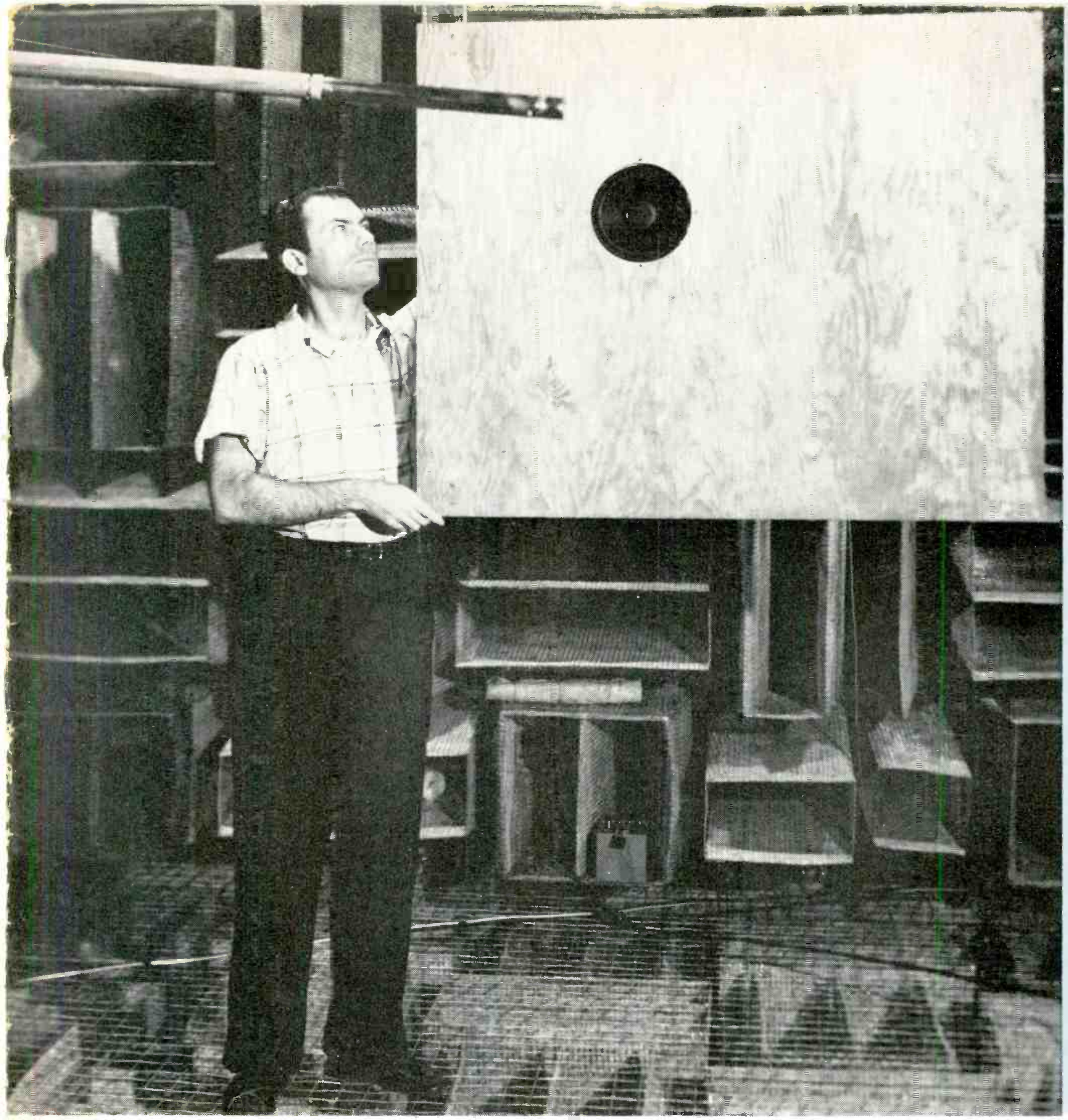

TECHNICIAN ENGINEER

NOVEMBER, 1961

Published for the Employees of the Broadcasting, Recording and Related Industries

INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS — AFL-CIO

LANDMARKS OF LABOR No. 29

ESTABLISHMENT OF THE BUILDING & CONSTRUCTION TRADES DEPARTMENT-AFL

On March 20, 1908 a formal charter was issued by the American Federation of Labor to seven building trades officials, the first board of the newly established Building Trades (later Building & Construction) Department. The seven charter officers were James Kirby, Carpenters; William J. Spencer, Plumbers; George F. Hedrick, Painters; James G. Hannahan, Steam Engineers; Frank M. Ryan, Iron Workers; William J. McSorley, Lathers; and Charles H. Leps, Tile Layers.

The Department had been suggested in 1888 by President Samuel Gompers at the St. Louis AFL convention. The Structural Building Trades Alliance was formed in 1903 and laid emphasis on national unions. The AFL, in its early days, feared that the building trades would dominate, but in 1907 the Federation took action leading toward chartering.

The founding convention was held in February, 1908 at Norfolk, Va., and the Department was formally chartered a month later. The building trades have played a strong role in the trade union movement for more than half a century and have done much to strengthen the sinews of unionism. The chartering of the Department 50 years ago was an important landmark of labor — one of the most important of this century.

Reprinted with permission from THE LABORER, official publication of the International Hod Carriers', Building and Common Laborers' Union of America.

The INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS
GORDON M. FREEMAN International President
JOSEPH D. KEENAN International Secretary
JEREMIAH P. SULLIVAN International Treasurer

TECHNICIAN ENGINEER

VOL. 10, NO. 10
ALBERT O. HARDY, Editor

in this issue

the cover

Walter Koidan, physicist in charge of National Bureau of Standards microphone calibration facilities, adjusts a baffle for a loudspeaker test. The sound radiated by the loudspeaker-baffle combination is measured by a microphone located 1 meter in front of the speaker cone. The Bureau's anechoic room, which can be seen in the background, essentially eliminates sound reflections from the walls. *(See story on Page 4.)*

index

For the benefit of local unions needing such information in negotiations and planning, here are the latest figures for the cost-of-living index, compared with 1960 figures: September, 1960—127.1; September, 1961—128.3.

COMMENTARY

I am sure that many of you who try to get a case processed by the National Labor Relations Board feel that our rear wheels are off. And some who represent respondents may be glad that they are. You may all rest assured that we on the Labor Board are equally concerned about the state of our rear wheels; about our seeming inability to keep abreast of our lengthening calendar of cases. We are especially concerned about giving prompt and effective relief because of the perishable nature of our clients' problems.

* * *

The serious delays in proceedings before the Labor Board are too well known to require documentation here. Before the House investigating committee headed by Congressman Pucinski, before the Government Operations and Appropriations Committees of both House and Senate and in the report of the Cox Panel, the delay skeletons in our closet have been thoroughly exposed, if not vigorously rattled.

The Cox report concludes, "These shocking delays seriously affect the usefulness of the National Labor Relations Act." And we in the Board have said equally tough things about the situation.

* * *

We are now studying various ways of taking the profits out of unfair labor practices, whether committed by employers or unions. One suggested remedy for use when an employer destroys the majority status of a union by illegal techniques during an organization drive is to restore the prior situation as fully as possible and to saddle the employer with the union for a twelve-month period during which he must recognize and bargain with it. Should the employer refuse to bargain "in good faith," it has been suggested that the Board seek injunctive relief in the Courts (pursuant to 10(j) of our statute) and request that the employer be required to demonstrate good faith by embodying existing conditions in a written document and, additionally, to make reasonable counter-proposals to reasonable union demands.

