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Aug. '49

FM-TV

★ Edited by ★
Milton B. Sleeper

PRINCIPAL TELEVISION AREAS

Based on the FCC's Proposed Allocations Plan, Released July 11, 1949

VHF AND UHF ALLOCATIONS TO AREAS OF 200,000 POPULATION OR MORE

AREA	POP. thous.	VHF channels
Birmingham	408	3
Boston	771	4
Chicago	3,397	7
Columbus	365	3
Dallas	377	3
Denver	384	5
Fort Worth	208	3
Houston	510	4
Los Angeles	2,904	7
Kansas City	399	4
Memphis	332	5
Milwaukee	587	4
Minneapolis	911	6
Nashville	242	4
Newark	430	1
New Orleans	540	5
New York	11,691	6
Okla. City	221	3
Omaha	224	3
St. Louis	816	6
St. Petersburg	210	6
Salt Lake City	204	5
San Antonio	319	5
San Francisco	1,428	6
Syracuse	258	3
25 Areas	28,136	111

AREA	POP. thous.	VHF channels	UHF channels
Albany	432	1	2
Atlanta	302	4	2
Baltimore	1,047	3	2
Buffalo	857	3	1
Cincinnati	789	3	2
Cleveland	1,214	4	2
Dayton	271	2	2
Detroit	2,296	3	2
Dist. of Col.	908	4	1
Grand Rapids	210	2	2
Indianapolis	387	3	1
Louisville	434	2	2
New Haven	308	1	2
Philadelphia	2,899	3	1
Pittsburgh	1,994	2	2
Portland, Ore.	406	5	1
Providence	712	1	2
Rochester	412	1	3
San Diego	256	3	2
Seattle	453	4	2
Toledo	341	1	2
21 Areas	16,928	55	38

AREA	POP. thous.	UHF channels
Akron	349	3
Bridgeport	217	2
Canton	200	2
Easton	325	2
Fall River	225	3
Hartford	502	3
Lawrence	232	2
Scranton	630	2
Youngstown	372	3
9 Areas	3,052	22

MARKET ANALYSIS

AREAS OF 200,000 POP. OR MORE	VHF	VHF-UHF	UHF
Areas	25	21	9
Pop., thous.	28,136	16,928	3,052
Channels	111	55-38	22
AREAS OF 100,000 TO 200,000 POP.			
Areas	15	16	16
Pop., thous.	2,172	2,360	2,200
Channels	53	33-27	37
ALL AREAS OF 100,000 POP. OR MORE			
Areas	40	37	25
Pop., thous.	30,308	19,288	5,252
Channels	164	88-65	59

VHF AND UHF ALLOCATIONS TO AREAS OF 100,000 TO 200,000 POPULATION

AREA	POP. thous.	VHF channels
Charlotte	101	3
Chattanooga	193	3
Des Moines	184	3
Duluth	136	5
Jacksonville	173	5
Knoxville	152	3
Little Rock	127	4
Miami	172	4
Mobile	115	4
Portland, Me.	106	2
Shreveport	112	3
Spokane	141	4
Tacoma	156	2
Tulsa	189	3
Wichita	115	3
15 Areas	2,172	53

AREA	POP. thous.	VHF channels	UHF channels
Binghamton	145	1	2
El Paso	116	5	2
Erie	124	1	1
Hamilton, O.	112	1	1
Johnstown	152	2	1
Lancaster	132	1	2
Lansing	110	1	1
Moline	175	2	1
Norfolk	191	3	2
Peoria	105	2	1
Phoenix	121	5	2
Port Arthur	139	2	3
Richmond	193	3	3
Sacramento	159	2	2
Utica	197	1	1
Wilmington	189	1	2
16 Areas	2,360	33	27

AREA	POP. thous.	UHF channels
Altoona	114	1
Atlantic City	100	3
Austin	106	3
Flint	189	3
Fort Wayne	118	2
Gary	112	1
Harrisburg	173	2
Kenosha	116	3
Reading	175	2
Saginaw	153	3
San Jose	129	3
South Bend	101	2
Sp'gfield, Mass.	150	2
Trenton	125	3
Waterbury	145	2
Worcester	194	2
16 Areas	2,200	37

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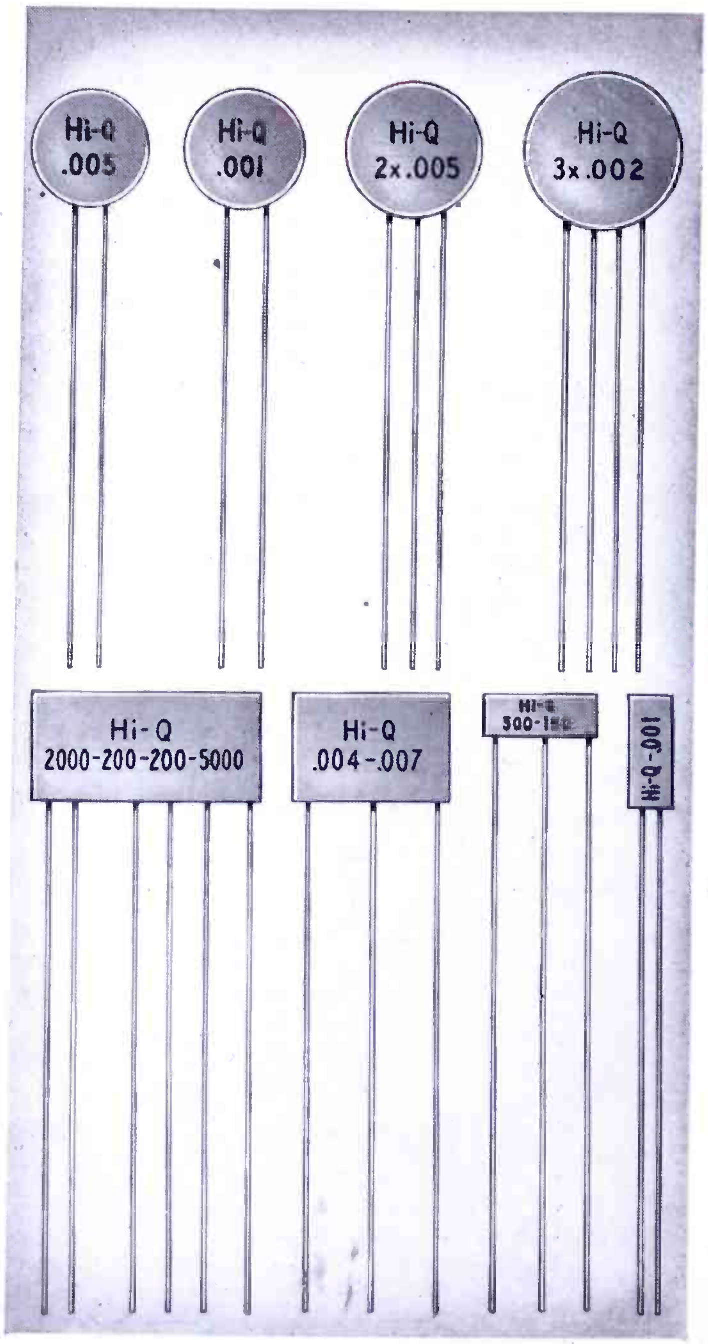

ILLUSTRATIONS APPROXIMATELY ACTUAL SIZE

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CONTENTS

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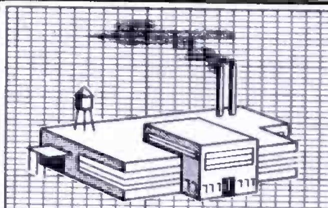
ABC



Set Production

SET production by RMA members to the first of June showed TV leveling off, and FM and AM down slightly below May. In any study of these figures and the trends they disclose, two qualifying factors should be borne in mind.

First, RMA figures do not include TV set production by Admiral. This concern has issued figures that show a monthly output of some 40,000 TV sets.

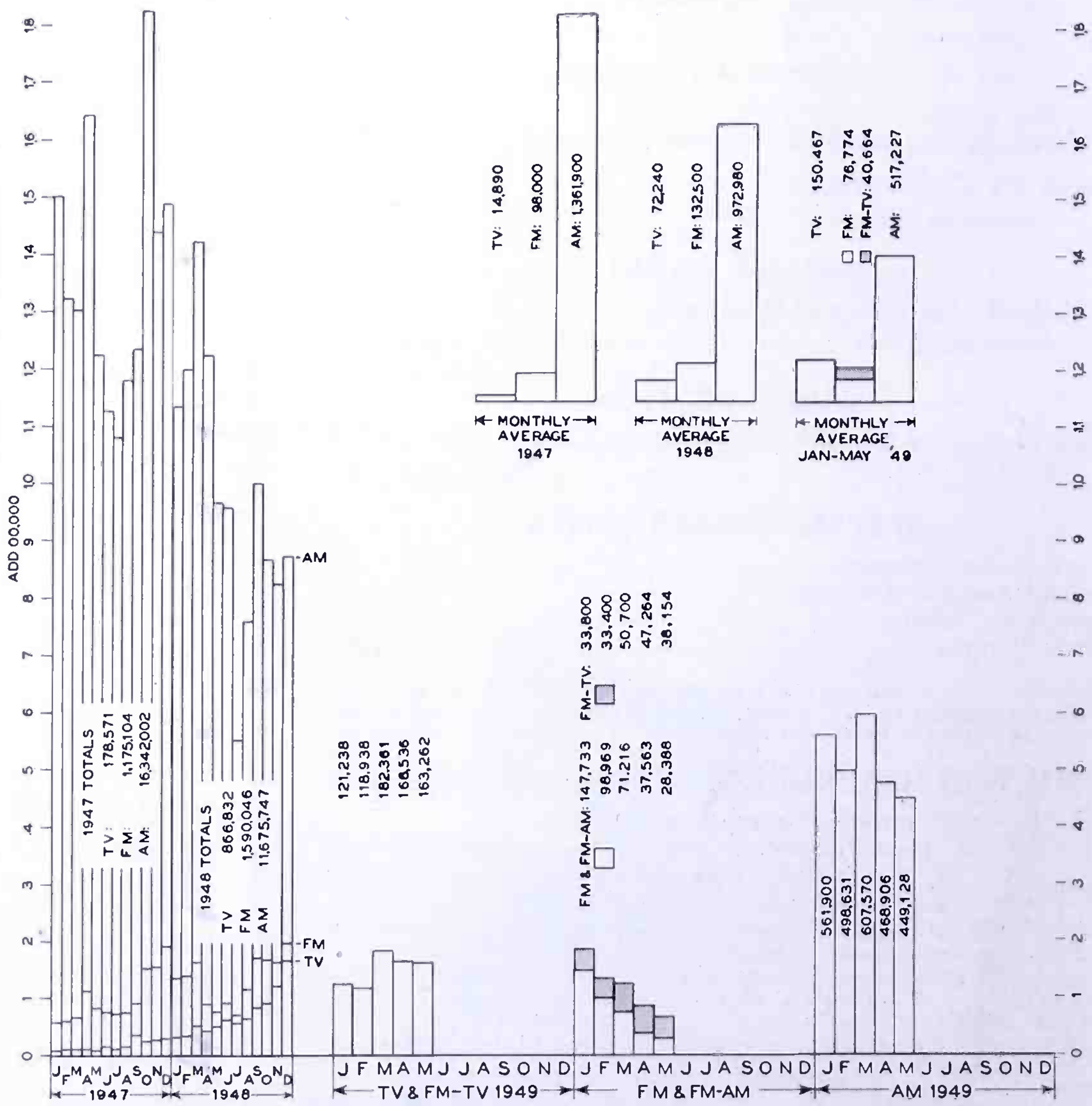
Second, in relating figures for FM sets to audience growth, an adjustment must be made for transitcasting and storecasting receivers. These sets may add little to the number of sets produced, but each one represents thousands of added FM listeners.

That is significant in any comparison with the AM audience, which is definitely on the decline. Even taking 10 years as the average useful life of an AM receiver, to maintain the postwar figure of 70,000,000 AM sets in use it would be necessary to produce 580,000 sets per month as replacements. In 1949, that figure was only reached in March. May hit a postwar record low, and June and July will certainly be lower still. And of course the RMA figures include export models.

Average AM set production for 7 months in 1949 will probably run 700,000 short of the number required as replacements, indicating a 10% drop in the total AM sets in use.

Speculation is rife as to the effect of the FCC's allocations plan on TV set production. Will VHF sets still sell in areas where it is proposed to add UHF channels? What will happen where people have expected more VHF assignments, only to learn that they may not have any added service until UHF transmitters are installed? Will the manufacturers promote TV converters? Or will they come up with other ideas?

So many factors are involved that we can only hope for the best, and wait until public reaction is expressed by its effect on production schedules.



TV, FM, and AM Set Production Barometer, prepared from RMA figures

THIS MONTH'S COVER

Release of the FCC's television proposal prompts three extremely important questions: 1) What do the allocations mean in terms of potential audiences large enough to support profitable broadcast operations? 2) Where will we have the large markets for TV sets? 3) What is the breakdown on VHF-only, V-UHF, and UHF-only in those areas? The summary of the allocations, presented on this month's cover, answers all three of those questions. It shows the markets, their population, and the VHF and UHF stations planned for each one. What no one knows at this time is the extent to which the proposed allocations may be modified.

WHAT'S NEW THIS MONTH

1. Facts about FM Reception 2. Data on Industrial Services
2. Price Competition Is Keener on TV Sets

1. Strong feeling has been expressed at the FCC in favor of prohibiting the duplication of programs on FM and AM. No explanation of this opinion in terms of public interest, convenience and necessity has been forthcoming, but it would be interesting to know the reasoning behind this new idea.

We have found that, for one who is to write about radio, there is no substitute for listening to it. Presumably, listening is even more necessary to those who are charged with the public responsibility of regulating radio to the end that the best broadcast service will be made available to the largest number of people.

Of course, there are some sets in some places that give what might be called perfect AM reception. They may have such an installation at the FCC offices. If so, the Commissioners may feel that, since they get completely satisfactory reception of AM programs, the duplication on FM is a waste of FM channels.

And they would be completely justified in stopping FM-AM duplication if that were the prevailing condition in metropolitan and rural areas. Only it isn't.

We haven't ever listened in at the FCC Washington offices, but we did check reception recently right across the street, at Hotel Raleigh. Our room was equipped with a good AM set, too, but heaven help the people who have to put up with the amount of noise and interference we heard there in order to hear even news programs. As for music—it just wasn't worth the struggle. So we just unlimbered an FM table model, and settled down to a little geniune enjoyment which included the Lux Theatre, one of our favorite programs. If there was any waste of radio channels in FM-AM duplication, as far as we were concerned, it was in the AM transmission!

Here it should be pointed out that the set we used, although an inexpensive model, provided high sensitivity and good limiting action. Some receivers we have encountered would have been just as noisy on FM as the hotel's AM set.

If it seems unreasonable to say that radio channels are wasted not by FM but by AM, consider this incident: At Great Barrington, we were listening to a give-away program on WLAD-FM at Danbury, Conn., 64 miles away. We heard the mc call a telephone number at Candlewood Lake, about 8 miles from the transmitter. The woman who answered didn't have her radio on, but the mc gave her time to tune in, and even told her the station's AM frequency. Then we heard the mc say: "You can't get us? There's a storm? Well, that's too bad!" Yes, it certainly was too bad that she couldn't hear the AM signals at 8 miles while the FM signals were strong at 64 miles!

But that's not an unusual situation. There's a Mutual AM station 22 miles away in Pittsfield, but we've never heard it. We get our Mutual programs on FM from Springfield, at a distance of 36 miles.

Why, we didn't have any NBC service at all after sundown, even though WTIC Hartford, 34 miles away, puts out 50,000 watts on AM, until WTIC-FM was boosted to its full power.

And here's one for the record: The only commercial station in the New York City area, AM or FM, that we can hear

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WHAT'S NEW THIS MONTH

(Continued from page 6)

with positive, day-to-day dependability is WQXR-FM!

So some of the Commissioners would like to confine the most interesting programs to AM? Well, some of the AM broadcasters might cheer such a decision, in the hope of discouraging FM listening. That might explain a newspaper clipping and an indignant letter we received from a reader located in a suburb of Boston. The clipping was a full page from the *Boston Sunday Herald*, carrying a feature story about the coverage of the baseball games by WHDH, and a half-page advertisement headed "Hear the Red Sox, Braves games over WHDH—now 50,000 watts, 850 on your dial." There was no mention of WHDH-FM. That was what riled our reader, for he wrote: "Their high-power FM station is also carrying the ball games with greater geographical coverage than WHDH-AM!"

If the FCC is concerned about spectrum utilization to the end that the best broadcast service be made available over the largest area, listening experience indicates that the most-wanted programs should be limited to FM. The use of records, even worn-out ones, doesn't make any differene on AM, because the background noise masks the needle-scratch. The end result of such a plan would certainly benefit listeners, encourage the expansion of FM broadcasting, and give the audio receiver manufacturers a much-needed break.

2. Part 3 of the quick-reference data on frequencies and technical requirements for mobile radio systems, scheduled for this issue, was put over until September in order to accommodate the analysis of the FCC's television proposal. It was not that the mobile radio data is of less importance, but it was necessary to get the TV information to our readers before the hearing starts on August 29.

3. Watching the steady increase in values offered at lower prices by TV set manufacturers, it's clear that a sharply competitive price situation is developing in this field. Is this merely an adjustment? What about this fall, and next year when new stations will create additional markets?

Let's take a look at the basic factors, and make some comparisons with audio receiving sets. First, let's go back to the transmitters, where the signals start.

Audio stations transmit signals of very high audio quality. Thus, depending on the design (and price) of the receiver,

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WHAT'S NEW THIS MONTH

(Continued from page 8)

reproduction in the home may range from mere intelligibility to virtual recreation of the original performance as it is heard by the studio audience. Just what the individual customer spends is determined by his tastes and his pocketbook, and the skill and imagination of the salesman. Excluding cabinet cost, it may be anywhere from $10 to $1,000. Within this broad price range, each set manufacturer can find a market for the type of equipment to which his facilities are best suited.

Television presents a totally different set of conditions. The human eye sets a fairly uniform, minimum standard of optical quality. Below it, the eye tires quickly, and fails to perceive sufficient details, or information. The maximum degree of optical quality is fixed, under Government regulations, by the RF bandwidth assigned to the transmitter. This has been set at a point which is considered acceptable to the human eye, and is based to some extent on years of experience with the optical quality of motion pictures.

Now, there is only a very narrow range between the minimum acceptable quality of TV reception and the maximum of which transmitters are capable. As a result, there is very little lattitude in the design of TV receiver circuits. The eye will not accept any appreciable deterioration of optical quality, nor can it see any justification for expensive design and construction. Aside from cabinetwork, and most TV sets are table models now, the cheapest set must give about the same performance as the most expensive model with the same size of picture tube. As for the highest-priced sets, it is impossible to obtain great improvement over the most inexpensive models of accepted performance because of limitations imposed by the transmission. This is apart, of course, from the integrity of the design, the quality of the product, and the extent of the service with which the manufacturer backs up his guarantee. However, while these are factors of the retail price, they cannot be demonstrated by dealers as point-of-sale features.

Such a narrow performance range limits the price range, and a narrow price range limits competition to a matter of production cost and sales expense. This strengthens the position of the large producer, and weakens the position of the smaller concern. It's becoming increasingly clear that it is easier to get into manufacturing TV sets than to make a profit on them, and it's beginning to look as if there's room for more audio than video set manufacturers.

NATIONWIDE TV SERVICE

NEW FCC PLAN, COMBINING VHF AND UHF, IS INTENDED TO PROVIDE TELEVISION PROGRAM SERVICE TO 70,000,000 PEOPLE IN 1,421 AREAS—*By* MILTON B. SLEEPER

AFTER the most intensive and exhaustive study ever made by the FCC and co-operating consultants, the Commission has released its proposal for televison rules and frequency allocations.

From any angle of approach, it is easy to find many faults in the plan. If, however, the plan is examined in the light of its intended purpose, *viz.*, to give the best service possible to the greatest number of people, there is little to criticize except that, from a commercial point of view, the allocations are unrealistic.

Basic Allocations Plan:

The new TV plan retains the present 12 VHF channels, numbered 2 through 13, and adds forty-two 6-mc. UHF channels, to be numbered 14 through 55. Channel 14 will start at about 470 or 500 mc., depending upon the action taken with respect to a request by Bell Telephone Laboratories for space to operate a broad-band mobile communications system just below 500 mc. Of the 42 UHF television channels 32 will be for metropolitan stations and 10 for community stations. It is proposed that the same transmission standards will be used for these UHF stations as for the present VHF stations.

The balance of the UHF band, allocated to experimental TV, will be kept available for further research.

Color Television Transmission:

In its notice of the new TV proposal, the Commission announced that it will consider changes in transmission standards for channels 2 through 55 looking toward color transmission or other television systems only if it is shown that operation is possible within a 6-mc. channel, and that existing TV sets designed for present standards will be enabled, by "relatively minor modifications," to receive programs transmitted in accordance with any newly-proposed system.

This limitation seems to rule out any possibility of color transmission on channels 2 to 55. Certainly any reduction of detail below present standards would not be acceptable to viewers, and it is difficult to see how the present amount of information transmitted within a 6-mc. band could be trebled, as would be necessary to transmit three colors.

Wilmotte-deMars Polycasting:

The FCC will consider evidence with respect to the Polycasting system proposed by Raymond M. Wilmotte and Paul A. deMars in a petition filed with the Commission on November 30, 1948. The complete text of their proposal was published in *FM-TV* for December 1948.

Changes in VHF Allocations:

Only three changes in VHF allocations are contemplated. In Syracuse, N. Y., the present channel 5 assignment to WSYR-TV would be shifted to channel 3.

Channels 2, 6, and 11, now allocated to Rochester, N. Y., would be changed to 5, 22, 32, and 44. This would shift WHTM from channel 6 to 5.

Channels 2, 4, 5, 7, and 9, now allocated to Cleveland, would be changed to 8, 11, 40, and 42. This would shift WXEL from channel 9 to 11.

Under these modified assignments, Rochester, which was an all-VHF area, would become a V-UHF area, with only one VHF station. There would be a similar shift in the status of Cleveland, with VHF and UHF stations equally divided.

VHF Interference:

The Commission's proposal makes no reference to interference between stations now on the air. Presumably, it is expected that this will be corrected by synchronized operation and the offset-frequency method now being tested. Such reports as have been made public indicate that these may prove to be satisfactory solutions.

Number of Stations & Areas:

A summary of the new allocations plan shows the following totals for VHF, V-UHF, and UHF areas:

	Areas	Population	Stations
VHF	91	31,554,000	269
V-UHF	116	21,228.000	232-221
UHF	1,213	16,900,000	1,431

Thus, provisions are made for a total of 488 VHF and 1,652 UHF transmitters.

It is very deceiving to draw any conclusions from these total figures as to potential audiences and markets for transmitters and receivers. The reason is that, in drawing up the allocations, no consistent effort was made to relate the number of allocations to the population of each area.

For example, VHF-only allocations were made in areas of as few as 1,000 population. Some 60 were made to areas of less than 50,000. V-UHF allocations were made to areas as small as 4,000 population, and allocations were made to 880 areas with populations of 100 to 10,000. We cannot expect, therefore, that all the allocations will be taken up. Rather, it appears that allocations were made wherever possible, whether or not a particular area had sufficient population to support program service.

Reasoning backward, it appears that those areas, which could have stations but can't support them will only get service if and when the range of transmitters in adjacent areas is increased beyond the estimates used for the allocations plan.

UHF for Large Cities:

Some apparent inequalities may be corrected in the forthcoming hearing. To pick just one instance, Boston, with a population of 771,000, is scheduled for 4 VHF channels, but none on UHF. Miles City, Mont., population 7,000, could have 3 VHF and 3 UHF channels. While Boston may be properly limited to 4 channels in the VHF band, it seems logical that it should have some UHF assignments, also. A similar discrepancy appears to exist in Chicago and New York City. In other words, failure to relate allocations to population has resulted in allowing for an excessive number of stations in low-population areas, and a potential insufficiency in high-population areas.

Perhaps it would be better not to confuse the public in those VHF-only sections now. If on the other hand, UHF television develops rapidly and successfully, it may be found advisable to move all TV broadcasting to UHF. Then, if UHF channels up to No. 55 are not available to the VHF stations, it will be necessary to give them still higher frequencies. That would be all right except that, quite probably, the new UHF sets won't be made to tune much above channel 55.

FCC's Television Hearing:

A hearing before the Commission en banc will commence at 10:00 A. M., on Sept. 26, to hear testimony and to receive evidence regarding the allocations proposal or other proposals as have been filed by interested persons. Prevailing opinion is that the hearing may extend over two to three months.

Following the closing of the record, the Commission will adopt the final rules, regulations, and standards. At this time, it seems probable that the green light for televison will be flashed about the first of February, 1950.

Analysis of the FCC Plan:

In the following pages, the FCC's proposal, with appropriate explanations and comments, is presented in six parts:

1. List of cities showing proposed frequency assignments and population. States are grouped according to standard geographical sections. Under each state, all VHF areas are listed first, then V-UHF areas, and UHF areas last. VHF channels already in use, or for which C.P's. have been issued, are enclosed by parentheses.
2. List of channels by numbers, showing proposed areas for each channel.
3. List of cities with population of 200,000 or more, and cities of 100,000 to 200,000 population, divided as to VHF-only, V-UHF, and UHF-only allocations. The complete table prepared for this section appears on front cover.
4. List of principles, in terms of priorities, on which the allocations table was planned.
5. Specifications of power, grades of service, and antennas.
6. Specifications of separation between stations, and service radii.

1: TV AREAS

PROPOSED ASSIGNMENTS OF TELEVISION CHANNELS

To help clarify the real significance of the FCC's plan for assigning television channels 2 to 55, the following allocations table has been arranged in state groups according to the standard plan for showing national distribution.

It must be emphasized that, in analyzing allocations in terms of potential audiences and markets for equipment, total figures taken from this table have little significance. Many of the allocations are most unrealistic, as is the case of 2 VHF and 3 UHF allocations to Havre, Mont., with a population of 6,000; or 4 VHF and 2 UHF channels for Butte, Mont., of 37,000; and 2 VHF and 4 UHF channels to Ely Nev., of 4,000. Moreover, 880 of the areas to which allocations are proposed have less than 10,000 population. Thus, to obtain a clear picture of any market area, it is necessary to transfer the data from the table to a map of the area in question.

In this table, VHF frequencies now in use, or for which C.P.'s have been issued, appear within parentheses. Figures at right are for population in thousands.

NEW ENGLAND

MAINE 1 VHF 4 V-UHF 6 UHF

Portland	6 13	106
Augusta	8 10 19 21 23	19
Bangor-Old Town	5 12 36 42	37
Calais	2 7 14 16 18	5
Ft. Kent-St. Francis	8 15 17 19 21	6
Biddeford-Saco	14 16	28
Brunswick	44	7
Houlton	25 27 29	7
Lewiston-Auburn	28 30	58
Presque Isle	31 33 35	17
Waterville	32 34	16

NEW HAMPSHIRE 1 V-UHF 5 UHF

Manchester	9 29	81
Berlin	26	19
Concord	31 33	27
Laconia	35	13
Littleton-Bethlehem	40	5
Portsmouth	39 41	14

VERMONT 1 V-UHF 5 UHF

Montpelier	3 20 22	8
Brattleboro	18	10
Burlington	15 17	28
Newport	38	5
Rutland	37	17
St. Albans	24	8

MASSACHUSETTS 1 VHF 7 UHF

Boston	(2 4) 5 (7)	771
Barnstable-W. Yarmouth	37	8
Brockton	48	62
Fall River-New Bedford	19 21 23	225
Lawrence-Lowell-Haverhill	25 27	232
Pittsfield	28	50
Springfield-Holyoke	36 38	150
Worcester	43 45	194

RHODE ISLAND 1 V-UHF

Providence	(11) 15 17	712

CONNECTICUT 1 V-UHF 3 UHF

New Haven	(6) 20 22	308
Bridgeport	14 16	217
Hartford-N. Britain	30 32 34	502
Waterbury	24 26	145

MIDDLE ATLANTIC

NEW YORK 2 VHF 5 V-UHF 19 UHF

New York City-NE New Jersey	(2 4 5 7 9 11)	11,691
Syracuse	(3 8 10)	258
Albany-Schenectady-Troy	(4) 42 44	432
Binghamton	(12) 23 25	145
Buffalo-Niagara	2 (4) 7 27	857
Rochester	(5) 22 32 44	412
Utica-Rome	(13) 33	197
Auburn	18	36
Batavia	36	17
Dunkirk	31	18
Elmira-Corning	14 16	61
Hornell	39	17
Ithaca	37	20
Jamestown	17	43
Malone	30	9
Massena	21	11
Middletown	35	22
Ogdensburg	34	16
Olean	19	22
Oneonta	27	12
Oswego	20	22
Plattsburg	32	16
Poughkeepsie	40	40
Saranac Lake	39	7
Tupper Lake	19	5
Watertown	41 43	33

NEW JERSEY 1 VHF 5 UHF

Newark	(13)	413
Asbury Park	46	15
Atlantic City	23 25 27	100
New Brunswick	48	38
Trenton	15 17 41	125
Vineland	39	8

PENNSYLVANIA 5 V-UHF 16 UHF

Erie	(12) 45	134
Johnstown	6 (13) 21	152
Lancaster	(4) 26 28	132
Philadelphia	(3 6 10) 44	2,899
Pittsburgh	(3) 9 24 26	1,994
Altoona	15	114
Du Bois	43	12
Easton-Allentown-Bethelhem	19 21	325
Emporium	33	4
Greensburg	48	17
Harrisburg	22 42	173
Hazelton	38	38
Lebanon	24	27
Lewistown	40	13
Meadville	47	19
New Castle	30	48
Reading	34 36	175
Scranton-Wilkes Barre	31 45	630
Uniontown	46	22
Williamsport	29	44
York	18 20	93

SOUTH ATLANTIC

DELAWARE 1 V-UHF 1 UHF

Wilmington	(7) 30 32	189
Dover	47 c	6

MARYLAND 1 V-UHF 5 UHF

Baltimore	(2 11 13) 14 16	1,047
Annapolis	49 c	13
Cumberland	39 44	39
Frederick	37	16
Hagerstown	35	33
Salisbury	43	13

DISTRICT OF COLUMBIA 1 V-UHF

Washington	(4 5 7 9) 33	908

VIRGINIA 3 V-UHF 16 UHF

Norfolk-P'tsmouth-Newport News	4 10 12 25 29	191
Richmond	3 (6) 8 15 17 19	193
Roanoke	7 10 20 22	69
Charlottesville	32	19
Covington	29	6
Danville	37	33
Emporia	27	3
Fredericksburg	41 45	10
Harrisonburg	36	8
Lexington	42	4
Lynchburg	14 16	51
Martinsville	31	10
Norton	32	4
Petersburg	21	31
Pulaski	39	9
Staunton	34	13
Suffolk	23	11
Waynesboro	38	7
Winchester	25	12

WEST VIRGINIA 1 VHF 3 V-UHF 10 UHF

Beckley	4	13
Charleston	8 12 30 40	68
Huntington-Ashland	(5) 25	79
Wheeling	7 28 41	61
Bluefield	15	21
Clarksburg	17	31
Elkins	23	8
Fairmont	31	23
Hinton	24	6
Martinsburg	27	15
Montgomery	34	3
Parkersburg	43 45	30
Sutton	33	1
Weston	19	8

NORTH CAROLINA 1 VHF 3 V-UHF 25 UHF

Charlotte	(3) 9 11	101
Greensboro	(2) 41 43 45	59
Wilmington	5 14 16	33
Winston-Salem	6 13 17	80
Ahoski	39	2
Asheville	14 18	51
Belhaven	20	2
Durham	33 35	60
Elizabeth City	31	12
Fayetteville	38 40	17
Gastonia	42	21
Goldsboro	26	17
Greenville	36	13
Henderson	18	8
Hendersonville	20	8
Hickory	34	13
High Point	23 25	38
Jacksonville	22	1
Kannapolis	19	25
Kinston	42	15
Lenoir	36	8
Morehead City	45	4
New Bern	32	12
Raleigh	28 30	47
Rocky Mount	24	26
Salisbury	21	19
Shelby	44	14
Wilson	44	19
Washington	34	9

SOUTH CAROLINA 2 V-UHF 14 UHF

Charleston	2 8 13 28 30	71
Columbia	4 7 10 39	62
Anderson	33	19
Barnwell	25	2
Bennettsville	15	5
Florence	27	16
Georgetown	18	6
Greenville	38 40	35
Greenwood	31	13
Myrtle Beach	37	2
Orangeburg	45	11
Rockhill	29	15
Seneca	35	2
Spartanburg	22 24	32
Sumter	32	16
Walterboro	34	3

GEORGIA 3 VHF 2 V-UHF 27 UHF

Cairo	6	5
Cordele	13	8
Savannah	3 9 11	96
Atlanta	(2 5 8) 11 32 34	302
Augusta	6 12 17	66
Albany	42	19
Americus	20	9
Athens	21 23	21
Bainbridge	9	6
Brunswick	37 39	15
Cartersville	39	6
Cedartown	19	9
Columbus	36 38 40	53
Dalton	25	10
Dawson	25	4
Douglas	30	5
Dublin	43	8
Fitzgerald	27	7
Gainsville	15	10
Griffin	29	13
Jessup	35	3
La Grange	22 24	22
Macon	14 16 18	58
Milledgeville	26	7
Moultrie	15	10
Rome	42	26
Statesboro	19	5
Thomasville	32 34	13
Thomson	41	3
Toccoa	27	5
Valdosta	17	16
Waycross	21 23	17

FLORIDA 3 VHF 1 V-UHF 35 UHF

Jacksonville	2 (4) 5 8 10	173
Miami	2 (4) 5 8 10 12	172
St. Petersburg-Tampa	3 6 (7) 9 11 13	210
Tallahassee	12 28	16
Apalachicola	44	3
Belle-Glade-Chosen	26	4
Clear Water	43	10
Crestview	18	2
Cross City	24	2
Daytona Beach	32 34 36	23
Deland	19	7
Everglades	40	0.6
Fort Lauderdale	30 32	18
Fort Myers	35 37	11
Fort Pierce	39	8
Gainesville	14 16	14
Hollywood	34	6
Key West	19 21	13
Lake City	26	6
Lakeland	33	22
Lakeworth	28	7
Leesburg	27	5
Mariana	37	5
Melbourne	15	3
Ocala	38	9
Orlando	21 23 25	37

Platka	40	7
Palm Beach	24	4
Panama City	14 16	12
Pensacola	20 22 24	37
Perry	22	3
Plant City	31	7
Quincy	19	5
Sebring	17	3
St. Augustine	42 44	12
Sanford	29	10
Sulphur Spgs.	45	5
W. Palm Beach	14 16 18 22	34
Winter Haven	41	6

EAST NORTH CENTRAL

OHIO 1 VHF 5 V-UHF 14 UHF

Columbus	(3 6 10)	365
Cincinnati	(4 7 11) 22 24	789
Cleveland	(4 5) 8 (11) 40 42	1,214
Dayton	(5 13) 14 16	271
Hamilton-Middletown	2 34	112
Toledo	(13) 39 43	341
Akron	25 36 38	349
Canton	32 34	200
Chillicothe	37	20
Gallipolis	27	7
Lima	28 30	44
Mansfield	21 23	37
Marion	33 35	30
Newark	29	31
Portsmouth	18 20	40
Sandusky-Fremont	17	25
Springfield	26 44	77
Steubenville	22	37
Youngstown	14 16 18	372
Zanesville	15	37

INDIANA 2 VHF 1 V-UHF 16 UHF

Bloomington	(10)	21
Tell City	3	5
Indianapolis	(6 8) 12 45	387
Anderson	27	42
Bedford	33	13
Columbus	43	12
Evansville	16 18 20	97
Fort Wayne	25 38	118
Gary	48 c	112
Kokomo	23	34
LaFayette	37	29
Logansport	21	20
Marion	18	27
Muncie	32	50
Richmond	41	35
Seymour	17	9
South Bend	40 42	101
Terre Haute	28 39	63
Vincennes	14	18

