radio Corporation of America, briefly introduced the new instrument and discussed its possibilities with New York City's Mayor LaGuardia participating as National Director of Civilian Defense. The program was broadcast by the NBC Blue Network.

The Alert receiver is a simple three-tube instrument about the size of a portable radio set. Since the unit requires

little power, it can be operated twenty-four hours a day over long periods of



Block diagram illustrating method used for automatically controlling receiver.

to the block diagram it will be seen that when the 24-cycle signal arrives it energizes a relay which places the loudspeaker in the circuit. At the same time the bell rings and/or the light flashes on. The 30-cycle signal removes the speaker from the circuit.

Widespread application of the instrument is possible in the interest of Civilian Defense, as it may be used to provide a local, regional or nation-wide instantaneous radio call system. It can also be used to perform other public services in case of fire, earthquakes, floods, etc. An additional use in broadcasting would be to call attention of listeners to special news bulletins, unscheduled broadcasts, and the like.

The Alert receiver can be built to operate from a-c, d-c or batteries. It can be incorporated in standard broadcast receivers as well as television sets.

The receiver was developed by Arthur F. Van Dyck, Stuart W. Seeley, and Harmon B. Deal, all of the RCA Laboratories.

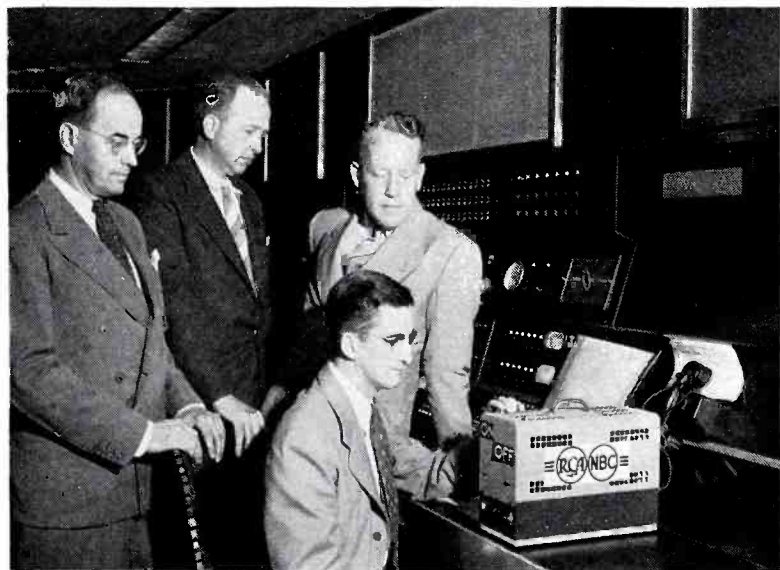
time at low cost. The receiver can be fixed-tuned to any one broadcast station. The set has a loudspeaker of its own which is normally silent. Referring

*It is interesting to note that the possibilities of the Alert Receiver was discussed in the article "The Radio Receiver as Part of the Broadcast System," Part II, by Arthur F. Van Dyck, p. 9, April, 1939, COMMUNICATIONS.—Editor.

David Sarnoff and Mayor LaGuardia examine the alert receiver at LaGuardia Airport.



A. F. Van Dyck, H. B. Deal and S. W. Seeley watch NBC operator transmit sub-audible signal.



Portable Broadcast Amplifier

By I. R. WOLFE

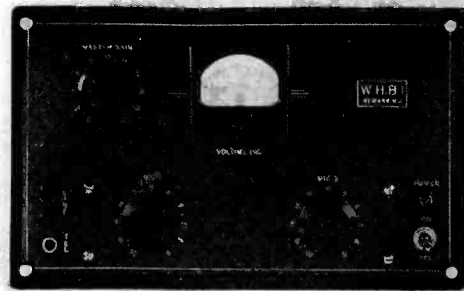
Engineering Department
W H B I

IT was not so long ago that the operator handling remote broadcasts, developed a pair of bulging biceps and generally enhanced his physique, grudgingly perhaps, while engaged in ferrying about a set of well weighted trunks containing the necessary adjuncts to pipe a program from a remote source.

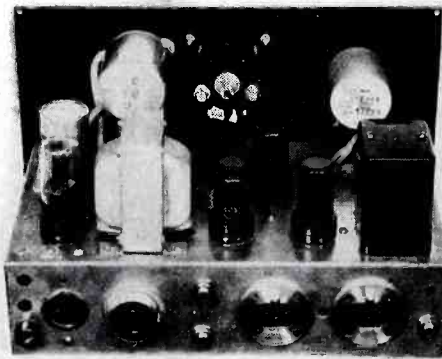
With the advent of midget tubes, transformers that fit in the palm of the hand, etc., a mobile amplifier could probably be built into a condensed milk can, and the outside job relegated to the anemic member of the staff without imposing a strain upon his delicate constitution.

The amplifier described here was not designed primarily for lightweight or compactness, but rather to comfortably accommodate all component units. It just happened to weigh under fifteen pounds when completed.

By including the power supply in the same unit, the nuisance of patching an external power unit is avoided. As an added safety feature, however, the cabinet for the microphones and cables holds a complete filtered plate and filament supply, ready for patching into the amplifier in the event of failure of the regular supply. By installing batteries in the mike and cable box, the amplifier



Front and rear views of portable amplifier.



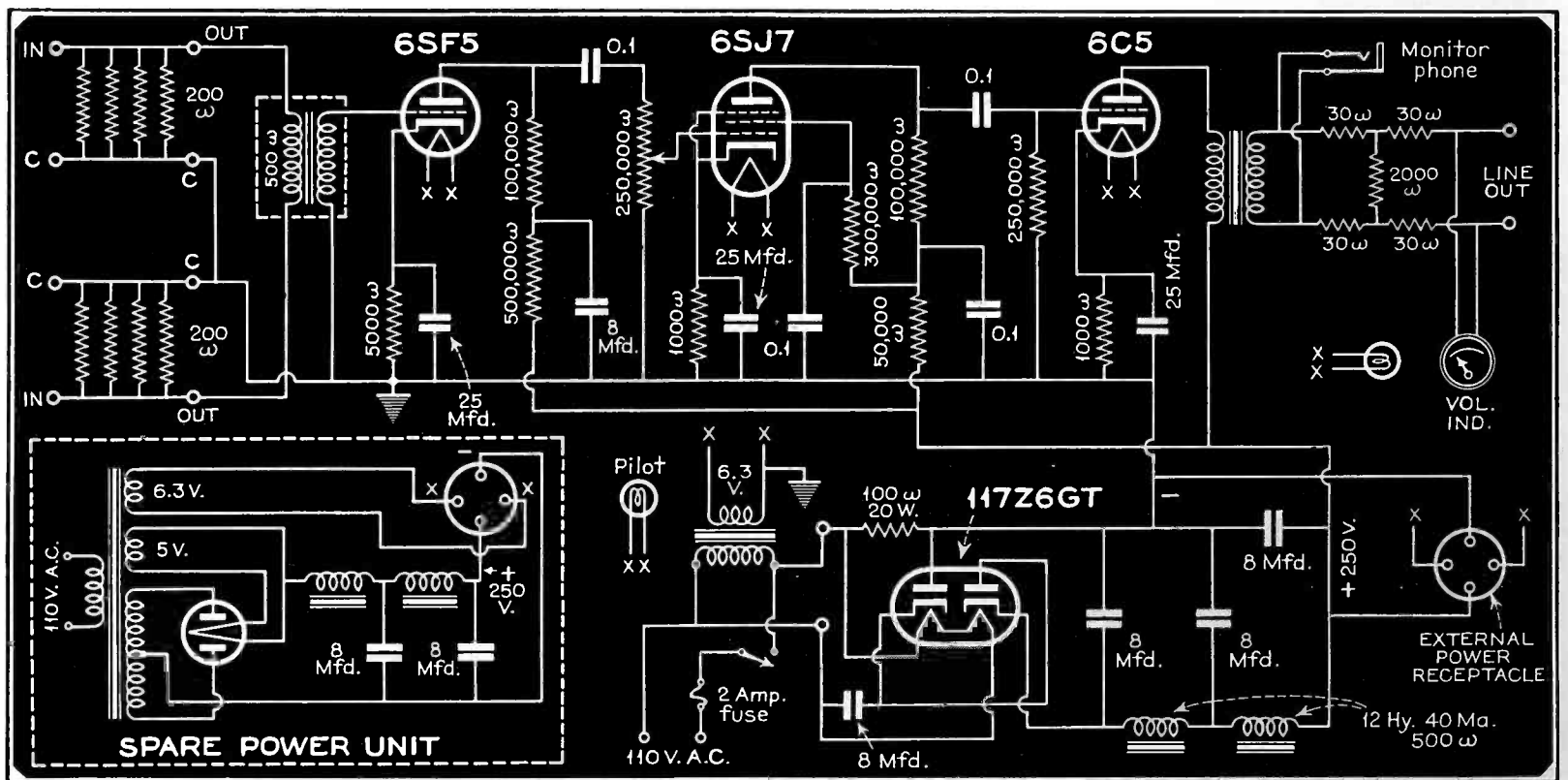
can be operated independently of an a-c source.

Plate-current meter and attendant switching system, microphone switches,

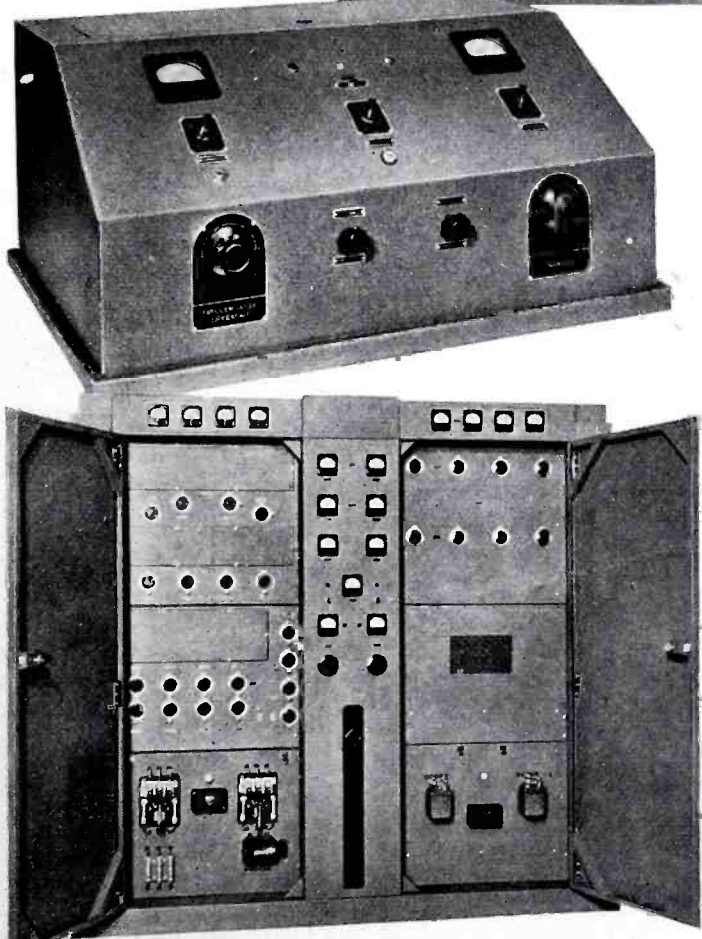
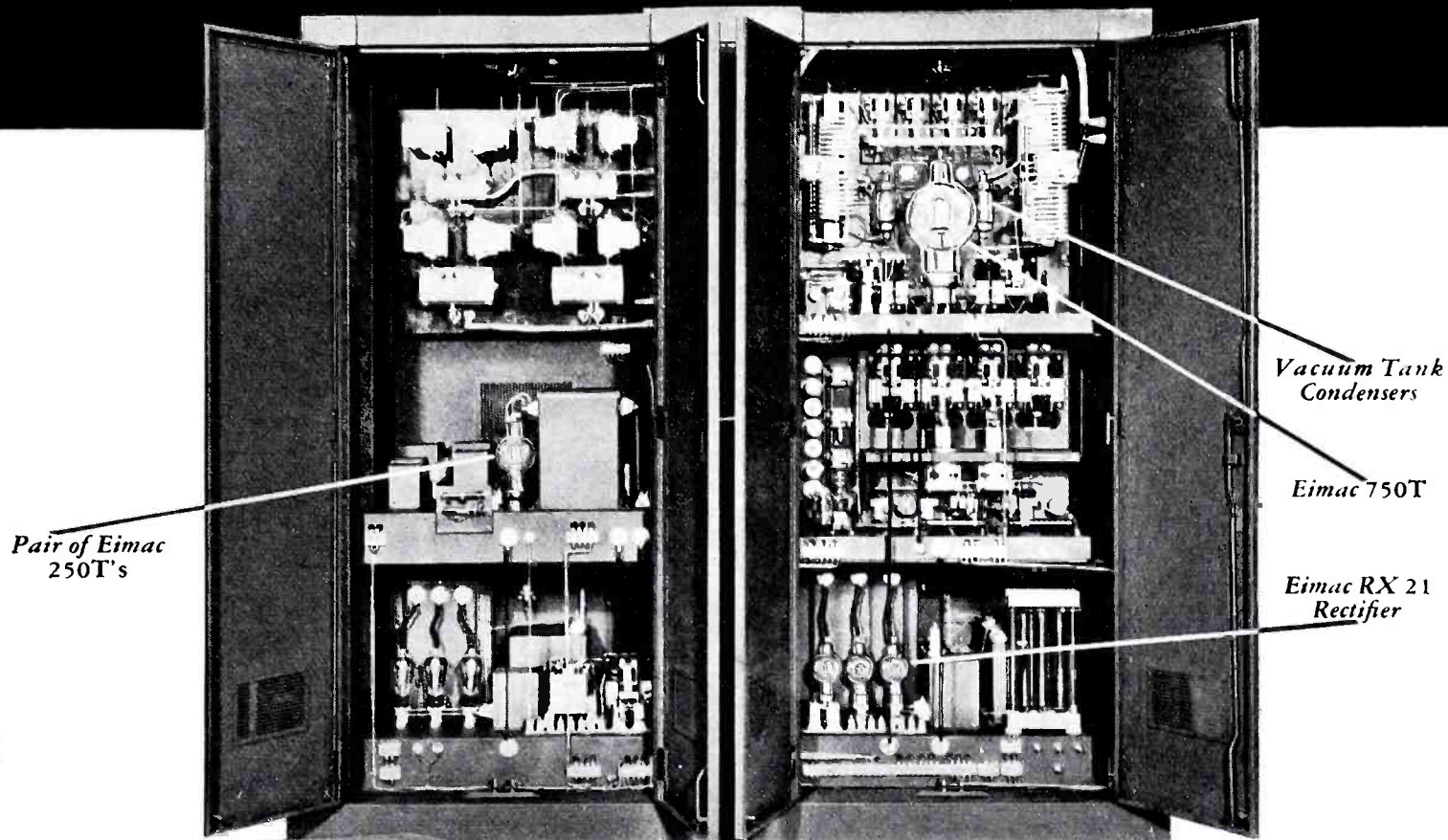
Circuit diagram of the portable amplifier.

variable output pads, etc., were omitted in the amplifier. In the light of past experience, these so-called conveniences were rarely utilized and made for potential sources of trouble. For checking plate currents when the occasion demands, the cathode return to ground in each amplifier stage is brought to a closed circuit jack on rear of chassis. Two microphone channels are provided. Additional channels could be included by additional faders or a selector switch. The amplifier circuit is conventional, the resistor and condenser values chosen for good frequency response. Choice of the tube lineup in the amplifier was determined after a number of different tube combinations were tried. The frequency response is linear within two decibels, from 60 to 10,000 cycles. No visible waveform distortion is noticeable on an oscilloscope up to an output of plus 15 db. The total useful gain is 80 db . . . more than sufficient for moving coil or ribbon microphones. With the master gain wide open, there is no audible trace of hum.

