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April 10, 2013

TO: Stan Adams
RE: Western Electric 1-B (101-B) Transmitter Notes

Dear Stan:

Thank you again for your help and wise counsel in our ongoing quest to understand the Western Electric 1-A and 1-B Transmitters. Your generosity in posting so many pictures of Western Electric transmitters on the net has made our task a whole lot easier.

I am working with a group of enthusiasts who grew up listening to KAAY and who have generated a lot of interest in its history. As you know, KAAY began as KTHS in Hot Springs and started operations at The Arlingotn Hotel in 1924 with a brand new Western Electric 1-B Transmitter along with the entire 101-B package of equipment. As you observed, only well-financed broadcasters could afford Western Electric. KTHS was built by the well-financed New York Hotel Company and seems to have been a very good installation.

Our immediate goal is to accumulate as much technical information as we can find on the Western Electric 1-B Transmitter. Our short-term goal is to model the 1-B in pSpice (or something similar) to model the WE 1-B performance and to model the KTHS antenna in EZNEC (or something similar). Our longer-term goal is to create a scale model of the transmitter and antenna. Right now this project is for our general amusement but it has turned it into quite an interesting project.

As you know, Western Electric was well-established in ship telephony and in 1920 it gained the rights under a Patent Agreement to make and sell Radio Transmitters on the open market. I believe that the WE 1-A Transmitters were a "Big Deal" at Western Electric in the 1920s and I suspect that there is a treasure trove of design and operating documents in a Collection somewhere. However, I can see that Radio Transmitters were a very small part of a big telephone company and I doubt that their early radio work gets much attention.

Our biggest desire is to find a Schematic Diagram and an estimate of the component values, but we will probably have to estimate the inductor values and to puzzle out the operation of the Variometer..

Here are a my preliminary notes on the Western Electric 1-B and all of the pictures that I have been able to find. We would greatly appreciate your advice on how to proceed.

Thanks,

Hollis

Western Electric Transmitter notes by Duncan Engineers April 10, 2013

The Western Electric 1-B Transmitter is physically different from the WE 1-A Transmitter in these ways:

(1) An extra Dial Control (WE 1-A has two Dial Controls; 1-B has 3)
(2) Two extra Meters (1-A has 4 Meters; 1-B has 6)

Data from: Western Electric Broadcasting Company
Radio Telephone Broadcasting Equipments [*sic*]
May 1923
Technical Bulletin T-670

1915 First Transatlantic Radiotelephony by Bell System (AT&T and Western Electric)

No. 101-A Radio Telephone Broadcast Equipment

No. 1-A (500 watt) Radio Transmitter
Power Equipment [Power Switchboard]
[Motor-Generator Set]
1A Speech Input Equipment
No. 2-C Radio Receiver

Operation on 300-600 Meters (500 kHz-1000 kHz)

Four Ammeters: Antenna Current
Oscillator Plate Current
Oscillator Grid Current - Insulated to 1600 Volts
Modulator Plate Current - Insulated to 1600 Volts

Dimensions: 78 inches High, 25 Inches Wide, 27 Inches Deep

Typical Readings	Plate Potential	1600 Volts	
	Total Plate Current	1.25 Amperes	[2000 Watts; Efficiency 25%]
	Filament Potential	14 Volts	[400 Watts]
	Total Filament Current	28.4 Amperes	

Filament Current provided by a Constant Potential Generator.

Western Electric Tubes

1	WE 211-A	Speech Amplifier
2	WE 212-A	Oscillator and Modulator

Operation - Oscillator and Modulator

Frequency controlled by Inductance of Oscillating Circuit
Frequency Adjusted by means of a Variometer

A portion of the Oscillator Coil included in the Antenna circuit is arranged to turn on an axis at right angles to its normal Inductance - coil inductance adds or opposes the overall inductance

Moveable coil also serves to vary the coupling between the antenna circuit and the portion of the coil system that is connected to the plates and grids of the Oscillator.

Oscillator Adjustment [apparently Bottom Front Panel Dial]

Variable Capacitor connects across the Plate Coil
Controls the Plate Current through the Oscillator Tubes
Controls the output of the Oscillator Tubes
Variable Capacitor in Parallel with 2 (two) fixed Capacitors

Both the Adjustable Inductance and the Adjustable Capacitor are calibrated using a Wavemeter.