ILLINOIS 2 VHF 3 V-UHF 28 UHF

Carthage	10	3
Chicago	2 (4 5 7 9) 11 13	3,397
Moline-Rock Island-Dav.	(4 5) 42	175
Peoria	(6) 12 31	105
Springfield	3 17	76
Aurora	41 43	47
Bloomington	26	33
Cairo	15	14
Centralia	24	16
Champaign	15	23
Clinton	38	6
Danville	19	37
Decatur	34 36	59
Elgin	20	38
Gailsburg	21	29
Harrisburg	32	11
Herrin	37	9
Jacksonville	23	20
Joliet	24	42
Kankakee	30	22
Kewanee	16	17
La Salle	33	13
Lincoln	44	13
Litchfield	29	7
Metropolis	22	6
Mt. Carmel	35	7
Mt. Vernon	27	15
Quincy	18 30	40
Rockford	27 29	85
Sterling	35	11
Urbana	22	14
Vandalia	40	5
Waukegan	46 c	34

MICHIGAN 2 VHF 7 V-UHF 28 UHF

Cheboygan-Mackinaw	4	6
Gladstone	13	5
Detroit	(2 4 7) 24 27	2,296
Grand Rapids	(7) 12 33 35	210
Iron Mountain	7 9 32 34	11
Kalamazoo	(3) 15	77
Lansing	(6) 45	110
Marquette	3 5 11 18	16
Sault Ste. Marie	8 10 14 16	16
Alpena	39	13
Ann Arbor	37	30
Battle Creek	29	43
Benton Harbor	44	17
Cadillac	23	10
Escanaba	25	15
Flint	14 16 34	189
Hancock	16	6
Harbor Beach	38	2
Holland	26	15
Houghton	27	4
Iron River	14	4
Ironwood	30	13
Ishpeming	20	9
Jackson	20 22	50
Ludington	30	9
Manastique	15	5
Manistee	27	9
Midland	28	10
Muskegan	17 19	48
Petoskey	29 31	6
Pontiac	48 c	67
Port Huron	46 c	33
Rogers City	42	3
Saginaw-Bay City	18 21 32	153
Tawas City	25	1
Traverse City	41 43	14
West Branch	36	2

WISCONSIN 2 VHF 27 UHF

Milwaukee	(3) 6 8 10	587
Superior-Duluth	3 6 8 10 12	136
Antigo	22	9
Appleton	28	28
Ashland	42	11
Beloit	18	25
Eau Clair	27 29	31
Fond du Lac	21	27
Green Bay	40 42	46
Hayward	36	6
Janesville	39	23
Kenosha-Racine	32 34 36	116
Ladysmith	45	4
La Crosse	41 43	43
Madison	14 23 25	67
Marshfield	35	10
Medford	15	2
Merrill	19	9
Oshkosh	16 31	39
Prairie du Chien	30	4
Rice Lake	23	6
Rhinelander	39	9
Shawano	44	6
Sheboygan	38	41
Sparta	17	6
Stevens Point	24 26	16
Whitehall	20	1
Warsaw	37	27
Wisc. Rapids	33	11

EAST SOUTH CENTRAL

KENTUCKY 1 VHF 1 V-UHF 19 UHF

Paducah	12	34
Louisville	(5 9) 29 31	434
Ashland (see West Virginia)		
Bowling Green	34	15
Corbin	45	8
Danville	38	7
Frankfort	15	11
Glasgow	40	6
Hazard	23	7
Henderson	41	13
Hopkinsville	36	12
Lexington	19	49
Madisonville	25	8
Mayfield	17	9
Maysville	39	7
Middlesborough	41	12
Murray	39	4
Owensboro	44	30
Richmond	21	7
Somerset	35	6
Vancleve	28	.75
Winchester	42	9

TENNESSEE 5 VHF 22 UHF

Chattanooga	3 9 12	193
Knoxville	6 10 13	152
Lexington	5	3
Memphis	(4) 6 8 10 13	332
Nashville	2 (4) 7 11	242
Bristol	26	14
Clarksville	42	12
Cleveland	30	11
Columbia	21	11
Cookeville	37	4
Dyersburg	30	10
Fayetteville	16	5
Harriman	17	6
Humboldt	35	5
Jackson	24	24
Johnson City	16	25
Lebanon	27	6
Lewisburg	29	4
Morristown	43	8
Murfreesboro	14	9
Paris	19	6
Pulaski	38	5
Shelbyville	31	7
Springfield	23	7
Tullahoma	33	5
Union City	28	7
Winchester	18	3

ALABAMA 4 VHF 20 UHF

Birmingham	(4) 6 (13)	408
Eufaula	3	6
Mobile	5 8 11 13	115
Montgomery	7 10	94
Alexander City	17	7
Andalusia	26	7
Auburn	33	5
Brewton	15	3
Clanton	27	4
Decatur	41	17
Demopolis	14	4
Dothan	45	17
Enterprise	39	4
Florence	43	15
Gadsden	44	37
Greenville	43	5
Huntsville	26	13
Jasper	20	7
Opelika	31	8
Selma	30	20
Sheffield	45	8
Talladego	35	9
Tuscaloosa	23	27
Troy	21	7

MISSISSIPPI 2 VHF 25 UHF

Jackson	3 9 12	88
Macon	2	2
Aberdeen	15	5
Biloxi	31 33	17
Brookshaven	18	6
Canton	24	6
Clarksdale	29 31	12
Columbia	29	6
Columbus	25	14
Greenville	43 45	21
Greenwood	21	15
Grenada	17	6
Gulfport	21 23	15
Hattiesburg	40 42	21
Laurel	16	21
Kosciusko	19	4
McComb	20 22	10
Meridian	36 38	35
Natchez	25 27	15
Pascagoula	28	6
Philadelphia	34	4
Picayune	44	5
Starkville	28	5
Tupelo	22	8
Vicksburg	35 37	24
West Point	32	6
Yazoo City	41	7

WEST NORTH CENTRAL

MINNESOTA 1 VHF 34 UHF

Minneapolis-St. Paul	2 (4 5) 7 (9) 11 13	911
Albert Lea	24	12
Alexandria	29	5
Austin	16	18
Bemidji	22	9
Brainerd	43	12
Chisholm	44	7
Crookston	20	7
Detroit Lakes	27	5
Duluth-Superior (see Wisconsin)		
Ely	18	7
Eveleth	37	7
Fairmont	26	7
Faribault	21	15
Fergus Falls	38	11
Grand Rapids	26	5
Hastings	40	6
Hibbing	39 41	16
Intern'l Falls	14 16	6
Little Falls	25	6
Mankato	44	16
Marshall	20	5
Montevideo	36	5
Moorhead (see Fargo)		
New Ulm	28	9
Northfield	14	5
Owatonna	42	9
Pine City	31	2
Red Wind	18	10
Rochester	32 34	26
St. Cloud	17 19	24
Thief River Falls	24	6
Virginia	21	12
Wadena	32	3
Willmar	15	8
Winona	38	22
Worthington	23	6

IOWA 8 VHF 1 V-UHF 29 UHF

Ames	(4)	13
Algona	10	5
Cedar Rapids	7 9	62
Charles City	12	2
Decorah	3	5
Des Moines	8 11 13	184
Iowa City	2	17
Sioux City	2 5 9	82
Davenport, Rock Island, Moline	(4 5) 42	175
Albia	34	5
Atlantic	32	6
Boone	25	12
Burlington	28	26
Carroll	40	5
Centerville	26	8
Chariton	41	6
Cherokee	38	7
Clarinda	23	5
Clinton	37	26
Creston	21	8
Dubuque	45	44
Fairfield	24	7
Fort Dodge	17	23
Fort Madison	14	14
Glenwood	28	5
Iowa Falls	33	4
Keokuk	32	15
Knoxville	43	7
Marshalltown	15	19
Mason City	39	27
Muscatine	40	18
Newton	29	10
Ottumwa	20 38	32
Red Oak	42	6
Shenandoah	16	7
Storm Lake	35	5
Waterloo-Cedar Falls	22 26	67
Webster City	19	7

MISSOURI 4 VHF 1 V-UHF 28 UHF

De Soto	2	5
Kansas City	2 (4) 5 9	399
St. Louis	4 (5) 7 9 11 13	816
Springfield	3 10 12	61
Jefferson City	6 43	24
Cape Girardeau	45	19
Carrollton	40	4
Corthage	25	11
Chillicotte	44	8
Clinton	20	6
Columbia	15	18
Flat River	31	5
Fulton	33	8
Hannibal	25	21
Hermitage	23	0.3
Joplin	19 22	37
Lebanon	27	5
Lexington	31	5
Louisiana	39	5
Marshall	17	9
Maryville	30	6
Mexico	22	9
Moberly	36	13
Nevada	34	8
Poplar Bluff	21	11
Rolla	35	5
St. Joseph	35 37	76
Salem	14	3
Sedalia	29	20
Sikeston	26	8
Van Buren	38	0.5
Washington	19	7
West Plains	41	4

NORTH DAKOTA 1 VHF 5 V-UHF 25 UHF

Dickinson	2 4 9	6
Bismarck	5 7 12 20 22	15
Fargo	6 10 13 14 16 18	33
Grand Forks	2 4 8 33 35 39	20
Minot	3 6 10 16 18	17
Williston	8 11 23 25 27	6
Ashley	36	1
Botteneau	32	2
Bowman	43 45	1
Carrington	17	1
Cooperstown	28	1
Crosby	36 38	1
Devils Lake	19	6
Ft. Yates	29	1
Grafton	26 30	4
Harvey	44	2
Hettinger	32 34	1
Jamestown	25	9
Kenmore	30	2
Langdon	41 43	2
Larimore	45	1
Mandan	33 35 37	7
Napoleon	27	1
New Rockford	15	2
Oakes	40 42	2
Rolla	23	1
Rugby	21	2
Stanley	42	1
Stanton	14	4
Valley City	31	6
Wahpeton	34	4

SOUTH DAKOTA 3 VHF 2 V-UHF 26 UHF

Mitchell	4 8	11
Pierre	6 10	1
Rapid City	7 12	14
Aberdeen	3 9 26 30	17
Sioux Falls	11 13 14 16 18	41
Belle Fourche	20	3
Brookings	41 43 45	5
Buffalo	30	0.5
Chamberlin	23	2
Custer	16	2
Deadwood	35	4
Dupree	17	0.5
Edgemont	39 41	2
Gettysburg	19	1
Hot Springs	33	3
Huron	32 35	11
Lake Andes	27	0.8
Lead	27	8
McIntosh	24	0.6
Madison	37 39	5
Martin	31	1
Miller	15	1
Mobridge	39 41	3
Phillip	14	0.8
Pine Ridge	43 45	2
Sisseton	44	2
Vermillion	31 33	3
Watertown	22 24	11
White River	21	0.6
Winner	42 44	2
Yankton	25 29	7

NEBRASKA 4 VHF 1 V-UHF 31 UHF

Lincoln	10 12	82
McCook	8 13	6
North Platte	2 5	12
Omaha	(3 6) 7	224
Hastings	4 39 41	15

Ainsworth	38	2
Alliance	15 37	6
Atkinson	34	1
Bayard	42	2
Beatrice	45	11
Bridgeport	40	2
Broken Bow	16	3
Columbus	26	8
Crawford	22	2
Fairbury	43	6
Falls City	33	6
Fremont	36	12
Gothenburg	14	1
Grand Island	35 37	19
Holdrige	25	3
Kearney	21 23	10
Lexington	18	4
Nebraska City	14	7
Neligh	17	2
Norfolk	15	10
Ogallala	24	3
O'Neill	20	3
Ord	30	2
Scottsbluff	18 20	12
Seward	24	3
Sidney	32	3
Stanton	22	2
Superior	29	3
Valentine	28	2
West Point	44	3
York	19	5

KANSAS 4 VHF 1 V-UHF 40 UHF

Garden City	9 11	6
Junction City	8	9
Topeka	11 13	68
Wichita	3 10 12	115
Great Bend	5 14	9
Anthony	39	3
Arkansas City	37	13
Atchison	18	13
Baster Spgs.	38	5
Belleville	27	3
Clay Center	38	5
Coffeyville	44	17
Colby	26	2
Concordia	34	6
Dodge City	24 43	8
El Dorado	16	10
Emporia	21	13
Ft. Scott	32	11
Goodland	28	3
Hays	22	6
Hutchinson	20	30
Iola	41	12
Kansas City (see Kansas, Mo.)		
Kinsley	41 45	2
Larned	30	4
Lawrence	39	14
Liberal	38	4
Lindsborg	42	2
McPherson	28	1
Manhatten	15	12
Newton	31	11
Norton	36	3
Oberlin	33	2
Osawatomie	24	5
Osborne	17	2
Ottawa	26	10
Phillipsburg	44	2
Pittsburg	30	18
Pratt	18	2
Russell	32	5
Salina	40	21
Scott City	31	2
Sharon Spgs.	21	1
Syracuse	29	1
Wellington	33	7
Winfield	35	10

WEST SOUTH CENTRAL

ARKANSAS 1 VHF 30 UHF

Little Rock	2 5 7 11	127
Arkadelphia	15	5
Batesville	20	5
Blytheville	44	11
Camden	42	9
Conway	24	6
Crossett	26	5
El Dorado	34	16
Fayetteville	31	8
Forrest City	16	6
Fort Smith	16 18	37
Harrison	26	4
Helena	14	9
Hope	22	7
Hot Springs	44	21
Jonesboro	23 25	12
Magnolia	20	4
Malvern	28	5
Morrilton	17	5
Newport	37	4
Paragould	18	7
Paris	39	3
Pine Bluff	38 40	21
Pocahontas	34	3
Rogers	33	4
Russelville	21	6
Siloam Springs	42	3
Springdale	45	3
Stuttgart	33	6
Texarkana	25 27	12
West Helena	27	5

LOUISIANA 3 VHF 23 UHF

Alexandria	5 11 13	27
New Orleans	2 (4 6 7) 10	540
Shreveport	3 10 13	112
Abbeville	28	7
Bastrop	23	7
Baton Rouge	43 45	35
Bogalusa	26	15
Crowley	17	10
DeRidder	29	4
Eunice	38	5
Hammond	14	6
Houma	24	9
Jennings	31	9
Lafayette	41	19
Lake Charles	23	21
Minden	14	7
Monroe	32 39	28
Natchitoches	24	7
New Iberia	34	14
Oakdale	19	4
Opelousas	15	9
Pineville	21	4
Ruston	16	7
Tallulah	30	6
Thibodoux	32	6
Winnfield	36	5

OKLAHOMA 2 VHF 3 V-UHF 29 UHF

Oklahoma City	(4) 7 9	221
Tulsa	2 (6) 11	189
Enid	13 15	28
Muskogee	8 23	32
Ada	20	15
Altus	16	9
Alva	23	5
Ardmore	32	17
Bartlesville	14	16
Beaver	36	1
Boise City	30	1
Chickasha	45	14
Clinton	31	7
Duncan	35	9
Durant	40	10
Elk City	14	5
El Reno	22	10
Frederick	27	5
Guthrie	24	10
Guymon	20	2
Hobart	25	2
Hugo	29	6
Lawton	18	18
Miami	36	8
McAlester	34	12
Norman	41	11
Okeene	29	4
Okmulgee	28	16
Ponca City	27	17
Seminole	43	12
Shattuck Jnc.	40	1
Shawnee	30	22
Stillwater	17	10
Woodward	45	5

TEXAS 12 VHF 8 V-UHF 118 UHF

Alpine	12	4
Amarillo	2 4 5 7 10	53
Brownsville	4 5 9	22
Dallas	(4 8) 12	377
Ft. Worth	2 (5) 10	208
Houston	(2) 8 11 13	510
Jasper	9	3
Laredo	3 8	39
Palestine	7	12
San Angelo	2 6	26
San Antonio	(4 5) 7 9 12	319
Wichita Falls	3 6	45
Abilene	9 24	27
Beaumont-Port Arthur	4 6 26 33 39	139
Corpus Christi	6 10 31 33	71
El Paso	2 4 5 7 9 41 44	116
Lubbock	11 13 33 35	32
Monahans	4 19	4
Odessa	7 21	10
Sweetwater	12 14 32	10
Alice	19	8
Athens	41	5
Austin	26 28 30	106
Ballinger	36	4
Bay City	16 40	7
Beeville	25	7
Big Spring	25	13
Borger	15	10
Brackittville	29	3
Brady	19	5
Breckenridge	17	6
Brenham	19	6
Brownfield	37	4
Brownwood	21	13
Bryan	14	12
Cameron	32	5
Canadian	28	2
Canyon	32	3
Center	40	3
Childress	19	6
Clarendon	26	2
Cleburne	44	11
Coleman	43	6
Colorado City	18	5
Cotulla	32	4
Crockett	22	5
Crystal City	24	7
Cuero	20	5
Dalhart	22	5
Del Rio	18	13
Denton	36	11
Dumas	45	2
Eagle Lake	29	2
Eagle Pass	16	6
Edinburg	21	9
El Campo	38	4
Eldorado	33	2
Falfurrias	23	6
Ft. Davis	14	1
Ft. Stockton	31	3
Fredericksburg	22	4
Galveston	21 24	72
Graham	15	5
Greenville	24	14
Gonzales	15	5
Hamilton	39	3
Hamlin	28	2
Harlingen	14	13
Haskell	30	3
Henrietta	23	2
Hereford	42	3
Hillsboro	25	8
Huntsville	17	5
Jacksonville	15	7
Junction	27	2
Kermit	38	3
Kerrville	17 31	6
Kilgore	43	7
Kingsville	17	8
La Grange	43	3
Lamesa	41	6
Lampassas	35	3
Liberty	44	3
Livingston	42	2
Littlefield	39	4
Longview	30	14
Lufkin	35	10
Marfa	20 25	4
Marshall	37	18
Mexia	34	6
McAllen	26	12
Midland	29	9
Mineola	21	3
Mineral Wells	42	6
Mount Pleasant	33	5
Nacogdoches	28	8
Orange	18	7
Ozona	45	2
Paris	19	13
Pampa	17	19
Pearsall	34	3
Pecos	27	5
Perryton	34	2
Plainview	23	8
Presido	16	1
Rankin	42	0.5
Rio Grande	29	3
Robstown	27	7
Rock Springs	20	1
Rosenberg	36	3
Sabinal	44	2
Sanderson	23	25
San Benito	34	10
San Diego	37	3
San Marcos	45	6
Shamrock	21	3
Sequin	41	7
Sherman	14	17
Seymour	34	3
Sierra Blanca	32	1
Snyder	22	4
Sonora	15	3
Spur	44	2
Stanford	20 40	5
Stephenville	29	5
Sterling City	16	1
Sulphur Spring	26	7
Taylor	23	8
Temple	37	15
Terrell	38	19
Texarkana (see Arkansas)		
Tyler	45	28
Uvalde	14	7
Van Horn	18	1
Vernon	38	9
Victoria	18	12
Waco	16 18	71
Wacahachie	31	9
Weslaco	42	7

MOUNTAIN

MONTANA 1 VHF 6 V-UHF 45 UHF

Helena	10 12	15
Billings	2 4 5 7 19 21	23
Butte	2 4 5 7 33 40	37
Great Falls	3 6 8 26 28	30
Havre	9 11 19 21 23	6
Miles City	3 6 10 14 16 24	7
Missoula	11 13 17 19	18
Anaconda	35 37	11
Baker	19	1
Big Timber	24	2
Bozeman	14 16	9
Broadus	29	0.6
Chester	30	0.5
Chinook	25	2
Chouteau	18	1
Circle	28	0.7
Cut Bank	43 45	3
Dillion	27	3
Ekalaka	26	0.7
Forsyth	32 39	2
Fort Benton	36 38	2
Glasgow	18 20 22	4
Glendive	21	5
Hamilton	44	2
Harlowton	44	2
Hardin	41 43	2
Hysham	37	0.4
Jordan	30	0.7
Kalispell	15	8
Lewistown	17	6
Libby	35 37	2
Livingston	32 34	7
Malta	27	2
Paradise	42	0.35
Philipsburg	29	1
Plentywood	29 31 44	2
Polson	27	2
Red Lodge	29	3
Roundup	35	3
Saco	45	0.5
Scobey	41	1
Shelby	14 16	3
Sidney	15 17	3
Stanford	15	1
Thompson Falls	25	0.7
Virginia City	45	0.4
Whitehall	22	1
White Sulphur Springs	20	1
Wibaux	40	0.6
Winifred	41	0.3
Winnett	42	0.4
Wolf Point	33	2

IDAHO 1 VHF 5 V-UHF 32 UHF

Boise	2 4 5 7	26
Coeur D'Alene	9 12 41 43	10
Idaho Falls	3 6 19 21	15
Nampa	9 12 23 25	12
Pocatello	8 10 35	18
Twin Falls	11 13 16	12
Aberdeen	43	1
Arco	28	0.5
Blackfoot	33	4
Bonners Ferry	31 33	1
Buhl	44	2
Burley	24	5
Caldwell	35 37	7
Cascade	18	1
Challis	26	0.6
Council	31	0.7
Diggs	39	1
Dubois	31	0.3
Gooding	22	3
Grangerville	45	2
Kellogg Wardner	16	4
Ketchum	36	1
Lewiston	32 34	11
MacKay	38	0.8
Malad City	45	3
Montpelier	26	3
Moscow	21	6
Mountain Home	39	1
Orafino	36	2
Preston	15 17	4
St. Anthony	41	3
St. Maries	18	2
Salmon	15	2
Sandpoint	20 22	4
Shoshone	14	1
Soda Springs	37	1
Wallace	39	4
Weiser	27 29	4

WYOMING 4 V-UHF 25 UHF

Casper	3 6 8 24	18
Cheyenne	11 13 14 16	28
Riverton	10 18 20	3
Sheridan	9 11 13 15 17	11
Basin	38	1
Buffalo	22	2
Cody	23 25	3
Douglas	36	2
Evanston	36	4
Gillette	30	2
Green River	41	3
Hanna	15	1
Jackson	44	1
Kemmerer	23	2
Lander	16	3
Laramie	19 21	11
Lusk	26	2
Midwest	32 34	1
Newcastle	23	2
Pinedale	14	0.6
Powell	27	2
Rawlins	17	6
Rock Springs	25	10
Sudance	25	0.7
Superior	29	1
Thermopolis	45	2
Torington	44	2
Wheatland	28 30	2
Worland	31 33	3

COLORADO 2 VHF 1 V-UHF 42 UHF

Denver	2 4 5 7 9	384
Pueblo	3 6 8 10	62
Alamosa	12 31	6
Boulder	41 43	13
Burlington	15	1
Canon City	28	7
Cheyenne Wells	39	0.7
Colorado Spgs.	20 24	37
Cortez	18	2
Craig	26	2
Del Norte	33	2
Delta	25	4
Durango	14	6
Ft. Collins	33 35	12
Ft. Morgan	25	5
Glenwood Spgs.	30 36	2
Grand Junction	15 17	12
Greely	29 31	16
Gunnison	19	2

Hugo	36	1
La Junta	16	7
Lamar	19	4
Leadville	32	5
Limon	22	1
Longmont	45	7
Los Animas	14	3
Loveland	27	6
Meeker	42	1
Montrose	27	5
Oak Creek	34	2
Ouray	38	1
Pagosa Spgs.	16	2
Rocky Ford	42	3
Saguache	40	1
Salida	44	5
San Luis	23	1
Silvertown	29	1
Springfield	25	1
Steamboat Spgs.	39	2
Sterling	34	7
Trinidad	18 21	13
Walden	37	0.6
Walsenburg	26	6
Wray	38	2
Yuma	17	2

NEW MEXICO 1 VHF, 6 V-UHF 32 UHF

Albuquerque	2 (4) 5 7	35
Carlsbad	10 22 24	7
Clovis	12 14 16	10
Gallup	3 10 17 19	7
Roswell	3 6 8 34 36	13
Santa Fe	9 11 13 30 32	20
Silver City	12 18	5
Alamogordo	19 21	4
Artesia	26 28	4
Belen	22 24	3
Bernalillo	20	2
Carrizoza	42	1
Chama	43	0.7
Clayton	27	3
Dawson	41	2
Deming	23 25	4
Farmington	21	2
Ft. Sumner	43	2
Hachita	37	0.8
Hobbs	15 17	11
Hot Springs	31 33	3
Laguna	28	0.5
Lordsburg	43 45	3
Los Alamos	34	5
Las Cruces	27 29	8
Las Vegas	17	6
Lovington	30	2
Magdalena	35	1
Park View	36	5
Portales	18 20	0.8
Raton	35 37	8
Roy	44	1
San Rita	20	3
Santa Rosa	25	2
Socorro	14 16	4
Taos	15	1
Tucumcari	29 31	6
Vaughn	45	1
Willard	39	0.5

ARIZONA 5 V-UHF 30 UHF

Flagstaff	9 11 14 16	5
Kingman	6 29 35	2
Phoenix	2 4 (5) 8 12 15 17	121
Tucson	3 6 7 10 14 16	37
Yuma	9 13 30 32 34	5
Ajo	19 21	1
Bisbee	19 21	6
Buckeye	39	1
Casa Grande	24	1
Clarkdale	43 45	3
Clifton	30	3
Coolidge	35 37	2
Douglas	15 17	9
Ft. Huachuca	38	1
Granada	15	1
Grand Canyon	40	0.6
Globe	22	6
Halbrook	27 29	1
Hayden	28 44	2
Jerome	36	2
Mesa	31 33	7
Miami	26	5
Morenci	32	3
McNary	34	2
Nogales	23 25	5
Parker	38	1
Prescott	23 25	6
Safford	36	2
St. Johns	38	1
San Simon	40	0.7
Superior	42	4
Tombstone	29	0.8
Wickenburg	41	1
Williams	30	3
Winslow	18 20	5

UTAH 2 VHF 2 V-UHF 27 UHF

Price	11 13	5
Salt Lake City	2 (4 5) 7 9	204
Cedar City	5 17	5
Ogden	12 34 38 40	44
Beaver	19	2
Brigham	42	6
Castle Dale	14	1
Duchesne	31	1
Ephraim	28	2
Escalante	25	1
Fillmore	37	2
Green River	43	0.5
Heber	16	3
Hurricane	21	2
Hyrum	20	2
Kanab	44	1
Lehi	44	3
Loa	45	0.4
Logan	30 32	12
Milford	32	1
Moab	20	1
Monticello	23	0.7
Nephi	18	3
Panquitch	42	2
Parowan	15	1
Provo	21 24	18
Richfield	22	4
St. George	38	4
Salina	35	2
Tooele	27	5
Vernal	33	2

NEVADA 4 V-UHF 23 UHF

Elko	10 15 17 19	4
Ely	3 6 14 16 20	4
Las Vegas	8 10 12 14 16 41 45	8
Reno	3 13 14 16	21
Austin	29	0.5
Battle Mountain	42	0.8
Boulder City	18 22	3
Caliente	28 30 43	1
Carson City	30	2
Eureka	40	0.6
Fallon	35	2
Gerloch	28	0.1
Goldfield	44	0.6
Henderson	27 32	7
Lovelock	25	1
McDermitt	26	0.2
McGill	23 25	3
Mina	39	0.4
Mountain City	34	0.9
Overton	34 36	1
Palisade	45	0.1
Pioche	24 26	1
Sparks	37	5
Tonopah	18 21	2
Wells	41	0.8
Winnemucca	18 21	2
Yerington	23	1

PACIFIC

WASHINGTON 2 VHF 2 V-UHF 32 UHF

Spokane	2 4 5 7	141
Tacoma	9 13	156
Seattle	4 (5) 7, 11 14 16	453
Walla Walla	6 8 10 38	18
Aberdeen	22	19
Bellingham	21 23	29
Bremerton	39 41	15
Centralia	24	7
Chehalis	28	5
Colville	45	2
Colfax	28	3
Ellensburg	42	6
Ephrata	17	1
Everett	43 45	30
Goldendale	29	2
Grand Coulee	27	4
Kennewick	26	2
Longview	40	12
Metaline Falls	29	0.5
Moses Lake	44	0.3
Mt. Vernon	19	4
Olympia	18	13
Omak	25	3
Oroville	32	1
Pasco	19	4
Port Angeles	32 34	9
Pullman	30	4
Puyallup	20	8
Republic	40	0.9
Ritzville	23	2
Sheldon	30	4
Sunnyside	15	2
Vancouver	38	19
Waterville	35	0.9
Wenatchee	37	12
Yakima	31 33	27

OREGON 1 VHF 3 V-UHF 33 UHF

La Grande	3 13	8
Klamath Falls	2 4 32 34	16
Medford	5 7 15 17	11
Portland	(3) 6 8 10 12 17	406
Albany	25	6
Ashland	19 21	5
Astoria	26	10
Baker	16	9
Bend	28 35	10
Burns	21 42	3
Canyon City	14	0.3
Coquille	24 26	3
Condon	22	1
Corvallis	23	8
Enterprise	40	2
Eugene	14 16	21
Gold Beach	40	0.5
Grants Pass	36 38	6
Heppner	41 43	1
Hood River	36	3
Kinzua	18	0.8
Lakeview	20 27 29	2
McMinnville	44	4
Madras	29	0.4
Marshfield (Coos Bay)	22 29	5
Newport	42	2
Ontario	20	4
Pendleton	24	9
Pineville	30	2
Redmond	45	2
Reedsport	18	1
Roseburg	31 33	5
Salem	32 34	31
Sprague River	41 43	6
The Dalles	27	6
Tillamook	19 21	3
Westfir	37	0.8

CALIFORNIA 3 VHF 5 V-UHF 81 UHF

Los Angeles	2 (4 5 7 9 11 13)	2,904
San Francisco-Oakland	2 (4 5 7) 9 11	1,428
Yreka	11 13	2
Bakersfield	10 14 16	29
Chico	12 36	9
Fresno	8 12 15 17	98
Sacramento	6 10 38 40	159
San Diego	3 6 (8) 14 16	256
Alturas	24	2
Arcata	30	2
Arroyo Grande	32	1
Banning	23	4
Barstow	25	2
Blythe	26	2
Brawley	20	12
Bridgeport	43	0.4
Calipatria	28	2
Calexico	22	5
Coalinga	41	5
Colton	39	10
Corona	35	9
Crescent City	45	1
Delano	38	5
Dinuba	29	4
El Centro	18	10
Escondido	41	5
Eureka	14 16 28	17
Fillmore	28	3
Ft. Bragg	24	3
Grass Valley	19	6
Hanford	19	8
Hollister	20	4
Indio	31	2
Independence	33	0.3
Inyokern	43	5
Laguna Beach	33	4
Lakeport	33	1
Lancaster	45	2
Lodi	21	11
Lompoc	42	3
Merced	24	10
Modesto	26	16
Mojave	20	2
Monterey	18	10
Mt. Shasta	23	2
Napa	29	8
Needles	24	4
Oceanside	27	5
Oroville	27	4
Oxnard	22	9
Placerville	34	3
Pacific Grove	45	6
Palm Springs	44	3
Paso Robles	25	3
Petaluma	23	8
Porterville	31	6
Portola	41	2
Red Bluff	25	4
Redding	18 42	8
Redlands	29	14
Riverside	19 21	31
Salinas	30	12
San Bernardino	15 17	44
San Luis Obispo	21	9
San Jose	35 37 39	129
Santa Barbara	24 26	35
Santa Cruz	14 16	17
Santa Maria	44	9
Santa Paula	18	9
Santa Rosa	17	13
Scotia	37	1
Sonora	32	2
Stockton	42 44	79
Susanville	22	2
Taft	36	3
Trona	40	2
Tulare	23	8
Turlock	28	5
Ukiah	20	3
Ventura	30	13
Victorville	37	3
Visalia	27	9
Wasco	34	5
Watsonville	22	9
Weaverville	39	0.7
Westwood	45	5
Willits	43	2
Willows	31	2
Yuba City	15	5

U. S. TERRITORIES

ALASKA

Anchorage	2 7 11 13	3
Fairbanks	2 4 7 9 11 13	3
Juneau	3 8 10	6
Ketchikan	2 4 9	5
Seward	4 9	1

PUERTO RICO

Mayaguez	2 4	50
San Juan	7 9 11 13	169

VIRGIN ISLANDS

	3	25

HAWAIIAN ISLANDS

Hilo Hawaii	2 4 7 9 11 13	23
Honolulu, Oahu	2 4 7 9 11 13	179
Lihue, Kauai	3 8 10 12	4
Wailuku, Maui	3 8 10 12	7

CANADA

ALBERTA

Calgary	2 4 10 12 14 16 18 27	80
Lacombe	8 29	2
Lethbridge	7 20 24	15
Medicine Hat	5 15 17	11
Red Deer	25	3

BRITISH COLUMBIA

Chilliwack	12 38	4
Cranbrook	17	3
Fernie	21	3
Kamloops	4 42	5
Kelowna	13 36	5
Nelson	6 38	6
Penticton	18	5
Port Alberni	42	5
Prince Rupert	3 7	
Trail	11 14	9
Vancouver-New Westminster	6 8 10 15 17 29 40 44	297
Vernon	2 42	5
Victoria	2 27 36	44

MANITOBA

Brandon	5 9 11 37 40	17
Portage la Prairie	14	
Winnipeg-St. Boniface	3 6 7 13 16 18 34 36 38	222

NEW BRUNSWICK

Cambellton	12 18	7
Edmundton	10 37	7
Fredericton	9 20	10
Moncton	17	23
New Castle	38	4
St. John	4 6 26 28	52
St. Stephen	22	3
Sackville	8 19	2
Woodstock	40	4

NOVA SCOTIA

Amherst	36	9
Antigonish	9 16	2
Bridgewater	10 33	3
Halifax	3 5 12 27 29 31 39	70
Kentville	15	4
Sydney	18 20	28
Truro	25	10
Windsor	23	3
Yarmouth	13 24	8

ONTARIO

Belleville	28	16
Brantford-Simcoe	20	38
Brockville	45	11
Chatham	19	17
Cornwall	36	14
Ft. Frances	5 28	6
Guelph-Kitchener-Galt	37	74
Haileybury	21	2
Hamilton	6 29 15	166
Kenora	9 19	8
Kingston	26	30
Kirkland Lake	3 16	20
London-St. Thomas	10 35	95
North Bay	2 27	16
Oshawa	24	29
Orillia Jnc.	3 14	20
Ottawa-Hull	7 9 11 14 16	155
Owen Sound	8 30	14
Pembrooke	4 31	11
Peterborough	38	25
Port Arthur-Ft. William	2 4 19 22 24	24
St. Catherine-Niagara Falls	34	51
Sarnia	44	19
Sault Ste. Marie	2 12 22	26
Stratford	23	17
Sudbury	5 7 23 25	32
Timmons	6 19	29
Toronto	9 11 13 42 40	667
Windsor	9 31 41	105
Wingham	33	2
Woodstock	26	12

PRINCE EDWARD ISLAND

Charlottetown	13 14	15
Summerside	11 21	5

QUEBEC

Amos	20	3
Chicoutimi	2 12 20	16
Granby	27	14
Hull Ottawa	14 16	33
Jonquiere	22	14
Matane	14	5

Montreal	2 5 8 10 12 42 44	903
New Carlisle	2 16	
Quebec	4 6 7 9 11 14 16	151
Riviere duLoup	5 26	9
Rimouski	3 23	7
Roberval	27	3
Rauyn	14	4
St. Hyacinthe-Drummondville	29	18
Ste. Anne de la Pacatiere	13 24	1
Shawinigan Fls.	25	20
Sherbrooke	43 45	36
Sorel	18	12
Three Rivers	23	42
Val d' Or	18	

SASKATCHEWAN

Moose Jaw	4 7 14 16	21
No. Battleford	12 22	5
Prince Albert	25	13
Regina	2 5 9 21 24 26 35	58
Saskatoon	6 8 15 20	43
Swift Current	28	16
Waterous	11 18	1
Yorkton	12 17	6

MEXICO

BAJA CALIFORNIA

Tijuana	10 12
Mexicali	11 7

SONORA

Nogales	13
Hermosillo	2
Ciudad Obregon	3
Navojo	5

CHIHUAHUA

Chihuahua	2
Hidalgo del Parral	3
Juarez	11 13

COAHUILA

Monclova	5
Saltillo	4

NUEVO LEON

Monterrey	2 6 10 12

TAMPAULIPAS

Nuevo Laredo	11 13
Matamoros	7

CUBA

Havana, Matanzas, Las Villas } Provinces 3 6 7 9 11 13

2: CHANNELS LIST OF THE CITIES PROPOSED FOR EACH ONE

In considering the channels assigned to a specific area, it is necessary to know where the same channel or channels have been assigned also. Therefore, the FCC proposal was rearranged in order to list each channel number with the areas to which that channel has been assigned.