A voltage doubler tube (117Z6GT) is used for the plate supply delivering 250 volts at the filter output from a 115-volt a-c line. The chassis is above ground (AMPLIFIER—continued on page 32)



EIMAC EQUIPPED BRAZILIAN ARMY STATION



Photos from top to bottom show a rear view of transmitter, the remote control and a front view of the transmitter constructed by Maya Rebello & Comp. of Rio de Janeiro for the Brazilian army

Here is supporting evidence of the fact that Eimac Tubes have world-wide acceptance, even by foreign government owned radio station.

With a single 750T in the final stage and a pair of 250T's as modulators this station puts 1200 watts on the antenna. Operated by remote control on four frequencies using phone, CW and ICW.

The transmitter was constructed by Maya Rebello & Comp. of Rio de Janeiro and employs Eimac RX 21 rectifier tubes as well as Eimac vacuum tank condensers in the final circuit. The design and construction does credit to its makers and the use of Eimac Tubes in the most important sockets is convincing evidence of their superiority and position in the world of radio.

Follow the Leaders to

Eimac
TUBES

EITEL-McCULLOUGH, INC. • SAN BRUNO, CALIFORNIA

Export Agents: Frazar & Co., Ltd., 301 Clay St., San Francisco

FILTER DESIGN

• Design and characteristics of low- and high-pass filters

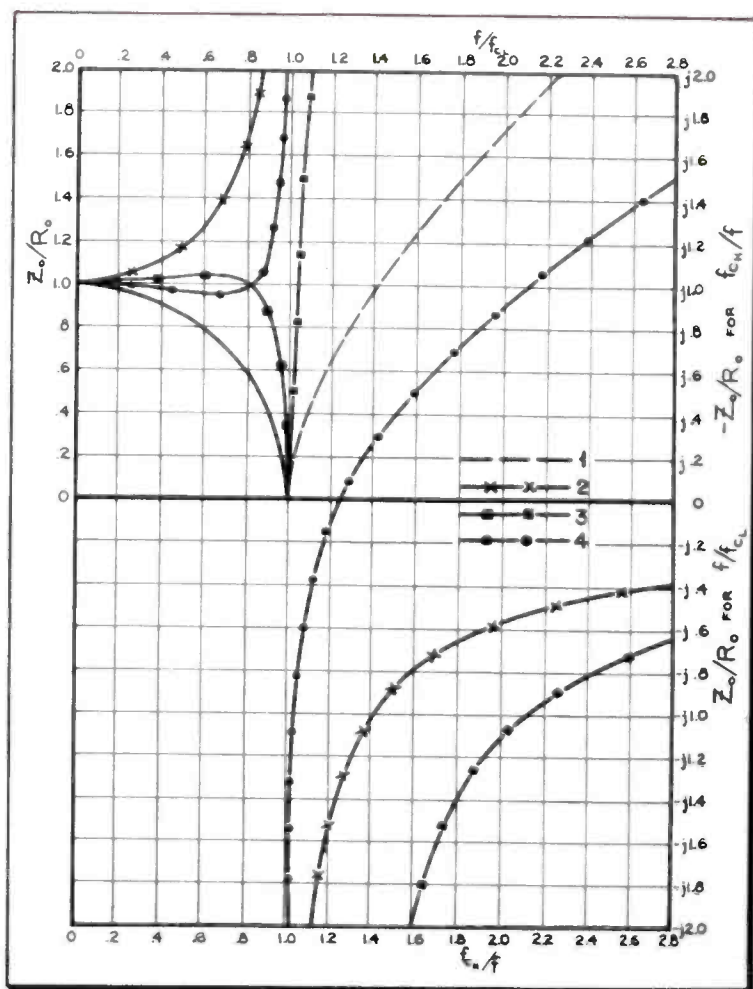
L. J. GIACOLETTO*

IN designing a low or high-pass filter the quantities which are usually known are the frequency at which cut-off is desired, f_c , and the resistive impedance, R_o , into which the filter is to work. These two quantities determine the elements of a prototype or m-derived, T or π , low or high-pass filter. By means of the chart and curves, the desired filter may be quickly designed and some of its characteristics predicted.

If f_c and R_o are known, the intersection of the f_c line and the R_o line on the chart determines a point with which is also associated a value of L and C as read from the lines sloping downward and upward. Next pick the desired filter section from those tabulated in Fig. 1; using the values of L and C obtained above, the elements of the filter can be computed as indicated in the figure.

The characteristics of a filter include

	LOW PASS		HIGH PASS
PROTOTYPE T		Z_o 1 α 6 β 5	
M-DERIVED T MID-SERIES		Z_o 1 α 8 β 7	
M-DERIVED T MID-SHUNT		Z_o 4 α 8 β 7	
PROTOTYPE PI		Z_o 2 α 6 β 5	
M-DERIVED PI MID-SHUNT		Z_o 2 α 8 β 7	
M-DERIVED PI MID-SERIES		Z_o 3 α 8 β 7	



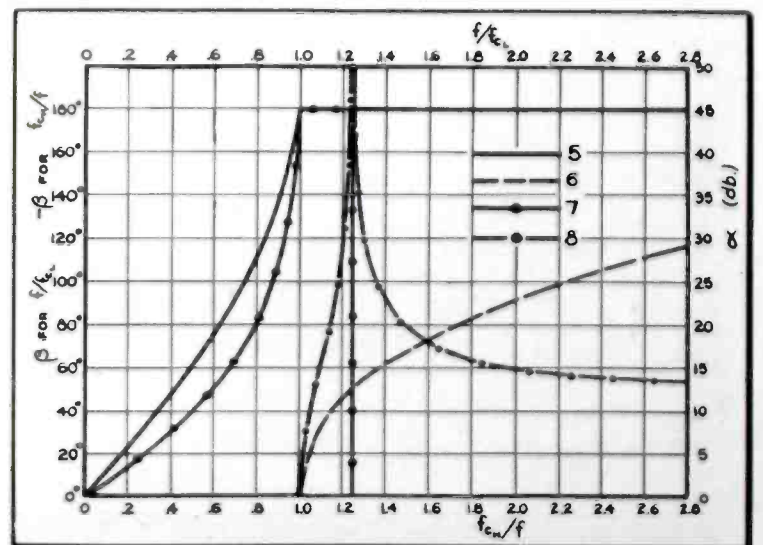
(Above) Fig. 1. Tabulation of filter sections.

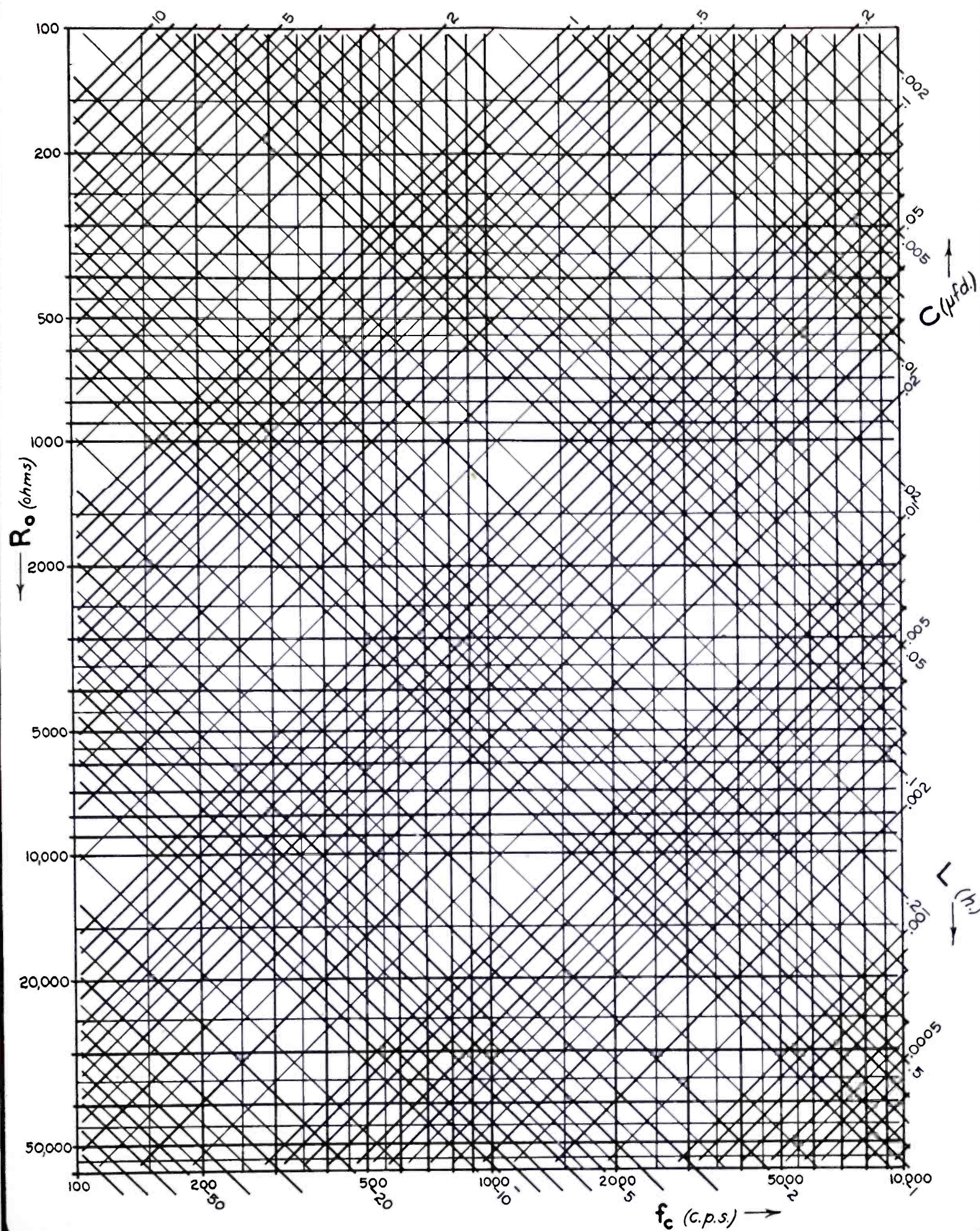
(Left) Fig. 2. Characteristic impedance variation for the filter sections tabulated in Fig. 1.

(Below) Fig. 3. Attenuation and phase shift for the filter sections.

the variation of characteristic impedance, attenuation, and phase shift as a function of the operating frequency. These characteristics can be obtained by first consulting Fig. 1 for the number of the curve showing characteristic impedance variation, Z_o , attenuation, α , and phase shift, β . The characteristic impedance curves are given in Fig. 2. Note that the abscissas are in terms of ratios of cut-off frequency to operating (FILTER—continued on page 35)

*Formerly at University of Michigan, now with Signal Corps Laboratories.—Editor.

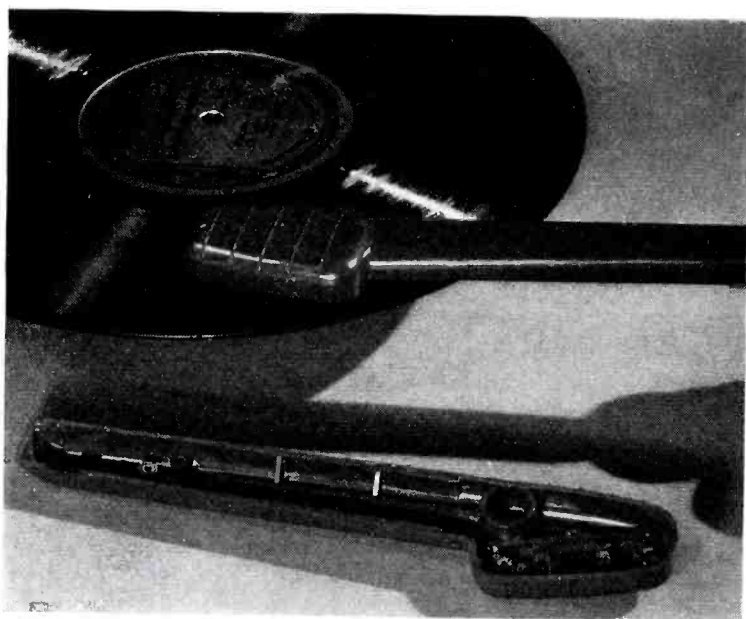




PLASTICS IN RADIO

and National Defense

By LEWIS WINNER
Market Research Engineer



• • •
A recent engineering application of plastics has been in pickups. Shown here is Webster Electric Company's Model A1-1 crystal pickup molded from Durez plastics by General Molded Products Co. In addition to weight reduction, production economies are attained through the use of plastics.
• • •

ONE word raced through the minds of everyone, a few months ago, when vital metals began disappearing from the market place, because of national defense needs. That word was—plastics. Possessing so many of the structural qualities of metals, in addition to many superb electrical characteristics, this substance was apparently the true panacea. But as quickly as this ideal hope rose, so was it, unfortunately, forced into a state of secondary hope, along with many other bright, but suddenly dimmed plans.

Many elements precipitated this condition, among them, being naturally enough, the excellent properties of plastics, which more than met the demands of the National Services. The aeronautical divisions, for instance, made a veritable raid on the facilities of the plastics industry, and are still continuing at a merry pace. The turrets, windshields, floors, in addition to rows of parts in the lighting, ignition, communications and control systems of planes are among the foremost users of plastics. Plywood that has been plastic bonded is used for bulkheads, bomb-bay doors, gusset plates and assorted panels. Plastics reinforced with plywood, metal cloth and fiber are being considered for wing coverings. In the German planes that have been brought down, plastic ribs and stays were found to have supported leakproof gas tanks. Plastics

were used here to minimize the probability of sharply cut metal parts, which had been ripped by bullets, from piercing the tanks with holes that might be too large for self-sealing. As a result of this finding, plastics may be put to such use in our planes.

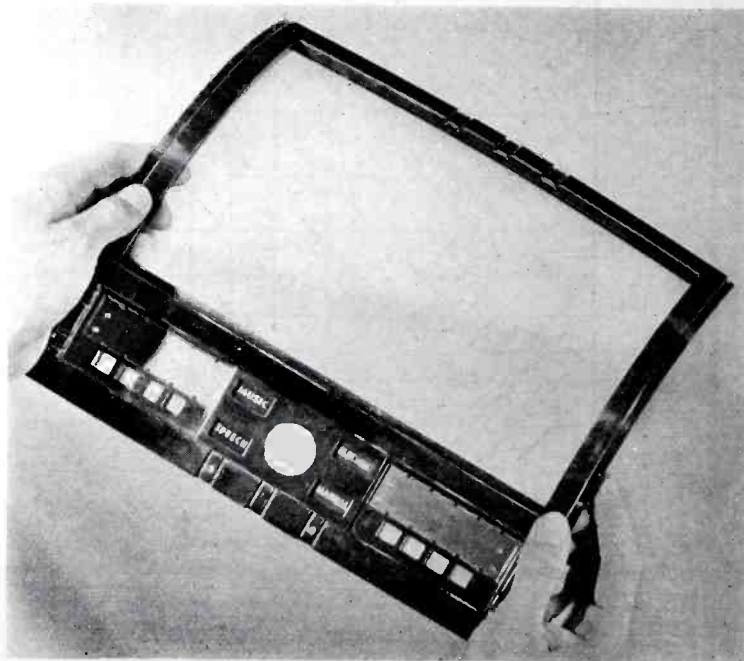
Plastic bonded plywood is used in other military components, such as in splinter protectors, and the popular PT mosquito boats. Gun blisters and gunstocks are now using plastics. In gas masks, valve guards, filter boxes, wire insulation, cable sheathing, scout cars,

tanks, trucks and countless other associated war implements, plastics is the "white haired" boy of the day. Even a special plastics division, under the direction of F. H. Tupper, has been established in the Quartermaster Corps to study and analyze all possibilities of plastics.