Antenna Relay operated by Pushbuttons on the Transmitter and the Operators Console

Negative Grid Bias - supplied by Resistors between the negative HV Supply Terminal and Ground.

Noise Filter to eliminate Commutator Noise

If the Plate Circuit is closed before the Filament Circuit, a destructive rush is prevented by a 20-second Time Delay relay

Motor-Generator

Driving Motor	DC or AC Induction Motor [Presumably AC at KTHS]
	5 1/2 HP Motor [4100 Watts]
	1750 RPM
HV Generator	1600 Volts
	1.25 Amperes [2000 Watts]
	Field Excitation obtained from LV Generator
LV Generator	Filament Current
	Field Excitation for HC Generator
	Shunt Wound
	Voltage varied by Field Rheostat - 0.2 Volts per Step

Power Switchboard

Two slate panels mounted on black finished angle iron
69 .5 inches High, 24.5 inches Wide x 10 inches deep

Motor started by momentary Pushbuttons - parallel at Operators Desk

Voltmeters Filament Voltage [nominal 14 Volts]
High Voltage (uninsulated)

Circuit Breaker - 25% overload

Field Rheostats LV Field Rheostat
HV Field Rheostat adjustable from inside the power Switchboard Cabinet

Switches Field Circuit of HV Generator
Plate Current Supply Circuit
Filament Current Supply
Motor Circuit

from The World's First Factory-Built Transmitters by John Schneider Radio World (November 22, 2011)

WWJ Detroit

WE 1-A Transmitter installed in February 1922

This 500-Watt unit consisted of two panels:

RF section and modulator on the left, and
the power control panel on the right, which controlled the two motor generators that provided the DC energy, located in another room because of their constant noise.

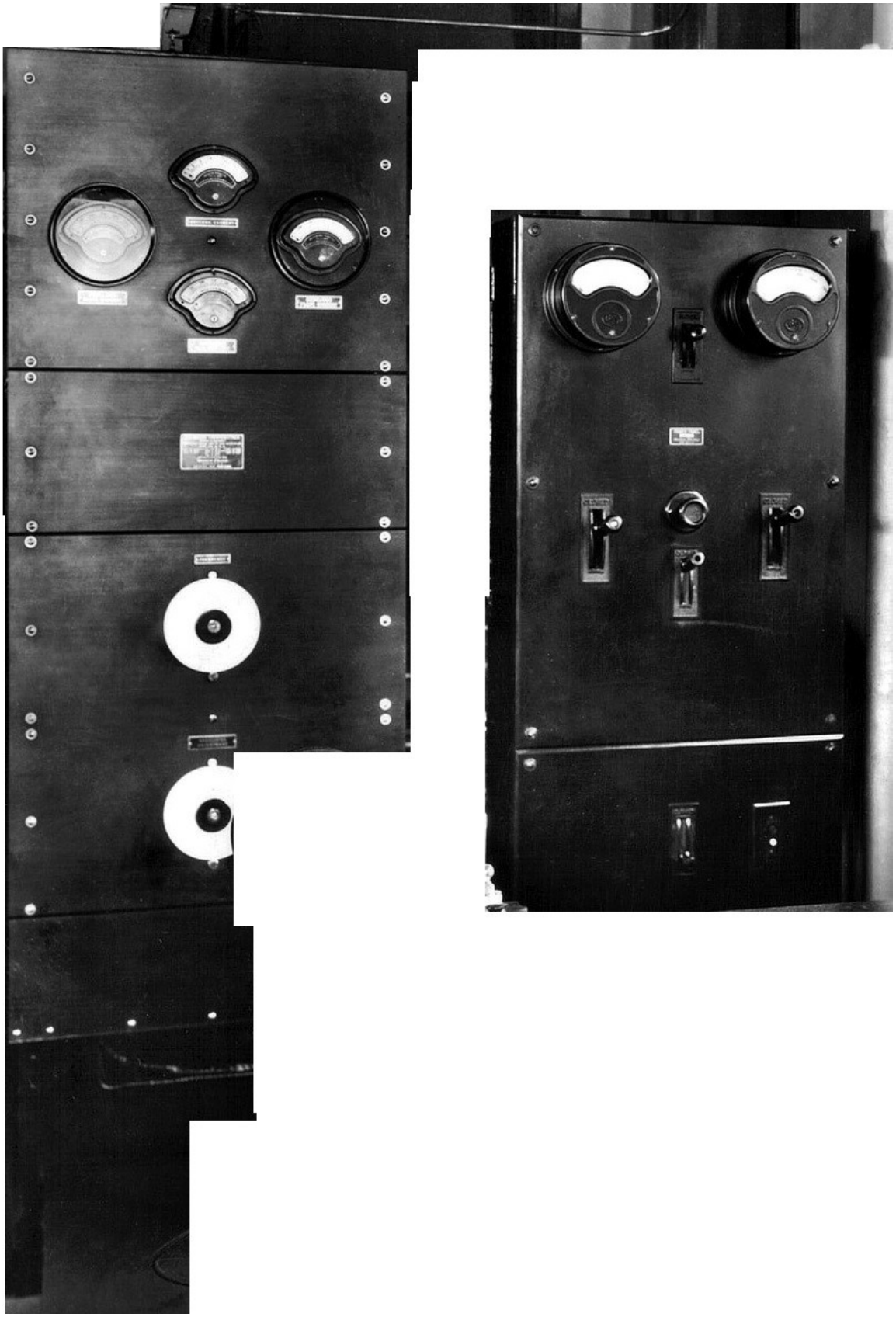
The two big knobs on the front of the transmitter are marked
"Oscillator Tuning" and
"Frequency"

