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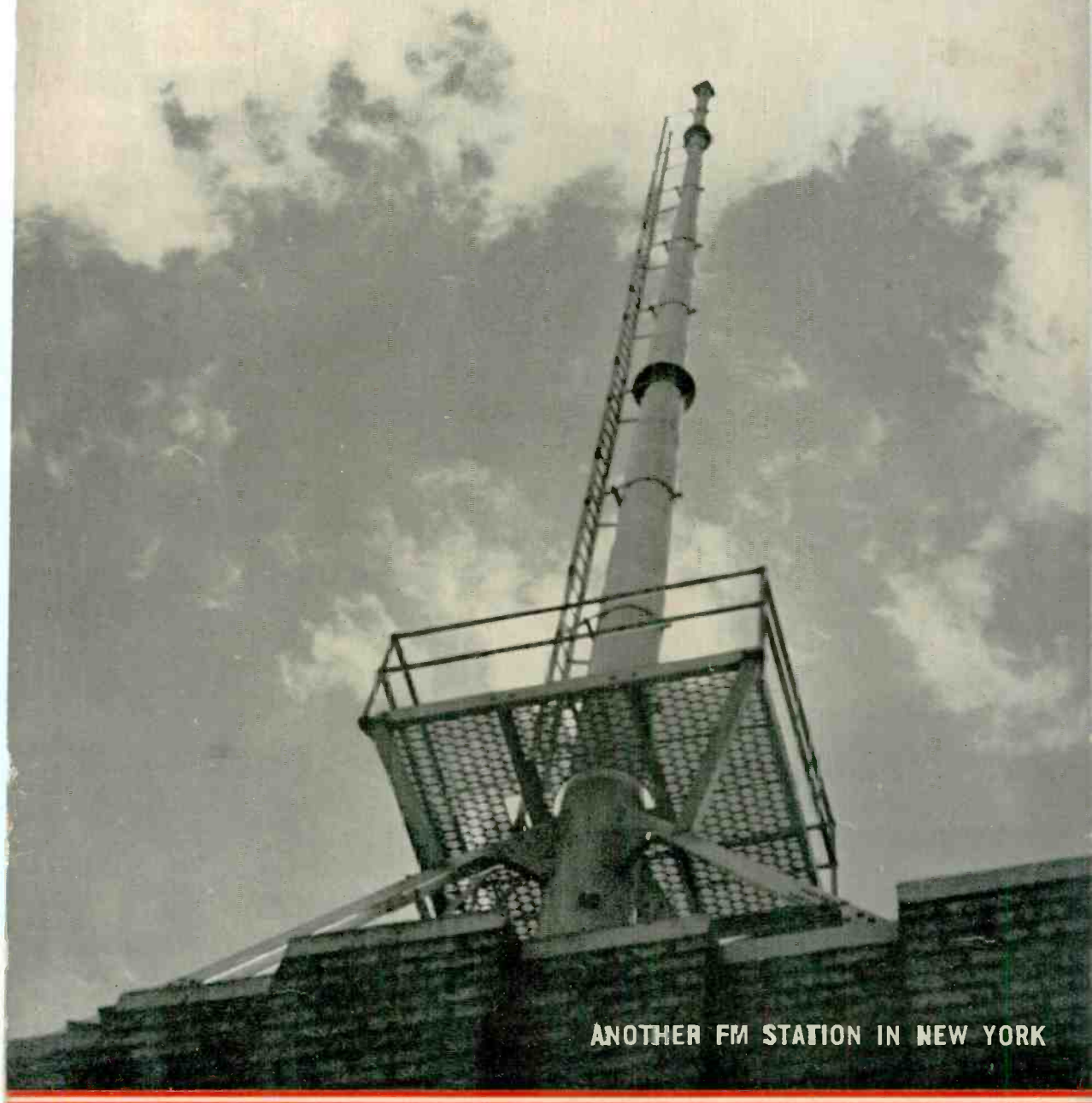
FM

APRIL 1942

ELECTRONIC EQUIPMENT

Engineering & Design Practice



ANOTHER FM STATION IN NEW YORK

THE JOURNAL OF WARTIME RADIO-ELECTRONIC DEVELOPMENT, ENGINEERING & MANUFACTURING ★ *Edited by M. B. Sleeper* ★

The Browning Laboratories

THE BROWNING LABORATORIES afford complete service for radio-electronic research and development.

According to the needs of individual clients, this service may include the analysis and investigation of new methods or devices; perfection of their electrical and mechanical design and operation; and the construction of pilot models or the production of limited initial quantities.

The Browning Laboratories are staffed by a group of highly competent and experienced radio-electronic specialists, under the direction of Glenn H. Browning. Precision equipment is available for measurements and tests. Designs and workmanship of the model shop meet the standards of modern production practices.

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Electronic Boundary Protection

A special service of the Browning Laboratories is the engineering of electronic boundary protection for industrial plants and public utilities. An original method is employed which affords unique, practical advantages over other systems.

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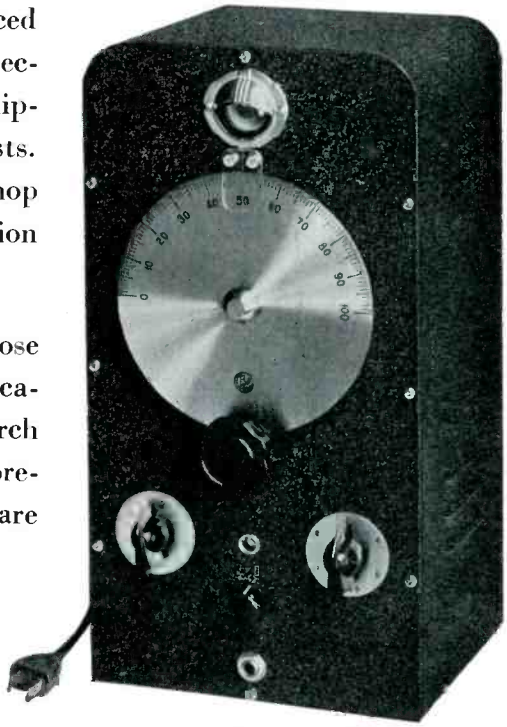
The Browning Frequency Monitor, illustrated below, is used as standard equipment for police and public utility emergency communications systems throughout the USA. It is available for one to four bands on frequencies between 1.5 and 60 mc. Delivery without delay.



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Coming—The Radio-Electronic Engineering

Wartime Products Directory

RADIO-ELECTRONIC Engineering & Design

WARTIME radio-electronic developments are bringing into use many new materials, components, and devices, as well as "equivalent" products made by companies new to radio manufacturers.

Precious hours are being spent in searches for the names of these companies or their nearest representatives. Annual directories, under present conditions, are sometimes helpful, but are more often inadequate or inaccurate.

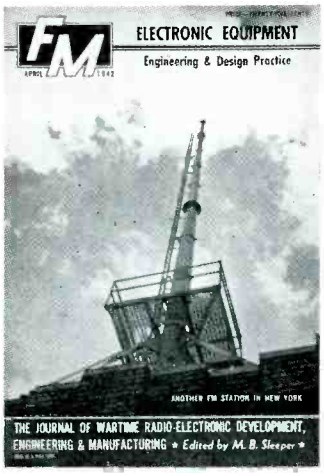
Today, a radio-electronic products directory of real value must be revised and brought up to the minute every month. This work must be done under the supervision of a manager who works not with mail-order lists but from his own intimate knowledge of the industry and all its procurement problems.

That is the manner in which the Radio-Electronic Wartime Products Directory will be presented, starting in *FM* Magazine next month. This Products Directory will show the names of:

1. Manufacturers of products and equipment not used commonly in the past.
2. Manufacturers of new products and equipment.
3. Manufacturers now producing items considered as "equivalent" products.
4. Representatives or distributors of radio-electronic equipment in manufacturing centers.

This directory, we wish to emphasize, is not being set up to be impressive by the quantity of names and products listed. Rather, it is being strictly streamlined to give quick answers to wartime products procurement questions.

M. B. SLEEPER, *Editor and Publisher*



CBS STATION W67NY

JUST what can be done by the holder of an FM Construction Permit if he really wants to get on the air is illustrated by the account of Columbia's W67NY, published in this issue.

Compared to FM stations built when materials were readily available, this is a simple installation. The tall mast, bare of the dipoles for which no copper is obtainable, stands as a gaunt reminder of the things that stopped the day Pearl Harbor was attacked, and that must now wait for peace to come again.

But that did not stop Columbia from carrying out their intention to give service to the FM listeners in the New York area. A temporary antenna, just a single dipole, was erected, and the transmitter was put in regular operation. Columbia undertook a job, and saw it through.

There are more FM transmitters available to those who were sincere in applying for CP's. Of course, in cities where there is no FM broadcasting on the air now, no purpose would be served by starting a new station at this time. However, in cities where one or more stations are already operating, pressure should be brought to bear on those holding CP's to get transmitters into service, even if they have to use temporary antennas and forego some of the finishing touches. Columbia is doing this very successfully, and so can others.

FM

ELECTRONIC EQUIPMENT ENGINEERING & DESIGN PRACTICE

COMBINED WITH APPLIED ELECTRONIC ENGINEERING

VOL. 2 APRIL, 1942 NO. 6

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M. B. SLEEPER, *Editor and Publisher*
S. R. COWAN, *Advertising Manager*

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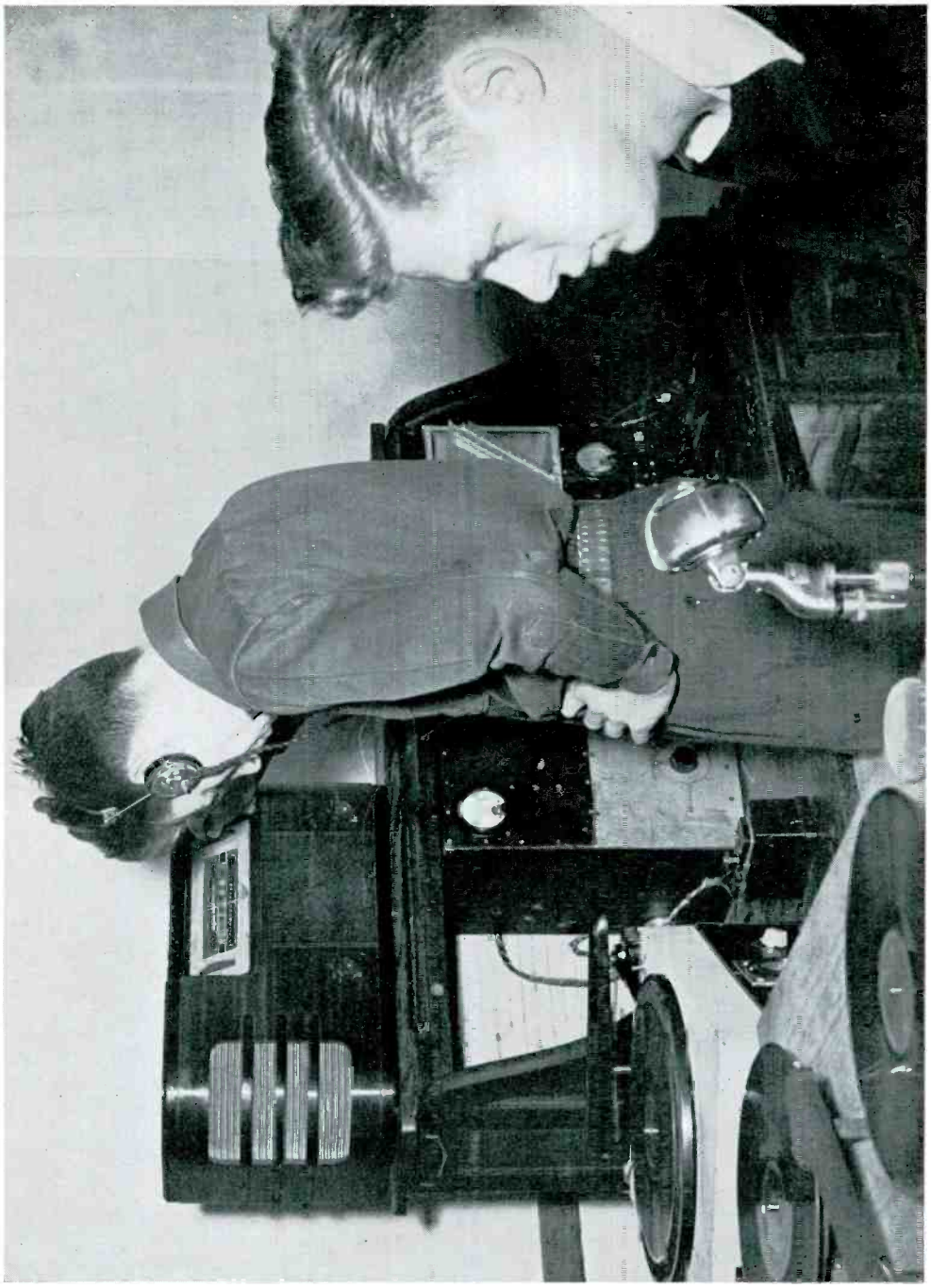
A charge of 25¢ each will be made for duplicating copies returned because of subscriber's failure to give change of address.

The publishers will be pleased to receive articles, particularly those well illustrated with photos and drawings, concerning all phases of FM developments. Manuscripts should be sent to the publication office, at New York City. Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM Magazine be responsible for their safe handling in its office or in transit.

Advertising correspondence, copy, and cuts should be addressed to the advertising office at New York City.



FM FOR UNION COLLEGE NETWORK

PAUL YERGIN, LEFT, AND FRANK CZECH, OF THE UNION COLLEGE RADIO CLUB, TUNE IN LOCAL FM PROGRAMS FOR REBROADCASTING OVER THE WIRED-WIRELESS SYSTEM WHICH RUNS TO FRATERNITY HOUSES AND DORMITORIES ON THE CAMPUS. MYRON MILLS, U.C.R.C. PRESIDENT, REPORTS THAT FACULTY AND STUDENTS ARE ENTHUSIASTIC OVER QUALITY OF THE REBROADCAST FM PROGRAMS

WAR REVISES RADIO INDUSTRY

What Is Happening to Radio Manufacturers and Broadcasters

BY M. B. SLEEPER

AS MUCH as we all deplore the fact of the War while it is in progress, confidence in our ultimate victory may well cause us to be grateful for the revisions it is bringing to both broadcasting and manufacturing. When peace comes again, the whole industry will make a new start, with the old slate wiped clean.

Purposely, the familiar expression "when we resume normal activities" was not used, because there will be no return to what was "normal" before last December.

Obsolete Equipment ★ In two years, or three, or five years, even the 1941 broadcast transmitters will have been made obsolete by the accelerated wartime progress of the whole radio art.

While some broadcast stations may continue in the present AM channels, a growing conviction is being expressed in many quarters that the then obsolete transmitters, as they are replaced, will be FM types. The determination to continue FM stations now on the air during the emergency seems to come from that belief.

Similarly, millions of receiving sets will have emitted their last harsh notes and whistles, while others will be long overdue at the junk piles. In 1941, many people resented the idea of having to buy new sets in order to get FM broadcasting, because they felt that their AM radios still owed them a few years of service. That resistance to change will be wiped out by the time listeners will be permitted to purchase sets again! Straight AM receivers may never reappear in dealers' stores.

What's Happening to Set Manufacturers ★ There is no discounting the current difficulties of the broadcasters, but it's business-as-usual with them compared to conditions among the set manufacturers. Here is their status as of the April 22nd zero hour:

1. These 30 companies had ceased all civilian radio production as of midnight, on the 22nd —

Belmont	Gilfillan	Setchell-Carlson
Colonial	Hallicrafters	Scott
Crosley	Hammarlund	Sparks-Withington
Delco	Kingston	Stewart-Warner
Eckstein	Meissner	Stromberg-Carlson
Electrical Research	Midwest	Templetone
Espey	Mission Bell	Watterson
Farnsworth	Noblitt-Sparks	Wilcox-Gay
Garod	Packard Bell	Zenith
General Electric	Philharmonic	
	Remler	

2. Eleven companies were given time for additional civilian production because they did not receive their war contracts in time to complete conversion before the 22nd, or because they needed additional time for retooling or getting in materials. The purpose of the extension was to keep their engineers and factory workers employed during the interim period. The companies are:

Continental	Galvin	RCA
Detrola	Magnavox	Sonora
DeWald	Pilot	Wells-Gardner
Freed	Philco	

3. Fourteen other companies were also given extra time for civilian production because, so far, they have been given little business, although they are expected to change over to war work later. They are:

Air King	Emerson	Howard
Andrea	Fada	Majestic
Ansley	General Television	Recordo-Vox
Automatic Electromatic	Hamilton	Traveler
		Warwick

R. C. Berner, former chief of the WPB Radio Section, remarked that equipment now being produced by the set manufacturers was so different from home radios that there is similarity only in the descriptive word "radio."

In this remark, he brought out a most significant fact. Whereas home sets had been reduced in recent years, with the notable exception of A-FM models, to the cheapest kind of designs, materials, and production and test methods, every one of these plants is at work now on equipment of the highest quality, built to meet specifications which require checking with elaborate precision instruments quite unknown in the sketchy laboratories of most radio factories. Much new production machinery is being added, required for mechanical designs never built into the junk sets sold by the million to American listeners.

Factory workers are being reëducated to the different and slower tempo of assembling and wiring required to assure tight mechanical construction and connections that will hold forever. They are learning to match care and

precise workmanship at every step against the exigencies of vibration in ships, planes, and tanks, of corrosion at sea, and of dampness and temperature extremes on battle fronts in jungles, deserts, and the frozen North.

Executives, engineers, and purchasing agents, released from the limitations of price competition, are now forgetting penny-pinching procedures as they bend every effort to raise and raise again the quality of their production.

Servicemen whose blundering work and scanty knowledge cost listeners so much patience and money are becoming skilled technicians.

Engineering schools are overflowing with boys who, three years ago, would have gone to work because there was so little market for college educations. Today, the Army, Navy, and private industry are competing for graduates.

This will be the background of the radio industry when peace comes again.

The FCC ★ It is easy to see that the radio-electronic industry of the future will expand in public service to a degree which challenges the imagination. The present time is none too soon to anticipate a complete reorganization and reorientation of the control which has been vested in the FCC.

Looking back, it is clear that the organization of the FCC has not kept pace with the technical progress and growth of the industry. To meet the needs of the future, it will be necessary to eliminate the dominating element whose willful, pedantic policies have dealt with personalities rather than conditions, and have been directed toward forwarding private convictions at the expense of public service.

The seriousness of this situation was brought out at the recent hearing before the Interstate Commerce Committee when Representative Sanders spoke for the broadcasters in his declaration that: "It has become the rule rather than the exception for the Commission to employ renewal proceedings as a means of compelling compliance with its regulations, or for punishing a licensee for his failure to do so."

This, indeed, is not news to those who want to know the facts, for broadcasters have been increasingly bedeviled by those Commissioners whose administration is notable for an amazingly elaborate technique of legal subterfuge and trickery used to enforce arbitrary, prejudiced, and capricious rulings, and to discipline the broadcasters to the point where, rather than protest, they comply quietly in order that they may continue in business.

Thus, time and thought and study have been diverted from the careful planning needed to pave the way for expanded public service in step with progress of the radio-electronic art. The radio industry of the future must not be hampered and heckled by men who are chiefly notable for their selfish and limited thinking.

W47A STAFF NOW HAVE AN ST LINK TO CONNECT THE STUDIO WITH THE FM TRANSMITTER. HERE THEY ARE, GETTING THE DATA ON THE NEW EQUIPMENT: L. TO R., W. VAN STEENBURGH, PROGRAM DIRECTOR; ROBERT HENRY, ASST. ENGINEER; LEONARD ASCH, PRESIDENT; GRANGER TRIP, COMMERCIAL DEPARTMENT; LLOYD KRAUSE, G.E. ENGINEER; D. S. HOAG, CHIEF ENGINEER

New Broadcast Facilities ★ On April 16th, the Defense Communications Board recommended to the WPB and the FCC that the following policy be put into effect at once: "No future authorization involving the use of any materials shall be issued by the Federal Communications Commission nor shall further materials

be allocated by the War Production Board to construct or to change the transmitting facilities of any standard, television, facsimile, relay, or high frequency (FM, non-commercial educational, experimental) broadcast station."

On April 27th, the FCC issued an order stating that: "Upon consideration of this recommendation [from the DCB, quoted above] the Commission has adopted a policy to grant no application for an authorization involving the use of any materials to construct or change the transmitting facilities of any standard, television, facsimile, relay, or high frequency (FM) broadcast station. The Commission, however, has deferred action on the recommendation of the Defense Communications Board with respect to experimental high frequency and non-commercial educational broadcast stations."