In order to produce the material just mentioned, it is necessary to have such basics as cotton linters, acetone, anhydrous ammonia, chlorine, formaldehyde, methanol, phenol, polyvinyl chloride, canvas duck (used for laminated plastics), nickel-steel (for molds), and some synthetic resin molding powders. These will all be found on the familiar OPM critical list. Thus, you have the reason for the hoarding of these essentials by the government. It is these elements that go into the production of five types of plastics that are most suitable for dimensional stability, tensile strength, hardness, heat and cold resistance and electrical insulating value; namely, urea-formaldehyde, phenol-formaldehyde, acrylic, polyvinyl chloride and cellulose nitrate.

In formaldehyde we have one of the most serious shortage problems. This vital substance is derived from methanol, which in turn is made with equipment that can be converted towards the (PLASTICS—continued on page 30)

• • •
An air-tight, vibration-proof Tenite frame cast directly around glass for the front of an RCA Victor radio, illustrating another use of plastics in radio construction. Photo from Eastman Kodak Co.
• • •



FM's First COMMERCIAL STATION Packs a 20-kw Wallop with GL-889's



W 4 7 N V ' s
antenna tops
WSM's 890-foot
radiator—highest
antenna tower in
America



Mr. DeWitt, left, chief engineer of W47NV, and W. Crockett of the G-E Nashville Office talk over FM

"Tube Performance Highly Satisfactory," Reports Chief Engineer Jack DeWitt of Nashville's W47NV

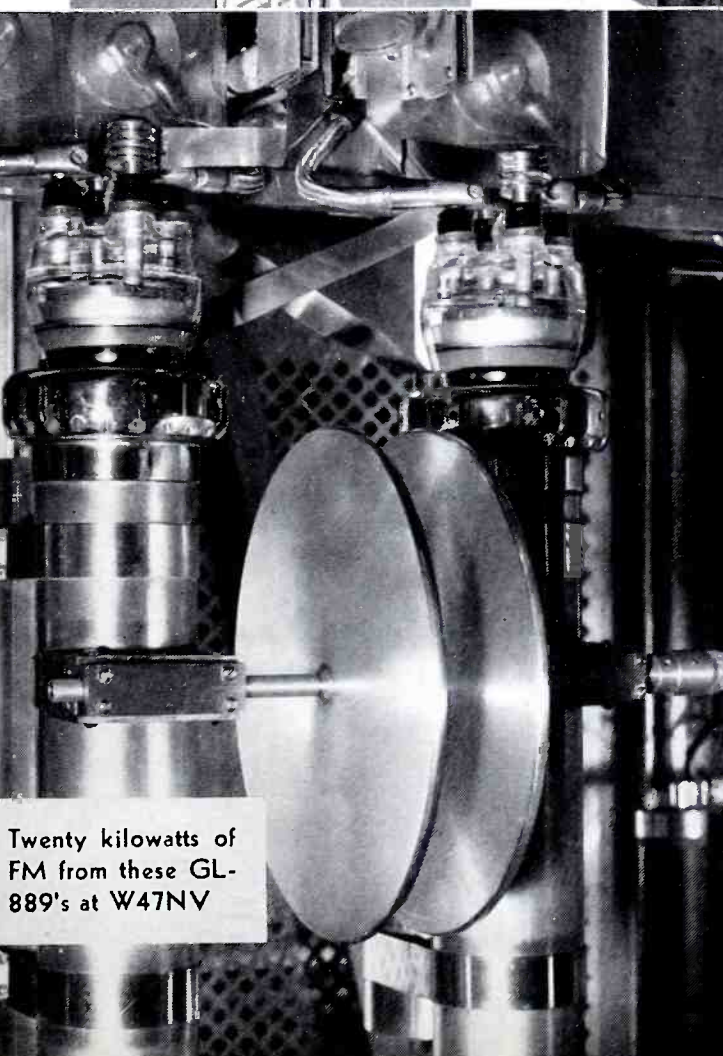
W47NV, operated by the National Life and Accident Insurance Company of Nashville, went on the air as the first commercial FM station March 1, and in June was granted full commercial status by the FCC. Read Mr. DeWitt's comments . . .

"We are operating at 20-kw output on a 10-hour-a-day schedule," he writes. "We have found the GL-889's to have excellent stability; they are easy to drive and to neutralize.

"We have tested both the regular and spare sets of tubes under operation conditions, and we find that the balance obtained with either pair is unusually good. All of the tubes have uniform characteristics, which, of course, is very important at FM frequencies.

"We have every reason to expect highly dependable service from them."

General Electric has transmitting tubes and a complete line of FM equipment to meet your needs. Get both through the nearest of the 80 G-E offices. General Electric, Schenectady, N. Y.



Twenty kilowatts of
FM from these GL-
889's at W47NV

GENERAL  ELECTRIC

161-21-8860



VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President

RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y.

GEORGE H. CLARK, Secretary

Scholarships

ON Saturday afternoon, August 12, 1939, in the auditorium of the Westinghouse Exhibit at the New York World's Fair, our Association presented the First Marconi Memorial Scholarship in Radio and Electrical Communication at RCA Institutes to Robert Barkey, graduate of Stuyvesant High School in New York City. The proceedings were broadcast over WOR and the coast-to-coast network of Mutual Broadcasting System.

On Saturday, August 17, 1940, the Second Marconi Memorial Scholarship was presented to Robert J. Stahl, a graduate of Bellarmine College Preparatory School of San Jose, California. The presentation was broadcast over KHJ, in Los Angeles, and the Mutual Broadcasting System.

On Saturday afternoon, August 23rd, 1941, at 2 P. M., Eastern Daylight Saving Time, over a coast-to-coast network of the Mutual Broadcasting System our Association will present three Scholarships in Radio and Electrical Communication—two at RCA Institutes and one at the Midland Television and Radio School.

At the time we first initiated these Scholarships, J. R. Poppele, Chairman of our Scholarship Committee, gave considerable thought to the best possible method of selecting the young man to receive the Scholarship. After consulting with executives of the American Institute of the City of New York, which organization, by virtue of years of experience in fostering science clubs in high schools throughout the entire United States, was eminently fitted for the job, it was decided that each year they would conduct an examination open to senior high school students in the high schools of the country and that the highest ranking contestant would receive the scholarship. This has been done these past three years—Messrs. Barkey and Stahl being the first and second winners.

This year, the American Institute presents us with three candidates for Scholarships. Mr. Charles J. Pannill, President of RCA Institutes and the Radiomarine Corporation of America—a Life Member of our Association—who originally kindly cooperated with us in making possible the previous awards—immediately agreed that in the interests of National Defense and more and better trained men in Radio that our Association should place two students in RCA Institutes under the Marconi Memorial Scholarship plan. We express our sincere appreciation to Mr. Pannill for his splendid cooperation now and in the past.

Mr. G. L. Taylor, President and Chief Engineer of the Midland Radio and Television Institute, when informed of our plans by "Jack" Poppele, immediately responded with an offer of cooperation in the form of a Scholarship at the Midland Institute. We gratefully acknowledged Mr. Taylor's grand assistance in the Scholarship endeavor.

The presentation program will originate in the New York, Akron, O., and Chicago studios of the Mutual Broadcasting System.

Present in the studios of WOR in New York will be "Jack" Poppele, Chairman of our Scholarship Committee and Chief Engineer of that station; Dr. H. C. Parmelee, President of the American Institute of the City of New York and President of the McGraw-Hill Publishing Company, our President, William J. McGonigle, and Stanley F. Goldfine, graduate of Erasmus Hall High School in Brooklyn, New York, who tied for top honors in the contest and will receive a two-year Scholarship at RCA Institutes in New York.

Our President's telegraphic request to the Hon. W. B. Spagnola, Mayor of Youngstown, Ohio, to do the honors in the Akron studios of Mutual—WJW—met with immediate favorable response. John Marsey, a graduate of East High School, Youngstown, Ohio, tied with Mr. Goldfine of Brooklyn for top honors in the American Institute contest. We requested his honor the Mayor of Youngstown to join with us in tribute to an outstanding student of his city. We deeply appreciate his fine spirit of service.

A telephone call to Chicago found W. J. Halligan, Chairman of the Midwest Chapter of our Association and President of the Hallcrafters, just recently departed by plane for Washington. We finally located "Bill" Halligan in Washington and he just about took our breath away. Our explanation of the plan to have him officiate in Chicago in presenting a Scholarship to the Midwest winner of the contest—and that the winner, William Allen Morgan, a graduate of Senior High School of Joplin, Missouri, might be unable to finance a trip to Chicago to accept—"Bill" immediately offered fullest cooperation even to the extent of having Mr. Morgan come to Chicago as a guest of Hallcrafters. (At this writing we do not have complete details on the winners and since Joplin, Missouri, is some five hundred miles from Chicago, our prexy thought it might be some financial burden for the winner to make the trip.) Mr. Halligan will present a one-year Scholarship in Radio Communication at the Midland Television and Radio Institute in Kansas City, Missouri, to Mr. Morgan in the studios of WGN, Mutual station in Chicago.

In recent conversation with Mr. John Cose, Superintendent of RCA Institutes, we learn with much pleasure that our first scholarship winner, Robert Barkey, made a splendid record during his two years study. In conversation with Mr. Barkey we found him still unspoiled by his success—first in winning the Scholarship and second in his fine record of achievement in his studies. We are certain Mr. Barkey will find it not too difficult to secure employment. However, our Association continues its interest in our Scholarship

students and since Mr. Barkey will be available the fifteenth of August we are endeavoring to secure for him the opportunity he deserves in the radio industry. Winner of a nationwide contest among high school seniors and an outstanding student these past two years at RCA Institutes, Mr. Barkey will be a creditable addition to the engineering staff of any radio organization. Interested organizations please contact "Jack" Poppele at WOR.

Code Proficiency

Over the Red network of the National Broadcasting Company, on May 30, 1941, the President of our Association spoke as follows:

"Mr. McGonigle:

"Communications is the first medium of Defense. The Signal Corps of the United States Army and the Communications Service of the Navy are doing a magnificent job of providing the best possible Communications for the armed forces of our country. We know they shall continue to do so.

"It is imperative, however, that all those in a position to render service in this important field should make their services available for our country's defense.

"The Army Amateur Radio System, comprised of skilled radio amateurs throughout the nation affiliated in a civilian capacity with the Signal Corps of the Army, is a valuable auxiliary of the service.

"In collaboration with the Signal Corps our Association made available—a Marconi Memorial Award—to be presented to the winner of the Annual Army Amateur Radio System Code Proficiency contest conducted in February of this year.

"The Chief Signal Officer of the Army announced the winner to be Mr. William B. Hollis, W5FDR-WLJR of Houston, Texas, who qualified at the highest speed transmitted—65 words per minute. This speed closely approximates the world's record.

"The Veteran Wireless Operators' Association congratulates Mr. Hollis, and the Army Amateur Radio System for this truly remarkable achievement.

"It is entirely fitting that the Award be presented to Army Amateur Hollis by one of the earliest wireless pioneers in America, his commanding officer—the Chief Signal Officer of the Army—Major General Joseph O. Mauborgne.

"We take you now to the War Department Message Center, Washington, D. C."

The NBC announcer in Washington then described the activity in the War Department Message Center and introduced Major General Mauborgne, who made the presentation via radio to Mr. Hollis. Mr. Hollis, W5FDR, responded in code from his station in Texas and his signals were broadcast and interpreted by Major Talley, Liaison Officer of the AARS.

The PROOF

IS IN THE PERFORMANCE!

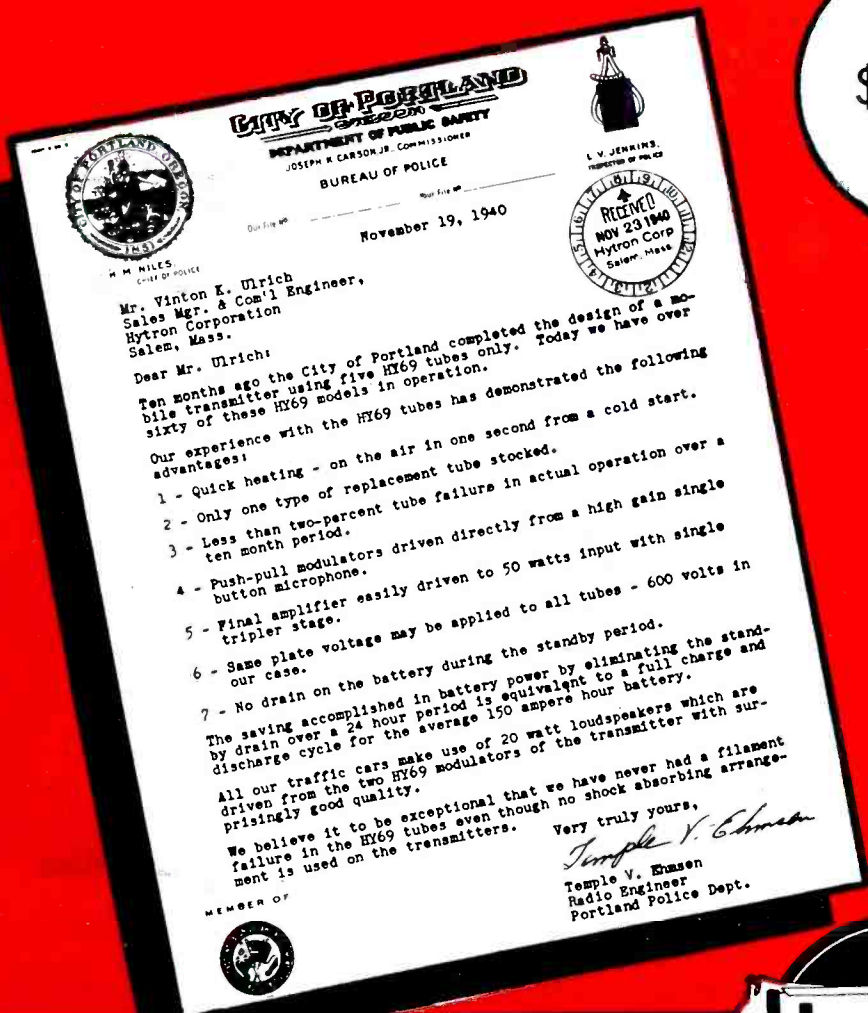
Records speak louder than words—that's why we reproduce below a letter from the Radio Engineer of the Portland, Oregon, Police Department.

Performance records like this — more than anything else — are creating new users everywhere thus establishing the leadership of HYTRON TRANSMITTING TUBES.

For example, so convincing was the performance record of Portland's car transmitters that the Oregon State Police is building equipment to utilize these same HY69 tubes while the Oregon State N.Y.A. Radio Division is constructing duplicates of these transmitters for several communities.



HY 69
\$ 3.95
NET



A TRULY ALL-PURPOSE BEAM TETRODE

Here is a tube that must be your first choice when it comes to portable-mobile units because of its instant-heating filament; its rugged construction, its reliability. Its low battery drain makes operation economical while its initial cost is low.

In addition, the HY69 is ideal for your AC-operated transmitter. Its 40 watt plate dissipation permits 50% more phone output (CCS) than the cathode equivalent HY61/807.

An extremely versatile tube; it may be used for 15 different applications—all for an investment of only \$3.95 net.

HYTRONIC LABS.

23 New Darby St., Salem, Mass.

Manufacturers of Radio Tubes Since 1921



A DIVISION OF
HYTRON CORP.

