

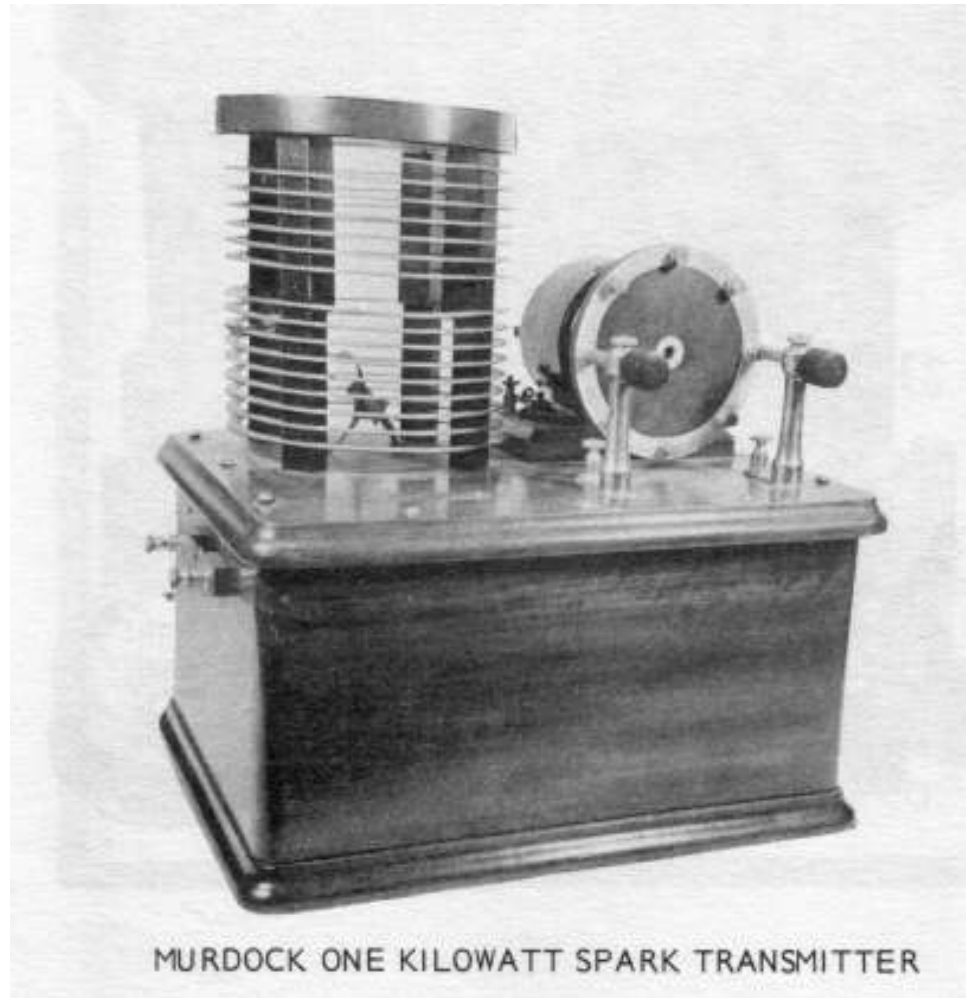
MODULATION & TRANSMITTERS

MODULATION AS THE LOAD...



MULE AS THE CARRIER

IN THE BEGINNING: SPARK





$\frac{1}{2}$ K W

150 MILES

150 Miles with the W-M $\frac{1}{2}$ K.W. Complete Set

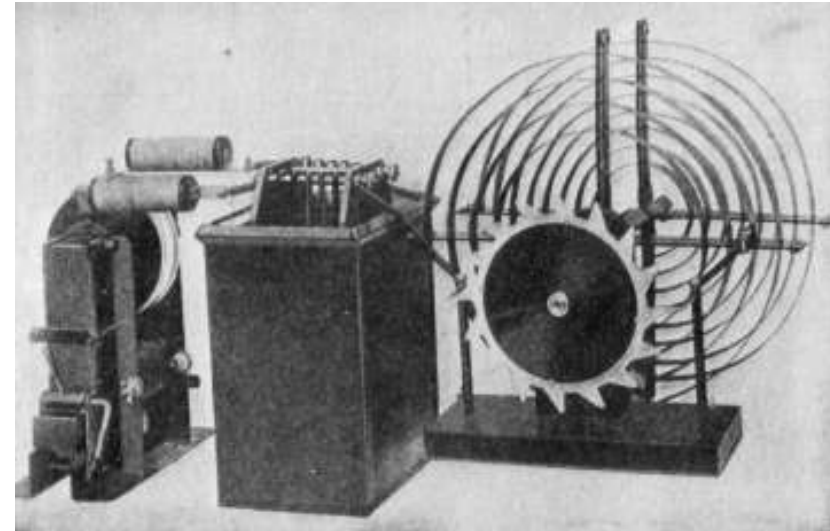
"Gentlemen— Although I have had your $\frac{1}{2}$ K. W. set in operation but a few days, I have already worked over 150 miles in the day time. (Signed) A. S. Gerhard, Omaha, Neb.