—From a speech by Frank W. McCulloch, Chairman, NLRB at the Federal Bar Association Annual Convention, 1961.

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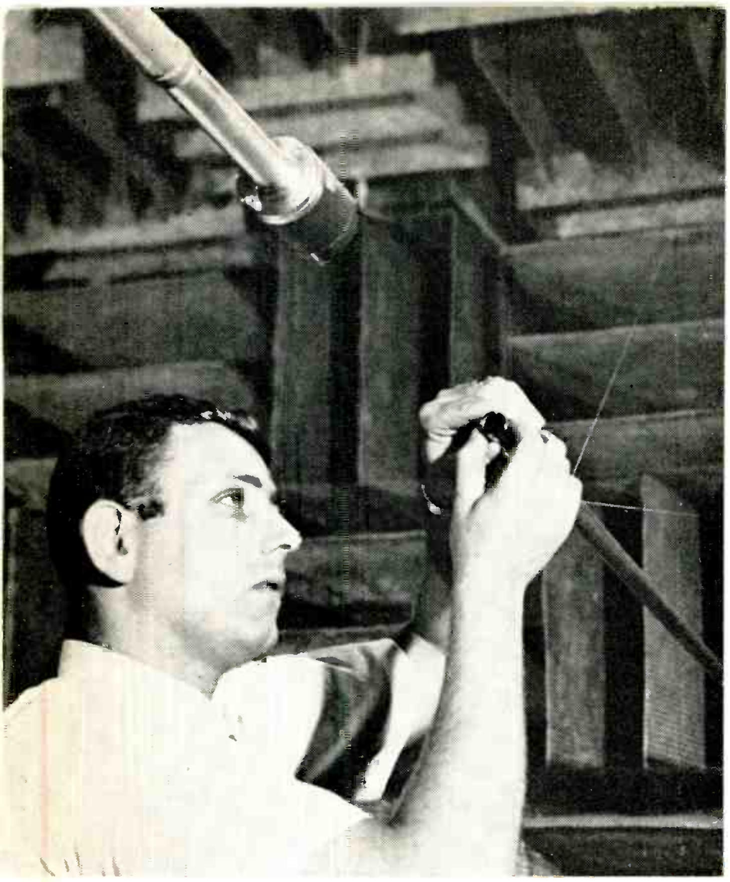
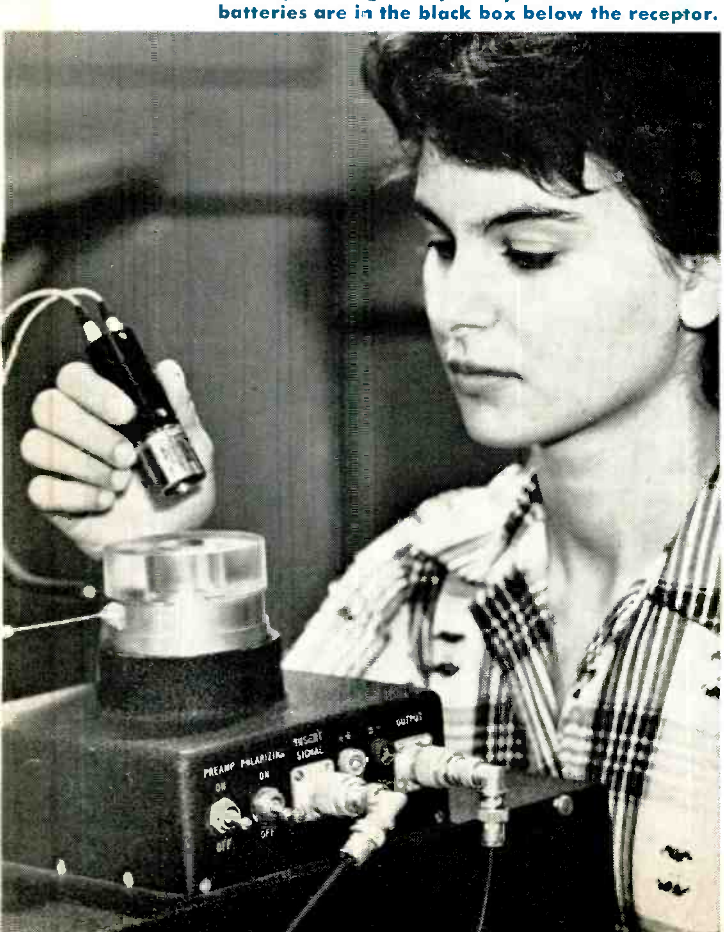


ABOVE: David S. Siegel, National Bureau of Standards physicist, connects a primary standard condenser microphone to a preamplifier in preparation for free-field reciprocity measurements. A dynamic microphone serves as the sound source. This work is done in the Bureau's anechoic room, which provides an environment essentially free from echoes.

BELOW: Kathaleen A. Puzzini, of the National Bureau of Standards, inserts a source microphone into a 20 cc coupler used for pressure calibration. The receptor microphone, not visible, is located in the base of the cavity housing. The preamplifier and associated batteries are in the black box below the receptor.



How National Bureau of Standards Researchers

CALIBRATE MICROPHONES

CALIBRATED microphones, which are finding increasing usefulness in both defense and non-defense applications, are required for the measurement of sound radiated by loudspeakers, for audiometric measurements, and for the measurement of noises and other complex sounds. These uses are in addition to well-known applications connected with the recording and broadcasting of speech and music.

Secondary standard microphones, which are used to calibrate other microphones and sound-measuring instruments, are calibrated against a set of primary standards in the Sound Laboratory of the National Bureau of Standards.

Measurement of high sound pressure levels has recently become particularly important because of the noise created by rockets, aircraft jet engines and jet engine test cells. For best accuracy, sound pressure produced by such devices should be measured with microphones which have been calibrated at high intensity sound levels.

Current research at the Bureau is aimed at extension of the range of microphone calibration to infrasonic and ultrasonic frequencies; the extension of the amplitude range to higher pressure sound levels; and increased accuracy and precision of operation.

Direct measurement of sound is difficult. However, sound measurement is feasible because microphones can change sound energy into electrical energy, which is more easily measurable. Usually the electrical signal is generated with the aid of a microphone diaphragm or ribbon, which responds to pressure or particle velocity, respectively.

Among the many kinds of microphones available commercially, the type most often used as a standard is the electrostatic, or condenser microphone. This device consists of a very thin diaphragm, which is the movable element, and a backplate placed at a small distance behind the diaphragm. The sound field impinging upon the diaphragm causes it to move, resulting in a change in capacitance between diaphragm and backplate. The capacitance change is detected by suitable instrumentation (Figure 1).

Calibrating a microphone is the process of measuring the "sensitivity" or "response." The response (M) is the ratio of the voltage (E) produced by the microphone across a given load to the sound pressure (P), (Response is thus M=E/P.) Therefore, when the response is known, measurement of the voltage is all that is needed to determine the pressure. Calibration is done over a wide range of discrete frequencies.

The response is usually expressed in terms of the voltage appearing at the microphone terminals under open-circuit conditions. Moreover, a calibrating voltage arrangement (Figure 1) permits one to measure the open-circuit voltage even though the microphone is terminated in the finite impedance of the amplifier.

The method for doing this is called the "substitution technique" and is performed as follows:

The microphone is first exposed to a sound field, and the resulting electrical output noted. Then the sound field is removed, and a calibrating voltage is inserted in series with the microphone. The magnitude of the calibrating voltage is adjusted until the same output voltage is obtained. Under this condition, the open circuit voltage of the microphone equals the calibrating voltage.

The Bureau performs two type of calibrations called the pressure calibration and the free-field calibration.