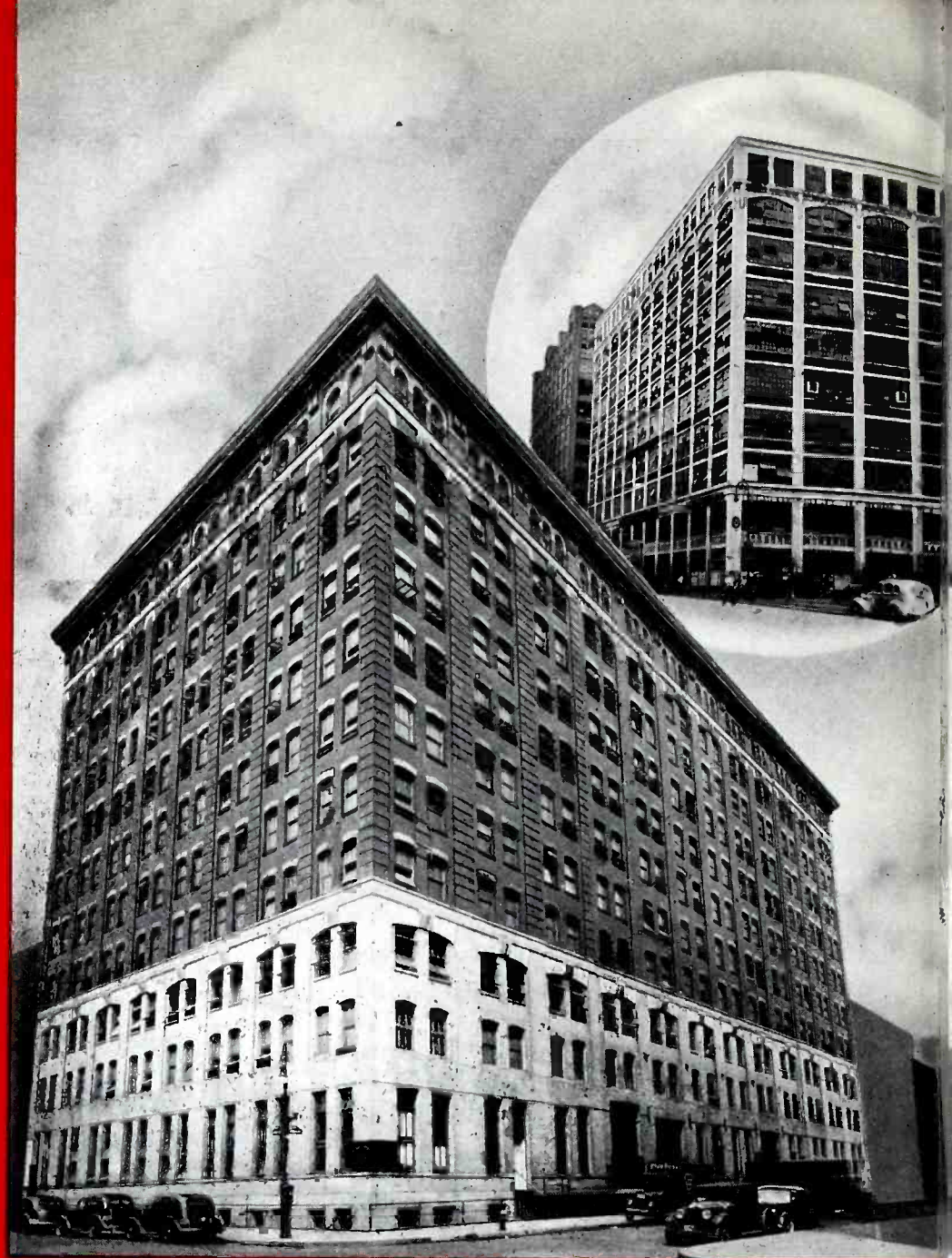
FOR BETTER
DELIVERIES

•
ANOTHER

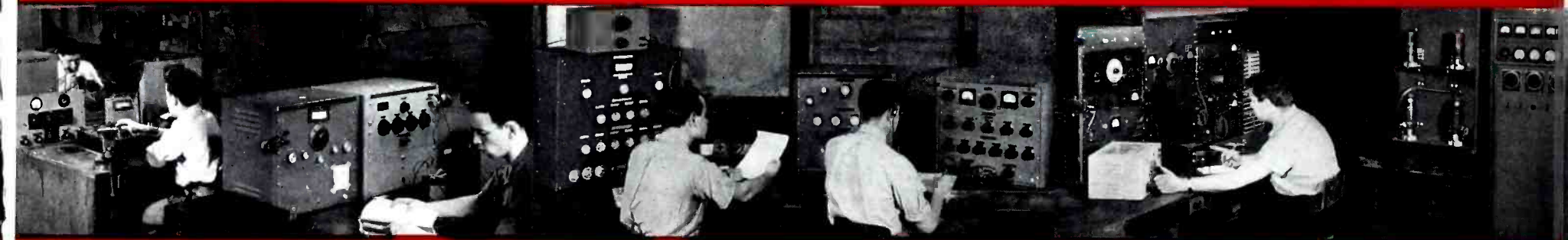


PLANT

Added facilities in another UTC plant now bring the size of UTC to thirty times that in 1933. This new plant assures a continuance of UTC's fine delivery record.



For Better Products . . . Continuous Research



As an organization founded on research and design ingenuity, the UTC research laboratories are unusually fine. A continuous research and development program is maintained to improve the quality and dependability of UTC products. In addition, customers' problems and their solutions are handled by a competent staff of application engineers.



UNITED TRANSFORMER CORP.

150 VARICK STREET



NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET, NEW YORK, N. Y. CABLES: "ARLAN"

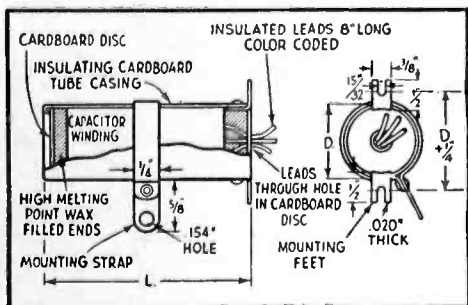
NEW PRODUCTS

ANTENNAS

Antennas for defense purposes, including marine, ship-to-shore, police and mobile units, are becoming an important part of production with Premax Products, division of Chisholm-Ryder Company of Niagara Falls, N. Y. Developed in aluminum, monel and steel, the Premax vertical antennas are supplied in standard designs varying in height from four to thirty-five feet. A special telescoping feature developed by Premax has made this type of antenna popular for marine and mobile units. Premax also produces a complete line of bases and mountings, especially designed for marine and other vertical installations—many of which are described in the new Radio Bulletin R-42.

CAPACITOR OFFERS UNIVERSAL MOUNTING FEATURE

Both in radio service work and in constructing new radio equipment, the problem of mounting capacitors is oftentimes a perplexing one. This is particularly true of by-pass and filter units of the higher values where size and weight make support by their own leads impractical. To solve this problem a universal mounting arrangement is made an integral part of the Type EZ dry electrolytic capacitors manufactured by Cornell-Dubilier Electric Corp., South Plainfield, N. J. These are equipped with a conventional mounting strap around the center. In addition they have a pair of slotted feet at one end. Thus they can be mounted in either horizontal or vertical positions and either above the chassis, below, or on one of the side walls. In re-



placement work they can usually be mounted under existing screws, through existing rivet holes or soldered direct to the chassis. Type EZ units are available in single, dual, triple and quadruple section units and in wide variety of capacity and voltage ratings. The multi-section units are supplied with a separate pair of leads for each section, or with common negative.

WHITE PLASTIC DIALS

White instrument dials that are not discolored by high temperature, light, chemical fumes, or moisture are being made at the Westinghouse Meter Division, Newark, N. J., by means of a recently developed liquid plastic material, which is sprayed on metal much the same as lacquer or paint would be. In typical tests, previous white lacquered dials changed to a light coffee brown after 10 hours of exposure to dry air at a temperature of 317 degrees Fahrenheit. Fumes from heated raw phenolic plastics changed white to

straw color after 120 hours, and a saturated sulphur dioxide atmosphere mottled dials with yellow splotches after 100 hours. Under identical test conditions the new plastic-coated dials were practically unchanged.

CRYSTAL PICKUP CARTRIDGES

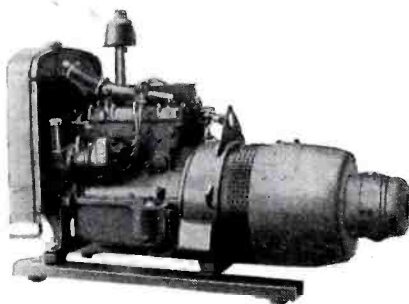
New type high-voltage low-pressure crystal pickup cartridges developed by Shure engineers now make available 1.4 volts output at 1,000 c-p-s (Audiotone rec-



ord), with only 1 ounce needle pressure. it is said. Will directly replace other flat-type cartridges in pickups with pressure of 1 ounce or more. The Shure "Hi-Lo" cartridge is designed for permanent point needles. Six types available to fit the manufacturer's requirements—with minimum pressures from 1 ounce to 2 ounces with outputs as high as 5½ volts. Write to Shure Brothers, 225 W. Huron St., Chicago.

KATOLIGHT PLANTS

Three new low-speed 1200 r-p-m models have been added to the line of Katolight plants manufactured by the Kato Engineering Company, Mankato, Minn. The new sizes are 5000, 7500 and 10,000 watts. Available with either two or three wire service or three phase, at 60-cycles. Generators are of the revolving armature type, generator frame being mounted directly to engine bell housing. Plants are furnished both with separate exciter attached to outer generator endbell and also with exciter winding carried on main a-c armature. The complete engine and generator assembly is mounted on rubber, permitting installation of plant



without bolting down on foundation. Design is such that plant used for portable track or moving vehicles can be anchored without restricting action of rubber mountings.

DECADE AMPLIFIER

This instrument is intended to be used as an accessory to the Model 300 Electronic Voltmeter for voltage measurements below 1 millivolt. It is a highly stable amplifier having a frequency response flat within 2 percent from 10 to 100,000 cycles and giving gains of exactly 10 and 100 times. With the 10X gain accurate voltage measurements down to 0.0001 volt (100 micro-



volts) can be made. The full 100X gain cannot be used because fluctuation noise in the amplifier circuits and tubes renders the indications of the voltmeter unsteady, but by exercising care readings down to 0.00003 volt (30 microvolts) can be obtained with fair accuracy. The amplifier is operated by self-contained batteries. The average life of a set of batteries on intermittent use is about 150 hours. Complete information on the decade amplifier, Model 220, can be obtained from the Ballantine Laboratories, Inc., Boonton, N. J.

NEW TUBES

The RCA Manufacturing Co., Inc., Harrison, N. J., have announced the following new tube types: RCA-6SL7-GT twin-triode amplifier, RCA-1631 beam power amplifier, RCA-1632 beam power amplifier, RCA-1633 twin-triode amplifier, and RCA-1634 twin-triode amplifier.

The 6SL7-GT is a twin-triode amplifier of the high-mu ($\mu=70$), single-ended type with separate cathode terminals for each triode unit. It is recommended for use in resistance-coupled circuits as a voltage amplifier or phase inverter. This high-mu type, like the 12SL7-GT, has separate cathodes which are brought out to terminals in the base and, therefore, offers much greater flexibility from the circuit designer's standpoint than do other high-mu twin-cathodes having only a single cathode connection.

The 1631, 1632, 1633, and 1634 are special-purpose tubes primarily for added convenience in the design of special storage-battery-operated mobile equipment. The 1631 and 1632 are intended for applications critical as to uniformity of characteristics, while the 1633 and 1634 are for applications critical as to matching of the two triode units. The 1631, 1632 and 1634 have 12.6 volt heaters and the 1633 has a 25-volt heater.

F-M EQUIPMENT

Radio Engineering Laboratories, Inc., 35-54 Thirty-Sixth St., Long Island City, N. Y., has announced a full line of new models of f-m transmission equipment for 1941. Known as the DL line, the equipment is based upon Armstrong's latest development—a new phase shift modulator. Literature is available from the above organization.

RECORDING DISCS

Mirror Record Corp., 58 W. 25th St., New York City, have announced new recording blanks coated on a tough, lightweight, fibrous base. They are available in sizes from 8 to 16 inches, and are said to be suitable for high-quality recording work.

MOBILE RADIO EQUIPMENT

The new Series M mobile equipment now being offered by Communications Equipment Corp., 134 W. Colorado St., Pasadena, Calif., is said to have been designed to meet the most critical demands of services employing radio for communication.

The 11M receiver employs ten (10) tubes and features noise silencer and squelch ac-



tion. A minimum drift crystal controlled oscillator, air-dielectric tuning condenser and remote control of squelch and volume are provided. Units for any frequency between 1.6 and 42 megacycles can be supplied.

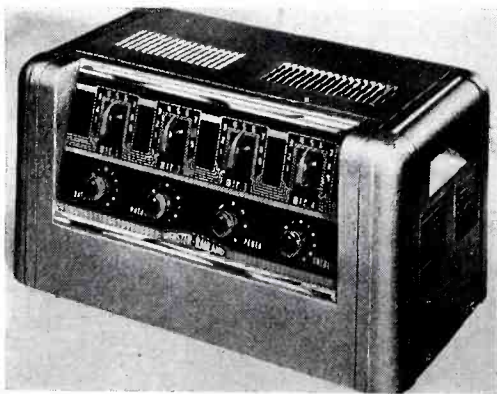
The 41M transmitter produces a 25-watt carrier completely free from noise, has built-in dynamotor, double pi antenna loading network, locking type tuning controls, and a "traffic control" speaker circuit. It is available for any frequency between 1.6 and 42 megacycles.

PAPER-CORE RECORDING BLANKS

W. W. Early, manager, RCA Victor Recording and Record Sales, has announced the development of a 16-inch fire-resistant, paper-core recording blank to replace the conventional aluminum base discs. Quality is said to be good. Further information may be obtained from RCA Manufacturing Co., Inc., Camden, N. J.

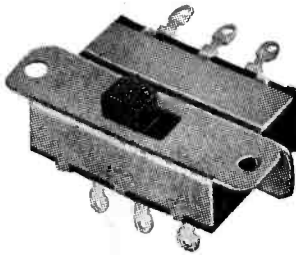
BI-POWER AMPLIFIER

Webster-Rauland, 3825 Armitage Ave., Chicago, presents their new 60 watt "Bi-Power" amplifier. The unit, rated at 60 watts, incorporates 4 microphone inputs, 2 phono inputs with dual fader, complete mixing and fading on all 6 inputs, separate bass and treble tone controls, remote mixing of 3 microphones, illuminated panel, etc. Complete specifications and description of this amplifier are found in the new Webster-Rauland catalog No. 141, available upon request.



SWITCH

In the accompanying illustration is shown the Stackpole SS-12 four-pole double-throw switch which is slide operated and indexed. It is said to have positive indent and good contact. Two other variations of the switch are available. The

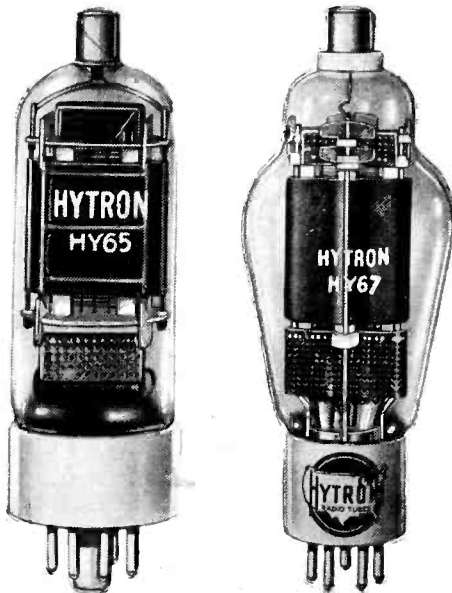


type SS-11 is the same as the SS-12 except that it does not have indent action. The SS-10 is a four-pole double-throw unit without indent action and arranged to operate by insertion of an a-c plug and is placed in the rear of portable sets to change the circuit from battery to a-c operation. Further data from Stackpole Carbon Co., St. Marys, Pa.

