FM EXPANSION RAPID

ACTIVITY and planning in the Frequency Modulation (FM) broadcast art, when spread upon a map of the United States, reveal a rapid recent growth of this improved system of radio sound which is fully in keeping with all broadcasts for its rosy post-war future.

Now identified in 38 states, this expansion is developing quite naturally along lines of population density in a pattern inspired by the 44 FM stations (listed below) now on the air. It has begun to make its marks on the vast stretches between the Mississippi Valley and the Rocky Mountains. In the more congested areas of the industrial northeast it is upholding the wisdom of FM Broadcasters, Inc., in its recommendations for additional space in the spectrum.

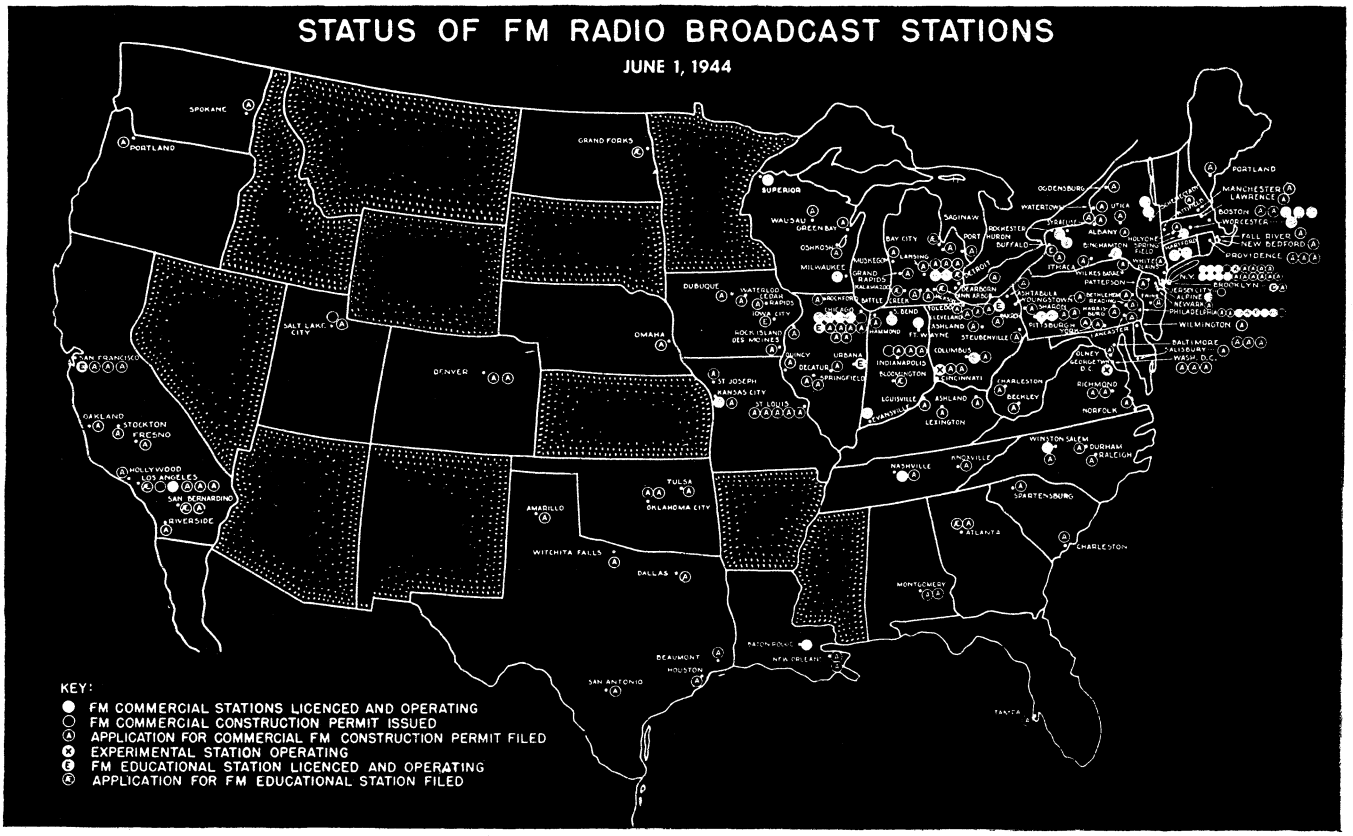
Because of the wartime equipment "freeze," growth of the static-free, full-fidelity system must be measured largely by applications for FM stations. These arrive at the Federal Communications Commission daily. The map, as of June 1, spots 154 applicants. More applications have been received by the FCC since that time at the rate of almost one a day.