PRESSURE CALIBRATION

The pressure response of a microphone M_p is defined in American Standards as the ratio E/P, where E is the open-circuit voltage and P is the sound pressure applied uniformly over the surface of the diaphragm.

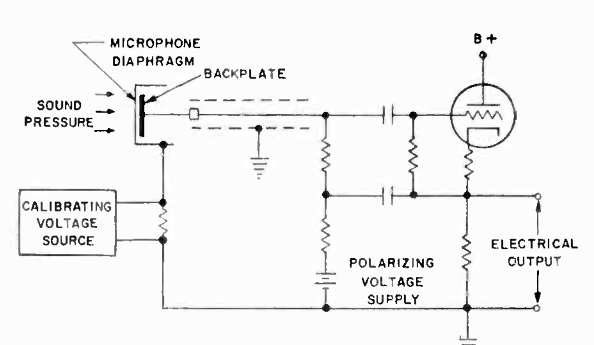


FIGURE 1

Circuit diagram of cathode-follower preamplifier connected to a condenser microphone. The National Bureau of Standards uses the calibrating-voltage arrangement shown here to permit measurement of the open-circuit voltage of the microphone generated by response to a sound pressure.

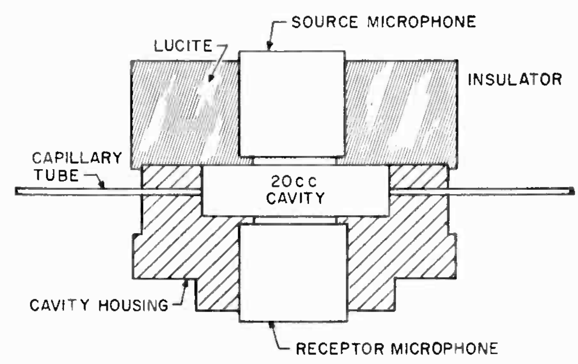


FIGURE 2

Simplified drawing of a 20 cc coupler used at the National Bureau of Standards for primary and secondary pressure calibrations of condenser microphones from 10 to 10,000 cps.

Pressure calibrations are performed on condenser microphones only; the response is usually expressed as 20 $\log_{10}$ (E/P) decibels relative to one volt per microbar.

The Bureau maintains a set of primary standard condenser microphones. Primary calibration of these units is carried out periodically by the reciprocity technique which permits one to obtain the response of a microphone from absolute measurements of length, barometric pressure, and electrical impedance, combined with measurements of several voltage ratios. Two microphones and an auxiliary sound source are required. One of the microphones must be reversible (able to operate as a sound source or receptor.) The sound source may be a third microphone.

In the experimental procedure, the sound source and receptor are coupled acoustically by means of a cavity (Figure 2), in which the microphone diaphragms make up part of the cavity enclosure. The receiver microphone is placed in the lower wall of the cavity and the sound source in the upper wall. At each frequency, a voltage is applied to the sound source which generates a sound pressure within the cavity. The receiver detects the sound and generates a voltage which is measured with the aid of the calibrating voltage arrangement (Figure 1).

In practice, it is not necessary to determine the sound pressure or the individual voltages. Only the ratio of the driving voltage (or current) to the open-circuit voltage of the receiver microphone must be measured. However, the volume of the cavity and the barometric pressure must be known, since the product of the responses is expressed in terms of these quantities in addition to a current-to-voltage ratio.

The Bureau calibrates secondary standard microphones submitted by other governmental agencies and private organizations by a comparison method in the same coupler used for primary calibration (Figure 2). A stable microphone in the upper wall of the coupler is used as the sound source. A primary standard microphone is first placed in the lower wall, and the ratio of the driving voltage to the open-circuit receiver voltage is measured as a function of frequency.

This procedure is then repeated with the test microphone substituted for the primary standard. The response of the test microphone is calculated from the known response of the primary standard and the voltage ratios. Another independent set of measurements is made to compare the test microphone with a different primary standard, and the average of the two sets is reported to the nearest 0.1 decibel in a test report. The standard deviation derived from an analysis of many pressure calibrations made over a period of several years is 0.06 decibel.

Coupler reciprocity calibration is performed at NBS approximately every six months on two standard microphones. By using both of these microphones to perform secondary calibrations, possible errors in a secondary calibration caused by a microphone-response drift with time are virtually eliminated.

Calibrations are performed in the coupler (Figure 2) at discrete frequencies from 50 cycles per second (cps) to 10 kilocycles per second (kc/sec). In the lower frequency range, the cavity dimensions are small compared to a wavelength and uniformity of sound pressure throughout the cavity is assured. But at frequencies above 3 kc/sec, this condition no longer holds when air is the coupling medium. However, use of hydrogen in the cavity increases the wavelength at each frequency by a factor of about 3.8; and in this way accurate calibrations can be made as high as 10 kc/sec. The capillary tubes permit the introduction of hydrogen and also serve to maintain barometric pressure within the cavity.

FREE-FIELD CALIBRATION

A free field is one in which the effects of boundaries are negligible over the region of interest. The actual pressure at a point on the diaphragm of a microphone placed in an otherwise free sound field will differ from the pressure which would exist at that point in the field with the microphone removed.

The free-field response of a microphone, M_f, is defined in American Standards as the ratio E/P_f, where E is the open circuit voltage and P_f is the sound pressure which existed at the microphone's location prior to the insertion of the microphone into the sound field. The free-field response is expressed as $20 \log_{10} (E/P_f)$ decibels relative to one volt per microbar, and is defined for a plane, progressive sound wave whose direction of propagation has a specified orientation with respect to the microphone.

A knowledge of the free-field response permits one to ascertain the sound pressure in a free field when the microphone is absent, although, of course, the microphone must be used to take the measurement.

The free-field response of a microphone depends upon all characteristics which determine the pressure response. In addition it is affected by the geometric shape of the microphone and supporting structures, since reflections from obstacles affect the sound pressure which actually exists at the diaphragm. Therefore, once a standard-shaped microphone and supporting device are specified, the difference between the free-field response and pressure response is also standardized.

This difference, called the "diffraction correction," is a function of both frequency and orientation of the microphone with respect to the sound wave. If the diffraction correction and pressure response are known, the free-field response can be calculated by simply adding the diffraction correction to the pressure response.

Free-field measurements are usually more time-consuming and less accurate than couple measurements, so that standardization of microphones and supporting mechanisms is of great value.

Secondary free-field calibration can be performed by the Bureau in its anechoic chamber on many types of microphones over a frequency range of 50 cps to 15 kc/sec. Microphones submitted by other Government agencies or private organizations for use as secondary standards are calibrated at normal or grazing incidence by comparison with the Bureau's primary standard condenser microphones.

The sound source used to excite the test microphone and primary standard is usually a stable loudspeaker. The standard microphone is first placed at such a distance from the sound source that it is operating essentially in the plane-wave region of the speaker' radiated field. Voltage-ratio measurements similar to those made in pressure calibrations are taken as a function of frequency. The standard is then removed, the test microphone placed in the same position, and voltage-ratio measurements again taken at each frequency.

The response of the test microphone is calculated from the voltage ratios and the known free-field response of the standard. As in pressure calibrations, another set of measurements is taken, usually with a different standard, and the two sets averaged to obtain the final results. The standard deviation, calculated from many free-field calibrations, is 0.17 decibel.

The Bureau is presently engaged in performing primary reciprocity calibrations on standard microphones in the anechoic chamber in order to obtain diffraction corrections at frequencies as high as 20 kc/sec for a new preamplifier shape under consideration by the American Standards Association. This work is being done in conjunction with other acoustical laboratories in the United States.