INSTANT-HEATING TUBES

Hytronic Laboratories announce the addition of two instant-heating r-f beam tetrodes to its line. One of these, the HY65, has about one-third the power capacity of the well-known HY69. The HY67 has a 65-watt plate dissipation and more than twice the r-f output of the HY69.

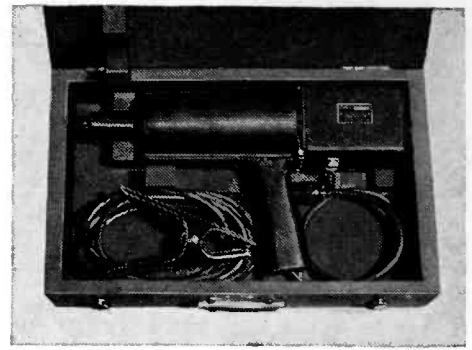
The HY65 is supplied with an all-ceramic octal base having 6V6GTX base wiring except for the plate which is connected to a top cap. The HY65 is completely shielded for r-f and no neutralizing is required even at its maximum frequency rating of 60 megacycles. It is designed to replace the 6V6 and 6L6 type tubes in low-



power stages and is for use also in portable and emergency type equipment. The instant-heating filament makes the HY65 particularly desirable for battery-operated transmitters where power must be conserved during stand-by periods.

The HY67 is an all-purpose graphite-anode r-f beam-power tetrode with rugged four-way mechanical support making the tube suited for use in aircraft and similar application where the equipment is subjected to vibrations and mechanical shock. The r-f shielding of the HY67 is complete, therefore, neutralizing is not necessary.

Further information may be secured from Hytronic Corp., 76 Lafayette St., Salem, Mass.

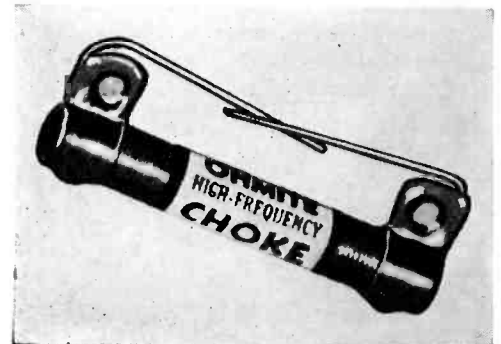


LOW-RESISTANCE TESTER

The Shallcross Manufacturing Co., Colingdale, Pa., has just added to its line of special electrical testing and measuring instruments a new portable electric bond tester that may be operated by non-technical personnel. The unit is designed for the accurate measurement, to a small fraction of an ohm, of contacts of switches and bus bars, low-resistance grounding and shielding of radio equipment, measurement comparison of motor armature resistance, testing the effectiveness of electric bonds on airplanes and other vehicles, etc. There are two models, the Aero-Gun model and the milli-ohm-meter model. Both are described in Bulletin B 26.

R-F PLATE CHOKE

The new 2½ meter band r-f plate choke Z-O has been added to the series of r-f plate chokes made by Ohmite. It is single layer wound on a low power factor steatite tube. The winding is covered with a moisture resisting insulating material which protects the wire. Because of its small



size, the new choke is adaptable to transceivers, mobile transmitters, and therapeutic and diathermy equipment . . . it measures 1¾ inches long by ¼ inch in diameter. Mounting is by means of wire leads. Other sizes available are for the 5, 10, 20, 40, 80, and 160 meter bands. For further information, write to the Ohmite Mfg. Co., 4835 Flournoy St., Chicago.

"SCREW-TITE" LUGS

A new solderless, "screw-tite" lug is announced by the Ideal Commutator Dresser Co., 4025 Park Ave., Sycamore, Illinois.



This lug is the set screw type made of seamless, pure electrolytic copper with a heavy brass check-proof shell that reduces heating. Full current carrying capacity is evenly distributed from wire to lug. Eight sizes are available for No. 14 wire to 2,000,000 C. M. Cable. Each size is suitable for a wide range of wire. One or two hole types are available with square or round ends. Special sizes and angular types of "screw-tite" lugs are also available. It is fully approved by Underwriters' Laboratories, Inc.

FILAMENT TRANSFORMER

Thordarson announces the addition of a new "19" series filament transformer. This transformer, T-19F75, is suitable for use with the new RCA 816 rectifier tube. Characteristics of the tube make its application particularly suitable for amateur radio work, and Thordarson, realizing the in-



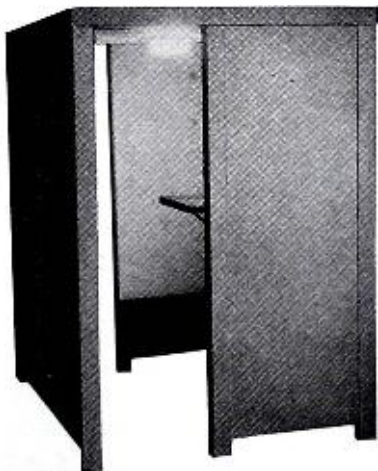
evitable popularity of the tube, designed the T-19F75 to match it. The T-19F75 is an open frame type with a 115-volt 50-60-cycle primary. Its secondary rating is 2½ volts at 5 amps. ct. The test voltage is 7,500 volts r-m-s. More complete information is given in Catalog No. 400-F, available free from any Thordarson distributor or direct from the factory: Thordarson Electric Mfg. Co., 500 W. Huron St., Chicago.



RCA's automatic record changer features a tandem tone arm which plays both sides of the record without turning it over.

CONFERENCE ACOUSTI-BOOTH

The Burgess Model 501 Conference Acousti-Booth, for use in noisy plants where a quiet conference place is necessary, has just been announced by the Bur-



gess Battery Company, Acoustic Division, 530 West Huron St., Chicago. Similar in construction to the Burgess Telephone

Acousti-Booth, this new conference booth has walls of sound-absorbent construction to soak up factory noise.

SPEAKER ENCLOSURES

In the accompanying illustration is shown the "JR" model "Tri-Tilt" speaker enclosure. Removable bezel and bottom permit easy installation of either 3, 4, 5



or 6" speakers. Two other models are available, one for 8, 9, 10 or 12" speakers and another for all heavy-duty speakers. Catalog available on request. Vibraloc Mfg. Co., 325 Miguel St., San Francisco, Calif.

MIKE STAND

A departure from the conventional microphone stand adjustment is offered by the "Trigger" principle introduced by Atlas Sound. The adjustment mechanism requires only a "touch-of-the-finger" in



order to release the locking mechanism and permit vertical adjustment. The new "Trigger" will be available on at least six of the microphone floor stands in the new 1941 line. Atlas Sound Corporation, 1449 39th Street, Brooklyn, N. Y.

TRANSMITTER-RECEIVER

The Jefferson-Travis Radio Mfg. Corp., 380 2d Ave., New York City, announces that its 5-watt portable transmitter-receiver for aircraft, Model PTR-5, is now available for delivery. It is a complete unit and self-contained in every respect. In order to operate the set, it is necessary merely to attach the antenna. No installation work is involved. The weight of the whole unit, including the receiver, transmitter, dynamotor, power supply, and



all batteries, completely self-contained in a two-tone grey fabric case, is 31 pounds.

RECORDING DISCS

Allied Radio has made available a line of 6½" double-faced recording discs. These Knight discs are said to feature low surface noise and to afford good reproduction of high and low frequencies. They are non-inflammable, and Underwriters' approved. They are constructed with a cardboard base and coated on both sides with a type C black coating. These discs will soon be available in 8" and 10" sizes. Allied Radio Corp., 833 W. Jackson Blvd., Chicago.

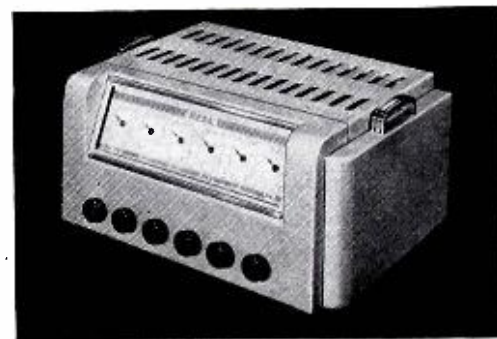
AIR ASSOCIATES STATION

The Federal Communications Commission on July 2nd approved the application of Air Associates, Inc., Bendix, N. J., for construction permit and license covering a new Class I experimental radio station, using call letters W6XFY. The commission also granted Air Associates license for a new Class I experimental portable mobile radio station on aircraft, using call letters W10XOF.

The new experimental station will be erected at the company's plant in California. It is to be used to carry on the company's program of research and development work in connection with its present and projected line of ultra-high frequency aeronautical and aircraft radio equipment.

AMPLIFIER

In the accompanying illustration is shown the 48-watt amplifier of the Bell Sound Systems, Inc., 1185 Essex Ave., Columbus, Ohio. The unit has individually controlled electronic base and treble boost. Inverse feedback has been incorporated in the design of the amplifier. Three microphone channels and a phono channel have separate volume controls.



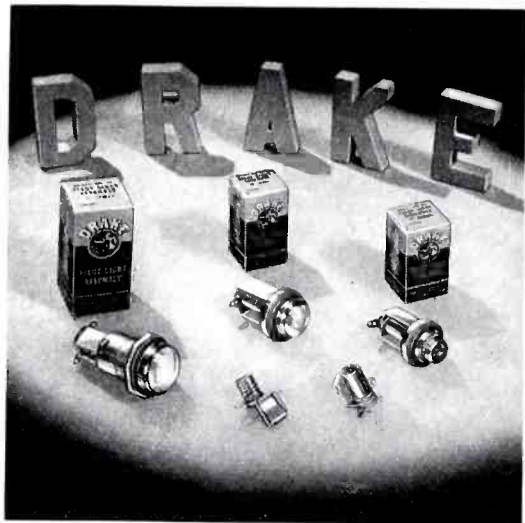
PERFORMANCE
STRENGTH and
LOW COST...

For outstanding performance - strength to meet severest wind conditions and low initial cost use Wincharger Vertical Radiators. These superior radiators are already demonstrating their efficiency and economy in over 300 commercial broadcasting and police stations throughout the United States.

Built of uniform triangular cross sections to insure highly efficient radiation - designed and built to withstand 100 mile wind velocity - these towers guarantee you years of low cost service. Complete erection service, including lighting equipment, anchors, base and ground systems is available.

WRITE TODAY FOR FULL DETAILS AND QUOTATIONS

WINCHARGER VERTICAL RADIATOR
WINCHARGER CORPORATION SIOUX CITY, IOWA



PILOT LIGHT ASSEMBLIES

STANDARD TYPES IN LARGE VARIETY

Chances are you'll find it easy to get from us a standard type and size assembly to exactly suit your needs. For, we make stock units and parts in big variety. If a special design is required, our skillful engineers will gladly cooperate in creating a unit to exacting specifications.

Drake Assemblies are precision-built from finest materials. They are used by most leading electrical manufacturers. Will you write us about your needs?



SEND FOR CATALOG

DRAKE MANUFACTURING CO.
1713 W. HUBBARD ST. • CHICAGO, U. S. A.

Variable
SELECTIVITY

Simplified
OPERATION

Wide
Voltage
Range

Linear
Meter Scale



Harmonic Wave ANALYZER

You can measure the individual components of a complex wave accurately and rapidly with this new Harmonic Wave Analyzer. The variable selectivity feature makes this instrument useful at both high and low frequencies with no sacrifice of accuracy. The wide voltage range covers values of nearly every application. Simplicity of operation saves time in making tests. Get complete information about the many other outstanding features.

Write for Bulletin #T-103

HEWLETT-PACKARD CO.
Laboratory Instruments
481 Page Mill Road • Palo Alto, California



AMPLIFIER

A 70-watt amplifier, for use in ball parks, stadiums, church towers, and other large installations is announced by John Meck Industries, 1313 W. Randolph St., Chicago. Four independently controlled microphone input channels and one phonograph input channel allow handling of large stage set-ups. The unit embodies two separate power transformers and rectifiers. Output impedances of 2, 4, 8, 166, 250, and 500 ohms are provided. A monitor speaker and monitor volume control may be supplied.

MILLER CATALOG

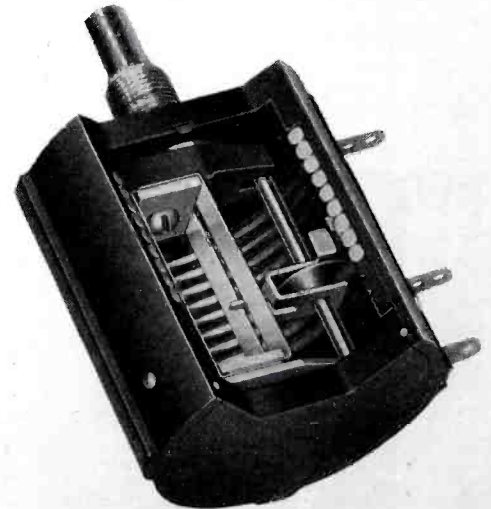
The J. W. Miller Co., 5917 S. Main St., Los Angeles, Calif., have just released Catalog No. 42 covering radio coils and allied products. This 46-page booklet also contains a number of circuit diagrams and data on tuners, receivers, etc. Copies available on request.

GENERAL CEMENT CATALOG

General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill., have issued Catalog No. 142, covering radio chemicals and products. The following are a few of the many items listed in this booklet: service cement, hammer finish kits, cabinet repair kits, phono needles, phono stylus set screws, wire stripper, switches, dial cables, radio knobs and knob pullers.

HELIPOT

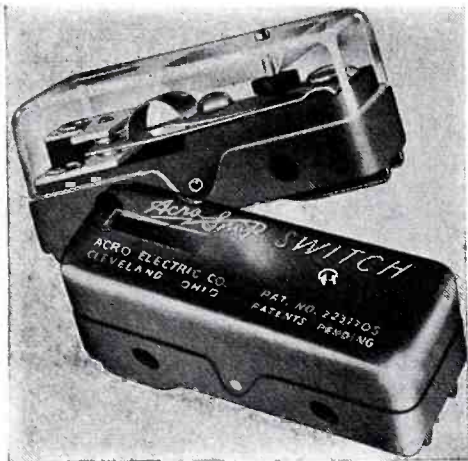
The Beckman Helipot is a new kind of potentiometer-rheostat which is said to combine wide range with fineness of adjustment. The Helipot consists essentially of a long potentiometer slide wire coiled helically into a small case, with a slider



contact rotated in the usual manner by a knob. By means of a simple guide wheel the slider contact automatically follows the helical path of the resistance winding. Literature on this unit may be secured from National Technical Laboratories, 820 Mission St., South Pasadena, Calif.

SWITCH

Acro Electric Co., 3174 Fulton Rd., Cleveland, Ohio, are offering a new snap-action switch which is said to operate on a new principle and to be suitable for a wide variety of applications. The switch



can be adapted to special shapes, sizes and positions or built into almost any style mechanism. It is single-pole and is furnished with normally open, normally closed or double-throw contact arrangement. Literature on request.

ATLAS SOUND CATALOG

Catalog F-41 is now available from Atlas Sound Corp., 1443 39th St., Brooklyn, N. Y. Listed are various types of horns, baffles, speakers, speaker enclosures, microphone stands and connectors. Copies available on request.

JANETTE BULLETIN

The latest Janette bulletin deals with rotary converters and dynamotors. These units are designed for use with sound apparatus. Write to Janette Mfg. Co., 556-558 W. Monroe St., Chicago, for Bulletin 13-25.