The "W-M" $\frac{1}{2}$ K.W. Complete Set Boxed for Shipment \$40.00

The "W-M" 1 K.W. Complete Set Boxed for Shipment \$60.00

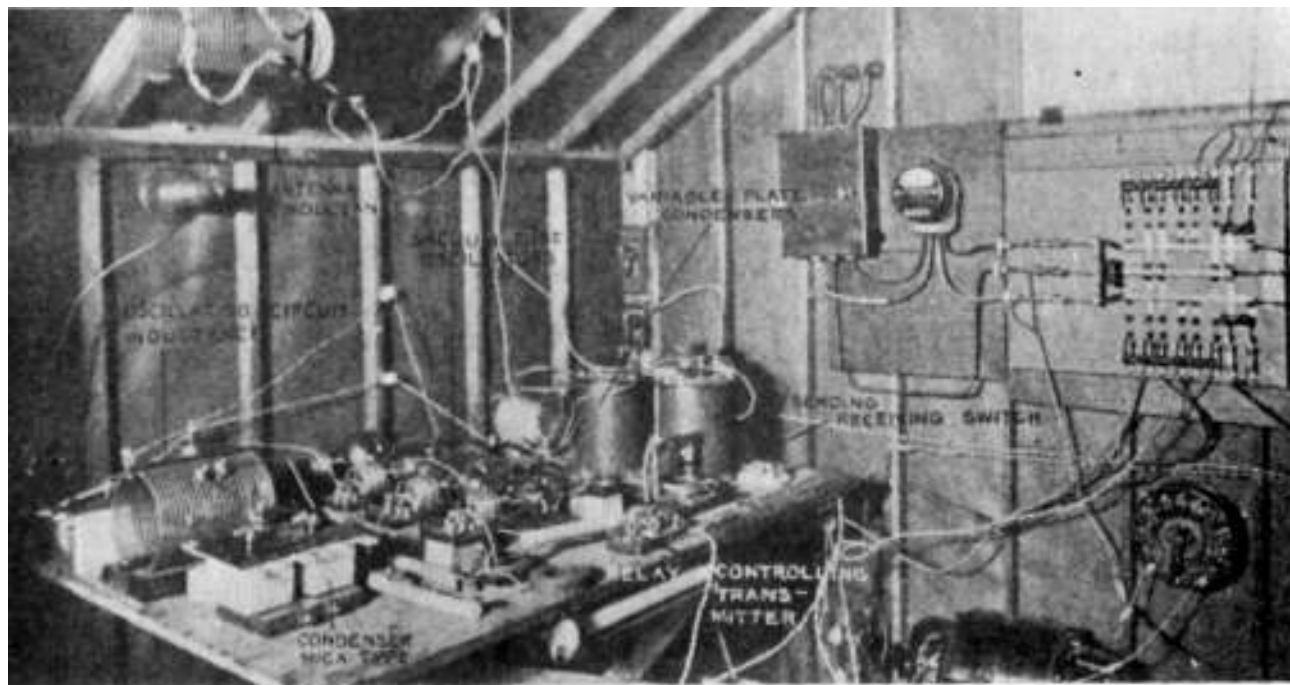
Send 2c. postage for our complete catalog "K" listing high power apparatus exclusively.

WORTS-MCKISSON MANUFACTURING CO.
DEPT. M, TOLEDO, OHIO

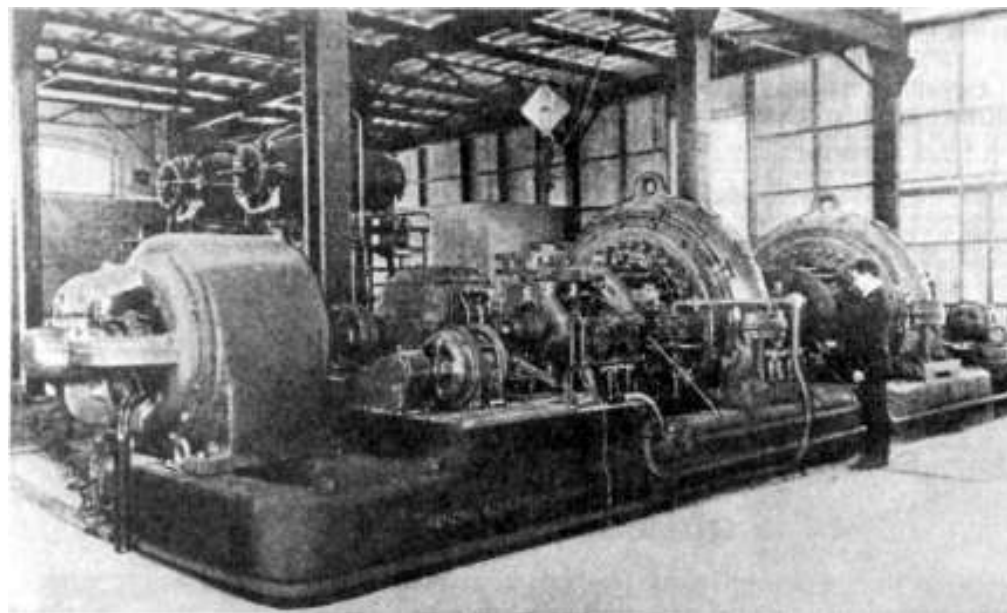


*THE WONDER OF IT
ALL....*

***EARLY HAM
RADIO
SHACK
EARLY 1920s***



***ALEXANDERSEN
COMMERCIAL
TRANSMITTER 50
KW MID-1920s***



DRAWBACKS TO THE USE OF SPARK

***BANNED ON 80, 40, 20 and 5 METER AMATEUR BANDS
AFTER 1924 BUT CONTINUED TO BE USED ON THE LOWER
BANDS***

CONTINUED USE UNTIL 1930s IN MARITIME STATIONS

SPARK STATIONS OPERATED UP TO OUTBREAK OF WW II

SPARK SOUND 

DAWN OF THE VACUUM TUBE **AGE**

CHANGES IN TRANSMITTERS & RECEIVERS

THE “SWEET NOTE”