Estimates reveal that these applicants will spend $10,000,000 for broadcast equipment alone. Set manufacturers predict 20,000,000 receivers in the hands of listeners within four years after the war.

FM BROADCAST STATIONS IN OPERATION AS OF JUNE 1, 1944

State and City	Licensee	Call Letters	Frequency (kc.)
CALIFORNIA			
Los Angeles	Don Lee B'casting Sys.	KHJ-FM	44,500
Los Angeles	*M-G-M Studios, Inc.	KTLO	46,100
CONNECTICUT			
Hartford	Travelers B'casting Serv.	WTIC-FM	45,300
Hartford	WDRC, Inc.	WDRC-FM	46,500
ILLINOIS			
Chicago	CBS	WBBM-FM	46,700
Chicago	Moody Bible Inst. of Chicago	WDLM	47,500
Chicago	WGN, Inc.	WGNB	45,900
Chicago	*WHFC, Inc.	WEHS	48,300
Chicago	Zenith Radio Corp.	WWZR	45,100
INDIANA			
Evansville	Evansville On The Air, Inc.	WMLL	44,500
Fort Wayne	Westinghouse Radio Sta., Inc.	WOWO-FM	44,900
Indianapolis	*Associated B'casters, Inc.	WABW	47,300
South Bend	South Bend Tribune	WSBF	47,100
LOUISIANA			
Baton Rouge	Baton Rouge B'casting Co.,	WBRL	44,500
MASSACHUSETTS			
Boston	Westinghouse Radio Stas.	WBZ-FM	46,700
Boston	Yankee Network, Inc.	WMTW	43,900
Boston	Yankee Network, Inc.	WGTR	44,300
Springfield	Westinghouse Radio Stas.	WBZA-FM	48,100
Worcester	Worcester Telegram Pub. Co.	WTAG-FM	46,100
MICHIGAN			
Detroit	John Lord Booth	WLOU	44,900
Detroit	Evening News Assn.	WENA	44,500
MISSOURI			
Kansas City	Commercial Radio Equip. Co.	KOZY	44,900
NEW JERSEY			
Alpine	Edwin H. Armstrong	WFMN	43,100
Jersey City	*Bremer B'casting Corp.	WAAW	49,500
NEW YORK			
Binghamton	Wylie B. Jones Adv. Agency	WNBF-FM	44,900
New York	Bamberger B'casting Serv.	WBAM	47,100
New York	Municipal B'casting Sys.	WNYC-FM	43,900
New York	Columbia B'casting Sys., Inc.	WABC-FM	46,700
New York	*William G. H. Finch	WFGG	45,500
New York	Interstate B'casting Co., Inc.	WQXQ	45,900
New York	Marcus Loew Booking Agency	WHNF	46,300
New York	Metropolitan Television, Inc.	WABF	47,500
New York	Muzak Radio B'casting Sta.	WGYN	44,700
Rochester	Stromberg-Carlson Co.	WHFM	45,100
Rochester	WHEC, Inc.	WHEF	44,700
Schenectady	Capitol B'casting Co., Inc.	WBCA	44,700
Schenectady	General Electric Co.	WGFM	43,500
NORTH CAROLINA			
Winston-Salem	Gordon Gray	WMIT	44,100

(Continued on page 756)



FM EXPANSION RAPID

(Continued from page 721)