Free-running high-power oscillator.
The antenna capacity was a part of the oscillator circuit
Frequency tended to drift as the wind blew the hammock-style wire antennas around.
Static buildup on the antennas during wind storms also caused frequent transmitter failures.
Later in 1922, Western Electric introduced the 1-B transmitter that added a third big "Antenna" knob to control an output coupling transformer.

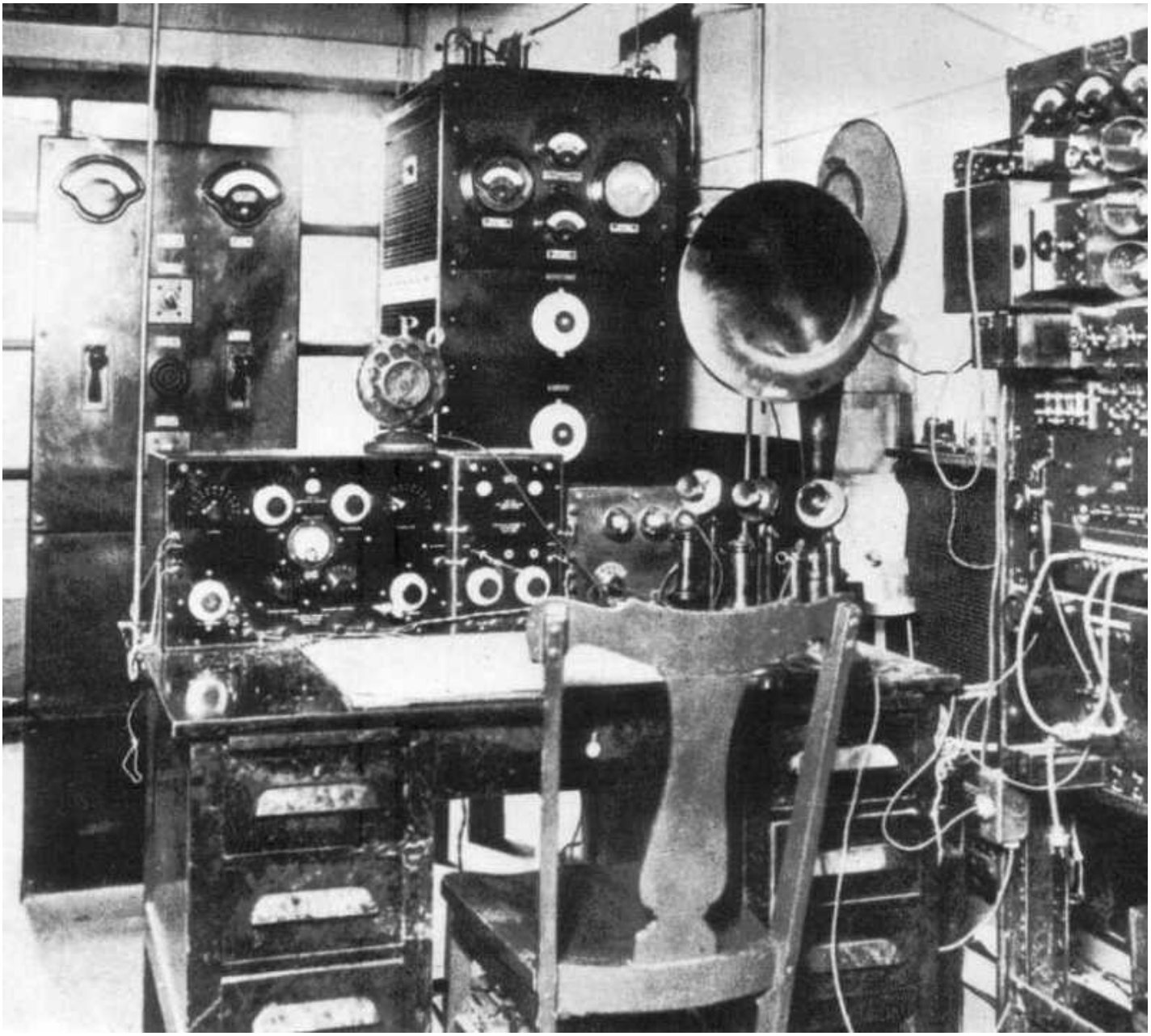
Early Western Electric 1-A and 1-B Transmitters

