E.L. Marmen

NAB's 22nd Convention

Notes on Modulation of AM Transmitters

New 10KW Amplifier Tube for FM

Western Electric OSCILLATOR

NUMBER 5

OCTOBER 1946

Western Electric
OSCILLATOR

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DEVOTED TO DEVELOPMENTS IN COMMUNICATIONS AND ELECTRONICS

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THE COVER

"Something *old* and something new." The *old* in this symbolic Broadcasting scene is the Stradivarius violin which was made by the master craftsman in 1714. The new refers both to the WOR studio in which the picture was made, and to the Western Electric Custom Built Console in the control room in the background. In all there are three new studios at WOR, and all three are equipped with these Consoles, which give a high degree of flexibility to studio operation. For close-up photographs of this new equipment, turn to the inside back cover, page 39.

THIS ISSUE

Two Bombs and the Man

We have just returned from a four months' trip to Bikini where we witnessed the explosion of two atomic bombs. Arrayed against the terrifying might of those two bombs was every conceivable type of electronic equipment which could possibly help in measuring the strength, the characteristics, the nature of atomic fission and in determining its effects. Again, many types of electronic equipment thus far devised for peace or war were exposed to the bombs in an effort to determine how such equipment would be affected by atomic bombs.

Even to the engineers and scientists who have helped to develop this great complexity of electronic equipment, the show was startling. Here was the greatest scientific experiment in history. It was a working exposition of all the latest in electronics communications and measuring equipment. Telemetering came in for its most extensive use to date. Television was used to great advantage to help observers get a close-up vision of the explosions, and even stratovision (television transmissions relayed by planes in the air) was successfully employed for the first time. Frequency modulation rolled up its sleeves and went to work in helping to measure the fury of the bombs. Electronic measuring equipment probably saved lives by its splendid performance in measuring and determining the presence and amounts of the radioactivity which was present in terrifying quantities after the underwater bomb explosion. Drone planes, or uninhabited planes, as they are now being called, took off from distant islands, flew to Bikini, cruised around and through the atomic clouds and returned safely to their distant home ports. Uninhabited boats, controlled entirely by radio, sailed unerringly into the lagoon, picked up samples of radioactivated waters and returned to their mother ship.

Just how great the accomplishments of radio and electronics were at Bikini was forcefully brought home by an incident which occurred on the writer's trip home. He saw a straight and stalwart figure stride through the lobby of a Chicago hotel. Although elderly in years he still had the unconquerable look of youth. He was Dr. Lee De Forest, the man who, in 1906, added a grid or third element to the diode vacuum tube and started electronics on its amazing journey.

If what was done and demonstrated at Bikini in Electronics was mainly the result of only 40 years work, just think where the science of electronics will lead us in the next 40 years. Electronics, encompassing as it does radio, television, industrial electronics, radar and all the other endeavors which stem from electronics, is a career, a profession, which challenges the mind and the imagination. It beckons to the young. It offers success, adventure, romance and achievement to those who pursue any or all of its myriad paths into the future.

W. W.

NAB Convention

"NAB Convention!" Within the industry those words are as famous as "World Series" or any other term that makes itself a part of the American Scene. The NAB Convention, and there have been only 22 of them, including this one, has earned its fame. It is a part of Broadcasting. It has helped to color and shape and mold the progress of the industry. Every American who flips a switch and then relaxes to receive enjoyment, instruction, news and education over his radio owes a debt to the NAB Convention because it is through the work of the NAB at its conventions and throughout the year that Broadcasting has been helped to become one of the greatest contributors to the life that we call "American." The statement by NAB President Justin Miller on the opposite page will be of particular interest to all broadcasting people, as will the article on page 4 by Edward J. Heffron, which gives a vivid description of the NAB's origin, services and aims.

WHN'S FM Plans

FM is still a storm center of controversy among broadcasters, but not to Herbert L. "Herb" Pettey, executive director of WHN. He believes solidly in FM and is willing to bet a considerable outlay for equipment to prove it. The story of WHN's FM plans is told on page 8, as well as something of the history of this popular 50 kw AM station and its FM affiliate, WMGM.

Saga of the Fastax Camera

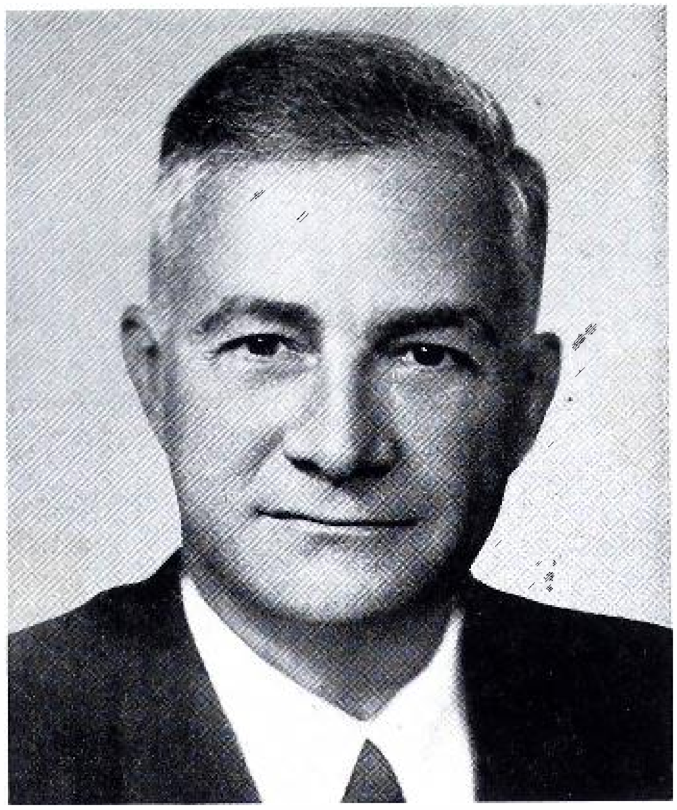
This little high speed motion picture camera went to war. It also served in the great atomic bomb experiments, and it is now playing an important role in industry in making "super slow motion" studies of fast moving parts. Among other things it reveals to design engineers the frailties of high speed parts and clocks their fatigue points. Two articles tell the Fastax story: *Fastax—A New Tool for Industry* on page 15 and *Fastax at Bikini* on page 17.

A New High Frequency Bridge

In the installation of a four-element Clover-Leaf antenna at WINX-FM at Arlington, Va., a new high frequency bridge was used for the first time. This bridge was developed by Bell Telephone Laboratories to afford a means of determining a match between a load impedance and the characteristic impedance of a coaxial line. A description of this bridge and how it works begins on page 30.

NAB Convention

October 21-24, 1946



"RADIO BROADCASTING—
A Trust for the American People"

By Justin Miller

President, National Association of Broadcasters

IN the brief space of a quarter of a century the development of Radio Broadcasting has produced a great industry: using the specialized skills of many crafts and many professions.

But Radio Broadcasting is far more than an industry. It is a great American institution like the press, motion pictures, the church, the schools, the colleges and the universities of our great country. In the same brief quarter-century, Broadcasting has been accepted by our public as a major source of entertainment and enlightenment. It is universally conceded—even by the critics—that American Broadcasting is vastly superior to that of any other country.

In the critical days which lie just ahead, it is important that we in the Broadcasting Industry stand together, alert to dangers of encroachment upon the right of the people to free and untrammelled Broadcasting. Ours is a sacred trust for the people of America.

National Association of Broadcasters

Twenty-three Years of Service to Broadcasting

By Edward J. Heffron

National Association of Broadcasters

• • For many men in Broadcasting, this article on the history, aims and services of the National Association of Broadcasters will evoke remembrance of things past in radio — reaching back to the days before Broadcasting became big business. For other, younger men it presents a story full of color and flavor of Broadcasting's aims, struggles and problems then and now and how they are being met. The author expresses the opinions of the National Association of Broadcasters, and the editors feel that these opinions, whether one agrees or disagrees with them, will be of special interest to all broadcasting people. • •

RADIO celebrated its 25th anniversary only last year. Twenty-three years ago, therefore, Broadcasting was but a babe which had not yet learned to walk by itself and had hardly learned to talk. It was the side interest, chiefly, of manufacturers of radio equipment, telephone companies, power companies, and newspapers. Its main program fare was music, amply punctuated by static and interference.

In those days they called radio stations "radiophone stations." At least that's what they called WDAP in April 1923 when a small group of pioneers met in the WDAP studios at the Drake Hotel in Chicago to consider the desirability of forming a trade association. WDAP was "the official radiophone station of the Board of Trade of the City of Chicago." It is now WGN.

At their meeting on April 26, 1923 these "Founding Fathers" (one of whom was Judith Waller) decided to form the National Association of Broadcasters. They set up a temporary organization, met again on May 15, and called a national convention for October 11 at the Commodore Hotel, New York.

NAB's first officers and directors, elected at this convention, with their station connections as of that time, were: Eugene F. McDonald, Jr. (WJAZ—Chicago), president; Frank W. Elliott (WOC—Davenport), vice president; John Shepard III (WNAC — Boston), vice president; J. Elliott Jenkins (WDAP—Chicago), secretary; Powell Crosley, Jr. (WLW—Cincinnati), treasurer; and William S. Hedges (WMAQ — Chicago), Harold J. Power (WGI—Medford Hillside, Mass.), Henry A. Rumsey (WDAP—Chicago), Robert Shepard (WEAN — Providence), G. Brown Hill (KQV—Pittsburgh), W. S. Harris, and Bowden Washington, directors.

Klugh First Managing Director

NAB's first managing director (the office was replaced, in 1938, by a full-time president) was Paul B. Klugh, of Madison, New Jersey.

NAB's first headquarters address was 1265 Broadway, New York City.

The procurement and release of tax-free music seemed to be the chief preoccupation of NAB during its first year or two of existence, if indeed it was not the main consideration which led to its formation. According to the first annual report, "The (NAB) Music Bureau released 400 late popular copyrights from June 29, 1923 to August 1, 1924. This amount of music adequately supplied broadcasters who played tax-free music." (BMI wasn't such an innovation then, after all.)

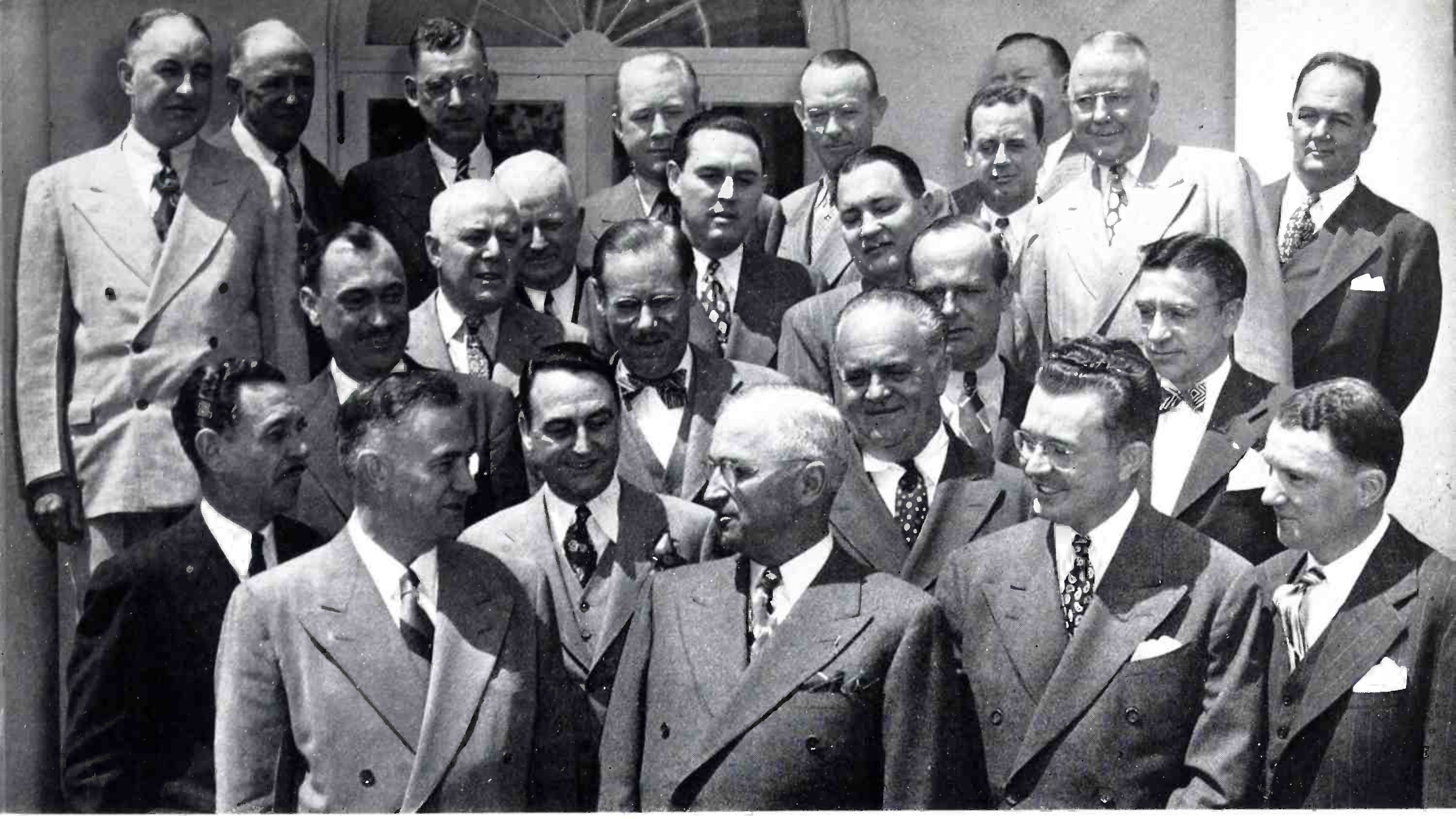
An interesting subject debated at the 1923 convention was "Whether Politicians Should Be Allowed to Use Stations." A proposal was adopted providing that the political party applying for time should be required to bring to the studio a speaker from the opposing party, and that the speakers representing both parties should be given equal time. (One has visions of Mr. Roosevelt escorting Mr. Dewey to the studio. Or, Mr. Smith squiring Mr. Hoover!)

Radio regulation, what there was of it, was in the hands of the Secretary of Commerce. The broadcasters seemed to be thoroughly satisfied with the administration of those powers by the then incumbent of that office—Herbert Hoover—but they were apprehensive that his successors might not all be as fair and able as he. In 1924 a radio bill introduced by Congressman (now Senator) White was pending before the Congress. It provided for a committee of 15 to advise with the Secretary of Commerce on all matters pertaining to radio. The NAB Legislative and Legal Bureau urged that the powers of this committee, as specified in the White bill, be enlarged, and that membership of the committee be limited to eight members representing the government and seven representing the radio industry, the seven to be made up as follows: one from the most representative association of broadcasters, one from the most representative association of radio manufacturers, one from the most representative association of radio amateurs, and four from among those with recognized attainments in the field of radio communications.

While these early broadcasters were entirely satisfied with Herbert Hoover's fairness, they were not altogether pleased with the way the new industry was being regulated. This was largely due to the fact that Mr. Hoover was working with an outmoded statute, the law governing "radiotelegraphs" passed in 1912. In 1923 the Court of Appeals of the District of Columbia, in the case of *Hoover v. Intercity Radio Company,* had held that the Secretary of Commerce could not withhold a broadcasting license even when no wavelength could be assigned which would not interfere with existing stations.

Need for Wavelength Allocation

So in the fall of 1925, when NAB convened for the third time, there was still no adequate system of allocation of wavelengths. Some thought they should be allocated on the basis of priority, some (probably the Johnnies-come-lately) on the basis of fitness. That there was need of some system, however, was proved by the remarks of an Ohio member at the 1925 convention: "I sometimes wonder if station owners realize how much their stations are being interfered with a comparatively short distance away. . . . We put on a new station last January, used high power, and we imagined . . . that we were kicking out everywhere. I was down in Mississippi on a hunting trip, and took a set down there, and I want to tell you



President Truman chats with NAB President Justin Miller when the NAB Board of Directors visited the White House recently following Board meeting in Washington.

that the reception of our station wasn't more than five per cent efficient . . . it sounded like a windmill, with a number of other stations dropping over on us . . . a California station . . . was loud enough to tear our station all to pieces. Other stations slipped a little bit and perhaps we slipped a little bit. . . . There are entirely too many stations on the air. . . . The broadcast listener cannot hear with a fractional degree of satisfaction . . . this hash and jumble and pound of electric fans, flying machines, and everything else, that drown out the carrying wave of the music of practically every broadcasting station in the country must be remedied."

As to why other stations "slipped a little bit" and perhaps his station "slipped a little bit," was shown by the remarks of another delegate at the convention, who said: ". . . the last four months we have been given two settings by our [Department of Commerce] radio inspector. . . . We have one meter that has been calibrated by the Bureau of Standards, and also has been calibrated by the General Radio Company, and they do not seem to agree. . . . The Department [of Commerce] should have some equipment so we could accept their standardization."

These things are amusing now simply because time has introduced so many changes. They seem funny for the same reason that Grandpa's handle-bar mustache seems funny. But at this 1925 convention there was one contribution that was funny *per se*. A Philadelphia broadcaster reported: "I had an experience in the spring with one of Philadelphia's well known violinists, who offered to come down to the studio, after much persuasion, and play. About five minutes before he was ready to go on, the announcer came to my office and said, 'Mr. So and So isn't going to play.' I asked, 'Why not?' 'Well, his manager has just come in and says he won't play unless you pay him twenty-five dollars.' I went into the studio and asked, 'What is the difficulty?' 'There is no difficulty at all. Unless he is paid the twenty-five dollars he will not play.' I said that was not the arrangement. Well, he said he would not argue the point, but would not play unless he were paid twenty-five dollars. . . . I went out and got a violin and a bow, and I said, 'Now, I have never played a violin in my life, but I am going to play, if you do not. I am not going to announce who I am. The radio public can use their own judgment.' He played!"

New Headquarters Building of NAB in Washington.

In 1925 there were 570-odd AM stations, no networks at all (the first network, NBC, was started the following year), and, of course, no FM stations. Only about 60 people, representing less than 100 stations, were present at the 1925 convention—and not all of them were members of NAB. Today, counting AM and FM stations, including both licenses and construction permits, there are approximately 1760 stations. And at this year's NAB convention there will be more than 2000 people representing more than 1000 NAB members.

NAB's 402 Accomplishments

Trade associations sometimes grow with the mere passage of time—but they only grow old, they don't grow big. They grow big only if they produce results. A few years ago "What NAB has done for the Broadcasting Industry" was inventoried, under that title, and produced 402 items.

Not a few have been added since. Obviously, therefore, a comprehensive catalogue of NAB's activities and achievements can't be given here. But a few highspots can be mentioned.

A trade association should properly do four things, among others. It should provide regular and special services to the industry, defend the legitimate interests of the industry, work for improvement of the industry, and promote public understanding of and regard for the industry.

The regular NAB service which most members have rated above all others is NAB *Reports*, established in 1930. In this weekly house organ all departments have cooperated with the Director of Information and his assistant (now Charley Batson and Ben Miller) in providing the membership with helpful information not ordinarily available in the trade press—or in greater detail or with more convenient breakdowns than the trade press. In addition, special manuals, pamphlets, and studies have been sent to the membership, from time to time—not to mention bushels of letters—by the FM Department (Bob Bartley), the Department of Broadcast Advertising (Frank Pellegrin, Hugh Higgins, Allen Brown, Lee Hart), the Research Department (Ken Baker, Helen Schaefer), the Special Services Department (Art Stringer), the Legal Department (Don Petty, Bryce Rea), the Engineering Department (Jim Middlebrooks), the Employee-Employer Relations Department (Richard Doherty, Pete Peterson, Milton Kibler), and the Public Relations Department (Ted Heffron, Bob Coleson, Dorothy Lewis).

BMI Organized

The special services that NAB can and does render to the membership are exemplified by its activity with respect to music performing rights. As we have seen, the problem of music was one that agitated the industry from the very beginning. After years of deliberation and dis-

A. D. WILLARD, Jr.
Executive Vice President of the NAB

cussion the broadcasters concluded that as long as they should be exclusively dependent on ASCAP for their major music requirements, they would be helpless. So at a special convention called by NAB at Chicago in September 1939 they took steps that resulted in the formation of Broadcast Music, Incorporated, a competitive music licensing and publishing organization. BMI built up a library of music which soon was able to provide broadcasters, and still provides them, with an additional music supply. Thereafter NAB was instrumental in securing a standard broadcaster's contract from ASCAP which materially reduced the industry's payments for performing rights.

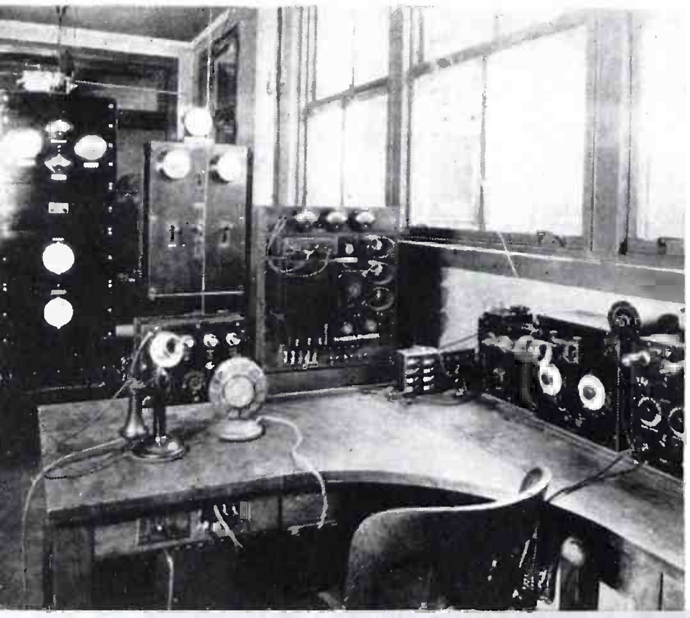
Defense of the legitimate interests of the industry, and special services to the industry, overlap. Solution of the ASCAP problem was a special service and at the same time a defense of the legitimate interests of the industry *vis-a-vis* the American Society of Composers, Authors and Publishers. But NAB's main defense work has been *vis-a-vis* the Congress and the Federal Communications Commission.

No one has ever seriously charged, and no one can fairly charge, that NAB is a lobbying organization, in the accepted meaning of the word. No special blandishments are practiced on members of Congress. No member of the NAB staff is detailed to frequent the halls of Congress. But at the urging of some influential constituent or some importunate pressure group, Congressmen do occasionally introduce bills, as to the fairness and propriety of which even they are not always persuaded. They figure that if it's unfair to any segment of the citizenry, this will become manifest after the bill has been publicly introduced—by way of complaint from those to whom it's unfair. Obviously, all the radio stations cannot exercise constant scrutiny over the hundreds of bills and resolutions that go into the hopper each year. That's why it's so important to have, in Washington, an organization representative of all broadcasting interests which keeps a wary eye on proposed legislation and which is prepared to state the case for the industry and for the listener—openly and legitimately — in any Congressional hearings that may be held.

A similarly alert contact must be maintained with the activities of the Federal Communications Commission. It is only natural for a group of men who are deciding where their authority ends and another's begins, to favor themselves. It is natural for them sometimes to assume prerogatives which perhaps they don't rightfully possess. So sound democratic practice requires that someone should check up on them, that someone or some agency should be constantly alert to resist such enlargements of function as they might consciously or unconsciously seek to assert.

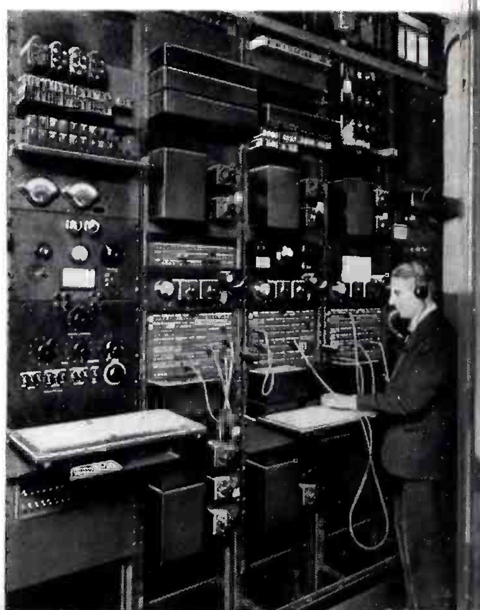
It is with reference to Congress and the FCC that NAB gets in some of its most important work in behalf of the legitimate interests of the industry. And some-

1922: Only a year before the NAB was formed, the first commercial transmitter in the country was installed at WWJ, Detroit (shown in picture below).



1923: Broadcasting studios looked like this the year the NAB was formed. Here are the studios of WEAF. The first chain broadcast emanated from them.

1926: First network was started this year by NBC. Below, an early Telephone Switchboard room where stations were interconnected throughout the U. S.



times this is effected by going to Congressional Committees or the FCC direct.

In any case here is where the higher echelons of NAB — President Justin Miller, Executive Vice President A. D. Willard, Jr., Secretary-Treasurer C. E. Arney, Jr., are most active.

One of the greatest things NAB has ever done was to adopt the famous self-regulatory Code of 1939. The industry was proud of it, the public applauded it, and there can be no doubt that it was a progressive social instrument which conferred great benefits on the industry and on the public.

The Code made sound contributions under the headings of religious programs, children's programs, and length of commercial copy. But one of its most significant contributions was to recognize the industry's social responsibility in the matter of providing equal opportunity to both sides of a controversy on a public issue, irrespective of wealth or lack of it. They recognized that when both sides were equally rich or equally poor, they could be counted on to match each other's efforts, but that this was not true when one side was rich, the other poor. And since it would have been undemocratic to force one side of any controversy to petition for time virtually *in forma pauperis,* the Code provided that all time on member stations devoted to the discussion of controversial public issues should be free time, divided equally between the controversialists. Certain exceptional provisions were made with respect to political programs and "forum" programs; but the principle of giving a fair share of time to all points of view was rigidly maintained.

This progressive Code was almost universally accepted by broadcasters, and worked admirably. But in June 1945 the FCC issued its decision in the WHKC case, stating: "The Commission . . . is of the opinion that the operation of any station under the extreme principle that no time shall be sold for the discussion of

C. E. ARNEY, Jr.
Secretary-Treasurer of the NAB

controversial public issues . . . is inconsistent with the concept of public interest established by the Communications Act as the criterion of radio regulation . . . The fact that it places an arduous task on management should not be made a reason for evading the issue by a strict rule against the sale of time for any programs of the type mentioned."

The line was broken. Next, the lawyers began urging cautions upon the industry, pointing out that, under the Communications Act of 1934, each licensee was solely responsible for seeing to it that his license was used "in the public interest, convenience, and necessity," and that a broadcaster's subscription to a mandatory NAB Code might be construed by FCC as constituting an illegal delegation by the licensee to NAB of some measure of his exclusive statutory responsibility; and a further caution that a mandatory NAB Code might be held to contravene the anti-trust laws.

In normal times NAB could and should have faced these questions, and faced them down. But there was a war on, and a war-related job of broadcasting to be done which took precedence over everything else. It took precedence, and it was done—to the everlasting credit of American radio.