NLRB Clears Chattanooga IBEW Local

Local 662 Vindicated in Picketing and Handbilling Case

IN a precedent-setting decision, the full NLRB considered the unfair labor practice charges arising from a strike at WOGA, Chattanooga, Tenn., and found that Local Union 662 did not violate either Section 8 (b) (4) (i) (B) or (ii) (B) of the Labor Management Relations Act, as charged. The Board, in doing so, substantially reversed the Intermediate Report and recommendation of its Trial Examiner and adopted only a minimal portion of the latter's conclusions.

The picketing issue, in brief, was that the IBEW picketed in front of the premises of an automobile-dealer sponsor, while broadcasting from the station's "Musicmobile" was in progress, curbside. The handbilling listed in the complaint consisted of the distribution of leaflets to union members and to the public, advising of the unfair status of WOGA and urging that business firms of the community did not merit patronage and support so long as they continued to place advertising with the station. After some sponsors withdrew, a new leaflet was issued with a revised list of sponsors, deleting those who withdrew. The Trial Examiner decided that the picketing constituted unlawful restraint or coercion of a secondary employer and that the leaflets unlawfully coerced the secondary employer since the latter did not handle or distribute any product of the primary employer—the radio station.

In the course of the progress of the unfair labor practice case, the National Association of Broadcasters filed an *amicus curiae* brief with the Board. The Association stated that the Congress had proscribed secondary boycotts in the broadcasting industry and that because the WOGA case involved "this serious problem," the NAB felt an authoritative NLRB decision (is) was called for. In its summation, the NAB urged the adoption of the Trial Examiner's recommendations. The Reply Brief of the IBEW contended that the NAB's conclusion that the exception of the broadcasting industry from the "publicity proviso" of the Act by the Communications Act is without the slightest support in law or legislative history. Counsel for the IBEW went on to say that the NAB's proposition that Congress was aware of a distinction between secondary boycotts involving products and those involving services was not supported by the language it quoted as legislative history.

The Board's final words are: "As we have found that neither the Respondent's picketing nor its leaflet distribution was unlawful, we shall dismiss the complaint in its entirety." The Board's Decision and Order (with members Rodgers' dissent and Leedom's dissent in part) was issued in Washington, D. C., on October 31, 1961, and is noted as Case No. 133 NLRB No. 165.

Gordon M. Freeman, International President of the IBEW, hailed the Board's landmark decision as "the first definitive guide we have had concerning the right of a labor union to publicize its dispute with an employer in the communications industries.

"Particularly important in the Board's action upholding the right of a labor union to publicize the names of sponsors who continue to advertise on struck radio and TV stations is the Board's view of the station as 'a very important producer in the intermediate stage leading toward the ultimate sale or consumption of the product.' By this view, the Board has given the full scope to the protection of the right of labor unions in all industries to advise the public of labor disputes, which was added by the Congress at the insistence of then-Senator Kennedy during the debates on the Landrum Griffin Act in 1959.

"Also important is the holding that the picketing of remote broadcasts, as distinguished from those at the principal studio of the station, was a form of primary picketing which is lawful under the National Labor Relations Act. As radio and TV stations continue the trend to such broadcasts, this aspect of the decision will have even greater significance."

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MACHINERY, ATTENTION!

IN WASHINGTON, D. C., a new automation-and-electronic brain story was related by *Washington Post* columnist, Jerry Kluttz, a member of the American Newspaper Guild AFL-CIO. At the Pentagon an Army general went to the automatic data processing room in search of advance information. He toyed with the largest and most sophisticated electronic machine and received several routine answers from it. The General then asked the device: "What about World War III?" The machine clanged, lights came on, bells rang, and it spit out this one word answer: "YES." His curiosity aroused, the General could hardly wait to ask: "Yes, what?" The machine promptly answered: "Yes, SIR!"

Enlist Your Dime With Mrs. Roosevelt In the AFL-CIO's 'March on Cancer'

DIMES from America's union men and women can help wipe out cancer just as dimes from American workers helped lead to the dramatic victory over polio.

The campaign which saved generations of children from the shadow of crippling, often fatal, paralysis honored Franklin D. Roosevelt.

The campaign which the AFL-CIO is launching will honor Mrs. Eleanor Roosevelt, staunch ally of her husband in his strivings for a better America and a champion of social progress in her own right.

Nothing like it has ever been attempted by the labor movement.

Unions and union members have been in the forefront of many a drive for worthy causes. But this campaign, to raise one million dollars as organized labor's contribution to the Eleanor Roosevelt Cancer Foundation will be a joint project of every one of the unions affiliated with the AFL-CIO.

The AFL-CIO Executive Council set the million dollar goal and pledged—unanimously and enthusiastically—that it will be met. November will be the big month; the million dollars will be presented to Mrs. Roosevelt at the AFL-CIO convention in December.

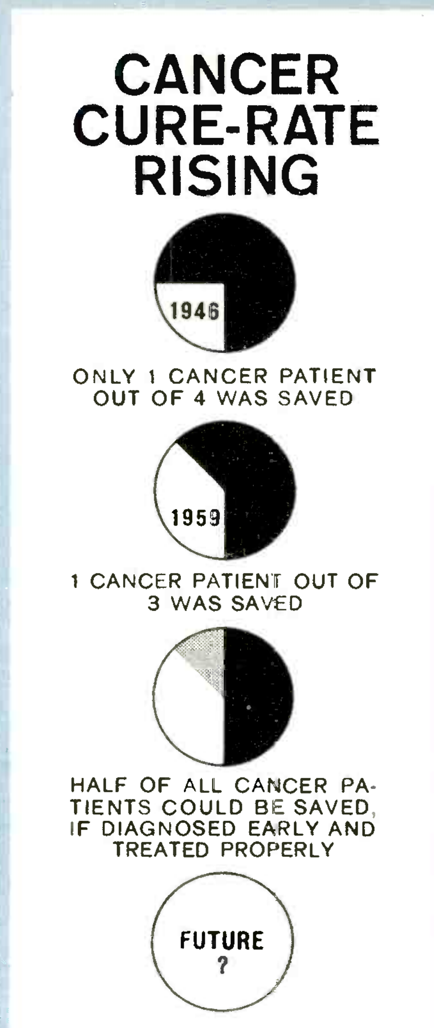
The council also pledged that every dime contributed by every union member and every dollar donated by every local union will be turned over to Mrs. Roosevelt. No part of the funds collected will be retained by labor for administrative or fund-raising costs. These expenses will be met directly by the AFL-CIO and the affiliated unions.

The money contributed—the dime per member quota set by the labor movement—will be used:

- To build laboratories and cancer research institutes at hospitals and medical schools throughout the nation.
- To sponsor an international fellowship program for cancer research and training of medical scientists both here and abroad. Just as cancer knows no national boundaries, so the search for a cure must draw on the talents of the world. The fellowship program will be carried out through the International Union Against Cancer, an affiliate of the World Health Organization.

Mrs. Roosevelt's son, Representative James Roosevelt, is president of the foundation. Gen. Omar N. Bradley of World War II fame is chairman of the board of governors. Heading a distinguished scientific advisory board is Dr. John R. Heller, president of the Memorial Sloan-Kettering Cancer Center and former director of the National Cancer Institute.

To avoid multiple appeals to the public, the Eleanor Roosevelt Cancer Foundation has affiliated with the American Cancer Society whose efforts over the years have led to new techniques of treating cancer, alerted millions to the need for frequent physical checkups and helped cure many thousands of men and women through early detection and treatment of the disease.