The FCC will give special consideration to those who have made substantial expenditures in connection with authorizations already issued, or have actually commenced construction prior to April 27th, provided substantially all materials and equipment necessary to complete construction are on hand.

The new Order also states that: "every applicant who desires to prosecute a pending application involving the use of materials to construct or change the transmitting facilities of any standard, television, facsimile, relay or high frequency (FM) broadcast station, shall, on or before July 31, 1942, file with the Commission a formal petition embodying a statement of such facts and circumstances as he believes would warrant the granting of his application in the public interest.

"The filing of such petition will be constructed as an indication of the desire of the applicant to prosecute his application, and, in the event the petition is denied, the application will be designated for hearing. Failure of any such applicant to file such formal petition on or before June 1, 1942, or such further time as the Commission may, upon satisfactory showing allow, will be deemed an abandonment of the application, and such application will be retired to the closed files of the Commission and dismissed with prejudice."

Broadcast Repairs and Replacements ★ The foregoing will not preclude the issuance of authorizations involving essential repairs or replacements needed to maintain existing services. In fact, materials and equipment for these purposes are now assigned an A 3 priority rating.

Names, New and Old ★ From month to month, War is bringing changes to the radio-electronic industry in all its branches, and to all those who have a part in it.

New companies are coming into being. Some will become competition for the long-established manufacturers. Some, failing to put down strong roots, will disappear when the War is over, along with those which will not recover their pre-War status.

As production was diverted to War needs, many radio manufacturers discontinued their advertising or cut their schedules sharply, for fear of creating ill will on the part of those who might be encouraged to order products that could not be delivered. For a period of time, that was undoubtedly a wise course.

Now that the public is well acquainted with conditions confronting all industry, many well-known company and brand names are already on the way to being forgotten. Meanwhile, newcomers, set up in business by War contracts, are establishing themselves on a permanent basis by aggressive presentation of their names and the importance of their activities.

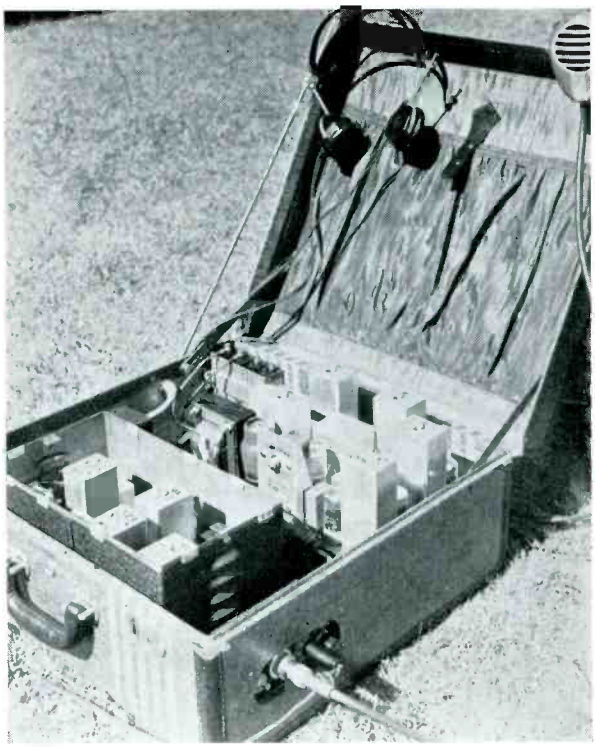
The older companies will discover, as others did after 1918, that war work, no matter how important it was during the emergency, has no merchandising value when peacetime production and sales are to be renewed if, meanwhile, the names have appeared only on name plates of military equipment.

Apropos of this, Nathan D. Golden, writing in Domestic Commerce, published by the Department of Commerce, said: "Advertising does not become a non-essential with the advent of war." Maintenance of identity is particularly important when the products manufactured in normal times are no longer made available by established methods of distribution. Golden continued: "Intelligent advertising tied in with the War effort can maintain the valuable good will of the product and keep alive company names."

It is easy to understand that, with all the changes that come with the transition from war to peace, and with every accent on forgetting the old and moving forward with the new, companies that have not maintained their positions by continuity of advertising will be seriously handicapped in meeting the competition of newer concerns which have been operating under more aggressive management policies.

FM MAGAZINE GOES TO LARGE SIZE

Beginning with the May issue, *FM* Magazine will be published in the large, standard size, 8¾ ins. by 11⅝ ins. This will permit the use of larger, more readable diagrams, and greater detail in the photographs. The superior quality of printing and paper which has characterized this publication will be continued, despite the rising production costs.



STANDARD MOBILE TRANSMITTER AND RECEIVER, REBUILT FOR PORTABLE USE

MOBILE FM FOR PORTABLE SERVICE

Connecticut State Police Use This Reconstructed FM Mobile Equipment as a Portable Unit for Many Emergency Situations

BY SYDNEY E. WARNER *

ABOUT six months ago, the necessity for a light, compact FM unit became apparent in the Connecticut State Police system. In order to operate from the Department of Aeronautics plane, it was necessary to restrict the size and weight of the unit to less than 40 pounds, and to mount the units in a compact carrying case.

The equipment available was a standard Link type 25 UFM transmitter and 11 UF receiver. The first change made was to take out the motor generator section of the transmitter and substitute a vibrator pack. This pack supplies the receiver with plate voltage in the receive position and, by means of relays, also furnishes plate supply for the transmitter when the handset button is depressed for transmitting. Since the vibrator pack is mounted close to the receiver, precautions had to be taken in shielding leads to relays, so that "hash" would not be introduced in the receiver.

To further save on power supply requirements, the 807 output tube was removed and the antenna coupling coil fed directly from the 6C5 stage. This presented no complications, since the 807 tube in the Link unit is a straight amplifier, and the signal present in the 6C5 output is at the carrier frequency, deviated ± 15 kc. The output obtained is about 3 watts, which is sufficient for an emergency rig. The 6K6 receiver output tube was also replaced by a 6J5 which reduced the drain on vibrator drain by about 15 ma. more.

Total drain is about 9 amps. from a 6-volt battery. This changes but slightly when in the

* Radio Supervisor, Connecticut State Police, Hartford, Conn.

transit position. The unit was also arranged for operation from a 12-volt supply by simply throwing a switch, since 12 volts are standard in many planes and boats.

Antenna connections were simplified by arranging for a plug-in feed to the antenna used on the plane and also to a socket where a collapsible whip can be inserted. The mounting case was purchased from a luggage store and is of the light airplane type. A standard Link control panel was mounted on the side of the box for simplicity. Operation on two frequencies is obtained by throwing a switch mounted on the panel. This inserts the extra crystal. Receiving is usually done on cushioned phones, one for the pilot and one for the operator, when the equipment is taken aloft.

The unit will operate anywhere that 6 volts DC are available and has been used in a plane, boat and at many inaccessible places. Mr. Frank Bramley, of our Radio Division was responsible for the unique features of construction, and deserves much credit for his ingenuity. The FM Link Company has since developed a similar unit which also has the advantage of 110 volts AC operation combined with the above features described.

We have found this portable FM unit invaluable for checking on traffic tangles from the airplane, since it affords communication with all our cars and fixed stations. The reduced power of the transmitter is more than offset by the height of the plane above the ground.

On occasions when traffic jams develop, or cars have to be rerouted around an accident on a main highway, airplane communication with our system performs an effective service for which there is no substitute on the ground.

Where it used to be necessary for patrol cars or motorcycles to push their way through or alongside lines of stalled cars one officer can go up now and get a complete view of the extent of the tieup. Then he can report the availability of secondary roads which bypass the center of the trouble. The portable FM unit we have made up affords instantaneous 2-way communication with all cars on the scene and with the nearest barracks station if it should be necessary to summon more cars.

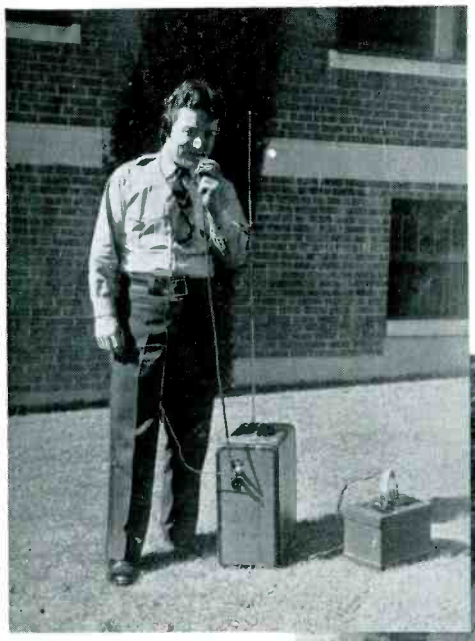
In these times, we are particularly concerned with emergencies which may come up on our rivers or along the Connecticut shore of Long Island Sound. Making the portable FM unit available for service in our speed boat or in any craft we are called upon to use gives us an important extension of our radio network.

The range of the portable over water or when it is set up on the ground is in the neighborhood of four or five miles. This varies considerably with the topography of the land which must be covered. In practice, we find that this unit has sufficient range to communicate with one or more cars at all times. That is all we need, since a car can then relay messages or instructions to any point in the State.

If the need arises, we can use our emergency truck [1] in conjunction with the portable equipment as a temporary emergency station. The truck, of course, serves for this purpose when

[1] Emergency Truck to Supplement State-wide FM System, by Sydney E. Warner, *FM* Magazine, September, 1941.

WITH THE FM PORTABLE ABOARD (SEE INSERT) THIS PLANE IS USED TO SEND INFORMATION AND INSTRUCTIONS TO PATROL CARS OR THE FIXED STATIONS AT THE BARRACKS



LEFT: SYDNEY WARNER AND THE PORTABLE 2-WAY EQUIPMENT AS IT IS USED AT INACCESSIBLE SPOTS WHERE A PATROL CAR CANNOT GO

RIGHT: 2-WAY FM COMMUNICATION GOES WHERE PATROL CARS CAN'T. THE PORTABLE EQUIPMENT CAN BE PUT INTO OPERATION IN A MINUTE'S TIME ON THE POLICE SPEED BOAT

we can drive it to the scene of an accident or any unusual situation where its equipment is required. Now, with the portable unit, we feel that we can meet any condition that may arise, calling for communication with our radio network.

At the time of the Hartford bridge disaster, we could not get a car close enough to the scene. Accordingly, we carried in the FM portable and a battery. That served as our main station during the emergency, and was highly effective in speeding up the relief work.

Altogether, this equipment has proved a highly useful adjunct to our state-wide communications system.

RADIO-ELECTRONIC PRODUCTS DIRECTORY

NEW products are coming into use in the design and production of radio-electronic equipment. Some are improvements, some are equivalent substitutes. In either case, it is essential to have an up-to-the-minute reference source of information about these products with the names of the manufacturers and their nearest representatives or distributors.

Starting next month, you will find such a Wartime Radio-Electronic Products Directory in every issue of *FM* Magazine.

In addition, you will find the names of companies now manufacturing "equivalent" products which, in the past, have been available from only a limited number of sources.

That is, if Government specifications call for a part from a particular manufacturer, it may well happen that that company is already far behind in deliveries. In such a case, you will probably find in FM's directory the names of other concerns making the same item.

Small RF chokes, for example, were made by only four or five companies up to a few months ago. Now, there are a dozen or more sources on this particular item. If one can't deliver, then some other one can.

The same thing is true of transformers, coils, sockets, terminals, insulating materials, condensers, resistors, and many other products. Companies which never made such items a few months ago are now turning them out in quantities to meet our emergency needs.

Concerning the use of equivalents, it may be well to clear up questions in the minds of those not familiar with standard practice by quoting from official procurement instructions issued to contractors to the Government:

Substitution of Equivalents ★ "The use of the name of a manufacturer, or of any special brand or

(CONTINUED ON PAGE 45)

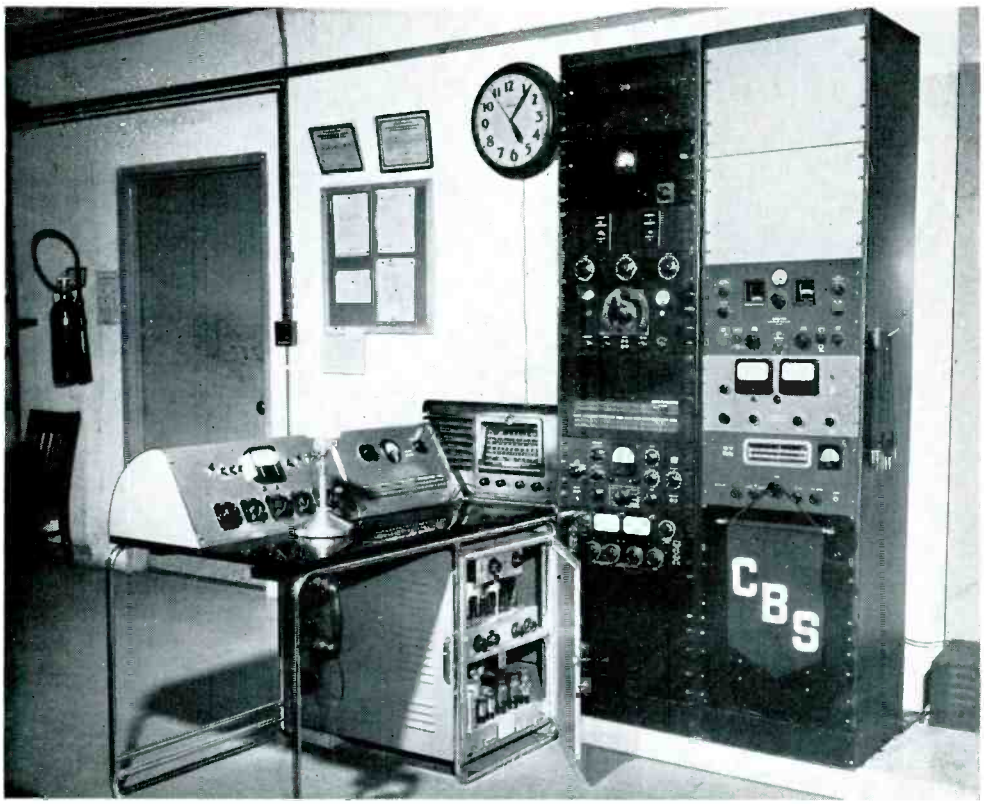


FIG. 1. OPERATING CONSOLE AND CONTROL EQUIPMENT AT W67NY, ON THE TOP FLOOR OF 500 FIFTH AVENUE

WAR DID NOT STOP W67NY

Even Though Restrictions Held Up the Completion of This CBS Station at New York, It Is Giving Splendid Service to FM Listeners

BY CLYDE HOULDSON*

AFTER exhaustive tests of AF and RF equipment, the Columbia Broadcasting System's FM station W67NY, for the New York area, was formally put in operation on December 1, 1941, carrying a regular schedule of programs. This new CBS FM station operates on an assigned frequency of 46.7 mc. The transmitter is located on the 60th floor of the building at 500 Fifth Avenue, New York City.

CBS FM Studio Equipment ★ The main origination point for Station W67NY programs is a studio located in the CBS Building, 485 Madison Avenue, New York, having equipment especially designed for FM use. All programs, whether composed of recordings, local originations, or CBS network shows are routed through this studio.

The equipment used in the control room consists of four pre-amplifiers, one booster amplifier, one program amplifier and one monitor amplifier. Ribbon microphones are employed. Some alterations were required in the audio components in order to comply with the FCC FM Standards of Good Engineering Practice. Standard talk-back and studio speaker arrangements are incorporated in the FM control studio.

Two additional pre-amplifiers are employed for the two turntables. For "spotting" or testing of recordings and transcriptions, a separate monitor amplifier and loudspeaker are used in the control room. By means of a test switch position, the engineer can spot

* Engineer in Charge, Station W67NY, 500 Fifth Avenue, New York City.

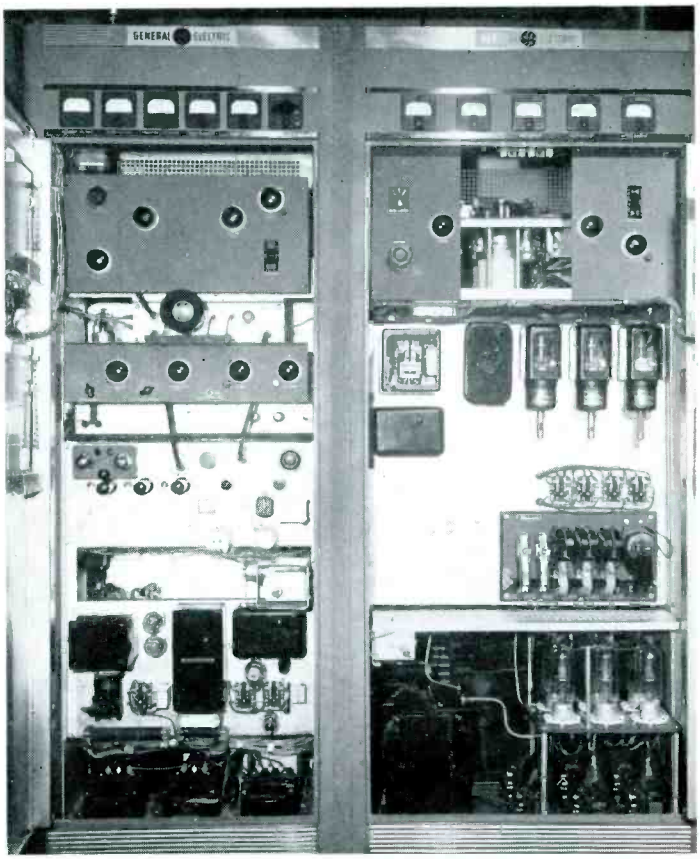


FIG. 2, LEFT: THE 250-WATT MODULATOR. RIGHT, THE 3-KW. AMPLIFIER AND RECTIFIER. THESE UNITS ARE COMPLETELY SELF-CONTAINED, REQUIRING NO AUXILIARY EQUIPMENT OTHER THAN THE OPERATING CONSOLE. TUBES ARE COOLED BY A MOTOR-DRIVEN BLOWER WHICH IS MOUNTED BEHIND THE RELAY PANEL

recordings and, at the same time, have the air program on a separate monitor-speaker system.

Relatively short telephone lines connect the studio with the FM transmitter. The line coil and equalizer employed at the transmitter give a flat AF response from 20 to 16,000 cycles. In order to avoid any interruption of FM program service, two other lines are available and can be employed in case of line failure.

AF Equipment at the Transmitter ★ An audio console is employed at the transmitter for all mixing and switching purposes. The audio console contains line coils, equalizers, and provides all audio facilities for the W67NY transmitter.

The equipment contained in the console consists of five pre-amplifiers — four as pre-amplifiers and one as a booster — a limiting amplifier, a monitor amplifier, power supplies, and relays for switching.

A number of alterations were made in the console, consisting of the substitution of a limiting amplifier for the program amplifier normally furnished, and the installation of new input transformers on all pre-amplifiers and booster amplifiers in order to meet the audio-frequency characteristics set forth by the FCC for FM stations. Also, because of the removal of the program amplifier and its associated power supply, it was necessary to add a separate power supply unit. This unit provides heater and plate voltage for the five pre-amplifiers. A new matching network was added, permitting the monitor amplifier to be used as an emergency amplifier in case of failure of the limiting amplifier.

Both audio-frequency and rectified RF monitors are available. In the AF monitor, a transformer is bridged across the input to the transmitter, while the rectified RF monitor is fed from the output of the FM station monitor. By using the VI and monitor selector switch, it is possible to check the quality of the audio entering the transmitter and the RF output from the transmitter. This method of switching is helpful for an audible check, should trouble be encountered with the land lines connecting the studio and transmitter, the audio equipment, or the FM transmitter itself.