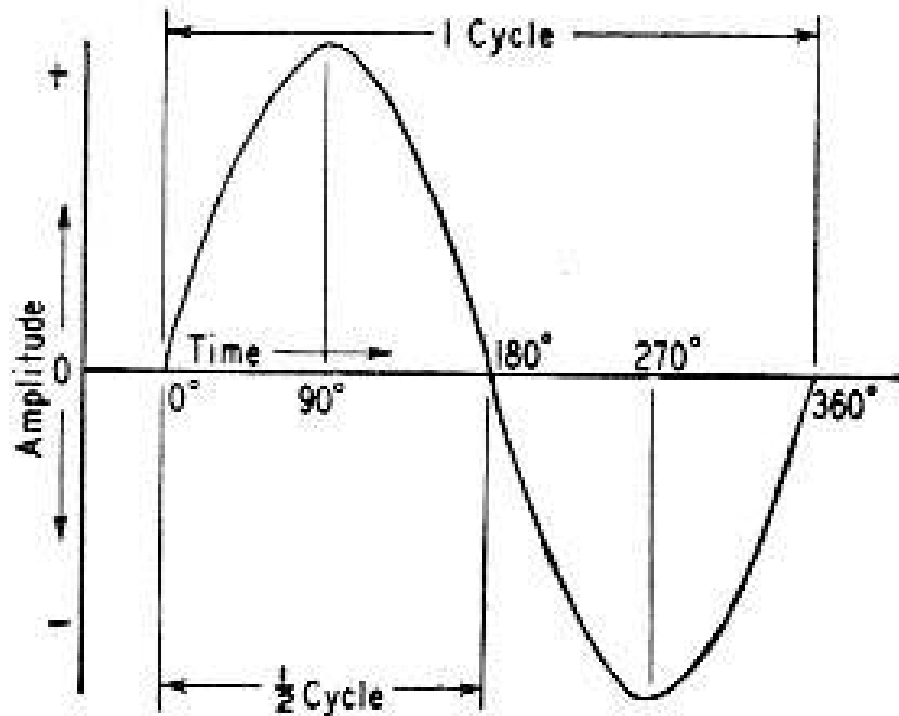
THE CARRIER: A MULE TO CARRY A LOAD

“WIRELESS TELEGRAPHY” MORPHS TO RADIO

MODIFYING THE CARRIER

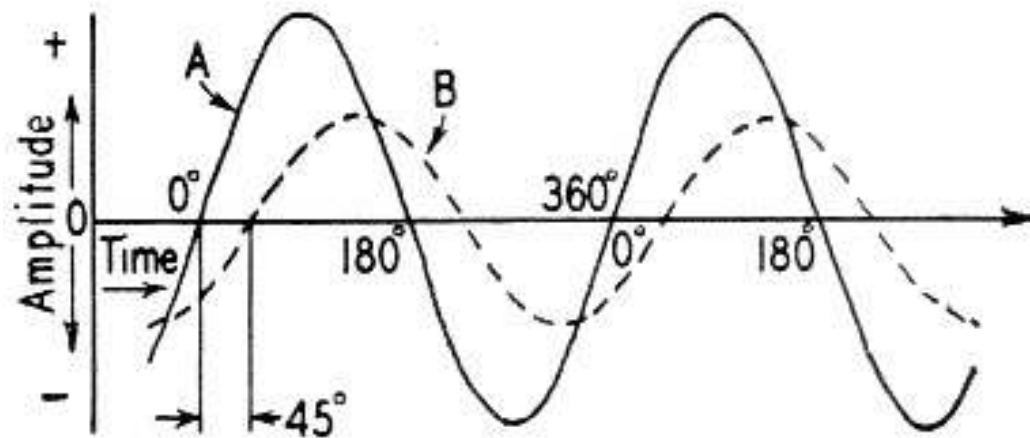
(LOADING DOWN THE MULE)