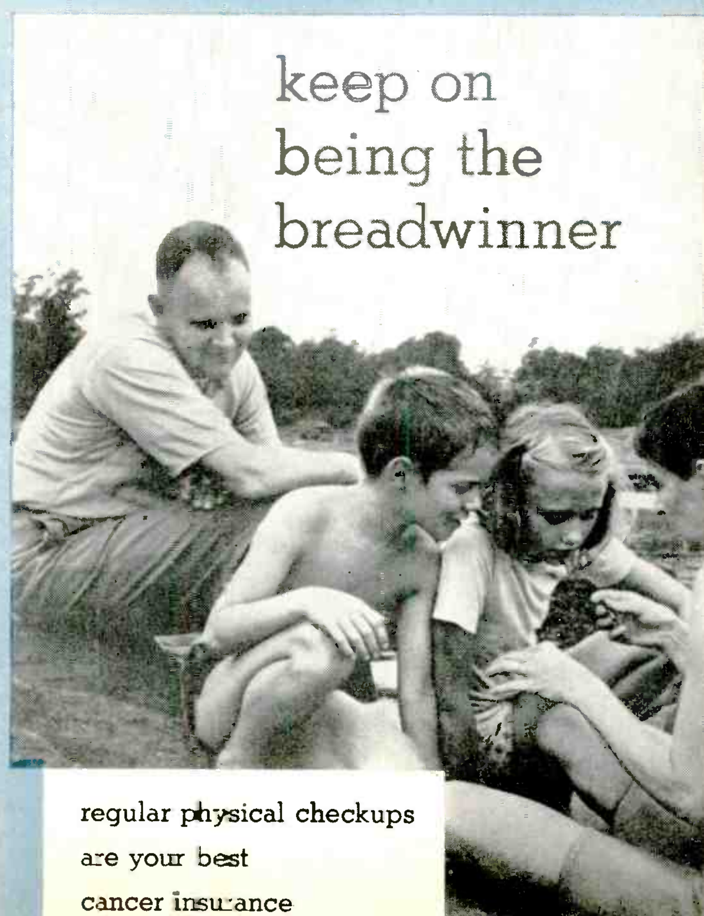
Nothing like this campaign has ever before been attempted by the labor movement. Every dime donated by every union member and each dollar contributed by a local union, will be turned over to Mrs. Roosevelt for the purpose of fighting the scourge of present-day mankind, cancer. No part of the funds collected will be retained by labor for administrative or fund-raising costs. These expenses will be met directly by the AFL-CIO and the affiliated unions.

This is a campaign which your officers are backing 100 per cent. In fact, President Gordon M. Freeman and Secretary Joseph D. Keenan feel so strongly on the subject, that in the name of all members of our Brotherhood, a substantial check has been sent to President George Meany of the AFL-CIO to be presented to Mrs. Roosevelt at the AFL-CIO Convention in December. We are sure that even though this contribution has been made, our local union officers and members will want a more personal part in this campaign, by giving their dimes.

Local Unions may make contributions for their membership directly from their local union treasuries, provided the members vote for such action, or by collecting direct contributions from the members and forwarding them to the International Office.

Since all money collected will be turned over to Mrs. Roosevelt on the 7th of December, we ask our locals to move quickly on this campaign. Make all checks payable to the "Eleanor Roosevelt Cancer Foundation" and send them to:

> *Gordon M. Freeman, International President*
> *c/o Journal Department, IBEW*
> *1200 - 15th Street, N. W.*
> *Washington 5, D. C.*



Benjamin Franklin's kite-and-wet-string experiment helped to prove electrical nature of lightning. Another such experimenter was electrocuted. Many thought it was explosions of gases.

The HEYDAY *of the* WIRELESS

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A History of Communications

Part Three

The loose ends begin to come together as discoveries in electricity lead to solutions of the mysteries of broadcasting . . .

THE incredible speed of communication afforded by telegraphy changed the world's business methods. When Bell came forward with his telephone, popularly called "the talking telegraph," many competent observers believed the science of communications had about reached its peak. But more was yet to come, based on experiments which began before the birth of Christ.

The telephone and telegraph both operated on the crudest electromagnetic principle of electricity. The next step was to be the wireless telegraph which would depend on the more advanced functions of electron-flow in an electrical current.

The ancient Greeks discovered that if they rubbed amber, the fossilized resin from an extinct type of pine tree, they could set up unusual and mysterious forces which would cause hair to stand on end, bits of cloth to be attracted, and the like. Since the Greek word for amber was *elektron*, that name has come down to us today as "electron"; the elementary charge of negative electricity and the foundation for today's great industries in radio communications, music reproduction, television, radar, direction-finding . . . everything which uses an electron tube.

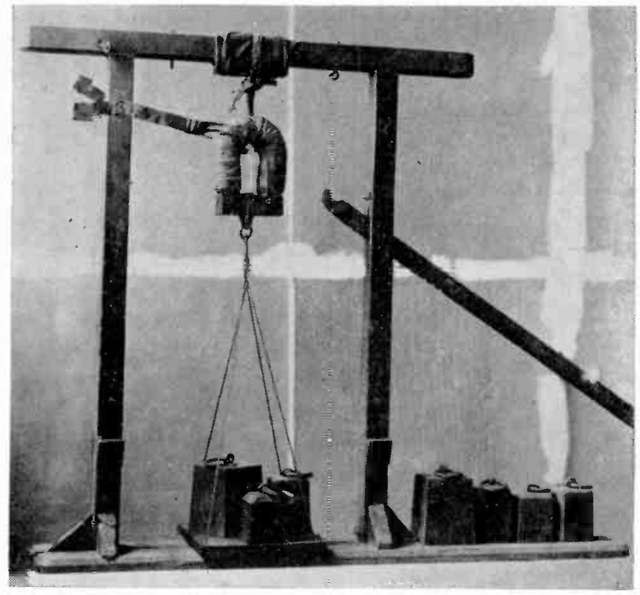
About the middle of the 16th century, experimenters were playing with crude static machines. One of them, Otto von Guericke (1602-1686) described his as consisting of a ball of sulphur "about the size of the head of an infant" mounted on a shaft so it could be rotated by a crank. When a hand was held against the spinning ball, a static charge was built up in the ball, as well as in the hand held against it. Few people saw any relation between the sparks generated by the larger static machines and lightning. They thought lightning was caused by the explosion in the sky of "exhalations of vapors" of sulphur, animal and vegetable matter. One of the observers who differed was Benjamin Franklin, who proved his point by conducting an electrical charge to earth down a damp kite string. He was spared the fate of another early experimenter, George Richman of Sweden, who was electrocuted during a similar experiment.

The Leyden jar, a crude form of condenser, had been accidentally discovered by a professor Musschenbroek of the University of Leyden in 1745. Static electricity was temporarily stored in it. Soon it was discovered that electricity would not only flow along a wire (early experimenters considered it a type of invisible fluid) but could also leap across a void of air.

The next step was to discover, by exhausting the air in a glass tube, that electricity could be made to "flow" much easier. Up until 1800, the only electricity experimenters had at their disposal was high-voltage; the discharge from static machines stored for short periods in Leyden jars. In 1800, Italian Alessandro Volta developed the storage battery. His first one was extremely simple; a plate of copper and a plate of zinc separated by a piece of moist paper. This was further developed, of course, and experimenters were soon able to command a steady flow of lower-voltage, easier-handled electricity. Along came Michael Faraday, an inquisitive young British apprentice bookbinder. He developed a magnetic generator for current, generating it by rotating a 12-inch copper disc whose outer edge passed beween the poles of a large horseshoe magnet. His crude machine of 1831 was improved with the use of electromagnets and wire-wound armatures and thus alternating current was born.