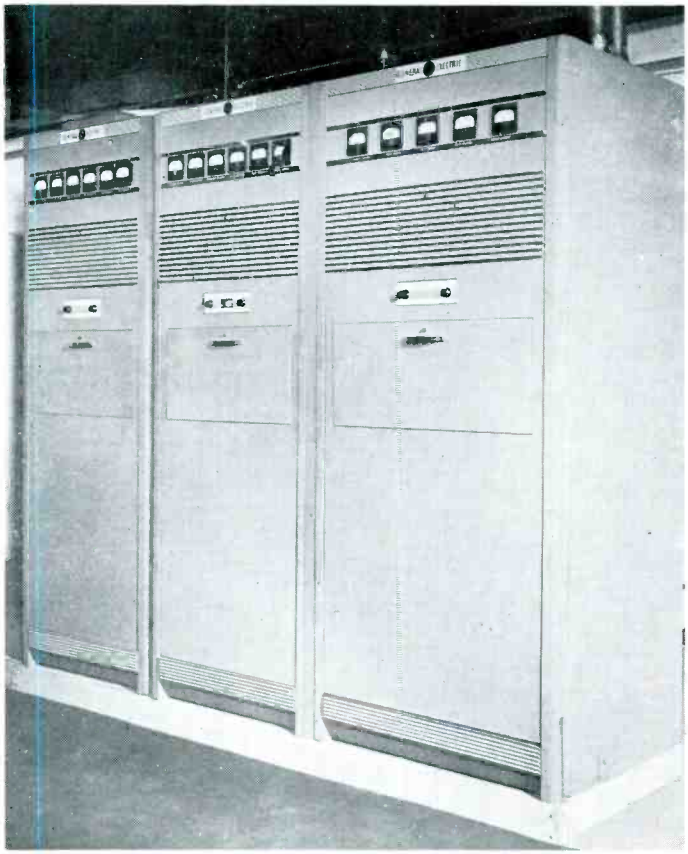


FIG. 3. CENTER AND RIGHT-HAND UNITS ARE THE MODULATOR AND POWER AMPLIFIER AS THEY APPEAR WHEN THE DOORS ARE CLOSED. THE GRILLWORK OPENS FORWARD, AS WELL AS THE PANELS BELOW, GIVING ACCESS TO THE CONTROLS AND ADJUSTMENTS WITHOUT THE NEED OF OPENING THE DOORS. UNIT AT THE LEFT IS AN FM 333 MC. ST LINK TRANSMITTER

The output of the monitor amplifier is fed to a dual loudspeaker mounted on a 4- by 5-ft. baffle located behind and above the audio console.

A novel arrangement permits the quick change of amplifiers in case the limiting amplifier should fail. Simply by throwing two ganged key switches to an emergency position, the monitor amplifier is then used to feed the FM transmitter. This change of amplifiers can be accomplished so quickly that the break is barely perceptible on the air. Emergency power switches are also provided in case of failure of the units that furnish plate and heater voltages.

Most of the important elements of the audio facilities are terminated in the jack field shown on the console. This adds to the flexibility and helps in patching out defective equipment, should this become necessary.

In all, the present audio console provides for two turntable inputs, local microphone, and four incoming lines. For local announcements and test program purposes, a dynamic microphone is employed.

The open door of the console, Fig. 1, shows quite clearly the mounting of the limiting amplifier and the monitor amplifier. Doors on all sides of the console make the equipment easily accessible, and servicing is simplified to a large degree.

During the time that W67NY is on the air, the small broadcast receiver, directly under the clock, is tuned to Columbia's key station, WABC. By monitoring continuously, it is possible to receive all air raid warnings as transmitted by Station WABC on instructions received from the Interceptor Command.

The rack near the console contains regular and emergency power supplies in the top section. The next lower panel contains the pre-amplifiers. Below are located the regular and emergency power transfer switches, making it possible to change plate and heater voltages in case one of the units should fail. This equipment is in addition to that contained in the audio circuits of the console, and may be employed with the W67NY transmitter in case of necessity. Below are the line volume controls and the beat frequency oscillator.

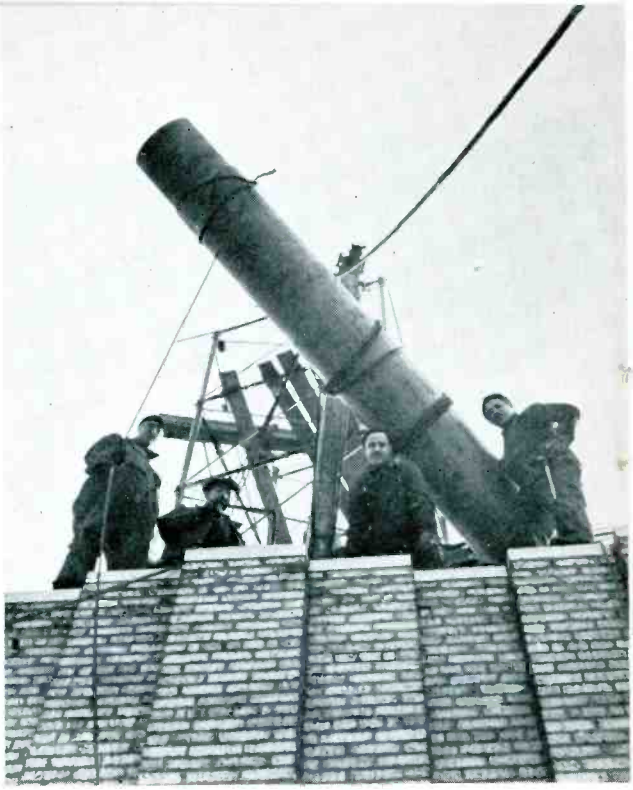


FIG. 4, LEFT: THE BOTTOM OR SOCKET SECTION OF THE FM ANTENNA BEING HOISTED FROM THE 58TH TO THE 60TH FLOOR. FIG. 5, RIGHT: THE NEXT STEP WAS TO RAISE IT TO THE ROOF OF THE TANK HOUSE, AND THEN TO THE SUPPORTING BASE. THIS MAST SECTION WEIGHS 2,200 LBS.

Next are the jack fields and the noise and distortion meter. Below the noise meter is the CBS transmission measuring set.

The second rack contains an all-wave receiver, the FM station monitor, and an FM tuner. The audio outputs of the receivers appear on the jack field of the other rack. In this way, it is possible to patch the receiver outputs into the monitor amplifier for checking purposes or into the mixer of the program amplifier. The second rack also contains a constant voltage transformer, which prevents any erratic changes of line voltage to the limiting amplifier.

The all-wave receiver is used for checking a 100-kc. crystal against the standard frequency transmission from Station WWV. The receiver is also used for test purposes with the various stages of the transmitter. It may be employed as a check during the initial frequency setting of the master-oscillator circuit and, by feeding a low audio frequency, 100 cycles, into the transmitter, it is possible to measure the deviation at any point. By means of the 100-kc. crystal and a multivibrator circuit, it is possible to obtain check points every 10 kc. The receiver was especially valuable for this purpose when the transmitter was being operated for the first time.

The FM Transmitter ★ The transmitter employed consists of a 250-watt modulator and exciter unit and a 3-kw. power amplifier. The exciter is operated from 115 volts, single phase, while the amplifier is on 230 volts, 3-phase, 60 cycles. Modulation is produced in the exciter unit by means of a reactance tube modulator. The total swing is one ninth of that appearing in the final stage, the output frequency of the modulator-oscillator circuit being multiplied nine times to obtain the assigned frequency of 46.7 mc. This arrangement of frequency multiplication also increases the modulation nine times to the full deviation of 75 kc. The output of the 250-watt exciter is link-coupled to the grid circuit of the 3-kw. amplifier, two type GL-8002-R air-cooled tubes being used in a neutralized push-pull stage operating class "C." High voltage is supplied by six GL-872-A mercury vapor tubes connected in a three-phase full-wave rectifier. The output from the power amplifier is fed to the antenna through a balanced pair of coaxial lines.

Fig. 2 shows the modulator and amplifier units from the front, with the doors open. Ordinarily, during operating hours, the fronts are closed, as in Fig. 3. In this illustration our ST link transmitter can be seen also, at the extreme left. It is not used in connection with W67NY, however.

Antenna ★ Plans contemplate the eventual installation of a four-bay antenna composed of horizontal loops stacked vertically. Such an

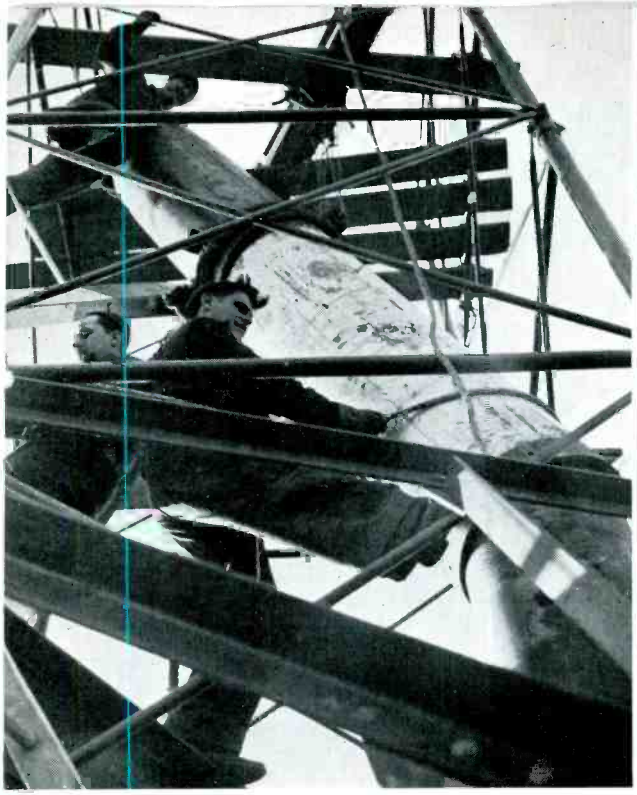


FIG. 6, LEFT: WITH THE BOTTOM SECTION IN PLACE, THE SECOND SECTION WAS LOWERED INTO PLACE AND WELDED TO THE FIRST. THE PIPE SCAFFOLDING WAS USED TO SUPPORT THE SECTIONS UNTIL THEY WERE WELDED. FIG. 7, RIGHT: LOOKING UP THE MAST AFTER COMPLETION

antenna will radiate a circular horizontal pattern and will provide a power gain of 4.5 over a half-wave dipole. In other words, with a transmitter power of 3 kw., the effective radiated power will be 12 kw. The supporting structure is already in place, but the loops are not yet in place.

Special problems are, of course, always encountered in skyscraper installations. In the case of the W67NY installation, it was necessary to bring all materials to the 58th floor by means of a freight elevator, hoist them to the 60th floor through a shaftway, and then transfer them laterally through the elevator control room to the transmitter room floor. Materials for the tower were then hoisted in two steps to the roof of the tank house where the tower was assembled. Figs. 4 to 6 show various steps in moving the tower material into place, while Fig. 7 shows the completed tower. The tortuous route followed necessitated bringing the mast up in sections which were then welded together.

The lower portion is a pyramid structure of fabricated steel. This base was welded to the steel building columns. The completed tower was designed to withstand an ice load of 1½ ins., exposed to wind velocity of 110 miles an hour. It weighs 15 tons.

In order to bring additional FM service to the listeners in the New York area at the earliest possible date pending completion of the permanent antenna, W67NY is presently airing its programs through a temporary antenna consisting of a single-bay "turnstile." We shall continue to use this until materials are available to complete our turnstile.

MANY NEW FM DEVELOPMENTS

Among those who are not completely informed, there is an impression that progress in the development of FM communication has been brought to a stop by the WPB orders which have stopped the erection of new FM broadcasting stations.

While it is true that this particular phase of FM activity is at a standstill, there is more new development and design work on FM equipment going on than ever before. Unfortunately, wartime restrictions prohibit the publication of information on this subject.

However, there is sound reason behind the contention, on the part of those who are in a position to know, that there will be a widespread expansion of FM broadcasting and a shift from AM to FM transmission as soon as peacetime activity can be resumed.

More than that, the theoretical advantages claimed for FM over AM in the ultra-high-frequency bands have now been definitely substantiated by practical experience under all kinds of operating conditions.

WARTIME TUBE REVISIONS

WPB Stops Production on 349 Obsolete and Little Used Types, While Navy Issues Important Instructions

A MUCH-NEEDED housecleaning of vacuum tube types, already long overdue, has been brought about by the War Production Board's Radio Tube Unit, of which John F. Wilson is chief.

Figures made up from manufacturers' 1942 production records show that only 780,000 tubes of 289 obsolete and little-used types were sold. They comprised only .6% of the 135,000,000 tubes manufactured last year. The others eliminated by the WPB are duplicated types.

Following is the text of the WPB order:

WPB Limitation Order L-76 ★ The fulfillment of requirements for the defense of the United States has created a shortage in the supply of iron or steel and other critical materials for defense, for private account and for export; and the following Order is deemed necessary and appropriate in the public interest and to promote the national defense:

Section 1151.1 — GENERAL LIMITATION ORDER L-76.

(a) *Definitions.* For the purposes of this Order:

(1) "Tube" means any device consisting of an evacuated enclosure containing a number of electrodes between two or more of which conduction of electricity through the vacuum or contained gas may take place.

(2) "Manufacture" means the sealing in and the exhausting of the mounted tube assemblies.

(3) "Producer" means any individual, partnership, association, business trust, corporation, governmental corporation or agency, or any organized group of persons, whether incorporated or not, engaged in the production of tubes.

(4) "Tube Type Number" means either those designations given in the commercial and technical literature of producers of tubes, or those designations given by the Tube Division of the Radio Manufacturers Association of America, for each specific type of tube.

(5) "Preferred Order" means tubes produced under a specific order, contract or subcontract for the Army or Navy of the United States, the United States Maritime Commission, the Panama Canal, the Coast and Geodetic Survey, the Coast Guard, the Civil Aeronautics Authority, the National Advisory Commission for Aeronautics, the Office of Scientific Research and Development, any foreign country pursuant to the Act of March 11, 1941, entitled "An Act to Promote the Defense of the United States" (Lend-Lease Act), or produced with the assistance of a Preference Rating of A-1-j or higher.

(b) *General Restrictions:*

(1) From the effective date of this Order, no Producer shall manufacture any Tubes of the type listed in List "A", as amended from time to time.

(2) The restrictions contained in subparagraph (b) (1) shall not apply to Preferred Orders.

(c) *Records.* All persons affected by this Order shall keep and preserve for not less than two years accurate and complete records concerning inventories, production, and sales.

(d) *Audit and Inspection.* All records required to be kept by this Order shall, upon request, be submitted to audit and inspection by duly authorized representatives of the War Production Board.

(e) *Violations.* Any person who wilfully violates any provision of this Order, or who, in connection with this Order, wilfully conceals a material fact or furnishes false information to any department or agency of the United States, is guilty of a crime, and upon conviction may be punished by fine or imprisonment. In addition, any such person may be prohibited from making or obtaining further deliveries of or from processing or using material under priority control and may be deprived of priorities assistance.

(f) *Reports.* All persons affected by this Order shall execute and file with the War Production Board such reports and questionnaires as said Board shall from time to time request.

(g) *Communications to War Production Board.* All reports required to be filed hereunder and all communications concerning this Order shall, unless otherwise directed, be addressed to: "War Production Board, Washington, D. C., Ref: L-76."

(h) *Applicability of Priorities Regulation No. 1.* This Order and all transactions affected thereby are subject to the provisions of Priorities Regulation No. 1 (Part 944), as amended from time to time, except to the extent that any provisions hereof may be inconsistent therewith, in which case the provisions of this Order shall govern.

(i) *Effective Date.* This Order shall take effect seven days after the date of its issuance.

Issued this 17th day of April, 1942.

J. S. KNOWLSON,
Director of Industry Operations

Tubes Discontinued ★ Pursuant to the restrictions contained in subparagraph (b) (1) of Limitation Order L-76, no producer shall manufacture any tubes of the types enumerated in Tube List "A".

Tubes For Navy Equipment ★ The following letter, accompanied by Tube Table RE 38A 134E, was issued by the Navy Department, Bureau of Ships, on April 13th:

The history of vacuum tubes used in Navy equipment has been an unhappy one for some years past, particularly with respect to the insidiousness and persistency with which new types have been continually injected into use. Too little consideration has been given to the fact that every new type of tube employed in a piece of equipment must be stocked and made available to the various users of radio equipment throughout the world. It is believed that in many cases the confused idea has persisted that because quantity of a new type of tube was small, its introduction was relatively innocuous whereas the reverse is, in fact, true.

This situation is becoming increasingly serious with the country at war, both because of the world-wide distribution of naval forces and activities and a possible difficulty of obtaining certain of the older and less common types of tubes from the tube manufacturers operating under wartime production restrictions.

Reference to Table RE 38A 134E will show that there are over 200 different types of tubes listed whereas the functional service performed by these tubes can be met by 77 types as listed under "Vacuum Tubes for Use in New Equipment." These figures and lists do not include Cathode Ray Tubes or certain tubes used in equipment classified as "secret" or very special tubes for employment at ultra-high frequencies (250 megacycles and upward). The status of such tubes is now being made the basis of separate consideration by the Bureau.

In order to correct the situation with which the Navy is faced at the present time of having to maintain a stock in excess of 200 types of tubes, two separate and distinct actions would appear necessary. One is to modify already existing equipments to effect a reduction in the number of types of tubes. This action is now being undertaken by the Bureau. A second and more immediately important action is to exercise every precaution to preclude the introduction of any type into the service, via new equipments, that are not on the approved list "Vacuum Tubes for Use in New Equipment,"

(CONTINUED ON PAGE 43)

TUBE LIST "A"

00A	1T1G	6AF6GT	6V6GX	24
0Z3	1T4GT	6AF7G	6V7G	24S
01A	1T5G	6AG5GT	6W5G	25A6
01AA	1U1	6AG6G	6W6GT	25A6G
1A1	1W1	6AH5G	6X5	25A7G
1A1/5E1	1Y1	6AL6G	6X5G	25AC5G
1A5G	1Z1	6B6	6X6G	25B5
1A7G	2	6B7S	6Y3G	25B6G
1B1	2A3H	6B8GT	6Y5	25B8GT
1B4	2A7S	6C5G	6Y5G	25D8GT
1B4P	2B6	6C5MG	6Y5GT	25L6
1B4P/951	2B7	6C7	6Y5S	25L6G
1B7G	2B7S	6C8GT	6Y5V	25N6G
1B8GT	2B5	6D5G	6Y6	25RE
1C1	2C5	6D5MG	6Y6GT	25S
1C4	2S/4S	6D6G	6Y7G	25X6GT
1C5G	2W3	6D7	6Z3	25Y4GT
1D1	2W3GT	6D8	6Z4	25Y5
1D2	2X3G	6E4GT	6Z5	25Z3
1D4	2Y2	6E6	6Z5/12Z5	25Z4
1D7G	2Y3	6E7	6Z6MG	25Z4GT
1E1	2Y4	6E8G	6Z7G	25Z5MG
1E2	2Z2	6F5MG	7	25Z6G
1E4G	2Z2/G34	6F7S	7A7LM	27S
1E5G	3	6G5	7B5LT	29
1E5GP	3B8GT	6G7	7B6LM	31
1E5GT	3C5GT	6G7S	7B8LM	35A5LT
1E7G	3LE4	6H4G	7C5LT	35L6G
1F1	3Q5G	6H5	7D7	35RE
1F7GH	3S5	6H6G	7G7	35S/51S
1F7GV	4	6H6MG	7H5	35Z3LT
1G1	4A1	6H7S	7R7	35Z5G
1G4G	4A6G	6H8G	8	35Z6GT
1G5GT/G	5	6J5G	9	40
1G6G	5T4	6J5GX	WD11	45A
1G6GT	5V3G	6J6GT	WD12	46A1
1G7GT/G	5W4	6J7MG	WX12	46B1
1H5G	5W4G	6K6G	12A	48
1J1	182B/482B	6K6MG	12A5	49
1J5G	183/483	6K7MG	12A8Z	50C6G
1K1	401	6L6GT	12B6	50L6G
1K4	485	6L6GX	12B7	50Y6G
1K5G	950	6M6G	12C8GT	50Z6G
1K6	1232	6M7G	12D5GT	50Z6GT
1K7G	1852	6M8GT	12J5G	50Z7G
1L1	1853	6N5	12J7G	51
1L5G	5X3	6N5G	12K7G	52
1L5GT	5Y3G	6N6	12K8GT	55
1LB6	5Z4G	6N6GT	12Q7G	55S
1LC5	5Z4MG	6N6MG	12S7GT	56AS
95	6	6N7G	12SA7G	56S
V99	6A4	6N7GT	12SC7GT	57AS
X99	6A4/LA	6P5G	12SK7G	57S
117E4GT	6A5G	6P6	12Z5	58AS
117L7GT	6A6X	6P7G	14	58S
117M7GT	6A7S	6P8G	14A4	64
117Z6G	6A8MG	6Q6	14A7	65
117Z6GC	6AB5	6Q6G	14B6	68
1N5G	6AB6G	6Q7MG	14B8	69
1N1	6AC5G	6R6G	14C5	70
1N5G	6AC6G	6S5	14E6	70A7GT
1N6G	6AC6GT	6S6GT	14E7	70L6GT
1N6GT	6AD5G	6SE7GT	14F7	75S
1P1	6AD5GT	6T5	14N7	79
1P5G	6AD6G	6T6	14Y4	82V
1Q1	6AE5G	6T7G/6Q6G	15	85AS
1Q5G	6AE5GT	6U5	17	87S
1R1G	6AE6G	6V4G	18	88S
1R4	6AE7GT	6V5G	20	89
1S1G	6AF5G	6V6G	22	