Here, again, it is advisable to transfer the data to a map, particularly for studying possible co-channel and adjacent-channel interference.

CHANNEL 2 (42)

Calais, Me.
Boston, Mass.
N. Y. City
Buffalo, N. Y.
Baltimore, Md.
Greensboro, N. C.
Charleston, S. C.
Atlanta, Ga.
Jacksonville, Fla.
Miami, Fla.
Hamilton, Ohio
Chicago, Ill.
Detroit, Mich.
Nashville, Tenn.
Macon, Ga.
Minneapolis, Minn.
Iowa City, Iowa
Sioux City, Iowa
De Soto, Mo.
Kansas City, Mo.
Dickinson, N. D.
Grand Forks, N. D.
North Platte, Neb.
Little Rock, Ark.
New Orleans, La.
Tulsa, Okla.
Amarillo, Tex.
El Paso, Tex.
Ft. Worth, Tex.
Houston, Tex.
San Angelo, Tex.
Billings, Mont.
Butte, Mont.
Boise, Idaho
Denver, Colo.
Albuquerque, N. M.
Phoenix, Ariz.
Salt Lake City, Utah
Spokane, Wash.
Klamath Falls, Ore.
Los Angeles, Cal.
San Francisco, Cal.

CHANNEL 3 (40)

Montpelier, Vt.
Syracuse, N. Y.
Philadelphia, Pa.
Pittsburgh, Pa.
Richmond, Va.
Charlotte, N. C.
Savannah, Ga.
Tampa, Fla.
Columbus, Ohio
Tell City, Ind.
Springfield, Ill.
Kalamazoo, Mich.
Marquette, Mich.
Milwaukee, Wis.
Duluth, Wis.
Chattanooga, Tenn.
Eufaula, Ala.
Jackson, Miss.
Decorah, Iowa
Springfield, Mo.
Minot, N. D.
Aberdeen, S. D.
Omaha, Neb.
Wichita, Kans.
Shreveport, La.
Laredo, Tex.
Wichita Falls, Tex.
Great Falls, Mont.
Miles City, Mont.
Idaho Falls, Idaho
Casper, Wyo.
Pueblo, Colo.
Gallup, N. M.
Roswell, N. M.
Tucson, Ariz.
Ely, Nev.
Reno, Nev.
La Grande, Ore.
Portland, Ore.
San Diego, Cal.

CHANNEL 4 (49)

Boston, Mass.
N. Y. City
Albany-Schenectady-Troy, N. Y.
Buffalo, N. Y.
Lancaster, Pa.
Washington, D. C.
Norfolk, W. Va.
Beckley, W. Va.
Columbia, S. C.
Jacksonville, Fla.
Miami, Zla.
Cincinnati, Ohio
Cleveland, Ohio
Chicago Ill.
Moline, Ill.
Cheboygan, Mich.
Detroit, Mich.
Memphis, Tenn.
Nashville Tenn.
Birmingham, Ala.
Minneapolis, Minn.
Ames, Iowa
Kansas City, Mo.
St. Louis, Mo.
Dickinson, N. D.
Grand Forks, N. D.
Mitchell, S. D.
Hastings, Neb.
New Orleans, La.
Okla. City, Okla.
Amarillo, Tex.
Beaumont, Tex.
Brownsville, Tex.
Dallas, Tex.
El Paso, Tex.
Monahans, Tex.
San Antonio, Tex.
Billings, Mont.
Butte, Mont.
Boise, Idaho
Denver, Colo.
Albuquerque, N. M.
Phoenix, Ariz.
Salt Lake City, Utah
Seattle, Wash.
Spokane, Wash.
Klamath Falls, Ore.
Los Angeles, Cal.
San Francisco, Cal.

CHANNEL 5 (45)

Bangor, Me.
Boston, Mass.
N. Y. City
Rochester, N. Y.
Washington, D. C.
Huntington, W. Va.
Wilmington N. C.
Atlanta, Ga.
Jacksonville, Fla.
Miami, Fla.
Cleveland, Ohio
Dayton, Ohio
Chicago, Ill.
Moline, Ill.
Marquette, Mich.
Louisville, Ky.
Lexington, Tenn.
Mobile, Ala.
Minneapolis, Minn.
Sioux City, Iowa
Kansas City, Mo.
St. Louis, Mo.
Bismarck, N. D.
No. Platte, Neb.
Great Bend, Kans
Little Rock, Ark.
Alexandria, La.
Amarillo, Tex.
Brownsville, Tex.
El Paso, Tex.
Ft. Worth, Tex.
San Antonio, Tex.
Billings, Mont.
Butte, Mont.
Boise, Idaho
Denver, Colo.
Albuquerque, N. M.
Phoenix, Ariz.
Cedar City, Utah
Salt Lake City, Utah
Seattle, Wash.
Spokane, Wash.
Medford, Ore.
Los Angeles, Cal.
San Francisco, Cal.

CHANNEL 6 (42)

Portland, Me.
New Haven, Conn.
Johnston, Pa.
Philadelphia, Pa.
Richmond, Va.
Winston-Salem, N. C.
Augusta, Ga.
Cairo, Ga.
Tampa, Fla.
Columbus, Ohio
Indianapolis, Ind.
Peoria, Ill.
Lansing, Mich.
Milwaukee, Wis.
Duluth, Wis.
Knoxville, Tenn.
Memphis, Tenn.
Birmingham, Ala.
Jefferson City, Mo.
Fargo, N. D.
Minot, N. D.
Pierre, S. D.
Omaha, Neb.
New Orleans, La.
Tulsa, Okla.
Beaumont, Tex.
Corpus Christi, Tex.
San Angelo, Tex.
Wichita Falls, Tex.
Great Falls, Mont.
Miles City, Mont.
Idaho Falls, Idaho
Casper, Wyo.
Pueblo, Colo.
Roswell, N. M.
Kingman, Ariz.
Tucson, Ariz.
Ely, Nev.
Walla Walla, Wash.
Portland, Ore.
Sacramento, Cal.
San Diego, Cal.

CHANNEL 7 (43)

Calais, Me.
Boston, Mass.
N. Y. City
Buffalo, N. Y.
Wilmington, Dela.
Washington, D. C.
Roanoke, Va.
Wheeling, W. Va.
Columbia, S. C.
Tampa, Fla.
Cincinnati, Ohio
Chicago, Ill.
Detroit, Mich.
Grand Rapids, Mich.
Iron Mtn. Mich.
Nashville, Tenn.
Montgomery, Ala.
Minneapolis, Minn.
Cedar Rapids, Iowa
St. Louis, Mo.
Bismarck, N. D.
Rapid City, S. C.
Omaha, Neb.
Little Rock, Ark.
New Orleans, La.
Okla. City, Okla.
Amarillo Tex.
El Paso, Tex.
Odessa, Tex.
Palestine, Tex.
San Antonio, Tex.
Billings, Mont.
Butte, Mont.
Boise, Idaho
Denver, Colo.
Albuquerque, N. M.
Tuscon, Ariz.
Salt Lake City, Utah
Seattle, Wash.
Spokane, Wash.
Medford, Ore.
Los Angeles, Cal.
San Francisco, Cal.

CHANNEL 8 (37)

Augusta, Me.
Ft. Kent, Me.
Syracuse, N. Y.
Richmond, Va.
Charleston, W. Va.
Charleston, S. C.
Atlanta, Ga.
Jacksonville, Fla.
Miami, Fla.
Cleveland, Ohio
Indianapolis, Ind.
St. Ste. Marie, Mich.
Milwaukee, Wis.
Duluth, Wis.
Memphis, Tenn.
Mobile, Ala.
Des Moines, Iowa
Grand Forks, N. D.
Williston, N. D.
Mitchell, S. D.
McCook, Neb.
Junction City, Kans.
Muskogee, Okla.
Dallas, Tex.
Houston, Tex.
Laredo, Tex.
Great Falls, Mont.
Pocatello, Idaho
Casper, Wyo.
Pueblo, Colo.
Roswell, N. M.
Phoenix, Ariz.
Las Vegas, Nev.
Walla Walla, Wash.
Portland, Ore.
Fresno, Cal.
San Diego, Cal.

CHANNEL 9 (39)

Manchester, N. H.
N. Y. City
Pittsburgh, Pa.
Washington, D. C.
Charlotte, N. C.
Bainbridge, Ga.
Savannah, Ga.
Tampa, Fla.
Chicago, Ill.
Iron Mtn., Mich.
Louisville, Ky.
Chattanooga, Tenn.
Jackson, Miss.
Minneapolis, Minn.
Cedar Rapids, Iowa
Sioux City, Iowa
Kansas City, Mo.
St. Louis, Mo.
Dickinson, N. D.
Aberdeen, S. D.
Garden City, Kans.
Okla. City, Okla.
Abilene, Tex.
Brownsville, Tex.
El Paso, Tex.
Jasper, Tex.
San Antonio, Tex.
Havre, Mont.
Coeur D'Alene, Idaho
Nampa, Idaho
Denver, Col.
Sheridan, Wyo.
Santa Fe, N. M.
Flagstaff, Ariz.
Yuma, Ariz.
Salt Lake City, Utah
Takoma, Wash.
Los Angeles, Cal.
San Francisco, Cal.

CHANNEL 10 (45)

Augusta, Me.
Syracuse, N. Y.
Philadelphia, Pa
Norfolk, Va.
Roanoke, Va.
Columbia, S. C.
Jacksonville, Fla.
Miami, Fla.
Columbus, Ohio
Bloomington, Ind.
Carthage, Ill.
S. St. Marie, Mich.
Milwaukee, Wis.
Duluth, Wis.
Knoxville, Tenn.
Memphis, Tenn.
Montgomery, Ala.
Algona, Iowa
Springfield, Mo.
Fargo, N. D.
Minot, N. D.
Pierre, S. D.
Lincoln, Neb.
Wichita, Kans.
New Orleans, La.
Shreveport, La.
Amarillo, Tex.
Corpus Christi, Tex.
Ft. Worth, Tex.
Helena, Mont.
Miles City, Mont.
Pocatello, Idaho
Riverton, Wyo.
Pueblo, Colo.
Carlsbad, N. M.
Gallup, N. M.
Tucson, Ariz.
Elko, Nev.
Las Vegas, Nev.
Walla Walla, Wash.
Portland, Ore.
Bakersfield, Cal.
Sacramento, Cal.

CHANNEL 11 (36)

Providence, R. I.
N. Y. City
Baltimore, Md.
Charlotte, N. C.
Atlanta, Ga.
Savannah, Ga.
Tampa, Fla.
Cincinnati, Ohio
Columbus, Ohio
Chicago, Ill.
Marquette, Mich.
Nashville, Tenn.
Mobile, Ala.
Minneapolis, Minn.
Des Moines, Iowa
St. Louis, Mo.
Williston, N. D.
Sioux Falls, S. D.
Garden City, Kans.
Topeka, Kans.
Little Rock, Ark.
Alexandria, La.
Tulsa, Okla.
Houston, Tex.
Lubbock, Tex.
Havre, Mont.
Missoula, Mont.
Twin Falls, Idaho
Cheyenne, Wyo.
Sheridan, Wyo.
Santa Fe, N. M.
Flagstaff, Ariz.
Price, Utah
Seattle, Wash.
Los Angeles, Cal.
San Francisco, Cal.
Yreka, Cal.

CHANNEL 12 (38)

Bangor, Me.
Binghampton, N. Y.
Erie, Pa.
Norfolk, Va.
Charleston, W. Va.
Augusta, Ga.
Miami, Fla.
Tallahassee, Fla.
Indianapolis, Ind.
Peoria, Ill.
Grand Rapids, Ill.
Duluth, Wis.
Paducah, Ky.
Chattanooga, Tenn.
Jackson, Miss.
Charles City, Iowa
Springfield, Mo.
Bismarck, N. D.
Rapid City, S. D.
Lincoln, Neb.
Wichita, Kans.
Alpine, Tex.
Dallas, Tex.
San Antonio, Tex.
Sweetwater, Tex.
Helena, Mont.
Coeur D'Alene, Idaho
Nampa, Idaho
Alamosa, Colo.
Clovis, N. M.
Silver City, N. M.
Phoenix, Ariz.
Ogden, Utah
La Vegas, Nev.
Portland, Ore.
Chico, Cal.
Fresno, Cal.

CHANNEL 13 (42)

Portland, Me.
Utica, N. Y.
Newark, N. J.
Johnstown, Pa.
Baltimore, Md.
Lynchburg, Va.
Asheville, N. C.
Winston-Salem, N. C.
Charleston, S. C.
Cordele, Ga.
Tampa, Fla.
Dayton, Ohio
Toledo, Ohio
Chicago, Ill.
Gladstone, Mich.
Knoxville, Tenn.
Memphis, Tenn.
Birmingham, Ala.
Mobile, Ala.
Minneapolis, Minn.
Des Moines, Iowa
St. Louis, Mo.
Fargo, N. D.
Sioux Falls, S. D.
McCook, Neb.
Topeka, Kans.
Shreveport, La.
Alexandria, La.
Enid, Okla.
Houston, Tex.
Lubbock, Tex.
Missoula, Mont.
Twin Falls, Idaho
Cheyenne, Wyo.
Sheridan, Wyo.
Santa Fe, N. M.
Yuma, Ariz.
Price, Utah
Reno, Nev.
Tacoma, Wash.
LaGrande, Ore.
Los Angeles, Cal.
Yreka, Cal.

CHANNEL 14 (66)

Calais, Me.
Biddeford, Me.
Bridgeport, Conn.
Elmira, N. Y.
Baltimore, Md.
Richmond, Va.
Bluefield, W. Va.
Wilmington, N. C.
Macon, Ga.
Gainsville, Fla.
Panama City, Fla.
W. Palm Beach, Fla.
Dayton, Ohio
Youngstown, Ohio
Vincennes, Ind.
Flint, Mich.
Iron River, Mich.
S. Ste. Marie, Mich.
Madison, Wis.
Murfreesboro, Tenn.
Demopolis, Ala.
International Falls, Minn.
Northfield, Minn.
Ft. Madison, Iowa
Salem, Mo.
Fargo, N. D.
Stanton, N. D.
Philip, S. D.
Sioux Falls, S. D.
Gothenburg, Neb.
Nebraska City, Neb.
Great Bend, Kans.
Helena, Ark.
Hammond, La.
Minden, La.
Bartlesv'le, Okla.
Elk City, Okla.
Bryan, Tex.
Ft. Davis, Tex.
Harlingen, Tex.
Sherman, Tex.
Sweetwater, Tex.
Uvalde, Tex.
Bozeman, Mont.
Miles City, Mont.
Shelby, Mont.
Shoshone, Idaho
Cheyenne, Wyo.
Pinedale, Wyo.
Durango, Colo.
Los Animas, Colo.
Clovis, N. M.
Socorro, N. M.
Flagstaff, Ariz.
Tucson, Ariz.
Castle Dale, Utah
Ely, Nev.
Las Vegas, Nev.
Reno, Nev.
Seattle, Wash.
Canyon City, Ore.
Eugene, Ore.
Bakersfield, Cal.
Eureka, Cal.
San Diego, Cal.
Santa Cruz, Cal.

CHANNEL 15 (55)

Ft. Kent, Me.
Burlington, Vt.
Providence, R. I.
Trenton, N. J.
Altoona, Pa.
Bennettsville, S. C.
Gainsville, Ga.
Moultrie, Ga.
Melbourne, Fla.
Zanesville, Ohio
Cairo, Ill.

Champaign,
Kalamazoo, Ill.
Manistee, Mich.
Medford, Mich.
Frankfort Wis.
Brew, Ky.
Abeton, Ala.
Wilrdeen, Miss.
Mlmar, Minn.
Carshalltown, Ia.
Columbia, Mo.
New Rockford, N. D.
Miller, S. D.
Alliance, Neb.
Norfolk, Neb.
Manhatten, Kans.
Arkadelphia, Ark.
Opelousas, La.
Enid, Okla.
Borger, Tex.
Graham, Tex.
Gonzales, Tex.
Jacksonville, Tex.
Sonora, Tex.
Kalpellis, Mont.
Sidney, Mont.
Stanford, Mont.
Preston, Idaho
Salmon, Idaho
Hanna, Wyo.
Sheridan, Wyo.
Burlington, Colo.
Grand Jnc., Colo.
Hobbs, N. M.
Taos, N. M.
Douglas, Ariz.
Granado, Ariz.
Phoenix, Ariz.
Parowan, Utah
Elko, Nev.
Sunnyside, Wash.
Medford, Ore.
Fresno, Cal.
San Bernardino, Cal.
Yuba City, Cal.

CHANNEL 16 (64)

Calais, Me.
Biddeford, Me.
Bridgeport, Conn.
E mira, N. Y.
Baltimore, Md.
Lynchburg, Va.
Wilmington, N. C.
Macon, Ga.
Gainsville, Fla.
Panama City, Fla.
W. Palm Beach, Fla.
Dayton, Ohio
Youngstown, Ohio
Evansville, Ind.
Kewanee, Ill.
Flint, Mich.
Hancock, Mich.
S. Ste. Marie Mich.
Oshkosh, Wis.
Fayettesville, Tenn.
Johnson City, Tenn.
Laurel, Miss.
Austin, Minn.
International Falls, Minn.
Shenandoah, Iowa
Fargo, N. D.
Minot, N. D.
Custer, S. D.
Sioux Falls, S. D.
Broken Bow, Neb.
El Dorado, Kans.
Forrest City, Ark.
Ft. Smith, Ark.
Ruston, La.
A tus, Okla.
Bay City, Tex
Eagle Pass, Tex.
Presido, Tex.
Sterling City, Tex.
Waco, Tex.
Bozeman, Mont.
Miles City, Mont.
Shelby, Mont.
Kellogg Wardner, Id.
Twin Falls, Idaho
Cheyenne, Wyo.
Lander, Wyo.
La Junta, Colo.
Pagasa Springs, Colo.
Clovis, N. M.
Socorro, N. M.
Flagstaff, Ariz.
Tucson, Ariz.
Heber, Utah
Ely, Nev.
Las Vegas, Nev.
Reno, Nev.
Seattle, Wash.
Baker, Ore.
Eugene, Ore.
Bakersfield, Cal.
Eureka, Cal.
San Diego, Cal.
Santa Cruz, Cal.

CHANNEL 17 (56)

Ft. Kent, Me.
Burlington, Vt.
Providence, R. I.
Jamestown, N. Y.
Trenton, N J.
Richmond, Va.
Clarksburg, W. Va.
Winston-Salem, N. C.
Augusta, Ga.
Valdosta, Ga.
Sebring, Fla.
Sandusky, Ohio
Seymour, Ind.
Springfield, Ill.
Muskegon, Mich.
Sparta, Wis.
Mayfield, Ky.
Horriman, Tenn.
Alexander City, Ala.
Grenada, Miss.
St Cloud, Minn.
Ft Dodge, Iowa
Marshall, Mo.
Carrington, N. D.
Dupree, S. D.
Neligh, Neb.
Osborne, Kans.
Morrilton, Ark.
Crowley, La.
Stillwater, Okla.
Breckenridge, Tex.
Huntsville, Tex.
Kingsville, Tex.
Kerrville, Tex.
Pampa, Tex.
Lewistown, Mont.
Missoula, Mont.
Sidney, Mont.
Preston, Idaho
Rawlins, Wyo.
Sheridan, Wyo.
Grand Jnc., Colo.
Yuma, Colo.
Gallup, N. M.
Hobbs, N. M.
Las Vegas, N. M.
Douglas, Ariz.
Phoenix, Ariz.
Cedar City, Utah
Elko, Nev.
Ephrata, Wash.
Medford, Ore.
Portland, Ore.
Fresno, Cal.
San Bernardino, Cal.
Santa Rosa, Cal.

CHANNEL 18 (59)

Calais, Me.
Brattleboro, Vt.
Auburn, N. Y.
York, Pa.
Asheville, N. C.
Henderson, N. C.
Georgetown, S. C.
Macon, Ga.
Crestview, Fla.
W. Palm Beach, Fla.
Portsmouth, Ohio
Youngstown, Ohio
Evansville, Ind.
Marion, Ind.
Quincy, Ill.
Marquette, Mich.
Saginaw, Mich.
Beloit, Wis.
Winchester, Tenn.
Brookshaven, Miss.
Ely, Minn.
Red Wing, Minn.
Fargo, N. D.
Minot, N. D.
Sioux Falls, S. D.
Lexington, Neb.
Scotts Bluff, Neb.
Atchison, Kans.
Pratt, Kans.
Ft. Smith, Ark.
Paragould, Ark.
Lawton, Okla.
Colo. City, Tex.
Del Rio, Tex.
Orange, Tex.
Van Horn Tex.
Victoria, Tex.
Waco, Tex.
Chouteau, Mont.
Glasgow, Mont.
Cascade, Idaho
St. Maries, Idaho
Riverton, Wyo.
Cortez, Colo.
Trinidad, Colo.
Portales, N. M.
Silver City, N. M.
Winslow, Ariz.
Nephi, Utah
Boulder City, Nev.
Tonopah, Nev.
Winnemucca, Nev.
Olympia, Wash.
Kinzua, Ore.
Reedsport, Ore.
El Centro, Cal.
Monterey, Cal.
Redding, Cal.
Santa Paula, Cal.

CHANNEL 19 (55)

Augusta, Me.
Ft Kent, Me.
Fall River, Mass.
Olean, N. Y.
Tupper Lake, N. Y.
Easton, Pa.
Richmond, Va.
Weston, W. Va.
Kannapolis, N. C.
Cedartown, Ga.
Statesboro, Ga.
Deland, Fla.
Key West, Flo.
Quincy, Fla.
Danville, Ill.
Muskegon, Ill.
Merrill, Wis.
Lexington, Ky.
Paris, Tenn.
Kosciuska, Miss.
St. Cloud, Minn.
Webster City, Iowa
Joplin, Mo.
Washington, Mo.
Devils Lake, N. D.
Gettysburg, S. D.
York, Neb.
Oakdale, La.
Alice, Tex.
Brady, Tex.
Brenham, Tex.
Childress, Tex.
Monahans, Tex.
Paris, Tex.
Baker, Mont.
Billings, Mont.
Havre, Mont.
Missoula, Mont.
Idaho Falls, Idaho
Laramie, Wyo.
Gunnison, Colo.
Lamar, Colo.
Alamogordo, N. M.
Gallup, N. M.
Ajo, Ariz.
Bisbee, Ariz.
Beaver, Utah
Elko, Nev.
Mt. Vernon, Wash.
Pasco, Wash.
Ashland, Ore.
Tillamook, Ore.
Grass Valley, Cal.
Hanford, Cal..
Riverside, Cal

CHANNEL 20 (53)

Montpelier, Vt.
New Haven, Conn.
Oswego, N. Y.
York, Pa.
Roanoke, Va.
Belhaven, N. C.
Hendersonville, N. C
Americus, Ga.
Pensacola, Fla.
Portsmouth, Ohio
Evansville, Ind.
Elgin, Ill.
Ishpeming, Mich.
Jackson, Mich.
Whitehall, Wis.
Jasper, Ala.
McComb, Miss.
Crookston, Minn.
Marshall, Minn.
Ottumwa, Iowa
Clinton, Mo.
Bismarck, N. D.
Belle Fourche, S. D.
O'Neill, Neb.
Scotts Bluff, Neb.
Hutchinson, Kans.
Batesville, Ark.
Magnolia, Ark.
Ada, Okla.
Guymon, Okla.
Cuero, Tex.
Marfa, Tex.
Rock Springs, Tex.
Stanford, Tex.
Glasgow, Mont.
White Sul. Spgs., Mont.
Sandpoint, Idaho
Riverton, Wyo.
Colo. Spgs., Colo.
Bernalillo, N. M.
Portales, N. M.
San Rita, N. M.
Winslow, Ariz.
Hyrum, Utah
Moab, Utah
Ely, Nev.
Puyallup, Wash.
Lakeview, Ore.
On ario, Ore.
Brawley, Cal.
Hollister, Cal.
Mojave, Cal.
Ukiah, Cal.

CHANNEL 21 (61)

Augusta, Me.
Ft. Kent, Me.
Fall River, Mass.
Massena, N. Y.
Easton, Pa.
Johnstown, Pa.
Petersburg, Va.
Salisbury, N. C.
Athens, Ga.
Waycross, Ga.
Key West, Fla.
Orlando, Fla.
Mansfield, Ohio
Logansport, Ohio
Gailsburg, Ill.
Saginaw, Mich.
Fond du Lac, Wis.
Richmond, Ky.
Columbia, Tenn.
Troy, Ala.
Greenwood, Miss.
Gulfport, Miss.
Faribault, Minn.
Virginia, Minn.
Crestan, Iowa
Poplar Bluff, Mo.
Rugby, N. D.
White River, S. D.
Kearney, Neb.
Emporia, Kans.
Sharon Spgs., Kans.
Russelville, Ark.
Pineville, La.
Brownwood, Tex.
Edinburg, Tex.
Galveston, Tex.
Mineola, Tex.
Odessa, Tex.
Shamrock, Tex.
Billings, Mont.
Glendive, Mont.
Havre, Mont.
Idaho Falls, Idaho
Moscow, Idaho
Laramie, Wyo.
Trinidad, Colo.
Alamogordo, N. M.
Farmington, N. M.
Ajo, Ariz.
Bisbee, Ariz.
Hurricane, Utah
Provo, Utah
Tonopah, Nev.
Winnemucca, Nev.
Bellingham, Wash.
Ashland, Ore.
Burns, Ore.
Tillamook, Ore.
Lodi, Cal.
Riverside, Cal.
San Luis, Ob., Cal.

CHANNEL 22 (52)

Montpelier, Vt.
New Haven, Conn.
Rochester, N. Y.
Harrisburg, Pa.
Roanoke, Va.
Jacksonville, N. C.
Spartanburg, S. C.
La Grange, Ga.
Pensacola, Fla.
Perry, Fla.
W. Palm Bch., Fla.
Cincinnati, Ohio
Steubenville, O.
Metropolis, Ill.
Urbana, Ill.
Jackson, Mich.
Antigo, Wis.
McComb, Miss.
Tupelo, Miss.
Bemidji, Minn.
Cedar Falls, Iowa
Joplin, Mo.
Mexico, Mo.
Bismark, N. D.
Watertown, S. D.
Crawford, Neb.
Stanton, Neb.
Hays, Kans.
Hope, Ark.
El Reno, Okla.
Crockett, Tex.
Dalhart, Tex.
Fredericksb'g, Tex.
Snyder, Tex.
Glasgow, Mont.
Whitehall, Mont.
Gooding, Idaho
Sandpoint, Idaho
Buffalo, Wyo.
Limon, Colo.
Belen, N. M.
Carlsbad, N. M.
Globe, Ariz.
Richfield, Utah
Boulder City, Nev.
Aberdeen, Wash.
Condon, Ore.
Marshfield, Ore.
Calexico, Cal.
Ocnard, Cal.
Susanville, Cal.
Watsonville, Cal.

CHANNEL 23 (56)

Augusta, Me.
Fall River, Mass.
Binghamton, N. Y.
Atlantic City, N. J.
Suffolk, Va.
Elkins, W. Va.
High Point, N. C.
Athens, Ga.
Waycross, Ga.
Orlando, Fla.
Mansfield, Ohio
Kokomo, Ind.
Jacksonville, Ill.
Cadillac, Mich.
Madison, Wis.
Rice Lake, Wis.
Hazard, Ky.
Springfield, Tenn.
Tuscaloosa, Ala.
Gulfport, Miss.
Worthington, Minn.
Clarinda, Iowa
Hermitage, Mo.
Rolla, N. D.
Williston, N. D.
Chamberlin, S. C.
Kearney, Neb.
Jonesboro, Ark.
Bastrop, La.
Lake Charles, La.
Alva, Okla.
Muskagee, Okla.
Falfurrias, Tex.
Henrietta, Tex.
Plainview, Tex.
Sanderson, Tex.
Taylor, Tex.
Havre, Mont.
Nampa, Idaho
Cody, Wyo.
Kemmerer, Wyo.
Newcastle, Wyo.
San Luis, Colo.
Deming, N. M.
Nogales, Ariz.
Prescott, Ariz.
Monticello, Utah
McGill, Nev.
Yerington, Nev.
Bellingham, Wash.
Ritzville, Wash.
Carvallis, Ore.
Banning, Cal.
Mt. Shasta, Cal.
Petaluma, Cal.
Tulare, Cal.

CHANNEL 24 (53)

St. Albans, Vt.
Waterbury, Conn.
Pittsburgh, Pa.
Lebanon, Pa.
Hinton, W. Va.
Rocky Mount, N. C.
Spartanburg, S. C.
La Grange, Ga.
Cross City, Fla.
Palm Beach, Fla.
Pensacola, Fla.
Cincinnati, Ohio
Centralia, Ill.
Joliet, Ill.
Detroit, Mich.
Stevens Pt., Wis.
Jackson, Tenn.
Canton, Miss.
Albert Lea, Minn.
Thief Run Falls, Minn.
Fairfield, Iowa
McIntosh, S. D.
Watertown, S. D.
Ogallala, Neb.
Seward, Neb.
Dodge City, Kans.
Osawatomie, Kans.
Conway, Ark.
Houma, La.
Natchitoches, La.
Guthrie, Okla.
Abilene, Tex.
Crystal City, Tex.
Galveston, Tex.
Greenville, Tex.
Big Timber, Mont.
Miles City, Mont.
Burley, Idaho
Casper, Wyo.
Colo. Springs, Colo.
Belen, N. M.
Carlsbad, N. M.
Casa Grande, Ariz.
Provo, Utah
Pioche, Nev.
Centralia, Wash.
Coquille, Ore.
Pendleton, Ore.
Alturas, Cal.
Ft. Bragg, Cal.
Merced, Cal.
Needles, Cal.
Santa Barbara, Cal.

CHANNEL 25 (56)

Houlton, Me.
Lawrence, Mass.
Binghamton, N. Y.
Atlantic City, N. J.
Norfolk, Va.
Winchester, Va.
Huntington, W. Va.
High Point, N. C.
Barnwell, S. C.
Dawson, Ga.
Dolton, Ga.
Orlando, Fla.
Akron, Ohio
Ft. Wayne, Ind.
Escanaba, Mich.
Tawas City, Mich.
Madison, Wis.
Madisonville, Ky.
Columbus, Miss.
Natchez, Miss.
Little Falls, Minn.
Boone, Iowa
Carthage, Mo.
Hannibal, Mo.
Jamestown, N. D.
Williston, N. D.
Yankton, S. D.
Haldridge, Neb.
Janesboro, Ark.
Texarkana, Ark.
Habart, Okla.
Beeville, Tex.
Big Spring, Tex.
Hillsboro, Tex.
Marfa, Tex.
Chinook, Mont.
Thompson Falls, Mont.
Nampa, Idaho
Cody, Wyo.
Rock Springs, Wyo.
Sudance, Wyo.
Delta, Colo.
Ft. Morgan, Colo.
Springfield, Colo.
Deming, N. M.
Santa Rosa, N. M.
Nogales, Ariz.
Prescott, Ariz.
Escalante, Utah
Lovelock, Nev.
McGill, Nev.
Omak, Wash.
Albany, Ore.
Barstow, Cal.
Paso Robles, Cal.
Red Bluff, Cal.

CHANNEL 26 (50)

Berlin, N. H.
Waterbury, Conn.
Lancaster, Pa.
Pittsburgh, Pa.
Goldsboro, N. C.
Milledgeville, Ga.
Belle-Glade, Fla.
Lake City, Fla.
Springfield, Ohio
Bloomington, Ill.
Holland, Mich.
Stevens Pt., Wis.
Bristol, Tenn.
Andalusia, Ala.
Huntsville, Ala.
Fairmount, Minn.
Grand Rapids, Minn.
Centerville, Iowa.
Cedar Falls, Iowa
Sikeston, Mo.
Grafton, N. D.
Aberdeen, S. D.
Columbus, Neb.
Colby, Kans.
Ottawa, Kans.
Crossett, Ark.
Harrison, Ark.
Bogalusa, La.
Austin, Tex.
Beaumont, Tex.
Clarendon, Tex.
McAllen, Tex.
Sulphur Springs, Tex.
Ekalaka, Mont.
Great Falls, Mont.
Challis, Idaho
Montpelier, Idaho
Lusk, Wyo.
Craig, Colo.
Walsenburg, Colo.
Artesia, N. M.
Miami, Ariz.
McDermitt, Nev.
Pioche, Nev.
Kennewick, Wash.
Astoria, Ore.
Coquille, Ore.
Blythe, Cal.
Modesto, Cal.
Santa Barbara, Cal.

CHANNEL 27 (54)

Houlton, Me.
Lawrence, Mass.
Buffalo, N. Y.
Oneonta, N. Y.
Atlantic City, N. J.
Emporia, Va.
Martinsburg, W. Va.
Florence, S. C.
Fitzgerald, Ga.
Toccoa, Ga.
Leesburg, Fla.
Gallipolis, Ohio
Anderson, Ind.
Mt. Vernon, Ill.
Rockford, Ill.
Detroit. Mich.
Houghton, Mich.
Manistee, Mich.
Eau Clair, Wis.
Lebanon, Tenn.
Clanton, Ala.
Natchez, Miss.
Det. Lakes, Minn.
Lebanon, Mo.
Napoleon, N. D.
Williston, N. D.
Lake Andes, S. C.
Lead, S. D.
Belleville, Kans.
Texarkana, Ark.
W. Helena, Ark.
Frederick, Okla.
Ponca City, Okla.
Junction, Tex.
Pecos, Tex.
Robstown, Tex.
Dillion, Mont.
Malta, Mont.
Polson, Mont.
Weiser, Idaho
Powell, Wyo.
Montrose, Colo.
Loveland, Colo.
Clayton, N. M.
Las Cruces, N. M.
Halbrook, Ariz.
Tooele, Utah
Henderson, Nev.
G'nd Coulee, Wash.
Lakeview, Ore.
The Dalles, Ore.
Oceanside, Cal.
Oroville, Cal.
Visalia, Cal.

CHANNEL 28 (47)

Lewiston, Me.
Pittsfield, Mass.
Lancaster, Pa.
Wheeling, W. Va.
Raleigh, N. C.
Charleston, S. C.
Lakeworth, Fla.
Tallahassee, Fla.
Lima, Ohio
Terre Haute, Ind.
Midland, Mich.
Appleton, Wis.
Van Cleve, Ky.
Union City, Tenn.
Pascagoula, Miss.
Starkville, Miss.
New Ulm, Minn.
Burlington, Iowa
Glenwood, Iowa
Cooperstown, N. D.
Valentine, Neb.
Goodland, Kans.
McPherson, Kans.
Malvern, Ark.
Abbeville, La.
Okmulgee, Okla.
Austin, Tex.
Canadian, Tex.
Hamlin, Tex.
Nacogdoches, Tex.
Circle, Mont.
Great Falls, Mont.
Arco, Idaho
Wheatland, Wyo.
Canon City, Colo.
Artesia, N. M.
Laguna, N. M.
Hayden, Ariz.
Ephraim, Utah
Caliente, Nev.
Gerloch, Nev.
Chehalis, Wash.
Colfax, Wash.
Bend, Ore.
Calipatria, Cal.
Fillmore, Cal.
Turlock, Cal.

CHANNEL 29 (56)

Houlton, Me.
Manchester, N. H.
Williamsport, Pa.
Covington, Va.
Norfolk, Va.
Rockhill, S. C.
Griffin, Ga.
Sanford, Fla.
Newark, Ohio
Litchfield, Ill.
Rockford, Ill.
Battle Creek, Mich.
Petoskey, Mich.
Eau Clair, Wis.
Louisville, Ky.
Lewisburg, Tenn.
Clarksdale, Miss.
Columbia, Miss.
Alexandria, Minn.
Newton, Iowa
Sedalia, Mo.
Fort Yates, N. D.
Buffalo. S. D.
Yankton, S. D.
Superior, Neb.
Syracuse, Kans.
DeRidder, La.
Hugo, Okla.
Okeene, Okla.
Brackittville, Tex.
Eagle Lake, Tex.
Midland, Tex.
Rio Grande, Tex.
Stephenville, Tex.
Broadus, Mont.
Philipsburg Mont.
Plentywood, Mont.
Red Lodge, Mont.
Weiser, Idaho
Superior, Wyo.
Greely, Colo.
Silvertown, Colo.
Las Cruces, N. M.
Tucumcari, N. M.

of 1 kw. Antenna gain is expressed as the ratio in db of the maximum radiation from the antenna to the radiation in the equatorial plane of a half-wave dipole, with equal power input.