It was this type of electricity which was made of use in developing the telegraph and telephone. It remained for Heinrich Hertz to show, in 1887, that electromagnetic waves are in complete accordance with the waves of light and heat. He discovered he could direct and reflect "electric waves." He founded the theory upon which all modern radio signalling devices are founded. The basic laws which he drew up have never needed changing.

The first Hertzian transmitter was a spark-gap affair and he called his laboratory receiver a "resonator." He was the first to explore the wave theory, using his "resonator." In 1892, a 20-year-old named Guglielmo Marconi read an article on the Hertzian waves written by Sir William Crookes and was inspired to experiment with them, using the mysterious waves to operate a telegrapher sounder at a distance without a connecting wire. Within a year he was operating his "wireless telegraph" at a distance of a mile and three-quarters. He offered his invention to the Italian government, which politely turned it down. Thus rebuffed, Marconi, on the suggestion of his mother, went to England. The first thing he did was apply for a patent, which was



From this crude contraption, Joseph Henry's first electromagnet, sprang Morse's telegraph, Bell's telephone, alternating current and much of today's communications industry. Magnet is now in Smithsonian Institution in Washington, D. C.

granted July 2, 1897. Included in the world's first wireless telegraph company he formed was Prof. James A. Fleming, who was to invent the Fleming Valve which, years later, Lee DeForest transformed into the world's first electron tube, "the audion." In 1897, sea warfare was revolutionized when radio signals were transmitted 18 miles from a shore station to a ship at sea.

Marconi was preoccupied with getting more distance from his spark-gap transmitter. It remained for Sir Oliver Lodge to patent the use of a tuning coil in 1898. Still, ionization between the open-gap electrodes was a problem, solved in part by the quenched-gap invented by Max Wien. Marconi had started out using a "coherer" of powdered metal to provide electrical resistance and a "decoherer" (simply a little hammer). This was soon superseded by the detector; first a magnetic, then an electrolytic and, thirdly, a crystal of galena or silicon. (After years of abandoning elemental detectors for electron-tube detectors electronics engineers are moving back to another crystal—germanium.) In December, 1901, at a cost of $200,000 the Marconi Company managed to send the letter "S" . . . three little dots . . . across the Atlantic Ocean.

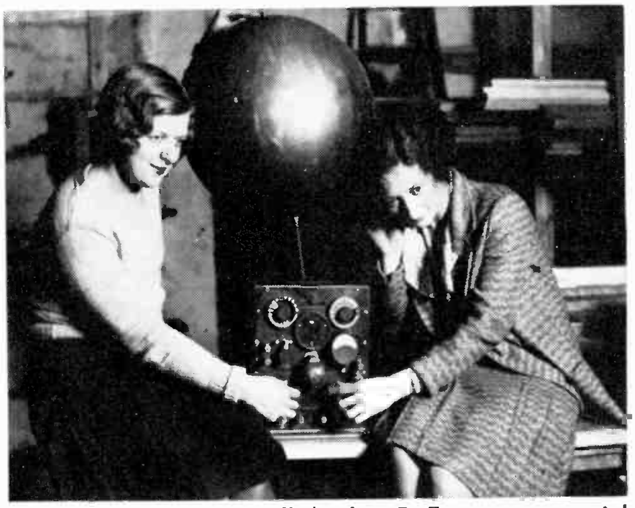
Dr. Ernest F. W. Alexanderson of General Electric, working with Dr. R. A. Fessenden, a professor at what is now the University of Pittsburgh, invented a machine called an Alexenderson alternator. This produced a spark with a frequency of 100,000 cycles per second. This made continuous oscillations possible and led to radio-telephony since such oscillations could be modulated. Fessenden had been able to send voice signals by air as early as 1900 by voice-modulating the waves of a spark transmitter with a frequency of 20,000 cycles. His effective distance was about a mile.

The stumbling block was a suitable modulator and the pioneers had to wait for the electronic tube. Prof. James Fleming took a tip from Thomas Edison's early electric light bulb experiments and patented, in 1904, a diode electron tube which rectified (detected) incoming radio signals. Soon it was used to smooth out incoming alternating current instead of using batteries in receiving sets. As it first existed, it was only a rectifier. DeForest was granted a patent in 1906 on a device which added a third electrode to Fleming's diode and came up with the "audion."

The audion not only detected the radio signal but amplified it. In series, several tubes could build up a feeble signal to blast-like proportions.

Nobody believed DeForest and he was actually haled into court on fraud charges when he tried to sell stock in a company. Some time later he signed away all his rights in this foundation-block of all radio-communications for $50,000. It was to be the foundation of an industry worth not millions, but billions of dollars.

Now all the basic elements for modern radio communications were present: a suitable current, tuning facilities, and an amplification device. Society was not long in putting them to work. In 1912 the first radio communications on trains were installed on the Delaware, Lackawanna and Western Railroad. E. H. Armstrong patented the regenerative, or feed-back, circuit in October, 1914. On July 28, 1915, the American Telephone and Telegraph Co., which had bought DeForest's audion tube rights, working with Western Electric, completed a wireless telephone call from Arlington, Va., outside Washington, D. C., to Hawaii, almost 5,000 miles away. The military significance was considerable and not overlooked at the time. Germany had been cutting trans-oceanic cables but they could not stop radio-transmittal. Three months later, conversations were going on from Arlington to France with the receiving antenna atop the Eiffel Tower.



These girls are "tuning in" the first DeForest commercial radio set. The large ball was the aerial. DeForest was a great physicist but a poor businessman, signing away his rights in the audion for $50,000. It was to be worth untold billions.

In 1919 trans-Atlantic airplane passages in planes equipped with radio communications underscored the aviation value of radio.

In 1922, American Telephone and Telegraph, owners of DeForest's audion met head-on in the courts with the Marconi Company, owner of the Fleming valve patent. The latter claimed DeForest's detector was an infringement. The verdict was unique in that it "split the tube down the middle." The judges ruled that the third electrode, the grid, was DeForest's but the first two, the filament and plate, belong to Fleming. Thus neither AT&T or the Marconi Company could use the device without the consent of the other. Monroe Upton, writing "Electronics for Everyone" says: "This has always seemed a strange decision to radio men. By the same logic, the Wright brothers should share their glory with the inventor of the box kite."

The stage was set for commercial radio broadcasting. For several years, hopeful amateurs had been winding coils around oatmeal boxes and hopefully scratching away at galena crystals. Western Electric, building a big transmitter for the Navy, had no objections when the engineer substituted recordings for his tired voice.

DISTRESS CALLS!

Before 1900 there was no special radiotelegraph call for sea emergency; an early operator on a ship in peril once simply tapped out "HELP." In 1903 Italy suggested SSSDDD. By 1904 the formerly land-based telegraph operators working on Atlantic ships resorted to "CQ" which meant "Attention all stations." Later a "D" was added and CQD meant distress.

German ships were using "SOE" in 1906 and recommended it be adopted as an international distress signal but the final dot (E) was potentially in danger of being obscured by static. At an international conference, American delegates suggested "NC"; the flag signal for help. Finally, "SOS" was adopted although British ships continued to use "CQD" for some time.

"SOS" does not mean either "save our ship" or "save our souls," nor did "CQD" mean "come quick-danger." The calls were adopted because they could be sent speedily and could be quickly recognized by their cadence.

"Mayday" was adopted in 1927 as an international voice radio distress signal. It is derived from the French phrase "M'aider" meaning "Help me."

DeForest had broadcast from New York's Metropolitan Opera in 1910, using an arc transmitter. He started broadcasting record music in 1916 and, at 11 p. m., Tuesday, November 7, 1916, he broadcast the first radio "blooper"; he confidently announced that Charles Evans Hughes had been elected U.S. President. Late West Coast returns reversed the results.