SOUND SYSTEM

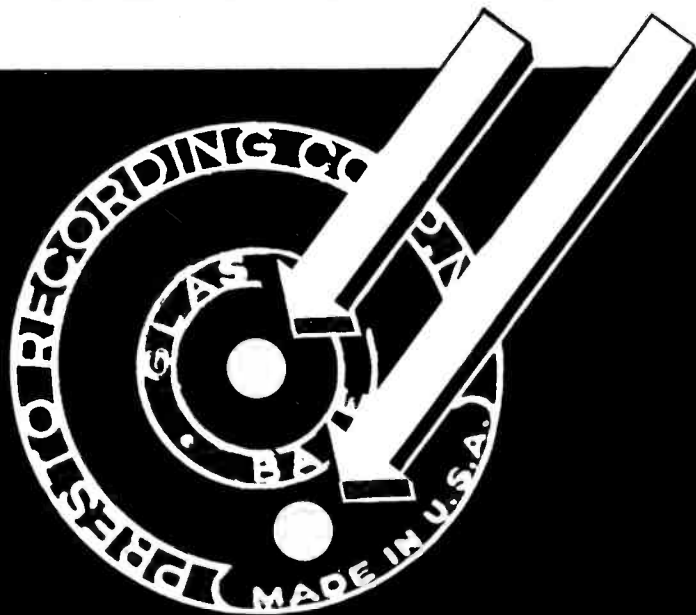
Erwood Sound Equipment Co., 228 West Erie St., Chicago, have just announced a new centralized public-address system for clubs, schools and other institutions that require the distribution of either phonograph, radio or microphone programs. The system utilizes a 7-tube, 30-watt amplifier that has provision for two microphones. It also incorporates an automatic record changer and a 9-tube radio set. Monitor speakers are provided for monitoring the program.



ONLY

PRESTO

GIVES YOU THIS



A Glass Base Recording Disc With Two Holes

... A center hole protected by a brass eyelet to insure a snug, concentric fit on the turntable shaft and to prevent chipping when the disc is removed from the table. Unprotected center holes start cracks, cause "wows".

... A second hole for the drive pin that is vitally necessary to drive your cutting mechanism without slippage. Lack of a positive drive causes imperfect grooving, ruined recordings.

These exclusive features together with the extra thickness of the base make the Presto Glass Disc as safe to handle as an ordinary transcription.

Recording Engineers tell us that Presto glass discs give a

better quality of reproduction, less surface noise because of their extra smoothness and rigidity. They are worth trying at your station. Ask your distributor for a sample shipment today.

IMPORTANT NOTICE: If you are using Presto recoated aluminum discs as well as glass discs, ask your distributor for our new thin rubber turntable mat. The thin mat compensates exactly for the difference in thickness of the discs, keeps the adjustment of your cutting mechanism and needle angle correct for both types. You will receive a thin mat without charge with your first order for Presto Glass Discs.

PRESTO
RECORDING CORP.
242 WEST 55th ST. N.Y.

In Other Cities, Phone . . . ATLANTA, Jack. 4372 • BOSTON, Bel. 4510
CHICAGO, Har. 4240 • CLEVELAND, Me. 1565 • DALLAS, 37093 • DENVER,
Ch. 4277 • DETROIT, Univ. 1-0180 • HOLLYWOOD, Hil. 9133 • KANSAS
CITY, Vic. 4631 • MINNEAPOLIS, Atlantic 4216 • MONTREAL, Wel. 4218
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World's Largest Manufacturers of Instantaneous Sound Recording Equipment and Discs

Over the Tape

ATTORNEY AND CONSULTANT

J. Albert Stobbe, recently general manager of Arcturus Radio Tube Co., has announced that he will engage in practice as attorney and consultant for industrial, communications, electronic and management matters. Mr. Stobbe is located at 63 Wall St., New York City.

SYLVANIA ROUND-UP

A manifest spirit of mutual cooperation between management and personnel marked the meeting of the Hygrade Sylvania Corporation officers and executives from Salem and New York who joined with some 250 executives, foremen and supervisors of the Emporium and St. Marys plants at a festive dinner in the Sylvania Cafeteria on May 27th. Members of the Board of Directors in brief talks gave testimony to the success of the efforts of all personnel combined with management in building a radio tube and lamp business in a little over a quarter century from a few hundred units per day to one of over 125,000 radio tubes per day, and 168,000 incandescent and fluorescent lamps per day. Titled "The Sylvania Round-Up," this occasion was the second of its kind held in the company, the first having been held a few weeks ago in Salem, Mass.

PRESTO EQUIPMENT

KGDM, in Stockton, California, has just installed a pair of Presto 63-A transcription turntables, complete in console cabinets. KSFO, in San Francisco, recently purchased a Presto 11-A transcription table in portable case for general purpose use. The table being small and light weight, easily lends itself to portability.

DRY ELECTROLYTIC CONDENSER PATENTS UPHELD

In an exhaustive opinion dated June 19, 1941, in the case of *Samuel Ruben & P. R. Mallory & Co., Inc., v. Ariston Laboratories, Inc.*, Judge Barnes of the United States District Court for the Northern District of Illinois, Eastern Division, upheld the validity of the Ruben patents Nos. 1,710,073 and 1,714,191, covering dry electrolytic condensers, and found that defendant had infringed. The Mallory Company is the exclusive licensee under the patents, with the right to grant sublicenses.

BLAIR-STEINBERG OFFICES

The Blair-Steinberg Sales Co., manufacturers' representatives for the Cornell-Dubilier Electric Corp., David Bogen Co., Inc., University Laboratories, Jackson Electrical Instrument Co., Vaco Products Co., and Atlas Resistor Co., announce the removal of their offices to larger quarters at 395 Broadway, New York City, where they will maintain eastern seaboard stock facilities for the benefit of their distributors.

NEW OHMITE FACTORY

The Ohmite Manufacturing Co., engaged exclusively in the manufacture of quality rheostats, resistors, tap switches, and chokes, has recently completed an addition to the factory on West Flournoy St., Chicago. The enlarged plant, extending the frontage to several hundred feet, doubles the production space and greatly expands the company's facilities to take care of the increased requirements for products in industry and national defense.

SLOAN FELLOWSHIP TO BAHLS

W. Endres Bahls, who is in charge of development and design work in connection with special radio tubes at the Harrison, New Jersey, laboratories of the RCA Manufacturing Co., has been awarded an Alfred P. Sloan Foundation Fellowship for a year of advanced study of industrial problems at Massachusetts Institute of Technology. One of eleven engineers chosen from all U. S. industry to receive the honor, Mr. Bahls will spend one year at the Institute attending the Business and Engineering Administration School.

LEAR BULLETIN

Lear Avia, Inc., Dayton, Ohio, have available an interesting bulletin describing the operation, construction and applications of the Learmatic Navigator. This new instrument is said to supply the aircraft pilot, automatically, with a continuous graphic solution of navigational problems, including instrument approach and landing.

RECORDIT REPRESENTATIVE

Recordit, St. Louis, manufacturers of "Brush-Off," product to remove threads from home recording discs, has appointed National Recording Supply Co., Hollywood, to represent it in seven western states.

EXPORT OFFICES

The Amplifier Co. of America, 17 West 20th St., New York City, announces the opening of their export offices at 36 Pearl Street, under the direction of Mr. R. V. Collins. Mr. J. J. Sloane, former export manager, will now handle all special government defense contracts.

R.C.P. REPRESENTATIVE

Milton Reiner, president of Radio City Products Corporation, 88 Park Place, New York City, announces the appointment of L. M. Bornstein to represent his company's line of radio and electrical test equipment for the territory including Missouri, Kansas, Iowa and Nebraska. Headquarters for this territory will be at 5418 Paseo, Kansas City, Mo.

GENERAL INDUSTRIES BULLETIN

The General Industries Co., Elyria, Ohio, have just issued a catalog illustrating and describing their line of phonograph mechanisms. List prices are given. Copies available from the above organization.

DU MONT SALES OFFICES

For the convenience of dealers and the general public interested in television reception, new sales offices have just been opened in New York City by Allen B. Du Mont Laboratories, Inc., of Passaic, N. J. Previously occupying part of the 42nd floor of 515 Madison Ave., the sales offices are now located in suite 1714 on the 17th floor of the same building, while Du Mont television studios and station W2XWV occupy the entire 42nd floor.

G-E PLASTICS PLANT

During the first week in July the General Electric Company formally placed in operation at Taunton, Massachusetts, its fifth plant for the manufacture of plastic parts. The plant, which will add approximately 25 per cent to G-E plastics pro-

duction and will be the third largest molding plant in the United States, is housed in a structure which has been idle for 20 years and was formerly a motor factory associated with the G-E Lynn Works. Authorized by the company's board of directors on February 28, some presses were actually in production on June 2, and the formal opening of the unit occurred just four months after the authorization.

G-E CATALOG

A new 60-page catalog containing full information on the entire G-E line of insulating materials has been published by the Glyptal and insulating materials sales section of the General Electric appliance and merchandise department, Bridgeport, Conn. Copies will be sent to those having an interest in this subject. The catalog lists prices, and describes hundreds of items, including different varnished cloths, varnishes, Glyptals, tapes, cords, sleeves, varnished tubings, mica materials, wedges, and soldiering materials.

HOWARD CABINET PLANT

Howard Radio Co., 1731 W. Belmont Ave., Chicago, announces the opening of their new cabinet plant under the supervision of Mr. Charles B. Shapiro, executive vice-president. Mr. Shapiro, who has had wide experience in the manufacture of furniture and radio cabinets, was recalled from the Pacific Coast, where he had been in charge of western sales, to organize the new department.

SLEPIAN HONORED

Dr. Joseph Slepian, a self-instructed electrical engineer who 26 years ago exchanged a college teaching career for a factory job, has been elected to the National Academy of Sciences. Despite a thorough education in mathematics, Dr. Slepian had never studied engineering when he resigned from the faculty at Cornell University to become a coil winder in the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Company. Now he is associate director of the Westinghouse Research Laboratories. His election to the Academy, the oldest scientific advisory body of the Government, placed him in the foremost ranks of the Nation's scientists.

BULLETIN ON ELECTRIC DRILLS

"The Fast, Modern Way to Drill," a new bulletin showing the latest U14 type $\frac{1}{4}$ " capacity, small, light, one-hand electric drills, has just been issued by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago. Containing six pages of information and specifications on Thor $\frac{1}{4}$ " portable electric drills for every industrial application, this circular presents the complete range of models, motor sizes, speeds and switch styles.

MACKAY OFFICES

The Marine Division of the Mackay Radio and Telegraph Co. has moved from the International Telephone Building to larger space in the Port Authority Commerce Building at 111 Eighth Ave. In announcing the move, Admiral Luke McNamee, president of Mackay Radio, stated that his company is to supply the radio equipment and service for many of the new vessels under construction for the Government and private operators in the National Defense shipbuilding program and is expanding its facilities at other principal American ports, as well as New York.



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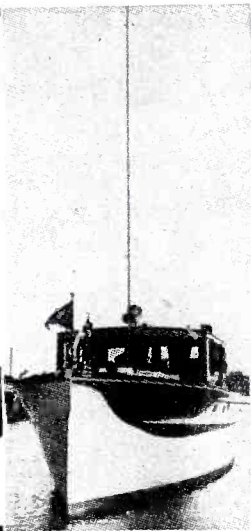
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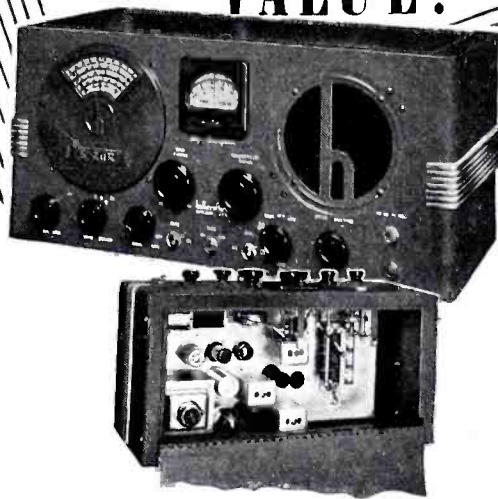
CRYSTALS by HIPOWER

The Hipower Crystal Company, one of America's oldest and largest manufacturers of precision crystal units, is able to offer the broadcaster and manufacturer attractive prices because of their large production and the exclusive Hipower grinding process. Whatever your crystal need may be, Hipower can supply it. Write today for full information.

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The 1941 SKY CHAMPION has all the essentials for good reception; automatic noise limiter, AVC switch, standby switch, inertia bandspread tuning, separate electrical bandspread, beat frequency oscillator, battery-vibrapack, DC operation socket.

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Plug-in CAPACITORS



ELECTROLYTIC, WAX AND OIL-FILLED

- Introduced some time ago as an electrolytic type, Aerovox Plug-in Capacitors are now available also in wax- and oil-impregnated paper types. Thus more than ever before, these plug-ins are the logical choice for aircraft, military, police, sound-system and other equipment where continuity of service is the prime requisite.
- Type 71 is a wax-impregnated wax-filled paper capacitor in aluminum casing with prong base that fits standard octal base. Plated base pins eliminate oxidation and insure low-resistance positive contact with socket and circuit. Octal base guarantees proper insertion in circuit. Single and multiple sections. 200, 400 and 600 v. D.C.W.
- Type 72 is an oil-impregnated oil-filled paper capacitor in aluminum-sprayed tin-plate container, with prong base that fits standard UX socket. Hermetically sealed. Positively leakage and seepage proof. In single and multiple sections. 400 and 600 v. D.C.W.

● Have You a Copy?



Loose-leaf Transmitting Capacitor Catalog available to anyone engaged in commercial radio or electronic work. Write for copy on your business letterhead.

Meanwhile, submit your problems for engineering aid, specs., quotations.



DAVEN APPOINTMENT

The Daven Company, Newark, N. J., announces the appointment of Norman B. Neely Enterprises as West Coast representatives.

KNOOP JOINS DU MONT

Walter A. Knoop has joined Allen B. Du Mont Laboratories, Inc., Passaic, N. J., pioneer manufacturers of cathode-ray tubes, oscillographs, television equipment and allied products, in the capacity of sales engineer. He is assisting Len Cramer who heads the instrument and television transmitter sales.

STACO BULLETIN

The Standard Electrical Products Co., 417 First Ave., N., St. Paul, Minn., has made available a new bulletin which lists seven new staco relays. Descriptions and prices are given. Write for Bulletin No. 641.

CROWLEY EXPANDS PLANT

To keep pace with growing demands for national defense and also new applications for its high-frequency iron cores and custom-built ceramics in industry, Henry L. Crowley & Co., West Orange, N. J., has added a wing to its already extensive plant. For several years past this organization has specialized mainly in high-frequency iron cores. Now the organization is once more stepping up its custom-built ceramic or Crolite production capacity, in keeping with the wider array of applications opened up by its various new formulae.

WEBSTER CHICAGO APPOINTMENT

"Win" Hartford, well known radio sales executive, has been appointed sales manager for Webster-Chicago. Mr. Hartford started his radio sales career as assistant sales manager for the Kellogg Switchboard and Supply Co., later becoming sales manager for Thordarson Electric Mfg. Co.

NEW HALLICRAFTERS PLANT

In order to keep pace with the increasing demand for Hallicrafters communications equipment by both distributors and National Defense, W. J. Halligan, president of The Hallicrafters Co., announces the opening of plant number two. The new plant will be used for fabricating steel chassis.

WESTINGHOUSE BOOKLET

Protective gaps for distribution circuits are described in a new 8-page booklet recently announced by the Westinghouse Electric and Mfg. Co. Application, construction, identification, and ordering information are outlined whereby maximum protection may be obtained by the three-point protection principle on distribution circuits. A cross-section view of protective gaps identifying all the important parts shows the type of construction for all gap styles. Both single and double protective gaps are outlined dimensionally along with an illustration of their position on a transformer. A copy of descriptive data 38-190 may be secured from department 7-N-20, Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa.