LISTING BY NEW NAVY TYPE NUMBER

NEW NAVY TYPE NUMBER	COMMERCIAL DESIGNATION	OLD NAVY TYPE NUMBER
01-A	01-A	38001
1B4-P	1B4-P	38032-A
1C6	1C6	38236
1D5-G	1D5-G	
1E1	1E1	
1E7-G	1E7-G	38717-E
1F7-G	1F7-G	
1H6-G	1H6-G	
1J6-GX	1J6-GX	
2A3	2A3	38213
2A5	2A5	38215
2B7	2B7	38227
2X2/	2X2/879	
4A1	4A1	
		40
5U4-G	5U4-G	41
5Z3	5Z3	38593
		45
6A6	6A6	38616
6A7	6A7	38617
6AB7	6AB7/1853	38853
6AC7	6AC7/1852	
6AG7	6AG7	
6B7	6B7	38627
6C5	6C5	
6C5-G	6C5-G	
6C6	6C6	38636
6C8-G	6C8-G	
6D6	6D6	38646
6E5	6E5	38655
6F6	6F6	
6F6-G	6F6-G	
6F7	6F7	38667
6F8-G	6F8-G	38768-F
6H6	6H6	38566-H
6J5	6J5	38565-J
6J5-GT	6J5-GT	(38765-J)
6J7	6J7	
6J7-G	6J7-G	
6K6-GT	6K6-GT	
6K7	6K7	38567-K
6K7-G	6K7-G	
6K8	6K8	38568-K
6L6	6L6	
6L6-G	6L6-G	
6L7	6L7	
6N7	6N7	
6Q7-G	6Q7-G	
6R7	6R7	38567-R
6R7-G	6R7-G	
22	22	38022
24-A	24-A	38024
25Z5	25Z5	38255
27	27	38027
30	30	38030
31	31	38031
32	32	38032
33	33	38033
34	34	38034
35	35	38035
36	36	38036
37	37	38037
38	38	38038
39	39	38039
40	40	38040
41	41	38041
42	42	38042
45	45	38045
47	47	38047
50	50	38050
53	53	38053
56	56	38056
57	57	38057
58	58	38058
59	59	38059
71-A	71-A	38071
75	75	38075
76	76	38076
77	77	38077
78	78	38078
80	80	38180
81	81	38181
82	82	38182
83	83	38183
84	84	38184
85	85	38085
89	89	38089
112-A	112-A	38012
203-A	203-A	38103
204-A	204-A	38104
X206	206	38106
207	207	38107
211	211	38211
X214	214	38114
217-C	217-C	38117
849	849	38149
850	850	38150
851	851	38151
852	852	38152
857-B	857-B	38157-B
858	858	38158
860	860	38160
861	861	38161
862	862	38162
864	864	38064
865	865	38165
866-A	866-A	38166-A
868	868	38268
869-A	869-A	38169-A
870-A	870-A	(38170)
871	871	38171
872-A	872-A	38172-A
874	874	38274
876	876	38276
878	878	
	879 (SEE 2X2)	
884	884	38884
886	886	38286
893	893	38193
921	921	
954	954	38954
955	955	38955
956	956	38956
958	958	38958
959	959	38959
1616	1616	38267
1624	1624	
1625	1625	
1626	1626	
1629	1629	
	1852 (SEE 6AC7)	
	1853 (SEE 6AB7)	
2051	2051	
38015	WE:215-A	38015
38111-A		38111-A
38112	WE:212-E	38112
38116	GE:1C9049; WL:S-2894160	38116
X38120	WE:220-B	38120
38142		38142

LISTING BY OLD NAVY TYPE NUMBER

OLD NAVY TYPE NUMBER	NEW NAVY TYPE NUMBER	COMMERCIAL DESIGNATION
(6J5-G)	6J5-GT	6J5-GT
(6V6-G)	6V6-GT	6V6-GT
(870)	870-A	870-A
38001	01-A	01-A
38012	112-A	112-A
38015	38015	WE:215-A
38019	19	19
38022	22	22
38024	24-A	24-A
38027	27	27
38030	30	30
38031	31	31
38032	32	32
38032-A	1B4-P	1B4-P
38033	33	33
38034	34	34
38035	35	35
38036	36	36
38037	37	37
38038	38	38
38039	39	39
38040	40	40
38041	41	41
38042	42	42
38045	45	45
38047	47	47
38050	50	50
38053	53	53
38056	56	56
38057	57	57
38058	58	58
38059	59	59
38064	864	864
38071	71-A	71-A
38075	75	75
38076	76	76
38077	77	77
38078	78	78
38085	85	85
38089	89	89
38101	801	801
38103	203-A	203-A
38104	204-A	204-A
X38106	206	206
38107	207	207
38110	10	10
38111-A	38111-A	
38112	38112	WE:212-E
X38114	214	214
(38170)	870-A	870-A
38171	871	871
38172-A	872-A	872-A
38180	80	80
38181	81	81
38182	82	82
38183	83	83
38184	84	84
38193	893	893
38205	38205	RC:VR105-30
38211	211	211
38213	2A3	2A3
38215	2A5	2A5
+X38217	38217	GE:FG-17
38220	38220	AE:ZB-120
38222	38222	RP:RK-22
38227	2B7	2B7
38233	38233	RP:RK-33
38236	1C6	1C6
38250	38250	RC:VR-150
38255	25Z5	25Z5
38266-A	836	836
38267	1616	1616
38268	868	868
38274	874	874
38276	876	876
38278	38278	HS:1278
38282	38282	WE:2828
38286	886	886
38401	38401	EL:302.5
38402	38402	EL:582.5
38403	38403	EL:5B HD
38404	38404	EL:3C
38412	38412	WE:312-A
38565-J	6J5	6J5
38566-H	6H6	6H6
38567-K	6K7	6K7
38567-R	6R7	6R7
38568-K	6K8	6K8
38593	523	523
38616	6A6	6A6
38617	6A7	6A7
38627	6B7	6B7
38636	6C6	6C6
38646	6D6	6D6
38655	6E5	6E5
38667	6F7	6F7
+38674	38674	GE:45X674

NOTES

GENERAL:-

1. *THE NAVY VACUUM TUBE SPECIFICATION* RE 13A 600 *HAS BEEN ISSUED TO QUALIFIED VACUUM TUBE MANUFACTURERS. EQUIPMENT MANUFACTURERS MAY REVIEW COPIES AT THE VARIOUS INSPECTORS OF NAVAL MATERIAL OR AT THE BUREAU OF SHIPS, NAVY DEPARTMENT, WASHINGTON, D.C.*

2. THE PRINCIPLE DIFFERENCE BETWEEN NAVY AND COMMERCIAL VACUUM TUBES IS THAT NAVY SPECIFICATIONS, IN GENERAL, STIPULATE CLOSER TOLERANCES.

3. THE CHARACTERISTICS OF THE VACUUM TUBES LISTED HEREIN MAY BE FOUND IN ANY COMPLETE REPUTABLE VACUUM TUBE HANDBOOK EXCEPT FOR THE SPECIAL TYPES WHOSE COMMERCIAL DESIGNATION IS PRECEDED BY IDENTIFYING LETTERS TO INDICATE THE MANUFACTURER. COMMERCIAL LITERATURE FOR THESE VACUUM TUBES IS AVAILABLE FROM THE RESPECTIVE CONCERNS AS LISTED BELOW.

LIST OF MANUFACTURERS

- AE. AMPEREX ELECTRONIC PRODUCTS CO.
- EL. ELECTRONS INC.
- EM EITEL McCULLOUGH INC.
- GE GENERAL ELECTRIC CO.
- HS. HYGRADE SYLVANIA CORP.
- RC: RCA MANUFACTURING CO.
- RP: RAYTHEON PRODUCTION CORP.
- WE. WESTERN ELECTRIC CO.
- WL: WESTINGHOUSE LAMP CO.

4. *ALL VACUUM TUBES EXCEPT THOSE LISTED IN THE TABLE HEADED "VACUUM TUBES FOR USE IN NEW EQUIPMENTS" ARE FOR REPLACEMENT USE ONLY AND ARE NOT TO BE INCORPORATED IN EQUIPMENTS OF NEW DESIGN WITHOUT SPECIFIC APPROVAL OF THE BUREAU OF SHIPS (OR THE GOVERNMENT DEPARTMENT CONCERNED)*

5. CATHODE RAY AND UHF TYPES HAVE NOT AS YET BEEN SELECTED FOR THE PREFERRED LIST.

6. IT IS INTENDED TO REPLACE THE ACORN TYPES 954, 955 and 956 WITH OTHER TYPES OF AN IMPROVED DESIGN

7 WHERE AN OLD NAVY TYPE NUMBER IS INCLUDED IN PARENTHESES, THE RESPECTIVE LISTINGS COVER THE PROPER REPLACEMENT

REVISED TYPE NUMBERS OF VACUUM TUBES USED BY U. S. NAVY WILL SAVE MUCH MISUNDER-

6SA7	6SA7		X218	218	38118				38116	38116	WL:S*2894160 GE:189049	38674-A	38674-A EL:6C				
6SF5	6SF5		X219	219	38119	38205	RC:VR105-30	38205									
6SJ7	6SJ7					+X38217	GE:FG-17	38217	38117	217-C	217-C	38717-E	1E7-G	1E7-G			
6SK7	6SK7		801	801	38101	38220	AE:ZB-120	38220	X38118	218	218	(38765-J)	6J5-GT	6J5-GT			
6SN7-GT	6SN7-GT		803	803	38803	38222	RP:RK-22	38222	X38119	219	219	38766-Y	6Y6-G	6Y6-G			
6SQ7	6SQ7		805	805		38233	RP:RK-33	38233	X38120	38120	WE:220-B	38768-F	6F8-G	6F8-G			
6V6-GT	6V6-GT	(6V6-G)	807	807	38807	38250	RC:VR150-30	38250	38138	838	838						
6X5-GT	6X5-GT		808	808	38808	38275	RC:VR75-30		38142	38142		38803	803	803			
6Y6-G	6Y6-G	38766-Y	809	809		38278	HS:127B	38278	38143	843	843	38807	807	807			
6ZY5-G	6ZY5-G		812	812		38282	WE:282-B	38282	38145	845	845	38808	808	808			
			813	813		38290	RC:VR90-30		38146	846	846	38814	814	814			
10	10	38110	814	814	38814				38149	849	849	38833	833-A	833-A			
12A6	12A6		815	815		38401	EL:302.5	38401	38150	850	850	38837	837	837			
12J5-GT	12J5-GT		826	826		38402	EL:5B2.5	38402	38151	851	851	38842	842	842			
12K8	12K8		829	829		38403	EL:5B HD	38403	38152	852	852	38853	6AB7	6AB7/1853			
12SA7	12SA7		833-A	833-A	38833	38404	EL:3C	38404	38157-B	857-B	857-B	38884	884	884			
12SF7	12SF7		836	836	38266-A	38405	EL:1C		38158	858	858	+38897	38897	GE:16X897			
12SJ7	12SJ7		837	837	38837	38412	WE:312-A	38412	38160	860	860						
12SK7	12SK7		838	838	38138				38161	861	861	38954	954	954			
12SQ7	12SQ7		842	842	38842	+38674	GE:45X674	38674	38162	862	862	38955	955	955			
12SR7	12SR7		843	843	38143	38674-A	EL:6C	38674-A	38165	865	865	38956	956	956			
			845	845	38145				38166-A	866-A	866-A	38958	958	958			
19	19	38019	846	846	38146	+38897	GE:16X897	38897	38169-A	869-A	869-A	38959	959	959			

VACUUM TUBES FOR USE IN NEW EQUIPMENT

ONLY THE FOLLOWING TUBES MAY BE USED IN NEW EQUIPMENTS UNLESS OTHERWISE SPECIFIED OR UNLESS IT CAN BE DEMONSTRATED TO THE BUREAU OF SHIPS (OR THE GOVERNMENT DEPARTMENT CONCERNED) THAT THESE TYPES DO NOT ADEQUATELY SERVE THE PURPOSE.

	TYPE TUBE	FILAMENT VOLTS	TWIN DIODES	DIODE-TRIODES	TRIODES	TWIN TRIODES	TETRODES	TWIN TETRODES	PENTODES REMOTE CUT-OFF	PENTODES SHARP CUT-OFF	RECTIFIERS VACUUM	RECTIFIERS GAS	CONVERTERS	POWER	VOLTAGE REGULATORS	INDICATORS
RECEIVING		--													38205 38250	
		2.5												2A3		
		5.0									5U4-G					
		6.3	6H6	6SQ7 *6SR7	6J5 955	*6SL7-GT 6SN7-GT			6AB7 *6SG7 6SK7 956	6AC7 6AG7 6SJ7 954	6X5-GT		6SA7	6K6-GT 6L6 6V6-GT *1635		6E5
		12.6	*12H6	12SQ7	12J5-GT				12SF7 12SK7	12SJ7			12SA7	12A6		1629
TRANSMITTING					*RC:811 826 833-A 838 845 846 851 862 893 1626 *RC:8005 38111-A *WE:316-A		807 813 814 860 861 1624 1625	815 829	803 837		2X2 81 836 1616 *8013(RC:R61378) *8016(RC:R6158) *8020 *8021(WE:705-A)	83 857-B 866-A 869-A 870-A 872-A 38674-A				
	TRIGGER	6.3			884		*2050									

PHOTO TUBES —— 868 AND 921

FOOTNOTES:-

X TUBE OBSOLETE. NO LONGER MANUFACTURED OR NONE ARE USED IN NAVY EQUIPMENT NOT COVERED BY RE 13A 600.

+ TUBE ALSO COVERED BY NAVY DEPARTMENT SPECIFICATION 17T21 AND DESIGNATED THEREIN AS FOLLOWS:

38217 as 0517
38674 as 1674
38897 as 1297

* INDICATES TYPES FOR WHICH NAVY TYPE NUMBER AND SPECIFICATIONS HAVE NOT BEEN ISSUED.

E REVISION	JANUARY 15, 1942
D REVISION	JANUARY 1, 1942
C REVISION	JANUARY 10, 1941
B REVISION	JUNE 15, 1938
A EDITION	AUGUST 30, 1937

RADIO & SOUND BRANCH - BUREAU OF SHIPS
NAVY DEPARTMENT -- WASHINGTON, D.C.

NAVY TYPE VACUUM TUBES AND NEAREST COMMERCIAL EQUIVALENTS

E REVISION - JANUARY 15, 1942

RE 38A 134 E

STANDING AND CONFUSION, AS EXPLAINED IN THE ACCOMPANYING OFFICIAL COMMUNICATION.

SPOT NEWS

Notes and Comments, personal and otherwise, about broadcast, communications, and television activities

I.R.E. Summer Convention ★ Will be held at Cleveland on June 29th, 30th, and July 1st. The Institute hopes that engineers who will get as much as three days vacation will spend them at the Convention.

Radio Set Census ★ Of 1940 shows 71.1 per cent of homes in 30 states have receivers. Complete report, Series H-5, No. 2, can be obtained upon request from the Bureau of the Census, Washington, D. C.

RMA Convention ★ Will be held at Stevens Hotel, Chicago, on June 9th. Annual banquet has been cancelled, and meeting will be cut to one-day session because of pressure of war efforts.

FCC Rule Relaxed ★ Order No. 91-A, issued on April 21st, permits the operation of a broadcast station of any class to be operated by holders of any class of commercial operator license, in cases of inability to secure operators of a higher class. The order should be read in its entirety, for there are other provisions which apply in this situation.

Charley Golenpaul ★ Says that "electronic gadgeteering" on the part of radio hams and experimenters will create a big and totally new market for components when the War is over. Many servicemen are getting their feet wet in special electronic work right now, and parts jobbers are watching closely the development of this radio offshoot.

FM Frequency Change ★ FCC has granted a modification of General Electric's construction permit to change from 45.7 to 48.5 mc., using 5 kw. effective radiated power from the Schenectady station.

Data on Microphones ★ A book of technical data, specifications, diagrams, and curves has just been issued on the new series 556 Super-Cardiod Dynamic microphones. A copy can be obtained by writing to Shure Brothers, 225-A West Huron Street, Chicago, Ill.

W75P Debut ★ FM affiliate of KDKA is now on the air at Pittsburgh for six hours daily, from 11 A.M. to 2 P.M., and from 6 to 9 P.M. Program director is Mrs. Helen Replogle. Local programs and NBC programs not carried by KDKA will be broadcast.

Interference Elimination ★ The 1942 edition of the Sprague Manual of Interference Elimination is now available. Data shows how to locate noise-making devices, how to determine what type of filter is required, and the circuits and components necessary. All types of noise-making electrical equipment are considered, from fluorescent lights and mercury vapor lamps to vibrators and gas engines. The Manual can be obtained from Sprague jobbers or from the Sprague Products Company, North Adams, Mass., for twenty-five cents.

Eugene Blan ★ Twenty-one-year-old son of New York's Blan-the-Radio-Man was one of 32 accepted from a group of 211 Air Corps Cadet applicants.

Gordon Gray ★ Granted an extension for the completion of W41MM, at Winston-Salem, from April 14th to October 14th, 1942.

Milwaukee Police FM ★ WPB has allocated the equipment necessary to provide 75 FM units to the police and 34 for the fire department.

Sam Schwartz ★ Is now 20 years older than he was when Sun Radio first opened its doors for business at Vesey Street, New York City. The vanishing amateur business has been more than replaced by an expansion of Sun's increasing sales to government and civilian laboratories, schools, and research laboratories.

Expansion ★ Radio City Products have added extensively to their manufacturing facilities and machine shop equipment in new quarters at 127 West 26th Street, New York City.

More FM for Philadelphia ★ Application was made on April 14th by WDAS Broadcasting Station, Inc., for a new FM station to operate on 47.7 mc., to cover 9,300 square miles and a population of 3,992,000.

Stanley Jerome Marks ★ Son of J. M. Marks, president of Fada Radio & Electric Corporation, has been accepted as a Cadet in the U. S. Air Corps.

Recording Blanks ★ Glass-base discs, under the trade name Black Seal are being produced by Gould-Moody Company, 395 Broadway, New York. They are available in the thin, flexible weight or medium weight, 10, 12, or 16 ins. in diameter, with either two or four holes. The holes are machined directly in the glass, so that no grommets are used.

FCC Ruling ★ To aid Latin American students in flying courses conducted by the CAA, the FCC, on April 22nd adopted an order under Section 318 of the Communications Act permitting them to operate radio equipment necessary to their training. They must meet requirements for licensed operators except for citizenship, and hold an FCC certificate showing qualification. They will be permitted to use only equipment designated by CAA, and only in the actual course of their training.

(CONTINUED ON PAGE 37)

NEWS PICTURE

Marjorie Eleanor Allen, of W47NY, is our first woman broadcast station transmitter engineer and control engineer. As news announcer, she may very well rate first place among women for her speaking voice. A graduate of the American Radio Institute in New York, she passed her amateur license exam after 4½ weeks of instruction. She now holds a 2nd class radiophone and 2nd class radio telegraph operator's ticket, and handles code at 35 words per minute. Evenings, she teaches radio to an American Women's Volunteer Service class in Greenwich Village

SINGLE-UNIT MOBILE FM EQUIPMENT

Part 2. Operation, Alignment and Service Notes, and Wiring Diagrams for the New REL Victory Model FM Equipment

BY A. H. QUIST, JR.*

Operation ★ It is assumed here that the transmitter and the receiver are tuned properly. The process of doing this will be described later. Snap the POWER switch on the remote control unit to the ON position, indicated by the REC (green) pilot light. After the set has been allowed to heat up for a few minutes, a rush should be heard in the loudspeaker if the volume control has been advanced sufficiently in a clockwise direction, and if the SQUELCH switch is OUT (in the down position). With the squelch IN (squelch switch in up position), nothing will be heard in the loudspeaker unless a signal of predetermined strength is being received. The value of this predetermined signal is set at the radio unit by a means to be described later. If the microphone has been plugged into its socket on the remote control unit, pushing the button will turn on the Transmitter, indicated by the TRANS (red) pilot light. The green light will remain on at all times, as long as the POWER switch is on, even when in the transmit position. Therefore, in transmit position, both lights will be on. In the 565AWE model, which utilizes a handset instead of the microphone alone, a switch is provided on the left end to turn the loudspeaker on or off. The handset receiver remains in the circuit in either case.

*Engineering Department, Radio Engineering Laboratories, Long Island City, N. Y.