OHIO			
Columbus	WBNS, Inc.	WELD	44,500
PENNSYLVANIA			
Philadelphia	Wm. Penn B'casting Co.	WPEN-FM	47,300
Philadelphia	Pennsylvania B'casting Co.	WIP-FM	44,900
Philadelphia	*Seaboard Radio B'casting	WLBG	46,500
Philadelphia	WCAU B'casting Co.	WCAU-FM	46,900
Philadelphia	Westinghouse Radio Stas.	KYW-FM	45,700
Philadelphia	WFIL B'casting Co.	WFIL-FM	45,300
Pittsburgh	Westinghouse Radio Stas.	KDKA-FM	47,500
Pittsburgh	WWSW, Inc.	WTNT	44,700
TENNESSEE			
Nashville	National Life & Accident Ins.	WSM-FM	44,700
UTAH			
Salt Lake City	*Radio Serv. Corp. of Utah	KSL-FM	44,700
WISCONSIN			
Milwaukee	Journal Company	WMFM	45,500
Superior	Head of Lakes B'casting Co.	WDUL	44,500

EXPERIMENTAL FM BROADCAST STATIONS OPERATING AS OF JUNE 1, 1944

Crosley Corp., Cincinnati, Ohio	W8XFM	43,200	1kw
Jansky and Bailey, Georgetown, D. C.	W3XO	43,200	1kw
National B'casting Co., Inc., New York, N. Y.	W2XWG	45,100	1kw

*C. P. only.

PRACTICAL ELECTRONICS

(Continued from page 735)

choosing it so that the tube will start to conduct at 470 volts. What happens is shown in Fig. 3. The horizontal line represents time, divided into periods of 1/120 second each; height of the sine waves above the line indicates voltage during each instant while current is flowing in the direction which would permit the tube to conduct; and height of the sine waves below the line, voltages during the non-conducting alternation of the cycle. The shaded portion represents the part of the cycle during which the tube actually does conduct electricity.

We can see that there is current flow in the tube during only half the normally conductive alternation. The tube starts to conduct only when the voltage reaches 470 and continues till it drops practically to zero. If the grid potential were set at a less negative voltage, the tube would fire earlier and put out more electricity during each cycle. Thus, it is possible to vary the output power from maximum, when the control-electrode is at cathode potential, to 50%, with the control-electrode set to fire at peak voltage.

A.C. CONTROL VOLTAGES USED

We can do more than that. Instead of maintaining the control-electrode at a fixed potential, we can feed it with alternating current from the same source as the anode. By using a combination of resistors, coils and condensers—to be explained in a later lesson—we can cause the electrode to reach its maximum or minimum voltage at any desired time in the cycle. It can have such a high negative voltage when the anode is at its peak that the tube will not fire at that time. Then the control voltage can become positive as the plate voltage drops, so that the tube fires—for example—during only the last 10% of the conductive alternation. See Fig 4, where current is carried during the last quarter of the alternation.

By selecting the instant the grid voltage reaches the "firing point" for the corresponding anode voltage at that instant, we have complete control of the output.

There is one thing wrong with the thyratron control electrode. It is so big that a large number of electrons must swarm onto it to change its voltage very much. This means that considerable power is required in the control circuit—some current has to flow. When alternating current is used, the control-electrode's low impedance introduces difficulties. A special type of tube, the *shield-grid* thyratron, overcomes these difficulties. The construction is revealed in Fig. 5. The shield-grid—connected to the cathode—takes over the old grid's job of encircling all possible paths between cathode and plate. Control voltage is confined to the small cylindrical electrode, which requires few electrons for a large voltage change. This kind of tube can operate where little power can be spared for control purposes.

The thyratron is a tube which can supply moderate quantities of current—limited by the emissive ability of the cathode—and

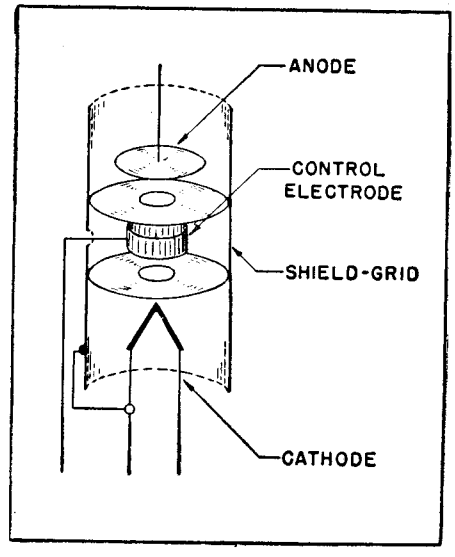


Fig. 5—A shield-grid thyratron. The "grid" is the ring between the discs of the shield-grid.