Program Department Inaugurated

And be it said further to the credit of American radio that as soon as the war-pressure was relaxed, long before FCC issued its "Blue Book," NAB had begun to come to grips with the old problem. Thus as early as May 14, 1945, the NAB Program Managers Committee recommended establishment of a Program Department, a recommendation which was considered favorably by the NAB Board on January 5, 1946—whereas the "Blue Book" was not released until March 7, 1946. Obviously the purpose of an NAB Program Department was neither to confect programs nor to produce them, but to study them and seek to improve them. In fact the recommendation of the Program Managers Committee read:

> "It is the obligation of every broadcasting station to operate in the public interest, convenience and necessity. . . .
>
> "The program managers committee . . . feels that a program department in NAB, with a paid Director in charge, can render great service toward the fulfillment of this obligation.
>
> "Therefore, this committee recommends to the NAB Board of Directors the establishment of such a program department."

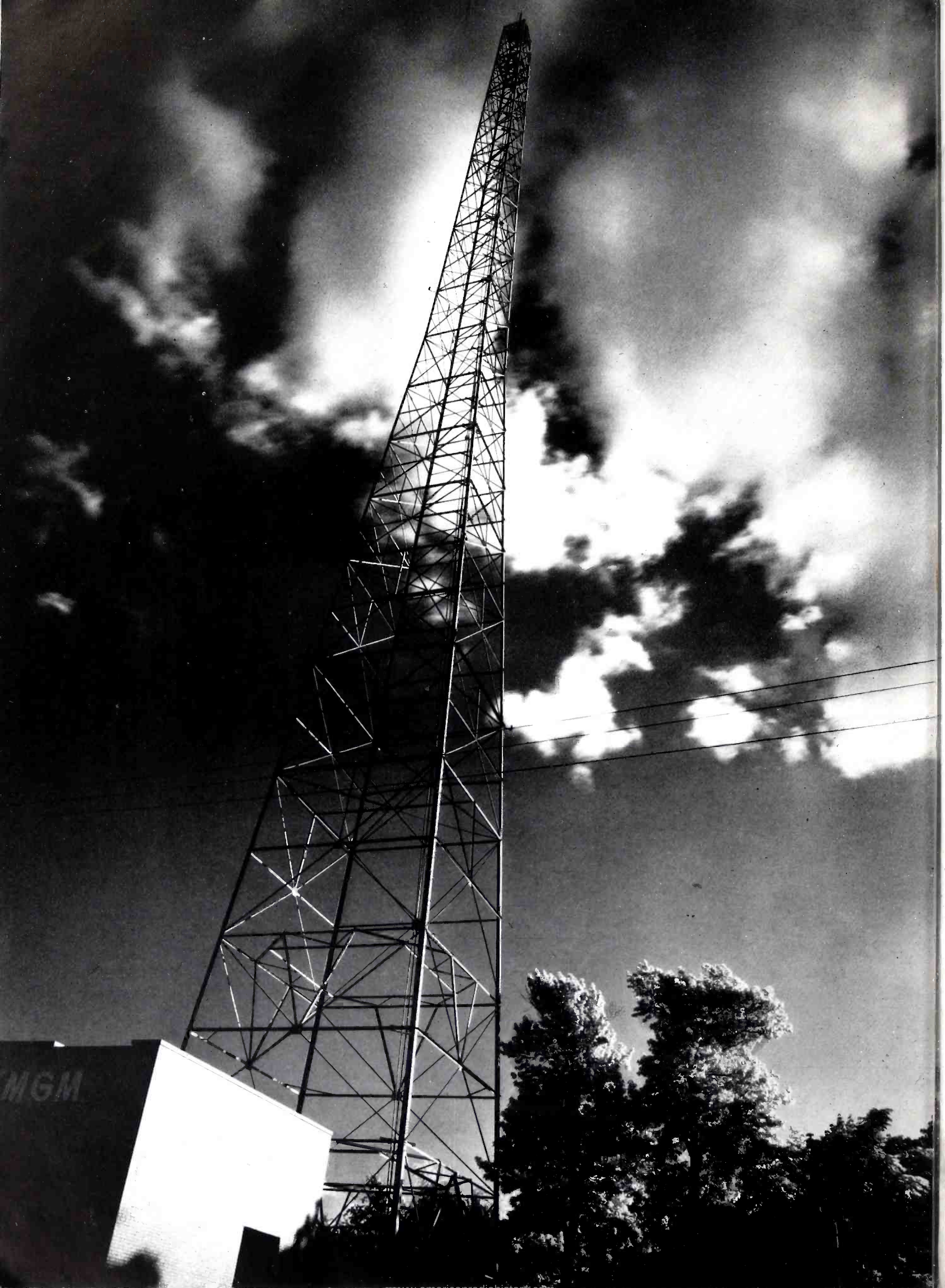
This resolution was adopted by the Program Committee ten months before the "Blue Book," and given a favorable nod by the Board two months before the "Blue Book." Given time to work out a well-considered program, this new department would have sought to establish the

(Continued on page 38)

1931: Technically, Broadcasting had vastly improved as NAB entered eighth year. Antenna designs like half-wave vertical radiator were more efficient.

1940: Frequency Modulation invented by Maj. Edwin H. Armstrong was a milestone in Radio that year and created for the NAB a great new area of service.

1946: As a result of the war, Radio Broadcasting gained new importance as a medium for keeping the People informed of major events in a changing world.


MGM

"WHN Does It Again . . . In FM"

Loew's popular New York AM Station has big plans underway in FM

By George de Mare

HERBERT L. "Herb" Pettey, executive director of New York's WHN and its FM counterparts, WMGM in the East and KMGM on the West Coast, believes in FM in a big way. And now WHN—all its long life a station that likes to stay out in front and pioneer new fields—is betting over $125,000.00 of new equipment on Herb's confidence in frequency modulation.

It was in 1941 that WHN went to the top in AM power and received its 50 kw license. Its plans were big and when its Western Electric transmitter was installed, it became one of the Nation's few top-powered independent stations. In 1942, WMGM, WHN's FM sister, was born as one of the pioneer FM stations of the Nation at 46.3 mc, starting with a 1 kw Western Electric transmitter and the call letters W63NY (later WHNF). Going into FM on a major scale, WHN has worked out plans for a bigger and better FM installation and FM programs of highest quality.

Herb Pettey has said: "Frequency Modulation in my opinion is due for an unprecedented and impressive growth—a growth of such proportions that eventually FM will completely displace AM radio except in clear channel stations in strategic geographical areas."

Now that's putting down the chips with no "ifs," "ands" or "buts!" To look over the new FM set-up beginning to take shape at Cliffside, New Jersey, we went to see Paul Fuelling, WHN's chief engineer. We went with Paul for a 20-minute ride from New York to WHN's FM transmitter building and antenna tower on the Palisades overlooking the Hudson River. Paul Fuelling is another FM believer and this quiet, able engineer is putting up a really top grade FM installation out there.

The location of the FM installation is in itself newsworthy. As you walk up to the entrance to the transmitter building you see that it is placed right on the edge of the high Palisades which look down on New York's upper Manhattan — a commanding position both for sightseeing and for the location of an FM antenna. The antenna tower, shown on the opposite page, seems to "grow" right out of the building, but on closer inspection you see that it is some 15 feet in the rear. It is atop this 335-foot Blaw-Knox tower that a new Western Electric Clover-Leaf Antenna will soon be erected. This 54A Antenna was delivered some time ago, so to WMGM goes the distinction of being the first New York station to receive a Clover-Leaf.

WMGM's transmitter building overlooks upper New York City from the New Jersey side of the Hudson River. This is the view through the front door.

Inside the transmitter building, Paul showed us around. This building also houses WMGM's FM studios. From here, seven hours a day, FM listeners in this area get a well-rounded program of music, sports and newscasting at 99.3 mc.

Let's take a typical day's program going out over this station's airways from 2 P.M. to 9 P.M. on a Monday.

PROGRAMS

2:00	Musical Caravan
3:00	Baseball
5:00	Styles in Song
5:15	Moods in Music
5:45	Washington Inside Out
6:00	Magic of Music
6:30	William Lang
6:45	Harry Horlick
7:00	George H. Combs
7:15	Broadway Musical Favorites
7:45	Johannes Steel
8:00	Books on Trial
8:30	Moonbeams
9:00	Station Signoff

Frank Roehrenbeck, general manager

Herbert Pettey, executive director

Paul Fuelling, chief engineer

Bert Lebhar, Jr., sales director

With one eye on the turntable, Grover Wizeman operates the 23C Speech Input Console at WMGM. The 25A Console in the right background will replace the 23C when the station's new 10 kw transmitter is installed.

Behind this program and the big future programs now in the planning stage, Paul Fuelling is proceeding with the installation of equipment for what promises to be one of the best FM stations of its size in the country. Right now, you can see the 1 kw Western Electric 503 Type Transmitter with its associated equipment. You can also see the space reserved for a new Western Electric 506 Type 10 kw FM Transmitter. When the new equipment is installed, the present 1 kw transmitter will serve as the driver for the 10 kw amplifier.

One feature Paul mentioned particularly was the FM Synchronizer developed by Bell Telephone Laboratories. "The Synchronizer in our present transmitter," he said, "is absolutely foolproof and has been really dependable in keeping us on frequency."

1126 Type Amplifier Used

The programs are fed through a Western Electric 23C Speech Input Equipment. Other studio facilities include two turntables with Western Electric reproducers and equipment which includes a Western Electric 1126 Type Program Amplifier.

When the 10 kw transmitter plant goes into operation, a Western Electric 25A speech input equipment, which the station already has received, is waiting to serve with it. The new 54A antenna will replace the present Western Electric coaxial antenna.

These carefully worked out FM plans are similar to those which in the AM field made WHN one of the Nation's leading independent stations. Herb Pettey believes in station specialization, and with unexcelled equipment and technical facilities, WHN has, in addition to a number of noted evening programs, become known as "The Sports Station of the Nation." The station is particularly proud of its crew of stellar sports commentators such as Red Barber, Bob Bryar, Connie Desmond, Clem McCarthy, Tedd Lawrence, Sam Taub, Ward Wilson, Bert Lee, Marty Glickman, and many others. It covers virtually every important sports event from baseball to roller skating, (it covered the recent National Roller Skating Championships). Among its feature evening shows, General Manager Frank Roehrenbeck boasts of the extremely popular *Books on Trial*, emceed by Sterling North, in which an author has the chance to defend his views before his critics. Others include the *Commentator's Roundtable* with Sidney Walton, the *Gloom Dodgers, Ted Husing's Bandstand,* and the *Congressional Record* in which one of the Nation's Congressmen gives an account of his job and his views on a question of national importance. Of WHN's top commentators, listeners are treated to the programs of George Hamilton Combs, Jr., Sidney Walton, Johannes Steel, William Lang and, for Hollywood, Adrienne Ames.

WHN's 50 kw AM equipment is housed in a modern, excellently designed transmitter building in Rutherford, New Jersey, "six miles from 42nd Street and Broadway," a few miles south of the FM building. There the station's two huge Blaw-Knox antenna towers 400 feet high are landmarks on the Jersey meadows as you cross the Hackensack River Bridge. The directional array is aimed a little north of due east (toward New York's 110th Street) in order to avoid interference with a powerful station on the same frequency (1050 kc) in Southwestern Mexico.

Neat and Trim Transmitter Layout

Paul Fuelling has a right to be proud of this AM layout, and the transmitter supervisor, B. H. "Bernie" Stahl, has a right to be proud of the way it's maintained. Neat, trim, clean as a whistle, beautifully air conditioned, everything from replacement tubes to diesel stand-by power plant in perfect condition, this might well serve as a model station transmitter layout. The transmitter which powers this AM station is completely Western Electric and represents the fourth Western Electric AM transmitter installation in a row for WHN. From its 500 watt power in 1932 to the 1 kw plant installed in 1934, the 5 kw plant which followed in 1936,

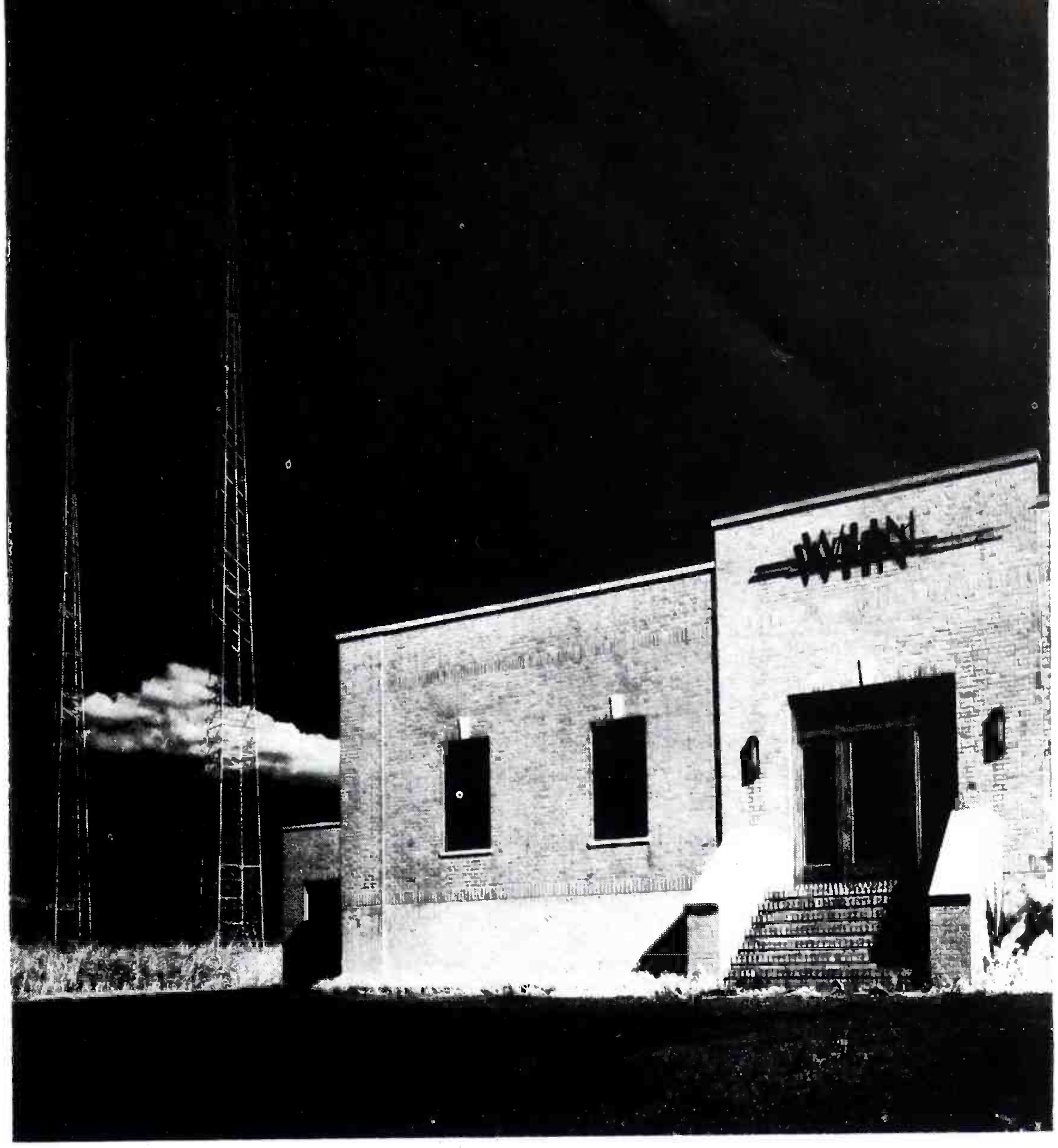
Paul Fuelling, chief engineer, checks the 1 kw Western Electric FM transmitter at WMGM. The blank area at the right will be filled by additional units which will give the station a power of 10 kw.

and the 50 kw installed in 1941, all were of Western Electric manufacture. The 1 kw transmitter is still in perfect working order and is installed as a stand-by.

Push Button Control for Emergencies

In this 50,000 watt transmitter, special relay circuits have been provided which are insurance that WHN should never go off the air for even a few seconds during its broadcast day. A panel of push buttons takes care of any emergency, providing split second switching from 50 kw to 5 kw or 1 kw of power. Located in the "F" unit of the transmitter, one button automatically controls the heating of the filaments of the separate 5 kw rectifier tubes, the second cuts out the final stage, keeping the transmitter on the air at 5 kw of power, and the third button provides for instant switching to the 1 kw stand-by.

The maintenance of the transmitter plant is under the supervision of Bernie Stahl and we asked Bernie how he managed to keep the station in such top-notch operating condition. He obliged us with his maintenance schedule which we reproduce here as one showing real results in keeping a large station in apple pie order.



This striking photograph — made with infrared sensitive film — shows WHN's up-to-the-minute transmitter building and antenna towers at Rutherford, N. J. Power is beamed directly at New York City, six miles away.

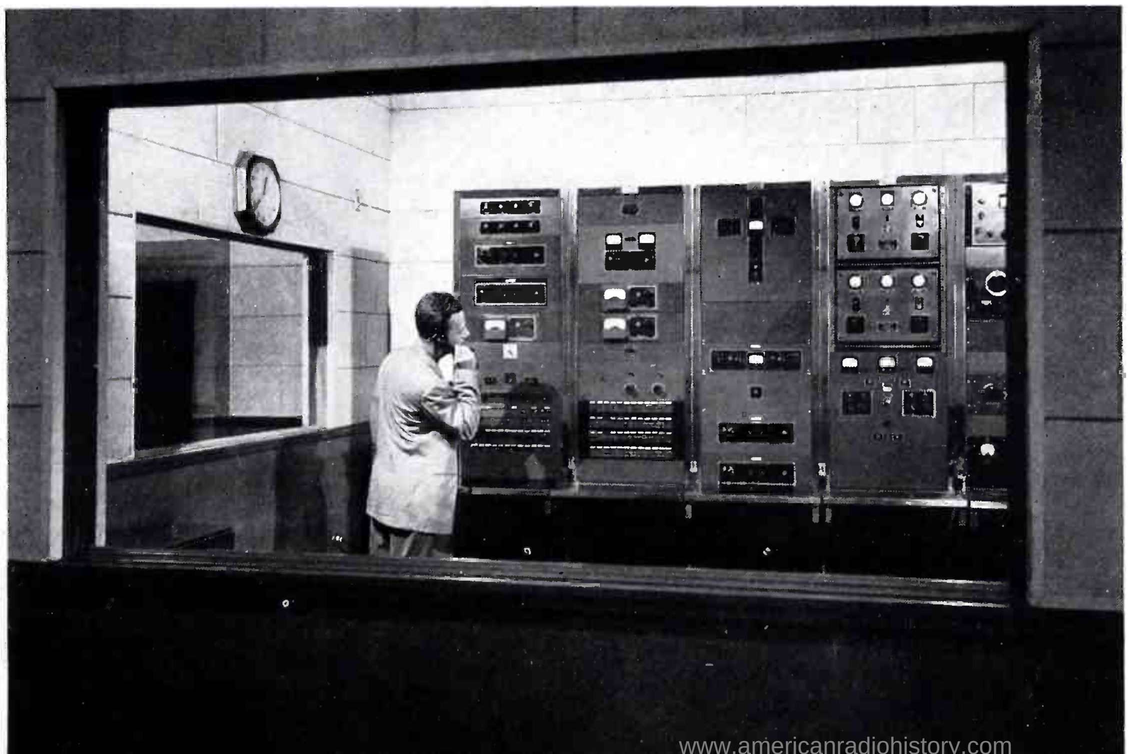
Mondays

1. Switch to alternate water pumps and crystal oscillator.
2. Inspect filament terminals, coil connections, antenna relay contacts and condensers for excessive heating.
3. Clean dust from F, A, C, D, E and 33B units with damp rag.
4. Check terminal blocks for loose connections.
5. Test 1, 5, 50 kw transmitters.

Tuesdays

1. Switch water pumps and crystal oscillator.
2. Inspect filament terminals, coil connections, antenna relay contacts and condensers for excessive heating.
3. Wash off with soap and water, insulators, condensers and water tubing in C, D, E units, water tubing insulators and relay in basement and the plate choke, protector and filter condensers in 50 kw enclosure.
4. Clean dust from caps and 33B units with damp rag.
5. Test 1, 5, 50 kw transmitters.

Western Electric amplifiers, volume indicators, switches, jack panels, equalizer panels and phase monitor — rack mounted and grouped for convenience — have their own room at WHN's transmitter building.

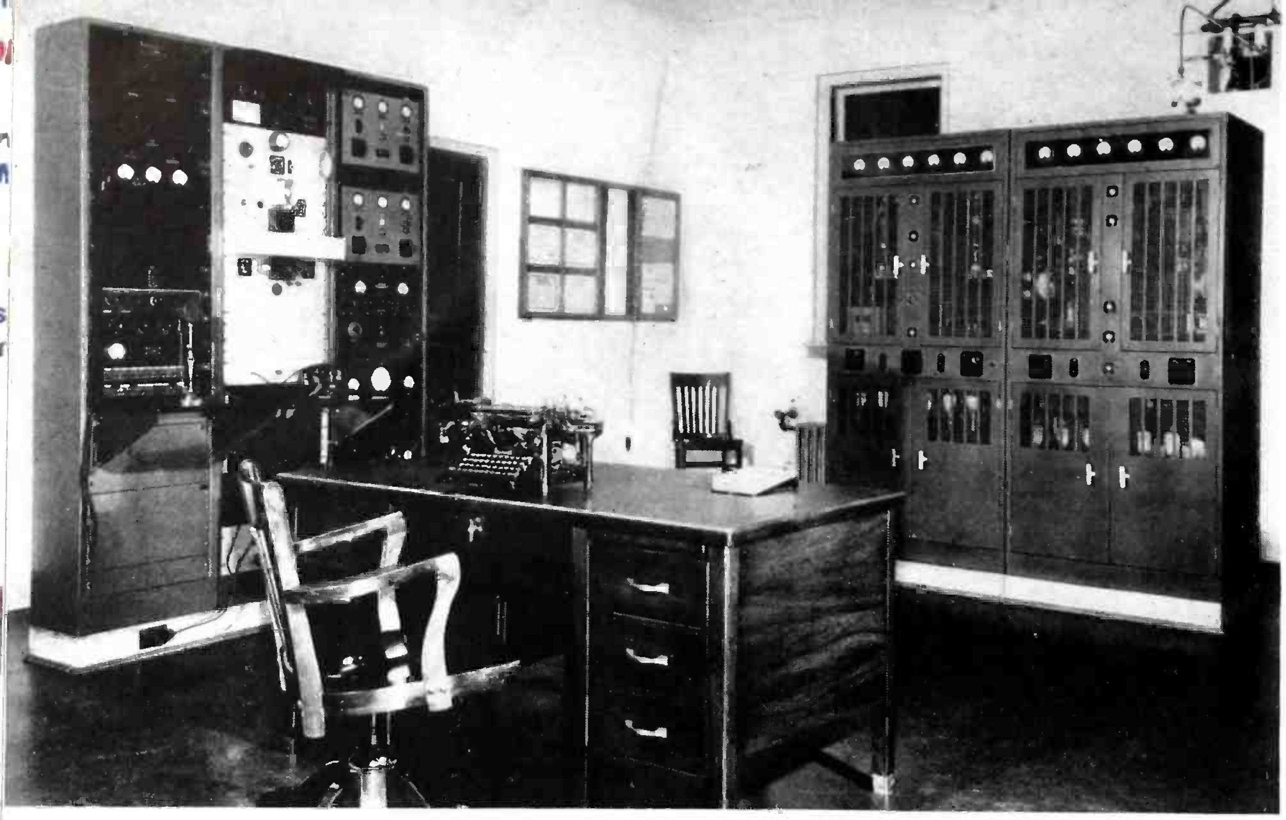


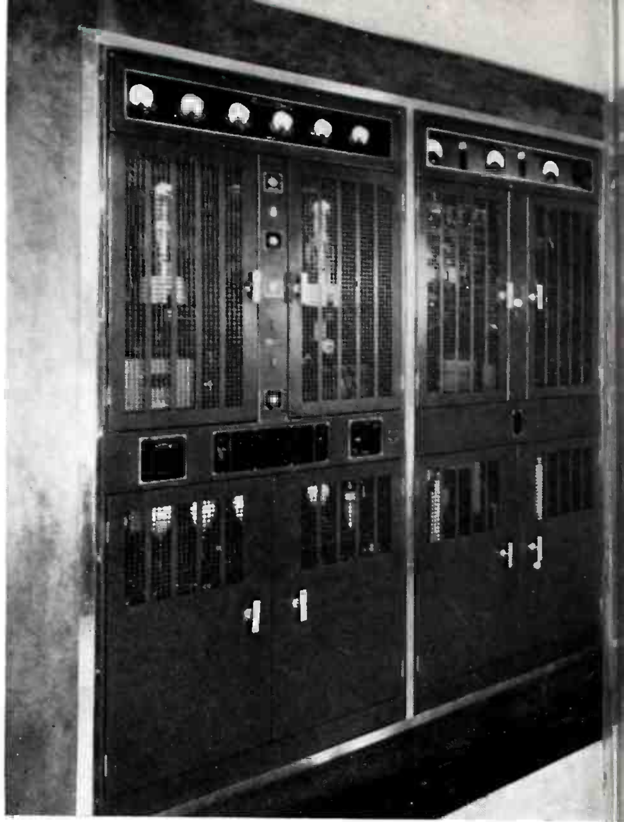
Wednesdays

1. Switch water pumps and crystal oscillator.
2. Inspect filament terminals, coil connections, antenna relay contacts and condensers for excessive heating.
3. Wash off with soap and water, rectifier unit H; also all equipment in high voltage transformer room. Include tuning coils, plate RF choke in back of D and E units.
4. Oil lower motor of H unit, if necessary. Do not over-oil.
5. Clean dust from all units with damp rag.
6. Test all transmitters.
7. Clean antenna tuning houses.

Thursdays

1. Switch water pumps and crystal oscillator.
2. Inspect filament terminals, coil connections, antenna relay contacts and condensers for excessive heating.
3. Blow out all transmitter equipment including plate filter choke with compressed air and follow up with damp rag.
4. Thoroughly clean 1 kw transmitter with damp rag, inspect connections.
5. Test all transmitters.





The three Western Electric AM transmitters shown in these photos cover the past 12 years in WHN's history. The 1 kw, above, was installed in 1934. It replaced an earlier Western Electric 500-watt transmitter, of which no photographs are available. In 1936 when WHN went to 5 kw, shown in center picture,

FRIDAYS

1. Switch water pumps and crystal oscillator.
2. Inspect filament terminals, coil connections, antenna relay contacts and condensers for excessive heating.
3. Make frequency runs on 1 and 50 kw transmitters, use regular forms.
4. Clean dust from all units with damp rags.
5. Test all transmitters.

SATURDAYS

1. Switch water pumps and crystal oscillator.
2. Inspect filament terminals, coil connections, antenna relay contacts and condensers for excessive heating.
3. Make frequency run on all radio lines, use regular forms.
4. Clean tower insulators and all equipment in *both* tuning houses with damp cloth, check all connections, polish gaps across condensers.
5. Clean dust from all transmitter units with damp cloth.
6. Test all transmitters.

SUNDAYS

1. Switch water pumps and crystal oscillator.
2. Inspect filament terminals, coil connections, antenna relay contacts and condensers for excessive heating.
3. Use damp cloth on caps G, K and rest of equipment in 5 kw. Check oil levels on choke and transformers.
4. Clean top of all units. Clean meters and check for 0 adjustment.
5. General cleaning and inspection.
6. Test all transmitters.

(Daily antenna meter readings are recorded in operating log at half hour intervals.)

ADDITIONAL WORK SEMI-MONTHLY

1st and 15th of each month lubricate Rotex bearing.

Every second Friday rotate 255B rectifier tubes as per schedule.