LAFAYETTE PROMOTES MAKEN

Radio Wire Television, Inc. (Lafayette Radio), New York City, announces the appointment of Guy Maken as purchasing agent. Mr. Maken has served for some time as assistant purchasing agent and now steps into the post vacated by Ben Miller, who has resigned to join Meissner Mfg. Co.

You and your associates can obtain a year's subscription to **COMMUNICATIONS** (12 issues) for only \$1.00 each by using the Group Subscription Plan.

A regular yearly subscription to **COMMUNICATIONS** costs \$2.00 — but when four or more men sign up at one time, each one is entitled to the half-price rate. (Foreign subscribers on the "G-S-P" only pay \$2.00 each).

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Employed by

Nature of business

(State if Manufacturer, Broadcast Station, etc.)

Product

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(State if Manufacturer, Broadcast Station, etc.)

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(State if Manufacturer, Broadcast Station, etc.)

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Name

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City-State

Occupation or title

Employed by

Nature of business

(State if Manufacturer, Broadcast Station, etc.)

Product

VIBRATION ISOLATION CHART

A large 4-color vibration isolation chart of interest to design engineers has been issued by Lord Manufacturing Co., manufacturers of bonded rubber mountings. This chart shows the percentage of vibration isolation it is possible to obtain in a flexibly mounted assembly with any combination of static deflection and disturbing frequencies. Copies of this chart, which measures 17 x 22 inches, can be obtained by writing to Lord Manufacturing Co., Erie, Pa.

"FORMING ALUMINUM"

"Forming Aluminum" is the title of a new booklet issued by the Aluminum Company of America. This 56-page booklet gives detailed information on available alloys, blanking and piercing, drawn shapes, spun shapes, shape forming, embossing, coining and stamping. Copies available from the above organization. Write to Aluminum Company of America, Pittsburgh, Pa.

AMERICAN PHENOLIC PLANT

The American Phenolic Corporation, fabricators of Amphenol radio and electrical parts and molders of bakelite, polystyrene and other synthetic resins, has acquired a new manufacturing plant to house their connector and socket factory and have further erected an additional building which will be devoted exclusively to the production of polystyrene and other ultra-low-loss insulating materials such as coaxial cables, coil forms, insulators, etc. Mr. Arthur J. Schmitt, president of this corporation, announces that although National Defense orders now represent about 80% of the firm's production, the increased facilities will enable fairly prompt delivery of parts required for ordinary radio production.

CANNON DISTRIBUTORS

Cannon sound plugs will now be available for immediate deliveries in the East, instead of having to wait, as heretofore, for direct factory deliveries from Los Angeles. The Terminal Radio Corp., well-known radio parts jobber in New York, has been appointed distributors of Cannon equipment in New York and will carry a complete stock of Cannon plugs and receptacles. Catalogs of Cannon sound products are also available directly from the Terminal Radio Corp., 68 West 45th St., New York City. An equally well-stocked Terminal radio supply house is located at 80 Cortlandt St., New York.

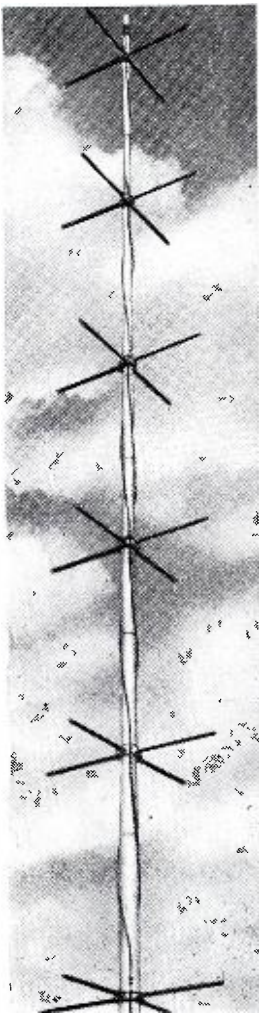
RECOATING RECORDING BLANKS

A false rumor is being circulated among radio stations, advertising agencies and recording studios to the effect that the Government considers it unpatriotic for them to have their aluminum recording blanks recoated—that instead they should turn over their used discs to the Government during the current aluminum collection campaign.

An announcement issued recently by the Office of Civilian Defense states specifically only aluminum "no longer of any use to the consumer" should be asked for.

Instead of attempting to obtain more new aluminum under the terms of their priority rating, the Presto Recording Corp. is recoating discs in some cases 20 or 30 times, thus making more efficient use of the supply of aluminum now owned by the recording industry. In so doing, they actually release more aluminum to the defense industries than would be made available if the used discs were turned in as scrap.

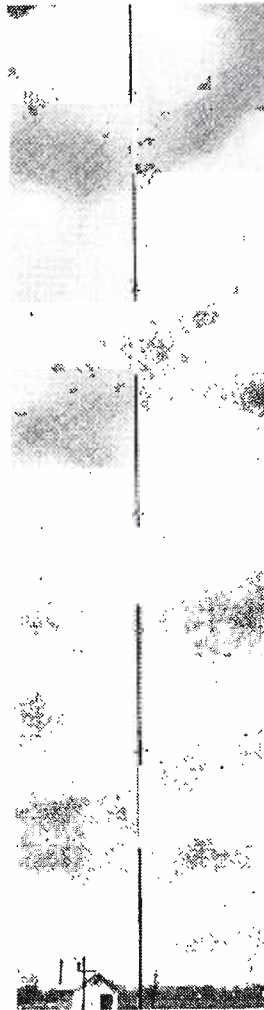
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AM FM RADIATORS

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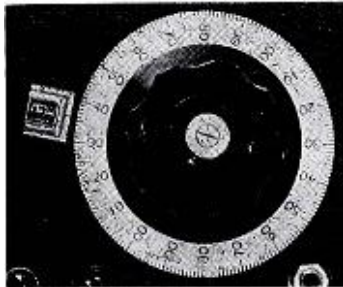


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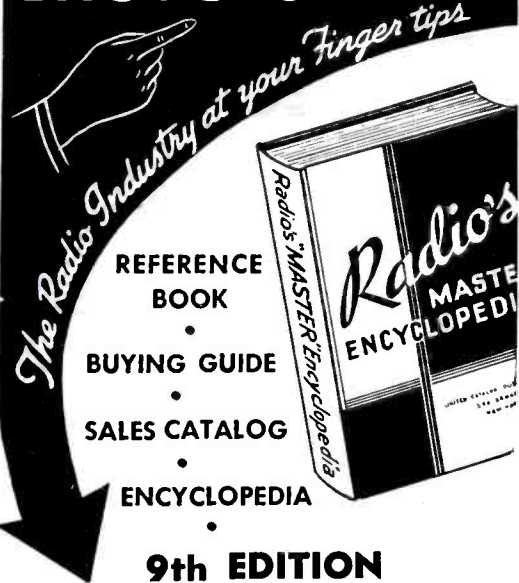
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in the MFM* is typified by the frequency control — a fifty-turn, 4-inch dial with Veeder counter — total range 8,000 divisions, readable to 0.003% in frequency.

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As the official source book of the radio industry it is constantly used by many American and Foreign governmental agencies, also industrial organizations, engineers, purchasing agents, laboratories, radio amateurs and service men, radio distributors, broadcast stations, schools, colleges, libraries, and by many others interested in Radio and allied fields.

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W. E. PERSONNEL CHANGES

Lewis W. Abbott, for the last six years general manager of the Western Electric Company's installation department, retired June 30 after more than two score years of service with the Bell System. Gustaf A. Johnson, formerly the Company's personnel director, succeeds Mr. Abbott in directing the nationwide field force now engaged in installing telephone equipment in Bell System central offices expanding to meet the mounting communications needs of the preparedness program, as well as in scores of military, naval and other defense establishments.

NEW CLARE PLANT

C. P. Clare & Co., manufacturers of multiple contact relays, keys, switches and associated electro-mechanical apparatus, now occupies a new daylight plant located at Sunnyside and Keating Avenues, Chicago. This new building affords an approximate increase of 300 per cent in floor space and is the company's second expansion in four years.

FEDERAL TELEGRAPH BULLETIN

The Federal Telegraph Co., 200 Mt. Pleasant Ave., Newark, N. J., have issued a price list on their line of transmitting and rectifying tubes. Copies available on request.

• • •

PLASTICS

(continued from page 16)

production of ammonia quickly. And ammonia is quite the important element in the manufacturing of many types of gunpowder. Thus both members of the formaldehyde group find themselves in difficulties. The acrylic plastics also use methanol as a base. Cotton linters and nitric acid, which go towards the production of cellulose nitrates, are used to make explosives, and so we have another shortage problem here, too.

However, there is a bit of a bright side to this picture, in that there remain some dozen types of plastic substances that use materials that are readily available. The only drawback here is that molds, which are made of nickel steel, are difficult to get, although that problem is being ironed out by authorities in associated metal fields in consultation with OPM, the thought being that the release of a moderate amount of this metal for moulds, will eventually re-

lease many extra pounds of a variety of important metals needed for defense.

A shortage of skilled workmen and molding presses, contributed two more of the difficulties that were run into, with the race to plastics. This, of course, is a problem that only time can seem to solve. Production has increased tremendously in the manufacture of presses, and countless schools have been set up to yield mold makers. It is, of course, important to remember that the production of plastics is a highly technical procedure and too much rush will completely destroy any anticipated improvement in production.

In the jump to plastics, it was readily realized, of course, that only in non-conductive portions of the equipment would it be of use, notwithstanding the possibilities of spraying the plastic bases with scrap metal paint. In either instance, certain forms of plastics are acceptable. All plastics fall into four general fields. These are: cellulose plastics, protein plastics, natural resin plastics and synthetic resin plastics. There is, then, another division of these plastics in types; that is, thermoplastic and thermosetting. The thermoplastic materials soften upon being heated and become solid again when cooled. This process can be repeated over and over again. The thermosetting plastics, on the other hand, are compounds, which alter their chemical constitution with definity, in the course of molding, under heat or pressure of both. Nitrocellulose plastic, invented by John Wesley Hyatt, in 1869 is an example of the thermoplastic class, while the phenol-formaldehyde plastic, developed by Dr. Leo Baekeland in 1907, is an example of a thermosetting plastic. The cellulose plastics use cotton linters and are treated with nitric or sulphuric acid; then camphor, alcohol and color are added, and the result is a dough-like substance that can be rolled, baked, seasoned and polished into sheets, rods, tubes, etc. Protein plastics were originally made of sour milk and formaldehyde, a form of alcohol coming basically from coal, air and water. Now, milk has

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been replaced by soy beans, lignin, coffee beans and even peanuts. Shellac was the first natural resin used in plastics, playing a major role in the development of the phonograph. In the last class, we find synthetic resin plastics or the phenol resins used in phenol-formaldehyde.

The soybean plastic appears destined to become a possible salvation for those who chose and still choose plastics as the "gap" in the present problem. Probably the most prolific user of the soybean has been Henry Ford. At his plant a plastic consisting of 70% cellulose fiber and 30% soybean resin binder has been developed. The cellulose portion of this plastic contains 50% southern slash pine, 30% straw, 10% hemp and 10% ramie. This latter material is, oddly enough, an Egyptian plant, which thrives in many parts of America. Intriguing about this process is that wheat and corn may be substituted for soybeans, thus taking care of some of our difficult surpluses. According to tests made at the Ford plant, sheets of this soybean plastic will absorb a blow ten times as great as steel without denting. The tensile strength of the soybean plastic now is about one-half that of steel. However, there is great strength in the fibres of the ramie plant, a greater percentage of which can be added to the soybean plastic for additional strength.

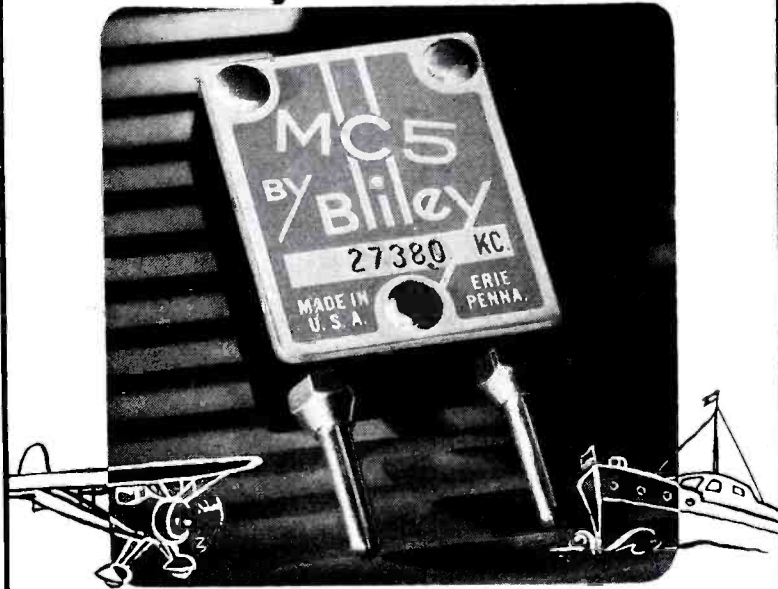
Dependent upon the material used and the product desired, either of two methods of molding are used. One is the compression method and the other is the injection method. The most practical type of compression molding machine usually is a hydraulic press, which exerts an even pressure, and closes as the molding granules or slabs are reduced to the required plasticity. While a pressure of 500 pounds per square inch is sufficient for compression molding purposes, the use of higher pressures to 3,000 pounds and more results in a quicker cycle with increased production. Accordingly, the higher pressures are generally recommended. Molds are heated generally by steam under 150 pounds pressure, with temperature carefully regulated to the level indicated by a preliminary test.

Injection molding offers a speedier process of molding than compression. In this method, the plastic material is heated outside the mold itself. Then the proper amount of softened material is forced into the mold chamber. The mold, being cool, permits the material to harden, after which the finished piece is automatically ejected. Sometimes, injection machines have multiple molds, allowing the forming of more than one article on each injection.

The use of plastics in radio has been

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Biley Crystals



Positive, dependable frequency control for radio transmitters in marine-craft (ship harbor service) and in itinerant aircraft (3105kc. and 6210kc.) is economically obtained with the type MC5 Crystal Unit. This unit, low in cost yet precision-built, is made possible by the application of quantity production methods to an essentially custom manufactured product. WRITE FOR CATALOG G-12

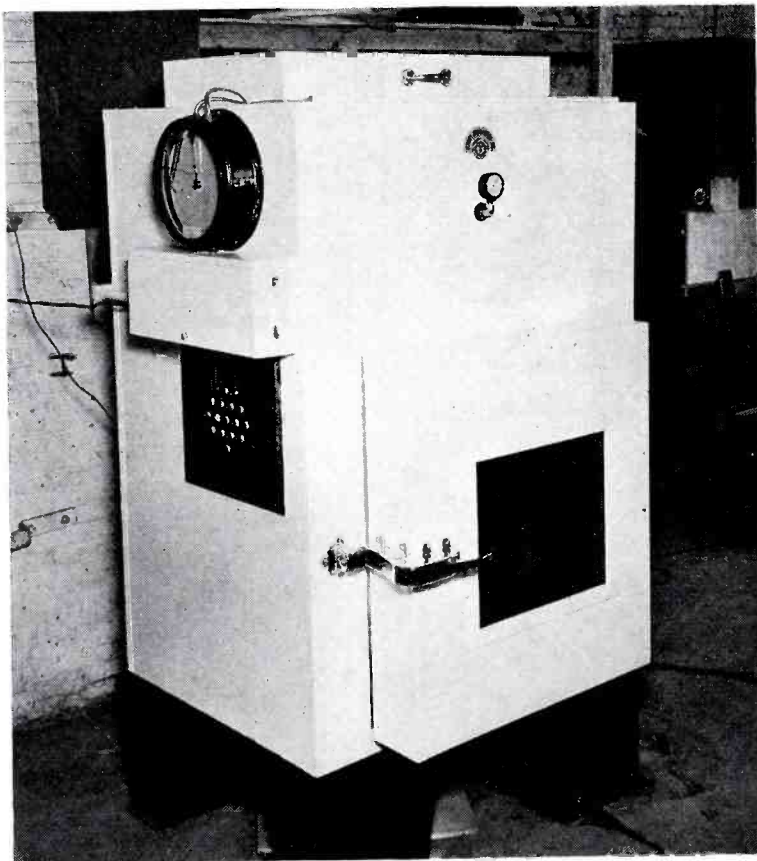
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practically restricted to cabinets. Recently, plastic tubes were designed to house electrolytic condensers. As insulation for wire, it has also been widely accepted, in addition to many other insulating portions of receivers and transmitters. But, as an out-and-out substitute for metal, it has not as yet gained acceptance, and for many reasons, as we have pointed out. And it must be remembered, too, that the annual production of plastics of all kinds has been estimated at about 100,000 tons, which is quite feeble alongside the production of metals it is being asked to take the place of. However, according to many specialists, it is entirely possible that within the next nine months not only will the plastic production increase tremendously, but in a variety of metallic forms that may yet redeem the original hopes of many, when the metals began to walk away from home.