Classes of Stations & Power:

Channels 46 to 55 are for community stations only in those communities which are not part of a metropolitan district, and to which, except for special cases, no assignment has been made in the allocations table. Effective radiated peak power of not less than 7 db (5 kw.) and not more than 13 db (20 kw.) will be authorized, with an antenna 500 ft. above average terrain, as prescribed in the Engineering Standards. Co-channel assignments will not be less than 140 miles apart, and adjacent-channel assignments not less than 60 miles apart.

Metropolitan stations are intended primarily to render service to a single metropolitan district or a principal city and to the surrounding rural area. Except for wide-coverage stations located at high elevations, metropolitan stations will be authorized to use effective radiated peak power as set forth below, with an antenna 500 ft. above average terrain.

Chan.	Min. Power		Max. Power	
2-6	10 db	(10 kw.)	20 db	(100 kw.)
7-13	10 db	(10 kw.)	20 db	(100 kw.)
14-55	10 db	(10 kw.)	23 db	(200 kw.)

Notes on Antennas:

Antennas higher than 500 ft. should be used if available, but a reduction in effective radiated peak power will be required so that interference caused to Grade A service on the same and adjacent channels will not be increased by the height above 500 ft. Where a height of 500 ft. is not available, a lower antenna will be authorized, but power will be limited in accordance with the preceding table.

The Commission intends, from time to time, to consider horizontal power increases for all community and metropolitan stations.

Directional Antennas:

No provision has been made in the allocations for the use of directional antennas, with the exception of WGAL-TV on channel 4 in Lancaster, Pa., and WDEL-TV on channel 7 in Wilmington, Del., where it is planned to authorize the use of directional antennas to permit the use of increased power. The Commission does not propose to make changes in the plan based on the use of such antennas. However, the Commission does recognize that a directional antenna may be useful in certain situations, and their use will be permitted in appropriate cases. The best available information, according to the Commission, indicates that nulls deeper than -10 db, as compared to the maximum radiation in any direction, may not be practical because of reflecting surfaces which may be in the vicinity of the transmitter.

6: COVERAGE TRANSMITTING RANGE & CHANNEL SEPARATION

A very thorough study of service radii and separation of co-channel and adjacent-channel allocations has been made by the Ad Hoc Committee. On the basis of their findings the FCC has worked out the tables presented here for frequencies of 63, 195, and 600 mc.

In working out estimates of field intensities required at the antenna of a television receiver, it was considered that half-wave dipoles, connected to the set by 50 ft. of RG59U cable, would be typical for 63 and 195 mc. A small rhombic, with a 300-ohm line as the lead-in, was assumed to be typical for the 600-mc. frequency range.

63-MC. TRANSMISSION

Grade of Service	10 db (10 kw.)	20 db (100 kw.)
Service Radii, in Miles		
A	12	20
B	16	27
C	43	57
Co-Channel Separation, Miles		
A	148	215
B	134	205
C	252	328
Adj.-Channel Separation, Miles		
A	50	75
B	50	78
C	105	141

195-MC. TRANSMISSION

Grade of Service	10 db (10 kw.)	20 db (100 kw.)
Service Radii, in Miles		
A	13	21
B	17	29
C	36	46
Co-Channel Separation, Miles		
A	111	172
B	108	162
C	164	232
Adj.-Channel Separation, Miles		
A	50	73
B	51	78
C	84	109

600-MC. TRANSMISSION

Grade of Service	7 db (5 kw.)	10 db (10 kw.)	13 db (20 kw.)	23 db (200 kw.)
Service Radii, in Miles				
A	7	10	12	21
B	12	14	17	29
C	24	27	31	43
Co-Channel Separation, Miles				
A	92	103	125	172
B	92	99	108	162
C	115	125	141	212
Adj.-Channel Separation, Miles				
A	36	43	49	73
B	33	40	46	78
C	58	62	75	102

The service radii at 600 mc. apply to relatively smooth terrain. For relatively rough terrain, as in the vicinity of Washington, D. C., and New York City, an increase in power of about 10 db may be required to provide the same grades of service and radii indicated in the table.

It should be noted that these are conservative figures, and are based on the use of conventional receiving antennas. At any given point, reception may be considerably better or worse than indicated by the tables. Signal strength level will be more consistent near a transmitter, tending to fluctuate more widely from hour to hour, day to day, and month to month, as the fringe of the service area is approached. Also, at the fringe, co-channel and adjacent-channel interference will vary more noticeably with the time of day and the time of year.

Undoubtedly types of antennas will be developed which, by offering greater gain and directional selection, will offset variations in propagation effects. Knowledge of receiving conditions is still theoretical, but there is every reason to expect that improvement will be made as practical experience is gained in the UHF band.

Summary:

Altogether, The FCC plan is a real challenge to the industry. By the time the new plan is finalized, the Commission and the Ad Hoc Committee will have spent nearly a year and a half on the frequency allocations. Then, the engineering of equipment and the construction of new stations will be only in the initial stages.

There's no use thinking back and wishing that the TV allocations had been settled sooner. The truth is that research had not progressed far enough. Basic data was not available. Many problems are still unanswered. But the answers will come. The whole story of radio progress is a record of doing tomorrow what seems impossible today.

SPOT NEWS NOTES NOTES AND COMMENTS ABOUT SIGNIFICANT ACTIVITIES OF PEOPLE & COMPANIES

Even Worse by Radio:

"Have a good lunch?" "Yes, indeed, it was just packed with delicious, flavorsome goodness, and every bite was chock-full of wholesome nourishment, too, including energy minerals, vitamins, and protein, the food elements so vital to robust good health." If anyone talked like this, you'd consider him a grade-A bore. At least that's what advertising agency Young & Rubicam states in a recent piece of advertising. "You can't always ignore a boring acquaintance," the copy continues. "But most people can, and do, ignore boring advertising." Now, there's a glimmer of progress. Can we hope that agencies will some day learn that that sort of drivel sounds still worse by radio, and that people can, and do, ignore it by switching off their sets?

Newspaper Program Schedules:

Since newspapers and broadcast stations compete for advertising dollars, publishers have generally begrudged and some have refused space required for carrying program schedules. DuMont station WDTV Pittsburgh has found a smart way to win the goodwill of the newspapers. Each night, before the station signs off, the announcer concludes with: "The program schedule for WDTV can be found in the following newspapers. . . ." Then he names 25 papers published in Pittsburgh and the surrounding area.

J. Clifford Durr:

Former FCC Commissioner was principal speaker at the recent Bill of Rights Congress in New York. Sponsors of this Communist-front sound-off on the FBI included Vito Marcantonio, Henry Wallace, Beanie Baldwin, and Harry Bridges.

TV Interference on 27 Mc.:

Complaints of TV interference, addressed to the FCC, have brought to light the fact that some sets are using an IF frequency of 27 mc., disregarding FCC allocations which provide for the use of 27.12 mc. by type-approved or certified diathermy and industrial heating equipment. Looks as if the most practical way to lick this trouble is for manufacturers to use a different IF frequency.

Price Reductions:

Announced by Westinghouse on 16 audio receivers, including 2 FM-AM table models, 1 FM-AM console, and 7 FM-AM phono combinations. Cuts on these models range from $20 to $200.

Stamps Show Microphones:

We learn from philatelist S. N. Shure, president of Shure Brothers, Inc., 225 W. Huron Street, Chicago, that his company's model 55 mike appears on three anniversary and commemorative stamps just issued by the Philippines. He might send you a set if you ask him.

"An American, Excellency, a Mr. Coy, seeks advice on amicable cohabitation of divers elements of a common identity."

Frequency Range Extended:

We have been advised by Howard Carlson, author of "Portable FM Equipment" which appeared last month, that the frequency range of the Doolittle model PJZ-11 has been extended to cover 152 to 174 mc.

16-in. TV at New Low Price:

Lowest price tag we've seen on a 16-in. TV set is $279, carried by Meck's new table model.

Railroad Radio Conference:

Annual meeting of the Communications Section of the Association of American Railroads will be held at Portsmouth, N. H., from September 27 to 29. Details can be obtained from secretary A. H. Grothmann, 30 Vesey Street, New York 7, N. Y.

New TV Set Line:

Sylvania will market a full line of 10- and 12½-in. TV sets this fall. Models will include table and console cabinets, with FM and automatic phonographs. They will be made in the Colonial plant.

South Africa Tests FM:

Concerning FM tests being conducted by the South African Broadcasting Company, the *Johannesburg Star* reports: "This is of first-class importance in South Africa, which suffers from worse electric storms than any other country in the world. . . . If and when FM transmitters are provided for general use, our people will enjoy much truer reception than ever before."

Better Business Bureau:

Complains irregular practices are being used to promote TV set sales. Among examples cited were "$200 trade allowance" which was an authorized price reduction, and which could be obtained without a trade-in, mis-description of cabinet woods, misleading terms, and exaggerated tube counts.

Railroad Radio:

Motorola president Paul Galvin reports that the use of 2-way FM at the Union Pacific's North Platte terminal has raised the 70% record of delivery promises to 98%. Moreover, cost of the radio system in that yard was amortized in six months.

Survey of Chicago FM Listeners:

FM Broadcasters of Chicagoland is making a coincidental telephone survey to determine percentage of FM homes in Chicago service area, and amount of FM listening time. Also, monthly surveys will be made on increase in number of sets and hours of listening. Participating stations are WEFM, WMOR, WOAK, WILA, WJJZ, WXRT, WRGK, and WEAW.

Numbers on C-R Tubes:

All Sylvania picture tubes and their respective cartons now carry serial numbers. Purpose is to enable jobbers and dealers to keep sales records for warranty purposes.

Mobile FM for Signal Corps:

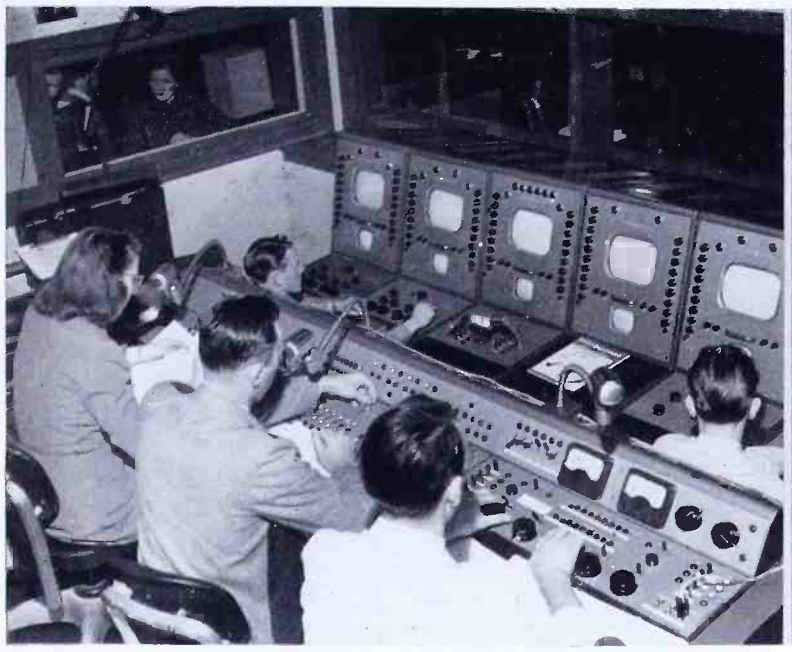
A contract for FM ground and vehicular equipment, amounting to more than $1.8 million, has been awarded to Federal Telephone & Radio Corporation.

NAB Says "Audio-Video"

Under a newly-planned reorganization, NAB will set up an Audio Department and a Video Department. The former will be devoted to matters concerned with FM and AM broadcasting, and the latter with television broadcasting. We're relieved that they didn't call them the Radio and Television departments.

More FM Interest:

Item from WBEN-FM tells that, "because of added interest in FM in the Buffalo area," four hours have been added to the station's daily schedule. Now WBEN-FM operates on 106.5 mc. from 1:00 P. M. to midnight.



NEWS PICTURES

TOP: Installation at WGN-TV's studio A. In the foreground is the G. E. program control console, with film camera console beyond. Sponsor's room is at left.

Twelve of the notables who attended RCA's Carfone demonstration of adjacent-channel operation, are left to right: W. E. Darnell, Daniel H. Arnold, W. S. Grenfell, Jeremiah Courtney, Ray E. Simonds, Franklin Smith, William Rothman, Frank DeBrouse, R. W. Malcolm, H. Gwilym, J. C. Fields, and R. Welsh.

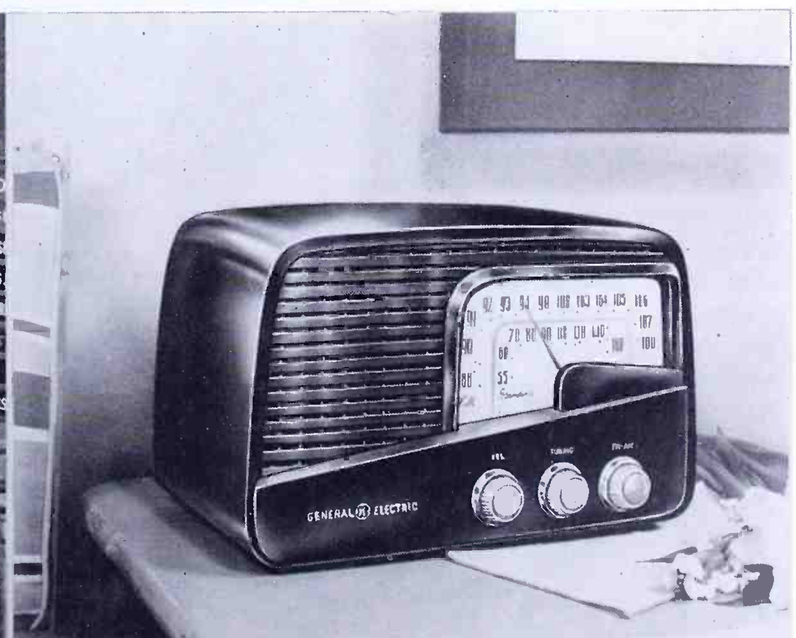
CENTER: This 16-in. cathode-ray tube is the one-millionth produced by RCA. Here it is being examined admiringly by RCA president Frank Folsom, left, L. W. Teegarden, vice president in charge of technical products, and J. G. Wilson, executive vice-president in charge of the

RCA Victor division, at the right.

Organizers of Chicagoland FM Association, formed to promote the sale of sets and time, are, left to right: Walter F. Myers, chief engineer of WFMF and WJJD; Ralph J. Wood, Jr., WMOR; Bernard Jacobs, WOAK; Ted Leitzell, WEFM; and Ed Wheeler of WEAW.

BOTTOM: Here's a window used by W. Wendell Budrow, manager of WBEC-FM, to promote his station at Pittsfield, Mass., by promoting Zenith's high-sensitivity receivers.

General Electric has started deliveries on this $49.95 FM-AM set, using the Armstrong limiter-discriminator circuit for FM. The set has six tubes and a selenium rectifier.



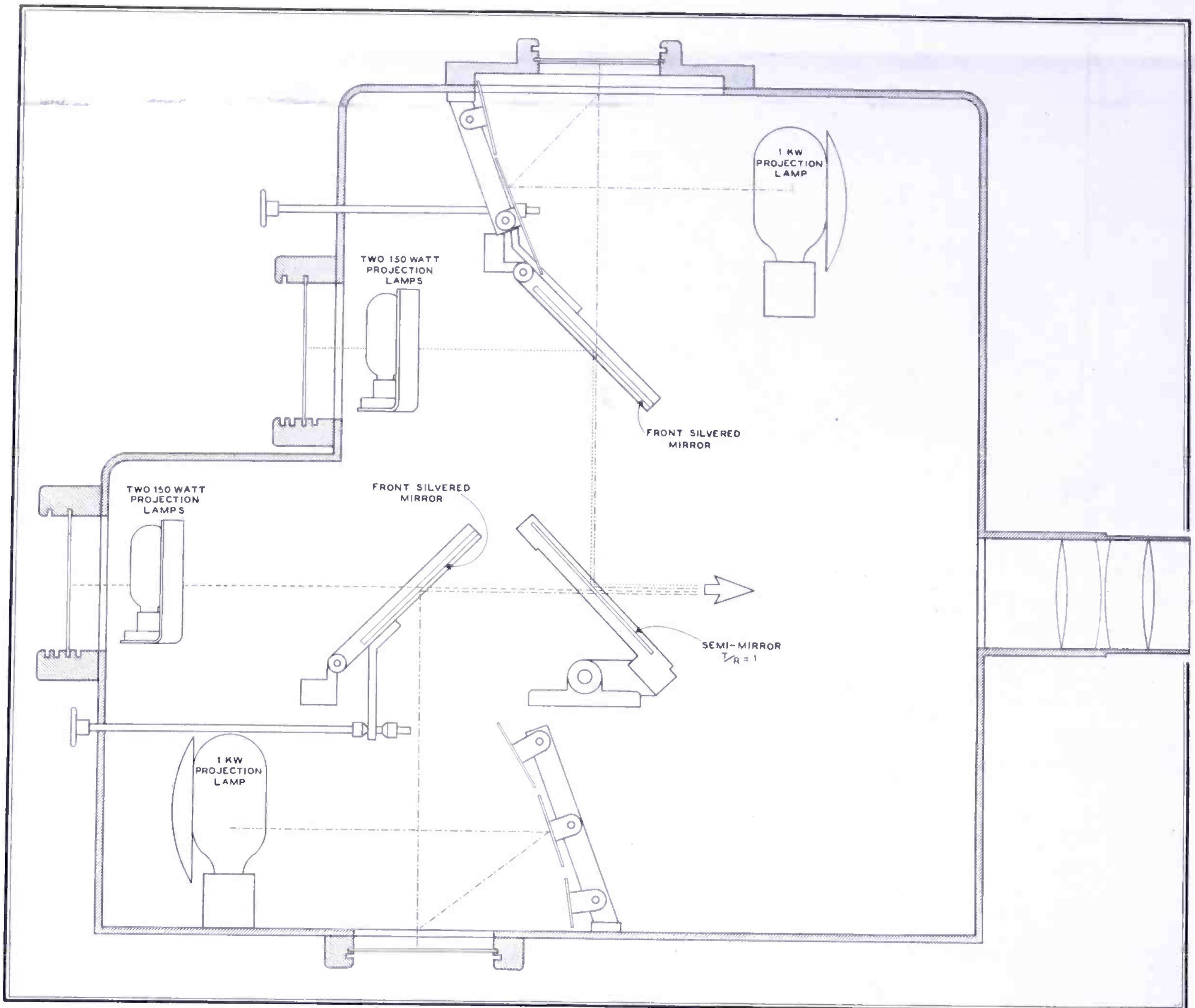


Fig. 1. Two moveable mirrors and the semi-mirror, or optical mixer, permit unlimited combinations of effects from four slides

LOCAL TV COMMERCIALS

A VERSATILE OPTICAL SYSTEM, CARRYING FOUR SLIDES, PROVIDES CONTINUOUS ANIMATION AND ATTENTION-COMPELLING EFFECTS — *By* CHESTER A. SNOW*

TELEVISION stations are rapidly learning that while it's easy to sell local advertisers the idea of using television, the high cost of producing effective commercials is a serious stumbling block.

A national advertiser can afford the expense of trick movie shots and animated cartoons for, once produced, a large number of copies brings the cost per showing to a very reasonable figure. The local advertiser, on the other hand, must charge the entire cost of a commercial against a showing over only one station. And he's very liable to balk when he finds that the preparation runs up to perhaps as much, or more, than the cost of the time he would like to buy. Also, because national advertisers have set high standard of eye-catching ingenuity in devising their commercials, something as over-simplified as a plain, lettered card or an inanimate slide picture has little chance to compete for audience attention.

The Gray Telop was developed as a means for making highly effective use of inexpensive commercial copy. Credit for initiating this project is due to Howard Chinn's engineering group at CBS. Essentially, it is a versatile, 4-channel optical system with such flexibility of control that it can produce an unlimited variety of effects with the simplest copy forms.

Moreover, the focal length of the Telop lens is great enough to permit its use with a diplexer, so that only one TV camera is needed when the Telop is added to an installation of two film projectors. At the smaller stations, programmed largely from film, and equipped with only one film projector, the Telop is the least expensive means of producing added revenue.

Animating Still Pictures:

The accompanying photographs show the general design of the machine, while the drawing in Fig. 1 discloses the details of the optical system. Openings at the top, rear, and bottom permit as many as four slides to be set up at one time.

Efforts to produce commercials for local sponsors at a price reasonably related to the cost of time have shown that their inadequacy is not necessarily due to limitations of simple slides. Rather, they are ineffective because, lacking animation, they fail to make use of the very feature that makes television such a po-

*Project Engineer, Gray Research and Development Company, Inc., 16 Arbor Street, Hartford 1, Conn.

Fig. 2. Top and bottom slide-holders can be seen in this view of the projector

tentially powerful advertising medium.

Therein lies the importance of the Telop's optical system. That is, it provides animated effects from the simplest and least expensive slides. The only limit to the use of this device is the imagination of the individual who plans the commercials and sets up the sequence of operations for the controls. There are 5 basic adjustments;

1. The use of 1 to 4 different slides in any setup.
2. Variable brilliance for any 2 of the 4 light sources.
3. Reversing switches on the light controls.
4. Settings and changes of the two adjustable mirrors.
5. The use of the semi-mirror as an optical mixer.

Details of Design:

As Fig. 1 shows, up to 4 slides can be inserted at one time. The mounting at the top can be turned on a vertical axis, if desired. This can be seen in Fig. 2. The opening at the bottom accommodates small objects such as a watch, package of cigarettes or pills, or a piece of jewelry. Special slots in both rear positions are intended to take American Optical Company slide holders.

All the light controls are located at convenient height on the panel at the left, Fig. 2. There are two large handles to operate separate 2-kw. faders. They can be switched to control any 2 of the 4 light sources.

In addition, there are reversing switches for the faders, so that the lights under control can be dimmed by pushing the related handle either up or down. If, for example, one lamp is to be dimmed while the other is turned up, the reversing switches enable operator to accomplish that result with one hand, since the handles can be moved together, in the same direction, and the transition can be accomplished smoothly.

The selection of slides in their proper sequence is a function of the mirror settings as well as the light controls. Each mirror is positioned accurately to assure perfect register and focus. Rather than leave the precise setting of the mirrors to the operator, small permanent magnets are used to take each mirror to the final position of travel.

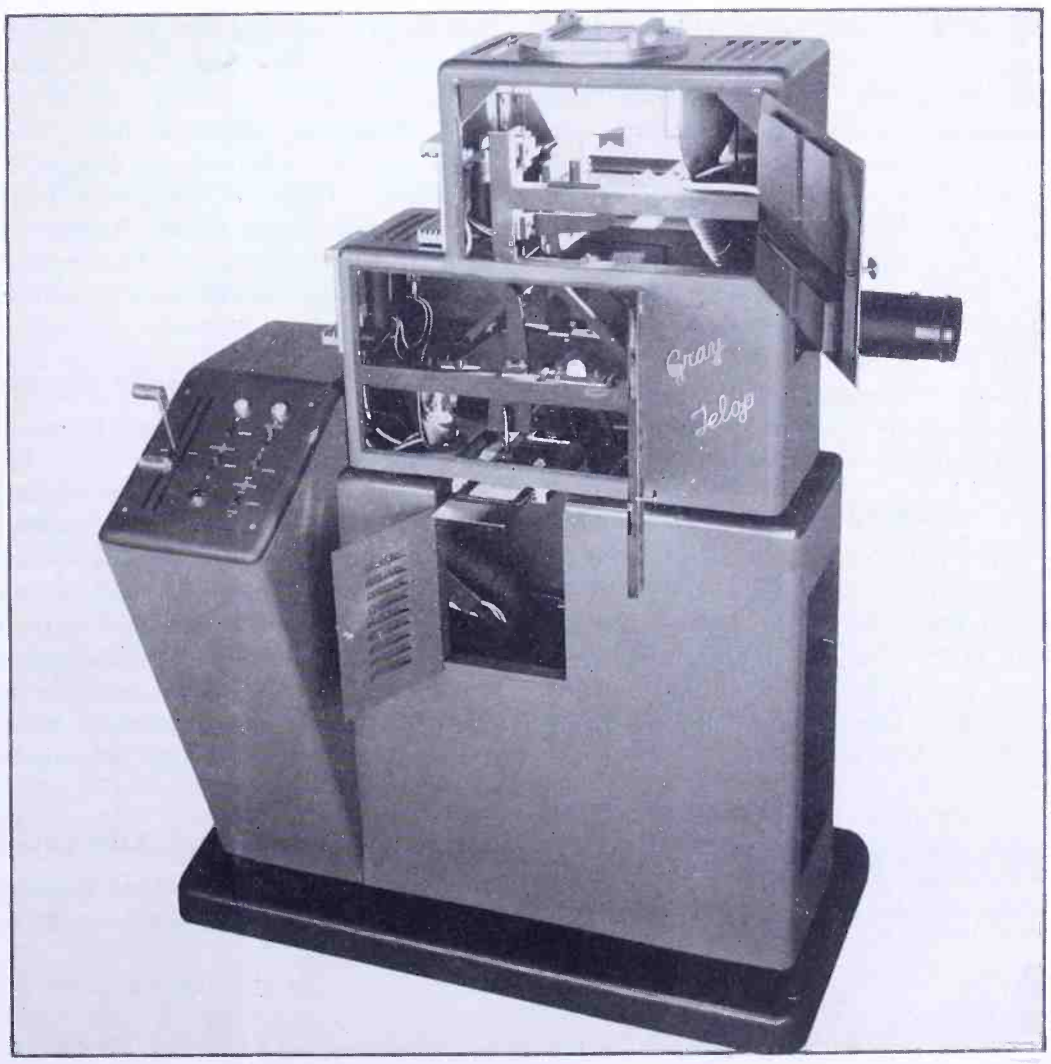
Optical mixing is accomplished with the semi-mirror. This reflects light from one side, projecting images from the top or upper rear slides into the lens, but it is transparent to images from the lower rear and bottom locations. Thus, either upper slide can be combined with either lower slide.

The use of the controls is explained most readily by typical examples of setups for commercial announcements.

Example A. No. 1: A slide showing a house is faded in from the top position. No. 2: The words "Any way you look at it" are faded in from the lower rear position and superimposed on the house while the slide of the house is turned upside down and back again. No. 3: Those words are switched off and, from the upper rear slide, the words "It's cheaper to buy than rent" are faded in on the picture of the house. No. 4: Those words are switched off, and finally, from the bottom position, the name and phone number of a real estate office are faded in as the house picture is faded out.

(Continued on page 29)

Fig. 3. Three doors give free access for replacing lights and cleaning mirrors



JEREMIAH COURTNEY'S* MOBILE RADIO NEWS and FORECASTS

CAUGHT in the middle between opposing a Senate bill that would give the Interstate Commerce Commission power to order railroads to install radio equipment for safety purposes, and at the same time asking the FCC for more frequencies, the Association of American Railroads and six individual roads withdrew their petition for a hearing and reconsideration of an FCC action which reduced the number of channels assigned to railroad radio service.

At the same time, the FCC denied a petition for reconsideration and rehearing filed by Aeronautical Radio, Inc. They wanted 12 pairs of channels below 500 mc. for public correspondence with aircraft. Interference considerations required exclusive frequency assignments for this purpose, which the FCC found impossible to grant. These were the only two petitions filed against the new land mobile radio service rules. Withdrawal of one and denial of other now permits all new land mobile frequency assignments to become fully effective.

The FCC staff promptly began grinding out new authorizations, badly backlogged while railroad and airline petitions hung fire. The current transitional period is also marked by no little confusion. Many problems found the staff torn between requiring immediate conformance with the new Rules, in the long-range interest of new services, and not imposing hasty frequency changes on particular applicants. It would seem that, in the absence of special circumstances, frequency modifications should be voluntarily assumed by all applicants, to accord with new Rules.

National Coordination Plans:

Power, petroleum and forest products services have filed their suggested national plans for frequency assignments with FCC. Coordinating frequency selections by applicants with industry area committees should reduce the possibility of future interference.

Taxicab Systems:

Taxi applications were being granted on all four channels without any showing of area frequency-coordination wherever there was no possibility of interference to telephone companies still using channels now assigned to taxi service. Taxi operators are still worrying about adjacent 60-kc. channels in the same area. As one taxi leader said in commenting on the subject: "We pass from Experiment No. 1 to Experiment No. 2."

Motorola's recent Chicago demonstration of 60-kc. adjacent channel operation to a lay group, with vice-president D. E. Noble explaining the highly technical aspects of the problem, produced this press relations gem:

"All representatives were in a position upon returning home to explain the various problems attendant to adjacent-channel systems operation."

Another sector of confusion in the taxi field is the base-station power limitation of 120 watts input. Taxi stations can continue to use greater power than that, if previously authorized, until the present experimental licenses expire November 1, 1949. But when they apply for regular licenses prior to that date, as required, a showing must be made that the power has been reduced to conform to the new rules. Otherwise, regular license applications will be returned or delayed in processing. Object of the power limitation is to reduce unnecessary interference to other distant stations, and to minimize adjacent-channel interference to stations of lower power.

Maritime Mobile Service:

There are still no definitive Rules for maritime mobile radio service. Frequency allocations have been finalized, but the use of particular frequencies is still not resolved. Proposed Rules should be out soon, and probably will be final by November 1. That's target date, at least, for all experimental authorizations expire then. To be on the safe side, renewals of experimental maritime mobile licenses should be filed sixty days in advance of November 1.

Rules and Allocations:

The May 6th issue of Federal Register, containing all land mobile service Rules, is now exhausted.[1] However, separate copies of the Rules can be obtained from Superintendent of Documents, Government Printing Office (not from the FCC).

Common Carriers:

The recent formation of a national association by the limited common carriers, known as the National Mobile Radio System, should be a boon to intercity truckers. Cost of erecting and operating private intercity systems is so great that most long-distance truckers will look to common carriers for their mobile communication needs. The national association should facilitate a satisfactory solution to the truckers' coverage requirements in different cities.

Existing limited common carrier licensees and permittees must file applications for modification of their permits or licenses in order to operate in regular service. Applications must be supported by current balance sheets and descriptions of technical qualifications.

Applicants entering this field must file new construction permit applications. All experimental applications pending when the new Rules were adopted were dismissed July 1, without prejudice. Refilings in regular service are now in order, although no regular grants will be made before September 1.

The American Telephone and Telegraph Company has objected to the priority categories which the FCC proposes to establish for rendering mobile communications service to present subscribers and new applicants. The priorities proposed would require the Company to drop lower-priority subscribers in favor of higher-priority applicants. A T & T objected to this proposal on the ground that it would cause inconvenience and expense to existing subscribers as well as particular hardship to those who had modified their methods of doing business as a result of having mobile telephone service. A T & T indicated that same results could be obtained through voluntary discontinuance of existing services and the normal growth of facilities. Their petition indicated that the discontinuance rate of mobile telephone service in congested areas is approximately 30% per annum.

Forecast:

Long-range: compulsory radio for railroads within next five years. Short-range: some changes in present 72- to 76-mc. fixed-circuit limitations that will redeem this present desert area of the radio spectrum.

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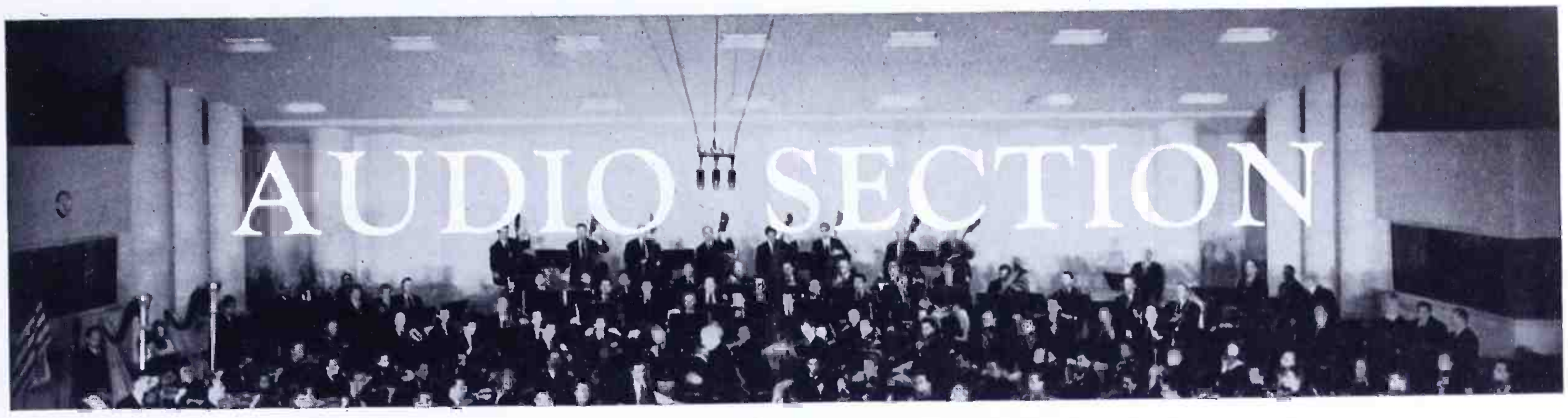
*Courtney, Krieger, and Jorgensen, Washington 6, District of Columbia.

[1] Complete tables of frequency allocations with footnote references, and a resume of technical requirements for common carriers and safety services were presented in *FM-TV* for June and July. Industrial and transportation services will be covered in September and October.



NEW NOTES ON CORNER SPEAKERS

FURTHER REFINEMENTS HAVE ADDED TO THE RANGE OF REPRODUCTION, AND IMPROVED THE APPEARANCE OF THIS FAMOUS DESIGN—*By* PAUL W. KLIPSCH*

CONTINUING effort has brought the corner-speaker system of sound reproduction to a high degree of development. In its present state, it offers a longer wavelength-handling capacity than any other contemporary type, and from 2 to 4 times the wavelength capacity per unit of occupied space than any other system. Various stages in the development have been reported in *FM-TV*, the *Journal of the Acoustical Society of America*, and *Electronics*.

The first experimental design, predicated on a selection of major dimensions that would permit the woofer to go through an average dwelling door, delivered a range from 80 to 250 cycles. This range was subsequently increased to 55 to 400 cycles at full efficiency, with usable efficiency down to 40 cycles.

Since 1946, further research has led to the design of the K-3-B, C, and D series, the latest models offering full efficiency down to 36 cycles and a considerably improved remaining efficiency at the 32.7-cycle low-C note of the pipe organ.

Some special woofer horn designs have been completed. Most noteworthy of these is the T-6, a tentative design which has been under study for a couple of years. This unit, owned by Dr. Brickenkamp of St. Louis, is a scale-up of the X-3 with altered taper and throat to accommodate an 18-in. driver. A comparison between this T-6 and the standard K-3-C indicates that the standard model offers all the performance of the scaled-up model, with about half the total bulk.

Experiments with Woofer Horns:

The latest development has been in drivers for the woofer horn. Preservation of full bass range of the woofer with improved efficiency in the middle- and high-frequency woofer range has been brought about by some very ingenious technology on the part of the Stephens Manufacturing Company.

The Brickenkamp T-6 woofer was developed especially for the electric organ. Experiments on placement and drivers were continued until it offered appreciable efficiency down to 24 cycles per second. Consideration was given to making this a standard for organ tone generation and reproduction, but meanwhile the K-3-C was developed to the point that it offered full efficiency down to D above low-C with relatively little loss at the lowest organ note. A direct comparison was made with the T-6 in one corner and the K-3-C in an adjacent corner, both operating from the same output amplifier. The most skeptical of the critics observed that there was only a slight difference in efficiency, within limits capable of equalization. As this test was conducted before introduction of the latest woofer driving motor, it would appear that the test favored the standard K-3-C on an absolute basis, and that the performance-per-cubic-foot and per-dollar is definitely in favor of the standard model over the special T-6.

Another special design is the Owendorff speaker. This consists of a woofer scaled up approximately 10% from the X-3 and using the Bostwick middle- and high-range components as a 3-way system. The taper was kept about the same as the X-3, but the larger size permitted performance down to an estimated 40 or 50. This writer heard the unit in Mr. Owendorff's New Jersey home in 1946 and noted the improvement over the X-3 performance, but no comparison has been conducted between it and a late model of the production series.