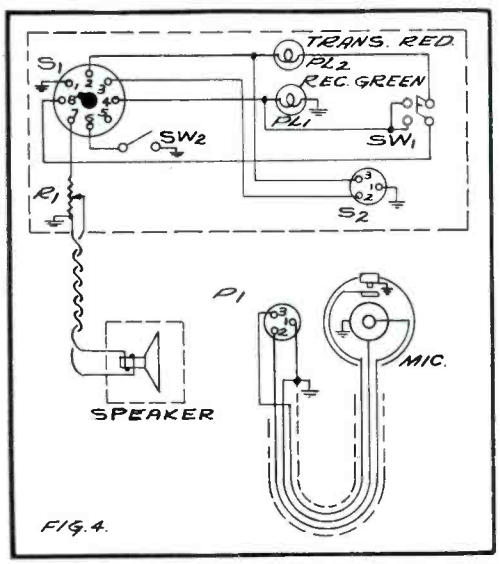


FIG. 4. WIRING OF REMOTE CONTROL UNIT WITH HAND MICROPHONE. THIS IS FOR MODEL 565A

Transmitter Tuning ★ The four test jacks on the transmitter are so shunted that, when a 0–100 millivoltmeter, having 100 ohms internal resistance is plugged into one of them, the currents represented by full scale deflection of the meter are as follows:

J1 — 21 milliamperes
J2 — 1.1 milliamperes
J3 — 21 milliamperes
J4 — 201 milliamperes

Following is the routine for checking the transmitter tuning adjustments:

1. Plug a 0–100 millivoltmeter, of 100 ohms internal resistance, into the oscillator jack. The REL No. 574 meter test unit is especially designed for this purpose. The meter should read approximately 35 mv. If it does not, tune T1 until 35 mv. are reached. Adjust both condensers if necessary, as they are in parallel. This circuit should not be tuned for minimum but actually for as near 35 mv. as possible.

2. Plug the millivoltmeter into the driver grid jack, and tune T2, T3, T4, and the driver grid for maximum reading of this meter. Do not tune any of the multiplier circuits rapidly because, in so doing, it is possible to tune off the correct frequency and get on another harmonic. See Figs. 6 and 7 for locations of the tuning controls.

3. Plug the millivoltmeter into the final grid jack, and tune the driver grid, driver plate, and final grid for maximum meter reading. This should be about 30 mv.

4. Plug the millivoltmeter into the final plate jack. Tune the final plate condenser for minimum reading of the meter. This should be about 50 mv. Departure from this value indicates lack of proper antenna loading. Adjust the antenna tuning condenser and the final plate tuning condenser alternately until the minimum plate reading is approximately 50 mv. Caution should be observed in handling the meter since the plate jack is 525 volts above chassis potential.

5. If any difficulty has been encountered in

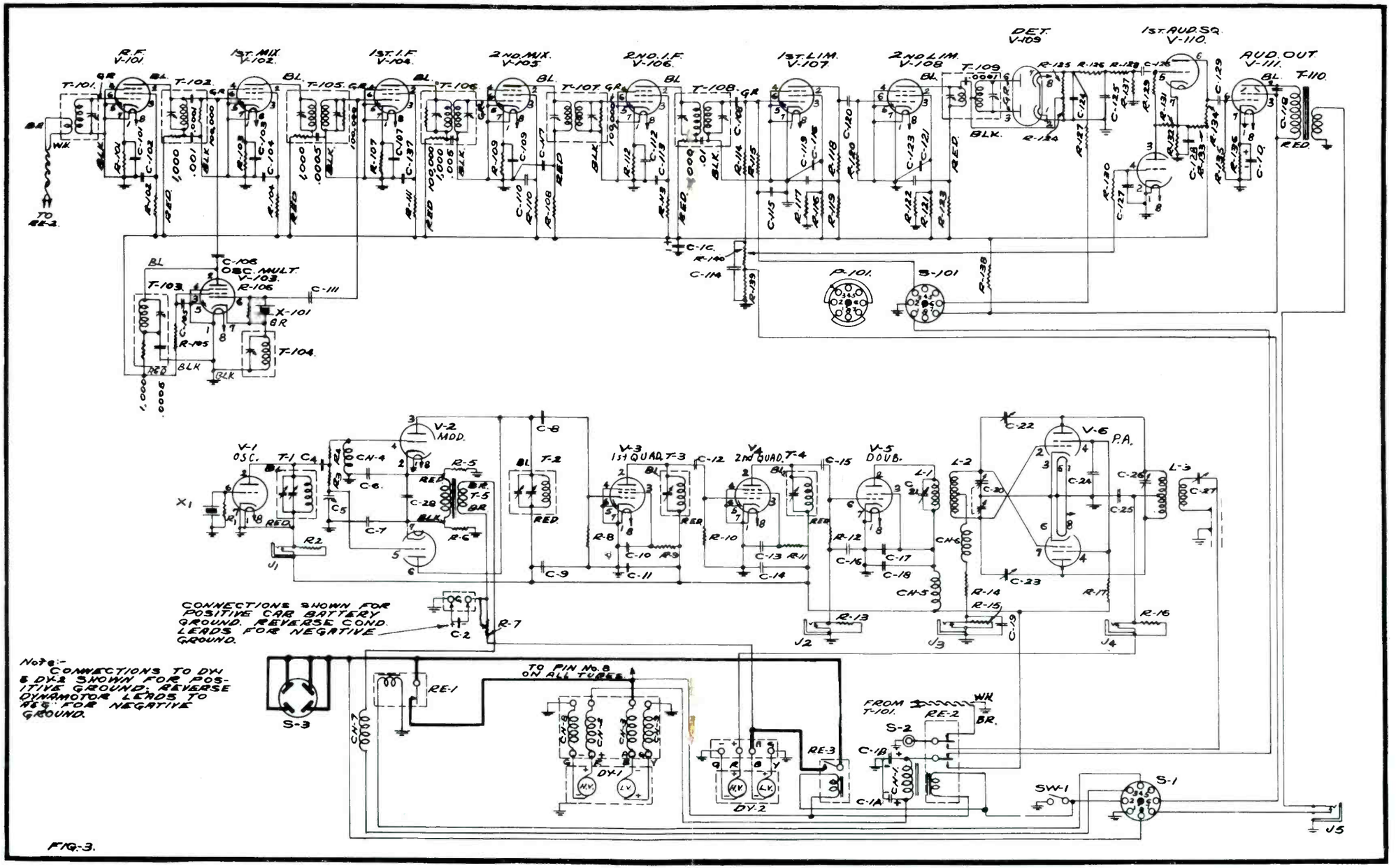


FIG. 3. THIS SCHEMATIC SHOWS THE COMPLETE WIRING OF THE TRANSMITTER, RECEIVER, AND POWER SUPPLY, BUT DOES NOT INCLUDE THE REMOTE CONTROL. THESE ARE SHOWN SEPARATELY IN FIGS. 4 AND 5

vertical attenuator on the scope until a good readable position, say 1 in. from the zero position on the scope, is reached. Mark this position. From this point on, do not touch the vertical attenuator on the scope nor any of the controls on the receiver. As a check, tune the signal generator to 15 kc. lower than the center frequency; the scope should now read the same amount below the zero as it was above it before. Disconnect the signal generator.

5. Connect an audio oscillator through a suit-

tuning, it was probably observed that the final grid current was considerably off to start with, and some of the stages may have been on the wrong frequency. In such an event, follow the more detailed procedure below.

6. It should not usually be necessary to change the positions of the neutralizing condensers from the settings originally made at the factory. However, the procedure is as follows: Disconnect plate and screen voltages from the 815 and observe what setting of the neutralizing condensers will prevent the value of final grid current from changing when the final plate condenser is tuned through resonance.

Alignment on New Frequency ★ The total frequency multiplication of this transmitter is 32. Therefore, the following relationships hold, where F is the transmitter mean frequency in megacycles:

Crystal Frequency, mc. = F/32
T3 should be tuned to F/8
T4 should be tuned to F/2

The information above will be required as noted in the following instructions:

1. Choose a crystal of the frequency F/32.

2. With the transmitter power off, connect a signal generator to the terminals of T3. This signal generator should be of a type which gives a resonance indication when an external tuned circuit is connected to it, showing that the proper frequency setting has been obtained. An excellent instrument for this purpose is the Aerovox LC checker. The two terminals, not the inductive loop, should be used for connecting to the tuned circuit under test. The signal generator should be set for the correct frequency (F/8) as ascertained from the previous instructions. This setting need be only an approximation. Tune the trimmer on T3 until the indicator on the signal generator shows resonance has been attained.

3. Apply the procedure above to T4, but using F/2 for the test frequency as indicated by the previous instructions.

4. With the signal generator now removed from the transmitter, turn on power and proceed to tune up as in "Routine Tuning," instructions 1 through 3. It is preferable to go through this part of the test with the plate and the screen of the 815 disconnected until grid drive on the 815 is evident.

5. Proceed as in 4 of "Routine Tuning" instructions. Then recheck the previous tuning to be sure that no circuit interaction has caused a shift from the original tuning.

Alignment of Modulator ★ It should never be necessary to align the modulator under ordinary conditions of usage. However, the procedure is briefly outlined here, in the event that it may be of use:

1. Set up a receiver for this test, tuned to exactly the same frequency as the transmitter to be tested. It is particularly important that the discriminator on this receiver is aligned properly and that it have low distortion at 500 cycles.

2. Connect the vertical deflection terminals of a cathode ray oscilloscope across the discriminator output terminals of this receiver, using the linear sweep for horizontal deflection.

3. Connect a signal generator at some convenient point in the IF system of the receiver, and tune the signal generator to approximately the IF of the receiver. This frequency can now be set more accurately by tuning the signal generator until the horizontal line on the scope assumes the same position it had before the signal generator was connected. Connection to the scope must be direct to the deflection plates, or through a DC amplifier.

4. Tune the signal generator until it is 15 kc. higher than the original setting and adjust the

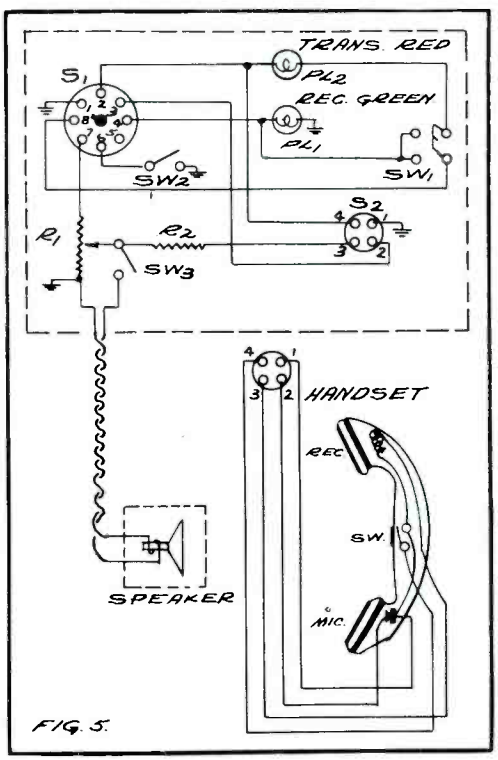


FIG. 5. CONNECTIONS FOR THE CONTROL BOX WHEN A FRENCH HANDSET IS USED

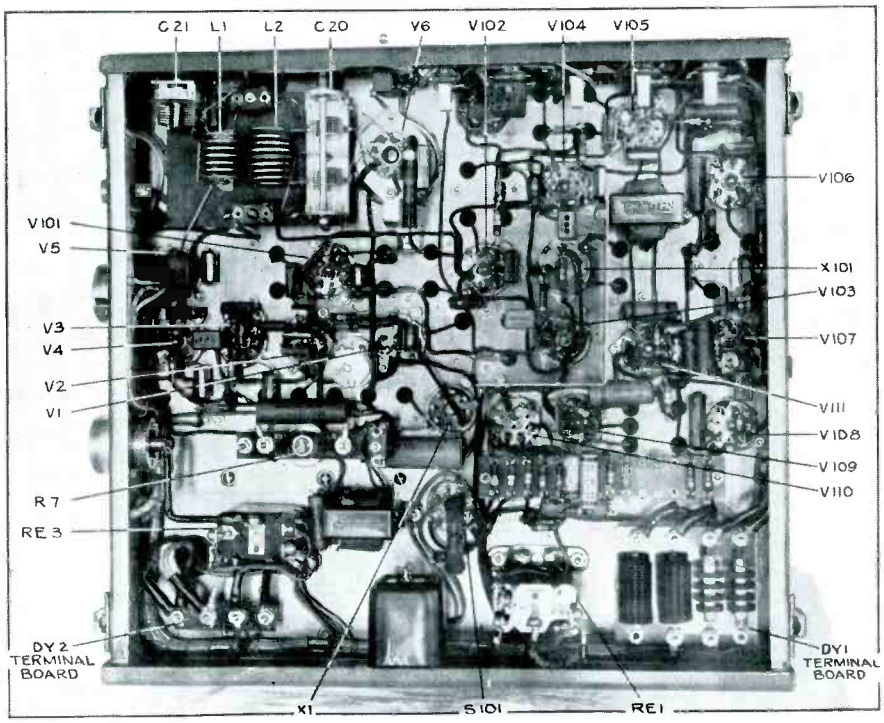


FIG. 6. UNDER SIDE OF THE CHASSIS. CONSTRUCTION IS REMARKABLY SIMPLE, CONSIDERING THAT THIS UNIT CARRIES THE COMPLETE TRANSMITTER, RECEIVER, AND POWER SUPPLY

able network to isolate the DC from the oscillator and, at the same time, insert 200 ohms to the microphone input circuit, in place of the microphone. It should be mentioned here that a switch is provided at the transmitter in place of the microphone push-to-talk switch, for convenience in testing. Set the audio oscillator for 500 cycles, and turn on the transmitter.

6. Tune C5, Fig. 7, on the transmitter until the wave shape appearing at the receiver oscilloscope is nearest to being a perfect sine wave, with the attenuator on the audio oscillator adjusted so that the peaks of the wave just touch the distance marked off on the scope. It may also be necessary to tune T2 on the transmitter. Disconnect the audio oscillator.

7. Check all previous tuning to see that it is still correct.

8. Connect the microphone in the circuit again, and speak into it in approximately the average tone of voice that will be used in service. While doing this, adjust R7, Fig. 8, so that modulation peaks hit approximately 100% as indicated by the mark on the scope. The transmitter is now completely aligned.

Servicing ★ In cases of failure or of poor performance, first have all of the tubes checked. The preferred way to do this is to replace any tubes suspected with known good ones, observing any change in performance. If all tubes appear satisfactory, check all voltages indicated in the table following. They should be reasonably close to the tabulated values. Any marked discrepancy will undoubtedly lead to a faulty component, such as a resistor, capacitor, or dynamotor.

Tubes should be checked as a routine matter, so that failures can be anticipated before they actually occur. This is also true of the dynamotors, which must be kept lubricated. Also, brushes and commutators should be checked for wear, and the commutators cleaned occasionally with fine sandpaper, not emery cloth. Relays should be checked for dirty contacts, and cleaned with carbon tetrachloride. Never file silver relay contacts; if they become too badly burned to function properly, they should be replaced.

All voltages recorded below are with reference to the chassis. All readings were taken on the 250-volt scale of a 20,000 ohms-per-volt instrument, unless otherwise noted.

Receiver Tuning ★ Following is the routine for checking the receiver tuning adjustments:

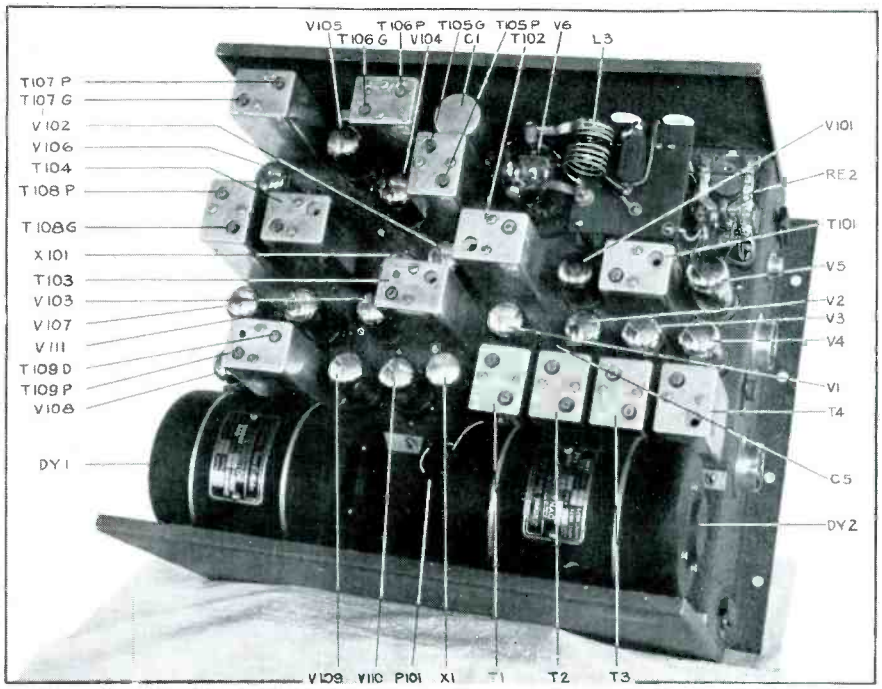


FIG. 7. TOP VIEW OF THE SINGLE-UNIT MOBILE EQUIPMENT. RECEIVER TUBES ARE INDICATED BY SINGLE NUMERALS, TRANSMITTER TUBES HAVE THREE NUMERALS

1. Squelch: The squelch control on the front panel of the radio unit, Fig. 6, should be set so that the loudspeaker will respond only when a signal having a minimum predetermined value reaches the antenna. This is determined by prevailing local conditions. If, for some reason, the operator finds that he is not receiving a signal when he has reason to believe that one exists, he need only snap the SQUELCH switch on the remote control unit to the down position. In this position, the squelch is out. A speaker jack is provided at the radio unit, Fig. 6, for the insertion of a 4- to 8-ohm loudspeaker to facilitate the testing process. When the test speaker is in use, the regular speaker is automatically cut out of the circuit.

2. Antenna: To tune the receiver to the car antenna system, a 574 meter test unit will be found most convenient. Use the test cable having an octal plug on either end, and plug into S-101 in place of P-101. See Figs. 3 and 7. With the receiver in operation and with the switch on the meter test unit set to LIM, turn on a transmitter which is of the same frequency as the receiver. It will be necessary to have this transmitter operating at very low power as, for example, by removing high volt-

VOLTAGE READINGS ON TRANSMITTER TUBES

Tube	*Function*	E_{p1} *Volts*	E_{p2} *Volts*	E_{sg} *Volts*	E_k *Volts*	*Remarks*
V1 — 7A4	Oscillator	200	—	—	0	
V2 — 7F7	Modulator	210	210	—	5.5	E_k on 10-V. scale
V3 — 7V7	1st Freq. Quad.	200	—	142	0	
V4 — 7A7	2nd Freq. Quad.	210	—	150	0	
V5 — 7C5	Freq. Dblr.	235	—	235	—	
V6 — 815	P.A.	510 *	510 *	142	0	

DY1 Output = 525 volts
DY2 Output = 240 volts

* Read at C.T. of plate tank coil.
Plate load = 100 M.A.

age from its final amplifier stage. Then tune the trimmer on T-101, Fig. 7, for maximum reading on the meter.

Alignment ★ When one of these receivers requires complete alignment, the procedure is as follows:

1. A signal generator having several ranges will be required, one range covering the region of 2,100 kc., so that deviations of 5, 10, 15 and 20 kc. each side of 2,100 kc. can easily be detected. This range ought to have outputs up to about 500,000 microvolts. This is for checking the discriminator and the second IF stages. Then a range covering approximately 7,500 to 15,000 kc., with outputs up to 40,000 microvolts, will be needed for alignment of the first IF stages and the crystal oscillator tank. For Antenna, RF, and multiplier tank alignment, a range covering 30 to 40 mc. will be required.

2. Connect the REL 574 meter test unit to the receiver as mentioned under "Receiver Tuning."

3. Connect the signal generator, set for 2,100 kc. between the grid of V106 and chassis. Then adjust the grid trimmer of T108 until the limiter meter, with the switch set to LIM on the meter test unit, reads maximum. The signal generator attenuator should be turned down so that the limiter reading is about 20 millivolts. Then adjust the plate trimmer on T108 until the limiter meter again reaches maximum.

4. Connect the signal generator between the grid of V105 and chassis. Then proceed as before, but adjusting the trimmers of T107 this time. Swinging the signal generator through plus or minus 20 kc. of 2,100 kc. should show equal deflections on the limiter meter. Furthermore, at plus or minus 15 kc., the limiter meter should read 10 millivolts when the peak is 20 millivolts. These results should be obtained with the signal generator at about 3,000 microvolts.