TRANSMISSION OF THE HUMAN VOICE via AMPLITUDE MODULATION

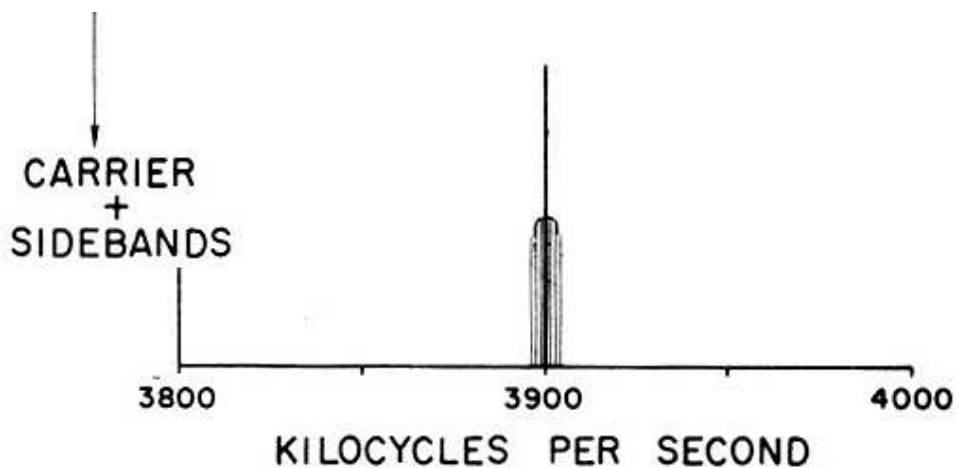
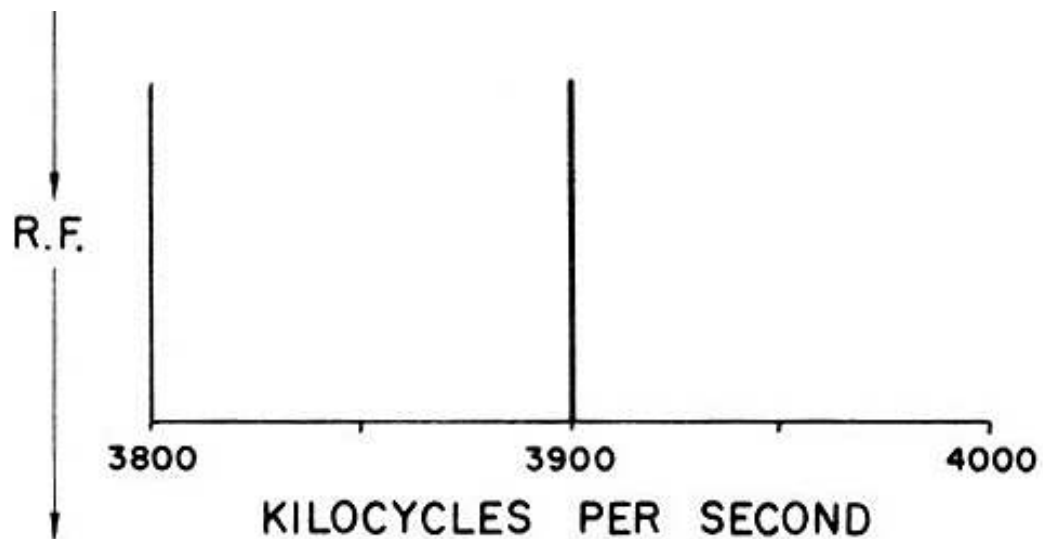


*PHASE MEASURED IN
TIME/DEGREES*

*LAGGING or
LEADING
WAVES*

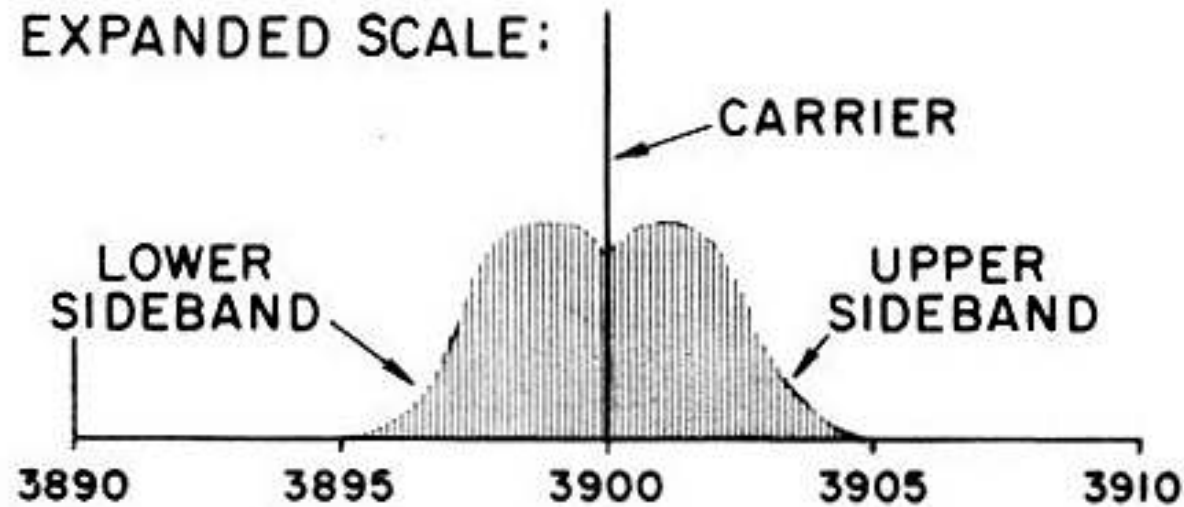


*RF CARRIER
UNMODULATED*

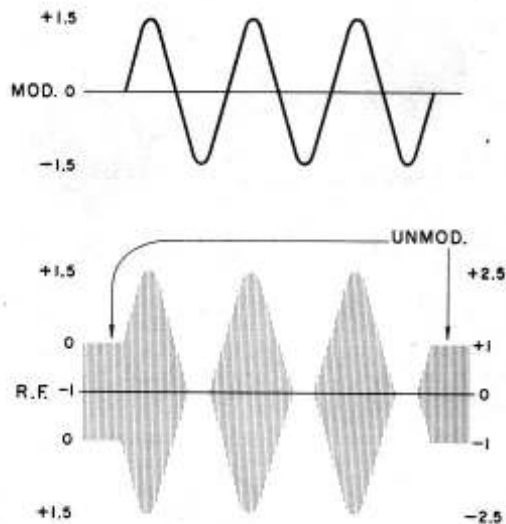


*RF CARRIER WITH
AUDIO DATA
SUPERIMPOSED*

WITH EXPANDED SCALE:



***CARRIER WITH MODULATION SUPERIMPOSED
(AS BOTH SIDEBANDS AND CARRIER ARE PRESENT,
THIS IS AM MODULATION)***

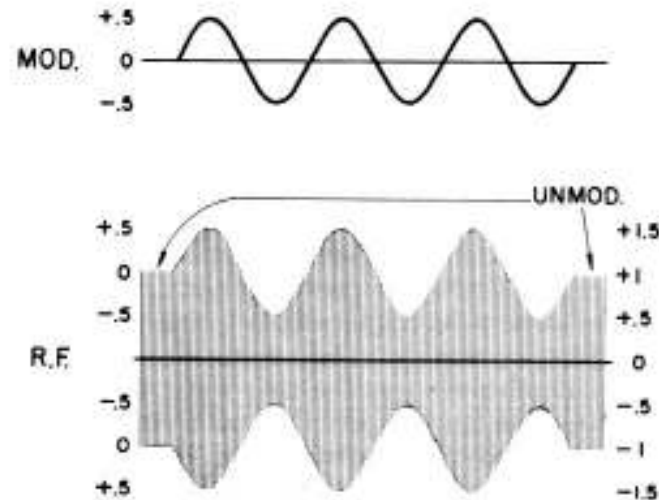


***OVER-MODULATION OF
CARRIER-OSCILLOSCOPE
PATTERN***

(+1.5 IS 150% MODULATION)

***UNDER-MODULATION
OF CARRIER-
OSCILLOSCOPE
PATTERN***

***(+.5 IS 50%
MODULATION)***



POWER IN THE MODULATED WAVE

INSTANTANEOUS POWER AT UPSWING PEAK

***INSTANTANEOUS POWER AT THE DOWNSWING
TROUGH***

PEAK POWER OUTPUT (PEP)

***AVERAGE POWER OUTPUT WITH 100% SINE-WAVE
MODULATION***

***BANDWIDTH OF A FULLY-
MODULATED AM SIGNAL IS***

6 KHZ MINIMUM

CALCULATION

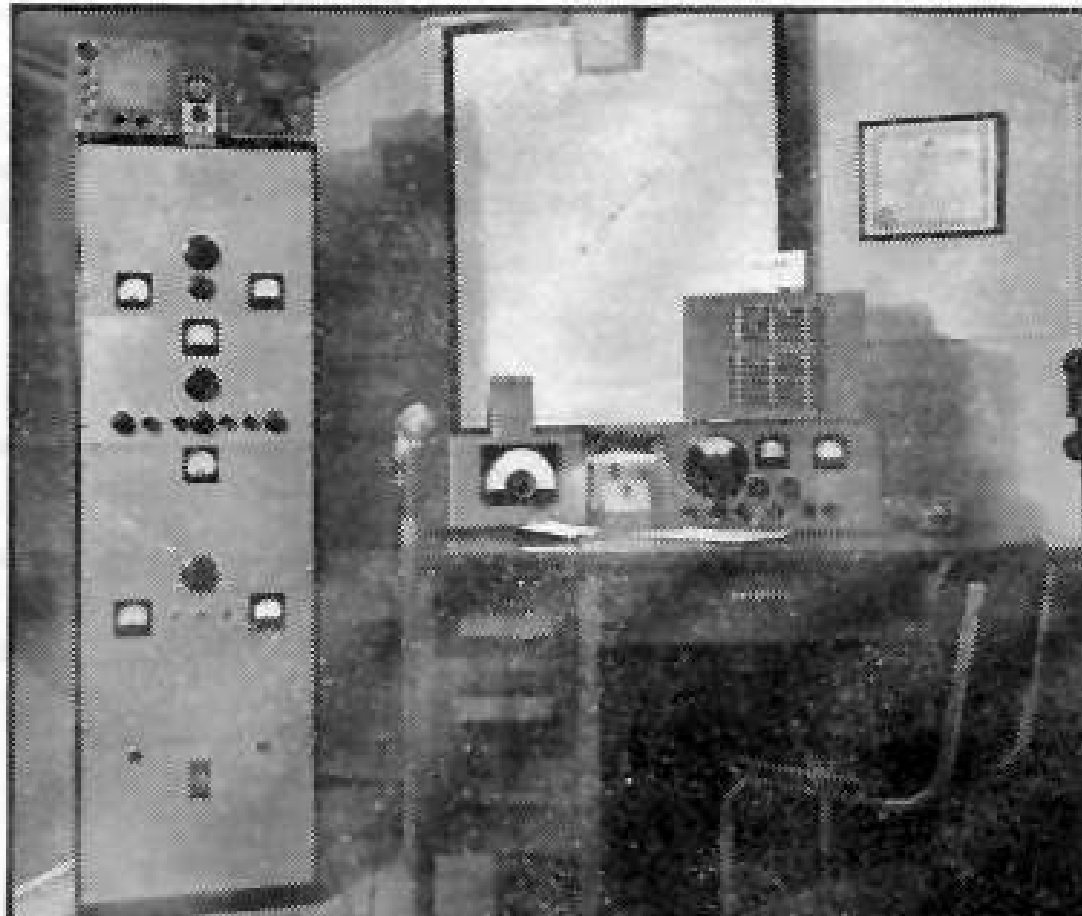
PROBLEMS WITH SIGNALS THIS WIDE

LINEARITY ESSENTIAL

NON-LINEAR SIGNALS: PROBLEMS

DEATH and RESSURECTION of AM!