February 1922	WWJ	Detroit	3 Front Panel Dials 4 Front Panel Meters
April 17, 1922	KPO	San Francisco	3 Front Panel Dials 4 Front Panel Meters
October 2, 1922	WMAQ	Chicago	No Picture
May 1923	WE - Technical Bulletin T-670		2 Front Panel Dials 4 Front Panel Meters
September 1922	WLW	Cincinnati	No Picture
June 1923	WOR	New York	3 Front Panel Dials 4 Front Panel Meters
December 1924	KTHS	Hot Springs	3 Front Panel Dials 4 Front Panel Meters
June 29, 1925	KFWI	San Francisco	3 Front Panel Dials 4 Front Panel Meters
September 21, 1929	KFWI "Modified" Schematic Diagram.		

WWJ Detroit February 1922



KPO San Francisco April 17, 1922



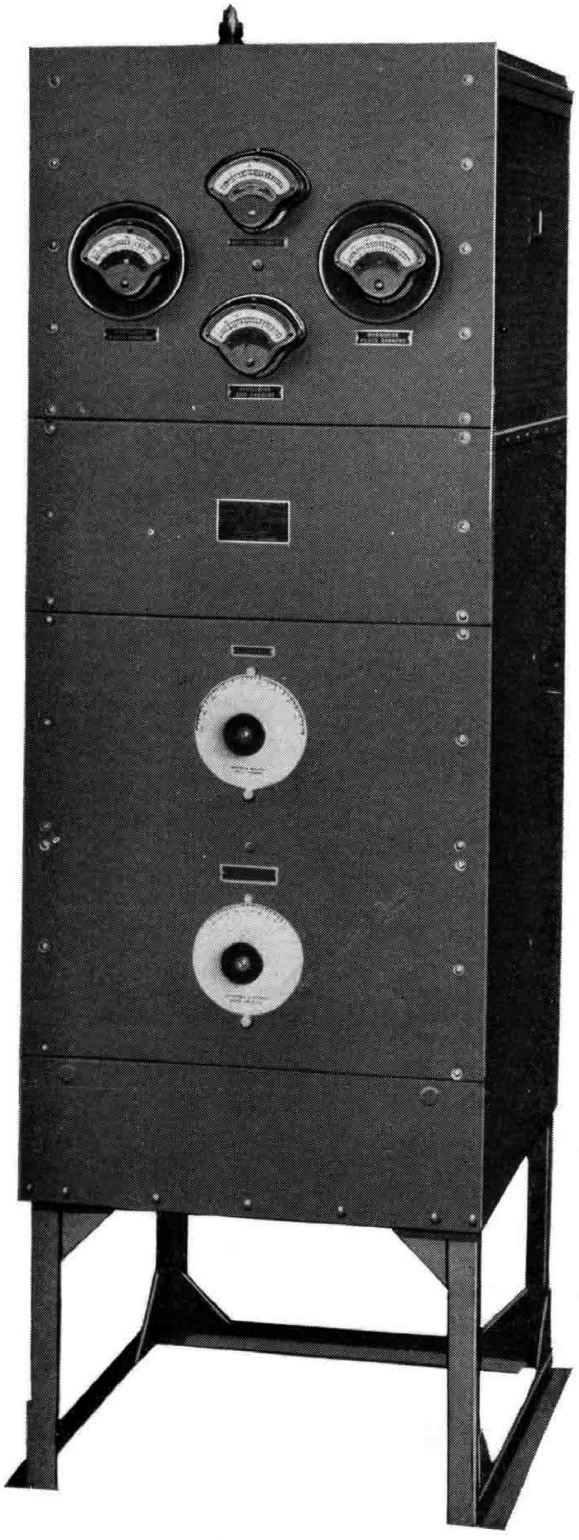
WMAQ Chicago October 2, 1922

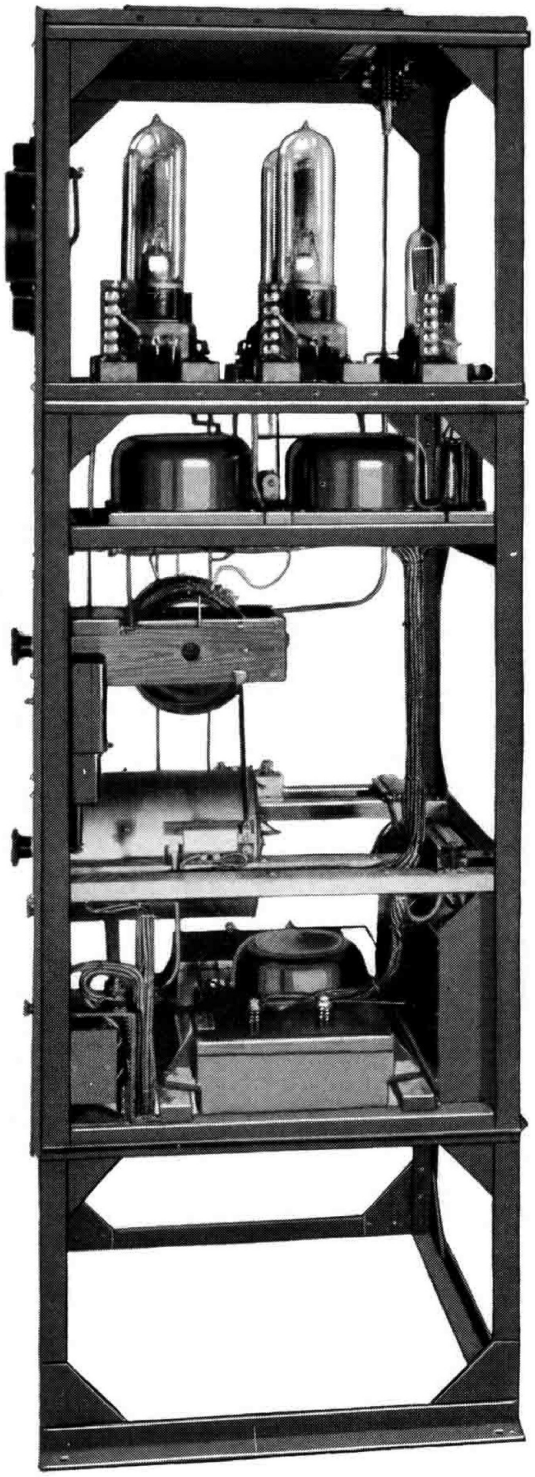
from The History of WMAQ Radio - Chapter 4