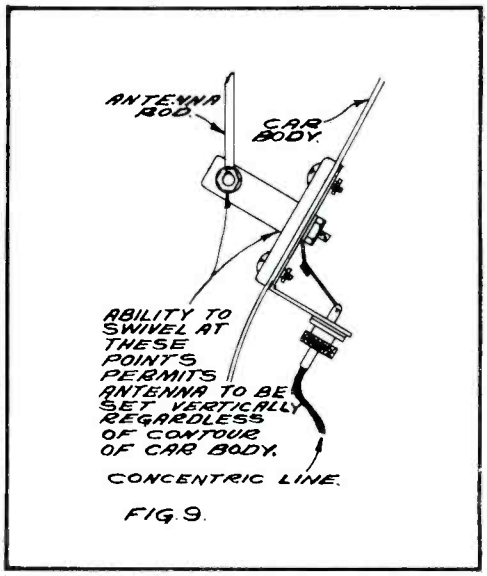


FIG. 9. METHOD OF MOUNTING THE ANTENNA, AND OF CONNECTING THE ANTENNA-LEAD FROM THE SET

5. With the signal generator still connected to V105, throw the switch on the meter test unit to DISC. With the signal generator set for 2,100 kc., it should be possible to swing the meter through both sides of zero, by tuning the diode trimmer of T109. The trimmer should be left at the point where the meter reads zero. It is sometimes necessary to make adjustments on the plate trimmer of T109 before these results can be obtained.

6. Connect the signal generator between the grid of V102 and chassis, and adjust its frequency to X plus 2,100 kc., where X is the

VOLTAGE READINGS ON RECEIVER TUBES

Tube Function	E_{p1} *Volts*	E_{p2} *Volts*	E_{sg} *Volts*	E_{k1} *Volts*	E_{k2} *Volts*	*Remarks*
V101 R.F. Amp.	210		150	2.7		Use 10V scale for E_{k1}
V102 1st Mix.	215		38	1.6		"
V103 Osc.-Mult.	205		190	0		"
V104 1st I.F.	212		98	3.5		"
V105 2nd Mix.	215		55	1.6		"
V106 2nd I.F.	212		82	1.3		
V107 1st Lim.	32		97	0		
V108 2nd Lim	20		100	0		
V109 Disc.				0	0	
V110 Sq. Aud.	93 *	140 †		0	117 ‡	
V111 Aud. Amp.	230		240	13		

* Pin No. 3. † Pin No. 6. ‡ Pin No. 7.

PARTS LIST FOR FIG. 3.

S1 - Control cable socket
S2 - Antenna socket
S3 - Battery cable socket
SW1 - Transmitter test switch
RE1 - Filament relay
RE2 - Trans.-Rec. relay
RE3 - Trans. dynamotor relay
DY1 - Dynamotor: 250 v., .09 amps. output
DY2 - Dynamotor: 525 v., .10 amps. output
J1 - Osc. plate jack
J2 - Driver grid jack
J3 - Final grid jack
J4 - Final plate jack
J5 - Loudspeaker test jack
CH1 - Filter choke
CH2 - 2.5 M. H. choke
CH3 - Special R.F. choke
CH4 - Special phasing choke
CH5 - 2 M.H. choke
CH6 - 1 M.H. choke
CH7 - 3 M.H. choke
CH8 - 2.5 M.H. choke
CH9 - Special R.F. choke
L1 - Plate tank inductance, driver
L2 - Grid tank inductance, final
L3 - Final plate tank, and ant. inductances
T1 - Crystal osc. tank: 940-1250 kc.
T2 - Phase mod. tank: 940-1250 kc.
T3 - 1st quad. tank: 3760-5000 kc.
T4 - 2nd quad tank: 15-20 mc.
T5 - Mod. trans.: 200:500 ohms
V1 - 7A4 oscillator
V2 - 7F7 modulator
V3 - 7V7 quadrupler
V4 - 7A7 quadrupler
V5 - 7C5 double-driver
V6 - 815 final R.F. amplifier
R1 - 250,000 ohms ½ w.
R2 - 5 ohms ½ w.
R3 - 50,000 ohms ½ w.
R4 - 50,000 ohms ½ w.
R5 - 10,000 ohms ½ w.
R6 - 10,000 ohms ½ w.
R7 - Mod. control: 3000-ohm rheo.
R8 - 300,000 ohms ½ w.
R9 - 50,000 ohms ½ w.
R10 - 200,000 ohms ½ w.
R11 - 50,000 ohms ½ w.
R12 - 300,000 ohms ½ w.
R13 - 1000 ohms ½ w.
R14 - 15,000 ohms ½ w.
R15 - 5 ohms ½ w.
R16 - 0.5 ohms ½ w.
R17 - 5000 ohms ½ w.
X1 - Transmitter crystal
C1A - 20 mfd. 450 v. electrolytic
C1B - 15 mfd. 350 v. electrolytic
C1C - 15 mfd. 350 v. electrolytic
C1D - 20 mfd. 350 v. electrolytic
C2 - 50 mfd. 25 v. electrolytic
C3 - .01 mfd. mica
C4 - 25 mmf. mica
C5 - Phasing condenser: 50 mmf. variable
C6 - .001 mfd. mica
C7 - .001 mfd. mica
C8 - .001 mfd. mica
C9 - .01 mfd. mica
C10 - .01 mfd. mica
C11 - .01 mfd. mica
C12 - .001 mfd. mica
C13 - .01 mfd. mica
C14 - .01 mfd. mica
C15 - .001 mfd. mica
C16 - .01 mfd. mica
C17 - .01 mfd. mica
C18 - .01 mfd. mica
C19 - .01 mfd. mica
C20 - Final grid cond.: dual 50 mmf. variable
C21 - Driver plate cond.: 50 mmf. variable
C22 - Neutralizing cond.
C23 - Neutralizing cond.
C24 - .01 mfd. 600-v. mica
C25 - .002 mfd. 1000-v mica
C26 - Final plate cond.: variable
C27 - Ant. cond.: 50 mmf. variable
C28 - .01 mfd. paper
V101 - 7H7 RF
V102 - 7H7 1st Mixer
V103 - 7H7 osc.-mult.
V104 - 7H7 1st IF
V105 - 7H7 2nd Mixer
V106 - 7H7 2nd IF
V107 - 7C7 1st limiter
V108 - 7C7 2nd limiter
V109 - 7A6 detector (disc.)
V110 - 7F7 Squelch-audio
V111 - 7C5 Audio output
X101 - Receiver crystal
S101 - Meter test socket, receiver
P101 - Receiver test circuit plug
T101 - Ant. trans.
T102 - RF trans.
T103 - Multiplier tank
T104 - Oscillator tank
T105 - 1st IF trans.
T106 - 1st IF trans.
T107 - 2nd IF trans.
T108 - 2nd IF trans.
T109 - Disc. trans.
T110 - AF output trans.: 10,000-ohm pri.; 4-8 ohm sec.
R101 - 250 ohms ½ w.
R102 - 30,000 ohms ½ w.
R103 - 1000 ohms ½ w.
R104 - 500,000 ohms ½ w.
R105 - 5000 ohms ½ w.
R106 - 100,000 ohms ½ w.
R107 - 1000 ohms ½ w.
R108 - 1000 ohms ½ w.
R109 - 1000 ohms ½ w.
R110 - 500,000 ohms ½ w.
R111 - 50,000 ohms ½ w.
R112 - 250 ohms ½ w.
R113 - 100,000 ohms ½ w.
R114 - 500,000 ohms ½ w.
R115 - 100,000 ohms ½ w.
R116 - 25,000 ohms ½ w.
R117 - 25,000 ohms ½ w.
R118 - 100,000 ohms ½ w.
R119 - 1000 ohms ½ w.
R120 - 50,000 ohms ½ w.
R121 - 25,000 ohms ½ w.
R122 - 25,000 ohms ½ w.
R123 - 100,000 ohms ½ w.
R124 - 100,000 ohms ½ w.
R125 - 100,000 ohms ½ w.
R126 - 100,000 ohms ½ w.
R127 - 1 meg ohm ½ w.
R128 - 500,000 ohms ½ w.
R129 - 1 meg ohm ½ w.
R130 - 1 meg ohm ½ w.
R131 - 1 meg ohm ½ w.
R132 - 100,000 ohms ½ w.
R133 - 100,000 ohms ½ w.
R134 - 1 meg ohm ½ w.
R135 - 500,000 ohms ½ w.
R136 - 300 ohms ½ w.
R137 - 500,000 ohms ½ w.
R138 - 500 ohms 5 w.
R139 - 500,000 ohms ½ w.
R140 - Squelch control: 500,000-ohm pot.
C101 - .001 mfd. mica
C102 - .001 mfd. mica
C103 - .001 mfd. mica
C104 - .001 mfd. mica
C105 - .001 mfd. mica
C106 - 2.5 mmf. mica
C107 - .01 mfd. mica
C108 - .0001 mfd. mica
C109 - .01 mfd. mica
C110 - .01 mfd. mica
C111 - 5 mmf. mica
C112 - .01 mfd. mica
C113 - .01 mfd. paper
C114 - .01 mfd. paper
C115 - .0005 mfd. mica
C116 - .01 mfd. paper
C117 - .01 mfd. paper
C118 - .05 mfd. paper
C119 - .01 mfd. paper
C120 - .0001 mfd. mica
C121 - .01 mfd. paper
C122 -
C123 - .01 mfd. paper
C124 - .0001 mfd. mica
C125 - .005 mfd. paper
C126 - .001 mfd. paper
C127 - .1 mfd. paper
C128 - .5 mfd. paper
C129 - .001 mfd. paper
C137 - .01 mfd. mica

PARTS LIST FOR FIG. 4

SW1 - Power switch: DPST
SW2 - Squelch switch: SPST
PL1 - Rec. pilot: 12-v. miniature bayonet-base tubular lamp
PL2 - Trans. pilot: 6-v. miniature bayonet-base tubular lamp
R1 - Volume control: 10-ohm pot.
S1 - Remote control cable socket
S2 - Microphone socket

PARTS LIST FOR FIG. 5

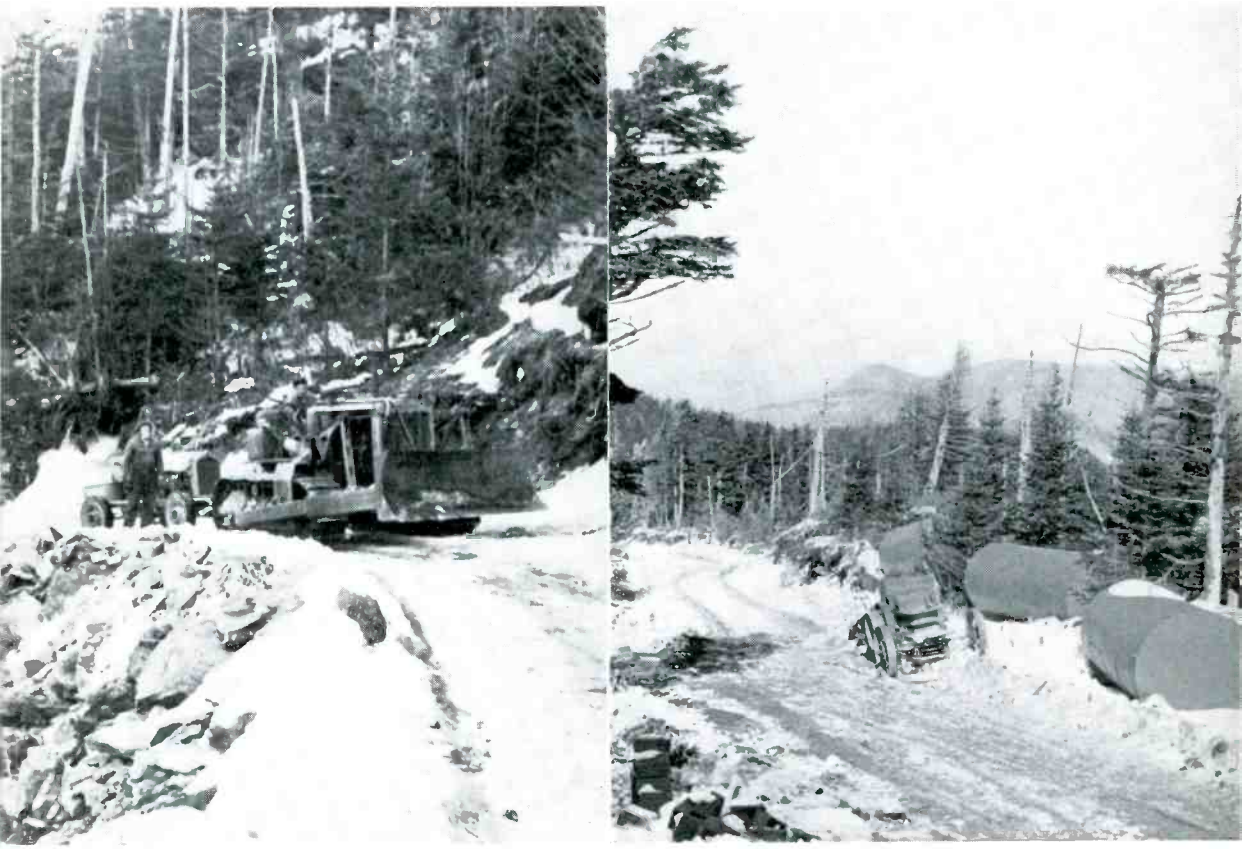
SW1 - Power switch: DPST
SW2 - Squelch switch: SPST
SW3 - Speaker switch: SPST
PL1 - Rec. pilot: 12-v. miniature bayonet-base tubular lamp
PL2 - Trans. pilot: 6-v. miniature bayonet-base tubular lamp
R1 - Volume control: 10-ohm pot.
R2 - 1500 ohms ½ w.
S1 - Remote control cable socket
S2 - Handset socket

FIG. 8. PARTS LIST AND VALUES OF COMPONENTS SHOWN IN THE WIRING DIAGRAMS, FIGS. 3, 4, AND 5

crystal frequency in kc. Adjust the output of the signal generator to about 50,000 microvolts. If the discriminator meter is not at zero, readjust the signal generator frequency slightly until zero reading is obtained. Adjust the trimmers on T104, T105 and T106 so that the meter reads maximum when it is switched back to the LIM position. Keep the meter reading at 20 millivolts by attenuating the signal generator output. Now readjust the three transformers in the order T105, T106, T104 for maximum reading on the limiter meter again. For a 20-millivolt reading on the limiter meter, the signal generator output should be approximately 30 microvolts. Reducing the signal generator output to zero should reduce the limiter reading to zero.

7. Connect the signal generator between the antenna terminal and chassis, and adjust the frequency to (2,100 + 4 X) kc. for receivers between 30 and 35 mc., or (2,100 + 5 X) kc. for 35 to 40 mc. This is the carrier frequency, and should show no deflection on the meter when in the DISC position. If this is not so, readjust the signal generator slightly until the meter is zero. Now switch the meter back to LIM. Adjust the trimmers in the order T103, T101, T102 and T104, for maximum limiter meter reading. With the signal generator output at zero, the meter should read about 6 millivolts; raising the signal generator output to 1 microvolt should multiply the previous limiter reading by 1.2 to 1.5. This last check is an

(CONTINUED ON PAGE 46)



LEFT: THE VERSATILE CATERPILLAR HAULED THE WELDING EQUIPMENT, NEEDED TO ERECT THE MAST, OVER SHEET ICE WHICH STOPPED THE TRUCK. RIGHT: OIL DRUMS GOT THIS FAR THROUGH THE SNOW

PROGRESS REPORT ON W41MM

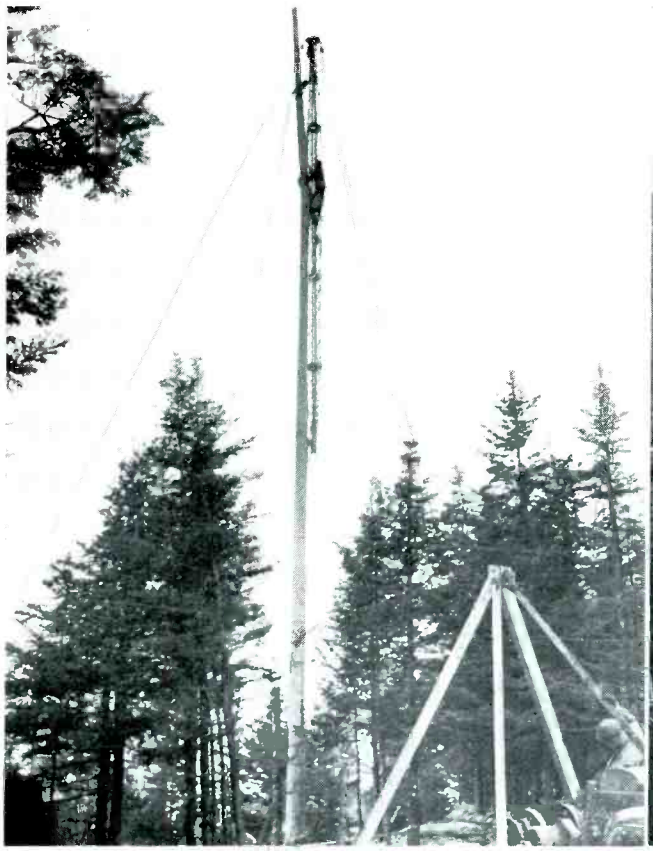
Construction Is Being Pushed on Gordon Gray's FM Station Atop Clingman's Peak, N. C.

BY C. M. SMITH, JR.*

THE writer began work in connection with the construction of W41MM, FM's largest-area project, in October of last year. Most of the major design features had been settled by that date, and orders had been placed for considerable equipment, including the G.E. transmitter, three 75-kva. caterpillar diesel generators, one similar 15-kva. machine, and switch-gear for use with them. Two of the large generators will be required to power the 50-kw. transmitter which is authorized, leaving one for a standby. The small machine is intended to be used during "off" periods eventually, and, more immediately, will supply the 3-kw. transmitter which we plan to put into operation while installation of the remainder of the equipment proceeds through the summer.

When it became apparent that for many months there would be little power required during much of each day, an automatic gasoline-engine-driven 1.5-kva. machine was procured for use during these periods. This made it possible to select standard equipment for oil

*Engineer, W41MM, Winston-Salem, N. C.



LEFT: THE LINGO MAST WAS ERECTED SUCCESSFULLY, DESPITE A MULTITUDE OF UNFAVORABLE CONDITIONS. RIGHT: TOP OF MT. MITCHELL. THE W4IMM ANTENNA ON CLINGMAN'S PEAK IS EVEN HIGHER

burners, refrigerators, etc., without having to run an AC 110-volt plant for 24 hours of every day. This was considered preferable to using auxiliaries designed for 32 volts, which would be off standard and possibly a greater source of interference to radio reception.

This installation was planned by Glenn D. Gillett consulting engineer of Washington, D. C., and the major items of equipment were selected by him.

In October, the one-mile road which had to be built along the side of the ridge from the state road to the site was roughed out for perhaps half of that distance. Design of the building was begun at that time and work was rushed as fast as possible on the road. By the time the building contractor was ready to begin, the road had been pushed through, but was so muddy as to require the help of a tractor to get a truck up it. Work on the road had to be stopped to permit materials to move to the site, for the Blue Ridge Parkway, which must be followed for 12 miles en route to the location, and over which we had permission to move, was to be closed to our hauling on December 1, and we tried to deliver materials enough in advance to keep going. The road is single-lane, and so much time was lost by each crew in getting out of the way of the other that we found it impossible to do road work and any significant amount of hauling simultaneously. The plate transformer for the 50-kw. transmitter and the antenna mast were among the heaviest items moved at that time. This hauling had finished making the road impassable when winter came to the mountain and everything, including the road, froze. From then until now it has taken chains, courage, and luck to get to the peak.

Hollow-tile walls and wood-joist floors and roof were chosen for the building, because of the critical conditions applying to steel. The engine room, which will have a concrete floor, was located at grade on bedrock so that the floor will need little steel reinforcement. The building will be stuccoed when the weather permits, and will be in the form of two stair steps on the side of the mountain, facing the southeast, and in the lee of the peak. It contains the transmitter room, studio-office, shop, storage space, and living quarters for four persons permanently or six temporarily. Permanent living quarters are on the lower level, and are reached by a stairway from

above. They include two bedrooms with a bath, a living room, kitchenette-dinette, pantry, and entryway with a door to the outside. From a large plate-glass window in the living room the staff will have an incomparable view — when the clouds permit.

No provision is made for visitors inside the house, but the roof of the living quarters is covered by a built-up roof, as is all of the building, and with a balustrade and flooring will constitute a terrace from which visitors may look into the transmitter room through a large plate-glass window. They will be able to see into the studio, too — or, if they choose, admire the view below, for which this terrace will be a superior vantage point.

The men engaged in constructing the building have lived through the winter in a frame bunk-house erected for that purpose. The nearest buildings of any sort are a mile away, and those are designed only for summer use. This bunk-house is about twenty feet down the slope from the road, and a hand-line is used to get up and down.