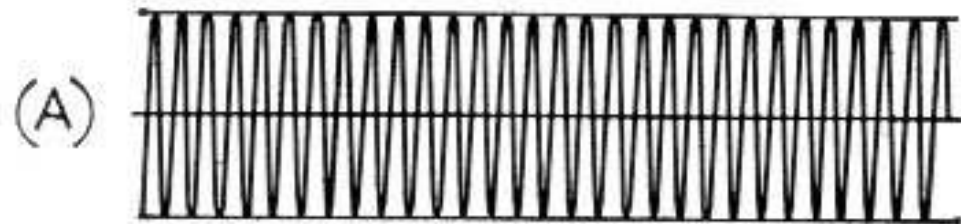
WHEN AM WAS KING!



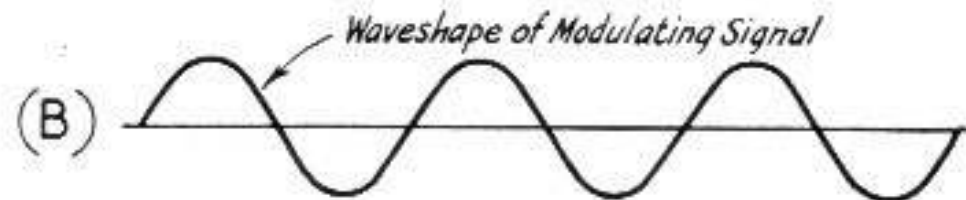
FREQUENCY MODULATION

(DIAGRAM FROM MANUAL)

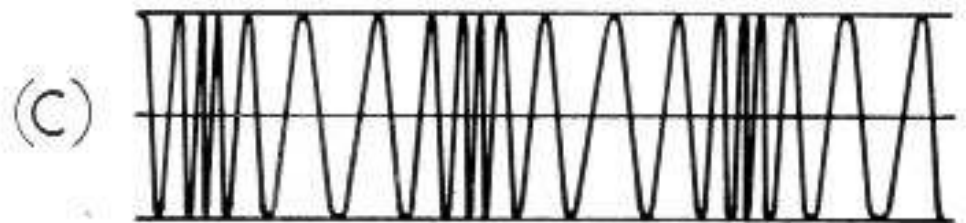
***UNMODULATED
CARRIER***



***MODULATING
SIGNAL***



***CARRIER
MODULATED***



***FM SIGNAL: SEVERAL PAIRS OF SIDEBANDS ALL
HARMONICALLY RELATED TO THE MODULATING
SIGNAL***

***CARRIER STRENGTH VARIES WITH THE MODULATION
(COMPARE WITH AM)***

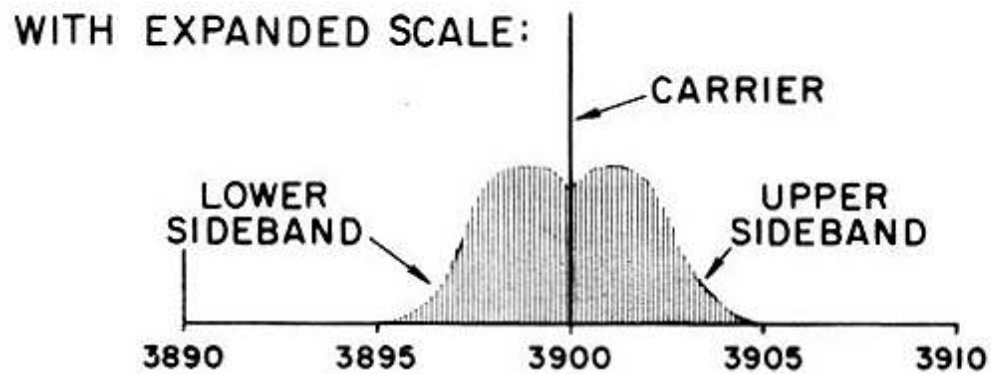
***ENERGY WHICH GOES INTO THE SIDEBANDS IS TAKEN
FROM THE CARRIER (TOTAL POWER OUTPUT IS
CONSTANT)***

ADVANTAGE OF FM OVER AM

WIDE BANDWIDTH LIMITS USE BELOW 29.5 MHZ

CHANNELIZED OPERATION

SINGLE SIDEBAND MODE



CONSERVATION OF SPECTRUM

CONSERVATION OF POWER

DSB vs SSB

EFFECTIVE GAIN OVER AM: 9DB

SSB: THE GREAT DEBATE

THE AM-SSB “WARS”

“DONALD DUCK” GAINS GROUND

KWM-1 ACCEPTED BY US MILITARY

THE TRANSCEIVER REPLACES SEPARATES

NEW SIDEBAND TECHNOLOGY

THE “DEATH” OF AM



***KWM-1 TRANSCEIVER 1957: THREE BANDS...175 WATTS
PEP INPUT...\$820!***

TRANSMITTER COMPONENTS

OSCILLATOR

BUFFER

AMPLIFIER

MODULATOR

POWER SUPPLY

***MICROPHONE, KEY, KEYBOARD, COMPUTER
INTEFACE***

THE OSCILLATOR

**“EVERY OSCILLATOR CAN AMPLIFY AND EVERY
AMPLIFIER CAN OSCILLATE”**

MANY DIFFERENT TYPES of CIRCUITS

STABILITY ISSUES

FUNDAMENTAL and HARMONIC OUTPUT

THE BUFFER STAGE

CATS and DOGS

A CONSTANT LOAD

AMPLIFICATION and DRIVE

FREQUENCY MULTIPLICATION

FILTERING

THE POWER AMPLIFIER

“DRIVING POWER”

**STABILITY: PARASITIC OSCILLATION
and NEUTRALIZATION**

HARMONIC SUPPRESSION

CLASSES and EFFICIENCY

**OUTPUT CIRCUIT and “TUNING”
THE LOAD**

THE MODULATOR & AUDIO ***COMPONENTS***

THE MICROPHONE

SPEECH AMPLIFICATION and GAIN

SHIELDING and HUM

OVER-DRIVING and DISTORTION

THE POWER SUPPLY

LINEAR vs SWITCHING

FILTERING

REGULATION

OVER-VOLTAGE, OVER-CURRENT PROTECTION

(WHAT MOTHER DIDN'T TELL YOU!)