The T-12 and T-13 designs were developed for very large power handling capacity, such as organ-tone generation in large churches and auditoria. The size of these designs approximately trebled the bulk of the K-3-C. They were built by a group which has been experimenting with electric organ-tone generation. It can be said that these special units offer the extra output capacity that several additional 15-in. drivers afford, since the power output is of the same order as the output of large pipe organs. Their high efficiency and low distortion are typical of all the writer's horn-loaded woofers, and the amplifier capacity need be only a fraction of that required for direct radiators of similar rated output. Their application would be limited to large installations, the smaller standard designs sufficing in power rating for medium auditoria and living rooms.

In other words, the standard model now offers full bass range, and any redesign would result in a considerable cost increase with, at best, only marginal or subliminal improvement in performance.

Experiments on Drivers:

An improvement in bass response, afforded by a treatment of driver cone rims, was reported in *FM* AND TELEVISION, November, 1948. Even as that article was going to press, it began to appear that this advance was not an unmixed blessing. The plasticizer was suspected of increasing the dissipation, which suspicion was confirmed as a result of work with a group in St. Louis. Still, the extended bass range was considered to be of sufficient importance as to justify the small sacrifice in middle-range efficiency. It was recognized, however, that recovery of this efficiency loss would be desirable.

Through the very cooperative efforts of the Stephens Manufacturing Corporation and the personal efforts of Mr. Howard Souther, a new driver was developed which offers the same high compliance as the treated drivers, the same full extension of the bass range without the

* Klipsch and Associates, Hope, Ark.

edge dissipation, and a higher average efficiency. In addition, the new driver is wound to optimum impedance for use in the late model horns.

Dissipation in a cone can be detected by impedance measurement of the driver in free space. The old driver, untreated, exhibited an impedance of approximately 30 times the DC resistance at 43 cycles. Treated, it showed a resonant frequency of 28 cycles and an impedance of 13 times the resistance. As the resistive component is lower at the lower frequency, and since the relation of resistive to reactive load would dictate a higher resonant impedance, it is evident that dissipation existed. The new driver exhibits 120 times the DC resistance at 29 cycles, indicating that the dissipation is lower even than the old cone untreated.

One series of tests was conducted involving 6 drivers of 4 types from 3 manufacturers, all mounted in identical horns in the 4 corners of the same room, alternating the drivers in the various horns. Instantaneous switching between units was provided. Drivers ranged in net price from $48 to $90. Observers were the writer, an assistant, and numerous members of the lay public. The treated drivers were unanimously acknowledged to exhibit the greatest range in the extreme bass, but they lacked a trifle in efficiency at the middle range.

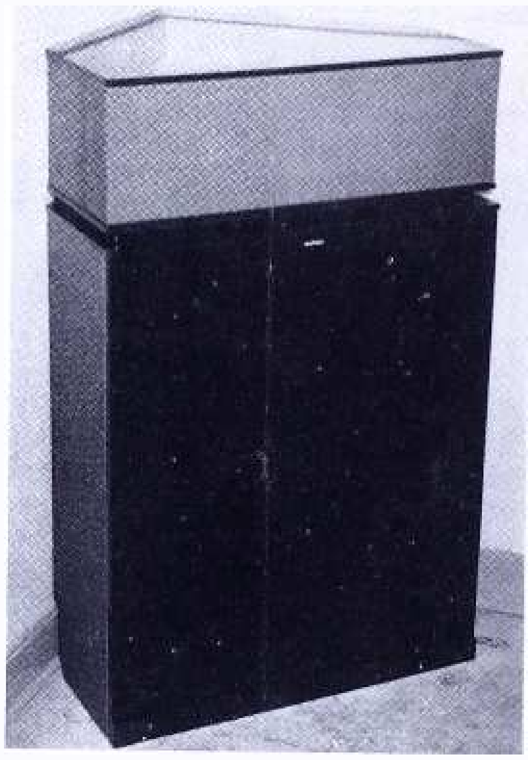
Later, a similar test between the new type driver and the treated drivers was conducted, with the finding that the new driver was equal to the treated driver in the extreme bass range, and even better in middle-range efficiency than the best of the other drivers tested. A highly gratifying finding, this, in view of the fact that this best driver is by no means the most expensive.

An impedance run of the new driver in the K-3-C and D series of horns shows that the trough efficiency at around 60 cycles is approximately 57%, compared to about 30% for the treated driver. The higher efficiency measured in the new driver is more valid than the lower efficiency of the treated driver, because the efficiency measurement is representative of the electro-mechanical transfer, and cannot recognize losses due to dissipation. A determination of relative efficiency by inserting enough loss in the more efficient driver with a calibrated attenuator indicates about 2 to 3 db better output with the new driver.

Built-in Installations:

From time to time, the writer has received inquiries as to feasibility of building the bass speaker into the construction of a new house, instead of installing it as a physically independent unit. It is recognized that this is possible, if the work is carried out by workers skilled in both architecture and acoustics, particularly in acoustics as related to the speaker system. But even then it would appear that the results would not offer advantages over the existing production models, and would be expensive. The problem of transferring technical knowledge resulting from many years of acoustical experience to the mind and hand of the architect would also be formidable.

However, many acoustical improvements available in architectural design are applicable to sound reproduction in general, and to the use of the corner speaker in particular. These relate to desirable room proportions, provision of at least one unbroken corner, design with respect to reverberation, limitation of abrupt breaks in columns, non-parallel walls, and certain irregularity of wall surfaces.



Latest designs are attractively styled

Room size and proportion bear more relation to the resultant sound in the room than is generally realized. A room less than about 16 ft. long reduces sound pressure at the ear in the frequency range below 50 cycles. An L-shaped room with one leg about 8 ft. width and 14 ft. long was found to be particularly poor for organ reproduction. With the speaker at the angle of the L, deemed necessary for high frequency coverage, there was substantially no bass below 60 cycles, yet the speaker had been tested with good results clear down to the 32.7 bottom of the pipe organ in another location.

The writer's living room (actually 2 rooms joined by a 7-ft. square opening) offers an effective width of 13 ft. and length of about 28 ft. The lowest organ notes produce standing waves, with best listening at the far corner opposite the speaker. Opening the kitchen door at the end remote from the speaker tends to reduce the standing waves.

The Brickenkamp T-6 is installed in a living room about 25 ft. wide, 40 ft. long, and 13 ft. high, with acoustic side chambers represented by large doors to the main hall and dining room. Standing waves exist here but not as bad as in the writer's living room. Organ notes tend to "pile up" in the corners, but observers agree that any part in the room is a good place to listen.

The Seifert installation is in a room about 30 ft. long, 18 ft. wide, and 9 ft. high, with doors at the ends. The end of the room opposite the speaker is lined with record albums except for about 10% area occupied by a window. Ceiling beams 9 ins. deep and spaced 2 ft. apart cross the room transverse to the direction of sound propagation. This room has less standing waves than any room of corresponding size that this writer has observed. The ceiling beams and the sound absorption at the back of the room appear to be responsible for this.

The Fairchild living room is probably the best this writer has ever observed. It was designed with acoustic performance definitely in mind. The ceiling consists of zig-zag surfaces concealed above acoustically transparent cloth. The north wall is glass, the west wall hardwood against brick, the east wall a sort of pressed fiber coarser than Celotex, and the south wall of glass at an angle to the north wall, and with about a third of the area opening into a hallway. Standing waves are not noticeable. Reverberation appears to be optimum. In spite of having to add a portion of a wall to produce a corner for the speaker, the corner horn system renders an excellent account of itself in this room. Details of this room were presented in *FM* AND TELEVISION for October, 1944.

This discussion of room acoustics has necessarily been qualitative. The final test of any audio system must necessarily be referred to the ear.

Functional Cabinet Design:

The prototype of the K-3-C and D woofers was the T-3-B-1 reported in the September, 1947 issue of *FM* AND TELEVISION. That was standardized as the K-3-B, built of ⅜-in. fir plywood. The C and D series are built of ½-in. hardwood plywood, with all other dimensions substantially unchanged. Yet the new model offers full efficiency down to 36 cycles compared to 42 cycles for the T-3-B-1. Much armchair philosophy has been expended trying to explain this improvement. The best opinion appears to be that the increased rigidity of the ma-

(Continued on page 28)

CORNER SPEAKERS

(Continued from page 26)

terial permits less acoustic absorption, but this explanation is far from satisfactory. The fact remains that there is a difference, even transferring identical drivers from one horn to the other.

This difference in the two horns, representing a mere 6 cycles at the extreme bass end, may appear to be marginal. But on certain pipe organ records there is a difference of 3 or 4 bass notes at the bottom of the pedal range, and this turns out to be more than marginal. The new design offers full efficiency at D above low-C, whereas the old unit begins to droop below F. These low notes are felt as much as heard, and the pressure against the chest is definitely lacking in the old model.

It was pointed out in earlier articles that the woofer horn structure must be air tight. Violation of this requirement in home-constructed woofers has resulted in very poor performance.

Air tightness is measured by using an imperforate motor board and special door. The door is fitted with 2 tubes, one of which is connected to a water manometer and the other to a mouthpiece. The pressure is blown up to 2 ins. of water pressure and held while the time required for the pressure to drop to one inch is observed. This time exceeds 6 seconds, representing a time-constant of around 9 seconds. Such a long time-constant may not be strictly necessary, but it is felt that no relaxation of standards of quality can be permitted.

Early models were built starting with one of the inner members, the front going on last. Inverting the assembly order has permitted the front to remain unbroken by any visible fastenings, whereby finishes can be applied directly to the woofer front.

The top housing of the styled models is made up of the same material as the corresponding woofer front. The top housing has been aimed at functional design for several reasons: shadowing of the high frequency horn mouth must be avoided, and rigidity and absence of vibration and rattles is paramount.

Studies in functional styling have been in progress since production started. Several styles regarded as attractive on paper have been discarded as being too bulky in appearance. Other styles which seem hardly worth taking past the drawing board stage have proved attractive and apparently less bulky even though the actual occupied space was reduced a mere 2%.

In a system as expensive as the corner 2-horn system, long life expectancy is important, as well as low obsolescene of styling.

In this 20-second spot, continuous animation is supplied by the projector, but the preparation calls only for 4 simple slides. To obtain variation, the slogan and the picture of the house can be changed from time to time.

Example B. No. 1: The words "It's later than you think" are faded in from the top. No. 2: The face of a clock, fitted in the bottom position, is faded in as the letters are faded out. No. 3: The words "Tomorrow is the last bargain day at —" are faded in and held while the clock face is faded out.

Only two slides are required for this spot, but the commercial is animated for the entire 20-second period.

Example C. No. 1: A sketch of a boy is faded in from the top. No. 2: While

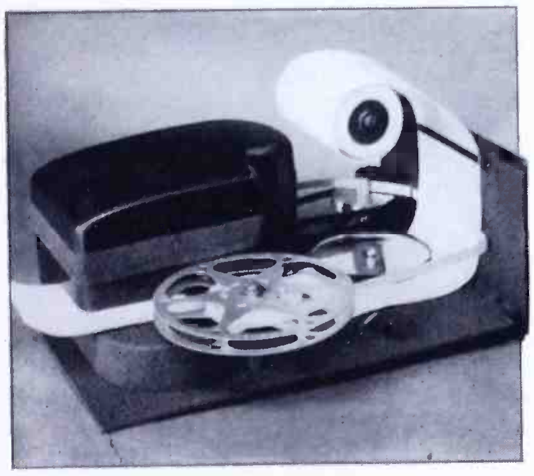


Fig. 4. Stage No. 1 fits the slide-holders

that is held, the word "Mother," enclosed in a balloon, is faded in from the bottom. No. 3: Those slides are switched off and the words "School starts September 7," are switched on from the upper rear. No. 4: As that slide is faded out, the words "— has a complete line of school supplies on hand now" are faded in.

This indicates a method of holding one slide while it is supplemented by another.

The foregoing examples illustrated indicate the endless possibilities of the Telop. But the machine is not limited to the use of slides. A special unit, called Stage No. 1, can be used at one of the rear positions. This device, Fig. 3, provides 3 kinds of animation: 1) lettering on the roll of paper can be fed down continuously by the motor drive, 2) news, announcements, and weather reports on tape can be drawn across the opening from the reel, and 3) small objects can be revolved slowly on the turntable disc. These functions can be combined with slides in the other three positions, if desired. For example, tape announcements from Stage No. 1, at the lower rear position can be shown with a test pattern inserted at the top.

Structural Design: Fig. 2 shows the high degree of accessibility to the optical system. This is essential because the mirrors and reflectors must be cleaned from time to time. The bottom section contains two blower systems which maintain a constant flow of air to carry off heat from the lamps. Interlocking switches permit the lamps to be turned on only if the blowers are operating.

Extremely rigid construction is used to prevent vibration when the switching controls are shifted, or when the operator walks around the machine. This is essential for, otherwise, the slides would appear to wiggle at the receiving sets just as they do when slides are changed in the portable projectors used for lectures. A heavy cast iron base plate brings the total weight up to 600 lbs.

The f/5 lens, 4 ins. in diameter, has a focal length of 18 ins. and an optical throw of 33 ins. Light intensity projected on the mosaic of the television camera is 12 to 15 foot-candles.

Operation of the machine calls for a reasonable amount of ingenious thinking, a little manual skill at the controls, and 3 kw. of power from a 115-volt, 60-cycle source.

NEW CATALOGS & DESIGN DATA

THE products listed here are described in new catalogs and bulletins now available. Unless otherwise noted, they will be sent on request, without charge.

BROADCAST EQUIPMENT

Slide & Tape Projector:

Compact, low-cost projector handles wide paper roll, narrow tape, or one slide. Mounts on stand or table. *INS-INP Television Dept., 235 E. 45th St., New York 17.*

HOME RECEIVERS

TV Tube Sizes:

Sets will not be listed in this section unless the diameter of the picture-tube is given. Rating of tube in square inches is not considered adequately descriptive.

TV Receivers:

Four new models are 12½-inch Rumson table model, 15-inch Sussex console, 12½-inch Sheffield console, and Bradford set with the new 19-inch short-neck tube. *Du Mont Laboratories, Inc., 654 Madison Ave., N. Y.*

Two 16-Inch Consoles:

Two cabinet designs, both listing at $479.50, have 29 tubes, and high-fidelity audio system with 12-inch speaker. *Freed Radio Corp., 200 Hudson St., New York 13.*

Portable TV Receiver:

Model weighing 38 lbs. has 7-inch tube, cabinet antenna, tunes all VHF channels. Priced at $179.50. Model 9-425. *Crosley Division, Avco Mfg. Corp., Cincinnati.*

GENERAL COMPONENTS

High-Voltage Resistors:

Molded resistors, intended as voltage dividers, are rated at 4 watts, 100 to 100,000 megohms, at 10,000 volts DC with 75°F. temperature and 50% relative humidity. Tolerance plus and minus 10%. Length 7⅞ inches, diameter 5/16 inch. Type 80X. *S. S. White, 10 E. 40th St., New York 16.*

Small Relays:

Aircraft-type relays 2¼ inches high, 21/16 inches wide, 1⅞ inches deep have contact combinations up to 4-pole, double-throw. For operation up to 230 volts, 60 cycles AC or 115 volts DC. Type DO. *Amer. Relay & Controls, Inc., 4925 W. Flourney St., Chicago 44.*

Saturable-Core Reactors:

Two types are available, built to customer specifications, for control circuits to provide automatic line-voltage regulation and for DC power supplies. *Sorenson & Co., Inc., Stamford, Conn.*

Plugs, Jacks, Switches:

Catalog of 12 pages gives specifications and mechanical drawings of plugs, jacks, and switches of many types for low-power circuits. Catalog S49. *Switchcraft, Inc., 1328 N. Halstead St., Chicago 22.*

Dust Caps for Connectors:

Screw-on caps protect male or female connectors when open, excluding dust, dirt, moisture, and mechanical damage. Available for all AN connectors. *Amer. Phenolic Corp., Chicago 50.*

Video-Circuit Trap:

A permeability-tuned, 4.5-mc. trap comprising a coil and shunt capacitor. Operates in the first video amplifier, attenuating the 4.5-mc. beat which exists in IF stages handling both picture and sound IF carriers. Type 203L5. *RCA Victor Div., Harrison, N. J.*

Heat-Dissipating Connectors:

To make connections to plate and grid terminals of Eimac tubes. Their use aids in keeping seal temperatures at safe values, and increases effectiveness of forced-air cooling. *Eitel-McCullogh, Inc., San Bruno, Calif.*

Blocking & Stabilizing Coil:

A horizontal-blocking oscillator coil and shock-excited frequency-stabilizing coil for use in TV receivers employing the 6SN7-GT as a combination horizontal blocking-oscillator and sync-control tube. Type 203R2. *RCA Victor Div., Harrison, N. J.*

COMMUNICATIONS EQUIPMENT

25- to 50-Mc. Mobile Units:

Circuits are designed for 20- or 40-kc. modulation band. The former is intended to permit adjacent-channel operation. Mobile transmitters have 30 or 50 watts output; associated fixed transmitters are rated at 50 and 250 watts. *General Electric Co., Communications Section, Electronics Park, Syracuse, N. Y.*

Bench Power Supply:

For bench-testing mobile radio equipment. Operates from 115 volts AC. DC output is variable from 0 to 8 volts. Can be used to deliver 10 amps. continuously, 30 amps. intermittently. *P. R. Mallory & Co., 3029 E. Washington St., Indianapolis 6.*

7-Channel Carrier Equipment:

Units designed for rack mounting provide up to 7 talking circuits with associated ring-down or dial-signaling channels from a 2-way radio link. Spectrum of 0 to 35 kc. is utilized. *Lenkurt Electric Co., 1126 County Rd., San Carlos, Calif.*

TEST & MEASURING INSTRUMENTS

Transmission Measuring Set:

Moderately-priced unit on rack panel for checking frequency response, impedance matching, and gain measurements. Accuracy plus or minus 1%, 20 to 20,000 cycles, attenuation to 111 db in .1-db steps. Model 11A. *Daven Co., 191 Central Ave., Newark 4, N. J.*

VHF Analyzer:

Oscilloscope with coaxial, wide-band mixer operates on 30 to 500 mc. Signals can be studied within a 30-mc. range at one time. High sensitivity permits use of signals down to 100 microvolts. Price $895. *Kay Electric Co., Pine Brook, N. J.*

Measuring Instruments

Three new instruments include null detector and vacuum-tube voltmeter for AC bridge measurements; universal bridge for measuring inductors and capacitors; AC power supply with continuously variable output. *Freed Transformer Co., 1718-36 Weirfield St., Brooklyn 27.*

Ultrasonic Analyzer:

Panoramic type of oscilloscope shows presence of all frequencies between 2 kc. and 300 kc. at one time. For analyzing ultrasonic vibrations from any source. Full scale deflection from 1 millivolt input. *Panoramic Radio Products, Inc., 10 S. 2nd Ave., Mt. Vernon, N. Y.*

Microwave Test Equipment:

Units for 2,700 to 3,200 mc. include a transition for coaxial cable to wave-guide, variable attenuator, standing-wave dector, and a termination. *Varian Assoc., 81 Washington St., San Carlos, Calif.*

VACUUM TUBES

19-Inch Short-Neck Tube:

New 19-inch cathode-ray tube is 21½ inches long. Designed to reduce cabinet depth of TV receivers. Shorter beam throw is described as giving sharper picture. *Du Mont Laboratories, Inc., Passaic, N. J.*

Transmitter Triode:

Type 304TL is a low-mu power triode for use as an amplifier, oscillator, or modulator. Plate dissipation is 300 watts. Operates at maximum ratings at frequencies up to 40 mc. *Eitel-McCullough, Inc., San Bruno, Calif.*

3-Inch Cathode-Ray Tube:

Type 3KP11 is intended for oscillograph use. Blue radiation, of short duration, is highly actinic and suitable for moving-film recording. High deflection sensitivity, with electrostatic deflection and focus. *RCA Victor Div., Harrison, N. J.*

ANTENNAS

VHF TV Antennas:

Combination high-band and low-band design, with separate orientation, is pre-assembled to reduce working time for installation. *Ward Products Corp., 1523 E. 45th St., Cleveland.*

Antenna Data:

Performance curves and field patterns of TV and FM antennas show results to be expected from each type of antenna. Catalog 30. *Technical Appl. Co., Sherburne, N. Y.*

BOOKS

Papers on UHF:

RADIO AT ULTRA-HIGH FREQUENCIES, Vol. 2, 1940-1947, a compilation of papers written by RCA engineers, 485 pages, 6 by 9 inches, cloth bound. Papers are grouped as follows: antennas and transmission lines, propagation, reception, relays, micro-waves, measurements and components, aids to navigation. Included in each section are summaries of related papers. A bibliography lists 330 papers on UHF by RCA authors, published from 1925 to 1940. Price $2.50. *RCA Laboratories Division, Princeton, N. J.*

Television Simplified:

UNDERSTANDING TELEVISION, by Orrin E. Dunlap, Jr., RCA vice-president in charge of advertising and publicity, 128 pages, 5½ by 8 inches, cloth bound. A non-technical explanation of television in which the text is supplemented by the generous use of interesting photographs and drawings, and a glossary of terms. An excellent book for those who want to acquire a general knowledge of television without going into technical details. Price $2.50. Published by *Greenburg, 201 E. 57th St., New York 22.*

Advertisers' Index

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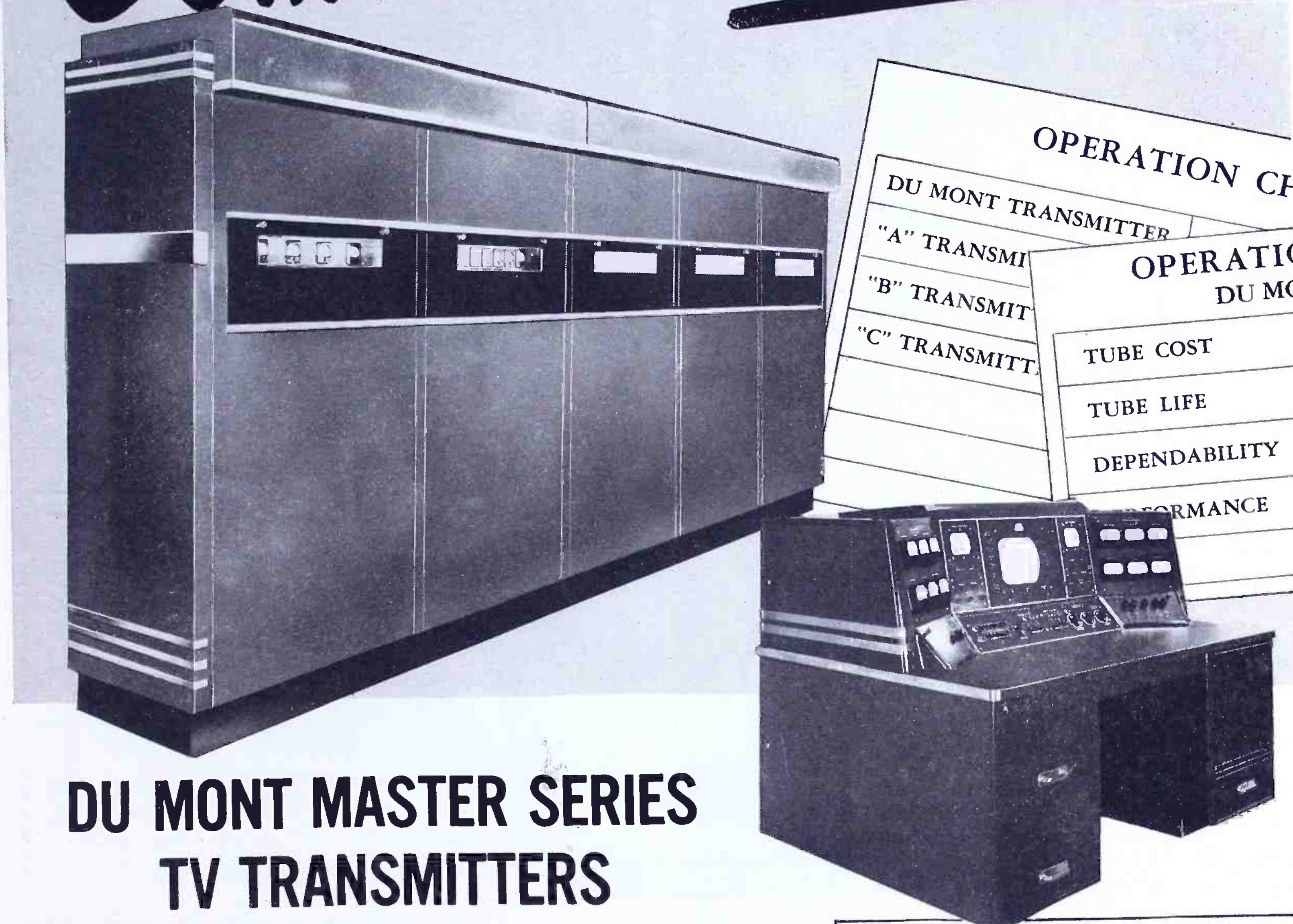

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FM-TV

Formerly, *FM* MAGAZINE and *FM* RADIO-ELECTRONICS

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CONTENTS

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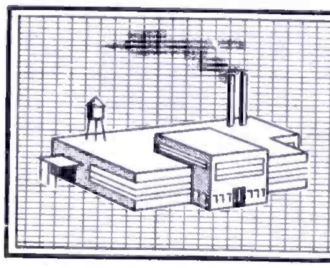
ABC



Set Production

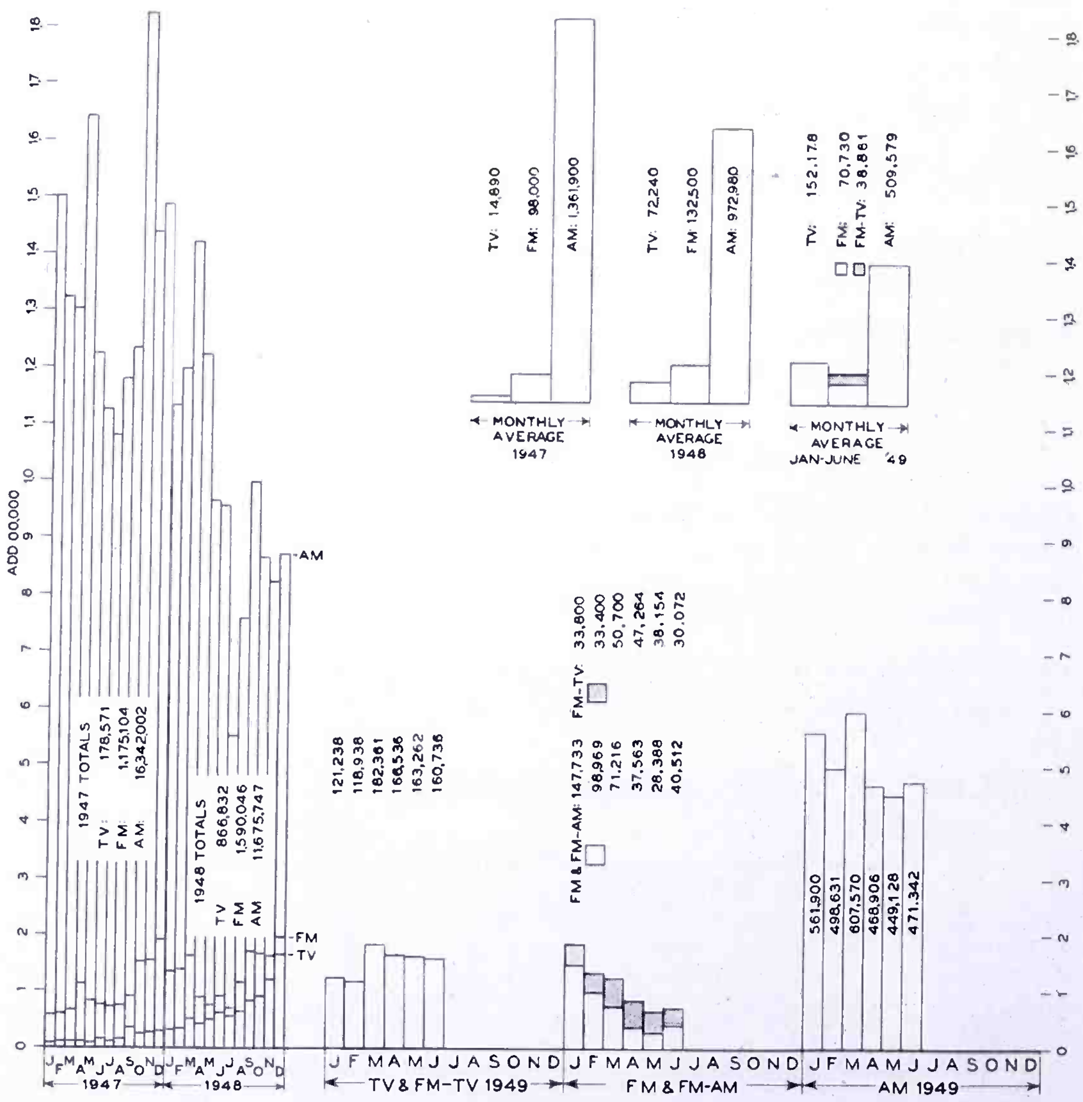
THE only important change in June production was a reversal of the five-month drop in FM sets. It's hard to tell how fast FM will bounce up from the low in May. However, the industry has been watching closely Zenith's success with the $39.95 Major model. It so far exceeds the capability of any low-priced AM set in delivering radio entertainment that there just isn't any comparison. If you haven't heard the Major, you have a surprise coming. You may have trouble getting one. Although Zenith is struggling to step up production, the demand is building up a backlog of orders which belies the statement that FM is dead.

In the AM category, RMA figures for the first six months of '49 show home sets trailing other types. Only 1,220,098 table models, consoles, and phono combinations, including export types, were shipped in that period. The balance comprised 1,150,905 auto sets and 686,474 portables, making the 6-month total 3,057,477 AM units.

This represents a drop of 56% below AM production in the same period of '48 when 6,817,621 sets were produced. On the basis of last year's figures, it can be expected that less than 5 million AM sets will be manufactured this year. That is a drop of almost 60% in number of AM sets, but a loss of dollar volume to the industry of more nearly 80%, because '48 production included many expensive phonograph combinations.

One lesson to be drawn from experience this year is that the day of radio furniture is virtually over. Even television sets reflect the new attitude of our American public, for '49 production figures show 591,482 TV table models, against 321,589 consoles, with current console demand dropping steadily.

Next step in the trend toward functional design will be the introduction of TV and FM sets in plain metal cabinets, complete except for the speaker, carried separately in an equally plain enclosure of wood.



TV, FM, and AM Set Production Barometer, prepared from RMA figures

Things You Should Know About:

TV: The most complete analysis of the FCC's new proposal for revising TV rules and allocations appeared in the August issue of *FM-TV*. Prepared for the use of broadcasters and equipment manufacturers, it includes a breakdown of potential audiences and markets. This analysis is presented in such convenient form that you will refer to it again and again. Copies of the August issue are still available.

FM: The most-discussed audio receiver is the little super-sensitive Zenith Major, an FM-only model that sells for $39.95 and delivers finer entertainment than any AM-only set at that price. If you are interested in the details of this receiver, you'll find them in the April issue of *FM-TV*, in an article by G. E. Gustafson, Zenith's vice president in charge of engineering. April copies are still available.

AUDIENCES: Receivers represent audiences. If you want to know the trends in TV, FM, and AM audiences, how they are growing or shrinking, watch the Set Production Barometer on page 4 of every issue of *FM-TV*. You can plot what's ahead by watching the monthly figures against the background of 1947 and '48 sales.

MOBILE RADIO: The October issue of *FM-TV* will carry detailed specifications of all mobile radio transmitters and receivers, and associated fixed-station equipment. It is the only compilation of such data, enabling you to check every feature right down to tube types and current drain. Also, October will contain the 4th and final part of the data on mobile radio rules and allocations. This will be on the transportation services.

AUDIO: Feature articles in the October issue will be devoted to audio developments related to broadcast transmission and reception, and recording. These will be timed with the AES Convention in New York City, October 27th to 29th. Watch for papers of outstanding interest, written by some of the leading authorities in this field.

***FM-TV* MAGAZINE**
GREAT BARRINGTON, MASS.

THIS MONTH'S COVER

One of the most useful, new service instruments is the antenna compass shown in use on this month's front cover. It's a dual-range meter that can be connected to the receiver by an extension cord as long as is necessary. As the antenna is turned around, the meter shows the strength of the signal received. This is faster and more accurate than talking the antenna into position, with someone at the set to shout up or report by telephone. There are other specific advantages in working by direct meter indication, as explained on page 13.

WHAT'S NEW THIS MONTH

A Criticism of the FCC's Television Proposal

The FCC's plan for allocations has not been received favorably by the radio industry. Expressed in terms which can be published, opinions of executives and engineers were summarized accurately when we said last month: "From any angle of approach, it is easy to find many faults in the plan. If, however, it is examined in the light of its intended purpose, *viz.*, to give the best service possible to the greatest number of people, there is little to criticize except that from a commercial point of view, the allocations are unrealistic."

Comments we have heard in New York, Philadelphia, Washington, and Boston, and over the telephone from points west, were much less moderate but no more specific.

Putting them all together, it seems that the manufacturers and broadcasters are in a very unhappy mood, and the FCC plan just rubs them the wrong way at a time when, with certain notable exceptions, video business is not showing a profit, and has knocked the props from under audio business.

The TV allocations shed no ray of light and hope on this situation, and it's hard to see how any plan could. The proposed addition of 42 six-megacycle UHF channels for which no equipment has been developed, an allocations table listing channels for hundreds of areas that cannot support TV stations, and the invitation to discuss color even before anyone has found the formula for black-and-white profits are just new irritants to an industry that is in the throes of the worst headache it has ever experienced.

To make a bad job still worse, the new plan has broadened the gulf between the radio industry and the FCC. Let's examine the three most obvious faults in the FCC proposal.

Allocations in the UHF Band:

The FCC takes the position that, unless they apply pressure, the industry will not push ahead with UHF development, and large parts of the country will have no TV service because of the shortage of VHF channels. The facts are:

1. The industry's VHF efforts have run up a tremendous financial loss, and plain business sense indicates that VHF television broadcasting and set sales must at least show a promise of reaching the break-even point before the large investment necessary can be made in UHF development.

2. It is certain that, when the industry is prepared economically to undertake commercial UHF development, considerable further improvement will have been made in video quality. What it will be, or what direction it will take, no one knows.

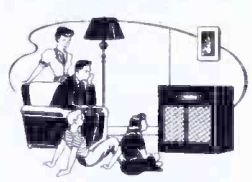
However, we can be sure that further development will be limited by the present 6-mc. channel width and the VHF standards of transmission. We said last April[1]: "The possibilities for further development of television are unlimited. Today, it is only in its initial stage as a public service. The industry is only beginning to raise its sights to look into the possibilities of UHF television. For all the limitations imposed by the 12 VHF channels, the present technical and economic situation is such that television will not start to use the higher band until there is a UHF system of such superior performance as to make VHF service obsolete by comparison."

3. That opinion is widely held in the industry today. But the planners are prepared to stifle television development

[1] "Obsolescence of TV Receivers" by Milton B. Sleeper, *FM-TV* April, 1949.

(*Continued on page 8*)

Admiral
Andrea
ARVIN
Automatic Radio
Belmont
Bendix Radio
CROSLEY
Emerson Radio
ESPEY
FADA Radio
Farnsworth
GAROD RADIO
GLOBE
hallicrafters
Hoffman
Magnavox
Motorola
National
Olympic
PHILCO
Regal
Sentinel Radio
Silvertone
Sparton
STROMBERG-CARLSON
Tele-tone
Temple
TRAV-LER
Westinghouse
ZENITH RADIO



Sub-miniatures, seven- and nine-pin miniatures, standard types, and the great Lock-In radio tubes are all included in the famous Sylvania line . . . all represented in the leading makes of home receivers—from portable models to console combinations and television receivers.

It is the high quality of these Sylvania tubes that has made them preferred . . . has made them famous throughout the world.

For full information about Sylvania tubes, see a Sylvania Distributor, or write Sylvania Electric Products Inc., Radio Tube Division, Emporium, Pa.

SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; PHOTOLAMPS; ELECTRIC LIGHT BULBS

WHAT'S NEW THIS MONTH

(Continued from page 6)

in its infancy by tieing down UHF development to the bandwidth used for VHF in the first commercial equipment ever to be put in operation.