There is rivalry for the honor as the first U.S. broadcasting station and it depends upon the individual's interpretation of "first" to determine which merits the title. If the first broadcast radio program makes that station the first, then the honor belongs to Prof. Fessenden, who, on Christmas Eve, 1906, from his experimental station at Brant Rock, Mass., sent out two musical selections, a poem, and a short talk which was heard by ship wireless operators in a radius of several hundred miles. He used a water-cooled microphone, the Alexanderson alternator he had helped to develop, and 1 kilowatt of power at a frequency of 50 kilocycles.

Radio station KDKA, Pittsburgh, is generally accorded the distinction of being the world's first commercial broadcast station. It was begun in 1916 by Dr. Frank Conrad, an engineer for Westinghouse Electric, in his garage. After wartime restrictions were relaxed, he came on the air early in 1920 licensed as Station 8XK. This equipment was subsequently moved to the Westinghouse plant in East Pittsburgh and, on the evening of November 2, 1920, began regularly-scheduled programs with the returns of the Harding-Cox election. It operated on 833 kc. with 50 watts of power. The first KDKA broadcast had an estimated 500 listeners. Two years later there were that many licensed stations in the U.S.!

Early headphone-wearing listeners would hear such as this:

"If you're receiving this program, please drop us a card." Sometimes several in the family would gather around a single earphone dropped into a china cup to amplify it enough so that all could hear. Papa kept the other one so he could monitor the reception!

Billy Jones and Ernie Hare, "the Interwoven Pair," were to early radio what "Uncle Miltie" Berle was to early TV. In 1921 an estimated 300,000 sets tuned in on the Dempsey-Carpentier title fight from New Jersey. In Pittsburgh, KDKA had a novel system for reporting baseball games: an employe would sit on the top row of bleachers. After every inning, he scribbed the results on a piece of paper and threw it over the fence. A courier waiting below picked it up, scampered to a pay-phone, and called in the results to the studio.

On May 19, 1921, the first government market reports were broadcast. The prices reported that day included butter at 37½ cents a pound and eggs at 30 cents a dozen. Theme songs were great things and anyone over 40 should remember who was identified by "Shine On, Harvest Moon," "Carolina Moon," "When the Moon Comes Over the Mountain" and "My Time Is Your Time"; all great* theme songs of popular early radio performers. Try your memory before looking at the bottom of the page.

The Great Depression of the late Twenties made but a small dent in the growing industry and, by World War II's beginning, the U.S. had 831 AM stations and one commercial FM station (which will be treated later).

Last year licensed commercial AM stations hit an all-time peak of 3,581. In 1960 the FCC authorized 668,000 radio broadcast stations of all kinds with over 2,200,000 transmitters between them. There were 217,102 amateur operators, 97,411 marine stations, 91,180 stations serving aviation interests, 11,452 serving land transportation, 64,804 industrial-use stations, 32,906 public safety stations such as police departments, 126,034 citizens-band broadcasters, 4,386 common carrier stations and 11,832 others of varied descriptions.

Tuning in to these were a total of 220,500,000 radios in the U.S. alone; an estimated 399,100,000 sets world-wide. Americans like radios in their automobiles; there are an estimated 41,500,000 auto receivers in operation. Serving these and the other electronic gadgets for the U.S. public are 64,000 service outlets with an annual income, from labor charges and parts, of over $3 billion.

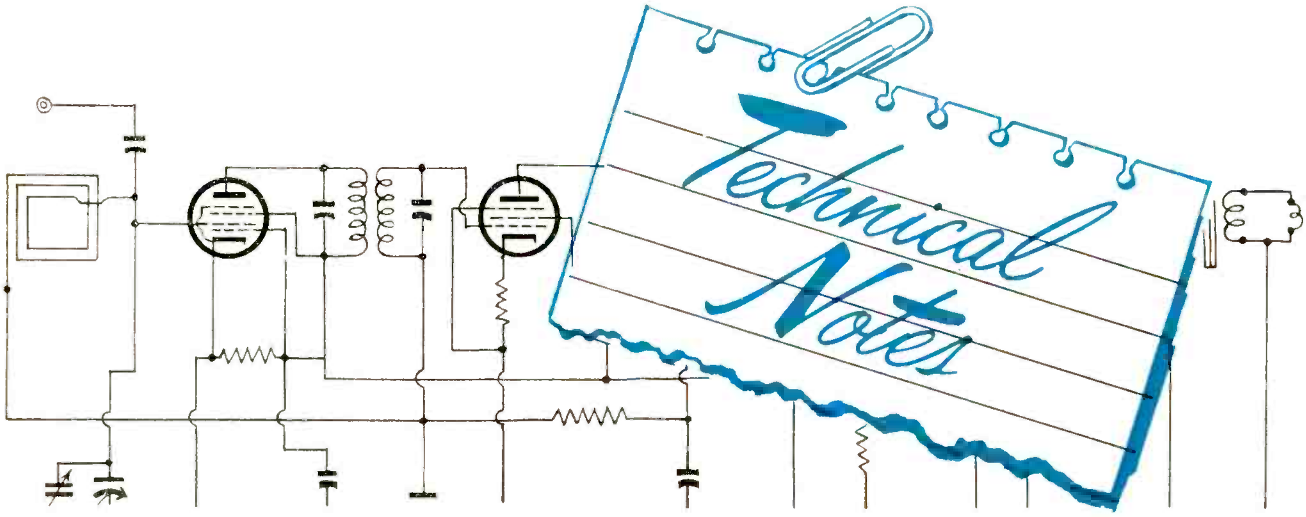
Some day man may step into a magic box, pull a switch, be de-ionized, be flashed across the country to another magic box, and re-ionized . . . making the trip in a twinkling of an eye. Fantastic? Old Doctor Hertz, puttering around his laboratory back in 1650, would have put you down as purely nuts if you had described today's electronic marvels to him. Who knows what lies ahead?

Next: Later developments in space communications: FM, television, radar.

GROWTH OF U.S. RADIO

Year	Licensed Stations (AM)	Families with receivers
1921	1	?
1922	30	60
1923	556	400
1924	530	1,250
1925	571	2,750
1930	618	12,049
1935	585	21,456
1940	765	38,049
1945	919	33,100
1950	2,086	40,411
1955	2,669	45,900
1960	3,581	

* The theme songs belonged, in order, to: Ruth Etting, Morton Downey, Kate Smith, and the world's "crooner," Rudy Vallee.



GLASS-COATED TRANSISTORS

Sealing the surface of a microminiature diode or transistor so that moisture and other contaminants won't get to it is a costly process—because you have to work with such extremely small sizes. More than 1,000 of these tiny transistors or diode "chips" can be cut from a single silicon wafer no bigger than a nickel.

Last month, International Business Machines Corp. announced a new technique—billed as less expensive and more reliable than any other approach—for covering microminiature transistors and diodes with a protective glass film only 1/10,000 in. thick.

With the IBM technique, some of the old safeguards are still kept. The transistors or diodes are made on wafers of silicon, and the wafer is then covered with a thin layer of silicon oxide. Normally, at this point, the wafer is sliced up into individual transistor or diode chips, and for further protection each chip might be enclosed in a hermetically sealed metal container or a glass or plastic capsule.

IBM gets around this costly individual handling of chips. After the silicon wafer has been coated with silicon oxide and before it's cut up into little chips, a special glass powder is applied to the oxidized surface, and the whole wafer is fired at more than 1,500 F. This produces a microscopically thin film of chemically resistant glass with a smooth surface free of any pinholes. The electrical contact into the actual diode or transistor itself is made through small holes etched through the oxide and glass film.