October 2, 1922

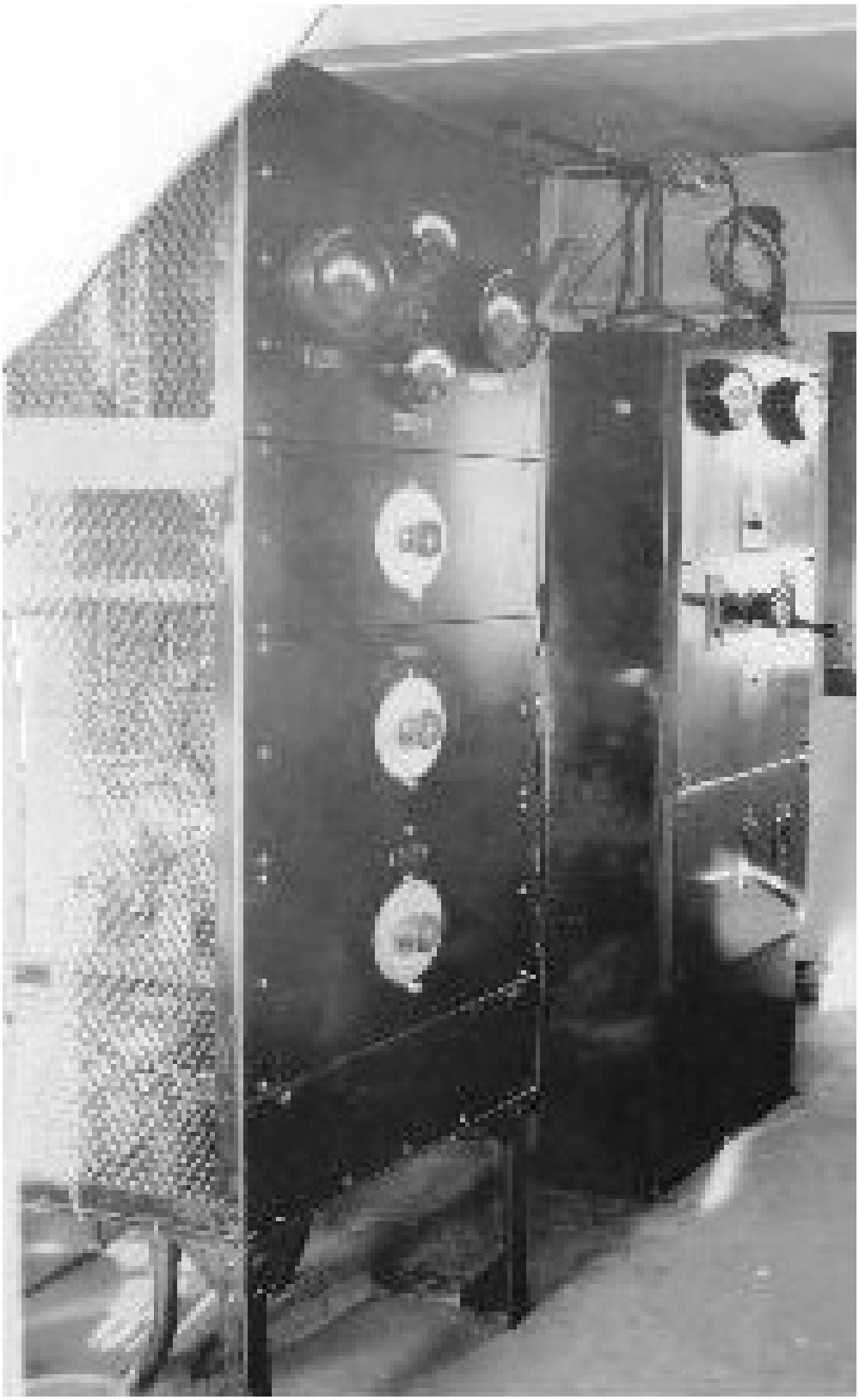
Early in September [1922] the new Western Electric transmitter was shipped to Chicago and installed in the control room above the third floor studios of [WMAQ]. It was a [Western Electric] type 1A 500 watt broadcast transmitter, the first of its kind to be built by Western Electric. The speech input equipment consisted of a single Western Electric type 8-A amplifier [KTHS had a 1A Speech Input Amplifier], operated entirely from batteries. Inasmuch as no high voltage battery supply in compact form was available, it was necessary to use 350 volts from no. 6 dry cells---which made quite an impressive array of batteries. The actual Operator Donald Weller continued as the only operator, engineer, technician and general maintenance man. With a great flourish of publicity WMAQ went on the air again with two special dedicatory broadcasts the evening of October 2, 1922.