Both radio and automotive industries have grown in public service by making a virtue of obsolescence based on technical progress. But the FCC, all the way back to the administration of Lawrence Fly, has spent its energies on effectuating ideologies, rather than facilitating the development of the industry in the service of public interest, convenience, and necessity. And now, sounding out the future of TV expansion with its ears tuned to voices on Capitol Hill, the Commission has decided that the optical quality of television must be frozen at the present standards, without waiting to see what improvements will come with UHF equipment when UHF equipment has been developed.

Allocations vs. Markets: Why, if industry is so dissatisfied with the TV allocations plan, haven't better plans been offered? There are several very good reasons.

The industry is not ready to go into UHF. Less than 20% of the transmitters which can be accommodated on VHF have been installed. During the current freeze, the limited number of markets for receivers has engendered the most devastating price competition that has ever existed in a business where prices have never been stable. The Government planners wouldn't know about it, but the manufacturers may not be able to invest in UHF development before VHF sales have climbed a reassuring distance beyond the break-even point.

The new allocations proposal is not self-explanatory, and the FCC, consistently indifferent to industry relations despite its protestations to the contrary, has not seen fit to issue more than a formal statement to accompany the allocations table.

The analysis of allocations to cities of 100,000 population and over, published on the front cover of *FM-TV* for August, 1949, is not a picture of practical thinking. It shows 164 channels for 40 VHF-only areas, 88 VHF and 65 UHF channels for 37 more areas, and 59 channels for 25 UHF-only areas. Of the 102 areas with 100,000 population or more, only 46 would have 4 VHF stations or more, while 56 would have 1 to 3 stations.

On the other hand, 2 VHF and 3 UHF channels are provided for Augusta, Me., with 19,000 population, and 3 VHF and 2 UHF channels for Sheridan, Wyoming,

(Continued on page 9)

WHAT'S NEW THIS MONTH

(Continued from page 8)

with 11,000 population, to pick just two examples.

Altogether 1,056 allocations are proposed for 880 areas of less than 10,000 population. It is obvious, therefore, that in 62% of the 1,420 areas where allocations are planned, TV stations will never be built!

Does this mean that 42 UHF channels are not needed to provide service where the population density is sufficient to support transmitters? Or, to put it differently, if allocations were made only to areas above 50,000 population, to take a very low figure, how many channels would be needed?

Frankly, we don't know. We haven't found anyone who does. The FCC may know, but they saw fit to leave the industry in the dark on that important point. So no one understands the significance of allocations to Hermitage, Missouri, with 75 families, or to Rankin, Texas, with 50 families.

Then there's the VH-UHF headache. Experience shows that at least two stations are required to build an audience large enough to support TV broadcasting. In 12 VH-UHF areas, ranging from 110,000 to 712,000 population, only 1 VHF channel is proposed. People in those areas aren't going to buy VHF sets to receive one TV station when they know that added local service, if, as, and when available, will be on UHF. And who would want to build a VHF station with the knowledge that he may have to plug along alone for several years?

Color Television:

As if to prove that Government planners never miss an opportunity to upset an industry's apple cart, the FCC has seen fit to stir up a tempest in the color teapot. With the disregard for realistic thinking that characterizes those who attempt to run business which is not their own, the Commission apparently thinks that someone can pull a color rabbit out of the 6-mc. hat.

Probably all the excitement stemmed from the remarkably fine color demonstration at the recent convention of the American Medical Association. However, that was neither radio transmission nor was it typical program material. In that demonstration, the camera was no more than 2 ft. from the objects viewed, a condition that is seldom if ever encountered in broadcast studio practice. No statement has been made as to the video bandwidth. Maybe the transmission was in accordance with TV standards, but it's probable that the AMA performance could not be reproduced over the air.

In any case, since the FCC is only interested in color transmission if it can be received by current VHF receivers with "relatively minor modifications," there is no urgency about discussing it at a time when the subject only confuses the main issue of ending the television freeze.

Regulation Does Not Imply Control:

There is an increasing tendency for government officials to give effect to ideologies that are not in harmony with the closely-integrated relationships between industries and consumers. As public servants assume the role of planners, whether developing their own pet schemes or acting under the direction of the political administration, they forget that the life-blood of industry is that uncertain margin between revenue and the cost of doing business. In their economy, the currency is votes and reciprocities.

(Continued on page 28)

ADDING FM TO AN AM ARRAY

WCAO BALTIMORE REPLACED ONE OF ITS TOWERS IN EIGHT DAYS, RESTORED THE ORIGINAL AM PATTERN WITHIN AN HOUR — *By* MARTIN L. JONES & I. MAGER*

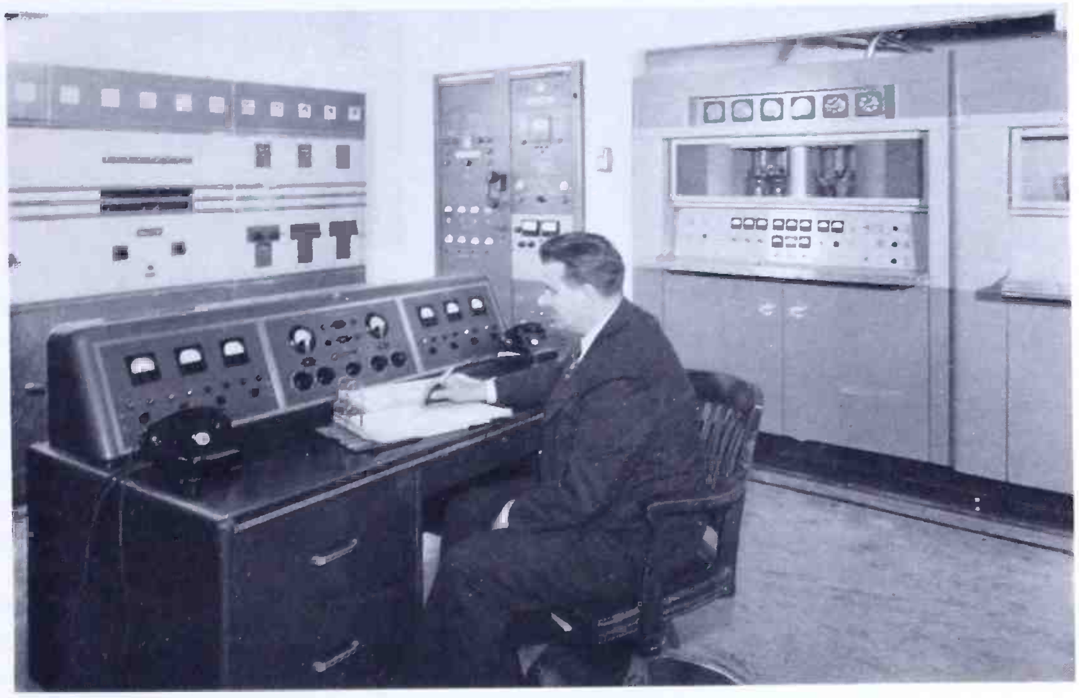


Fig. 1. Transmitter control room at WCAO, supervisor C. A. Seibold, Jr. at the desk

WHEN an AM station adds an FM transmitter, there is no question of affecting AM service if the FM installation is entirely separate. But if an FM antenna is to be mounted on one tower of an AM array, the sales and engineering departments are confronted not only with the necessity for operating on reduced AM power, temporarily, but the problem of restoring the original AM field pattern.

Lest others may be dismayed at the prospect of such an undertaking, this account of actual experience at WCAO Baltimore is offered as assurance that it is a relatively simple project, and can be completed within a surprisingly short period of time.

When station WCAO constructed a new transmitter building in 1941, FM was in its infancy, but space was provided for the possible future addition of an FM transmitter. At that time, the station had a construction permit to increase AM power to 5 kw. on 600 kc. Accordingly, the building was designed to house a Westinghouse type 5-HV transmitter, a 1-kw. stand-by transmitter and power division and phasing equipment for a 4-tower directional antenna array.

The antenna array consisted of four, 300-ft. towers in a straight line, fed by open-wire transmission lines. To provide a maximum of reliability and flexibility in operation, and to reduce time spent in tuning up the array, no expense was spared in installing adequate antenna tuning equipment. This foresight paid off six years later.

Fig. 1 shows the completed transmitter installation and control console. Part of the AM transmitter can be seen at the left, with the adjacent section containing the power division and phasing networks, with front-of-panel controls which provide a wide range of adjustment for each network. Common-point and transmission line inputs are indicated by the top row of RF meters.

Two separate racks carry monitoring, measurement, and certain control equipment. Below the phase monitor, on the left hand rack, are 4 meters which show antenna current at the base of each tower by remote indication. Just below are four meters and four telephone-type, double-throw key switches. Each key switch, by remote control, operates a motor-driven coil located in the matching network at the base of each antenna tower. The meter corresponding to each key switch indicates the position of the

Fig. 2. Array at WCAO, with new No. 1 tower and FM antenna in the foreground

*Respectively, Chief Engineer, Station WCAO, Baltimore, Md., and Sales Engineer, Electronics and X-Ray Division, Westinghouse Electric Corporation, Baltimore, Md.

variable tap on its coil. Thus, in the transmitter building and within reach are all the control and monitoring facilities necessary to adjust and observe the operation of the antenna array.

When WCAO applied for an FM construction permit, a site survey was made. It was determined that the AM location, Fig. 2, would be suitable because it has high elevation relative to, and a gradual slopedown to, the city of Baltimore.

It was decided to install a 3-kw. transmitter and low-gain antenna system for initial FM operation. A Westinghouse type FM-10, 10-kw. transmitter was purchased with the arrangement that the 3-kw. driver be delivered first, and the 10-kw. amplifier added at a later date. Work was started on that basis when the construction permit was received. The antenna system for interim operation consisted of 1 5/8-in. coaxial cable, an FM-AM isolation unit at the base of the No. 2 tower, and a single-bay turnstile antenna mounted on the top. This antenna system has been left intact and is still available for stand-by use.

Because delivery of a commercially-built FM-AM isolation unit could not be made in time, WCAO decided to build its own. This is shown in Fig. 3. It consists of two inductively coupled, series resonant circuits mounted in a weatherproof metal box. The circuits are tuned easily by adjustable air-di-electric capacitors, using a loosely coupled Q meter.

The tower crew installed the FM antenna and ran the coaxial cable, plus 1/4-in. copper tubing, down the side of the tower in less than 6 hours. The 1/4-in tubing was connected to a fitting in the cable, adjacent to the antenna, so that the line could be readily flushed clean. However, just as soon as the antenna was secured to the tower, the AM array was affected as shown by the befor-and-after observations in Table 1.

TABLE 1

BEFORE ERECTION OF FM ANTENNA

TOWER	I_A	PHASING
1	11 amp.	40°
2	28.6	262°
3	35.3	Reference
4	15.4	92°

Common Point 7.1 amp.

AFTER ERECTION OF FM ANTENNA

TOWER	I_A	PHASING
1	9.2 amp.	37.2°
2	25.2 amp.	258°
3	33	Reference
4	14.6	86°

Common Point 7.4 amp.

Surprisingly, it was not difficult to get the array back to normal adjustment. The operation took but ten minutes. Adjusting the remote tuning control of tower No. 2 to a 1/3-turn reduction in inductance of the shunt coil restored the original current values. A field intensity check of the 6 nulls of the array indicated that normal operation had not been disturbed.

The authors at the rear of the FM unit

The final installation was put in operation about 6 months later. This consisted of adding the Westinghouse 10-kw. amplifier, 3 1/8-in. line, an FM-AM isolation unit, and an 8-bay antenna on a new No. 1 tower. The tower had to be replaced by a stronger one to support a high-gain FM antenna. This antenna has two adjustable cans on its center conductor so that it can be tuned to present a low standing-wave ratio. The tower crew was cautioned not to paint either the cans or the center conductor, but paint them they did! This is not the first time the same thing has happened. The error was discovered when it came time to tune the antenna, and an otherwise perfectly good night was spent scraping off paint. The antenna was tuned with an RF bridge connected to the input to the coaxial cable, and fed by a small amount of energy taken from a low-power stage of the transmitter.

Fig. 3. Isolation unit built at WCAO

To avoid serious interruption to existing AM service during change-over to the new tower, special temporary authority was obtained for interim operation, using reduced power and one of the three other towers. By using two tower crews, only 8 days were required to dismantle the old tower and erect the new one.

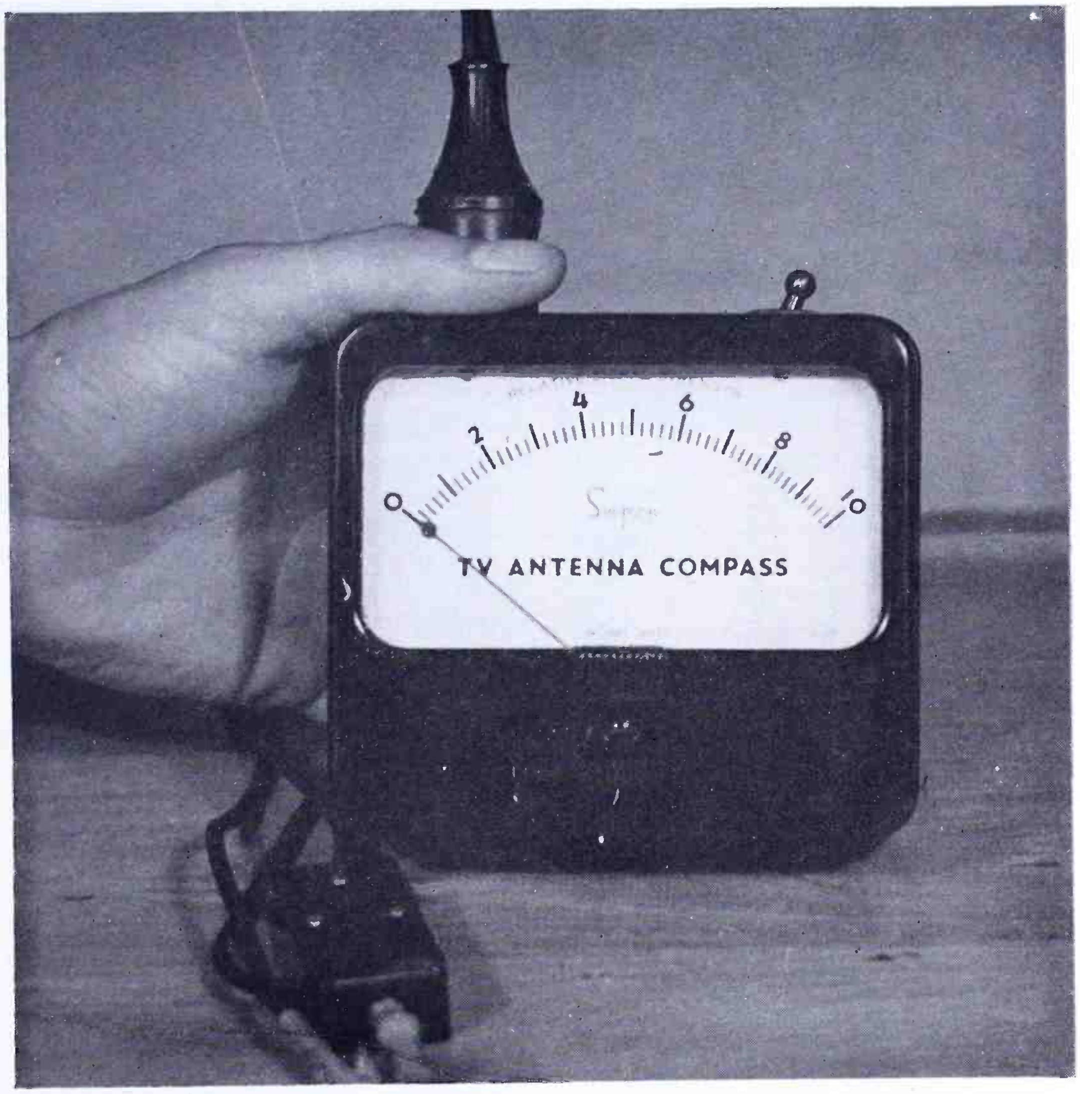
As in the case of No. 2 tower, resonant loop coupling of the FM was used for isolation at the new No. 1 tower. As might be expected, this coupling unit, together with 25-ft. overall increase in height, caused some detuning of the array. The extent of this detuning is shown in the phase and current values preceding and following the change-over. Table 2. Readjustment was not too difficult. Current, phasing, and remote tower tuning controls were available in the transmitter building. The array was adjusted to the original values in all but the new tower. The current in No. 1 tower was reduced by approximately 8% over its original value to allow for the expected increase in radiation.

TABLE 2

WCAO Four-Element Directive Array Operating Constants

	Original		With New Tower (before readjustment)		With New Tower (after readjustment)	
TOWER	PHASE	CURRENT	PHASE	CURRENT	PHASE	CURRENT
1	40°	11.0 amp.	9°	1.2 amp.	37°	10.1 amp.
2	262°	28.6	253°	21.3	261°	28.1
3	Ref.	35.3	Ref.	25.2	Ref.	35.1
4	92°	15.4	71°	19.8	93°	15.0

The validity of this adjustment was confirmed by a field check of the 6 monitoring points. The common-point resistance measurement was made, and the exact operating power established. No further tuning being required, proof of performance field intensity measurements were made at each of the monitoring points, and at locations along the same radials. Additional observations were made along two radials in the direction of the major lobe. Less than one hour was required to readjust the array; approximately three days were required for the field intensity proof of performance measurements.



This Antenna Compass indicates the signal strength fed to FM and TV receivers

LOCATING & ORIENTING ANTENNAS

A NEW METER PERMITS EXACT ADJUSTMENT OF TV-FM & COMMUNICATIONS ANTENNAS—*By* ROY ALLISON*

TO anyone familiar with the erection of VHF and UHF antennas, the use of the Simpson Antenna Compass is a new and surprising experience. The reason is that this instrument, connected to the receiver by a cord of suitable length, enables the man on the roof to follow the changing signal strength exactly as he moves or turns the antenna.

This method is so much more accurate than shouting down or using a telephone to determine the optimum adjustment as to make the latter method seem antiquated. Furthermore, re-checks on antennas installed by voice instructions have disclosed considerable differences, in some cases, between received signal strength and the maximum obtainable by the use of the Compass.

Checking TV Reception:

Essentially, the Antenna Compass is a DC microammeter which measures the video input to the picture tube of a television set. One lead has a small case containing a germanium rectifier. This lead is clipped to the video input of the picture tube at the socket. A needle point is used in the clip to pierce the insulation on the wire. The other lead is connected to the ground return circuit. It should be noted that most sets employ control grid drive, but some employ cathode drive. It is advisable, therefore, to refer to the schematic in order to determine the proper connection. The cable should be plugged into the meter as shown in the accompanying illustration.

If the antenna has been set up temporarily, and connected to the receiver, it is well to check the meter first at the set. Put the range switch in the LOW position, tune in a station, and adjust the contrast control so that the meter reading is at about one-third of the full scale deflection.

Then remove the cable plug from the meter, and connect a length of two-conductor cord between the meter and the cable plug. The meter should show approximately the original reading, and will be ready for use at the antenna.

Of course, if the antenna is mounted on a tower, the only adjustment possible is the orientation. In most cases, the Compass will show the adjustment for orientation to be much sharper than is indicated by merely watching the picture tube.

Experience shows that, if the signals are fairly strong, pickup can be reduced substantially by turning the antenna without affecting the picture noticeably. But with the antenna set for less than optimum pickup, if the signal strength is reduced by seasonal variations, it may drop below the value required for satisfactory signal-to-noise ratio.

The Compass is very helpful when two or more stations are to be received from different directions. Checking the signals on each channel, as the antenna is turned, gives exact answers to the questions of orienting separate upper- and lower-band antennas, and compromise adjustments that will provide sufficient signals from the weaker stations.

If the antenna can be moved around on a roof, the Compass shows the exact changes in signal strength. Often, a difference of a few feet makes a marked difference in the pickup.

Just as conditions vary at each installation, so the method of using the Compass will be different. But in every case, the exact information provided by this instrument removes the inaccuracies and uncertainties which result from trying to adjust the antenna by following voice instructions based on the appearance of received images.

Checking FM Reception:

For FM reception, the method of using the Compass on the roof is the same, but the connections at the set are necessarily different. The meter must be inserted in the grid return of the first limiter tube. Since this is a DC circuit, the germanium rectifier is not needed, but a .1 mfd. condenser must be connected across the points where the meter is cut into the grid return circuit. If that is not done, oscillation will be set up.

The operation of the Compass is the same as a conventional signal strength meter on an FM receiver, with connections extended to the location of the antenna.

For both FM broadcast and point-to-point communications receivers, the use of such an instrument is absolutely necessary when adjusting directional antennas, since a very wide change in the received signal cannot be detected by listening to the loudspeaker. This is due, of course, to the action of the limiter circuits. Consequently, received signal strength must be measured at a point preceding the first limiter.

* Engineering Consultant, North Egremont, Mass.

SPOT NEWS NOTES NOTES AND COMMENTS ABOUT SIGNIFICANT ACTIVITIES OF PEOPLE & COMPANIES

Scavengers of the Air Waves:

Our heartiest congratulations to FCC Commissioners Walker, Sterling, and Webster for their stand against giveaway programs. Whether they are lotteries or not, 30-minute programs that are personal to half a dozen listeners do not serve the public interest, convenience, and necessity. Broadcasting of such program material under FCC license implies Government approval of a national something-for-nothing philosophy which has no place in our United States. ABC has 13 giveaway shows, Mutual 10, CBS 8, and NBC 7. It's a sad commentary on the creative ability of the program directors when they have to give away merchandise in order to hold their audiences. As for the program content of these shows—radio is used only as an accessory to a game of chance played with telephone numbers. This, we hold, never was intended to become an authorized use of broadcast frequencies.

1950 Chicago Parts Show:

Will be held at Hotel Stevens during the week of May 22. New officers of the Show Corporation are: Jerome Kahn president, Walter Jablon vice president, William Schoning secretary, and Les Thayer treasurer, with Kenneth Prince as show manager.

TV Set Production:

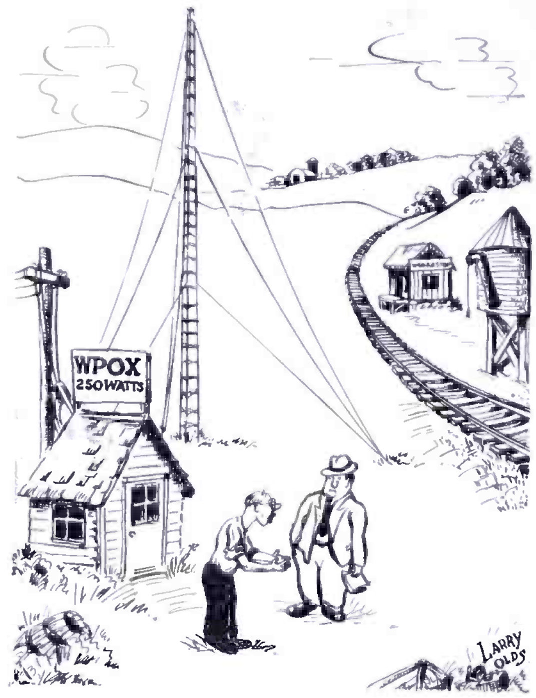
According to J. B. Huarisa, Admiral's executive vice president, production by this company has been increased from 10,000 to 13,500 TV sets per week. Admiral is not a member of RMA, and its production is not included in monthly RMA figures.

Sign of Progress:

CBS officials are listening critically to commercial announcements in an effort to increase their selling power. Dare we hope that, some day, broadcasters will begin to listen critically to their programs in an effort to make them more entertaining?

Commissioner Edward J. Hickey:

The man who staked his personal reputation on the success of FM for Connecticut's State Police system told us recently that since the installation went into operation on October 1, 1940, there has never been an interruption to state-wide police communications. Added the Commissioner: "That's a remarkable record, and the highest recommendation that anyone could give to FM." This was the first state-wide radio system ever installed, and led the way to what has become the universal use of FM for mobile radio. The installation was described in *FM* MAGAZINE, December 1940 and January 1941.



"Does that there FCC proposal mean someone's gonna build a TV station here?"

Picture Size vs. TV Standards:

Disappointment is being voiced widely over picture quality of 16-in. sets. People assumed that they would "see more" in bigger pictures. Instead, they feel that they see less because the defects of small pictures are magnified. Actually, the demand is for better optical quality. This point is so important as to deserve the most careful consideration in deciding on transmission standards for UHF.

Railroad Radio:

New report by the Communications Section of the Association of American Railroads contains 354 pages. Apparently much has been done in developing "non-pressure hot and cold bath treatment of lodgepole pine poles," and the requirement specification for "purple copy and black record ribbons for use in telegraph printers" is just coming along fine, but in the 20 pages devoted to railroad radio, we didn't see much evidence of interest or progress.

4th-Round Wage Demands:

UE officials seeking higher weekly pay, with work-week reduced to increase number of employees, might do well to study financial reports now coming out for first 6 months of 1949. RCA shows gross income up $11 million over same period of '48, but net profit was lower by $728,000. Sylvania increased gross income by $1.4 million, with net profit down $556,000. Philco sales in second quarter of '49 were 24% below same '48 quarter, with net earnings down 56%, while Stewart-Warner's sales dropped 26%, with net profits 57% under the same period of '48. Motorola upped gross income by $6.9 million, with only $258,000 added to net profit. Comments AFL publication *Labor's Monthly Survey:* "Perhaps your employer's prospects are excellent, but if his profit margin is being squeezed by price declines, your future will be more secure if you help him improve his competitive position."

25.8% Preference for AM:

Of 1,000 listeners reached by phone calls, WHA Madison, Wis., reports that 18.4% have FM-AM sets. Of these 74.2% prefer FM reception. Most of those preferring AM explained that certain favorite network programs were not available on FM. An additional 66% of the people called plan to buy FM sets. Zenith models have been promoted actively in this area.

Full-Time FM in Australia:

Sydney now has an FM broadcasting station on the air 7 days a week from 11:00 AM to 10:30 PM.

AES Convention & Exhibit:

The Audio Engineering Society's first convention and exhibit at New York City promises to be an event of unusual interest. It will be held on the 6th floor of Hotel New Yorker, October 27 to 29, with a banquet the first night. Further information can be obtained from George Daniel, Box F, Oceanside, N. Y.

Markets for FM Sets:

FM broadcasting has now progressed to the point where it can show a profit on big-scale promotion of receiving sets. This is indicated by the following comparison of FM and AM stations in the principal markets:

	FM	AM		FM	AM
Baltimore	6	7	New Orleans	7	11
Boston	6	7	New York	12	14
Buffalo	5	6	Philadelphia	10	10
Chicago	14	16	Pittsburgh	9	7
Cincinnati	4	5	Portland	6	10
Cleveland	6	6	Providence	5	6
Columbus, O.	5	4	Richmond	5	6
Dallas	5	5	San. Fran.	8	8
Detroit	6	5	San Antonio	6	9
Kansas City	4	4	Syracuse	4	5
Los Angeles	10	12	Toledo	3	3
Miami	7	6	Washington	9	7
				162	179

WDTV FIELD-STRENGTH REPORT

DATA PRESENTED HERE IS OF PARTICULAR INTEREST BECAUSE OF THE ROUGH TERRAIN IN THE PITTSBURGH SERVICE AREA—*By* THOMAS T. GOLDSMITH, JR.*

THIS report covers field measurements made during the period February 20 to March 25, 1949, to determine the performance characteristics of television station WDTV Pittsburgh.

A total of 1,148 measurements were made, all at a receiving antenna height of 28 ft. above the ground, and all lying precisely on 8 radials at approximately uniform spacing about the transmitter.

Basic Specifications:

Following are brief specifications of the television transmitter and the field equipment used in measurements reported here:

Television Equipment

Television transmitter	Montana & Grizella Sts. Pittsburgh, Pa.
North latitude	40° 29′ 37″
West longitude	80° 01′ 05″
Transmitter power output	5 kw. peak video 2.5 kw. audio
Diplexer efficiency	99.5%
Transmission line eff.	88%
Antenna power gain	3.8
Effective radiated power	Video—16.6 kw. Audio—8.3 kw.
Effective antenna height	815 ft.
Video modulation	Test pattern and program

Receiving Equipment

a. One 2½-ton G. M. C. bus
b. Built-in PE-197, 110-volt, 60-cycle, 5-kva Generator
c. Model M-58 Measurements Corporation field strength meter and standard dipole
d. Hallicrafters S-36 receiver
e. Model 18-B signal generator
f. Du Mont Type 72 Duo-band antenna
g. Du Mont Chatham receiver
h. 40-ft., 72-ohm, dual coaxial transmission line
i. 28-ft. collapsible antenna mast
j. Exacta camera

The receiving equipment was operated by Messrs. Robert P. Wakeman, J. D. O'Neill, and Herbert Ferrell.

Method of Measurements:

Eight approximately equi-spaced radials were laid out, emanating from the WDTV transmitter. The exact azimuths were selected from a consideration of population densities and main arteries of travel. Measurements were made at intersections of roads with these radials at spacings of .5 to 2 miles, the greater spacings being used at the extremities of the radials. At each cluster point, at least 3 measurements were made within a radius of approximately 100 ft.

The bus was equipped with two antennas, one 12 ft. high and the other 28 ft. high. Along the north radial, measurements were made on both antennas at every point. A statistical analysis of the height-gain relationship thus obtained has been made by Kenneth Norton of Central Radio Propagation Laboratory of the National Bureau of Standards and appears in Reference C of the Ad Hoc Committee report to the Federal Communications Commission. As this relationship is not employed in this report, these measurements will not be described in detail here. It was found that, statistically, a linear height-gain relationship exists. This statement must not be construed to mean that at any given location the received signal is linearly related to the height of the receiving antenna, but rather that the median value of a large number of measurements will be approximately proportional to the antenna height. On all other radials measurements were made only at the 28-ft. height.

All measurements included in this report were made using a Measurements model M-58 field strength meter and Du Mont type 72 Duo-band antenna. The field strength meter was calibrated by Measurements Corporation both before and after the survey. The calibration of the type 72 antenna versus the standard dipole is described later in the report.

During the entire survey, the transmission-line voltage at the transmitter was monitored with a diode rectifier and an Esterline-Angus recording meter. An analysis of the tape indicated that no significant variations occurred in this voltage at any time while measurements were actually being taken.

Presentation of Data:

It should be kept in mind that only a very simple dipole antenna was employed, and that no attempt was made to find the best possible location at each cluster. Of the total 1,148 measurements, all ghost-free pictures were classified as weak, good or excellent. Where multi-path conditions existed, pictures were classified as slight ghost or bad ghost.

Obviously, the installation of a receiving antenna having a reasonable amount of gain and some front-to-back ratio would bring many of the weak and good pictures up into the excellent class, and would eliminate many of the slight-ghost conditions.

A second count was made to determine the number of locations within the theoretical primary and secondary service areas actually receiving primary or secondary service. Of the 507 measurements made within the theoretical 5,000-uv/m contour, 47% actually exceeded 5,000-uv/m. Of the 1,081 measurements made within the theoretical 500 uv/m contour, 68% were found to exceed 500 uv/m.

Although these percentages are rather low, it should be pointed out that a very large number of the roads on which measurements were made lie along rather deep river valleys, whereas most of the Pittsburgh suburban residential areas are located on the hill tops. Consequently, these figures probably give a somewhat pessimistic view of the useable television signal in the Pittsburgh area.

Space does not permit reproduction of the 8 radials plotted. However, the one radial shown in Fig. 1 was selected because it is a particularly interesting example of rugged terrain, with a considerable number of measurements made at low points. The abscissa of the radial indicates the distance from WDTV transmitter. The lower ordinate indicates the elevation above mean sea level; and the upper ordinate, the field strength in microvolts per meter. The lower portion of the graph is, therefore, a profile of the radial on a four-thirds earth basis. Cluster points are indicated at their actual locations (elevation and distance) along the profile. The several values of field strength measured at each cluster are shown. A vertical line joins the extreme values, and the arithmetical averages are connected by straight lines. Because of the extreme roughness of the terrain, points on the curve lying between measured cluster points cannot be expected to indicate true values of signal strength. It will be noted that we were frequently obliged to make measurements at two consecutive points in deep valleys separated by a high hill. Obviously, the straight line connecting the low signal

*Director of Research, Allen B. Du Mont Laboratories, Inc., 2 Main Avenue, Passaic, N. J.

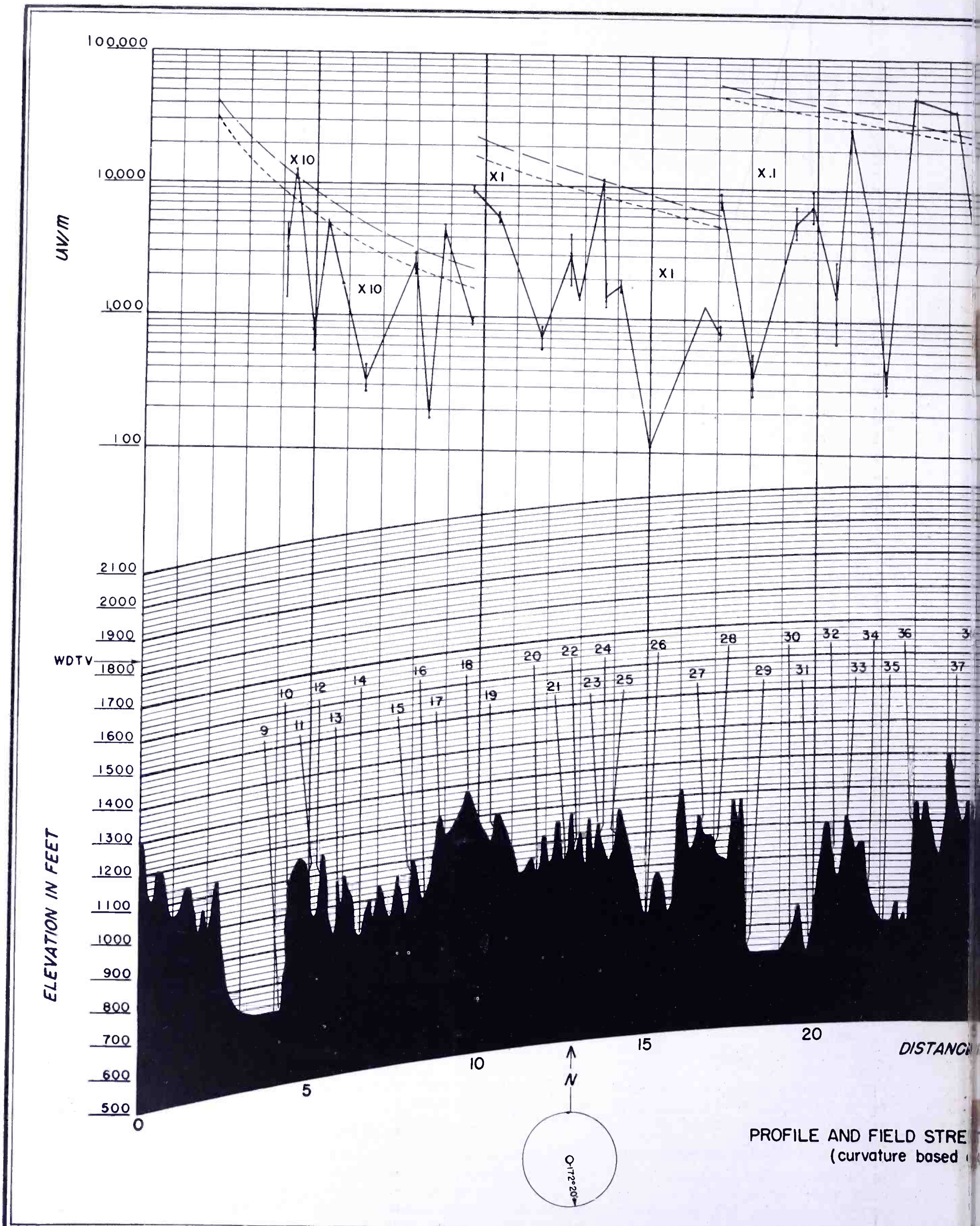
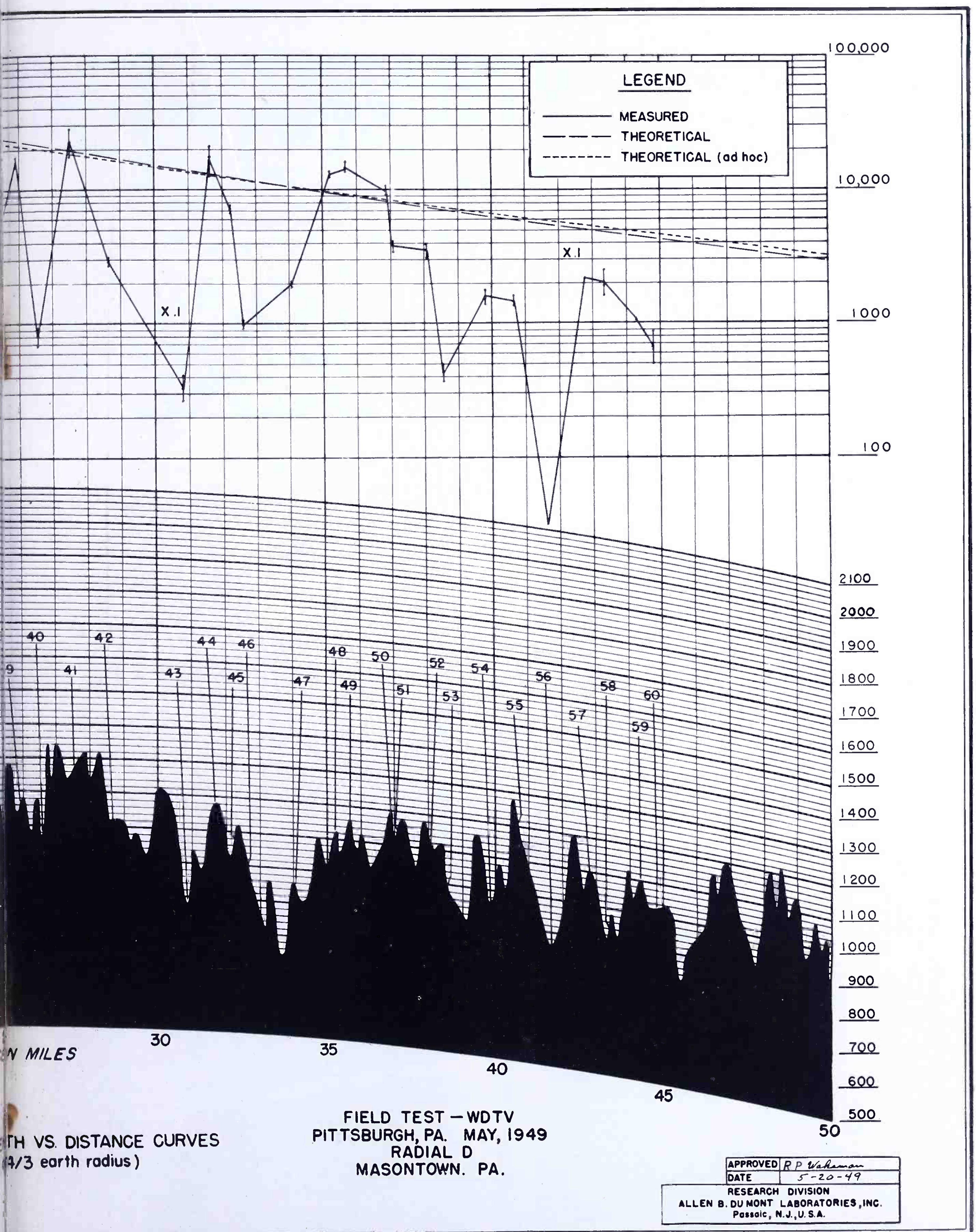


Fig. 1. Theoretical and measured values of field strength from WDTV *Pittsburgh, on channel No. 3. Actual values of the*



eo and audio signals, and description of the picture quality at cluster points 9 to 60 are shown in the accompanying table values obtained in the valleys bears no relation to the probable high signal values which would have been obtained on the hills. The same is true, of course, in places where consecutive measurements were made on hill tops separated by a deep valley.