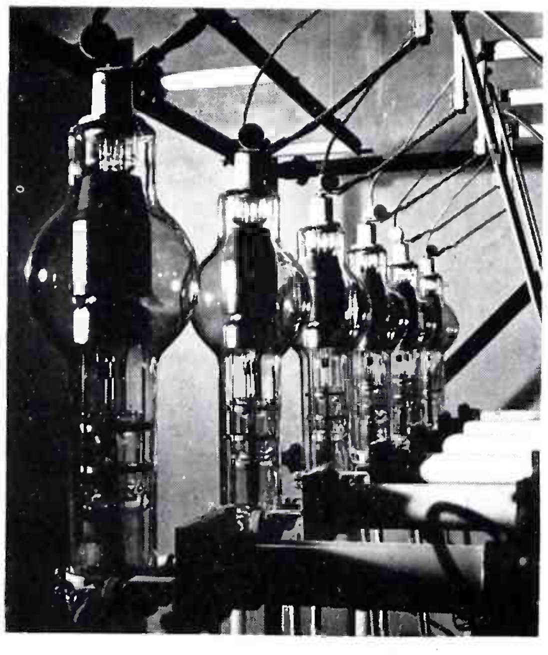
First of each month polish and check clearance of all protective gaps.

15th rotate 241B vacuum tubes.

MONTHLY

First of each month check electrolysis targets, check lubrication and clean voltage regulators, check oil level on transformers and plate regulator.

Check and polish filament and grid terminals of 298A power tubes.



Row of six mercury vapor rectifier tubes at WHN

Clean and polish terminals of 232B tubes, remove dust covers from A unit and clean with air.

Clean contacts of S63P-HV, transmitter room.

Make record of all lubrication and electrolysis target inspection in record book.

8 A.M.-4 P.M. WATCH

Daily dusting of speech equipment bays, etc.

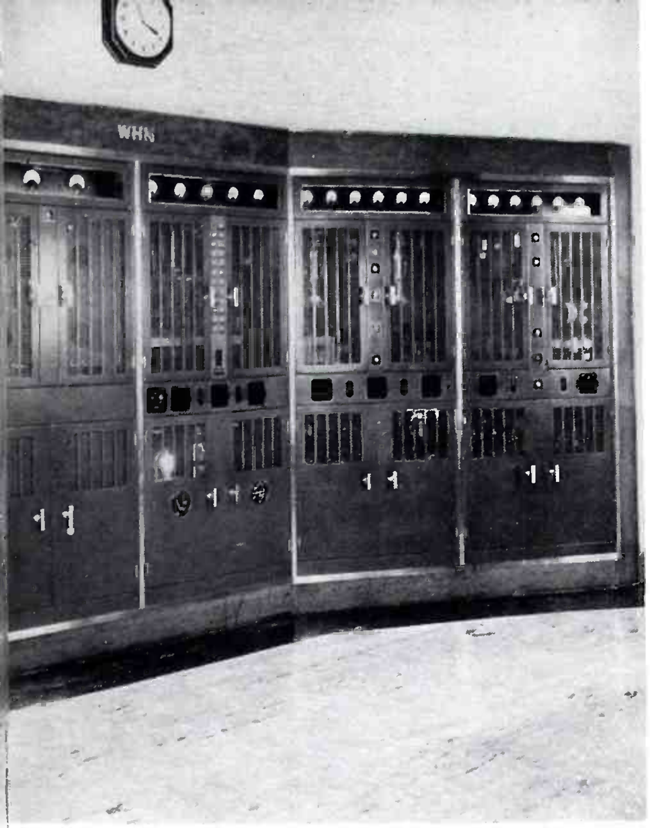
Every Monday polish patch cord plugs. Check gain controls for noise and clean if necessary. Check meter switches and clean.

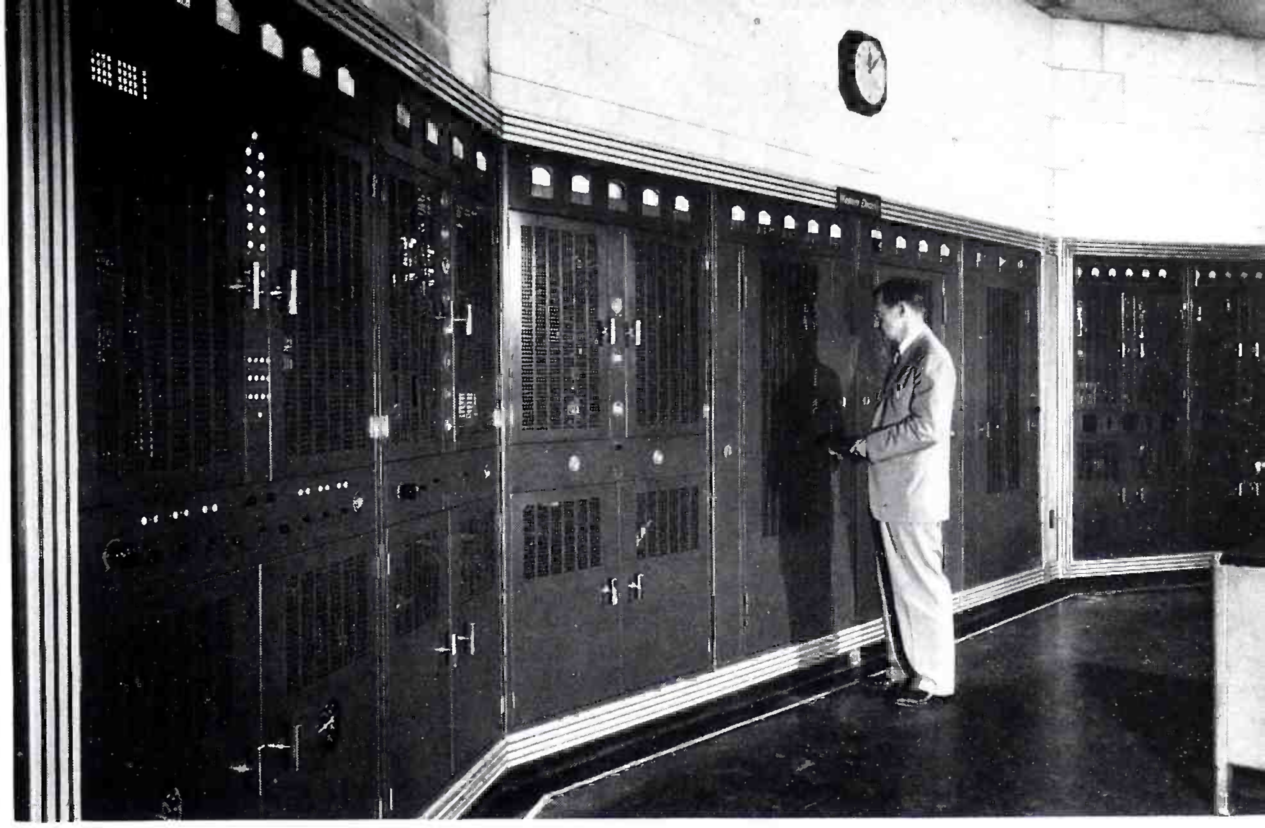
Check water and clean diesel battery. (Diesel stand-by power plant.)

Bernie Stahl made this comment, "In carrying out this maintenance schedule we rarely find it necessary to make any adjustments on our Western Electric transmitting equipment, and our daily oscilloscope tests show that the Doherty circuit is particularly stable in operation."

A Quarter-Century Old

WHN has one of Broadcasting's longest and most colorful histories. The station started in the Ridgewood section of New York City back in 1922, originally licensed to George Schubel of the *Ridgewood Times*. In 1923, it was sold to its present owner, the Marcus Loew Booking Agency. It was a 250-watter then and operated 57 hours a week. From its original site, it was moved to the Loew Building on Broadway, and in 1932 a number of other small stations were merged with WHN on the 1010 kc frequency band and the station became a 500 watter operating full time. In 1934, its power was boosted to 1 kw





the 1 kw was retained as a stand-by. Late in 1941 WHN received its present transmitter — a Western Electric 50 kw. This is shown at the right, above, with Chief Engineer Paul Fuelling standing in front of the equipment. When the 50 kw was installed, the 1 kw was again retained as the stand-by transmitter.

and in 1936 it became a 5 kw station.

Many personalities and colorful incidents are associated with WHN. It is believed to be the first station to broadcast remotes, when as far back as 1923 it picked up dance bands from the Silver Slipper, the Anatole Club, Cotton Club, Roseland and the Frivolity Club. Famed names in the entertainment world like Nils T. Granlund (N.T.G.), Harry Richman, Ted Husing, Bob Burns, Whispering Jack Smith, Van and Schenck and Major Edward Bowes are all part of WHN's glittering past. It was in 1934 while Major Bowes was managing director of WHN that he introduced to the airways his famous "Amateur Hour" and started the trend to audience participation shows.

The Marcus Loew Booking Agency which operates WHN and its sister stations in the FM field is a subsidiary of Loew's Inc., which also owns Metro-Goldwyn-Mayer.

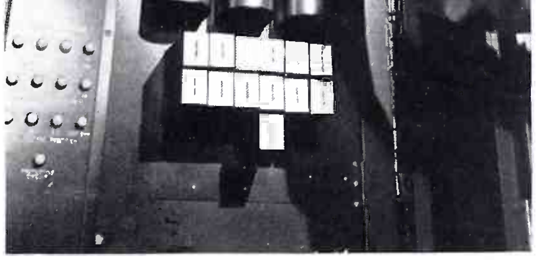
A Progressive Staff

The men who serve this farsighted, progressive station are top men in their own right. A lot of people in Broadcasting know Herb Pettey, WHN's executive director, who took over from Louis K. Sidney in 1937 when the latter went to Hollywood to handle radio and screen production for MGM. A former secretary of the FCC and Radio Director of the Democratic National Committee, Herb is one of the Industry's leading figures. He came to WHN in 1936 as sales director and assumed charge one year later. It was under his direction that the station went to 50 kw in 1941.

Ably assisting Herb Pettey is Frank Roehrenbeck, WHN's general manager with 25 years of varied management experience to help him keep the station operating at top efficiency 21 hours a day and to direct operations of a staff of 125 people. Frank joined Loew's in 1919.

The station also boasts one of the leading sales directors in the business—Bertram "Bert" Lebhar, Jr., who has made WHN a leader among New York's independent stations in gross billing and number of accounts. The post of sales promotion and merchandise manager is ably filled by Robert G. Patt. Publicity is handled by Jo Ranson, who has considerable newspaper and technical writing experience behind him. Raymond Katz is WHN's program director.

The technical staff headed by Paul Fuelling can be counted as one of the station's principal assets. Paul himself is responsible for the remarkable progressiveness of the WHN and WMGM technical thinking and its excellent operating plant. Like most of the country's top radio engineers, Paul has practically a lifetime of experience in the field. He was a "ham" in the old days as far back as 1912. In 1922, he designed, built and operated WBS for D. W. May of Newark. In 1932, Paul went to WHN and became chief engineer in 1939. Assisting him in the technical staff are—in addition to Supervisor Bernie Stahl—Harold Kane, Frank Kearney, Alfred Mehler, Karl Neuwirth, Orion Edewaerd, Oscar Marder, Charles Remer and Edward Meyers, transmitter technicians of WHN; Grover Wizeman of the WMGM transmitter; Frank Anzalone, Edward Greco and John Turner, supervisors of the WHN studios and Otto Korntheuer, Earl Gordon, Meyfert McIntire, Benjamin Lazarus, Carl Young, Allen Ferris, William Durkin, Israel Cohen, Ernest Schaufler, Sidney Taylor, Sanford Alper and Boris Momiroof, studio technicians.



A special relay panel in the "F" unit of the 50 kw transmitter at WHN provides split-second switching from 50 to 1 or 5 kw of power in emergencies.

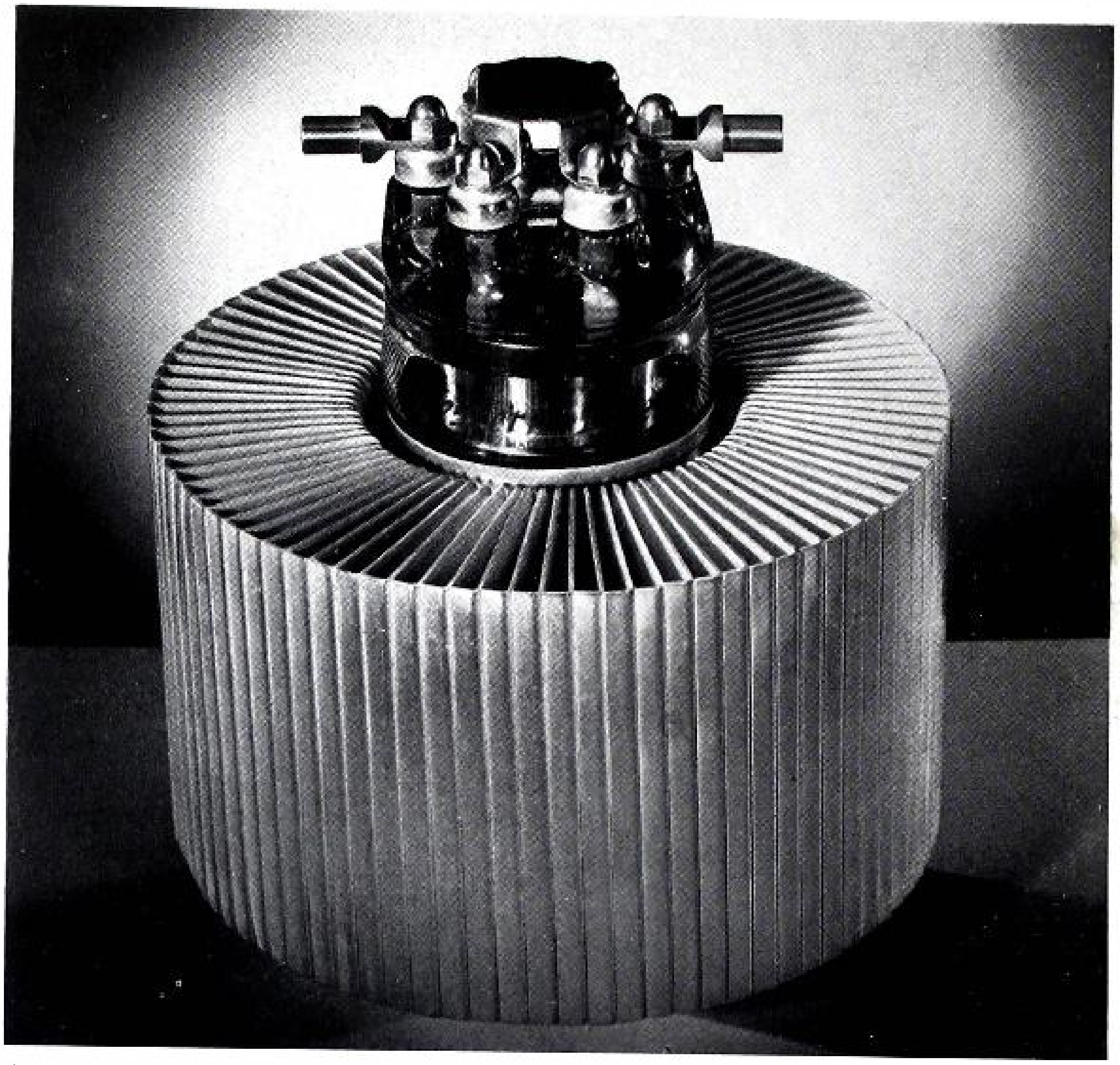
When we asked Herb Pettey to sum up for us some of his station's features, he let us have it straight. "It seems you've pretty well gone into our FM plans and operations, but it might be well to tell the boys that WHN has more than 15 million people in its primary area and blankets more than 11.6 per cent of all people in the entire country. We renew more sponsors than any other non-network station in New York. We air more than 280 minutes of news daily. And we have more big names of stage, screen, radio, sports, business and politics than any other New York station except network feeds."

THE 5541 VACUUM TUBE

10 KW Final Amplifier Tube for FM Transmitters

By C. E. Snow

Western Electric Radio Division



The 5541 — a single thoriated tungsten filament vacuum tube — used in final amplifier of Western Electric's new 10 kw FM transmitters. It is suitable for grounded plate, grounded cathode or grounded grid circuits.

Heart of the final amplifying unit in the new Western Electric 10 kw FM transmitter is a single thoriated tungsten filament vacuum tube, coded 5541. This tube, an important member of a family of high frequency power tubes being developed by Bell Telephone Laboratories, is remarkably adaptable, as it can be used not only with the highly efficient grounded plate circuit found in the new Western Electric 506B-2 Transmitter but also is suitable for operation in grounded cathode or grounded grid circuits. The element terminations are especially designed to attain this flexibility by means of suitable easily applied attachments.

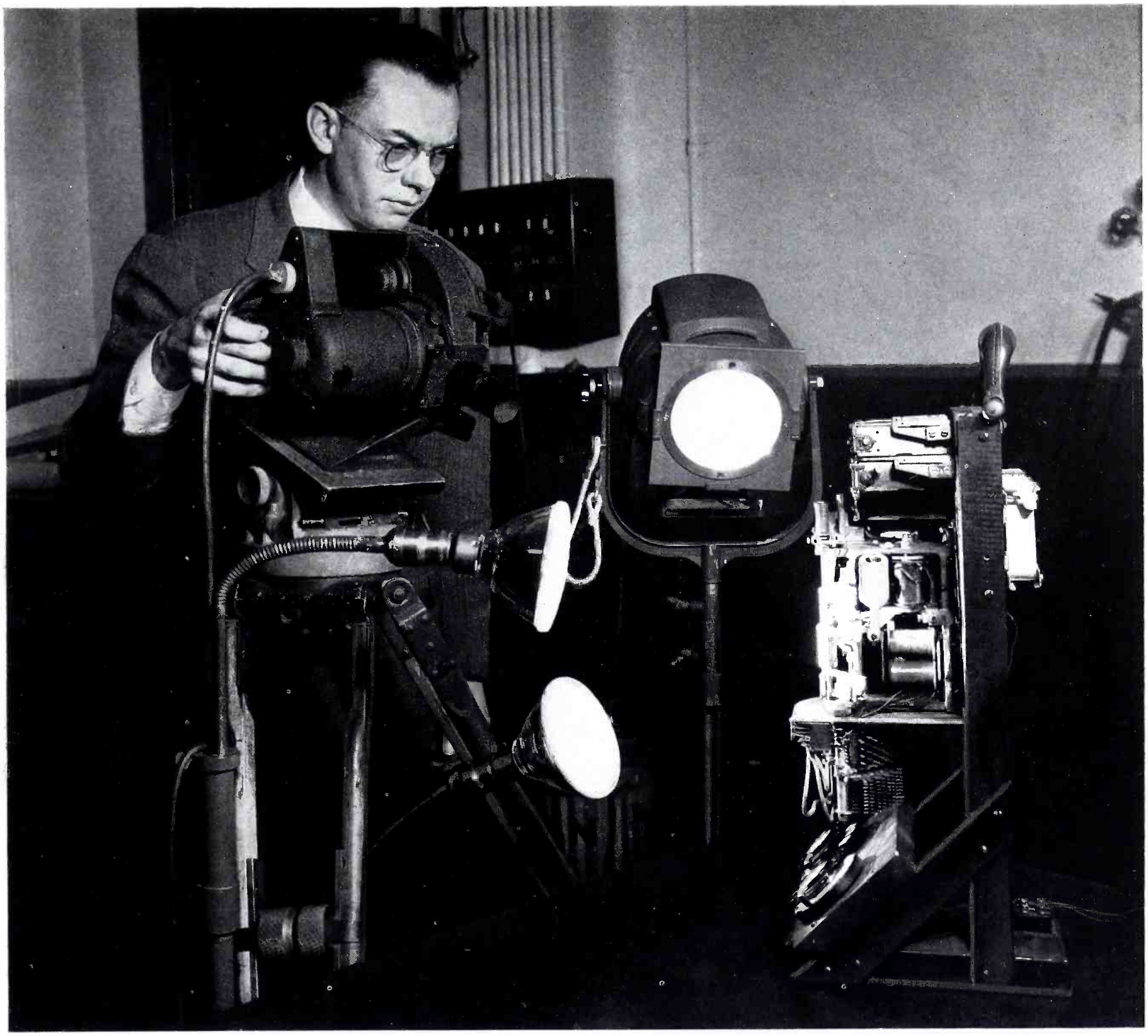
The important characteristics of the air cooled 5541 Vacuum Tube may be summarized as follows: The four strand thoriated tungsten filament has a nominal rating of 55 amperes at 7.5 volts. The tube has a mu of 26, maximum plate voltage of 8,000 volts and a plate dissipation of 10 kw. It is capable of operating at full ratings up to a frequency of 110 megacycles.

Its thoriated tungsten type filament is the most efficient filament for powers of this magnitude. For example, only one fifth of the filament power is required in the 5541 that would be necessary if the filament were constructed of pure tungsten. The filament structure is of the self-supporting type which requires no sliding contacts, insulators, or tension springs. These design features are attainable with the relatively short element lengths frequently associated with high frequency operation. As an aid to further simplification of circuit design, the filament strands are so located with respect to the grid that they minimize the amount of radio frequency power required to drive the tube. In fact, the drive power necessary to obtain a liberal margin of power above 10 kw is somewhat less than 500 watts.

The grid of the 5541 has been designed to meet requirements laid down by circuit engineers for a low inductance element and at the same time to possess great mechanical strength. In the accomplishment of these objectives, a unique application was made of some of the fundamental principles of structural engineering.

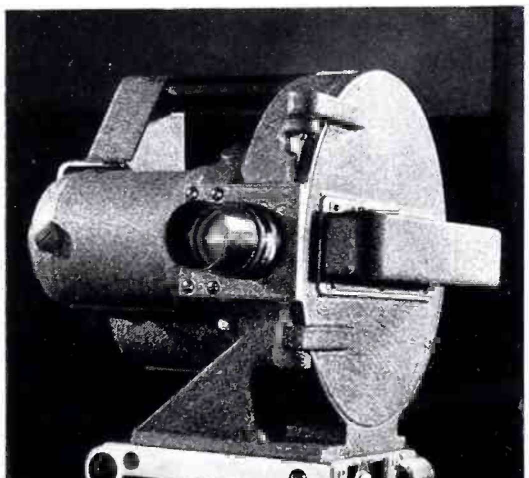
The internal connections to, and the support of, the grid are made by rugged low inductance, high conductivity leads, which provide an external terminal arrangement permitting great flexibility in the application to various types of circuits. In furtherance of the over-all requirement for mechanical strength, Kovar-to-glass seals are used throughout. In the choice of Kovar, advantage is taken of knowledge and techniques acquired during wartime production of military tube types. These Kovar seals are especially processed to minimize radio frequency losses which are much more pronounced in the high frequency portion of the spectrum to which FM broadcasting is assigned.

The tube is designed with clean lines which contribute to the high over-all efficiency of the cooling air stream, and it has the short, stubby anode which is characteristic of high frequency power tube construction. The cooling fins provided are designed to use available standard air blowers thus obviating the need for blowers which must be made especially for a single type of vacuum tube. In keeping with the general simplicity of element assembly, the exhaust operation is carried out through a copper tubulation located at the bottom of the anode. This is in contrast to the conventional glass tubulation and seal off tip at the opposite end of power tubes of former design. Here again, techniques learned during the war in the production of magnetrons and other special electron tubes are used in the manufacture of tubes for peacetime application. Safety from failure due to mechanical faults is obtained in great measure by the absence of screws and threaded parts in the tube's internal construction. All joints are welded or brazed, thus eliminating the possibility of their loosening during operation which in turn might result in element distortion or misalignment.



The Fastax reveals the innermost secrets of rapidly moving machinery. Here it is being used to "slow down" the high speed motion of telephone switching apparatus.

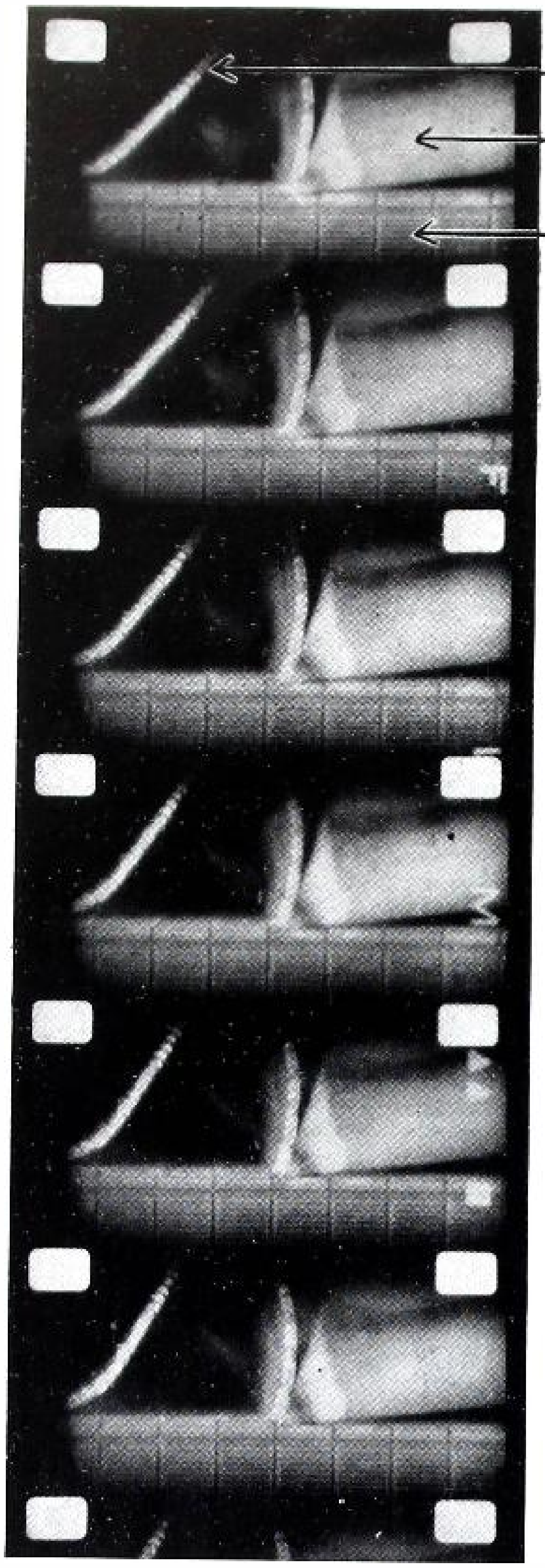
FASTAX—A New Tool for Industry



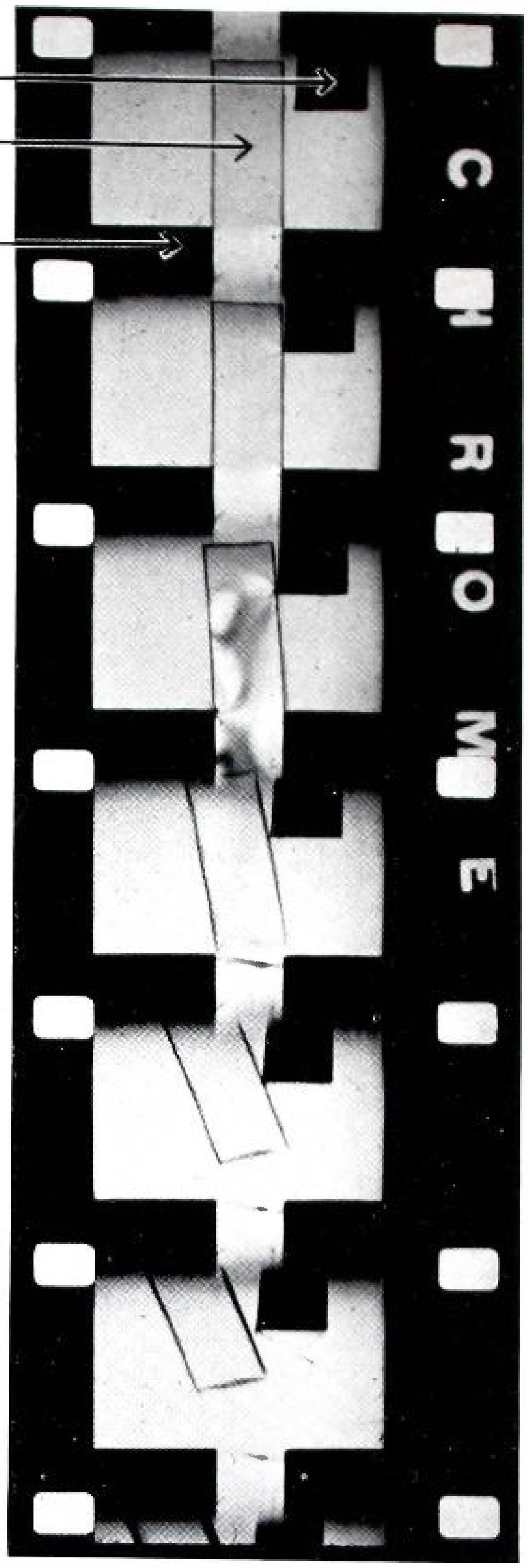
THE high-speed Fastax motion picture camera, whose unique role in making the photographic record of the atom bomb tests is described in the article immediately following, is rapidly becoming an important tool in American industry.