from Jim Hawkins: September 1, 1922- WLW began using a newly-installed Western Electric 1-A transmitter, raising the power to 500 watts and changing the operating frequency to 970 kilocycles. For an antenna, the station used two 125 ft. towers, supporting a 140 foot 12 wire "T"-type antenna.

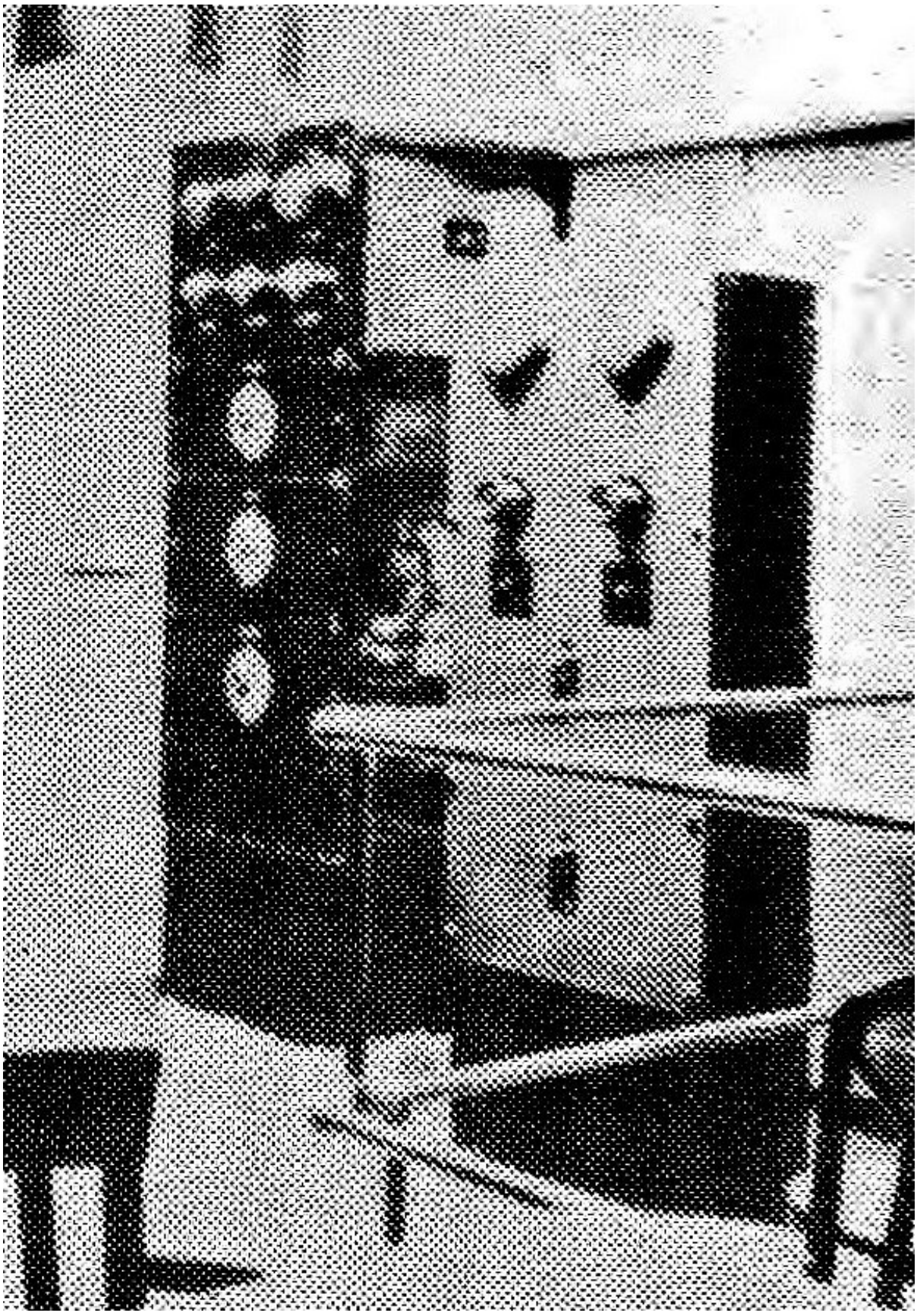




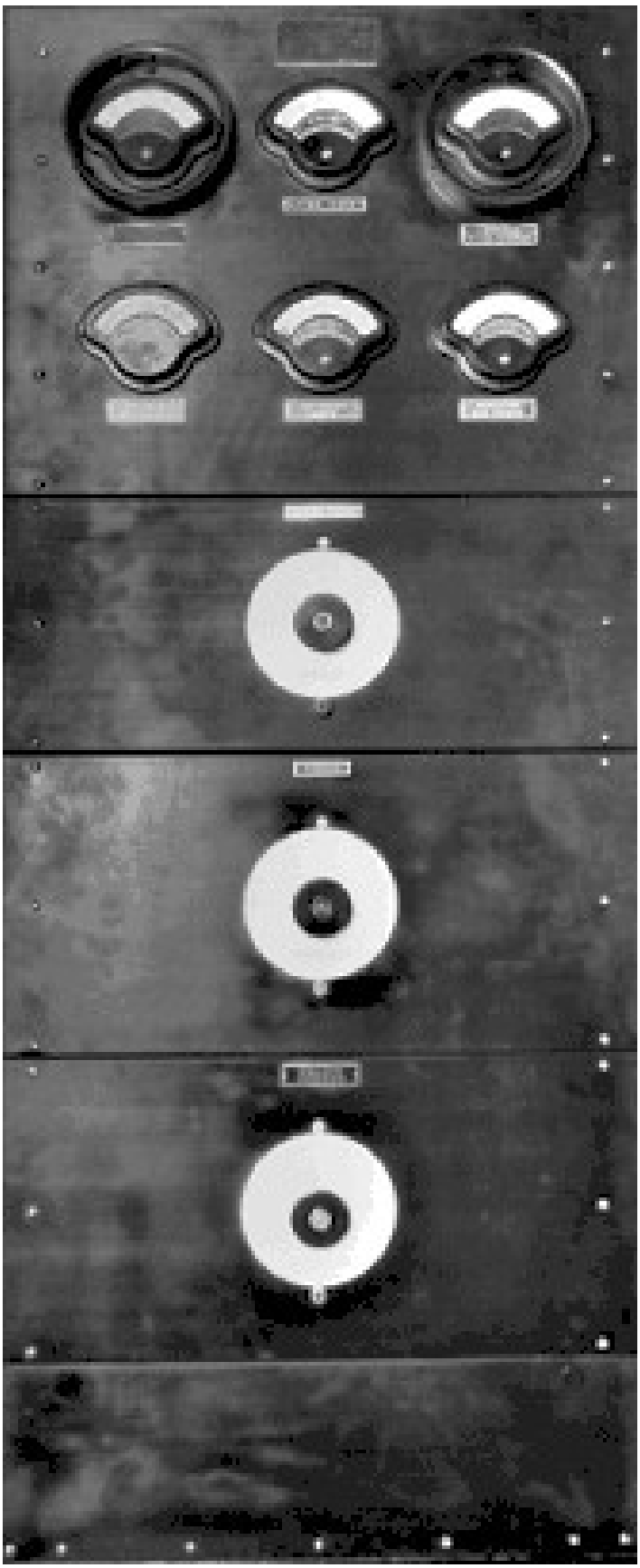
WOR February 22, 1922 using deForest Transmitter.
June 1923 WOR-AM went to 740 AM and moved to New York City



KTHS December 1924



KEWI San Francisco Western Electric Transmitter June 29, 1925



KFWI Schematic Diagram (marked as "Modified")