In addition to the measured data plotted, the smooth earth ground-wave field strength, as calculated by Norton's curves, is shown at the top of the graph. For comparison, the smooth earth ground-wave field strength as corrected by Fig. 1 of the Ad Hoc Committee Report is also shown. As can be seen, this correction in the case of channel 3 results only in a minor decrease in expected signal strengths for points lying within the primary service area and a very slight increase in expected signal strengths in the secondary and fringe areas.

It should be noted that whereas measurements made in New York and other large metropolitan areas have frequently shown considerably greater deviation from the theoretical at shorter distances

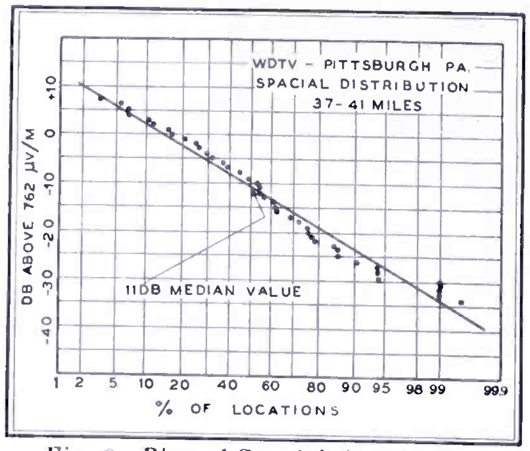


Fig. 2. Plot of Spacial distribution

from the transmitter than at greater distances, this is not particularly true in the Pittsburgh area. In the case of New York City measurements, this condition has been explained as being due to the heavily built-up areas close to the transmitter. In Pittsburgh, however, the absence of large buildings in the secondary service area is entirely counter-balanced by the very hilly terrain. Consequently, we find that the signal strength, as a function of distance, frequently varies to a marked degree throughout the entire area.

Detailed data taken on this radial is presented in the accompanying table. The three readings of microvolts per meter taken at cluster points for sound and picture signals are shown, with reference letters indicating picture quality. At each location, the antenna was oriented for maximum signals.

Sample Computations:

In order to obtain a suitable conversion factor from microvolts at the receiver terminals to the field strength in microvolts per meter, two locations were selected at which a minimum amount of reflection was experienced. At each of these locations, the field strength was obtained by measuring the voltage received on a standard dipole and dividing this value by λ/π, the effective length of a half-wave dipole. In each case, the field strength was then compared to the voltage measured using the Du Mont type 72 antenna. The average ratio thus obtained was

$E = 0.87e$

where

E = field strength in microvolts per meter

and

e = voltage at receiver terminals in microvolts

A laboratory setup to determine the relationship between voltages measured on the M-58 and RMS sync peak voltages was made by Mr. J. Minter of Measurements Corporation. This calibration was made for both the test pattern and typical television programs. It was found that the instrument reads essentially pedestal level regardless of modulation.

As the RMA standards specify that this voltage is to be 0.75 times sync peak voltage, a factor of 1.33 was used to convert from meter reading to sync peak. It is believed that the error resulting from a deviation from the RMA standard is a second-order effect. A second factor of 1.07 was employed to convert from the 28-ft. height at which our measurements were made to the 30-ft. height on which the theoretical curves are based.

Conclusions:

This is probably the first time that a complete field survey has been made in an area having terrain of the type found around Pittsburgh.

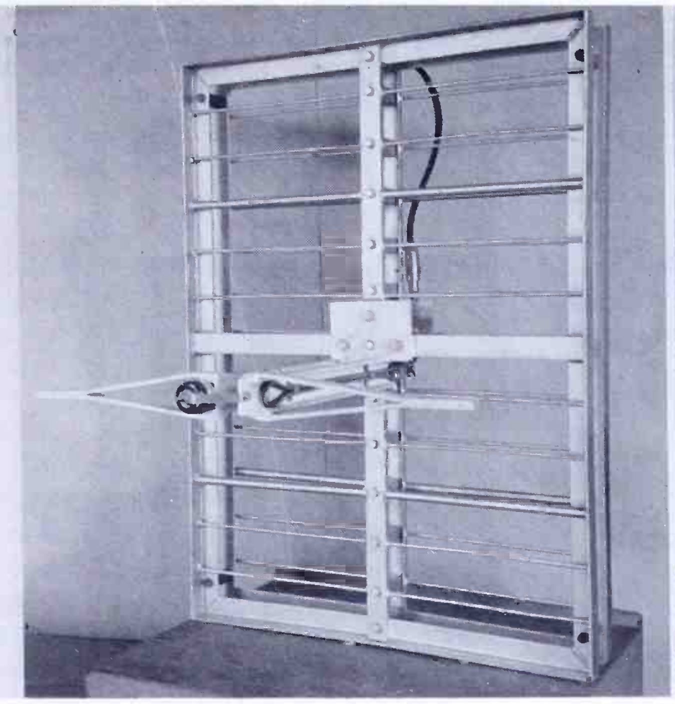
In accordance with methods suggested in the report of the Ad Hoc Committee to the Federal Communications Commission, a sample analysis of spacial distribution of field strength has been made. The results of this study are shown on the

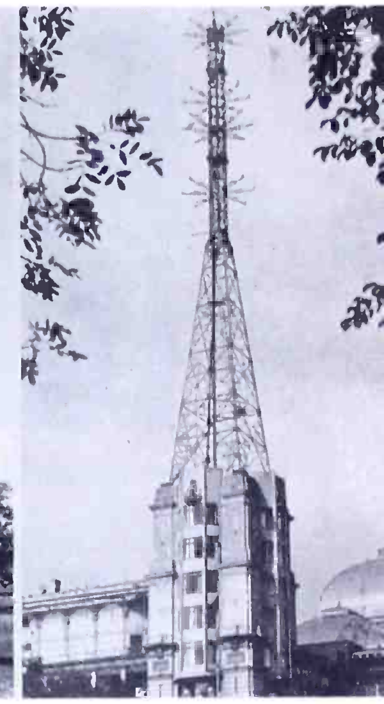
(Concluded on page 30)

MEASUREMENTS MADE ON RADIAL D

Pt. No.	MI.	SOUND, UV/M			PICTURE, UV/M			Pic. Qual.
		MARCH 14, 1949 11:21 AM to 3:45 PM						
9	4.2	33,000	24,000	23,000	50,000	13,600	31,000	EX
10	4.4	55,000	65,000	49,000	124,000	109,000	112,000	GD
11	5.0	8,700	8,200	8,700	8,700	5,500	9,500	SG
12	5.2	36,000	44,000	39,000	53,000	47,000	50,000	BCT
13	5.8	21,800	18,600	16,400	17,300	17,300	17,300	BCT
14	6.4	2,180	3,300	1,960	4,300	2,700	2,850	BCT
15	7.9	15,200	18,600	25,000	22,000	21,000	30,000	BCT
16	8.3	1,640	1,850	1,520	1,730	2,350	1,980	SG
17	8.8	39,000	38,000	39,000	39,000	43,000	50,000	SG
18	9.7	9,000	8,500	8,200	9,900	8,700	8,700	EX
19	10.4	5,700	5,300	3,700	6,200	5,200	5,800	EX
20	11.8	650	550	480	870	740	580	NSY
21	12.5	3,100	2,180	1,310	4,300	3,100	1,740	EX
22	12.8	980	1,200	1,090	1,500	1,360	1,360	BG
		MARCH 7, 1949 4:55 PM to 8:49 PM						
23	13.5	7,800	7,600	7,400	11,200	9,400	10,500	EX
24	13.6	1,420	1,310	1,200	1,860	1,360	1,240	EX
25	14.1	1,530	1,640	1,200	1,740	2,000	1,600	EX
26	15.0	55	33	82	99	81	161	WK
27	16.6	930	980	1,040	1,240	1,240	1,240	EX
28	17.1	820	550	760	700	920	740	EX
29	18.0	33	33	22	55	31	27	BG
30	19.3	380	360	380	430	470	740	GD
31	19.8	370	550	490	570	600	990	FR
32	20.6	240	164	142	285	68	99	FR
33	21.0	3,100	2,940	2,730	3,400	2,600	2,500	EX
34	21.7	310	370	390	470	530	480	FR
35	22.1	12	14	12	43	32	28	WK
36	22.9	3,900	3,600	3,400	5,100	5,000	4,800	EX
		MARCH 3, 1949 12:01 PM to 6:49 PM						
37	24.1	3,500	3,500	3,300	4,000	4,100	3,900	EX
38	25.0	164	230	55	270	136	150	FR
39	25.9	1,040	1,090	1,040	1,740	1,600	1,500	EX
40	26.5	65	53	45	93	84	68	BG
41	27.5	2,300	2,400	2,500	1,740	2,100	2,850	TG
42	28.7	230	300	250	310	300	270	TG
43	30.9	30	30	27	35	41	27	SG
44	31.7	930	1,750	1,640	1,240	1,740	2,100	EX
45	32.2	650	580	560	740	710	690	SG
46	32.7	65	79	69	94	107	94	WK
47	34.1	174	174	153	210	200	186	WK
48	35.2	1,090	980	940	1,360	1,360	1,240	EX
49	35.6	1,860	1,640	1,420	1,600	1,360	1,360	EX
50	36.9	850	910	820	940	1,050	910	EX
51	37.1	153	196	218	340	400	370	GD
52	38.1	310	262	262	310	390	390	FR
53	38.6	31	38	38	37	41	50	WK
54	39.9	142	164	153	136	150	174	WK
55	40.7	98	142	109	136	160	136	WK
56	41.7	Signal could not be measured						
57	42.8	218	262	251	210	222	222	FR
58	43.4	15	13	13	16	25	19	WK
59	44.3	104	109	79	108	99	105	WK
60	44.8	87	82	65	87	50	62	WK
00	00.0	00,000	00,000	00,000	000,000	000,000	000,000	WK
00	00.0	00,000	00,000	00,000	000,000	000,000	000,000	WK

PICTURE QUALITY: BCT: Bad coax transmission — BG: Bad ghost — EX: Excellent — FR: Fair — GD: Good — NSY: Noisy — SG: Slight ghost — TG: Transient ghost — WK: Weak.





NEWS PICTURES

AT the top, left, is something new in a super-gain television antenna built by RCA for WBNT, Columbus. The adjacent photograph shows a single section of the antenna, comprising a dipole and screen. One unit, 30 by 48 ins., weighs 100 lbs. Since gain is increased by stacking the units, a directional pattern can be achieved by increasing or reducing the number of units on any one side of the tower.

The third picture at the top shows how oil men run up towers in Texas. It hardly seems possible, but this 500-ft. mast was assembled completely, right down to the tower lights and a relay dipole, on the ground. Then, with a boom and donkey engine, it was pulled up to a vertical position. This particular antenna, at Thompson, Texas, 30 miles south of Houston, is part of a Link Radio mobile system operated by the West Production Company.

Quite different from television types in this country is the design of the BBC's installation at Alexandra Palace, North London. This is the only television station in the British Isles.

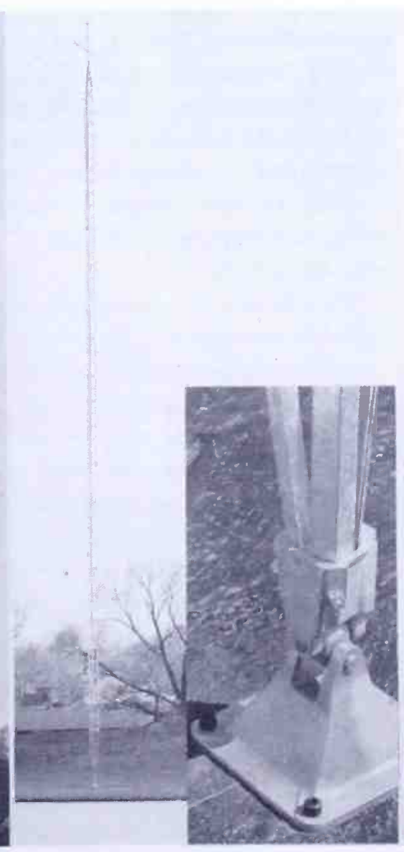
On the bottom row, the photograph at the left shows A T & T's tower design for microwave relays which will soon connect New York City and Chicago. This type, of reinforced concrete construction, carries a heavy load inposed by four lens antennas, and houses the considerable amount of equipment required.

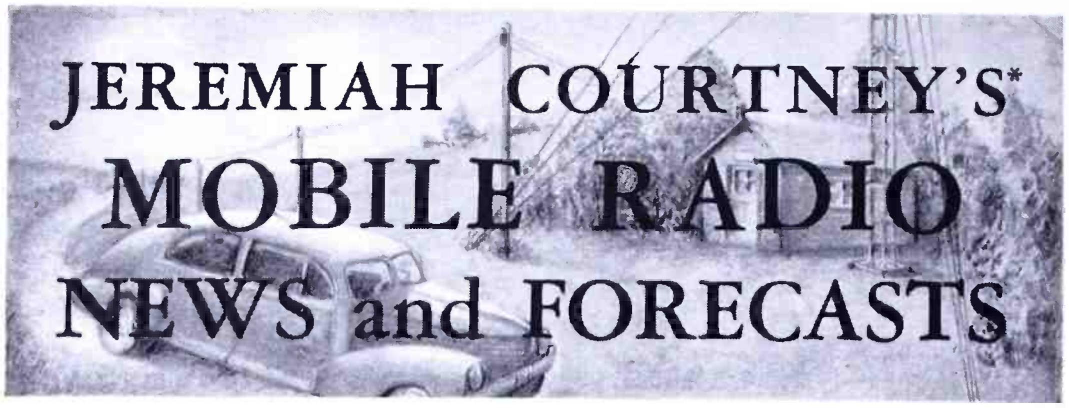
Blaw-Knox furnished the 500-ft. tower for DuMont station WDTV, Pittsburgh. Assembled from 2,700 structural pieces, it weighs 500 tons, and measures 60 ft. square at the base tapering to 5½ ft. at the top.

In sharp contrast is the slim guyed tower produced by Baker Manufacturing Company, Evansville, Wisc. The bottom section tapers to a universal joint, shown in detail, so that the tower can be assembled on the ground and erected in one piece.

The 3-legged, self-supporting tower is also a Baker design. Either this or the guyed tower can be used for a TV or FM receiving antenna, or the antenna of a fixed station in a mobile system.

Orange and white paint give an odd effect to the 350-ft. Blaw-Knox tower at KQV-FM, overlooking Pittsburgh. The 53 tons of structural steel, held together by 5,000 bolts, will withstand a wind of 125 miles per hour. The FM antenna adds 40 ft. to the height.





JEREMIAH COURTNEY'S* MOBILE RADIO NEWS and FORECASTS

THE flow of applications for FM mobile radio facilities has been so constant that the FCC apparently does not recognize that it is supported by the work of equipment manufacturers and their field representatives.

Need for Demonstrations:

At least, the cavalier treatment accorded the manufacturers and their field men in the matter of experimental frequencies for coverage-survey purposes, under the new land-mobile service rules effective July 1, 1949, suggests that the Commission believes that the source of the applications is a spontaneous urge, with which manufacturers' field service has no connection.

This view probably results from the fact that the FCC budget does not permit members of its engineering staff to spend a little time in the field each year. It demonstrates the gulf that separates the staff at Washington from the realities of commercial sales promotion. Applications don't just happen (ask any sales manager!) Somebody has to be sold on the contribution of radio to public safety or the efficient discharge of the applicant's business.

Method Now in Use:

How has all the selling of the past been accomplished? Certainly not by paper charts and oral representations. All manufacturers have held Class 1 experimental authorizations under the old Part 5 Rules. These rules set aside a batch of frequencies for Class 1 experimental purposes in the various mobile bands (1 in the 27-mc. band; 9 in the 30- to 40-mc. band; 1 in the 40- to 50-mc. band; 2 in the 72- to 76-mc. band; and 3 in the 152- to 162-mc. band). The portable and mobile licenses issued for these frequencies authorized operations "within the continental limits of the United States." A single manufacturer would have a license, for example, for all three 152-mc. experimental frequencies. Thus, his field representative could demonstrate to any prospective user, upon his first visit, the exact coverage range of the equipment he was selling.

*Courtesy, Krieger, and Jorgensen, Washington 6, District of Columbia.

Since the beginning of mobile radio, these authorizations have been used by manufacturers' representatives to show the doubting Thomas, far from Washington and its radio experts, what radio can do for *his* business in *his* area.

Actually, the Part 5 Rules provide that experimental stations "shall not be used to demonstrate equipment for prospective sales purposes." This anachronistic provision has been deemed to have been complied with in such cases on the theory that the field tests conducted by the manufacturer's representative were for the purpose of planning the most efficient radio system. Although all equipment sales were officially recognized as being only incidental to research and engineering surveys, sales nevertheless happily resulted; and with remarkable frequency in some fields, such as taxi radio. All of which benefited the affected user-industry, reduced manufacturers' selling costs, and contributed to the FCC's goal of securing maximum frequency utilization in the service of public interest, convenience, and necessity.

Effect of New Rules:

Under the new land-mobile Rules, however, no frequencies were set aside for experimental purposes. All the available mobile frequencies were assigned to various user-services. Employment of any of these user-service frequencies for experimental purposes was also strictly limited to the extent indicated in the NG1 footnote to the Part 2 frequency allocation table:

"NG1. On the condition that harmful interference will not be caused to services operating in accordance with the table of frequency allocations, the following classes of stations may be authorized to use frequencies in this band: 1) Experimental stations engaged solely in scientific or technical radio experiments not related to an existing or proposed service nor intended to develop a proposed service or specific use of radio, 2) contract developmental stations, and 3) export developmental stations."

So that there would be no ambiguity about the restrictive nature of the note, the FCC issued an explanatory release on July 11 (Public Notice 38164):

"In the past, the vast majority of applications for authorizations to conduct field intensity or field coverage surveys have been considered as falling within the class 1 experimental category and have been authorized as such. However, effective July 1, 1949, provisions have been made for such operations in the various mobile Rules of the Commission. Accordingly, operations of this character will no longer be authorized in the Class 1 experimental service but will be considered as falling within the developmental category in the particular service for which the person or organization for whom the tests are being conducted are eligible. For example; if a power utility is proposing a new radio communication system or a change in its existing system which requires field intensity surveys to determine the coverage to be obtained from the proposed system, the power utility would submit application for a developmental class of station in accordance with the Commission's Rules and Regulations governing power utility radio services (Part 11 of the Commission's Rules—industrial radio services). The authorization would then be issued in the name of the power company. This procedure differs from past procedures wherein most of these authorizations were granted to manufacturers or their field representatives to conduct such tests for potential licensees."

In announcing the new procedures no mention was made of the enormous burden that would be placed on the sales staffs of the various manufacturers. The power utility would henceforth have to be sold on radio without benefit of actual observation; if successfully sold, a developmental application would then have to be filed; then the usual application processing delay at the FCC would elapse; one or more revisits to the power utility would be necessary by the sales representative; then, assuming the power utility's interest in radio had not cooled meanwhile, a regular application would have to be filed; and finally, after a second application-processing delay, a construction permit would issue. Altogether, it is a most inefficient method.

Remedy Is Needed Urgently:

The need for remedying this situation is obvious. It affects not only manufacturers but all engineering consultants as well. Either some frequencies must be set aside for field survey purposes or the present rules must be liberalized to make the prospective user's entry into radio less difficult and time-consuming. The FCC staff has the problem under consideration and some remedial action may be expected prior to November 1, 1949, when the present experimental authorizations expire.

What the New FCC Allocations and Rules Mean to the

RADIO COMMUNICATIONS SERVICES

A QUICK-REFERENCE GUIDE TO THE FREQUENCY ASSIGNMENTS AND TECHNICAL REQUIREMENTS FOR THE VARIOUS CLASSES OF MOBILE RADIO SERVICE—Part 3

POWER RADIO SERVICE

Individuals or companies eligible to operate power radio systems are those engaged in generating, transmitting, collecting, purifying, storing, or distributing, by means of wire or pipe line, electrical energy, artificial or natural gas, water, or steam for use by the public, or by the members of a corporation organization; or

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

Applicants and licensees must cooperate in the selection and use of assigned frequencies in order to minimize interference and obtain the most effective use of facilities authorized. Each frequency or band is available on a shared basis only, and will not be assigned for the exclusive use of any one applicant. Such use may be restricted as to geographical area.

Mobile system frequencies have been made available on the basis of single-frequency, simplex operation. Not more than one frequency or band of frequencies will be assigned to a single applicant unless a conclusive showing is made that an additional assignment is necessary to the operation of the system.

Since most fixed, point-to-point circuits require simultaneous 2-way communication, it will be customary to assign two frequencies or bands with such frequency separation, where possible, as to allow full duplex operation.

Emission Limitations: Bandwidth for AM phone is 8 kc.; for FM phone, 40 kc. The specified band shall contain those frequencies on which 99% of the radiated power appears, extended to include any discrete frequency of which the power is at least .25% of the total radiated power. Radiation in excess of these limits is considered unauthorized emission. Emission appearing on any frequency removed from the carrier frequency by at least 50% but not more than 100% of the maximum authorized bandwidth must be attenuated not less than 25 db below the unmodulated carrier. Spurious or harmonic emission appearing on any frequency removed from the carrier frequency by at least 100% of the maximum authorized bandwidth must be attenuated below the unmodulated carrier by not less than:

40 db with maximum plate power input to the final stage of 3 watts or less.

60 db with more than 3 watts and including 150 watts.

70 db with more than 150 watts and including 600 watts.

80 db with more than 600 watts.

Modulation: Maximum audio frequency required for speech intelligibility is considered 3,000 cycles. Transmission of higher frequencies will not be author-

POWER RADIO FREQUENCIES

Freq.	Class	Notes	Freq.	Class	Notes	Freq.	Class	Notes
2292 kc.	Base, Mob.	1, 3	48.30	Base, Mob.	5	457.45	Base, Mob.	7
4637.5	”	1, 2, 3	48.34	”	5	457.55	”	7
35.06 mc.	”	3, 4	48.38	”	5	457.65	”	7
35.10	”	3, 4	48.42	”	5	457.75	”	7
35.14	”	3, 4	48.46	”	5	457.85	”	7
35.18	”	3, 4	48.50	”	5	457.95	”	7
37.46	”	5	48.54	”	5	952	to	
37.50	”	5	72.02	to		960	Fixed	8
37.54	”	5	75.98	Fixed	6	1850	to	
37.58	”	5	153.41	Base, Mob.	5	1990	”	8
37.62	”	5	153.47	”	5	2110	to	
37.66	”	5	153.53	”	5	2200	”	8
37.70	”	5	153.59	”	5	2450	to	
37.74	”	5	153.65	”	5	2500	Base, Mob.	7, 8, 9
37.78	”	5	153.71	”	5		Op. Fixed	
37.82	”	5	158.13	”	5	2500	to	
37.86	”	5	158.19	”	5	2700	Fixed	8
47.70	”	5	158.25	”	5	3500	to	
47.74	”	5	456.05	”	7	3700	Base, Mob.	7
47.78	”	5	456.15	”	7	6425	to	
47.82	”	5	456.25	”	7	6575	”	7
47.86	”	5	456.35	”	7	6575	to	
47.90	”	5	456.45	”	7	6875	Fixed	8
47.94	”	5	456.55	”	7	11700	to	
47.98	”	5	456.65	”	7	12200	Base, Mob.	7
48.02	”	5	456.75	”	7	12200	to	
48.06	”	5	456.85	”	7	12700	Fixed	8
48.10	”	5	456.95	”	7	16000	to	
48.14	”	5	457.05	”	7	18000	”	8, 9
48.18	”	5	457.15	”	7	26000	to	
48.22	”	5	457.25	”	7	30000	”	8
48.26	”	5	457.35	”	7			

[2] Limited to daytime use only, with a maximum plate power input to the final RF stage not to exceed 100 watts.

[3] Available for assignment to base and mobile stations in the power radio service on a shared basis with other services.

[4] Use of this frequency by stations in the power radio service is subject to causing no harmful interference to the marine mobile service.

[5] Available for assignment to base and mobile stations in the power radio service only.

[6] Assignable frequencies spaced by 40 kc. beginning with the frequencies 72.02 and 75.42 mc., and ending with the frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the power radio service on the condition that no harmful interference will be caused to the reception of television stations on Channels 4 or 5.

[7] Available for assignment to base and mobile stations in the power radio service on a shared basis with other services, under terms of a developmental grant only.

[8] Available for assignment to fixed stations in the power radio service on a shared basis with other services, under terms of a developmental grant only.

[9] Use of frequencies in the 2,450- to 2,500-mc. band and 17,850- to 18,000-mc. band is subject to no protection from interference due to the operation of industrial, scientific, and medical devices on 2,450 and 18,000 mc.

[1] This frequency may be subject to change when the Atlantic City table of frequency allocations below 27.5 mc. comes into force.

ized. On FM, deviation due to modulation must not exceed plus and minus 15 kc. from the unmodulated carrier.

Each transmitter authorized or installed after July 1, 1950, must be provided with a device which will automatically prevent modulation in excess of that specified above, except that this shall not apply to mobile transmitters using a maximum plate power input to the final RF stage of 3 watts or less.

Maximum Power: Maximum plate power input to the final RF state shall not exceed 2 kw. at 1.6 to 3 mc.; 500 watts at 25 to 100 mc.; and 600 watts at 100 to 220 mc. Power at frequencies above 220 mc. will be specified in the FCC authorization. Stations presently authorized to use power in excess of the limits specified above may continue their operation until the expiration of their current license term. Power and antenna height shall be no more than the minimum required for satisfactory technical operation commensurate with the area to be served and local conditions which affect transmission and reception.

Transmitter Measurements: Frequency and modulation measurements on each fixed and mobile unit must be made and entered in the log every 6 months, or whenever an adjustment is made that might affect frequency or modulation. Mobile units may be checked on the bench if they are operated under load conditions. The use of automatic frequency monitors is approved for frequency checking.

Any independent, qualified engineering measurement service may be employed, provided the log entries show the name and address of the firm, and the name of the person making the measurements.

Operator's License: While unlicensed persons may operate the transmitters, all adjustments or tests for installation, service, or maintenance "which may affect the proper operation of such a station, shall be made under the immediate supervision and responsibility of a person holding 1st or 2nd class commercial radio operator license, either radio-telephone or radiotelegraph, who shall be responsible for the proper functioning of the station equipment."

At radiotelegraph stations, adjustments affecting frequency must be made by a person holding a 1st or 2d class commercial radiotelegraph operator license.

No person is required to be in attendance at a transmitter when operating in the course of normal service, or at transmitters used for telemetering or for self-actuated retransmission.

Checking Lights: The licenseee shall make a daily check of the tower lights "either by visual observation of the tower lights or by observation of an automatic indicator to insure that all such lights are functioning properly." Any observed failure of a code or rotating beacon light not corrected within 30 minutes must be reported immediately by telegraph or telephone to the nearest Airways Communication Station or CAA office regardless of the cause of the failure, and notice given immediately on resumption of illumination. Lights and light controls must be inspected at least once every three months.

PETROLEUM RADIO SERVICE

Those eligible to operate stations in the petroleum radio service are persons engaged in prospecting for producing, collecting, refining, or transporting by means of pipelines, petroleum or petroleum products, including natural gas; or

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to the petroleum radio service as are listed under Technical Information for power radio service.

PETROLEUM RADIO FREQUENCIES

Freq.	Class	Notes	Freq.	Class	Notes	Freq.	Class	Notes
1602 kc	Base, Mob.	1, 2	48.86	Base, Mob.	4	457.35	Base, Mob.	6
1628	"	1, 2	48.90	"	4	457.45	"	6
1652	"	1, 2	48.94	"	4	457.55	"	6
1676	"	1, 2	48.98	"	4	457.65	"	6
1700	"	1, 2	49.02	"	4	457.75	"	6
2292	"	1, 2	49.06	"	4	457.85	"	6
4637.5	"	1, 2, 3	49.10	"	4	457.95	"	6
25.02 mc.	"	4	49.14	"	4	952	to	
25.06	"	4	49.18	"	4	960	Fixed	7
25.10	"	4	72.02	to		1850	to	
25.14	"	4	75.98	Fixed	5	1990	"	7
25.18	"	4	153.05	Base, Mob.	1	2110	to	
25.22	"	4	153.11	"	1	2200	"	7
25.26	"	4	153.17	"	1	2450	to	
25.30	"	4	153.23	"	1	2500	Base Mob.	
30.66	"	1	153.29	"	1		Op. Fixed	6, 7, 8
30.70	"	1	153.35	"	1	2500	to	
30.74	"	1	158.31	"	1	2700	Fixed	7
30.78	"	1	158.37	"	1	3500	to	
30.82	"	1	158.43	"	1	3700	Base, Mob.	6
33.18	"	4	456.05	"	6	6425	to	
33.22	"	4	456.15	"	6	6575	"	6
33.26	"	4	456.25	"	6	6575	to	
33.30	"	4	456.35	"	6	6875	Fixed	7
33.34	"	4	456.45	"	6	11700	to	
33.38	"	4	456.55	"	6	12200	Base, Mob.	6
48.58	"	4	456.65	"	6	12200	to	
48.62	"	4	456.75	"	6	12700	Fixed	7
48.66	"	4	456.85	"	6	16000	to	
48.70	"	4	456.95	"	6	18000	"	7, 8
48.74	"	4	457.05	"	6	26000	to	
48.78	"	4	457.15	"	6	30000	"	7
48.82	"	4	457.25	"	6			

[1] Available for assignment to base and mobile stations in the petroleum radio service on a shared basis with other services.

[2] This frequency may be subject to change when the Atlantic City table of frequencies below 27.5 mc. comes into force.

[3] Limited to daytime use only, with a maximum plate power input to the final RF stage not to exceed 1000 watts.

[4] Available for assignment to base and mobile stations in the petroleum radio service only.

[5] Assignable frequencies spaced by 40 kc., beginning with the frequencies 72.02 and 75.42 mc. and ending with the frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the petroleum radio service on the condition that no harmful interference will be caused to the reception of television stations on Channels 4 or 5.

[6] Available for assignment to base and mobile stations in the petroleum radio service on a shared basis with other services, under terms of a developmental grant only.

[7] Available for assignment to fixed stations in the petroleum radio service on a shared basis with other services, under terms of a developmental grant only.

[8] Use of frequencies in the 2,450- to 2,500-mc. band and the 1,750- to 18,000-mc. band is subject to no protection due to the operation of industrial, scientific, and medical devices on 2,450 and 18,000 mc.

FOREST PRODUCTS SERVICE

Those eligible to operate stations in the forest products radio service are persons engaged in tree logging, tree farming, or related woods operations; or

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to the forest products radio service as are listed under technical information for power service.

FOREST PRODUCTS RADIO FREQUENCIES

Freq.	Class	Notes	Freq.	Class	Notes	Freq.	Class	Notes
1676 kc.	Base, Mob.	1, 2	158.31	Base, Mob.	1	952	to	
1700	"	1, 2	158.37	"	1	960	Fixed	6
29.73 mc.	"	3	158.43	"	1	1850	to	
29.77	"	3	456.05	"	5	1990	"	6
49.22	"	3	456.15	"	5	2110	to	
49.26	"	3	456.25	"	5	2200	"	6
49.30	"	3	456.35	"	5	2450	to	
49.34	"	3	456.45	"	5	2500	Base, Mob.	
49.38	"	3	456.55	"	5		Op. Fixed	5, 6, 7
49.42	"	3	456.65	"	5	2500	to	
49.46	"	3	456.75	"	5	2700	Fixed	6
49.50	"	3	456.85	"	5	3500	to	
49.54	"	1	456.95	"	5	3700	Base, Mob.	5
49.58	"	1	457.05	"	5	6425	to	
49.62	"	1	457.15	"	5	6575	"	5
49.66	"	1	457.25	"	5	6575	to	
72.02	to		457.35	"	5	6875	Fixed	6
75.98	Fixed	4	457.45	"	5	11700	to	
153.05	Base, Mob.	1	457.55	"	5	12200	Base, Mob.	5
153.11	"	1	457.65	"	5	12200	to	
153.17	"	1	457.75	"	5	12700	Fixed	6
153.23	"	1	457.85	"	5	16000	to	
153.29	"	1	457.95	"	5	18000	"	6, 7
153.35	"	1				26000	to	
						30000	"	6

[1] Available for assignment to base and mobile stations in the forest products radio service on a shared basis with other services.

[2] This frequency may be subject to change when the Atlantic City table of frequency allocations below 27.5 mc. comes into force.

[3] Available for assignment to base and mobile stations in the forest products service only.

[4] Assignable frequencies spaced by 40 kc. beginning with the frequencies 72.02 and 75.42 mc. and ending with the frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the forest products radio service on the condition that no harmful interference will be caused to the reception of television stations on Channels 4 or 5.