THE CW TRANSMITTER

MECHANICAL & ELECTRICAL STABILITY ISSUES

PURITY OF POWER SOURCE

PURITY OF SIGNAL: CHIRP, CLICKS, SPURS, DRIFT

***MODERN METHODS OF GENERATING A STABLE
SIGNAL***

***ENHANCING THE SIMPLE CW TRANSMITTER: WHY
DESIREABLE***

THE AM TRANSMITTER

OSCILLATOR MAY BE XTAL, VFO, OR SYNTHESIZED

*FREQUENCY MULTIPLICATION SHOULD OCCUR IN
THE LOWER STAGES: REASON*

OSCILLATOR MAY NOT BE MODULATED: REASON

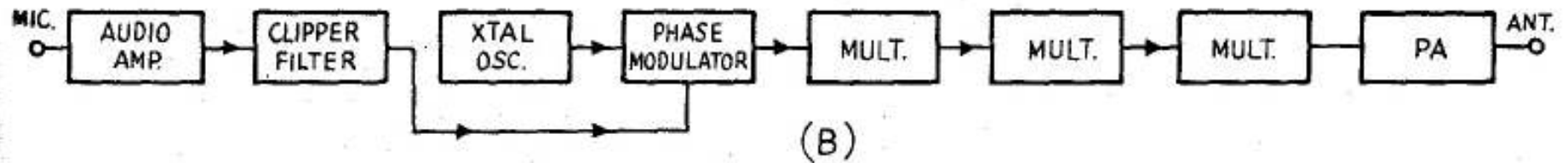
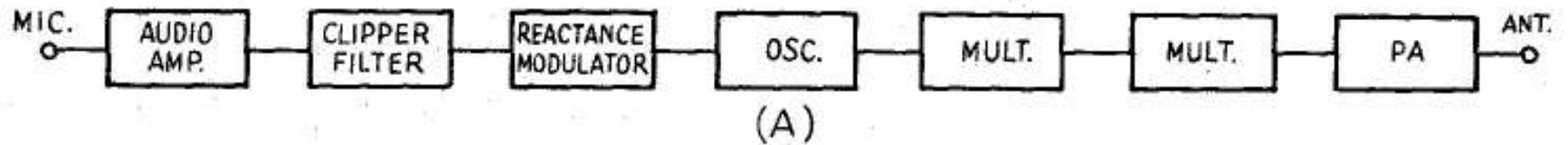
STABILITY OF OSCILLATOR

POWER SUPPLY ISSUES

REASON FOR SPEECH PROCESSING OF SOME SORT

AM IS ALIVE AND WELL TODAY!

THE FM/PM TRANSMITTER



AUDIO STAGE(S) SIMPLE AND LOW POWER: REASON

DIFFERENCE IN LOCATION OF FREQUENCY

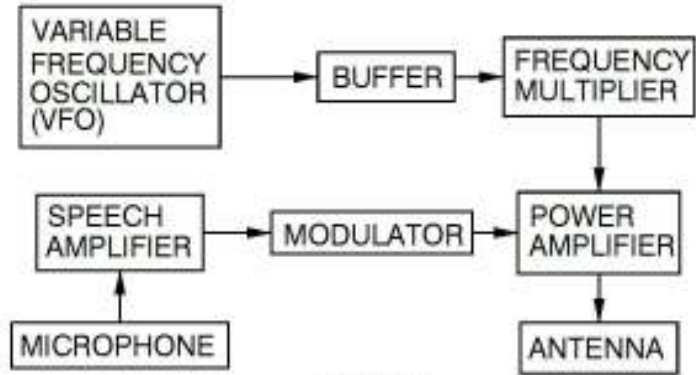
MULTIPLICATION STAGES COMPARED TO AM: REASON