During the war, Fastax cameras were used extensively in the development of war equipment. Short duration phenomena such as the explosive effect of ammunition, jet propulsion, and the jamming action of machine guns were seen by engineers for the first time by means of the Fastax. War manufacturers, observing frailties in materials and parts moving at lightning speed under the shock of simulated battle conditions, quickly recognized the possibilities of applying high speed motion picture photography to peace time production problems. As a result, hundreds of Fastax cameras are today at work in dozens of major industries making "super slow motion" studies of the high speed action of fuse blowouts, relays and switches, governors, gears, clutches, pistons, propellers, watch and clock movements, flow of metals, and the fatigue of materials. Yet the surface of potential applications has only been scratched.

Design engineers are making wide use



The Fastax at work for the machine tool industry. In these unretouched pictures it slows to a snail's pace the action of the cutting head of a 32-inch shaper, traveling at 65 surface feet per minute, as it bites into a piece of 18-8 stainless steel.



A Fastax film reveals what happens when a clear plastic test specimen is broken in an Izod impact testing machine. The pictures were taken in color with polarized light at a speed of 4000 per second. Note stress patterns in third frame from top.

of the Fastax. Models are photographed during various stages of development and faults are detected and corrected as the work progresses.

The first Fastax camera to be designed employed 16mm film and took up to 4,000 pictures a second. The second used 8mm film and operated at up to twice the speed —8,000 pictures per second! When a wider angle was desired for ballistic studies a third Fastax was designed for 35mm half-frame wide-angle pictures. This camera gives 3,500 pictures a second and has an angle view of 40 degrees or a width of field of 71 feet when the camera is 100 feet from the subject. The Fastax looks much like a conventional motion picture camera. The rotary shutter, however, is missing and in its place, between the lens and the film plane, is a glass prism — four-sided for 16mm and 35mm film or eight-sided for 8mm film, with opposing faces parallel. An exposure slit is provided ahead of and behind the prism. The prism rotates while taking pictures and acts both to provide synchronous relationship between the images and the fast moving film and to perform the function of a shutter. The light rays picked up by the lens pass through the prism and are focused on the surface of the film on the driving sprocket. As the prism rotates the image moves with the film across the exposure slit. As soon as the prism has rotated to the point where the light rays might strike two adjoining prism faces, the prism housing performs the function of a barrel shutter, blocking the light from the film and so forming the frame line.

View Finder Attached to Door

In the 8mm and 16mm cameras the view finder is attached to the door. A right angle prism mounted on the inside of the door fits into the sprocket behind the viewing hole through the surface of the sprocket. A microscope objective in the finder tube is focused through this prism and an additional right angle prism directly onto the film plane. A light trap, operating by an external lever, prevents light from the finder from fogging the film while the camera is in operation.

The speed of the camera is governed by the voltage applied to the motors and ranges from 150 frames per second to 8000 pictures per second for the 8mm camera, 4000 pictures per second for the 16mm camera, and 3500 pictures per second for the 35mm camera; the 100-foot load of film lasts from 1½ seconds to 25 seconds, depending on the camera speed.

In order to take fully exposed pictures with available lenses and Super XX film at such speeds, it is necessary that light of extreme intensity be employed. However, by keeping the subject area to a small size, the focused, overvolted filaments of a few 150-watt show window spotlights, having the sealed-beam reflector, are sufficient.

The versatility of the Fastax has enabled it to be used in many unusual applications. Black and white and Kodachrome film have been used successfully in the camera. Polarized light has been used in studying the stress and impact conditions in transparent materials. It is also possible to take high-speed pictures of self-luminous objects, such as the filaments of incandescent lamps.

Other applications are being made at the Bell Telephone Laboratories using special Fastax high-speed camera equipment to photograph continuous traces from a cathode ray oscilloscope.

THE FASTAX AT BIKINI

By John Waddell

Bell Telephone Laboratories

EYES that could wink 8,000 times a second caught the blinding glare and stunningly fast rise of the atomic explosions at Bikini. These "eyes" were the batteries of Fastax cameras, developed by Bell Telephone Laboratories and manufactured by Western Electric, that saw service on Bikini and watched unfold the most powerful phenomenon ever created by man.

The Fastax previously had been used successfully on a smaller scale at the original atom bomb test at Alamogordo, New Mexico.

In handling such projects involving highly specialized knowledge and technique the Armed Services usually require the aid of many civilians. For the Crossroads Project they requested a technical photographic engineer from the Bell Telephone Laboratories and the author was appointed for that job.

We arrived by air at Kwajalein, Marshall Islands, April 29th. As soon as the cameras were unpacked, we set up suitable maintenance procedures to insure proper operation under prevailing climatic conditions, as well as to provide the photographic techniques for best performance and data gathering.

The fleet of 80 target vessels was to be arrayed in a position such as to show the effect of the blast on ordnance, aircraft and live animals. The photographic study called for all types of ultra-high speed motion picture cameras, still cameras, aerial cameras and special cameras that had been devised for recording oscilloscopic, radar and spectrographic data.

Kwajalein was the base for the photographic planes, while the B17 Mother Ships and Drones operated from Eniwetok. Bikini formed the other point of the triangle, it being about 250 miles to the northwest of Kwajalein.

Three Groups Take Pictures

The photographic study was divided into three major groupings: the first under Captain Robert Quackenbush of the Navy which was to record the event from ships and from towers on Bikini Island; the second the Air Force under Col. P. T. Cullen was to record the event from the air with ultra-high speed motion picture cameras, with motion picture cameras operating from 16 to 120 frames per second, with aerial still cameras both manually operated and electrically operated and with radar oscilloscopic and spectrographic cameras; and third the Los Alamos group of Manhattan District was to record the event from towers on Bikini primarily with ultra-high speed motion picture cameras.

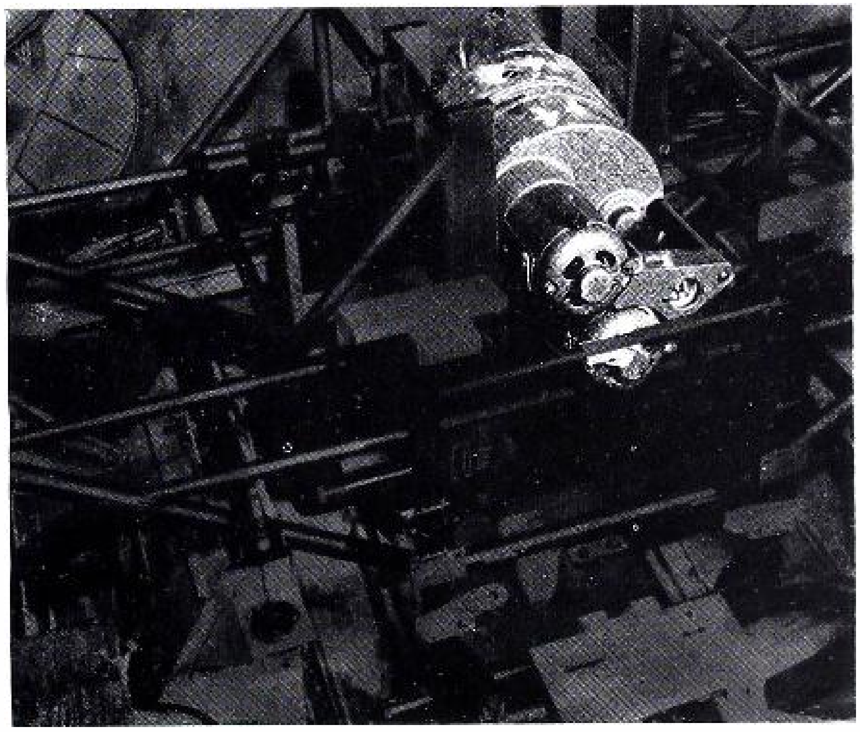
Three times the number of Fastax cameras that had been used at Alamogordo, New Mexico, were used on the Crossroads Project. The Air Force employed approximately 17 Fastax cameras and approximately 40 were required by the Los Alamos group. The Army Air Force Fastaxes were, of course, all airborne and were to be operated at a speed of 1,000 pictures per second. The Los Alamos group used their Fastax cameras at speeds up to 8,000 per second.

The Los Alamos group set up an electronic system for controlling all of the cameras both in the air and on ground installations. This circuit was such that the airborne 1000 PPS cameras were started two seconds previous to the blast and other higher speed cameras were started somewhat later (the total running time of the Fastax camera at full speed is about 1½ seconds). There was a tone signal simultaneously transmitted with the operating signal so that if the latter failed, the cameras could be manually operated.

The high speed cameras mounted on the towers at Bikini were rigidly supported and lenses of different focal lengths were used so that varying magnifications could be obtained of the blast, fire ball and of the damage to the ships due to the shock wave. The aerial test was more difficult because of the uncertainty as to the exact location of the bomb at the instant of ignition. The cameras were equipped with lenses varying from 35mm to 15 inches in focal lengths. It is interesting to note also that the lenses used were all standard photographic objectives and not of the telephoto type, which of course, rendered greater resolution than one could expect from the telephoto lens. Since the cameras

General Eisenhower watches demonstration of Fastax camera at Kwajalein by Maj. Perry M. Thomas, photo engineering officer, airphoto unit, Crossroads Project.

Wide-angle Fastax cameras mounted vertically in bottom of F13 photo plane which was directly over atom blast. More than 50 Fastax cameras were used at Bikini.



were designed with bayonet mounts, it was easy to change the lens set-up from one focal length to another. The three types of Fastax cameras used in the tower set-up were the 8000 per second 8mm, 4000 per second 16mm and the 3500 per second 35mm wide angle camera. The cameras were protected from excessive radiation by lead glass windows in lead housings. This simple set-up (relative to that at Alamogordo) was entirely suitable because of the relatively greater distance from the source of the gamma radiation.

On Kwajalein where the airborne cameras were fitted to the planes, more varied installations were required. Because of the mobility of the planes the cameras were mounted on free head tripods so that they could be quickly swung through a wide range. The planes used were F13's which were B29's modified for photographic work on the Crossroads Project as well as for mapping purposes and reconnaissance work elsewhere. On location the planes flew in a counter-clockwise orbit and hence the cameras were generally installed on the left hand side. There were automatically controlled cameras mounted in the top turrets, in the lower turrets and in the tail turrets which were controlled with the automatic gunsight. There were motion picture cameras installed in the tri-met (oblique mapping) position which is in the lower quadrant of the plane facing diagonally downward.

Mounted in Pairs

The high speed cameras were mounted in pairs in the blisters of the plane, one on top of the other on one tripod. The automatic control circuit started the top camera first and photographed the faster action which occurred at the instant of detonation and with the resulting fire ball and shock wave. The second camera started as the last part of the film was passing through the first and photographed the shock wave and the damage to the ships. The cameras of the pair were equipped with universal motors which meant that they could operate off standard 28 volts d-c power supply in the plane. As in the other camera installations described, the cameras were equipped with lenses of various focal length depending on the scene to be photographed.

Exposure tests were made of the sun so that the filter factors necessary to get a sharp image of such a subject could be established. It was found for example that a neutral density of 3.0, which is one-tenth of 1 per cent transmission, and the lens stopped down to f/22 would give a sharp image of the sun. But the maximum light of the flash would, of course, be from ten to a hundred suns in brightness and then would rapidly decrease to less than the sun. Using this basic data, the filter factors were established which were necessary to photograph the various phases of the blast as they occurred. Filter factors were also established for color photographs of the subjects. Also, absolute fields of view were completed for various lenses and cameras.

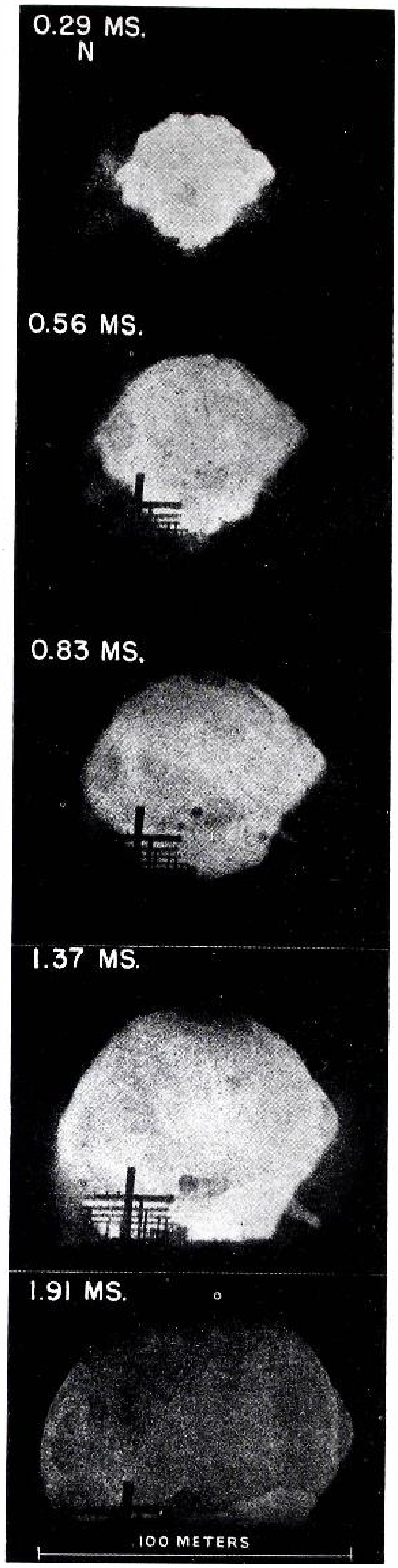
It was noted shortly after the arrival of the cameras that the high humidity and high temperature would have a tendency to affect certain parts of the cameras and immediate steps were taken to prevent any trouble occurring through the maintenance procedures, which as time went on proved wise for there were no Fastax camera malfunctions on any of the missions.

For the underwater test one other type of installation was made. This was for a plane which was to fly directly over the bomb at the instant of detonation. Four wide angle Fastax cameras were mounted in pairs with the fields of view of the two pairs at right angles in order to cover as large a field as possible. One camera of each pair was started as the others were finishing and thus as long a period of time as possible was covered. As in the other airborne Fastax cameras the speed was 1000 pictures per second.

Oscilloscopic Camera

As an additional feature two of the blast gauge B29 planes were fitted with oscilloscopic camera set-ups in order to study the effect of radiation accompanying detonation upon radio transmission. For this purpose a T34 cathode ray oscilloscope developed by Bell Laboratories and manufactured by Western Electric for Signal Corps use was installed in the plane along with a 35mm Fastax camera from which the prism had been removed. Radio circuits fed the oscilloscope, the trace of which on the oscilloscope screen was photographed by the camera continuously. The original tube as furnished with the oscilloscope was replaced with a tube having a short persistence (P11) coating, which was found best for high speed oscilloscope recording. The camera was run at 25 feet per second and frequencies up to 50 kc could be recorded under these conditions. This same set-up could be used very well to photograph blast pressures, sound intensity and other short duration events which occur at the time of the blast.

As to the Fastax pictures obtained through all this planning and effort, we never expect to see them and do not know how they turned out. The data to be derived from them is rated top-secret and that is enough for us. We do know that everyone in authority felt that the results achieved were all that could be expected and we have no doubts that they will prove to be worthwhile.



Fastax film taken at original atom bomb test at Alamogordo, New Mexico. The crossbars are silhouettes of poles carrying signal wires. Film was started by remote control 0.7 seconds before explosion.

MUSIC ON THE MENU

Tailor-made Program Distribution System provides a pleasant musical background for dining in the beautiful new Stouffer Restaurant in Cleveland

IT provides an atmosphere of music! That best describes the function of the Program Distribution System in Cleveland's Stouffer Restaurant, newest and finest of this famous restaurant chain. Lovely music provides a pleasant but unobtrusive background in the colorful and attractive dining rooms and cocktail lounges where Stouffer's patrons eat, drink and converse in pleasure and comfort.

The engineering and installation of this new system was handled by Graybar's New York sound dealer, the Smith Meeker Engineering Company. To achieve such fine sound reproduction, wide use was made of Western Electric's new 728B Loudspeaker which delivers music with exceptional presence and quality. Altogether 29 of these speakers were employed.

In placing the loudspeakers about the restaurant, Smith Meeker's engineers made certain that every listener would be placed in front of a loudspeaker, or within 25 degrees of its axis. By placing the 728B's in the 14-foot high ceilings on 10-foot centers, every inch of dining space is within the high quality zone of at least one speaker. With the loudspeakers so located, and with volume controls set at a low level, the reproduced music seems to permeate the rooms with absolutely even distribution and with no obvious source.

The only public room where this low-level type of distribution is not used is Dining Room 1, where two 728B Loudspeakers are mounted in the wall at one end of the room. Conventional high-level type of distribution is also used in the kitchen and in the employees' lounge.

The amplifying and control equipment is located in an anteroom where it is operated by one of the Stouffer hostesses. One standard 19-inch cabinet type relay rack houses the system's three Western Electric amplifiers, 117A, 118A and 124D, a monitor panel and a control panel. A transcription turntable is mounted in the same rack. A special reproducer arm permits the use of a Western Electric 9A Reproducer on this turntable within the restricted limits of the 19-inch cabinet.

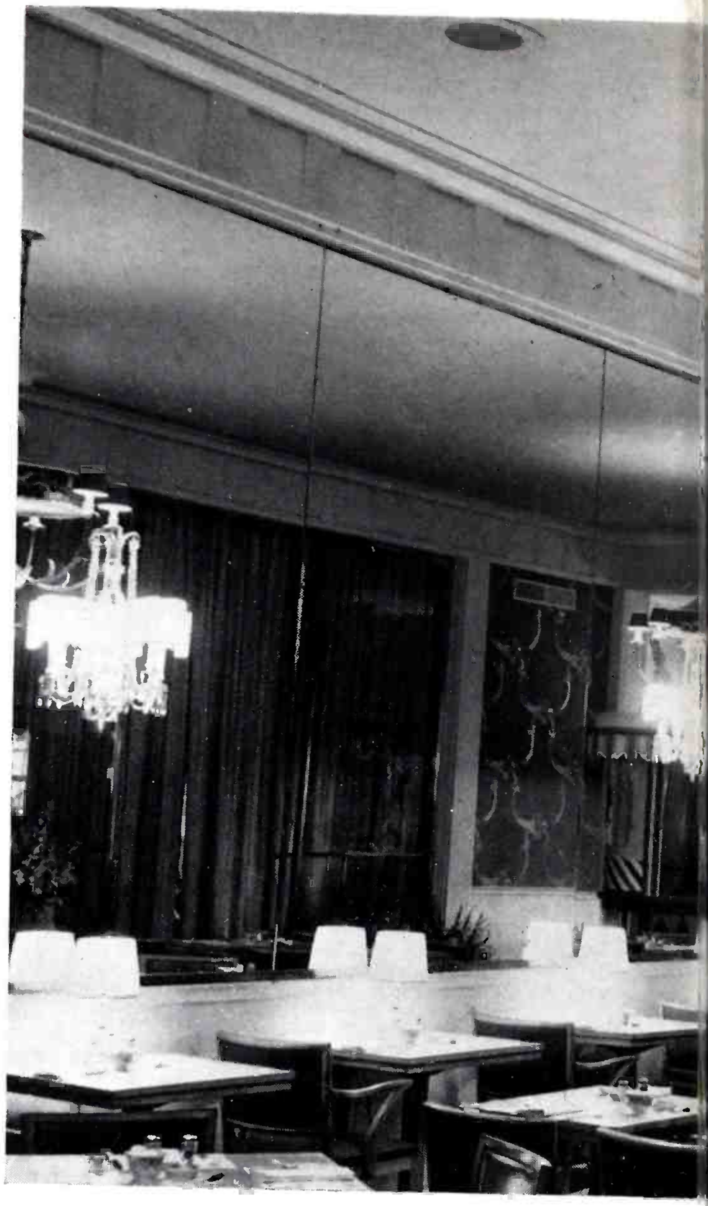
The low-level distribution system, which feeds most of the loudspeakers, is powered by the 117A and 118A Amplifiers which provide up to 50 watts of sound power. The high-level system is fed through the 124D Amplifier to the speakers in Dining Room 1, the kitchen and the employees' lounge.

The music distribution system provides two channels, either of which can be switched to any of the eight rooms in which loudspeakers are located. A system of remote controls provides for local selection of volume level for each room. In Dining Room 1, kitchen and lounge, a separate control is provided at each location. A remote control panel for adjusting the sound level in Dining Rooms 2 and 3 and the three cocktail lounges is placed in a central passageway conveniently located for checking and changing the sound level in these five rooms.

The system operates from four inputs: transcription turntable, radio receiver, microphone, and a telephone line from Muzak's Wire Program Service. Any two of these inputs may be operated simultaneously to feed the system's two channels. This permits the use of one channel for occasions requiring special program material without interfering with normal music distribution on the other channel.

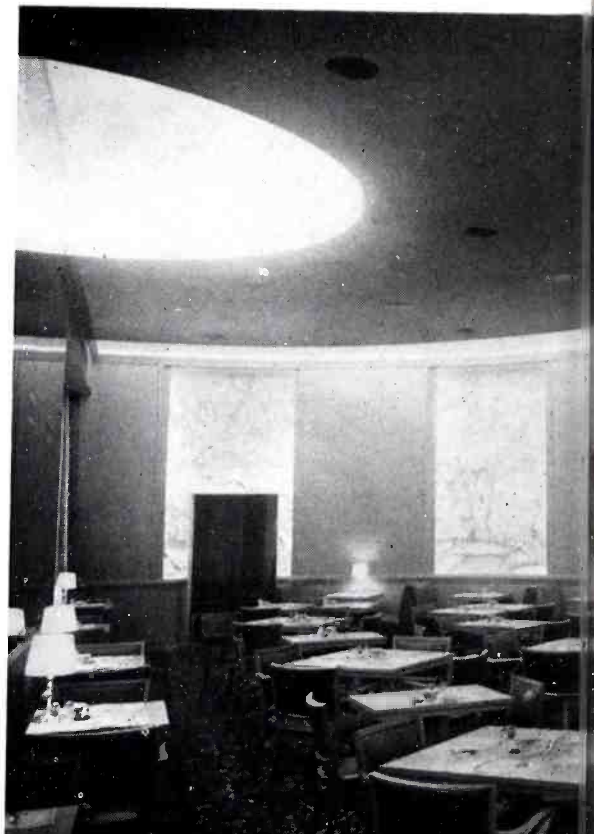
There's "music on the menu" in Stouffer's new Restaurant in Cleveland

In addition to the main volume controls located on the control unit, additional controls are provided in a corridor near the dining rooms and cocktail lounges to adjust sound levels locally.



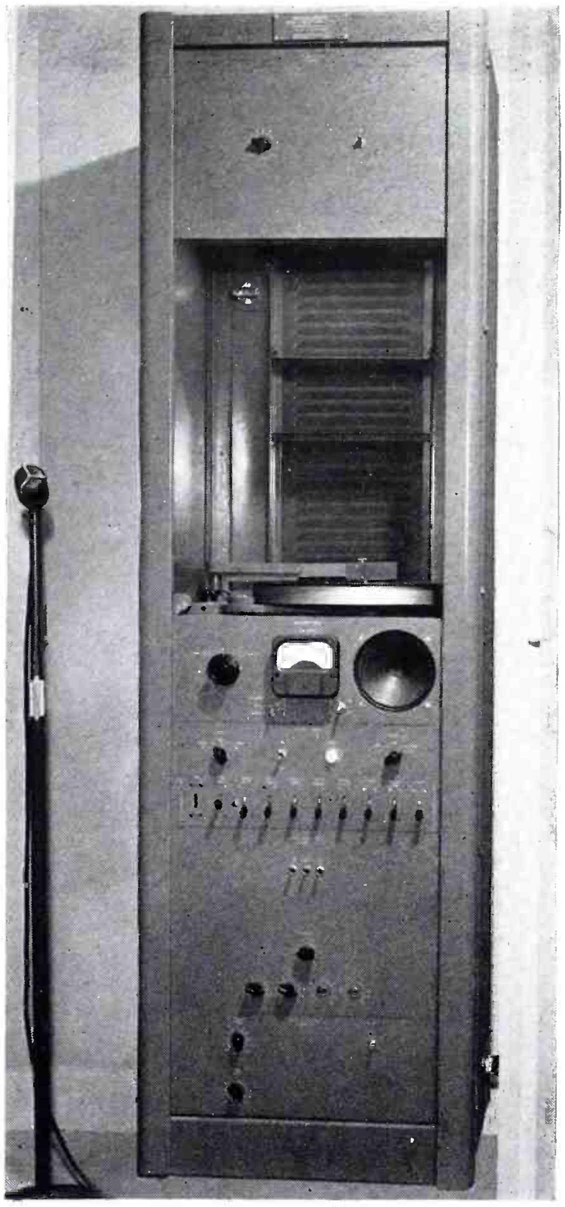
This beautiful dining room, with the "Circus Bar" colorfully and h
Every inch of dining space is within the high quality zone of at

The loudspeakers have been concealed in the ceiling of this colorful and attractive cocktail lounge. One of them is indicated by the small, slightly darker area in back of the air-conditioning fixture located in center of the ceiling.

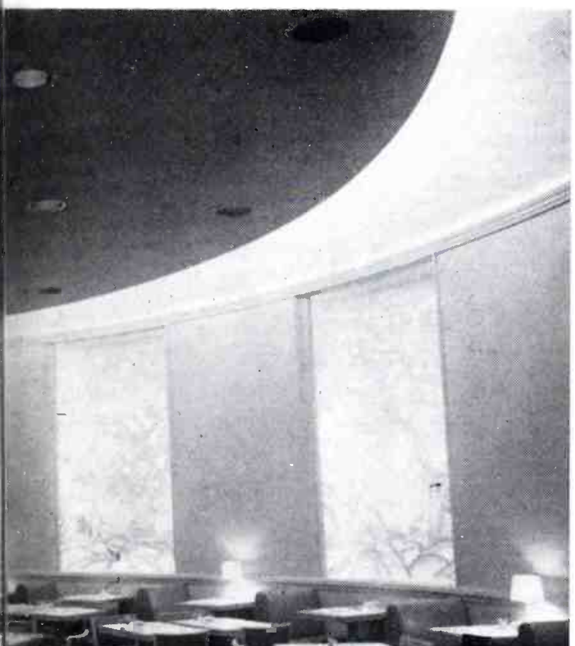


This view of the lovely Oval Room shows some of the 7
10-foot centers. With volume controls set at a low

omely decorated with circus scenes in the background, is typical of the charm of the new Stouffer Restaurant. t one of the Western Electric speakers which are mounted inconspicuously in the ceiling on 10-foot centers.