All building foundations are on bedrock. The earth was frozen hard before excavation could be completed, and the final removal of overlying earth was accomplished by literally blowing it over the edge of the cliff with dynamite. Brickmasons worked on into the winter, using calcium chloride in their mortar to prevent its freezing at temperatures above twenty degrees. When the temperature was below twenty, the masons waited.

VERY PRETTY, BUT HARDLY THE BEST KIND OF A ROAD FOR TRUCKING HEAVY EQUIPMENT

Water for use at the station will be pumped by an electric pump from a point 1,600 ft. from the house, and about 600 ft. below it in elevation. The contractor installed a gasoline-engine pump at this location last fall to provide water for construction work. The pipe line is drained when not in use, yet collected condensation froze solid at one point in it during an idle period. The moisture conditions at the top of the mountain range, where the rain clouds for the state form, are appalling. Equipment, even when under shelter, stays wet.

A month ago a 4-ft. snowfall isolated the men on the job for two weeks. Two men came out on foot to get assistance, walking all day and covering a distance of 30 miles before reaching an open road.

It was impossible to procure the type of antenna which it was originally planned to use. A steel tubular mast 90 ft. high and 20 ins. in diameter at the base is to be used to support a 3-bay Lingo turnstile until materials can be obtained for erecting a higher structure with a greater number of bays. This mast was erected while temperatures ranged below zero, with winds of high velocity blowing gustily. Riggers spent not more than ten minutes at a time aloft. The pole is set in bedrock on top of the peak, beside the building and about 50 ft. from it. During the snowstorm mentioned earlier, it was observed to sway over 3 ft. at the top, where its diameter is over 8 ins. Almost every morning sees it coated with an inch or more of rime where the wind swept fog against it during the night.

The officials of the Blue Ridge Parkway, or "the Scenic" as it is known locally, have, fortunately, been very generous in permitting hauling over their road. Otherwise our operations could never have continued through the winter. The heaviest single items to be delivered to the station were the three large diesel-generators mentioned above, which weigh 9,000 pounds each. Such a heavy load on the Parkway, which is not surfaced over this section, is in danger of damaging it severely if moved during a thaw. At the elevation of this road, freezes and thaws tend to alternate on a daily cycle throughout the winter, and it is for this reason that the permit to haul which we had been given was to be ineffective from December 1 to May 1. We found it impossible to get these machines from the factory until the last of January. When the first two arrived at the railhead, we made arrangements with those in charge of the Parkway to permit their being moved during the early morning hours of a specified day, following a check of road conditions by the Parkway engineer. The supplier's crew started as planned, taking two

machines on a tractor-trailer and the third, which had then come into Marion, on a truck. From Marion to the mountain is 35 miles, of which the first several are over a surfaced state road, quite steep and crooked. The next section is the Scenic, at the end of which it is 7 miles by single-lane unimproved mountain road, the state's and ours, to the transmitter location. This section involves many sharp turns and tight places, and one switch-back, where a vehicle must turn around and go out as it came in.

The plan was to haul the machines individually by 1½-ton truck from the end of the Parkway. One had been taken up as planned when snow began falling. Our foreman offered to take one of the two remaining on our truck, making one more trip from the Scenic to finish the job. He was much upset when, after the supplier's men went down and failed to return, he hiked 7 miles down the mountain to find all trace of men and machines gone! They had become fearful of the weather and left, going over 100 miles to the home office of their company. It took days to get them back, and they had the misfortune to find worse weather than before on top, but delivery was made. The heaviest loads were thus transported three full trips over the Parkway, instead of one.

It has been our good fortune that a camp for conscientious objectors was established in the valley below the portion of the Parkway which we find it necessary to use. The men from this camp have worked on the Parkway all winter, keeping it open when it would have been closed. There have been several washouts and slides. At the time this is written, work is still proceeding daily on the clearing of one slide which occurred a month ago and which, for a time, blocked the road completely.

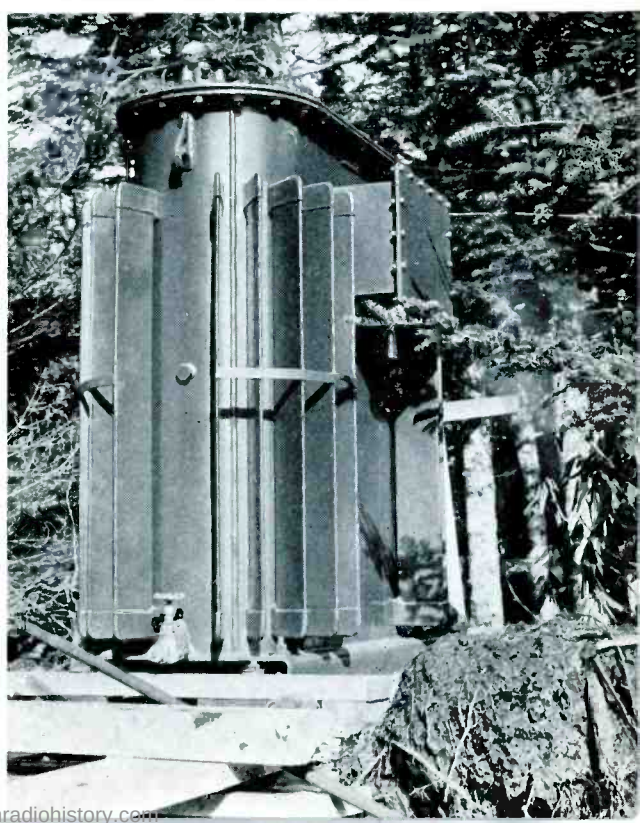
To get the road re-opened after the big snow took a week. Our foreman got the help of the state in getting a snowplow onto their road from Marion to the Parkway. There the Federal men took over, taking the foreman and a tractor mechanic — our bulldozer had broken down — to the end of the Parkway on a snowplow. Parts of two days were required for this trip. From there, the men hiked to the station, repaired the bulldozer, and used it to plow clear the remaining 7 miles of road.

Circumstances have delayed our work so that it has been necessary to change our plans many times. Originally it was expected that operation would begin at low power in November, and later we hoped to start at some time during the winter. Now, we hope to get 3-kw. FM transmitter on the air by May. These changes have kept all plans in a constant state of flux.

For example, we planned at first that about 30,000 gallons of fuel oil would be stored in buried tanks, and about 10,000 gallons of water. It was not possible to obtain the tanks and get them up last season, so other arrangements had to be made. Study indicated that it might be possible to pump water from the source we had picked during most of an average winter, and that the longest period in many years during which No. 2 fuel oil stored above ground would have remained non-fluid was two weeks. The largest tanks then procurable were of 2,500 gallons capacity, and were of much lighter construction than desired. Three of these were ordered and rushed to the mountain ahead of the hauling deadline, and it was planned to use two for oil and one for water temporarily, and to bury the two oil tanks this season for cold-weather use, since two of them will supply station needs through any expected period of temperatures ranging below the oil pour-point. The ground froze before the water tank could be buried, so that a smaller tank had to be pressed into service by building a mound over it. This froze during the storm mentioned, so that water was then obtainable only by melting ice.

A shallow-well water system, installed in the engine room, will pump water for the building from whatever tank is finally buried for storage, and supply it under pressure for use. The main pump at the source will be wrapped with heating cable, thermally insulated, and

BRINGING UP THIS TRANSFORMER FOR THE 50-KW. TRANSMITTER WAS AN ENGINEERING FEAT



THE AUTHOR, LEFT, STANDING ON THE ROOF OVER THE LIVING QUARTERS. THIS WILL BE AN OBSERVATION TERRACE FOR VISITORS. THEY WILL LOOK INTO THE TRANSMITTER ROOM THROUGH A WINDOW

held above freezing temperature by electric heating under thermostatic control. The pipeline will be drained by an automatic valve whenever this pump is not running, and this pump will fill the tank by manual starting at the house, stopping automatically when the tank is full.

Lack of availability of materials has been a problem, as would be expected, and has necessitated changes in plans. A copper tank for storing distilled water for tube cooling is being constructed locally of 20-ounce sheet copper in an angle-iron framework. Wiring will be installed partially in home-made ducts. Careful shopping has procured many necessities just before they became unavailable. Perhaps our luckiest break was in buying a truck in the nick of time, for no supplier of materials would send his own truck up during average winter weather.

It had been planned to use waste heat from the diesel engine radiators to heat the house. More than enough for the purpose will be available when the 50-kw. transmitter is running, even in the coldest weather. We intended to use the air passed through the radiators, rather than passing water through the engines, so as to avoid complications and vibration troubles. Since the engines are to be rubber-mounted on concrete blocks, and these supported in turn by cork pads over individual piers on bedrock, we wanted to avoid extra piping which might transmit vibration.

When it became probable that early operation would be at reduced power, and that full-time operation would not be economically justified for some time, the whole question of heating was reopened. There had been some fear, too, that oil odors might be circulated through the house. It developed that the use of this source of heat would require such large air volume as to present a problem in duct design, and so the plan was abandoned, and an oil furnace chosen. The heating system is so designed that waste heat from engines can be used at a future time if it becomes desirable, by installing one partition and changing two ducts. Should this be done, the oil plant will serve as a booster to increase the temperature of the air as required in the coldest weather, so that the volume of air handled will not need to be increased.

In a similar manner, it had been proposed that hot water be supplied by heat interchangers on the engine exhaust stack. Special equipment would be required, and a standard oil-fired automatic heater was chosen as more readily available and more immediately satisfactory.

For cooking and distilling water a bottled gas will be used, making a total of three types of fuel that must be stored. These are: No. 2 fuel oil for diesel engines, house heating, and water heating; gasoline for the automatic electric plant which will supply lights, refrigerators, oil burners, etc., as required when the

station is off the air; and bottled gas as mentioned above.

From main tanks, storing 30,000 gallons at some distance from the house, fuel oil can be transferred by a gear pump into either of the two 2,500-gallon buried tanks or to the house, and from either of these tanks to the house. There it will be metered, filtered, and stored in two 500-gallon day tanks, one for the engines and one for heating.

Cleanliness is extremely important in diesel fuels, and is best obtained by care in handling and by allowing the oil to settle well before using, the sediment and water being drained at intervals. We are taking great care in designing our oil-handling facilities to assuring cleanliness of the oil.

The day tanks, under the engine-room floor, are manifolded together in such a manner that all demands can be supplied from either, while the other is cleaned. A pit, entered through a manhole in the floor, will give access to the ends of the tanks and to all valves associated with them. Here the water and sediment can be drained off. The various machines will each have a supply line picking up from the manifold in this pit, and an overflow line returning to the manifold. These tanks will be insulated from the outside by 6 ft. of earth, and from the engine room by only 1 ft., and should maintain the oil in a fluid condition. They can be heated if it becomes desirable to do so.

The oil meter can be present for the amount it is to deliver, and will automatically stop the pump when this amount has been discharged. This is desirable in that almost an hour will be required to fill a day tank.

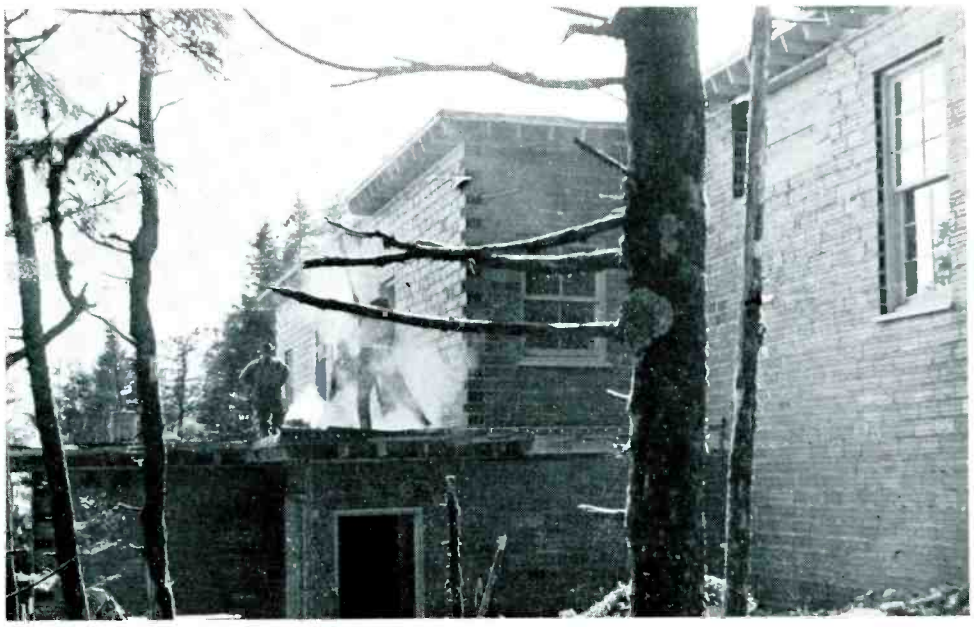
Gasoline will be stored in a 500-gallon tank under the same floor, with filling and venting from the outside and with all piping buried and under concrete, and none passing through the pit described above.

The quantities of gasoline and fuel oil mentioned will be sufficient to last through the worst of an average winter.

Wiring in the engine room will be in conduit rather than in trenchways, because of the possibility that oil or water might run into any trench. No lead-covered cable will be used in the installation. Junctions between the lengths of large-diameter conduit involved will be concrete boxes, metal lined, beside the wall in each case and raised above the floor surface. Two banks of heavy-duty batteries, 32 volts to each bank, will be arranged for interchangeable use in starting the various engines. These will be charged by a Tungar type of charger. All of the engine room equipment is to be installed and all piping put in place before the concrete floor is poured, and the power plant will be put into operation one unit at a time. The gasoline plant is already in service, supplying lights for the bunkhouse, for indoor work on cloudy days, and driving small power tools.

A heater-room, in the form of an alcove to the engine room, will contain the furnace for

VIEW TO THE EAST FROM W41MM. PARKWAY OVER WHICH THE EQUIPMENT WAS HAULED APPEARS AS SCARS ALONG THE RIDGE AT THE CENTER. ROAD TO THE STATION RUNS FROM LEFT TO RIGHT



THE ENGINE ROOM IS AT THE EXTREME RIGHT. THE DOOR, CENTER, OPENS INTO THE KITCHEN

house heating, water heater, water cooler for the transmitter, distilled water storage tank, and water still.

The diesel power generating equipment will be controlled from the transmitter room, where a switchboard of appearance harmonizing with that of the transmitter will be a part of the right hand wall of the room. Air circuit breakers are provided to tie each machine to the main bus, and to connect from the main bus to each load, with adequate provision for metering all generating and bus operating parameters.

From this board any machine can be started, brought into synchronism, tied to the bus, and loaded as desired. As many or as few machines as desired can be operated simultaneously. Self-regulated generators are used, and capacitor banks are provided for adjusting power factor and, through it, the voltage. All diesel generators are 3-phase, 220-volt units, and the switchgear is designed for these characteristics.

When all diesel machines are to be shut down, the operator must throw a switch which will start the 110-volt, single-phase gasoline machine and transfer to it all house-lighting and similar loads. Thereafter, this machine will run whenever a load is present on these circuits, and will shut down when there is no load. The main plant can then be closed down without throwing the house into darkness.

An alarm circuit will be arranged to awaken the staff of the station if the engine room temperature drops to freezing during the night, as might occur due to failure of either the heating plant or its electrical supply. Were this not done, such a failure might freeze the machine radiators and the water-cooler.

The one transportation problem which should be simplest, but may not be, is that of getting program service to the mountain. An S-T circuit on 337 mc. will be used. The distance is over a hundred miles, and line-of-sight either barely does or doesn't quite exist. Rhombic antennas will be installed at each end for our initial transmission.

The problem of access to the station has been greatly complicated by the war, for the state had intended to rebuild the road up from the Parkway last summer, and went so far as to call for bids on it. Unfortunately for this project, no one bid, and it seems probable that we shall have to do the best we can with the road that is there for the duration. The soil at these elevations is almost pure humus, and so greasy when wet that several tons of crushed stone spread near the building have completely disappeared into the mud.

This has been an exciting job, and an interesting one. Many problems have been met, while many of the hardest yet remain. Many solutions already decided on have yet to meet their test in practice. Electrical installations are just beginning, but one of these days "Mount Mitchell's Voice," from the top of the North Carolina mountains, will be the loudest, clearest voice for many radio listeners over an area of 70,000 square miles.

(CONTINUED FROM PAGE 20)

First-Quarter Profits ★ Stewart Warner statement shows net profit for first quarter of 1942 at $690,777, compared with $381,337 for the corresponding period of 1941. This represents an increase from 30 cents a share to 54 cents. Taxes rose from $760,235 in 1941 to $3,271,834 in 1942 for this period.

Rear Admiral S. C. Hooper ★ Speaking from experience which goes back to an active part in World War I, Admiral Hooper, testifying before a Senate sub-committee that, in the event of legislation which would authorize a merger of domestic telegraph companies and a consolidation of international communication companies into one system, the Armed Forces should retain veto power over such a merger.

The FCC, which would have power over such a consolidation had, he said, "little knowledge of the military requirements and principles involved." Admiral Hooper added: "Experience has shown that a non-military commission has very little sympathy with the needs of the Armed Service, as compared with those of the public."

Sensitive Aviation Relay ★ A DP-DT relay, designed to handle milliamperes at microvolts in aviation service has been brought out by Struther Dunn, Inc., 1335-A Cherry Street, Philadelphia. Frame is laminated, coils are for AC operation only. Sliding contacts are provided. Weight is 9½ oz., and dimensions 3⅜ ins. high, 2 ins. wide, 2¼ ins. deep. This relay is particularly suited to switching thermocouple circuits.

Belmar Needs Radio Mechanics ★ An urgent need for radio mechanics has been issued by the Radar Laboratory at Camp Evans, Belmar, N. J. Several hundred radio mechanics are wanted, at salaries of $1,440, $1,620, $1,800, and $2,000 a year. Those who have completed the radio defense course will receive $1,440 per annum. Camp Evans also has many vacancies for electricians at salaries of $1,800, $2,000, and up. The announcement from the Signal Corps emphasizes the urgency of filling these positions. Those interested should communicate by mail or in person, at once, with Leon H. Blumenthal, c/o Commanding Officer, Signal Corps Laboratory, Camp Evans, Belmar, N. J.

No Fooling at M.I.T. ★ The military guard means business. A student, running back into a building after his books, did not stop when he was ordered to halt. The sentry shot him. Fortunately, the sentry's aim was good, and he did not injure the student seriously.

Replacement Electrolytics ★ Three sizes of dry electrolytics have been brought out by Sprague Products, to replace wet types in aluminum cans. Extra protection is afforded by the use of an extra-high formation voltage.

CHARLEY SINGER, TRANSMITTER SUPERVISOR OF WOR, GETS INDIAN TROPHY IN RECOGNITION OF THE OUTSTANDING MAINTENANCE RECORD ACHIEVED AT WOR UNDER HIS DIRECTION

MELTING SLEET FROM FM DIPOLE

Thermostats Cut in Heating Elements to Melt Sleet off W51R Antenna

BY KENNETH GARDNER*

THE formation of sleet on an antenna having elements of comparatively large diameter, such as we have at W51R, is not serious with respect to the electrical characteristics. There are mechanical hazards, however, because wind resistance, and the resulting strain on the structure, increase directly with the diameter and as the square of the wind velocity.

Large icicles are a danger to life and property, too, and must be prevented from forming, particularly when the antenna is mounted on a city building, since falling ice endangers pedestrians, automobiles, and windows.

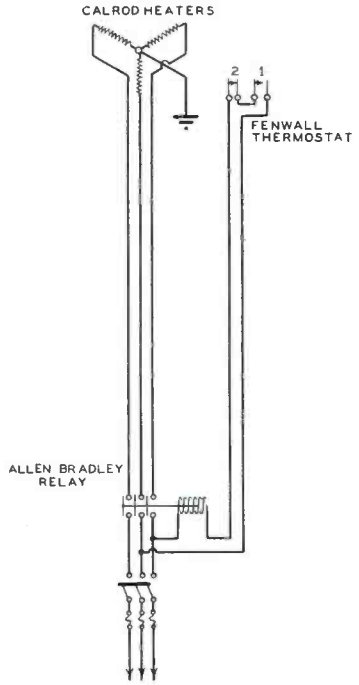


FIG. 1. ELEMENTARY CIRCUIT FOR MELTING SLEET WHEN THE TEMPERATURE IS BETWEEN 28° AND 32° FAHRENHEIT, THE CRITICAL RANGE

Sleet and ice form on objects whenever the temperature of the surrounding air is between 28° and 32° Fahrenheit. In other words, if the temperature is above 32°, the precipitation is rain. If the temperature falls below 28°, it is dry snow.