[5] Available for assignment to base and mobile stations in the forest products radio service on a shared basis with other services, under the terms of a developmental grant only.

[6] Available for assignment to fixed stations in the forest products radio service on a shared basis with other services, under the terms of a developmental grant.

[7] Use of frequencies in the 2,450- to 2,500-mc. band and 17,850- to 18,000-mc. band is subject to no protection from interference due to the operation of industrial, scientific, and medical devices on 2,450 and 18,000 mc.

MOTION PICTURE RADIO SERVICE

Those eligible to operate stations in the motion picture radio service are persons engaged in the production or filming of motion pictures or

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to motion picture radio service as are listed under Technical Information for power radio service.

The rules applying to this service specify that prior approval must be obtained from the Commission for each person who proposes to participate in the licensee's service.

MOTION PICTURE FREQUENCIES

Freq.	Class	Notes	Freq.	Class	Notes	Freq.	Class	Notes
1628 kc.	Base Mob.	1, 2	456.45	Base, Mob.	3	2110	to	
1652	"	1, 2	456.55	"	3	2200	"	6
2292	"	1, 2	456.65	"	3	2450	to	
4637.5	"	1, 2, 4	456.75	"	3	2500	Base, Mob.	
49.70 mc.	"	2	456.85	"	3		Op. Fixed	3, 6, 7
49.74	"	2	456.95	"	3	2500	to	
49.78	"	2	457.05	"	3	2700	Fixed	6
49.82	"	2	457.15	"	3	3500	to	
72.02	to		457.25	"	3	3700	Base, Mob.	3
75.98	Fixed	5	457.35	"	3	6425	to	
152.87	Base, Mob.	2	457.45	"	3	6575	"	3
152.93	"	2	457.55	"	3	6575	to	
152.99	"	2	457.65	"	3	6875	Fixed	6
173.225	"	2	457.75	"	3	11700	to	
173.275	"	2	457.85	"	3	12200	Base, Mob.	3
173.325	"	2	457.95	"	3	12200	to	
173.375	"	2	952	to		12700	Fixed	6
456.05	"	3	930	Fixed	6	16000	to	
456.15	"	3	1850	to		18000	"	6, 7
456.25	"	3	1990	"	6	26000	to	
456.35	"	3				30000	"	6

[1] May be subject to change when the Atlantic City table of frequency allocations below 27.5 mc. comes into force.

[2] Available for assignment to base and mobile stations in the motion picture radio service on a shared basis with other services.

[3] Available for assignment to base and mobile stations in the motion picture radio service on a shared basis with other services under terms of a developmental grant only.

[4] Limited to daytime use only, with a maximum plate power input to the final RF stage not to exceed 100 watts.

[5] Assignable frequencies spaced by 40 kc. beginning with the frequencies 72.02 and 75.42 mc. and ending with frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the motion picture radio service on the condition that no harmful interference will be caused to the reception of television stations on Channels 4 or 5.

[6] Available for assignment to fixed stations in the motion picture radio service on a shared basis with other services under terms of a developmental grant only.

[7] Use of frequencies in the 2,450- to 2,500-mc. band and 17,850- to 18,000-mc. band is subject to no protection from interference due to the operation of industrial, scientific, and medical devices on 2,450 and 18,000 mc.

RELAY PRESS RADIO SERVICE

Those eligible to operate stations in the relay press radio service are persons engaged in the publication of a newspaper or in the operation of an established press association; or

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to relay press radio service as are listed under Technical Information for power radio service.

RELAY PRESS RADIO SERVICE

Freq.	Class	Notes	Freq.	Class	Notes	Freq.	Class	Notes
72.02	to		457.15	Base, Mob.	3	2500	to	
75.98	Fixed	1	457.25	"	3	2700	Fixed	4
173.225	Base, Mob.	2	457.35	"	3	3500	to	
173.275	"	2	457.45	"	3	3700	Base, Mob.	3
173.325	"	2	457.55	"	3	6425	to	
173.375	"	2	457.65	"	3	6575	"	3
456.05	"	3	457.75	"	3	6575	to	
456.15	"	3	457.85	"	3	6875	Fixed	4
456.25	"	3	457.95	"	3	11700	to	
456.35	"	3	952	to		12200	Base, Mob.	3
456.45	"	3	960	Fixed	4	12200	to	
456.55	"	3	1850	to		12700	Fixed	4
456.65	"	3	1990	"	4	16000	to	
456.75	"	3	2110	to		18000	"	4, 5
456.85	"	3	2200	"	4	26000	to	
456.95	"	3	2450	to		30000		4
457.05	"	3	2500	Base, Mob. Op. Fixed	3, 4, 5			

[1] Assignable frequencies spaced by 40 kc. beginning with the frequencies 72.02 and 75.42 mc. and ending with the frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the relay press radio service on the condition that no harmful interference will be caused to the reception of television stations on Channels 4 or 5.

[2] Available for assignment to base and mobile stations in the relay press radio service on a shared basis with other services.

[3] Available for assignment to base and mobile stations in the relay press radio service on a shared basis with other services, under the terms of a developmental grant only.

[4] Available for assignment to fixed stations in the relay press radio service on a shared basis with other services, under the terms of a developmental grant only.

[5] Use of frequencies in the 2,450- to 2,500-mc. band and 17,850- to 18,000-mc. band is subject to no protection from interference due to operation of industrial, scientific, and medical devices on 2,450 and 18,000 mc.

SPECIAL INDUSTRIAL SERVICE

Those eligible to operate stations in the special industrial radio service are persons engaged in an industrial activity the primary function of which is devoted to production, construction, fabrication, manufacturing, or similar processes as distinguished from activities of a service or distribution nature, and, in addition, meets one or more of the following requirements:

1) The industrial operation for which radio is desired is being conducted in a remote or sparsely settled region;

2) The industrial operation is a construction project of a public character;

3) The use of a radio is required within the yard area of a single plant for mobile service communications and the use of a low-power industrial service does not meet the operational requirements of the industry otherwise found eligible under this subparagraph.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to special industrial radio service as are listed under Technical Information for power radio service.

[1] This frequency may be subject to change when the Atlantic City table of frequency allocations below 27.5 mc. comes into force.

[2] Limited to daytime use only, with a maximum plate power input to the final RF state not to exceed 100 watts.

SPECIAL INDUSTRIAL RADIO SERVICE

Freq.	Class	Notes	Freq.	Class	Notes	Freq.	Class	Notes
2292 kc.	Base, Mob.	1	72.02	to		952	to	
4637.5	"	1, 2	75.98	Fixed	8	960	Fixed	6
27.31 mc.	"	3	152.87	Base, Mob.	4	1850	to	
27.35	"	3	152.93	"	4	1990	"	6
27.39	"	3	152.99	"	4	2100	to	
27.43	"	3	154.49	"	3	2200	"	6
27.47	"	3	154.57	"	4	2450	to	
30.58	"	3	456.05	"	5	2500	Base, Mob.	
30.62	"	3	456.15	"	5		Op. Fixed	5, 6, 7
43.02	"	3	456.25		5	2500	to	
43.06	"	3	456.35	"	5	2700	Fixed	6
43.10	"	3	456.45	"	5	3500	to	
43.14	"	3	456.55	"	5	3700	Base, Mob.	5
43.18	"	3	456.65	"	5	6425	to	
49.54	"	4	456.75	"	5	6575	"	5
49.58	"	4	456.85	"	5	6575	to	
49.62	"	4	456.95	"	5	6875	Fixed	6
49.66	"	4	457.05	"	5	11700	to	
49.70	"	4	457.15	"	5	12200	Base, Mob.	5
49.74	"	4	457.25	"	5	12200	to	
49.78	"	4	457.35	"	5	12700	Fixed	6
49.82	"	4	457.45	"	5	16000	to	
49.86	"	3	457.55	"	5	18000	"	6, 7
49.90	"	3	457.65	"	5	26000	to	
49.94	"	3	457.75	"	5	30000	"	6
49.98	"	3	457.85	"	5			
			457.95	"	5			

[3] Available for assignment to base and mobile stations in the special industrial radio service only.

[4] Available for assignment to base and mobile stations in the special industrial radio service on a shared basis with other services.

[5] Available for assignment to base and mobile stations in the special industrial radio service on a shared basis with other services, under the terms of a developmental grant only.

[6] Available for assignment to fixed stations in the special industrial radio service on a shared basis with other services, under the terms of a developmental grant only.

[7] Use of frequencies in the 2,450- to 2,500-mc. band and 17,850- to 18,000-mc. band is subject to no protection from interference due to operation of industrial, scientific, and medical devices on 2,450 and 18,000 mc.

[8] Assignable frequencies spaced by 40 kc. beginning with the frequencies 72.02 and 75.42 mc. and ending with the frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the special industrial radio service on the condition that no harmful interference will be caused to the reception of television stations on Channels 4 or 5.

LOW-POWER INDUSTRIAL RADIO

Authorization for stations to be operated in the low-power industrial radio service may be granted to any person engaged in commercial activity or an industrial enterprise. All stations that are authorized in this service will be classi-

(Concluded on page 30)

NEW CATALOGS & DESIGN DATA

THE products listed here are described in new catalogs and bulletins now available. Unless otherwise noted, they will be sent on request, without charge.

BROADCAST EQUIPMENT

Diameter Equalizer:

Attachment for 33 1/3-RPM recorders automatically applies the equalization necessary to compensate for the loss in high-frequency reproduction occurring at the inner diameters of recording discs. Can be used for either out-in or in-out cutting. Model 628. *Fairchild Recording Equipment Co., Whitestone, N. Y.*

Portable Tape Recorder:

Comprising tape-drive mechanism and auxiliary spooling unit, combined with a portable 3-channel mixer. Uses 10½-in spools to give 64 minutes operation at 7½ ins. per second, or 32 minutes at 15 ins. per second. Designed to meet NAB specs, with a frequency response flat to 2 db from 50 to 15,000 cycles, and less than 2% distortion at full modulation. *Magnecord, Inc., 360 N. Michigan Ave., Chicago.*

Plug-in Amplifiers:

Carried on rack panel and terminal tray. Type BA-1-C unit is a pre-amplifier for use as microphone or transcription pre-amplifier, booster or medium-level line amplifier, or isolation amplifier. Type BA-12-A is designed as a program or line amplifier, monitoring amplifier, or isolation amplifier. *General Electric Co., Electronics Park, Syracuse, N. Y.*

Remote TV Control Unit:

Control panels 11 by 2⅝ ins. are designed for sloping-front control console. Panels provide remote control of monoscope camera, power supplies, relay receiver, sync generator, and stabilizing amplifier. Adaptors are available to permit the mounting of these panels on 19-in. racks. *RCA, Camden, N. J.*

GENERAL COMPONENTS

Retainers for Plug-in Parts:

Stainless steel retainers for tubes and plug-in units are made in 5 types for components of various dimensions and top shapes. Positive spring grip permits quick application and release. Samples are available on request. *Times Facsimile Corp., 229 W. 43rd St., New York 18.*

Super-Midget Relays:

Relay mechanisms ⅝ in. in diameter and 1⅝ ins. long and weighing ½ oz. are dust-sealed in polystyrene or glass enclosures. The latter can be evacuated and gas-filled. Windings up to 3,400 ohms permit operation at 75 volts DC with a minimum sensitivity of 5 millamperes at 80 milliwatts. Type SM. *Potter & Brumfield, 549 W. Washington Blvd., Chicago 6.*

Glass Waveguide Windows:

Various sizes and shapes are sealed in mountings which can be silver-soldered without damage. For frequencies of 3,500 to 40,000 mc., with narrow-band or wide-band transmission. *Sylvania Electric Products, Ins., 500 Fifth Ave., New York 18.*

Rhombic Antenna Resistors:

Terminating resistor contains two non-inductive resistors of 362.5 ohms sealed in a glazed ceramic shell, carrying terminal eyes and center connection. *Shallcross Mfg. Co., Collingdale, Pa.*

Miniature Coil Form:

Silicone-impregnated ceramic-form is 19/32 in. high by 3/16 in. diameter, with mounting bushing threaded 8-32. Can be furnished with adjustable powdered-iron slug. Samples available on request. *Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.*

Sealed Relays:

New circular describes a complete line of hermetically-sealed relays of all types for standard and special applications. *Automatic Electric Co., 1033 Van Buren St., Chicago 7.*

TV Replacements Parts:

Catalog sheets show replacement coils, transformers, and chokes packaged for shelf display. Items include peaking coils, horizontal line and width controls, horizontal and vertical blocking transformers, filament chokes, and IF transformers. *Super Electric Products Corp., 1057 Summit Ave., Jersey City 7, N. J.*

Audio Transformers:

Open-frame transformers are designed to make high-quality performance available at low cost. Line includes impedance-matching, input, output, and power transformers for all audio circuit applications. *Audio Development Co., 2833 13 Ave. South, Minneapolis, Minn.*

Smaller Electrolytics:

Midget-can electrolytic containers, in a wide range of single and dual ratings, measure 13/16 in. in diameter by 1½ ins. long. *Aerovox Corp., New Bedford, Mass.*

MATERIALS

Cellulose Tape:

Bulletin lists types of tape for various specific electrical and industrial applications. *Topflight Tape Co., York, Pa.*

Ferro-Magnetic Material:

Non-metallic substance called Ferramics is described as being so light in weight as to out-perform iron volume for volume. Material is said to be of uniform structure, free of organic compounds. Thus it does not decompose at elevated temperatures. *General Ceramics & Steatite Corp., Keasbey, N. J.*

Asbestos Coil Forms:

For coils subjected to high temperatures or sudden temperature changes, forms are made with spiral-wound asbestos tape, and then die-formed to square, oval, or round shape, with wall thickness from .01 in. up. Samples made to specifications are available on request. *Precision Paper Tube Co., 2045 W. Charleston St., Chicago 47.*

BOOKS

Information on FM:

Frequency Modulation, by Nathan Marchand, 409 pages, 6 by 9 inches, cloth binding. Five sections are devoted to fundamentals, transmitters, receivers, mobile equipment, and servicing. A practical treatment, in which mathematics are used only in explaining the theory of modulation. Price $5. *Murray Hill Books, Inc., 232 Madison Ave., New York 16.*

Electromagnetic Theory:

Fundamentals of Electric Waves, 2nd edition, by Dr. Hugh Hildreth Skilling, executive head of the Department of Electrical Engineering, Stanford University, 245 pages, 6 by 9¼ inches cloth bound. An explanation of electromagnetic theory for engineering students in their senior college year. Maxwell's equations are used to develop the presentation of waves, reflection, radiation, antennas, and wave-guides. Price $4. *John Wiley & Sons, 440 4th Ave., N. Y. 16.*

Amateur Communications:

Radio Amateur's Handbook, 26th edition, compiled by the ARRL Headquarters Staff, 736 pages, 6½ by 9½ inches, paper cover. This book, which has become the bible of the amateur fraternity, covers the theory, construction, installation, and operation of telegraph and telephone equipment for the amateur frequency bands. Price $2. *American Radio Relay League, W. Hartford, Conn.*

Vacuum Tubes:

Electron Tubes, Vol. 1, 1935-'41, edited by Alfred N. Goldsmith, Arthur F. Van Dyck, Robert S. Burnap, Edward T. Dickey, and George M. K. Baker, 475 pages, profusely illustrated, 6 by 9 inches, cloth bound. Four sections, covering general transmitting, receiving, and special tubes, present 15 papers and summaries of 32 papers by RCA engineers, as well as a list of 400 other papers which have been published by the technical press. Price $2.50. *RCA Laboratories Division, Princeton, N. J.*

Record Changers:

Automatic Record Changer Service Manual, Vol. 2, 1948. 432 pages, 8½ by 11 inches. Detailed illustrations, service instructions, and replacement parts lists on 45 models, including LP and dual-speed types and wire and tape recorders. Price $6.75. *Howard W. Sams and Co., Inc., 955 N. Rural St., Indianapolis 1, Ind.*

Sound Recording:

Elements of Sound Recording, by John G. Frayne and Halley Wolfe. 686 pages, 480 illustrations, 6¼ by 9¼ inches, cloth bound. 32 chapters cover the equipment, measurements, and practice of recording by all methods now in use. This exceptionally fine presentation for engineers, professional users of equipment, and students is based on courses given by the authors at the University of California. Price $8.50. *John Wiley & Sons, Inc., 440 4th Ave., N. Y. 16.*

TV Trouble-Shooting:

Pict-O-Guide, by John R. Meagher. Pocket-size, loose-leaf book of 100 pages, showing off-the-tube photographs of defective TV reception, with explanatory notes identifying each source of trouble. By matching received images with a picture in the book illustrating similar effects, the faulty component or circuit can be identified quickly. *RCA Tube Dept., Harrison, N. J.*

WHAT'S NEW THIS MONTH

(Continued from page 9)

Expense and payrolls, to them, are items in a budget met by taxes.

Because radio's pace is fast, and busy men's memories are short, let's turn back just three years and pick up the record of experience when another group of planners was cracking the whip over the radio industry. Let's run through the pages of a book issued by the Radio Manufacturers Association at that time, under the title "A Report to the Office of Price Administration."

It has some very interesting pictures. One shows the headlines on *The Chicago Sun* of August 14, 1945: "It's Over! It's Peace! It's Victory!"

And there's a quotation from the President under whom the planners are still at work. He said: "Production will do away with the necessity for government controls." To which the RMA replied on the opposite page: "But the radio industry today is far from that goal. It is, frankly, just plain stuck! The time for recrimination, for argument as to how it got that way in the six months since V-J Day, is past. More important is how to get it rolling."

RMA's complaint, just three years ago, was against the stifling effects of Government control exercised by OPA. At that time, the trouble was frozen prices. Today, it's frozen allocations. The book from which we quote contains many statements from member companies, such as: "We are not producing the maximum output of either our tube or receiving set facilities." "We are running at about 25% of our facilities." "Our present volume is under 30% of our maximum output." "We are at this time operating at less than half the rate necessary for efficient production."

Sounds like reports of the current status of TV production, doesn't it? But read this quotation: "We have not and are not accepting any orders subsequent to December 3, 1945, for delivery until some adjustment is made by OPA."

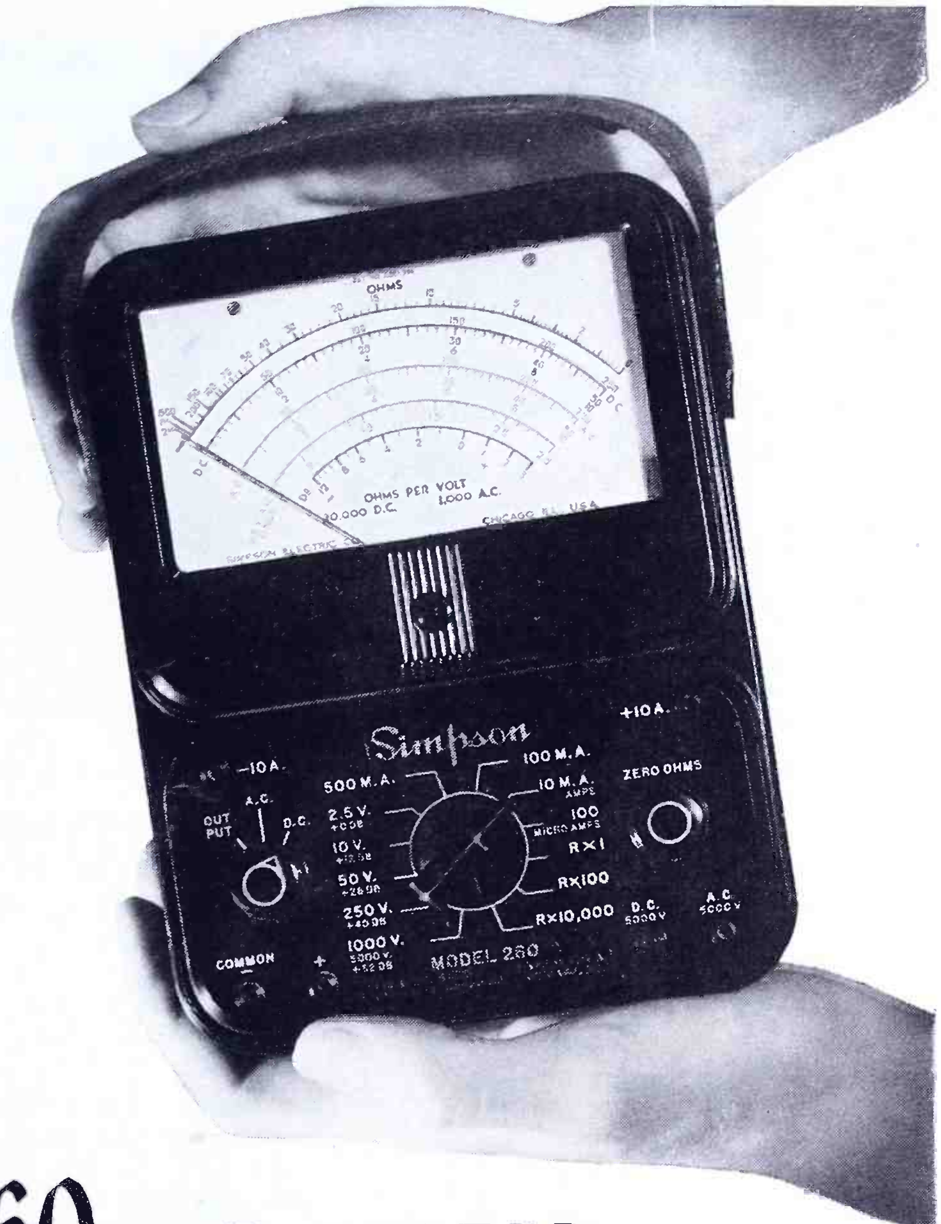
It took just two years to shift from an OPA freeze to an FCC freeze. The administration is the same. The planning is the same. The result is the same. The only difference is the name of the agency that has tied up the industry.

On August 20, 1945, Melvin Karns, chief of WPB's radio and radar division said: "It is estimated that the industry is in a position to produce between 3.5 and 4 million radio sets by the end of the year." Actually, the industry was able to ship and bill less than 300,000 in that period.

The FCC was in there pitching then, too. On August 17, 1945, Paul Porter,

(Continued on page 30)

1949 IS TV YEAR



Here are some of the many reasons why there are more Simpson 260 high sensitivity volt-ohm-milliammeters in use today than all others combined. The Simpson 260 has earned world-wide acceptance because it was the first tester of its kind with all these "Firsts":

Simpson 260 SET TESTER

WORLD FAMOUS FOR ALL THESE "FIRSTS"

- First high sensitivity instrument to use a metal armature frame.
- First to use fully enclosed dust proof rotary switch with all contacts molded in place accurately and firmly.
- First to do away with harness wiring.
- First to provide separate molded recesses for resistors, batteries, etc.
- First to cover all resistors to prevent shorts and accidental damage and to protect against dust and dirt.
- First with a sturdy movement adapted to the rugged requirements of a wide range of service work or laboratory testing.
- First to provide easy means of replacing batteries.
- First to use all bakelite case and panels in volt-ohm-milliammeters.
- First volt-ohm-milliammeter at 20,000 ohms per volt with large 4½" meter supplied in compact case (size 5¼" x 7" x 3⅛").
- First and only one available with Simpson patented Roll Top Case.
- First to provide convenient compartment for test leads (Roll Top case).
- First to offer choice of colors.

RANGES

20,000 Ohms per Volt DC, 1,000 Ohms per Volt AC
VOLTS: AC & DC—2.5, 10, 50, 250, 1,000, 5,000
OUTPUT: 2.5, 10, 50, 250, 1000
MILLIAMPERES, DC: 10, 100, 500
MICROAMPERES, DC: 100
AMPERES, DC: 10
DECIBELS: (5 ranges)—12 to +55 DB
OHMS: 0-2,000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center).

Prices: *$38.95 dealers net; Roll Top $45.95 dealers net.*

The Model 260 also is available in the famous patented Roll Top safety case with built-in lead compartment. This sturdy, molded, bakelite case with Roll Top provides maximum protection for your 260 when used for servicing in the field or shop.

25,000 volt DC Probe for television servicing, complete, for use with 260, $12.85

Simpson
INSTRUMENTS THAT STAY ACCURATE

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WHAT'S NEW THIS MONTH

(Continued from page 28)

then Chairman, announced: "The Commission is informed by transmitter manufacturers that 10-kw. transmitters will be immediately available for the new [FM] band." Actually, the delivery of 10-kw. FM transmitters did not start until 1947.

Then the planners moved again, even while FCC Chairman Coy, on May 18, 1948, was reassuring the NAB members that "The future of American radio must be planned and fashioned within the present formula of operation by private enterprise." This was followed by the announcement of a hearing on TV frequencies to start September 20. Finally, on September 29, television was gently eased into the deep-freeze locker with the assurance that its incarceration would last no more than six months. Now, as the six months stretch into twelve, the end is still at least six months away.

There's a Better Answer:

There's a better answer to the TV situation than the FCC's proposal. We don't presume to know what it is. But some things are clear:

1. VHF television is not perfect. It may not be permanent. But the public likes it, and it's the best system we have. Let's open it up to the public and the industry by establishing realistic allocations, based on the Ad Hoc Committee's propagation data, for areas that can support transmitters.

2. If that will not meet the demand for TV service, the broadcasters and set manufacturers will find it out. As businessmen, they will anticipate the need of using UHF, and will provide the equipment necessary. And in developing that equipment, they will come up with more sound and practical answers to the questions of UHF standards and color than anyone can give today.

3. The FCC must not make decisions in advance of technical progress. Rather, it must drop its closed-door policy of ruling by regulation, and adopt an open-minded attitude of allowing the industry the time and opportunity to give the public a television service so superior to what we have now as to eventually make the present system obsolete.

WDTV REPORT

(Continued from page 18)

graph in Fig. 2. All measurements within an annulus 4 miles wide, having a mean radius of 39 miles and centered about the transmitter, were compared to the smooth earth groundwave theoretical value at 39 miles, corrected in accordance with the Ad Hoc recommendations. There were 87 measurements lying within this area. The ratios were then converted to decibels and plotted on normal distribution paper. Although the values thus obtained represent spot measurements rather than sector median values, the distribution compares quite well with Fig. 2 of the Ad Hoc report which shows the slope of R (L) to be 22 db between the 10% and 90% values. As shown in Fig. 2 of this paper, we obtained a slope of 26 db. The slightly greater slope is readily understandable in view of the extreme roughness of the terrain. The median value shown here in Fig. 2 is, however, approximately 11 db below theoretical. As previously pointed out, this may be due, in part, to the fact that many of the roads on which measurements had to be made follow the river valleys. We do feel, however, that the smooth-earth groundwave curves, as corrected by the Ad Hoc report, are still somewhat optimistic for terrain as irregular as that encountered in the Pittsburgh area.

MOBILE SERVICES

(Continued from page 24)

fied and licensed as mobile stations. Such stations, however, need not necessarily be moved nor used while in motion, and may be at fixed locations.

Frequency Assignments:

The following frequencies are available for assignment to mobile stations in the low-power industrial radio service only:

27.51 mc.	35.02 mc.
33.14	42.98

On addition, the frequency 154.57 mc. is available for assignment to mobile stations in the low-power industrial radio service on a shared basis with services in other classifications.

Technical Information:

Low-power mobile stations operating on the frequencies listed above are subject to applicable regulations appearing in Technical Information for power radio service, in addition to the following:

Emission shall be confined to voice radio telephony.

Plate power input to the final RF stage of the transmitter shall not exceed 3 watts.

Maximum distance between the transmitter and the radiating portion of the antenna shall not exceed 3 ft.

Use of an antenna having a power gain greater than unity is prohibited.

The transmitter shall not be operated by remote control.

Use of repeater, control, or relay stations will not be permitted.

Stations licensed for operation on these frequencies shall not be used to communicate with stations operating on other frequencies.

Advertisers' Index

WHAT'S NEW IN AUDIO?

The papers and exhibits to be presented at the nation's first Audio Fair will cover the entire field of today's developments in this important phase of FM and TV broadcasting and reception. This event, sponsored by the Audio Engineering Society, will be held at the

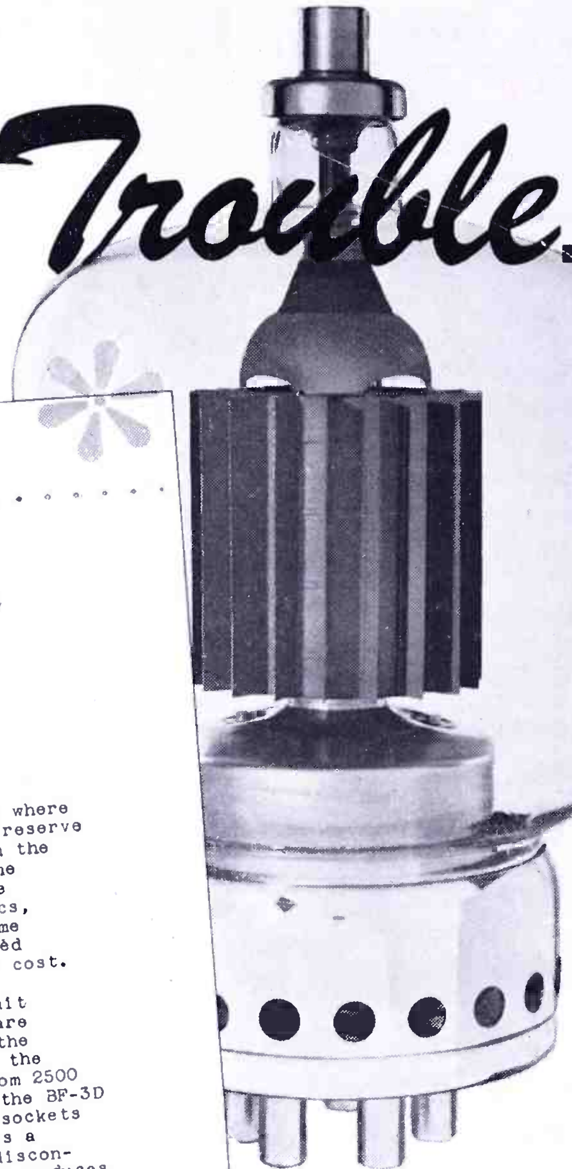
HOTEL NEW YORKER

34th Street & 8th Avenue, New York

October 27, 28, 29, 1949

Further information can be obtained from the Secretary, Audio Engineering Society, P. O. Box F, Oceanside, N. Y.

No Tube Trouble.....



EIMAC 4-1000A TETRODE

GATES
RADIO COMPANY
Manufacturing Engineers
QUINCY, ILLINOIS, U. S. A.

NO TUBE TROUBLE IN THIS 3 KW FM TRANSMITTER

If you are one of the many owners of FM transmitters where tube replacement cost has been heavily draining the reserve bank account, you will be particularly interested in the Gates BF-3D FM transmitter for 3000 watts power. The highly vulnerable power amplifier tubes which can be quickly damaged by changes in antenna characteristics, improper air circulation around the tubes and in some instances even low line voltage, have been engineered not only to good performance but to low maintenance cost.

On the attached brochure note the unique tank circuit design where the new 4-1000 power amplifier tubes are covered with a pyrex jacket which confines all of the air around the tube and finally concentrates it on the important end seal. Broadcasters are reporting from 2500 to 5000 hours of tube life and many purchasers of the BF-3D transmitter have the original set of tubes in the sockets after many months of use. To aid long tube life is a scientific air pressure control that immediately disconnects the plate voltage where the air for any cause reduces in pressure. Also a direct reading power and standing wave ratio indicator which tells the operator instantly if the antenna characteristics have changed because of icing or other reasons and is placing a heavy load on the power amplifier tubes.

The BF-3D, like all Gates products, is engineered not only for fine performance, meeting rigid FM requirements, but having the practical touch added by such things as longer tube life that means dollars to the broadcaster.

Further information about this fine transmitter that cannot be found in the attached brochure will gladly be given upon request.

Yours very truly,

GATES RADIO COMPANY

Sales Department

*This letter was distributed with a brochure on the popular Gates BF-3D, 3KW FM transmitter.

Follow the Leaders to Eimac TUBES

Commercially proven . . . the Eimac 4-1000A is an outstanding high-power tetrode. Its rugged construction and stability of performance enable the country's leading transmitter manufacturers to enthusiastically expound the tubes' advantages in their key socket positions.

Consider the Eimac 4-1000A tetrode for your high-power equipment . . . frequency limits are well into the vhf. Complete data is available, please write direct.

EITEL-McCULLOUGH INC.
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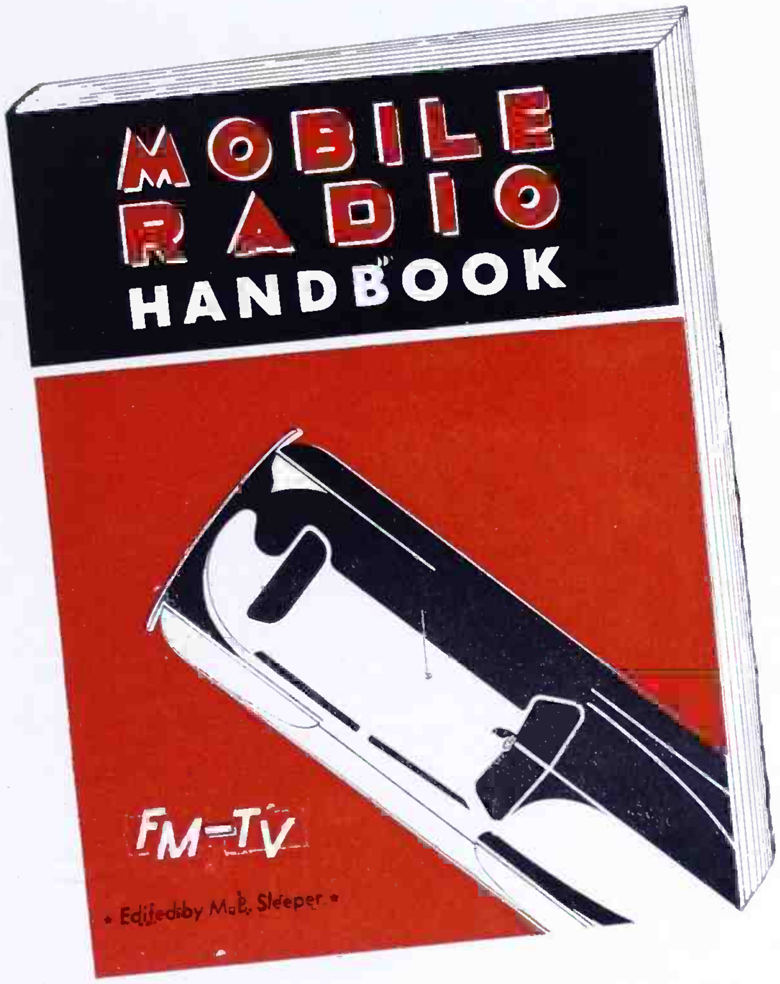

AT LAST!

A COMPLETE AUTHORITATIVE UP-TO-DATE HANDBOOK ON MOBILE RADIO & POINT-TO-POINT COMMUNICATIONS

COVERS ALL THE NEW SERVICES

EVERYONE concerned with mobile radio communications and associated point-to-point systems will find the MOBILE RADIO HANDBOOK an invaluable reference guide — the sort of a book that is kept at hand to give accurate and specific answers to the increasing complications of this field.

The HANDBOOK has been in course of preparation for more than a year, but it could not be completed until after the FCC released the new frequency allocations and rules last May.

Now, thanks to the efforts of 17 engineering specialists who have cooperated in preparing the text, the MOBILE RADIO HANDBOOK presents complete and completely up-to-date information.

Written as a working text, this book contains practical, straightforward answers to problems encountered in all phases of mobile radio planning and operation. It is intended for use by company executives and public officials concerned with the use of mobile radio, as well as for engineers, systems supervisors, operators, and maintenance men.

It is a big book, 8¾ by 11½ ins., with easy-to-read type, profusely illustrated with photographs and drawings, and handsomely printed on fine paper.

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1. THEORY: A non-mathematical explanation of FM transmission and reception and the advantages of FM over AM.
2. MOBILE INSTALLATIONS: Details of the newest transmitters; standard and adjacent-channel receivers; portables; railroad equipment; methods of installation; power supplies; charging generators.
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7. FCC REGULATIONS: Quick-reference information on common carrier, safety, industrial, and transportation services, showing qualifications, frequencies, and technical requirements.

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