Front view of the 19-inch cabinet-type relay rack which houses all amplifying and control equipment.



loudspeakers which have been placed in ceiling on music from these loudspeakers permeates the room.

This photograph of Dining Room 1 shows the beauty and charm of the restaurant's appointments. Two 728B Loudspeakers, concealed behind the grilles visible over the door, provide conventional high level distribution in this room.

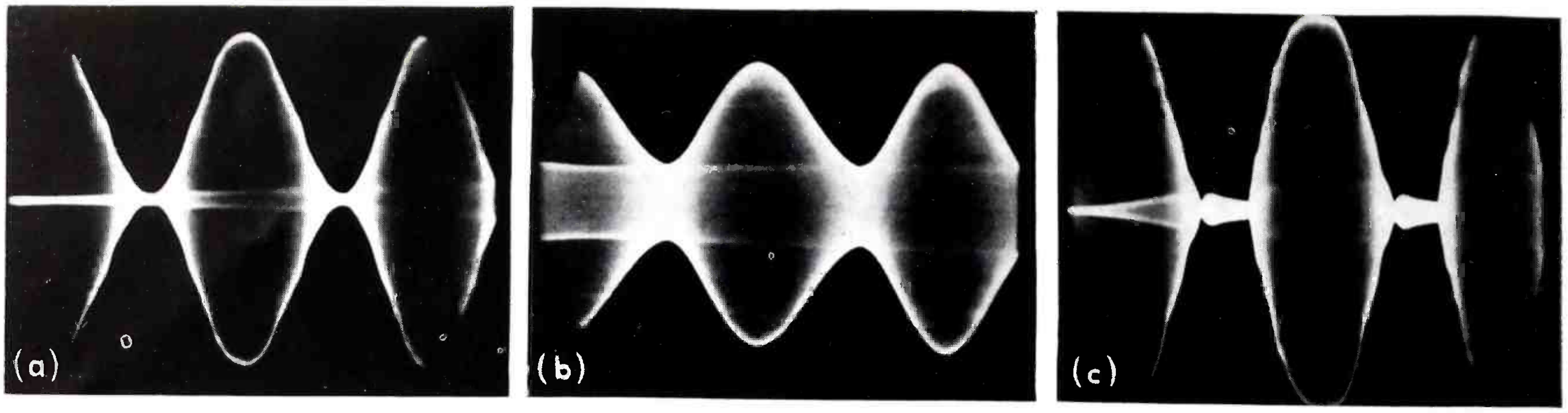


Figure 1—Oscillograms (a) and (b) show current and voltage envelopes, respectively, at point in transmission line or output circuit where impedance at sideband frequencies is lower than at carrier frequency, as in Figure 3. Modulation frequency is 7500 cycles. If observer is looking at voltage wave

Notes on Modulation of AM Transmitters

Laboratory Tests Show Effect of Sharply Tuned Antennas on Observed Modulation Waveform at High Audio Frequencies

By W. H. Doherty

Bell Telephone Laboratories

With directional antenna arrays in AM broadcasting the commonpoint impedance of the antenna system sometimes departs considerably at sideband frequencies from its mid-band or carrier-frequency value. The more remote side frequencies, at which the departure is greatest, correspond to the highest modulating frequencies. Practically, the effect of the impedance variations shows up only as an attenuation of these high frequencies, since the transmitter is modulated so lightly at high audio frequencies in actual program transmission that nonlinear distortion resulting from improper load impedance is negligible.

It is quite common practice, however, to modulate heavily with a test oscillator from time to time in measuring distortion over the audible frequency range. An interesting experiment carried out recently by the Bell Telephone Laboratories at Whippany, N. J., brings to light for readers of the *Oscillator* some important precautions to be taken if these measurements are to have any significance in cases where the impedance of the load or antenna is not essentially constant over the transmitted band.

The commonpoint impedance of the antenna array, or the impedance at the input terminals of the transmission line, may deviate from the ideal flat characteristic in various ways. For instance, in some cases the impedance looking into the line is lower at sideband frequencies than at the carrier frequency, while in other cases it is higher, or it may be higher on one side and lower on the other. Taking the particular case where the impedance of the line is a maximum at the carrier frequency and is lower for both sidebands, if the audio level into the transmitter is adjusted for 100 per cent modulation of the current fed into the line, then the voltage across the line will exhibit a lower percentage of modulation. That is, while each of the two side frequency *currents* is 50 per cent of the carrier current, the two corresponding side frequency *voltages* are not 50 per cent of the carrier voltage.

Tests Depicted in Oscillograms

A test under these conditions resulted in the oscillograms of Figure 1, above, where (a) and (b) are the envelopes of the current and voltage, respectively. Accordingly, if the voltage wave (b) rather than the current wave is being observed, the observer will not know that the current is 100 per cent modulated and will crank up the audio input in an endeavor to modulate more fully. Oscillograms (c) and (d) show the resulting current and voltage waves after a 3 db increase in audio input. The positive current peaks on picture (c) are seen to rise satisfactorily, but on the negative swing the current wave necessarily flattens at the zero axis because the tubes cannot deliver reverse currents. As a result the voltage wave seen in (d) inevitably shows severe distortion and cannot be made to appear fully modulated no matter how much the audio input level is increased. Oscillograms (e) and (f) represent another 3 db increase (200 per cent modulation).

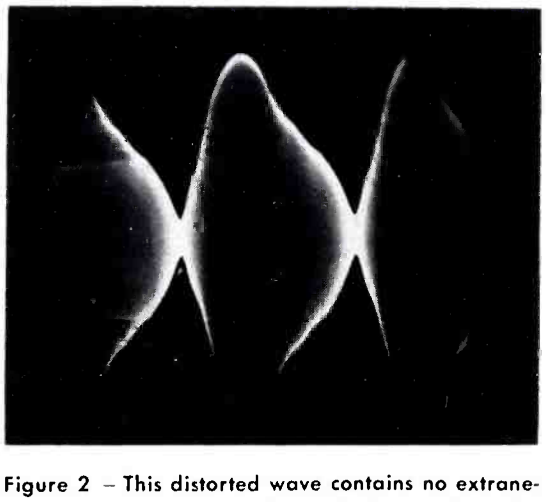
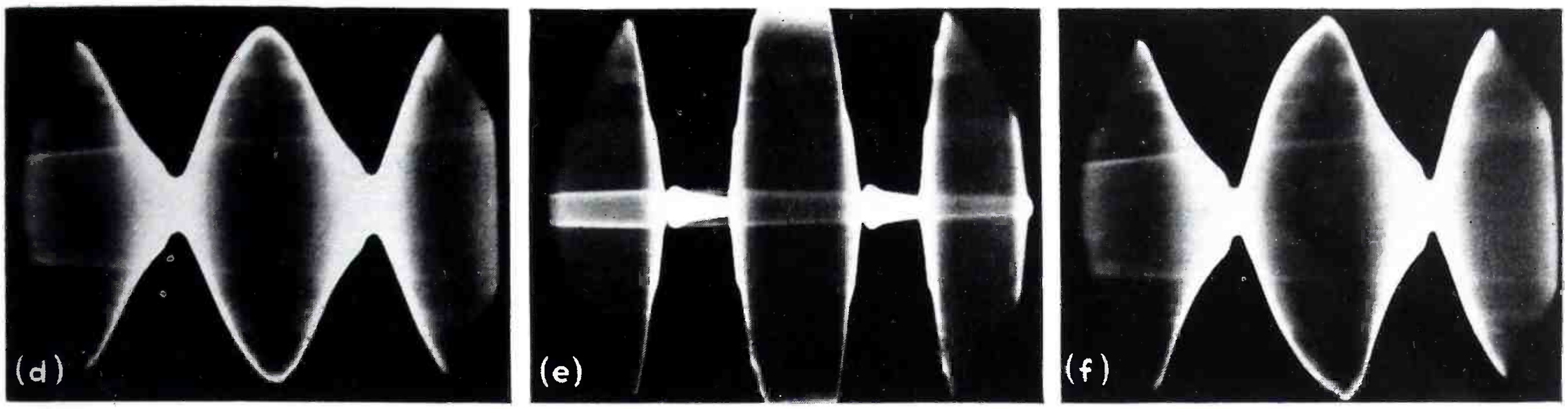


Figure 2 – This distorted wave contains no extraneous side frequencies but is simply the result of dissymmetry in amplitudes and phases of voltages at desired side frequencies at point of observation.

These oscillograms were taken with a modulation frequency of 7500 cycles. A standard Western Electric 443A-1 (1 kilowatt) transmitter was used as a power source, but the results would be the same with any other source of low-distortion modulated rf. A simulated load was employed having the impedance-frequency characteristic shown in Figure 3. The impedance at frequencies 7500 cycles on each side of the carrier frequency is seen to be only 60 per cent of the impedance at the carrier. This is why the voltage is only about 60 per cent modulated when the current is fully modulated.

Now it is well known to those familiar with transmission lines that when the impedance measured at some point in the line differs from the surge impedance, then at various other points in the line the impedance will be found to be quite dif-



(b) and does not know that current wave (a) is 100 per cent modulated, he will increase audio input, causing overmodulation of current wave and, inevitably, distortion of voltage wave. Oscillograms (c) and (d) are current and voltage, respectively, for 3 db, and (e) and (f) for 6 db overmodulation.

ferent again. Therefore the side frequency impedances given by Figure 3 for one point in the line will be different at other points. For instance, at a point removed a quarter wavelength from the point corresponding to Figure 3, the impedance-frequency relations would be as shown in Figure 4. Here we find the impedance *higher* for the side frequencies than for the carrier; higher, in fact, by the same ratio by which it was lower in Figure 3. Consequently, if one were to observe the modulation envelope at this new point he would find the current envelope only 60 per cent modulated when the voltage envelope is 100 per cent modulated, exactly the reverse of Figure 1(a) and (b).

A more striking case occurs at a point an eighth wavelength removed from the original point of measurement. Here the impedance-frequency curve is as shown in Figure 5, and because of the dissymmetry with respect to the mid-band impedance, the two side frequency voltages now are unequal in amplitude and shifted unsymmetrically in phase. As a result they combine with the carrier to produce the distorted voltage envelope shown in Figure 2, even though the envelopes at our other two points of observation are symmetrical and relatively undistorted.

While a monitoring rectifier and distortion measuring instrument would register a high percentage of distortion for the envelope of Figure 2, it is clear that this does *not* mean the radiation of extraneous side frequencies. Only the desired side frequencies are present, and the envelope distortion is entirely due to the phase and amplitude changes which they undergo at different points in the line. Similar phase and amplitude changes are undergone at points in the output or "tank" circuits of the transmitter or in the impedance matching or harmonic suppression circuits ahead of the transmission line, and the same kind of envelope distortion would be observed at such points.

Degree of Modulation Affected

It is fortunate that these test conditions are not met with in transmission of speech and music. When the amplitudes of the two side frequencies associated with the modulating tone are small, the envelope shape will be sinusoidal regardless of shifts in their relative sizes or phases. The *degree* of modulation, however, can be profoundly affected, and, like the carrier amplitude itself, will be different in different directions of the radiated pattern, so that the final demodulated signal will show a frequency response varying somewhat at different receiver locations.

(Continued on page 38)

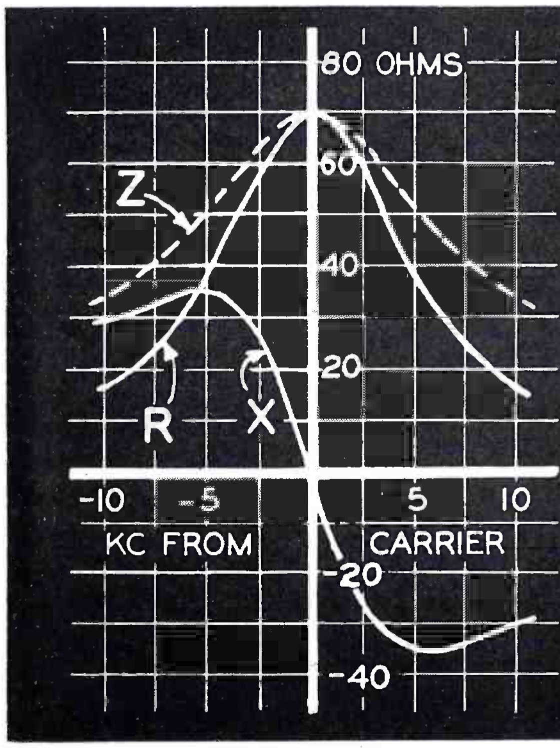


Figure 3 — When the impedance of the transmission line at sideband frequencies is lower than the impedance for the carrier frequency as shown on the curves above, the current wave will be fully modulated when the voltage wave is not, as is indicated in the oscillograms (a) and (b) of Figure 1.

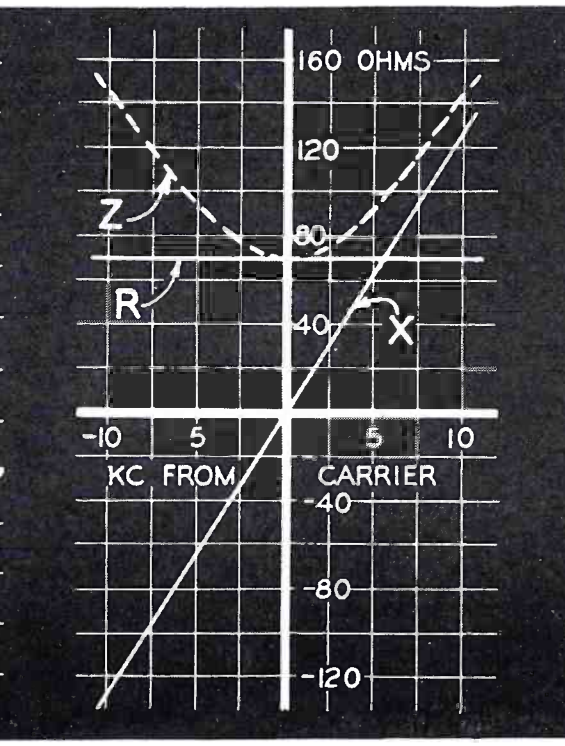


Figure 4 — At a point in the line a quarter wavelength removed from the original point, the impedance-frequency curves are markedly different. Here the impedance is higher for the sidebands than for the carrier, so that the voltage wave will be fully modulated when the current wave is not.

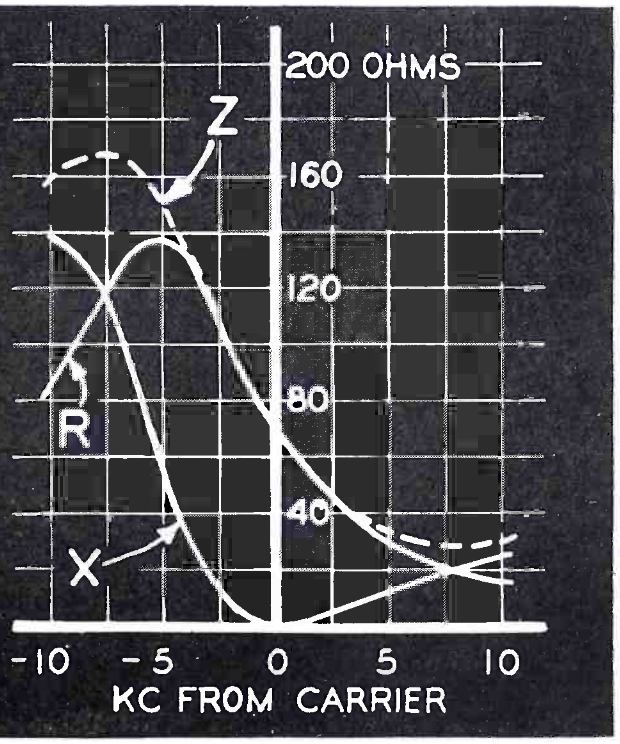
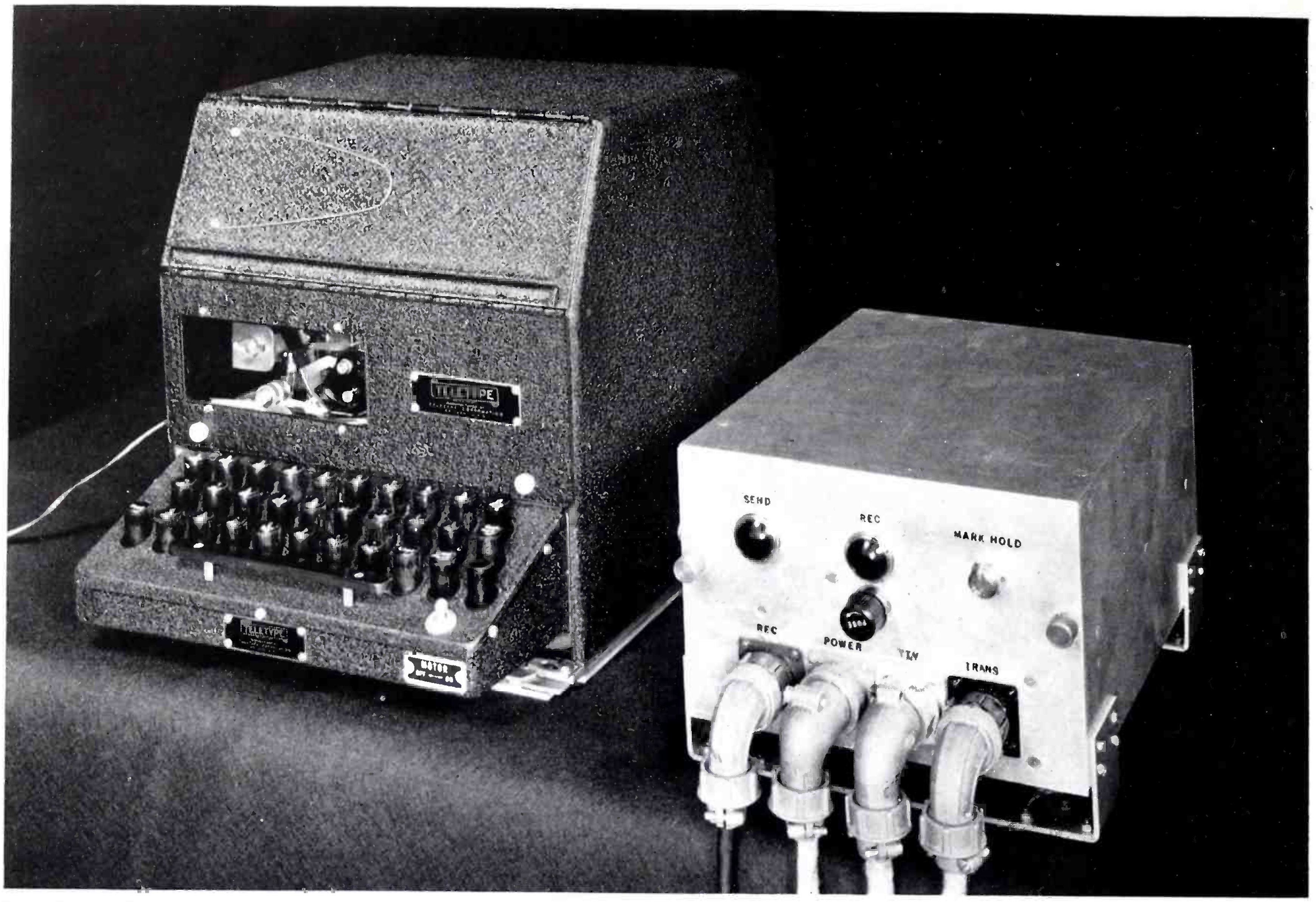


Figure 5 — At point in line an eighth wavelength from original point, impedance is higher for one sideband than for carrier, and lower for the other. Result is unequal side frequency amplitudes and unsymmetrical phase relations, with a consequent distorted envelope as shown in Figure 2.



The Airborne Teletype Equipment, consisting of a Model 31 Teletype Printer and its associated Converter-Control Unit, adds only 35 pounds to the weight of a plane.

HIGH FLYING TELETYPE

A New Lightweight Printer with Converter Unit Transmits Printed Communications Between Plane and Ground Over Existing Radio Equipment

By R. A. Vanderlippe
Bell Telephone Laboratories

ANOTHER milestone in the history of radio communications has been passed, for it is now practicable to send typed messages to and from airplanes in flight. The equipment which makes this possible is the new lightweight Model 31 Teletype Printer, developed by the Teletype Corporation, and an associated Converter-Control Unit, developed by Bell Telephone Laboratories.

The Model 31 Teletype Printer is smaller and lighter than a standard typewriter and uses the regular Teletype keyboard and signaling code. The Converter-Control Unit at a station which is sending converts this telegraphic code into frequency-shift signals in the audio frequency range for transmission over existing radio telephone equipment. At a station which is receiving, the Converter-Control Unit converts these frequency shift signals into electrical impulses for operating the receiving-typing part of the Teletype printer.

An interesting feature in connection with the use of this new instrument is that it will work with any existing radiotelephone installation capable of providing satisfactory two way voice communication. This, of course, means that by the simple addition of the Radio Teletype equipment, weighing less than 35 pounds, and without any modification of the radiotelephone equipment, two way typed communication, with all its advantages, may be achieved. The normal use of the radiotelephone equipment is in no way affected by the installation of the Radio Teletype.

A Radio Teletype network installed in aircraft and ground stations operates very much like a press-to-talk radio telephone network except that instead of spoken words it handles typed messages. No manual operation of a press-to-talk control is required since the radio transmitter is turned on automatically when the first Teletype character is sent.

The Model 31 Teletype Printer transmits electrical impulses and receives and translates them into printed characters in the same manner as standard land wire Teletype equipment. Two signaling conditions, commonly referred to as "marking" and "spacing," are used for transmission of Teletype signals. The unit of time during which a character is transmitted is broken into seven intervals. Each character begins with a spacing "start" interval and ends with a marking "stop" interval. During these intervals all printers which are receiving are synchronized with the printer which is sending. During each of the five time intervals between the start and stop intervals the signaling condition may be either marking or spacing, depending on the Teletype character being transmitted, so that 32 different signaling combinations are possible. By assigning one combination for "upper case" and one for "lower case," each of the remaining 30 combinations may be used for the transmission of two characters or symbols so that there are enough combinations for all characters and symbols on the Teletype keyboard.

Converter-Control Unit

The Converter-Control Unit performs the task of converting the marking and spacing conditions at the station which is sending into tones in the audio range for transmission over the radio telephone equipment and of reconverting these tones at the station which is receiving into electrical impulses for operating the receiving-typing portion of the Teletype printer. Circuits in the converter unit provide an automatic closure to condition the radio telephone equipment for transmission when the first Teletype character is sent. This function is disabled when a message is being received. Other control circuits provide for holding the selector magnet circuit of the Teletype printer in a marking condition during idle periods of the circuit so that noise on the radio circuit will not cause false characters to be printed and for lighting lamps to indicate whether the terminal is in a transmitting or a receiving condition.

As indicated in the block diagram below, marking impulses are transmitted at a frequency of 1615 cycles and spacing impulses at a frequency of 1275 cycles. When signals are being received, the 1615-cycle marking and 1275-cycle spacing tones, together with the important side band components resulting from signaling, are passed by the input band pass filter. These signals are limited in amplitude by a fast-acting amplitude-limiting circuit and applied to an approximately linear frequency discrimination circuit. The output of the discriminator circuit is a positive voltage for marking and a negative voltage for spacing signals. The output of the amplitude limiter is also applied to the "mark-hold" circuit.

The marking elements of the first Teletype character to be received cause the marking hold on the output circuit to be released so that subsequent signals may pass through the output circuit to the Teletype printer selector magnet. The plus and minus voltage conditions at the output of the discriminator result in a current of 20 ma in the selector magnet for a marking condition and zero current for a spacing condition.

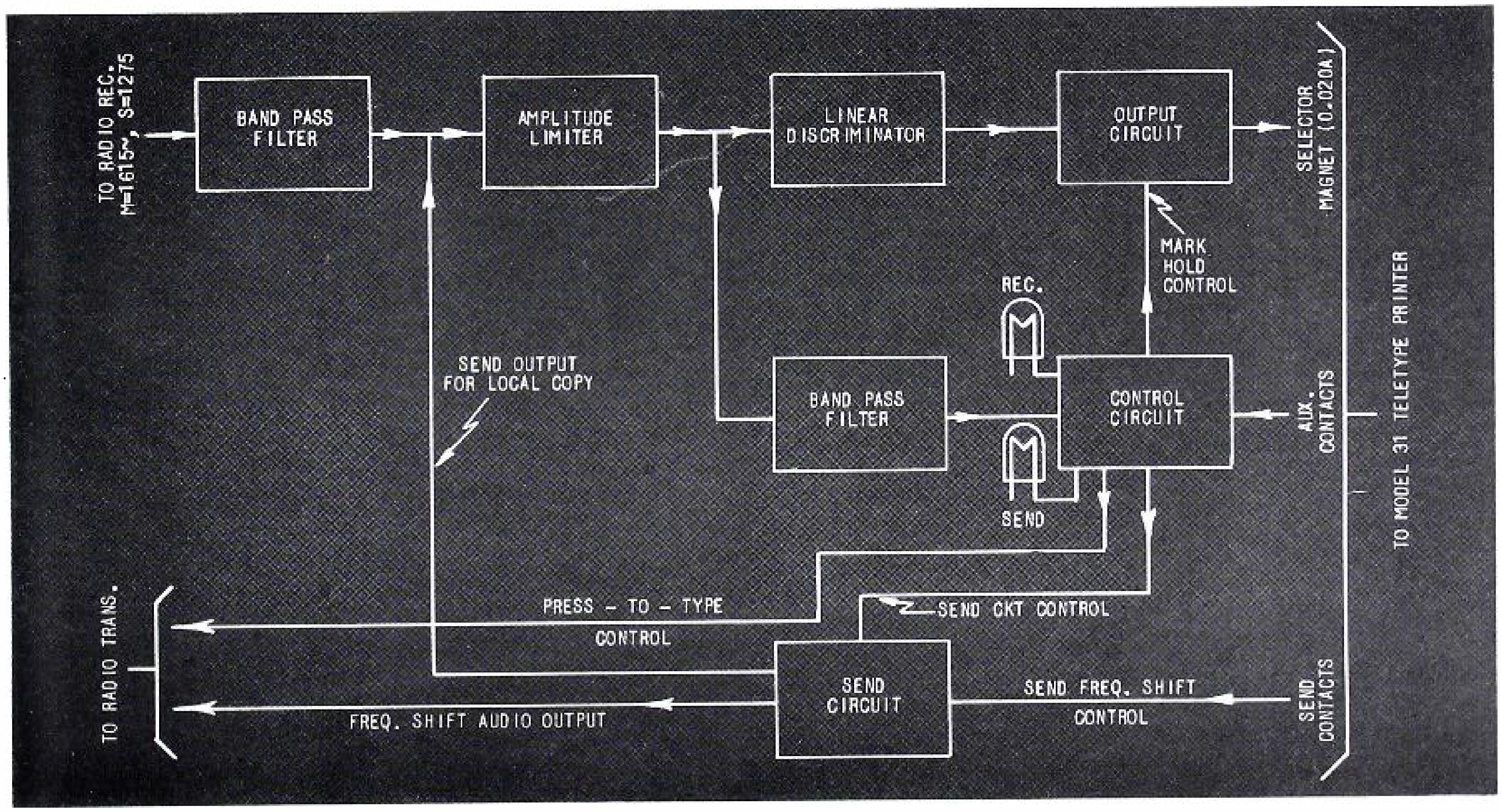
During transmission, the auxiliary contacts of the Teletype close during each character. These closures, operating through the control circuit, cause the press-to-talk control circuit of the radio transmitter to close at the beginning of transmission and remain closed as long as at least one character is sent every five seconds. Closures of the Teletype printer transmitting contacts which occur as the keyboard is operated are applied to the sending circuit and shift the oscillator frequency in accordance with the marking and spacing elements of the character to be transmitted. The output of the sending circuit modulates the radio transmitter in the same manner as a voice signal. A small amount of energy from the sending circuit is applied to the limiter input and passes through the limiter, discriminator and output circuits in the same manner as a signal received from a distant station. In this way, a local copy of the Teletype characters being transmitted is obtained.