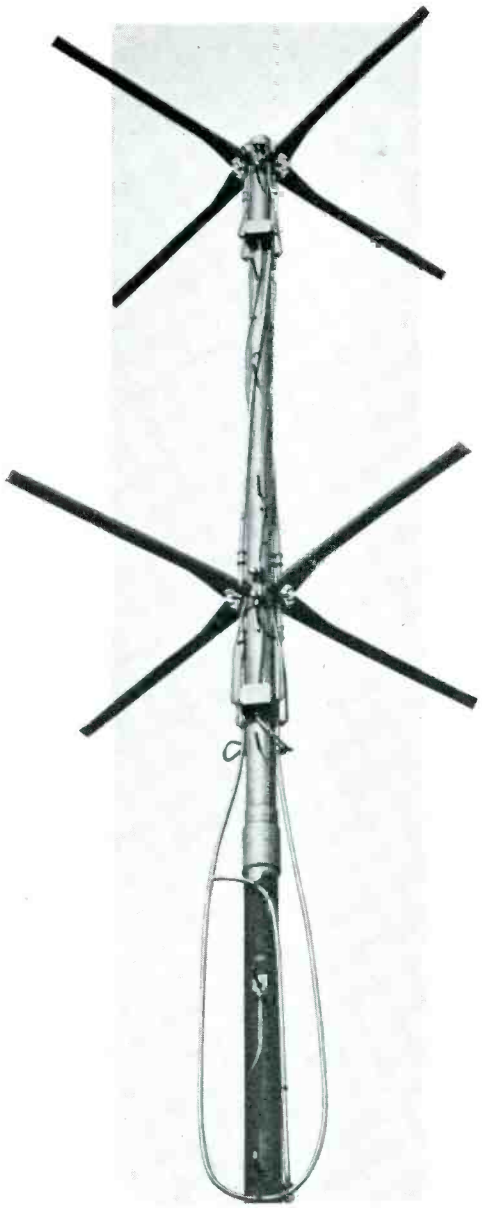


FIG. 2. CLOSE-UP OF THE W51R DIPOLE. THE CALROD HEATING ELEMENTS ARE BUILT INTO THE HOLLOW ARMS OF THE RADIATORS

*Chief Engineer, W51R and WHAM, Rochester, N. Y.

Therefore, it is only necessary to consider this narrow, but very dangerous, temperature range.

W51R's 2-bay turnstile has eight elements, as will be seen in Fig. 2. We built into each element a 4-ft. G.E. Calrod heater unit. The current is turned on to these units when the temperature is within the sleet-forming range in the following manner:

Two thermostats are mounted on the mast just below the turnstile. Free air circulation is provided around them. They are connected to an Allen Bradley relay, as shown in Fig. 1, in the circuit of the 3-phase, 208-volt supply.

Both thermostats No. 1 and No. 2 must be close to apply current to the relay. When either thermostat is open, no power reaches the heaters. Thermostat No. 1 closes when the temperature falls below 32°. No. 2 opens when the temperature falls below 28°.

During the past winter, there were several sleet and ice periods in Rochester, but at no time did ice form on the antenna. Peculiarly enough, in this locality sleet forms only when storms arrive from an easterly direction.

This suggests that we might use a third control, connected through a wind vane, so that the heater circuits could not be completed, even with the temperature between 28° and 32°, unless the wind was coming from the east. Or we might use a relay operated by a humidity-measuring device. Our experience, however, has been that the arrangement we are using is entirely satisfactory.

At a station which is manned 24 hours a day, simple manual control might be relied upon in the hands of a weather-conscious person, particularly one afflicted with responsive joints or muscles!

Other interesting details of our turnstile are shown in Figs. 2 and 3. The coaxial cable coming up the mast will be seen to split at a "T". One element of each doublet is fed from the half-wave loop which swings down from the juncture. The opposite elements are fed 180° out of phase, from the top of the "T".

Junction boxes below each bay are for connections to the heaters. The thermostats are located just below the half-wave loop, near enough to the radiators that they are exposed to the same temperatures as the dipole elements.

The exact design of the dipole elements can be seen in Fig. 3. The design provides light but rugged construction — a consideration dictated by the fact that this antenna is installed in the business section of Rochester, where we could take no chance with structural failure. All the parts, even to the climbing spikes, were welded. This is the antenna which replaced the vertical radiator originally installed at this FM station.

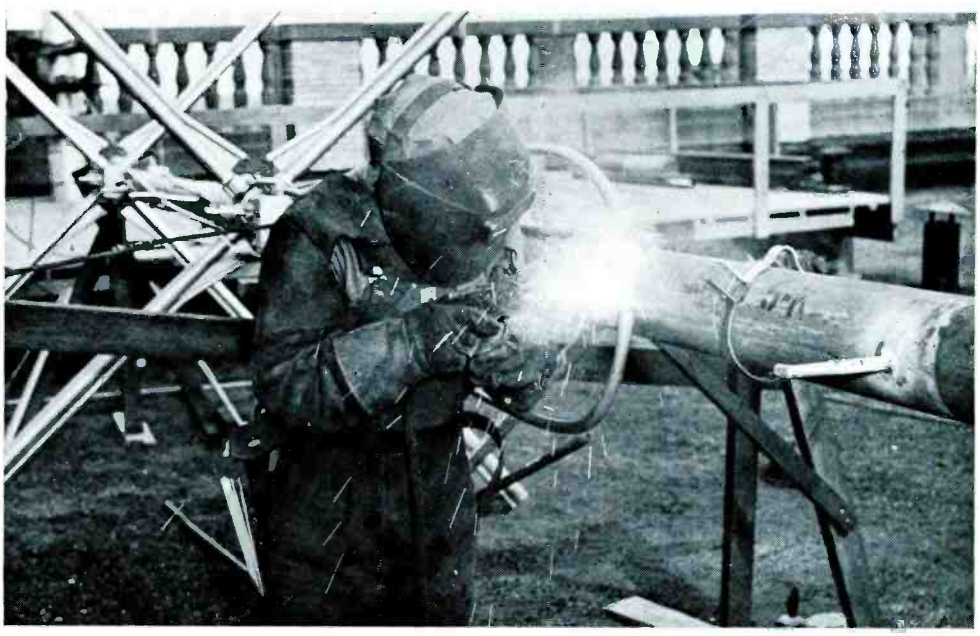


FIG. 3. FURTHER DETAILS OF THE W51R FM ANTENNA CAN BE SEEN IN THIS PHOTOGRAPH, TAKEN WHEN THE RADIATING ELEMENTS WERE BEING ASSEMBLED, PREPARATORY TO ERECTION

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For FM Magazine from November, 1940 to December, 1941

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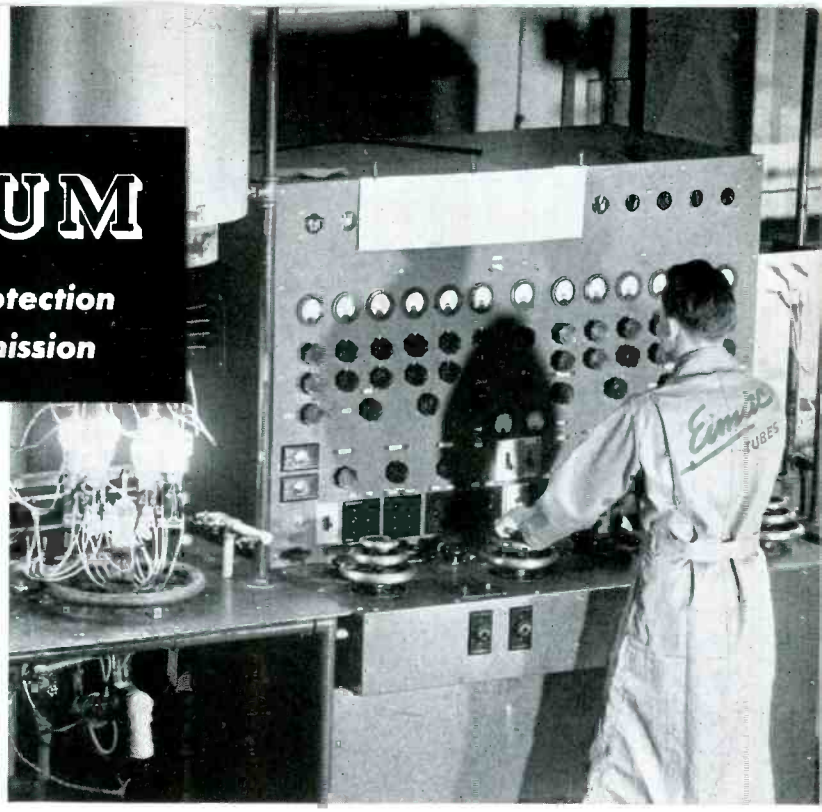
VACUUM

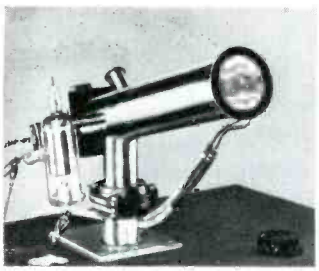
The Invisible Protection for Filament Emission



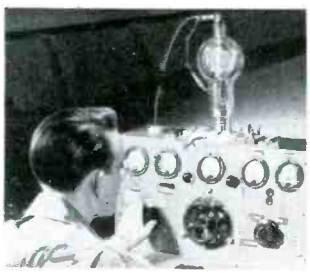
EIMAC 2000T

Filament Voltage	10 volts
Plate Voltage	up to 6000 volts
Plate Dissipation	2000 watts
Power Output (75% eff.)	6000 watts

Like a solid coat of armor-plate, hard, high vacuum protects filament emission in every Eimac tube. Extremely efficient evacuating pumps developed and built in the Eimac laboratories for the precise purpose of producing the highest possible degree of vacuum are shown in action above. It is this excellent vacuum that proved the idea fallacious that plate temperature destroyed emission... caused premature failures. Chiefly because of this processing, Eimac tubes today, and for the past number of years, have provided longer life, greater stamina and vastly superior performance.



ELECTRON MICROSCOPE virtually gives a moving picture projection of the action of electrons being emitted from a heated filament. Such observations enable Eimac engineers to constantly produce better filaments.



PEAK EMISSION TESTER measures the flow of electrons from the filaments of completed Eimac tubes. Of the long series of gruelling tests made to insure more efficient filament emission in every Eimac tube, this is the final test.

FLASH FILAMENT TESTER checks filaments before tubes are assembled and pumped. Here tubes are placed under a temporary vacuum, heated to much higher temperatures than will ever be required in normal use. Only perfect filaments reach the final stages of manufacture.

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WARTIME TUBE REVISIONS

(CONTINUED FROM PAGE 17)

as shown on the bottom of the enclosure. This second point is of the utmost importance, and the basic agenda of this letter.

The addressees are requested to carefully scrutinize the design of any equipments offered or which may be offered for use of the Naval Service, either on specification or catalog purchases, and ascertain that the vacuum tube complement will consist of tubes on the list of those acceptable for use in new equipments.

In the case of new equipments and particularly those purchased on specifications, there undoubtedly arises a question of engineering judgment in which design engineers will feel that in order to meet all the items of specification performance, special, or at least unapproved types of tubes will be necessary. In such cases it is recommended that the claims be carefully considered, and that the relative importance as well as the quantitative values of the performance compromises, be determined and the Bureau contacted in the premises before a design is crystallized around the employment of a non-standard tube. Where the performance compromise is relatively unimportant, the use of non-standard tubes will probably not be permitted. It is believed that in most cases the opposition to the use of Navy preferred types will be subjective rather than objective.

It is not the intention of this letter to attempt to restrict progress of the art where such progress definitely and unequivocally requires new, special, or unapproved types of tubes. In all cases careful analysis and scrutiny of design should be made to assure that a too often employed practice of requiring special tubes to meet the deficiencies or derelictions in circuit design is not being proposed or practiced rather than utilizing every effort to make circuit design satisfactory for use with standard tubes. Conservative circuit design around standard tubes in the long run probably produces the best Naval radio equipment.

In order to effect the desired utilization of preferred type tubes, no type of tube not included under "Vacuum Tubes for Use in New Equipment" will be permitted in the design of equipment which has an electrical equivalent on the preferred list. Where departures from this directive are absolutely essential the Bureau is to be contacted on the matter.

The agenda of this letter shall not be construed as affecting the terms or conditions of any contracts because of conflict between such terms or conditions and this letter.

Very respectfully,

J. B. Dow,
By direction

RADIO-ELECTRONIC PRODUCTS DIRECTORY

(CONTINUED FROM PAGE 10)

make, or the reference to any catalogs in describing any item contained in the specifications, and this Invitation to Bid does not restrict bidders to that manufacture or specific article; this means being used simply to indicate to prospective bidders the character or quality of the article required. Bids on other makes, brands, or cataloged items will be considered, provided the articles on which proposals are submitted are equal to those referred to, and provided further, that bidder clearly states on the face of his proposal exactly what he proposes to furnish, naming the manufacturer or brand and catalog number of the respective articles proposed to be furnished and forwards with his bid a cut, illustration, or other descriptive matter, or refers to a catalog previously filed with the State Procurement Officer, either or both of which will clearly indicate the character or quality of the article covered by his bid. In the absence of any statement to the contrary, or in the event of failure of bidder to strike out the words OR EQUAL wherever they may be used in connection with an article specified by manufacturer, brand, or catalog number, it shall be understood and agreed that bidder proposes to furnish the articles as named, indicated, and/or specified herein."

Instructions vary, of course, with the requirements of individual contracts, but the quotation above sets forth the underlying principle of Government procurement policy. This is to encourage competition, and to have available more than one source of supply on all equipment, components, and materials.

EXCISE TAXES ON RADIO SETS

Figures released by the Treasury Department show that the excise taxes paid by radio manufacturers for the first quarter of 1942, which was the last quarter that production was in full swing, exceeded the corresponding 1941 quarter by 300%.

This was due partly to the increase in the tax to 10%, and partly to the increased unit price of sets sold in 1942. The figures show:

Jan.	$632,760	Jan.	$2,650,829
Feb.	350,149	Feb.	2,679,303
Mar.	485,052	Mar.	2,046,024
Total	$1,467,961	Total	$7,376,156

Other taxes will be required to make up this loss of Federal revenue, for the excise taxes to be collected on home radio sets will drop to the vanishing point with the second quarter of this year as production shifts entirely to Government work.

SINGLE-UNIT MOBILE FM EQUIPMENT

(CONTINUED FROM PAGE 29)

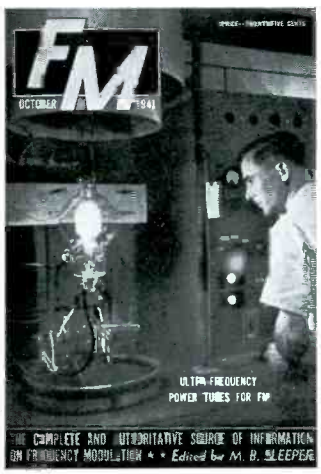
indirect measure of the receiver's ability to discriminate against noise. A more accurate check on this important feature can be made as follows:

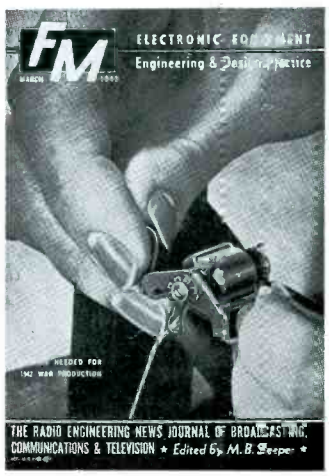
8. Connect an AC voltmeter across the loudspeaker terminals, and set the meter to a suitable scale so that when the signal generator output is at zero, the voltmeter reads somewhere near full scale. Observe the reading. Now turn the signal generator output up to 1 microvolt. The voltmeter reading should drop to one-tenth (20 db) of the original value. If this condition is not at least approximated, it would be well to retune some of the stages. However, do not touch T107, T108 and T109, since they will not affect this situation.

9. Turn on the transmitter which is going to be used to send signals to this receiver or, if this is not convenient, use a source of the exact frequency required. The receiver discriminator meter should show no deflection. If this is not the case, the diode trimmer of T109 should be readjusted slightly until the meter does read zero. However, if this has to be done, then step 4 of the foregoing procedure will have to be repeated, but this time, instead of using 2,100 kc. from the signal generator, such frequency must be used as will make the discriminator meter read zero. This frequency will be found to be very close to 2,100 kc.

Servicing ★ In general, in cases of either failure or of poor performance, the instructions for the transmitter will hold. Voltage data similar to that given for the transmitter is tabulated here for the receiver. All readings are to be taken on the 250-volt scale of a 20,000-ohm-per-volt instrument, unless otherwise noted.

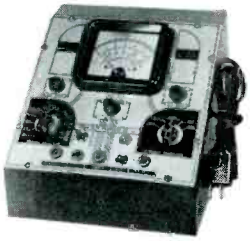
The DIRECT WIRE TO CARRY YOUR advertising message to the men who are responsible for our $2,000,000,000 wartime radio - electronic program





Contracts wanted . . .

ELECTRICAL & RADIO INSTRUMENTS



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★ ★ ★ ★ ★

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50-Watt Transmitter and Receiver

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The ability of this 50-watt FM unit to take the most severe punishment makes it suited to unusual applications. Specifications are:

Frequency: Any frequency in the 30–40 mc. band. **Power Source:** 105 to 125 v., 60 cycles, single phase from electric mains or engine-driven generator. Total load about 300 w. **Size:** 40 ins. high, 22 ins. wide, 12 ins. deep. **Accessories:** Supplied complete with coaxial antenna and 100 ft. of $\frac{3}{8}$-in. concentric cable. **Model 550-A:** has press-to-talk hand microphone. **Model 550-AWE:** has press-to-talk French type handset. Also available with desk control unit or for remote wire line operation. **Transmitter:** 7 tubes, output in excess of 50 watts, crystal-controlled phase shift, new single tube modulator. **Receiver:** 11 tubes, double IF superheterodyne, single crystal control, limiter acts on signals of less than 1 microvolt, with squelch action on less than .5 microvolt.

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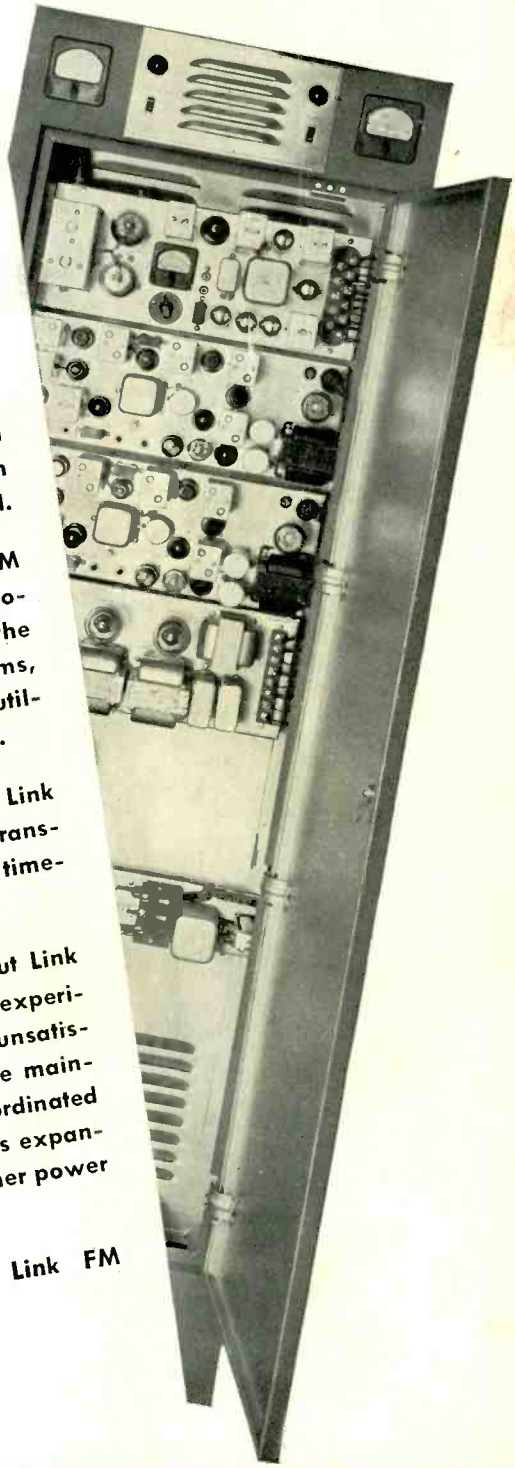

The soundness of Link FM engineering is well illustrated by the varied types of installations in which standard Link units are employed.

They range from simple 2-way FM emergency installations for the protection of industrial plants up to the largest state-wide police systems, and for interconnected public utilities covering still greater areas.

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