RESISTOR STANDARDS

The Electronic Industries Association's Working Group on Wire-Wound Resistors has invited industry participation in a stepped-up program of standardization of wire-wound resistors.

An engineering working group, designated P-1.4, will give particular attention to existing EIA specifications and the following military specifications:

MIL-R-26C Resistors, Fixed, Wire-Wound (Power Type); MIL-R-22 Resistors, Variable, Wire-Wound (Power Type); MIL-R-93 Resistors, Variable Composition, General Specifications for; MIL-R-18546 Resistors, Fixed, Wire-Wound (Power Type) Chassis Mounted; and MIL-R-19365 Resistors, Adjustable, Wire-Wound (Power Type).

Implementation of high-reliability specifications in accordance with the Defense Department report Parts Specifications Management for Reliability (the so-called Darnell Report) will also be emphasized.

EIGHT OTHER STANDARDS

Eight additional technical standards have been prepared by engineering committees of the Electronic Industries Association and published by the EIA Engineering Department in New York. They cover:

- *EIA-NEMA Standards on Outlines for Semiconductor Devices.* Defines the dimensional parameters of diode outlines DO-1 and DO-5. It is expected that this standard will be supplemented with additional diode and transistor outlines as they become standardized.
- *Definitions for Electromagnetic Delay Lines.* Covers definitions for electromagnetic delay lines used in pulse circuitry and includes definitions covering distortion, impedance, temperature coefficient, tilt, and time.
- *Color Coding for Stereo Pick-up Leads.* Covers color coding for stereo pick-up leads including coding for 3, 4, and 5-wire pick-ups.
- *Character Codes for Numerical Machine Price Tool Control Perforated Tape.* This standard for numerical machine tool control perforated tape is intended to serve as a guide in the coordination of equipment design, to minimize the number of sizes and codes of perforated tape used, and to minimize the variety of perforated tape preparation equipment required by users of numerically controlled machine tools.
- *EIA-NEMA Standards on Letter Symbols and Abbreviations for Semiconductor Data Sheets and Specifications.* Covers letter symbols and abbreviations for

semiconductor data sheets and specifications, and includes 146 symbols and abbreviations, as well as the criteria and conventions associated with each.

- *EIA-NEMA Standards for Environmental Method of Life Testing Lead Mounted Semiconductor Power Rectifiers.* Covers the environmental method of life testing lead-mounted semiconductor power rectifiers, and specifies the minimum and maximum length between the mounting and the rectifier body.

- *Recommended Practice for Preparation of Basing or Terminal Diagrams.* Intended as a guide in the formulation of basing and terminal diagrams for electron tubes and includes the use of terminal and base pin symbols, numbering, and drafting practices associated with basing diagrams. This standard also includes a number of typical diagrams illustrating these rules.

- *Wound Cut Cores.* Covers wound cut cores. This revision of EIA Standard RS-217 supplements the previously standardized dimensions for 400-cycle cores with dimensions for 60-cycle cores.

NON-MAGNETIC ALLOY

Navy scientists recently announced development of an important class of new-non-magnetic alloys that promises to benefit a wide range of people, from the underwater demolition expert working on mines to the housewife working in her kitchen.

The new alloys have been named Nitinol by their developers in the Magnetic Materials Division of the U. S. Naval Ordnance Laboratory at White Oak, Silver Spring, Md. Based on the Intermetallic compound TiNi (a combination of Titanium and Nickel). Nitinol has much to recommend it to the engineer with a troublesome non-magnetic materials problem.

Nitinol is corrosion resistant and can be hardened almost to the hardness of tool steel. Its toughness increases as temperatures decrease.

Boss got you frightened? Don't know whether you have a grievance or not? Get with it, fellow! Be an active, informed member of your local union. Attend meetings. Read your contract!

READING TIME

Basics of Analog Computers

By T. D. Truitt and A. E. Rogers; John F. Rider Publisher, Inc., New York. 400 pp. $12.50.

The many illustrations and the lucid descriptions, beginning with the premise that the reader knows nothing of the subject, make this book as nearly easy reading as such a book can be. Questions at the end of each section permit a quick check on whether each was understood and whether the reader missed anything, perhaps by reading too fast.

Simple examples are often used to show a mathematical relationship to familiar questions. For instance, the basic principle of integration is shown by the movement of an automobile—speed, distance and time (with speed shown as varying over a span of time) are shown to involve lengthy calculations unless integration is employed. Whether the reader realizes it or not, he is introduced to calculus. A somewhat lengthier explanation of differentiation is necessary but it is also painlessly done.

This book, in effect, is three volumes in one hard binding. The first is entitled "Analog Computing Principles and Techniques," the second is "General Purpose Analog Computers" and the third "Using the D. C. Analog Computer." Must reading for anyone who anticipates or has an interest in computers, with no previous knowledge of them. Recommended reading for those already having had association with computers, for review purposes.

Electronic Games and Toys You Can Build

By Len Buckwalter; Howard W. Sams Co. 128 pp. $2.50.

Electronic Games and Toys You Can Build is one of those "just-for-fun" books written for persons who like to build things. Each of the 15 electronic games and toys it describes and pictures is an original idea—devised and built by the author—and none are available commercially. Some challenge the player's judgment, some test manual dexterity, and others achieve "magical" effects. Each project is fully described, and is accompanied by many construction photos and a detailed wiring-construction diagram. (Here are some good ideas for Christmas toys.)

One game, called "Space Shot," features two satellites fighting it out in "space." "Find the Airport" lets you navigate under "visibility-zero" conditions. Amaze your friends with "the Mind Reading Act." Other titles include: "Test Your Nerve," "Penny Pitch," and "Countdown."

STATION BREAKS

HIGH-PITCHED VOICE

On November 5, Voice of America radio monitors ringing the Soviet Union made a major effort to penetrate the Soviet jamming curtain.

In an attempt to deliver a big Sunday punch through the Reds' radio barrier, Voice of America scrapped its regular programs on November 5 and massed 52 transmitters for eight-hour saturation broadcasts. The purpose of the mass effort was to tell the Soviet people the story of nuclear testing by their government.

Broadcasts were in Russian, English, Ukrainian, Georgian, Armenian, Lithuanian, Estonian, and Latvian.

Early reports say that the English version went through loud and clear, and the Russian did well, too, for at least three hours.

LOCAL 1212 APPOINTMENT

Peter Ippolito, a longtime member of Local 3, New York, and a practicing attorney, has been appointed a business representative of Local 1212, New York. For nine years he worked at CBS as an electrician—and, thus, has many close personal friends in the local union.

LOCAL PREDICTS FUTURE

Without benefit of a crystal ball or the stars, Local 410 of the American Federation of State, County and Municipal Employes, St. Louis, Mo., can predict what's going to happen next week.

Following are some of the predictions made by the local in its official publication, *Four-Ten:*

1. A member who was fired and who has ten days to appeal will call the union for the first time on the eleventh day.

2. A member who has taken sixty-four sick leave days last year will insist he should have been rated "good" on his attendance.

3. A member will call in to complain that there are not enough fans in the room where she works.

4. The next day, another member working in the same room will call in to complain that there are too many fans.

5. A member sitting at home on a holiday will call the union office and become indignant when he learns that his business agent took the holiday, too.

6. A member with a sound grievance will insist: "Don't mention my name."

7. A member who, in the past eighteen months, has had substantial wage increases and improvements in working conditions will complain because his dues have gone up a quarter a week.

8. A member will call the office with an urgent problem and then refuse to leave his name or phone number.

How does the local know these things will happen? It's easy. They happen every week. (PAI)

LAST LAUGH

ABOUT THAT RAISE...BOSS