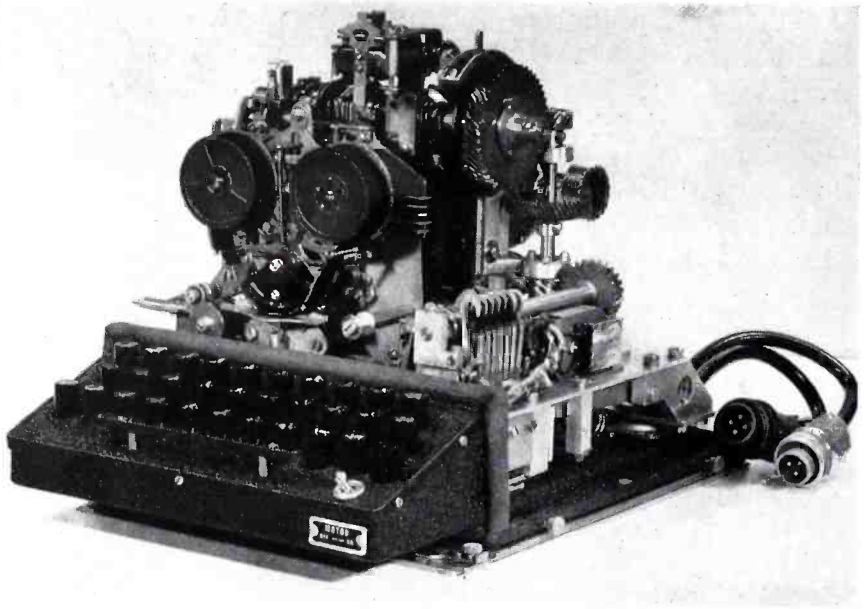
Release of the mark-hold circuit during a receiving condition causes a green-capped REC lamp to light. At the same time that the marking hold is released the sending control circuit is disabled to prevent accidental operation of the keyboard from interfering with the incoming signals. During the transmitting condition, a red-capped SEND lamp is lighted and the circuit for lighting the REC lamp is disabled.

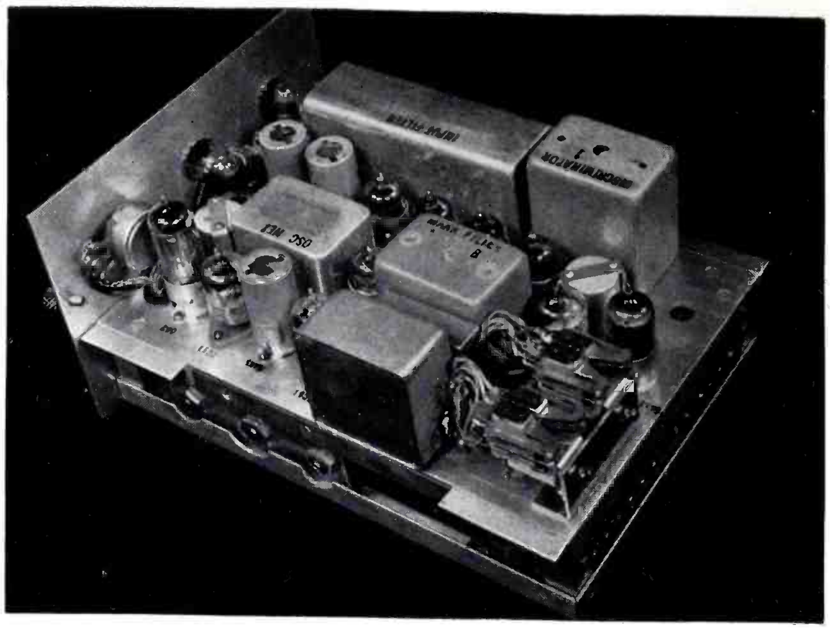
Power Supply

The primary source of power for the Converter-Control Unit and the Model 31 Teletype is the 26.5-volt battery commonly used in airplanes. Plate voltage supply of +250 volts for the Converter-Control Unit is normally obtained from a genera-

Block Schematic of the Converter-Control Unit, which converts Teletype impulses into audible tones for transmission over existing radiotelephone equipment.







At left, above, is the lightweight Teletype printer with covers removed. The photograph at the right provides an inside view of the Converter-Control Unit.

tor winding on the Teletype driving motor.

Tubes having 6.3-volt heaters are used in the Converter-Control so that this unit could be adapted for vehicles having a 6-volt battery by reconnecting the filament circuits. A vibrator type high-voltage supply circuit operating from 6-volt battery has been constructed for supplying plate voltage to the Converter-Control Unit.

The Model 31 Teletype Printer for sending and receiving is only 10½ inches high, 10 inches wide and 13½ inches deep, and weighs but 24 pounds. The Converter-Control Unit is 5 inches high, 7 inches wide and 9 inches deep, and weighs 8 pounds. This makes it possible to provide Teletype service over existing press-to-talk radio telephone circuits by adding less than 35 pounds to the weight of the communications equipment. No modification of the radiotelephone equipment is necessary. An additional feature of importance to aircraft operation is the fact that this equipment will operate in any position, even upside down.

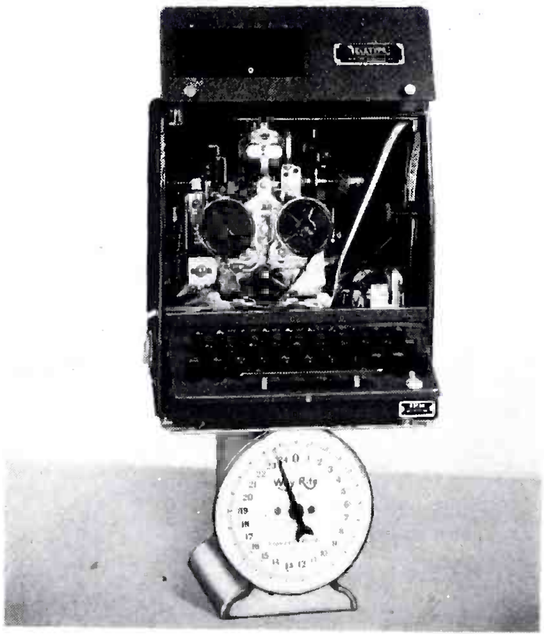
With Teletype operation, a printed record of all communications is available at all stations in the network. Messages may be handled easily and accurately by personnel with only a minimum of training and are received without attention from the operator. Since a standard Teletype code is used, messages may be sent from any other Teletype station such as a land line "weather" network. In international service, code groups of Teletype characters could be standardized to cover all routine phases of weather reporting, takeoff, landing and other instructions to the plane.

Of Value as a Typed Record

The Teletype printer has a special value where language difficulties exist or where the misinterpretation of a voice order due to faulty reception may lead to hazards in flight. In international air operations this is an important consideration as the combination of language difficulty, foreign accents and the usual run of distortion in voice transmission and reception may cause confusion and uncertainty to exist on the ground as well as in the air. The typed record itself of the actual two way conversation is also valuable, since it will exist at both ends of the circuit—airplane and ground. This means that there should be no question as to the instructions or inquiries having been transmitted or received and the written record may be filed for future reference.

The equipment is capable of a speed of 60 words per minute insuring rapid communication between the stations involved.

The new lightweight terminal equipment has special application to other fields also in which the larger size and weight of standard equipment has heretofore prevented the use of Teletype methods of operation. These fields include mobile service to trucks, cars and harbor craft and military applications to landing operations and forward command posts of advanced echelons of a battle force. Of particular importance in these uses is the advantage of making a record of instructions or other data without continuous attention from an operator. Also of importance is the fact that messages may be handled easily and accurately by operators with a minimum of training.

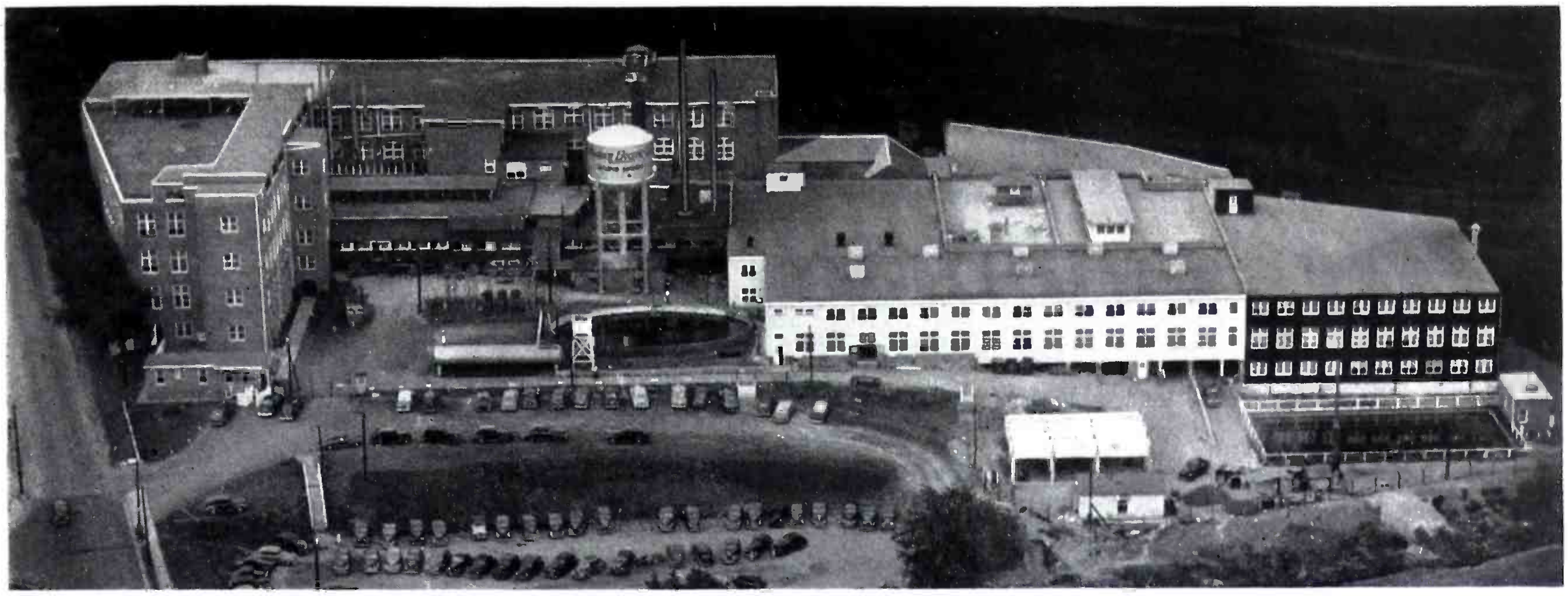


The Model 31 Teletype Printer weighs only 24 pounds and is smaller in size than a standard typewriter.

Demonstration Scheduled

A working demonstration of the Model 31 Airborne Teletype equipment is scheduled at the meeting of the PICAO (Provisional International Civil Aviation Organization) in Indianapolis, October 9th to 23rd inclusive. This meeting is held at the invitation of the United States Government to secure the participation of other interested nations in a general discussion and actual demonstration of the U. S. system of air navigation, communication, traffic control and allied problems affecting air transportation. It will have been preceded by a similar meeting held in England September 9th to 30th inclusive. The British meeting is sponsored by the British Government and will demonstrate to the delegates the British system of controlling air transportation.

Practically all the American manufacturers interested in aviation, communication and navigation matters are to be represented at the Indianapolis meeting, as are the Army, Navy and Civil Aeronautics Administration. At this meeting, the Model 31 Airborne Teletype equipment will be installed in one of the airplanes belonging to the CAA and two-way radio Teletype communication will be carried on between plane and ground during the scheduled flight demonstrations.



The Winston-Salem Plant of Western Electric's Radio Shops. Here the principal products are radars and other electronic devices for the United States Government.

Radio Shops Move to North Carolina

Two New Plants Acquired to Provide Larger Quarters for Western Electric's Radio and Electronic Activities

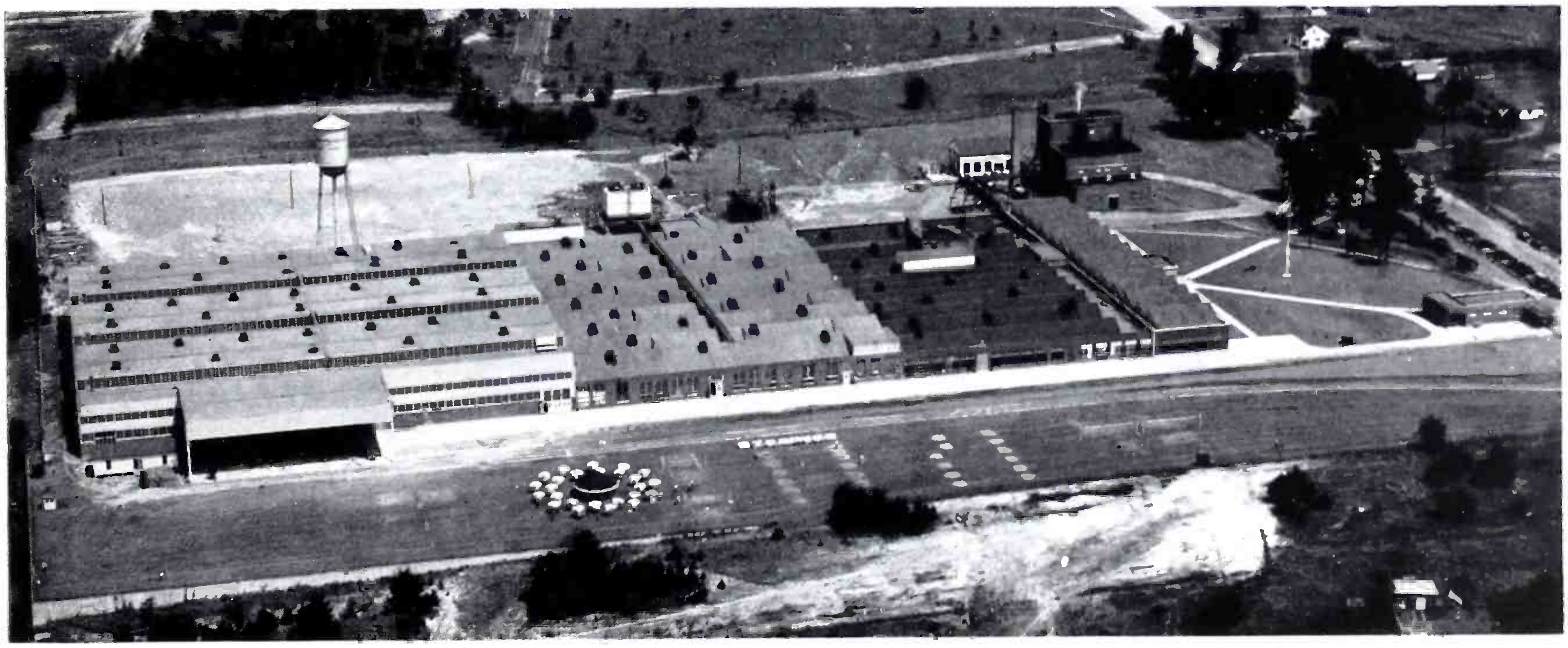
To provide additional space for the greatly expanded activities of its Radio Shops, the Western Electric Company has leased two new manufacturing plants. These plants, located in Winston-Salem and Burlington, North Carolina, will be devoted to the manufacture of radio broadcasting and radio communications equipment and electronic apparatus of all types.

Prior to the acquisition of the new locations, Western Electric's Radio Shops were located at the huge Kearny, New Jersey, plant and in smaller factories in and around New York City. However, due to the tremendous expansion of the telephone apparatus program, space at Kearny became more and more limited, and early in 1946 it was decided to transfer all radio activities to a new location.

To find a new home, a survey was made of hundreds of existing plants all over the country. Floor space requirements of 500,000 feet, availability of employees and transportation facilities—all were factors in the selection of a new location. The Piedmont area in north central North Carolina was the final choice, with plants located in Winston-Salem and Burlington, in the heart of the tobacco country. In April 1946 these plants were formally acquired.

Headquarters of the new Radio Shops is at Winston-Salem, where Manager Clyde C. Randolph and most of the key members of his staff are located. These include many electronics and engineering experts whose experience during the war in Western Electric's tremendous production program of radar and electronics equipment for the armed forces has proved invaluable to the organization and development of the new shops. Among the engineering chiefs are men whose names are well

Among the products manufactured in this plant in Burlington, North Carolina, are radio broadcasting equipment, radio communications equipment and hearing aids.



known in the broadcasting field, such as Robert N. Marshall and Jack Bedell, formerly with Bell Telephone Laboratories.

The Burlington Plant, about 50 miles east of Winston-Salem, is under the direction of C. W. Reynolds, who before the transfer was in charge of radio equipment manufacture at the Kearny plant. Built during the war years by the Fairchild Aviation Corporation, the Burlington plant is a modern, assembly-line type of structure, only one story high, but covering an area of more than 260,000 square feet of floor space. Perfectly suited for assembly operations, this building was selected to house the manufacture of radio broadcast transmitting and audio systems—both AM and FM, microphones, loudspeakers, sound distribution equipment and mobile radio telephones.

The activity at the Burlington Plant is impressive, for all major manufacturing operations are carried on in one big area with over 225,000 square feet of floor space—large enough to hold five football fields. Formerly used for the assembly of airplanes, the plant area is clear and open, affording an unobstructed view of the manufacturing and assembly operations going on all over the building. In one section stand row upon row of assembly tables covered with amplifiers and other audio equipment in various stages of manufacture. In another, hundreds of employees are busily engaged in turning out mobile radio telephone equipments. Stamping, cord-tipping and other semi-automatic machines are located efficiently throughout the plant. Assembly lines for AM and FM transmitters, microphones, reproducers, loudspeakers, amplifiers and speech input equipments, noise measurement instruments and train dispatching systems—all have their place on this huge floor. In the field of clinical instruments, Burlington is making hearing aids, audiometers for measuring hearing loss, and the artificial larynx.

Assembly Lines Moving

Many of these products are already coming off the assembly lines. Some are being held up temporarily by the prevailing shortage of materials and components normally furnished by outside suppliers. Very few projects are still going on at the Kearny locations waiting only for the word to move. Each of these jobs will be given that word when space is prepared, employees hired and trained, and progress at Kearny has reached a point where it can be transferred with a minimum of delay and production loss.

The Winston-Salem plant is a four-story brick building combined with a two-story

(Continued on page 38)

Top, opposite page: Multiple coil winding machines at Radio Shops' Winston-Salem Plant supply a good portion of the coils used in radio and electronic equipment. **Center, opposite page:** In air-conditioned room at the Burlington Plant, this operator fastens diamond stylus to moving coil assembly of 9 Type Reproducers. **Bottom, opposite page:** Assemblers putting final touches on a lineup of 23C Speech Input Consoles in the radio broadcasting section of the Burlington Plant. **Above:** In this section of the spacious Burlington Plant are concentrated all of the wiring and assembly operations on Western Electric mobile radiotelephones. **Below:** To supply the great demand for the 728B Loudspeaker, the sound instrument department at Burlington is turning out thousands of these popular units.

New High Frequency Bridge

. . . Helps Match Load Impedance and Characteristic Impedance of Coaxial Line

By H. R. Whaley
Western Electric
Broadcast Field Engineering Force

EARLY in August of this year a new four-element Western Electric Cloverleaf Antenna was installed at WINX-FM, the FM station of the WINX Broadcasting Company, Arlington, Virginia. In adjusting the antenna to match a 3⅛-inch coaxial transmission line, a new simplified bridge was used for the first time. This bridge was developed by Bell Laboratories to afford a means of determining a match between a load impedance and the characteristic impedance of a coaxial line.

In a Wheatstone bridge with equal ratio arms, detector current becomes smaller as the resistance of the standard arm approaches that of the unknown. Or the standard arm may be fixed at some desired value and the unknown adjusted to equal this value. It is possible to plot a curve of the ratio of the unknown resistance to the standard arm may be fixed at some desired A curve of this type is prepared for each bridge, but the variables are standing wave ratio vs. detector current rather than resistance ratio vs. detector current. Figure 1 is a calibration curve for one of the bridges.

High frequency bridge for 3⅛-inch coaxial line and its associated bridge detector current meter.

Checking Transmission Line

A standing wave existing near the transmitter end of a transmission line may be due to a mismatch between the antenna and the transmission line or to irregularities along the line itself or to both. Therefore, the first step in adjusting an antenna-transmission line system is to determine that the line itself is satisfactory. The line is opened at the antenna end and a standard termination is attached. The line is opened near the transmitter also, and the bridge is inserted in the line on the transmitter side of the break. The load side of the bridge is not immediately inserted in the coaxial line toward the load side of the break. The low power stages of the transmitter are then turned on, and the power input to the line adjusted to give full scale meter reading on the bridge detector current meter. A transmitter output of approximately 2 watts is required.

After the initial adjustment for full scale reading with the load side of the bridge open-circuited, the load side of the bridge is inserted in the line. This provides a complete path for the flow of rf power through the bridge to the standard termination at the antenna end of the line. At once the detector current will drop to a low value. Reference to the bridge calibration curve will give the standing wave ratio at the point where the bridge is inserted.

In the event that the line itself is causing a considerable standing wave at the measuring point, it will be advisable to locate and eliminate the discontinuity before proceeding further. This can be done easily with the aid of the bridge by opening the line and installing the standard termination at one or more intermediate points along the line. When the standing wave ratio due to line irregularities is judged to be satisfactory, the antenna may be adjusted.

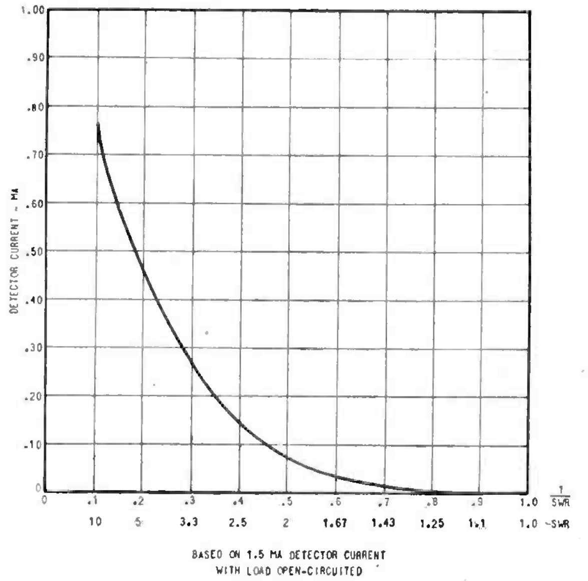


Figure 1 — Calibration curve for the new bridge.

The standard termination is removed from the line, the antenna reconnected, and the ⅛ wave line slugs in the tower structure adjusted for matched conditions. By observing the effect of each successive adjustment on the bridge meter, a perfect match can be obtained in a very short time. Where the line itself is very nearly flat, a certain amount of overcorrection may be made by means of the matching slugs so that the line at the transmitter end will look absolutely flat. This is of advantage in that metering of rf power output by means of a transmission line voltmeter then becomes quite accurate.

The suitability of a device based on the Wheatstone bridge for the determination of reflection coefficients (or standing wave ratios) may not be generally known by broadcast engineers, though bridges have been used for this purpose in carrier telephony for many years. For this reason a brief analysis of the operation of the bridge is given here. Figure 2 on page 32 is a schematic of the device. The resistances, capacities and inductance were all designed for use at frequencies of the order of 100 mc or higher. Care in assembly of the bridge has reduced the effect of strays to a minimum. The standing wave equations and bridge null conditions are as follows:

On a radio frequency transmission line the standing wave ratio is

$$\text{SWR} = \frac{1 + |A|}{1 - |A|} \qquad (1)$$

where A is the Reflection Coefficient, and

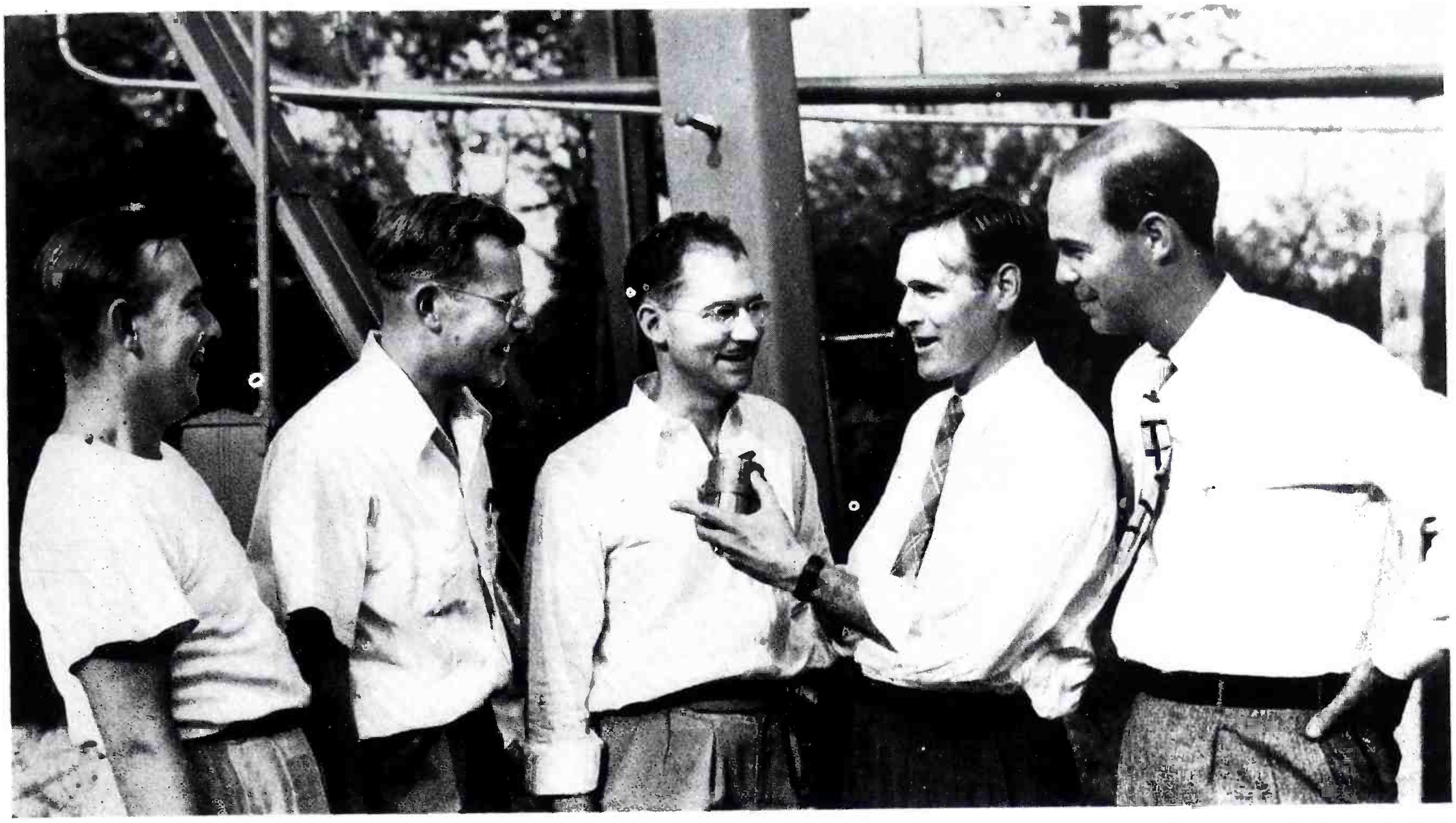
$$A = \frac{Z_R - Z_O}{Z_R + Z_O} \qquad (2)$$

here, Z_R = load impedance
Z_O = surge impedance of line

When the load is matched to the line, $Z_R = Z_O$. Under this condition we see from (1) and (2) that SWR = 1, A = O. This is the desired condition.