COMMENT

(Continued from page 1)

way to decrease the likelihood of power shut-offs.

Other protective measures fostered by the DCB include procurement of replacement parts, especially tubes, duplicate pumping and tube-cooling facilities, reduction in the vulnerability of antenna installations, standby transmitters, and alternative links between studios and transmitters if the two are geographically separated.

Concerning the supernetwork, reports to the board indicate that the 45,000 miles of program transmission circuits now in existence provide alternate routes to all but 2 of the 310 cities now served. Alternative power supplies for these program transmissions are provided by adequate storage battery reserves in 4000 relay centers, by two or more independent public power supplies in 800 centers, and by stationary engine-driven generators at 50 centers now, with 350 more on order. To provide for emergencies, 200 small and 25 large portable engine-driven generators are available at key points throughout the country.

AMPLIFIER

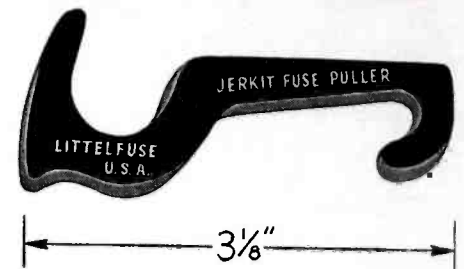
(Continued from page 12)

potential and care should be exercised to avoid grounding any part of the system. The filament transformer for the amplifier is mounted above the amplifier chassis and—arranged so that it may be rotated for a hum node position and then permanently fastened on its bracket. The current plate current for the amplifier is ten milliamperes, the filament drain, 0.9 amperes.

The duraluminum front panel has a

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black alumilite finish with suitable engraving. The chassis, and components are standard units obtainable through your radio dealer. The cabinets were made to order and are of 3/8-inch plywood construction covered with leatherette material. Split hinges on the cover of cabinet enable their removal during operation. The amplifier is fastened to the cabinet by 6-32 knurled head screws in each corner. Sections of 3/8-inch square dural rod are fastened to the inside corners of cabinet and the ends drilled and tapped to engage the knurl headed screws.

It is a matter of seconds to remove the unit for tube replacement or servicing. The open chassis type of construction employed will bring joy to the man who does the maintenance and repair.

For those desirous of constructing a similar amplifier, the following dimensions and suggestions may be helpful.

The panel is of #10 gauge duraluminum, 7 1/2 x 14 3/4. An alumilite finish can be applied by a concern having the agency for the process in your city. The panel is first drilled and machined to accommodate the 3-inch illuminated volume-indicator meter, fader pads, gain potentiometer, power switch, line posts and monitoring jack. Care should be exercised to avoid scratching panel as it may show when the finish is applied.

The gain potentiometer and the faders

are of the sliding contact type and have removable covers to facilitate cleaning. The chassis is a standard 7" x 12" x 3" cadmium plated steel unit. Front of panel is drilled together with front panel. Rear of chassis is drilled for microphone, a-c line, and external power unit receptacles, as well as for the closed circuit jacks and line fuse.

The physical arrangement of the tubes and transformers permits short wiring leads between amplifier stages. The wiring from, microphone receptacles to faders and faders to input transformer is done with shielded wire and held in place along the chassis by soldering it every few inches. The wiring to the gain control potentiometer is also shielded. The input transformer is a well shielded high-fidelity unit.

The precautions in the input circuit are well worth while and minimize any opportunity for stray hum pickup. The resistors and condensers used in each stage are grouped together and held in place on the chassis by a resistor mounting strip secured vertically near its associated tube. A number of different output transformers were tried using both series and parallel feed to the plate. A 2 db pad is used between the output transformer and line permitting both to face a resistive load.

All resistors used are of one-half watt rating metallized type. All paper condensers are of 400-volt type and electrolytics rated for 450 volts with the exception of the cathode by-pass condensers which are of 50-volt rating. The filter chokes are well known as a-c/d-c chokes and always seem to be on sale at some ridiculously low price. The filament transformer is a compact 6.3-volt 1-ampere unit which is secured in a tube shield can and arranged for single-hole mounting on an improvised angle. The external power unit uses an 80 tube in a full-wave rectifier with another pair of bargain filter chokes together with a dual 8 tubular electrolytic as the filter system. The power transformer specifications are: plate winding, 650 volts with center tap, about 40 milliamperes. Filament windings, 50-volts 2 amperes for rectifier and 6.3 volts 2 amperes for amplifier.

A small improvised chassis mounts the complete supply which is fastened inside of the microphone and cable box. A removable shield encloses and protects the unit from damage. Connections are made to a 4-prong receptacle mounted alongside the a-c line socket in the cabinet. In ordering the cabinet for the amplifier, it is well to leave the amplifier with the luggage store man to insure a proper fitting. The case for the mikes and cables has the same dimensions as the amplifier box but without the rear cutout for microphone and power receptacles.

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*Quotations on other frequency ranges supplied on request.

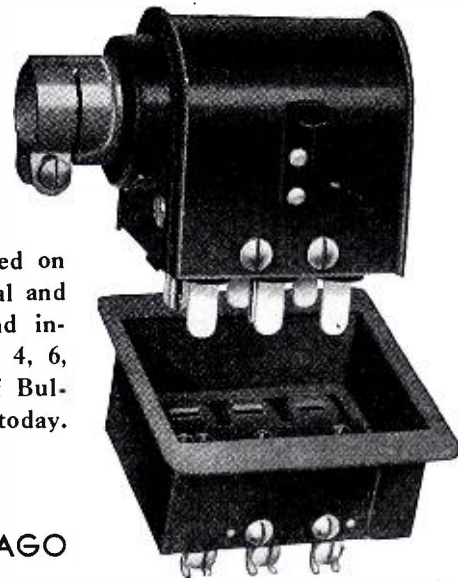
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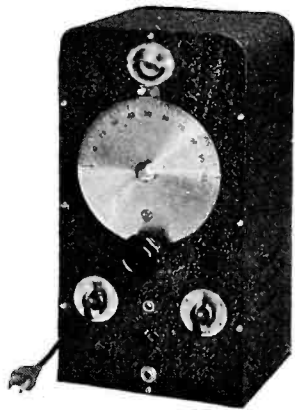
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CRYSTALS

(continued from page 10)

trodes of welding machines. Standard crystal elements mounted against the vibrating body or surface under strain have been used in these cases. In measurement of strains in propellers, the crystal element is made especially thin so as not to disturb the aero dynamic properties of the blade.

Still other applications include recording dynamic strains in structural members, machinery, recording the smoothness of finished surfaces, and in the medical field for electrocardiographic and electroencephalographic studies (where the instrument is used for the recording of heart beats and brain waves).

In the direct inking oscillograph, the crystal element drives a pen of low inertia and high stiffness which traces an inked record on a moving paper chart. The deflections of the pen are directly proportional to the electrical potentials applied across the crystal element. Two

types of pens are normally available: one responding to frequencies up to 60 c-p-s, the other up to 120 c-p-s. A thermostatically-controlled heater provides stabilization.

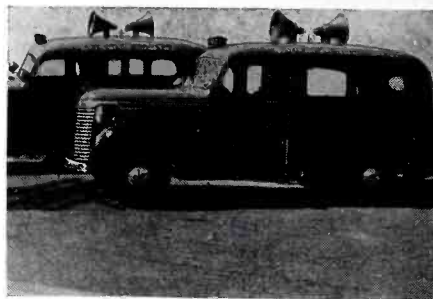
Surface Analyzer

The surface analyzer is in use at present in many of the plants manufacturing aircraft and automobile engines, machinery, motion-picture film, glass, watch parts, etc. It records the irregularities in finely finished surfaces to less than one-millionth of an inch. The surface under test is traced with a fine diamond point which actuates a crystal element, the generated voltage of which is magnified by an amplifier and then recorded on the moving chart of the direct inking oscillograph.

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Crystal pickups have been made available for a number of applications in the industrial and medical field. Some of these are the vibration pickups, pressure pickups, watch tick pickup, water leak detectors, heart beat pickups, etc.

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quently, large amplitudes cannot damage the pickup.

Pressure Pickups have been designed for measuring fluctuating fluid pressures usually under conditions where the maximum pressures at any time will not exceed 5000 lbs. per square inch. In these pickups, a stainless steel diaphragm is used to operate a crystal element. This pickup has been found very useful for checking the performance of compressors, gas pressure in guns, and pipe lines, performance of internal combustion and steam engines, etc.

Watch tick pickups have been used for accurately adjusting watches and clocks, etc., for actual positions of use. Ordinarily these pickups are incorporated as part of watch tick recorders.

Water leak detectors utilizing crystal elements have been successfully used for detecting underground leaks in water mains by exploration of the affected areas. Earphones are normally associated with these detectors for listening, and with little practice the noises created by the escaping water can be easily located.

Heart beat pickups employing crystal elements (sometimes referred to as electrical stethoscopes) are used for listening or recording heart pulsations. In the latter case, the instrument may be used with the direct inking oscillograph which produces a graphic record.

Galvanometers

Crystal reflecting type galvanometers have been employed for sound-on-film recording, electrocardiographic studies, vibration recording or analysis. In this instrument, a crystal element actuates a small mirror which reflects a light beam to a sensitized film.

Business Machines

Crystal elements have been employed in inter-office communicating systems, voice powered telephone systems, paging systems, and in dictating machines where they have considerably improved quality and articulation over the older acoustic type machines. Here the crystal elements are employed for both recording on, and transcribing from, wax cylinders or nitrocellulose discs, as well as in the associated microphone.

FILTER

(continued from page 14)

frequencies, f/f_{c1} in the case of the low-pass filter and f_{c2}/f in the case of the high-pass filter. The ordinate is plotted in terms of the ratio of characteristic impedance to R_0 , where R_0 is the characteristic impedance at zero frequency in the case of low-pass filters and at infinite frequency in the case of high-pass filters. The characteristic impedance is

a pure resistance as long as the frequency ratio is less than unity and above unity changes to a pure reactance. The curves of Fig. 2 are drawn in solid lines to the left of the unity frequency ratio and as broken lines to the right of the unity frequency ratio. The left-hand ordinates are to be used with the solid line curves and the right-hand ordinates, with the correct sign, are to be used with the broken line curves.

Attenuation and phase shift characteristics are given in Fig. 3. It must be borne in mind that these data assume that the filter is always terminated in its characteristic impedance, Z_0 , rather than in R_0 .

The elements for the m-derived filter sections shown in Fig. 1 have been computed for $m = 0.6$ and the characteristic curves for the m-derived filters are those for $m = 0.6$. This value of m gives a more constant input impedance throughout the pass band as indicated by curves 3 and 4 in Fig. 2. As contrasted with the m-derived sections the prototype sections, when terminated by a fixed value, have input impedances which vary over a wide range, and in general the input impedance may be something other than a pure resistance.

The chart is a plot of the relations,

$$R_0 = 2\pi f_c L \dots\dots\dots (1)$$

$$R_0 = \frac{1}{2\pi f_c C} \dots\dots\dots (2)$$

and can therefore be used to obtain the absolute value of reactances for condensers or inductances at any operating frequency. Whenever necessary, scales on the chart may be extended preferably by multiplying by some power of 10. If scale extension is employed, equations 1 and 2 may be used to determine the proper multiplying factors.

Another application for the chart is in designing the coupling circuits in wide-band television amplifiers.¹

¹Harold A. Wheeler, "Wide-Band Amplifiers for Television," *Proc. of I. R. E.*, Vol. 27, pp. 429-438, July (1939).

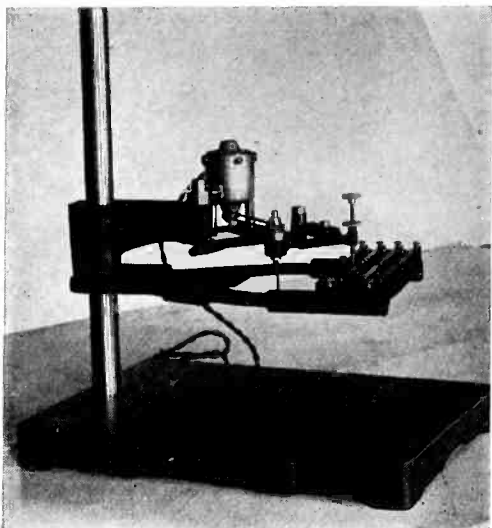
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APCO

(continued from page 7)

profit. At the 1940 APCO Conference it was generally agreed that police and fire departments, being supported by public taxation and absolutely essential for the protection of our citizenry should not be forced to spend thousands of dollars of public funds to obtain facilities generally considered to be in the public domain. Further action on this matter will undoubtedly constitute one of the most important points in the Conference agenda.

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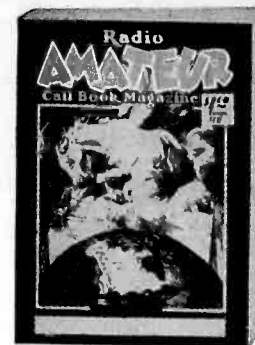
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FORMS CLOSE SEPT. 10

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GENERAL RADIO COMPANY has refrained from advertising its contribution to the arming of the Country through supplying equipment for the Armed Forces for National Defense. We have accepted the added strain upon our manufacturing facilities as a patriotic duty to the country in which we plan and propose to be doing business for countless years to come; and we have felt little inclination to burden the readers of **COMMUNICATIONS** with an account of the magnitude of our Defense business.

As manufacturers go, General Radio is a small organization. In normal times we have been able to produce instruments in sufficient quantity to take care of the requirements of Industry. In these emergency times, the volume of orders received from the Government plus the priority orders from subcontractors has sorely taxed our facilities. We have expanded in personnel and output to the limit of our physical structure.

As a result, without a priority preference rating it is sometimes difficult for us to fill orders, even for stock catalog items. How long this condition will continue, no one knows.

We ask the forbearance of our thousands of long-time friends. We assure them that our engineering staff is intact and busier than ever in developing devices and techniques for National Defense projects, which will benefit users of General Radio instruments in the future. Many new instruments have been brought up to the point of manufacture. New instruments will be developed constantly. At the very first sign of return to normal times these instruments will be available in quantity, immediately.

We do propose, however in future advertisements in this magazine to do a thing we have been wanting to do for a long time . . . we propose to take you into General Radio's plant as far as Government regulations will allow . . . to describe a number of unique methods of design, manufacture and calibration which, we believe, contribute in no small measure to our long-standing position in the instrumentation field.

We shall try to make these advertisements of sufficient value to hold your interest. We will welcome your comments.

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