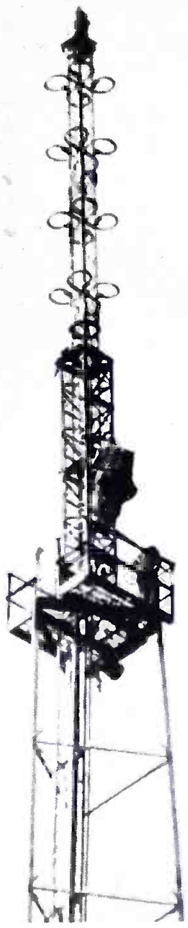
The bridge null conditions are established easily by reference to the simplified schematic, Figure 3 on page 32. The two arms, (R_1, R_2) and (R_S, Z_R), are essen-

WINX-FM—First Station to Erect a Clover-Leaf



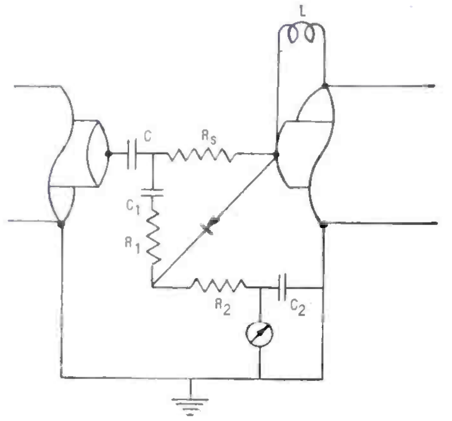
Engineers in cheerful mood discuss advantages of high frequency bridge at WINX-FM, Washington, D. C., where first Clover-Leaf antenna was installed. Left to right: R. L. Johnson, F. F. Mitchell, D. C. Ports of Jansky and Bailey, E. C. Haviland, Graybar Electric Company, and Ralph Cannon, chief engineer WINX-FM.

Silhouetted against the sky across the Potomac from Washington, D. C., is the 300-foot antenna tower of WINX-FM with its 4-element Western Electric Clover-Leaf Antenna.



Close-up of a Clover-Leaf. This is the top of the antenna at left as seen through a telephoto lens.

Engineer Cannon and John Aitkenhead, Western Electric broadcast field engineer, look over installation of coaxial type bridge developed by Bell Telephone Laboratories.



R_s = 51.5 ω (for 51.5 ω coaxial line)
$R_1 = R_2 \approx 50$ ω
$C_1 = C_2 \approx 500$ μμf
$C \approx 500$ μμf
$L \approx 3$ μh

Figure 2— Schematic of high frequency bridge.

tially in parallel across the generator voltage, E_g, since D is a high impedance crystal detector. The voltage available to drive current through D is $E_2 - E_1$.

But

$$E_2 = E_g \frac{Z_R}{Z_R + R_s}$$

$$E_1 = \frac{E_g}{2}$$

and

$$E_2 - E_1 = \frac{2Z_R - Z_R - R_s}{2(Z_R + R_s)} E_g = \frac{E_g}{2}\left(\frac{Z_R - R_s}{Z_R + R_s}\right)$$

However,

$$R_s = Z_O$$

So that $E_2 - E_1 = \dfrac{E_g}{2}\left(\dfrac{Z_R - Z_O}{Z_R + Z_O}\right)$

applying equation (2) we have, finally

$$E_2 - E_1 = \frac{E_g}{2} A \qquad (3)$$

It is at once apparent from an inspection of equations (1) and (3) that adjustments to the line-matching device which reduce standing waves will also reduce the voltage across the bridge detector. Small changes in E_g due to changes in transmitter loading and shift of the standing wave pattern do not obscure the changes in detector current brought about by changes in the standing wave ratio.

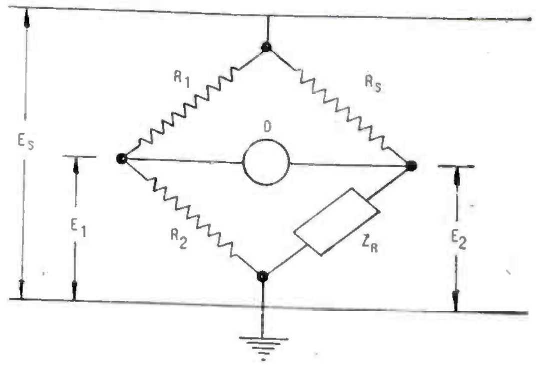
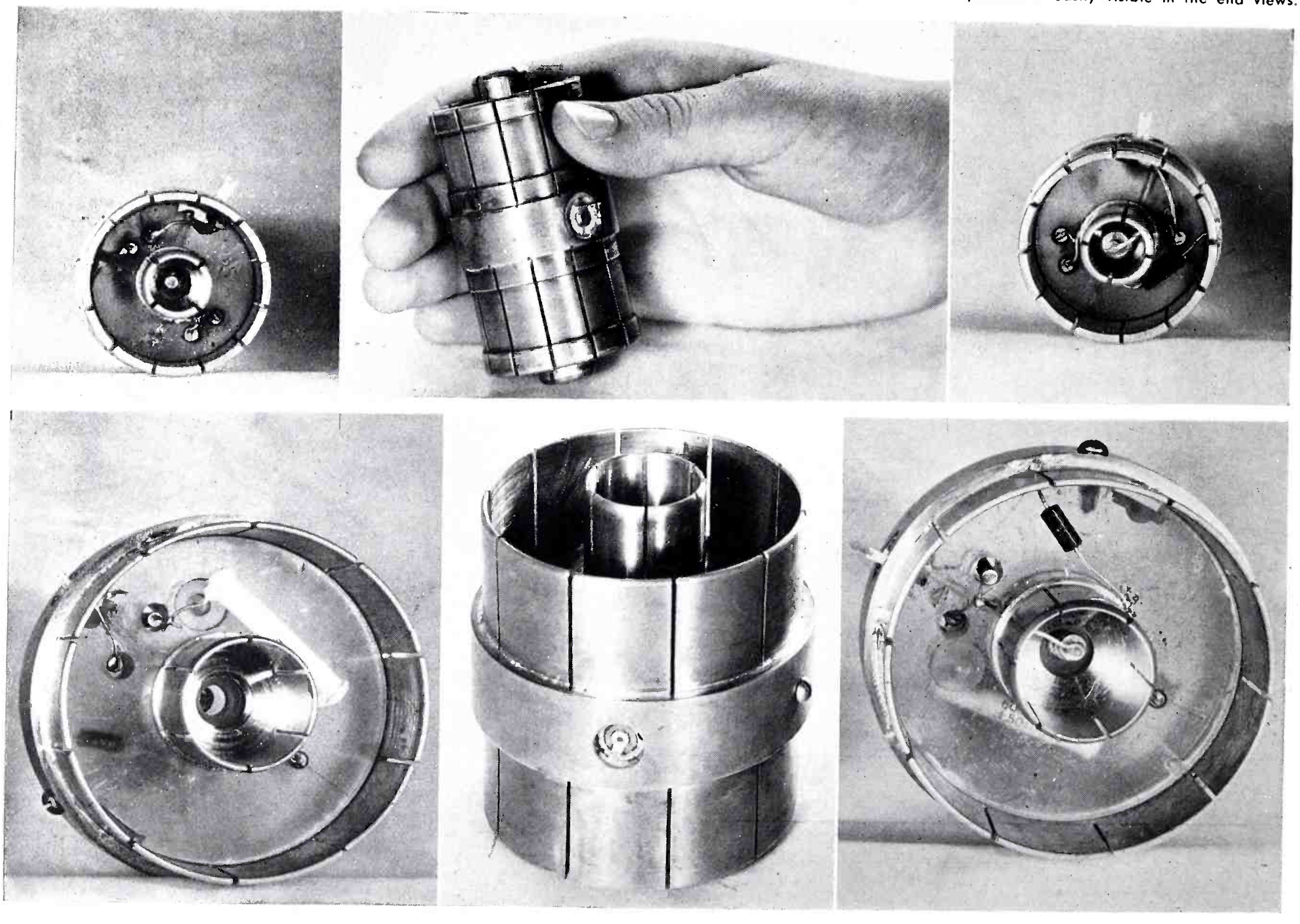


Figure 3 —Simplified schematic of the new bridge.

The resistances employed in the coaxial bridge are of the precision carbon-deposit type developed by Bell Laboratories. Their use for both the ratio arms and the standard means high accuracy in determining the optimum load impedance adjustment.

With this new bridge, FM station chief engineers now have a method of matching impedances of coaxial transmission lines and FM antennas of hitherto unparalleled simplicity, speed and reliability.

The high frequency bridge has been designed in two sizes, to fit 1⅝-inch and 3⅛-inch coaxial transmission lines. The top three photographs show the end views and side view of the 1⅝-inch bridge. The lower row shows the 3⅛-inch bridge. Arrangement of components is easily visible in the end views.



Can I Use an FM Antenna on My AM Tower?

You Can With the 730A Filter, an Ingenious New Tower-Base Bridging Filter that is Simple, Light Weight and Inexpensive

With so many AM broadcasting stations making their plans for entry into frequency modulation, the question, "Can I put my FM antenna on top of my present AM tower and still have both systems operate efficiently?" is being heard again and again. This is much more than a $64 question, for making use of an existing tower can save thousands of dollars in construction costs.

Before it is possible to give a direct answer to this important question, it is necessary to investigate the following factors which enter into the over-all problem.

1. Is the AM tower site suitable for desired coverage with FM?
2. Is the tower sturdy enough or can it be modified to support the additional weight and wind loading of the FM antenna and coaxial line?
3. Will the AM radiation pattern be acceptable with a possible change in tower height?
4. In the event that the realizable AM pattern is not satisfactory, can it be made so by some change in height of the AM tower before installation of the FM antenna?

After obtaining a satisfactory solution to these questions there still remains one further perplexing question:

Is it possible to excite the FM antenna without its coaxial transmission line short-circuiting the tower base insulators of a series-fed AM radiator?

Western Electric's answer to this final question is a decided "YES," based on a new device developed by Bell Telephone Laboratories called the 730A Filter, which is a compact, trouble-free unit inserted in the FM transmission line at the base of the AM tower.

Several Methods Explored

To go back for a moment to the question of feeding the FM antenna around the base insulators of the AM structure, several possible solutions will come to mind immediately.

First, the FM coaxial line might be formed into a coil at the base of the tower and anti-resonated by a condenser thus presenting a high impedance across the base insulator. This idea must be discarded because such a coil of anything larger than 7/8 inch line would be extremely difficult to fabricate.

Second, the FM coax might be run up inside the AM tower and be insulated from it for a distance of one-quarter wavelength at the AM frequency. This would require special insulators designed to withstand the strain of support of 200 to 400 feet of heavy coax and to also prevent leakage, under all weather conditions, of several kilovolts of rf potential. In addition, cross members within the tower may present serious problems in obtaining sufficient clearance to adequately isolate the line.

Third, where there is enough distance between transmitter and tower, it is possible to construct a coaxial section equal in length to one-quarter wavelength at the AM frequency, using the FM coax as the inner conductor. This section would vary in length from 200 to 400 feet and with a 3 1/8 inch FM line, an outer sleeve of about 6 1/4 inches would be required. Special insulators would be required at appropriate intervals, and the open end under certain conditions would require an end seal.

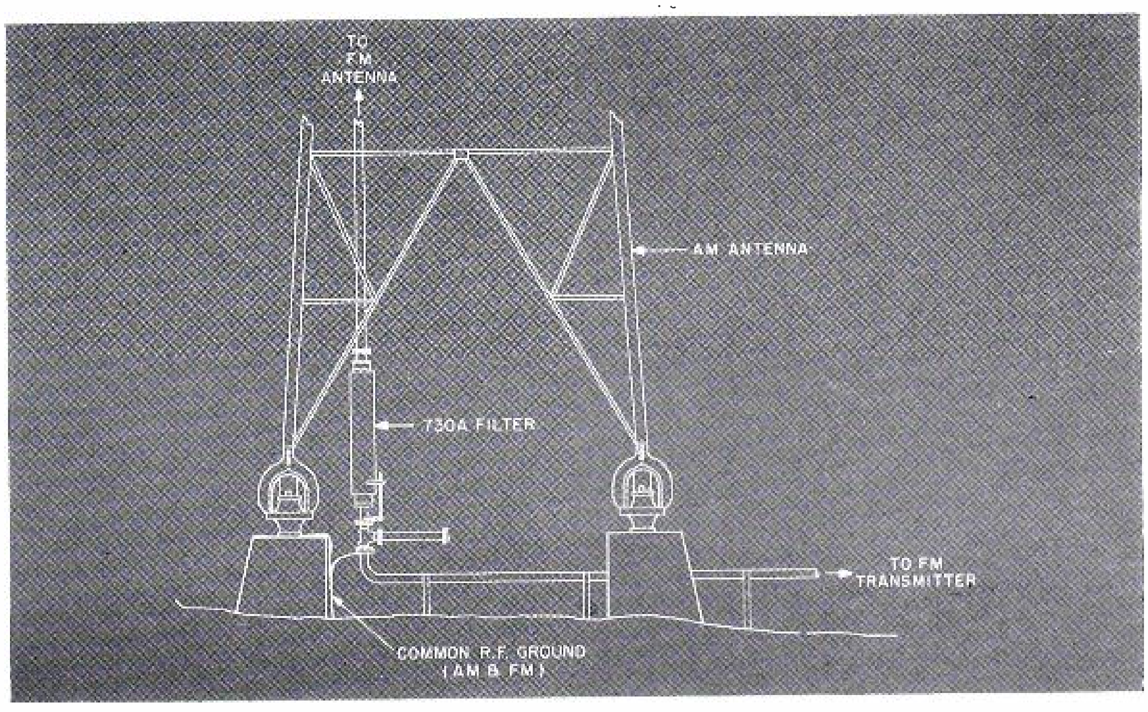
When these factors are taken into consideration, it becomes apparent that even after the design difficulties are overcome, such a device would be costly to construct and require careful maintenance.

In searching for a more straightforward method of doing this job, Bell Laboratories engineers proceeded in their accustomed way; first considering the ideal properties desired in such a device, then adapting these ideals to arrive at a practical solution to the problem. Let us summarize the ideal characteristics—then see just how well the 730A Filter meets the requirements.

Weatherproof, Gas-tight, Adjustable

The ideal bridging element would look like a low-loss 1:1 transformer at the FM frequency. It would present an infinite impedance to the AM frequency. It would be weatherproof and gas-tight. It would be non-radiating. Neither its FM transmission characteristic nor its AM impedance characteristic would vary appreciably over the bands of frequencies required for satisfactory transmission of program material. It would be adjustable in order to give optimum performance at any specified frequency in the FM band, yet the adjustments would be few in number and simple to make in the field. The ideal device would be small in size, light in weight, and trouble-free in operation. It would be relatively low in cost, easy to install and require no maintenance.

With these ideal characteristics in mind



Drawing of a typical installation of a 730A Filter in an FM transmission line at the base of an AM tower.

it is interesting to examine the Western Electric *730A Filter*.

The 730A Filter is provided with coupling flanges to facilitate its insertion in the proposed RMA standard 3⅛ inch FM transmission line at the base of the AM tower. A sketch of a typical installation is shown on page 33 and external dimensions are given at the right. Standard transmission line tapers may be employed to permit the use of the 730A Filter with standard lines of 1⅝ inch and 6⅛ inch diameters.

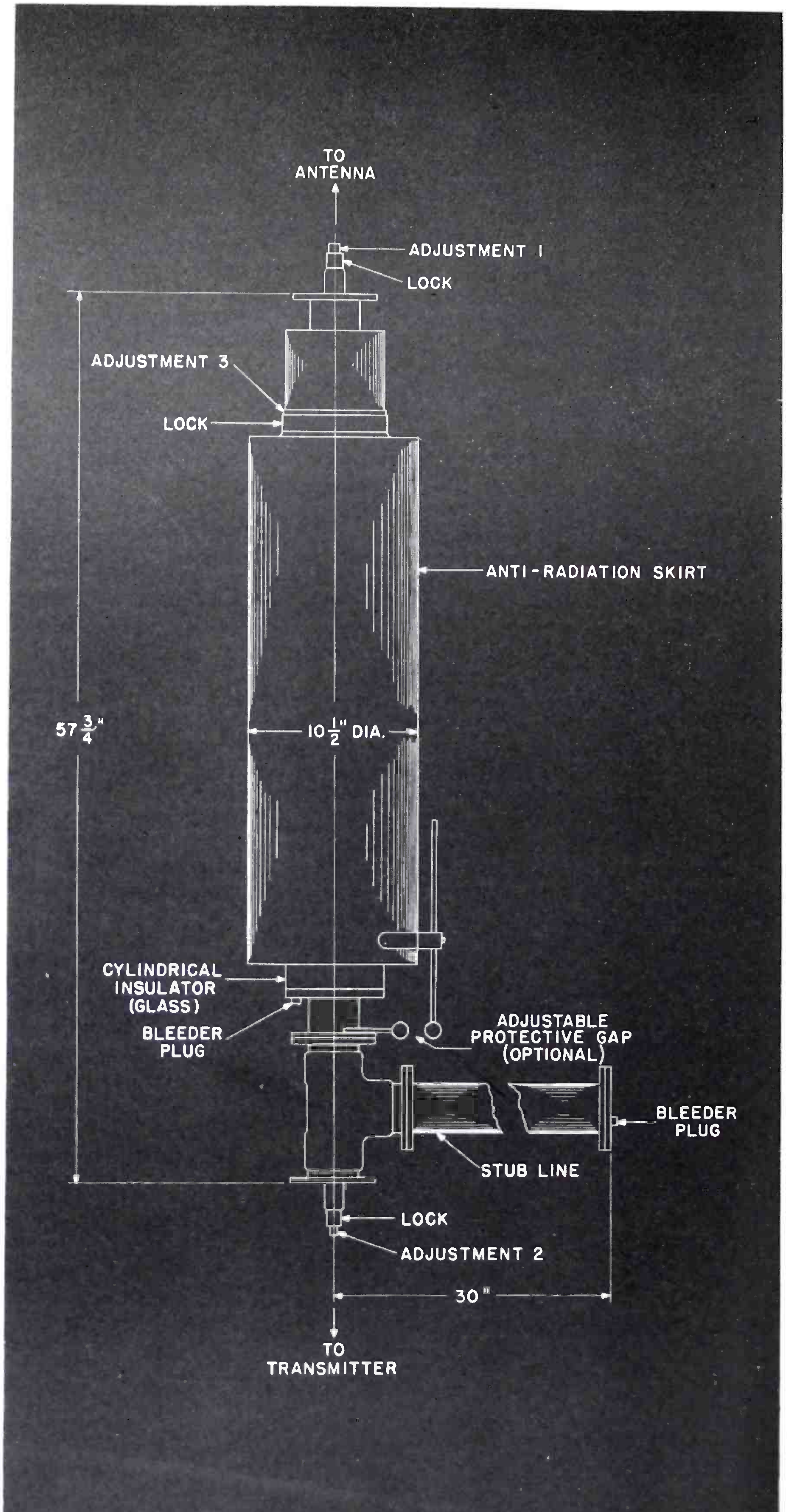
The loss at FM frequencies is extremely small, being approximately the loss occurring in a standard 20-foot length of 3⅛ inch coaxial transmission line. The small standing wave resulting from the adjustable impedance at the load end of the 730A Filter is exactly nullified by the conjugate impedance provided by the adjustment at the input end of the device. Accordingly, the Filter is a 1:1 transformer of extremely low loss, which looks like 51.5 ohms at the input end when inserted in a properly terminated standard FM transmission line of that surge impedance.

Ranges from 19.8 mmf to 28 mmf

The impedance at AM frequencies is a variable, depending both on the AM frequency and the FM frequency. The 730A Filter is, in effect, a capacity in parallel with the tower base insulators. This capacity ranges from 19.8 mmf when the 730A Filter is adjusted for 108 mc, to 28 mmf when the adjustment is for 88 mc. To compensate for this shunt reactance a slight readjustment of the AM antenna coupling unit may be made. The coaxial construction employed prevents radiation which might assume troublesome proportions if other arrangements were used. There is no discrimination against FM side currents over a band at least 600 kc wide. The AM impedance near 550 kc is within 1.8 per cent of its carrier value over the ±10 kc side bands; near 1600 kc it is within 0.6 per cent of its carrier value over the ±10 kc side bands.

The 730A Filter is weatherproof and gas-tight. It has three simple adjustments which can be made in a few minutes with the aid of a calibration curve and an ordinary ruler. These adjustments are made at the time of installation and thereafter require no further attention. After they are made, the 730A Filter is raised into place and bolted to the flanges of the adjacent transmission line sections. Its total weight is approximately 90 pounds, which is about the weight of a 34-foot length of 3⅛ inch line, and its position at the very bottom of the vertical run of transmission line makes installation a simple matter.

(Continued on page 38)



External dimensions of the 730A Filter. Designed for 3⅛-inch transmission line, standard transmission line tapers can be employed to permit its use with standard lines of 1⅝-inch and 6⅛-inch diameters.

New Traveling Wave Tube

It amplifies over a band 40 times wider than present tubes

IT looks like an oversize thermometer. But this entirely new and yet surprisingly simple vacuum tube amplifier, known as the traveling wave tube and developed by Bell Telephone Laboratories, may be of far-reaching significance in television and long distance telephone transmission. It may even make it practicable to send television all the way across the country.

Preliminary tests indicate the tube may amplify dozens of full color or black and white television programs simultaneously. Or it could theoretically handle more than 10,000 simultaneous cross-country telephone conversations or over a hundred million words a minute by telegraph.

Over the past three decades in which amplifier engineers have had the vacuum tube to work with, considerable progress has been made in developing tubes and associated circuits capable of amplifying wider and wider bands of frequencies. For example, a band width of about 10,000 cycles at the beginning of the period has been broadened to one of about 20,000,000 cycles (20 megacycles) today.

Breaking sharply with the past, this magic tube promises to amplify voice or television signals over a frequency band 40 times as wide as that of the best tube now in use and to give many times the amplification.

Conservative figures for the new tube show a power gain of 10,000 over a band width of 800 megacycles. By comparison the present pentode tube can give a power gain of only 10 over a band width of 20 megacycles; while a velocity modulation tube, operating in the microwave range, gives the same amplification over a band width of 10 megacycles. Engineers believe that even the above figures for the new tube can be improved, for it has by no means reached its full development.

In addition to these contributions to wideband amplification, the tube is remarkably simple. It is only about 18 inches long and only a few inches across. An entire amplifier hook-up, of which the tube is the heart, occupies a space less than two feet long and a few inches square and it can do the work of a maze of tubes and circuits.

The idea underlying the tube was proposed and was worked on during the war by a British scientist, R. Kompfner of Oxford University's Clarendon Laboratories. Dr. John R. Pierce of the Bell Telephone Laboratories, with Dr. L. M. Field, has solved the electronic problems of the new tube and overcome effects which rendered earlier efforts of little practical value. Together with F. H. Best, also of Bell Laboratories, who has handled mechanical design and construction problems, they have produced a practical, workable device.

Electrons "Blow Past" Wave

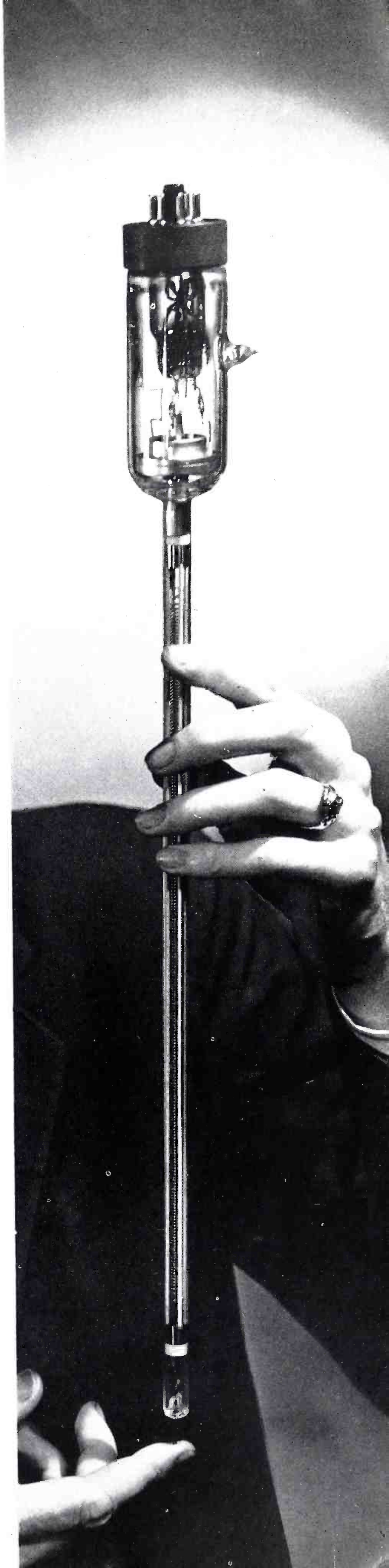
The principle of the tube's operation is entirely different from previous type amplifiers. It does not even look much like an ordinary tube for it has a narrow, glass stem about a foot long and then on one end, it flares into a bulb.

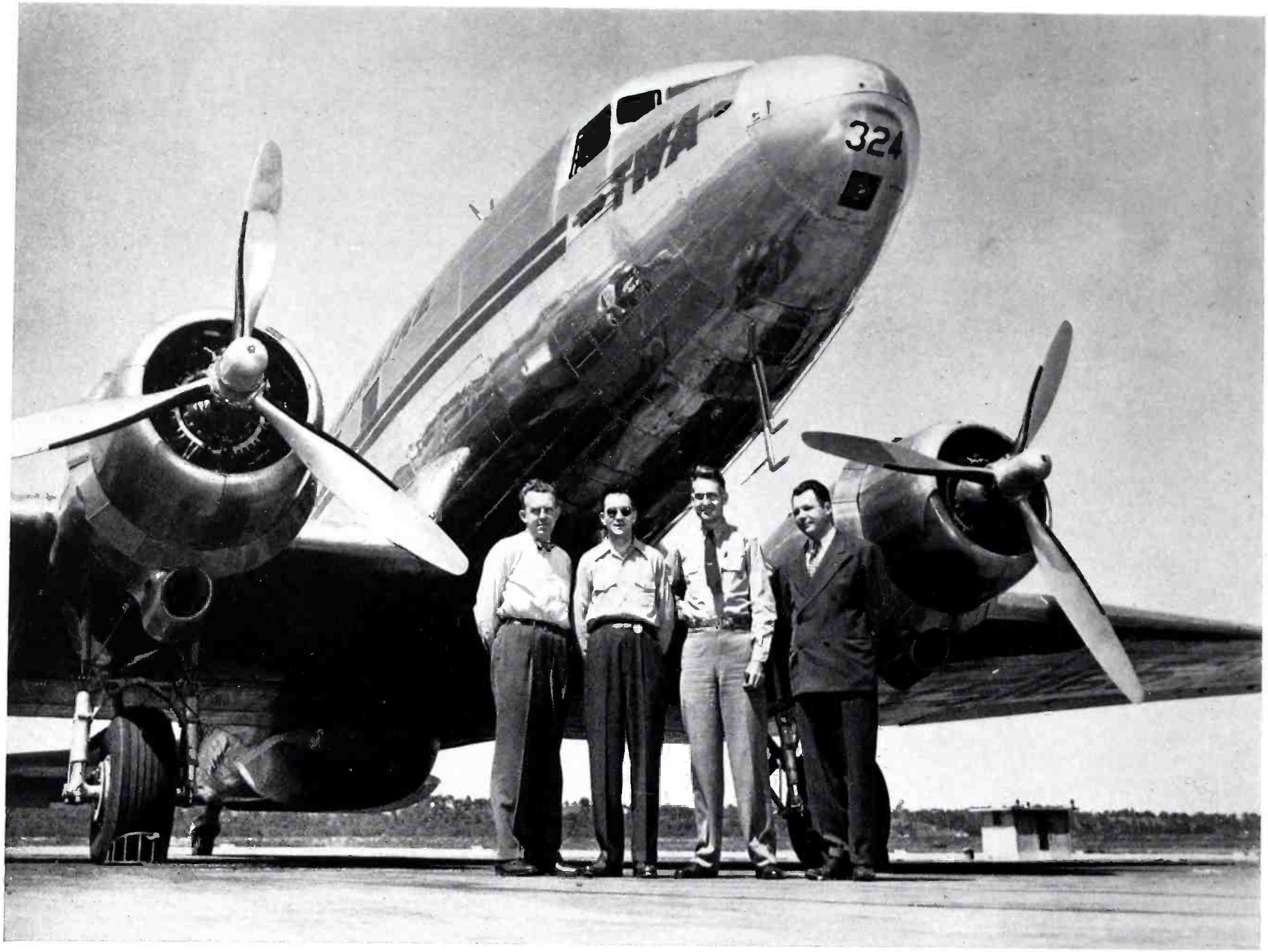
Inside the stem is the essence of the tube, a long coil of thin wire, or helix, running from one end of the stem to the other. The wave to be amplified is fed onto the coil at the bulb end through a wave guide and then drawn off at the other end in the same way.

The wave travels along the coiled wire at the speed of light but because of the winding of the wire, it moves along the length of the tube at only a thirteenth of this speed. Meanwhile, from the bulb—actually, an electron gun,—a beam of electrons is shot through the inside of the coil down the stem in the same direction the wave is moving and at approximately the same speed, i.e., one thirteenth the speed of light.

The speeds are not exactly matched, however, and on the average the electrons go faster than the wave. They tend to slow down, though, and in so doing, they give up some of their energy to the wave. As a result the wave gains a tremendous amount of energy and becomes many times amplified.

The picture is not unlike that of a breeze blowing past ripples on a pond—the ripples grow larger as the breeze blows them along. In the tube, the electrons "blow past" the wave on the coil and reinforce the wave by transferring energy to it.





The "Sky Lab" carried the radar equipment during the series of radar tests conducted by TWA. The men above helped carry out the tests. They are, left to right; Robert Buck, TWA Pilot; R. M. Davidson, Western Electric Field Rep.; Jack LeClaire, TWA Engineering Pilot, and Ralph Ayres, TWA Comm. Engineer.

TWA LOOKS AT RADAR

By Ralph C. Ayres
Communications Engineer, TWA
and R. M. Davidson
Western Electric Field Representative

IMMEDIATELY after the war, TWA, the Trans World Airlines, expressed to Western Electric and Bell Telephone Laboratories a desire to investigate the wartime developments in airborne radar for commercial applications. Western Electric and Bell Laboratories agreed to make available to the airlines their vast experience gained as the Nation's largest wartime supplier of radar and to cooperate in experiments for determining how best radar can be used to increase the safety and efficiency of commercial aviation.

The airlines recognized the differences inherent in commercial and military operations and therefore set out after V-J Day to find out what modifications in military radar were necessary in order to make radar as indispensable in peace as it was in war.

Military radar was not immediately adaptable to commercial airline functions for several reasons.

First, successful operation of any existing military radar system requires a highly trained observer who can interpret the scope pictures and who knows how to operate the system for optimum results. In commercial airlines today, the duties of the pilot or co-pilot leave no time for operation of existing types of radar, nor is there room in the cockpit for a radar operator. Second, practically all of the existing types of military radar for aircraft are heavy, bulky and require a great deal of primary power at 24 volts. Many commercial airlines' planes have comparatively low capacity 12-volt electrical systems which could not handle the load of a radar system. Third, most types of military radar were designed for specific purposes and no one type was developed to do the varied job which commercial airline applications require.

In view of these facts, Western Electric and Bell Telephone Laboratories decided to assemble a system using the best features of the most successful wartime radar units to give TWA a suitable radar for experimental work and to provide technical assistance for the tests. This experimental radar system gave TWA a medium power search radar with PPI presentation, high resolution, comparatively low weight and packaged for convenient installation.

The system had ranges of 5, 10, 20, 50 and 100 miles on radar and beacon with a radar pulse width of 6/10 microseconds and a repetition rate of 1,000 cycles per second, except on the 100-mile range where a rate of 600 cycles per second was used. Beacon pulse of 2.1 microseconds was used with a repetition rate of 350 cycles per second. The peak power was 40 kw on a frequency of 9375 megacycles and the antenna pattern was 1.4° in the horizontal plane and a cosecant squared pattern in the vertical plane. Presentation was PPI type on a 5 inch tube. Although no effort was made to reduce weight in this equipment, the over-all weight, including cables and inverter, was only approximately 250 pounds. For demonstration purposes, an auxiliary indicator and an auxiliary control panel were mounted in the plane's cabin.

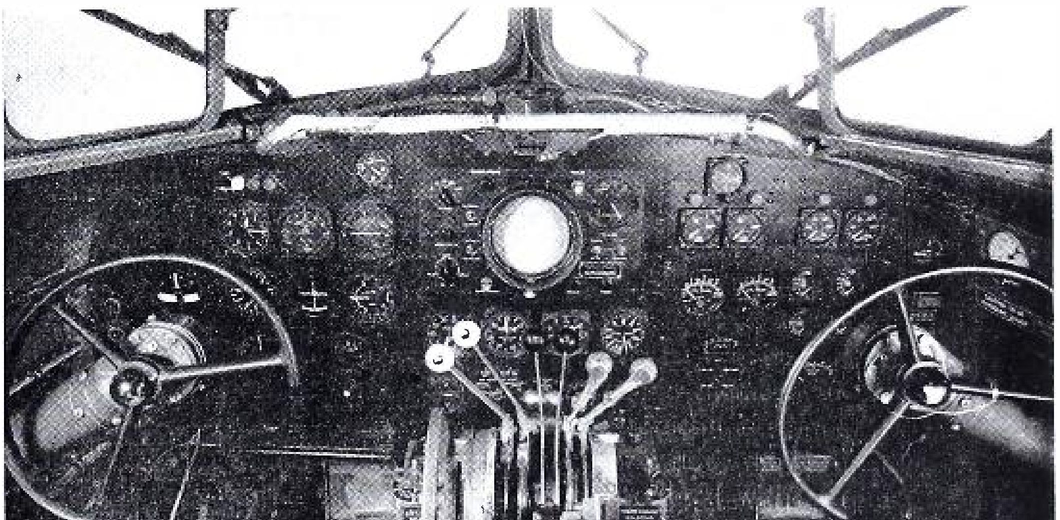
"Sky Lab" Covered the Country

The installation in TWA's plane No. 324, the *Sky-Lab,* was completed in May, 1946. The FCC granted license No. W10XB and flight tests began immediately. This plane, a modified C-47, is used by TWA to test all new types of equipment and is unrestricted as to regular schedules. About 200 hours were spent in the air over parts of the United States extending from New York City to Phoenix, Arizona. Four flights were made over the Rocky Mountains and six flights were made over the Appalachians. In addition, special flights were made in the heavily populated areas of Kansas City, Chicago and New York City, and flights were made in and around thunderstorms. Several flights were made in practicing low level approaches, both by glide-path localizer and by radar.

The results of observations in these tests led to the conclusion that radar in its present form needs further development for commercial airline use. Specifically, the results were:

1. Thunderstorms and regions of precipitation can be detected by radar and, since such regions are usually accompanied by a turbulence, such detection can warn the pilot and these regions may be avoided. With the trend toward larger and faster planes, avoiding regions of severe turbulence and hail becomes more important to the safety of the aircraft. The problem of constant observation of the scope is present but usually the pilot has meteorological information which would call for more frequent observations of the scope when flying in the areas in which such conditions were anticipated.
2. Low approaches can be made by radar if the observer is trained and the airport is a good radar target or if it is adjacent to easily recognized natural terrain features, such as the river at the Kansas City airport. Low beacon approaches can also be made but the same fundamental fault, namely, the necessity of constant observation of the scope is still present. The pilot must watch his flight instruments while making a landing and this precludes full attention to the radar scope.
3. The intensity of the present type of indicator is too low to be viewed in daylight without a hood and, with a hood, it requires an observer, as the pilot must give his attention to flight instruments.
4. As a navigational aid, it is good in certain regions and poor in others. Over areas with outstanding terrain features, such as coastal sections, rivers and lakes, it is good but it requires a trained observer to interpret the scope picture even under the best of conditions. In areas such as southwestern Kansas, even a trained and skilled observer has a difficult task locating recognizable features.
5. Aircraft collision warning by radar that also provides long range search is poor. Due to the limitations of scanning imposed by mounting the antenna on the belly of the plane as is necessary for PPI presentation, other planes on or above the flight level are shielded by the plane's structure, and those planes below flight level are difficult to detect as they are masked by the ground return. In flying over mountainous regions, even a skilled observer finds it hard to distinguish between mountain shadows (radar) and lakes. With a cosecant squared type antenna beam as required for good ground mapping, the elevation of obstructions is impossible to determine accurately. In flying over densely populated areas, critical adjustment of receiver gain is necessary to enable the observer to distinguish individual buildings and obstructions.
6. Radar installations can be made in commercial airline planes when their results can justify the weight. Even such a large unit as the 60-inch antenna can be installed without affecting the airspeed or flight characteristics of a DC-3, and the other units can be packaged to fit in existing airplanes.

Although future tests aimed specifically at detection and avoidance of turbulent areas connected with thunderstorms and



At right is the control and instrument panel of the TWA "Sky Lab," with the radar PPI scope in the center. At left is a picture of this scope as the plane passed over New York headed north. Manhattan Island, bounded by the Hudson and East Rivers, is clearly visible. Central Park can be seen in upper Manhattan.

hail are planned by TWA with this radar system as well as other types of radar, the results of the present tests lead to the following views toward radar for commercial airlines:

1. Radar offers great promise as a means of detecting and avoiding hail and thunderstorms.
2. Radar may be useful as a means of collision warning if such warning would give a visual or aural alarm independent of the radar scope, and the system could be designed to minimize or eliminate ground return or obstacles which were well out of any possible collision course whether they be other aircraft, high buildings, or mountain peaks.
3. Radar as a navigational system must be supplemented by other means. However, navigation by radar beacons, if reliable, would be valuable as would limited radar ground mapping in conjunction with weather and collision warning.
4. Airborne radar at present is not as effective as other methods of low level approach.
5. Additional displays on the radar scope, such as absolute altitude, artifical horizon, bank and turn indication, and airspeed combined with weather and collision warning would consolidate the important flight instruments and would eliminate much of the criticism of need for close observation of the scope.
6. Radar in its present stage will find its greatest application in the larger and faster airplanes but weight and bulk must be minimized.

In conclusion it must be realized that radar, the "magic instrument of the war", should not be considered the answer to all commercial aviation problems, but in an improved form promises definite benefits. The airlines, with the full cooperation of industry, are making every effort to bring the practical applications of radar to commercial aviation and thereby increase the safety and dependability of air service.

NAB

(Continued from page 7)

best principles and policies conformable to the Communications Act, the FCC regulations, and the anti-trust laws, in the fields of children's programs, religious programs, controversial public issues, length of commercial copy, and all of the items covered in the old 1939 Code together with any new items that its studies might have suggested. Such objectives of the "Blue Book," therefore, were already largely on the way to being accomplished.

The fourth function of NAB, as of any trade association, consists of what is commonly bunched together under the heading of public relations. Regular public relations efforts are going forward in the way of public addresses and public statements by the staff, chiefly by Judge Miller and Jess Willard, through publication and distribution of radio literature of interest and assistance to the general public, and through such observances as Radio's 25th Anniversary, Annual Radio Week, etc. But the big public relations job will be done, as it was done in 1939-40, in explaining and "selling" the new Code. For there will be a new Code, the Board of Directors having taken the necessary preliminary steps in that direction at its meeting in August. If it is as good as the 1939 Code it should be easy to "sell." As a matter of fact, it will probably be better.

We've referred specifically to the special chores of the various members of the NAB staff. But we shouldn't leave the subject without pointing out that the most important of all chores is that of coordinating the work of the staff, harmonizing it with Board directives, and making such spot decisions on policy as are inevitably required, from time to time, in such a widely dispersed organization. These functions are reserved, of course, to Judge Miller, Jess Willard, and Bee Arney.

And to make the NAB picture complete we should not omit reference to another staff member who, because his work is altogether internal, might otherwise escape mention. That his work is indispensable is indicated by the title of his job; and being one of the oldest members of the staff in order of seniority, he's important to NAB in more ways besides. He's Everett Revercomb, Auditor. And speaking of seniority, Ella Nelson, secretary to Bee Arney, is the oldest hand aboard—but oldest, let us hasten to add, only in point of seniority.

This is the new NAB—a nicely integrated team, old enough to be seasoned, young enough to avoid staleness, working under the leadership of a man who is determined that his best efforts and the best efforts of his staff shall be given to preserving a free radio for a free people.

Notes on Modulation

(Continued from page 23)

This rather fundamental experiment indicates that in modulating a transmitter heavily at a high audio frequency one should be careful, if the load is frequency-sensitive, to choose a suitable monitoring point. The type of transmitter employed is immaterial on this score. If the current wave is to be observed, the point of observation for determining 100 per cent modulation should be one where the resistance and reactance curves exhibit the type of symmetry shown in Figure 3; if the voltage wave is to be observed, the type of symmetry in Figure 4 is necessary. In no case should the impedance-frequency curves at the monitoring point resemble Figure 5 (with the resistance higher on one side of the carrier frequency and lower on the other) or the wave shape as seen at that point will inevitably be distorted however excellent the output wave from the transmitter may be.

Can I Use FM Antenna?

(Continued from page 34)

One model of this device is provided for all applications. Its voltage breakdown rating is such that it may be used for power combinations of 40 kw FM and 40 kw AM on the same tower, even under the most unfavorable conditions of tower input impedance. Under normally favorable conditions it will withstand fully modulated 50 kw of AM and 50 kw of FM simultaneously.

The only maintenance necessary is a periodic cleaning of the cylindrical insulator, just as is required for any transmission line end seal.

The Graybar Electric Company representative in your area will be in a position soon to supply detailed technical data and delivery information.

New Radio Shops

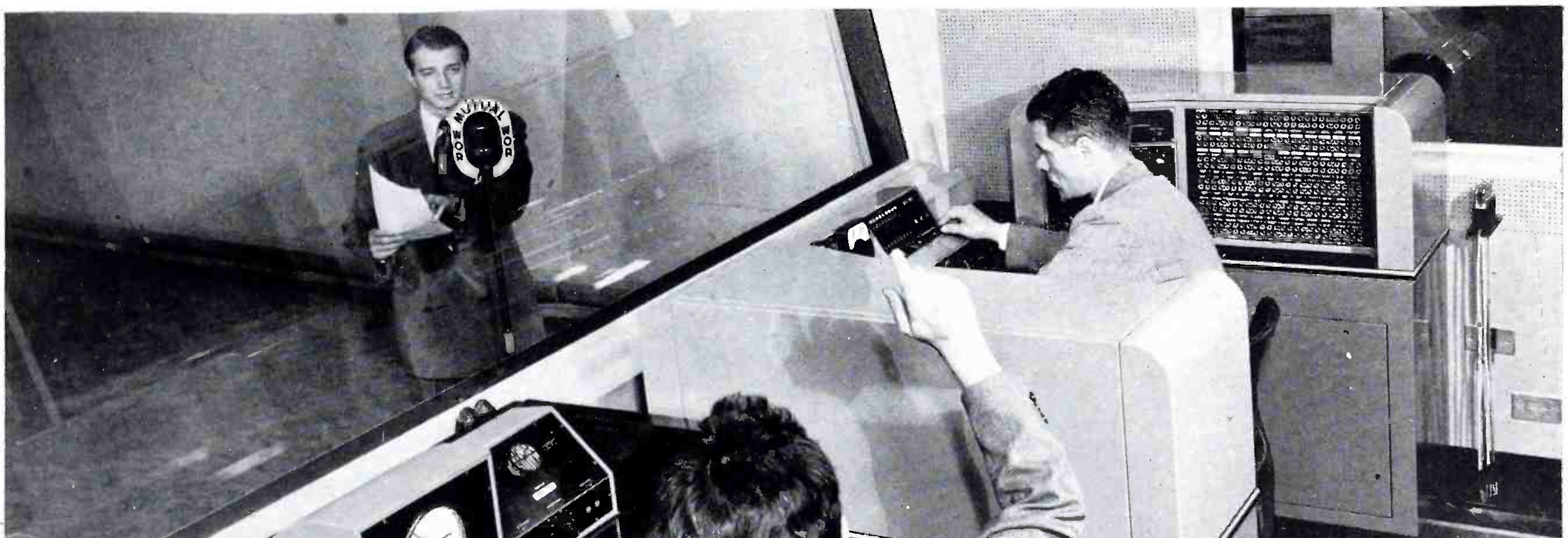
(Continued from page 28)

frame structure which was operated during the war by the National Carbon Company to manufacture components for electronic equipment for the armed forces. The armed forces will continue to receive the greater part of the output of this plant for here are being manufactured radars and other electronic equipment for the United States Government. From Winston-Salem will come battle-tested fire control and search radars of all types—plus post-war electronic equipment that is even newer and better, such as the radar for the Army's new six-engine B36 bomber.

Here too, is Radio Division's Coil Shop, already turning out coils by the thousands. When full production is reached this shop will produce all of the coils needed by the Radio Shops for the manufacture of its radio and electronic equipment.

Another new plant is being constructed at Allentown, Pennsylvania. When completed, it will give enlarged facilities for the manufacture of Western Electric vacuum tubes, crystals, thermistors and varistors for the Bell System and for commercial customers.

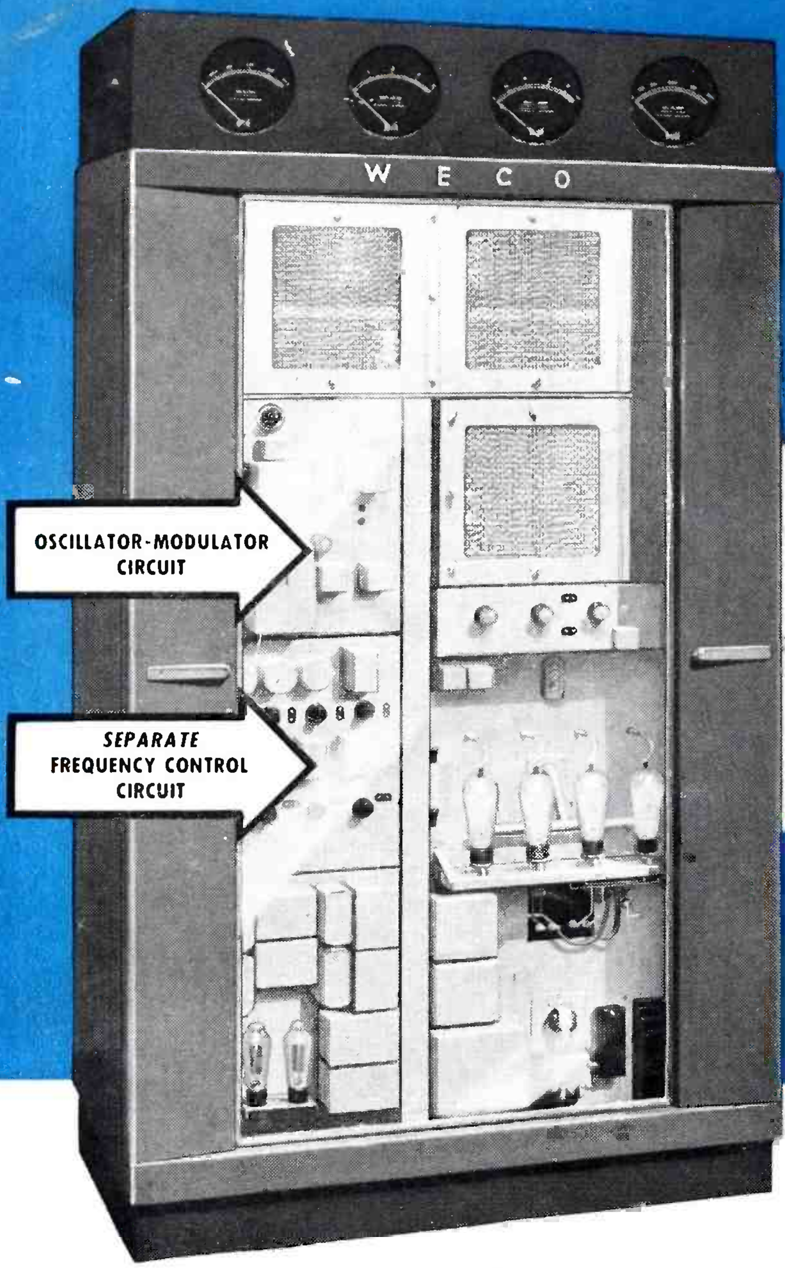
Tailor-Made Console Gives Modern Program Control

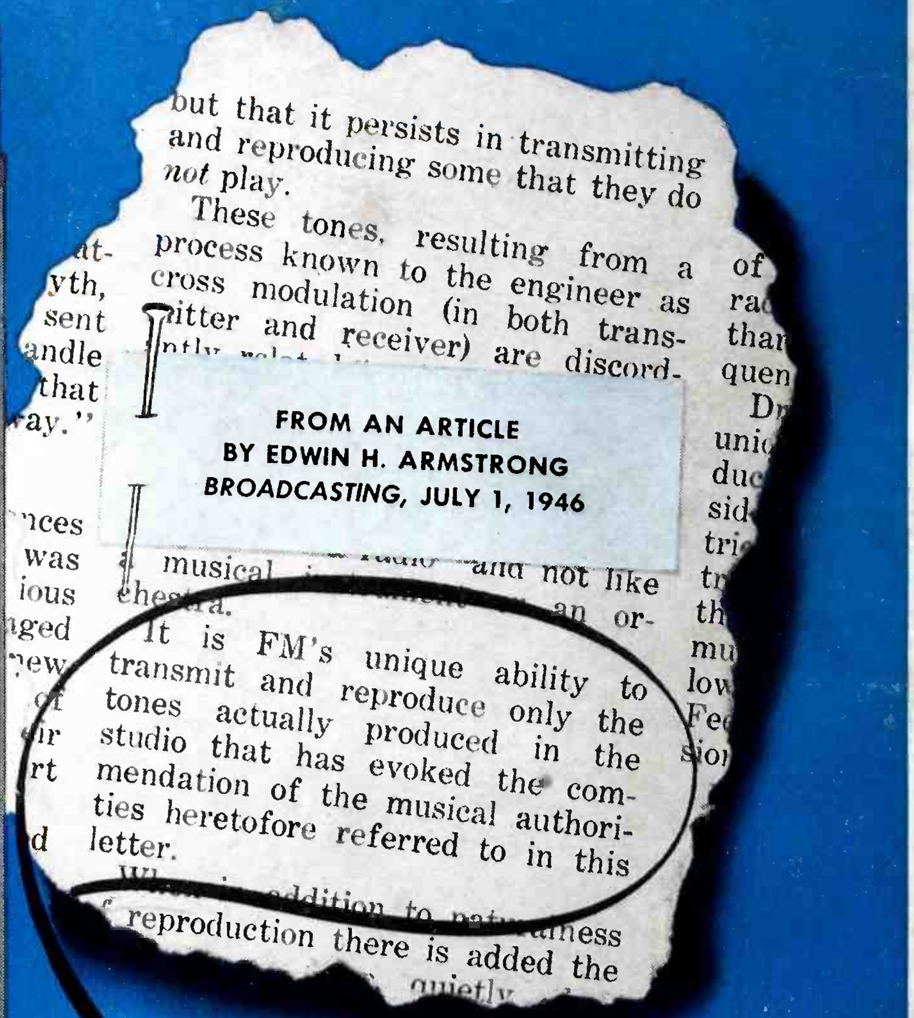


Close-up views of one of three identical Western Electric Custom Built Speech Input Consoles installed at WOR. Top view shows the console's clean well-designed lines which place everything within easy reach of the operator. Bottom view illustrates position of the console in relation to the producer's desk.

Important FM news

for Broadcast Managers . . . Engineers . . . Listeners




but that it persists in transmitting and reproducing some that they do *not* play.

These tones, resulting from a process known to the engineer as cross modulation (in both transmitter and receiver) are discord-

musical ... and not like ... an or-chestra.

It is FM's unique ability to transmit and reproduce only the tones actually produced in the studio that has evoked the commendation of the musical authorities heretofore referred to in this letter.

... reproduction there is added the ...

FROM AN ARTICLE
BY EDWIN H. ARMSTRONG
BROADCASTING, JULY 1, 1946

Unexcelled Performance of Western Electric FM Transmitters

Audio Frequency Response		±0.25 DB from 30 to 15,000 cycles
Harmonic distortion — for	±75 KC swing	Less than 0.5% from 30 to 15,000 cycles
— for	±100 KC swing	Less than 0.75% from 30 to 15,000 cycles
Intermodulation — — — for	*±75 KC swing*	*Less than 0.5% for 80% 50 cycles and 20% 1000 cycles; less than 1.0% for 80% 50 cycles and 20% 7000 cycles*
FM noise level		65 DB below ±75 KC swing
AM noise level		50 DB below 100% amplitude modulation
Carrier Frequency stability		Less than 2000 cycles deviation (no crystal heater)

IT is low cross modulation (intermodulation), as Major Armstrong points out, which allows FM to reproduce only the notes actually played and thus achieve such naturalness of tone.

Western Electric's Synchronized FM transmitters are unique in FM broadcasting because of their *unusually low intermodulation products*—achieved by a complete separation of the oscillator-modulator circuit from the frequency control circuit.

For other important features of Western Electric's complete new line of FM transmitters, contact your nearest Graybar Broadcast Equipment Representative, or write to Graybar Electric Company, 420 Lexington Avenue, New York 17, N.Y.

Western Electric

— QUALITY COUNTS —

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