*FM and PM MODULATORS OPERATE IDENTICALLY
(WHAT DO THEY DO?)*

PROCESSED AUDIO VERY DESIREABLE: REASON

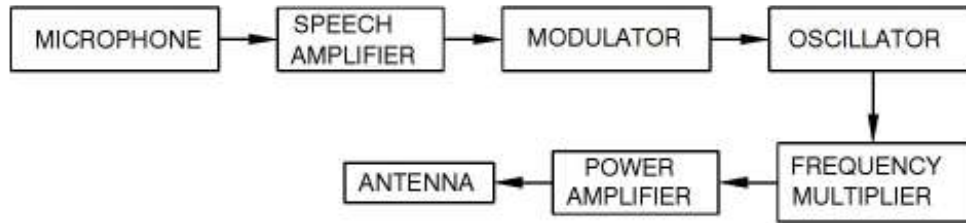
**TRANSMITTERS: A
COMPARISON**

AM TRANSMITTER



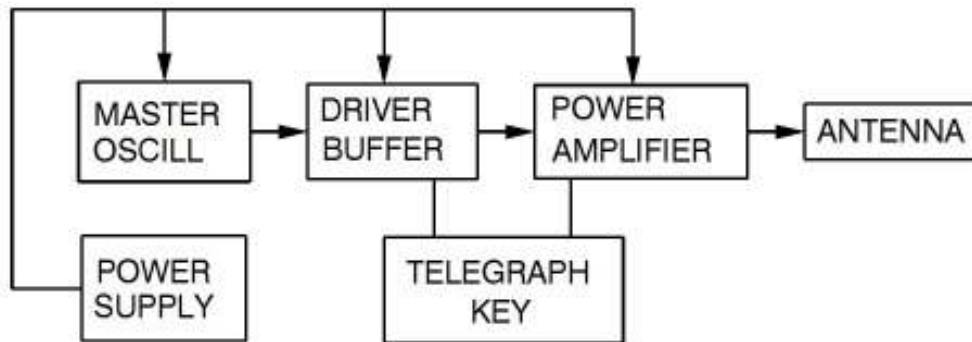
B130050

FM TRANSMITTER



B130090

CW TRANSMITTER



B130070

THE SSB TRANSMITTER

***ELIMINATING THE CARRIER: THE BALANCED
MODULATOR***

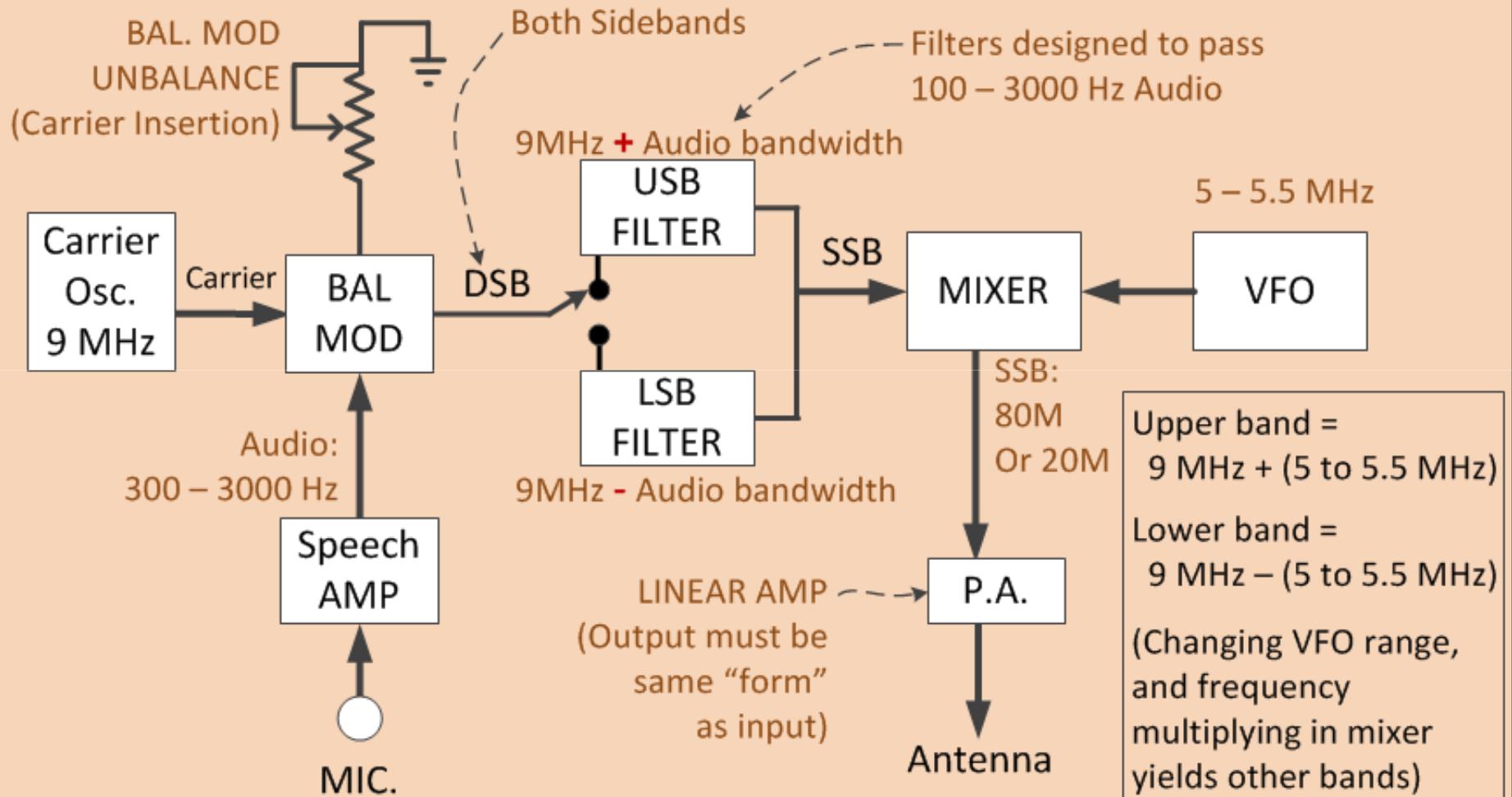
ELIMINATING ONE SIDEBAND: FILTERING

***FREQUENCY CHANGING MUST BE BY MIXING RATHER
THAN BY MULTIPLICATION***

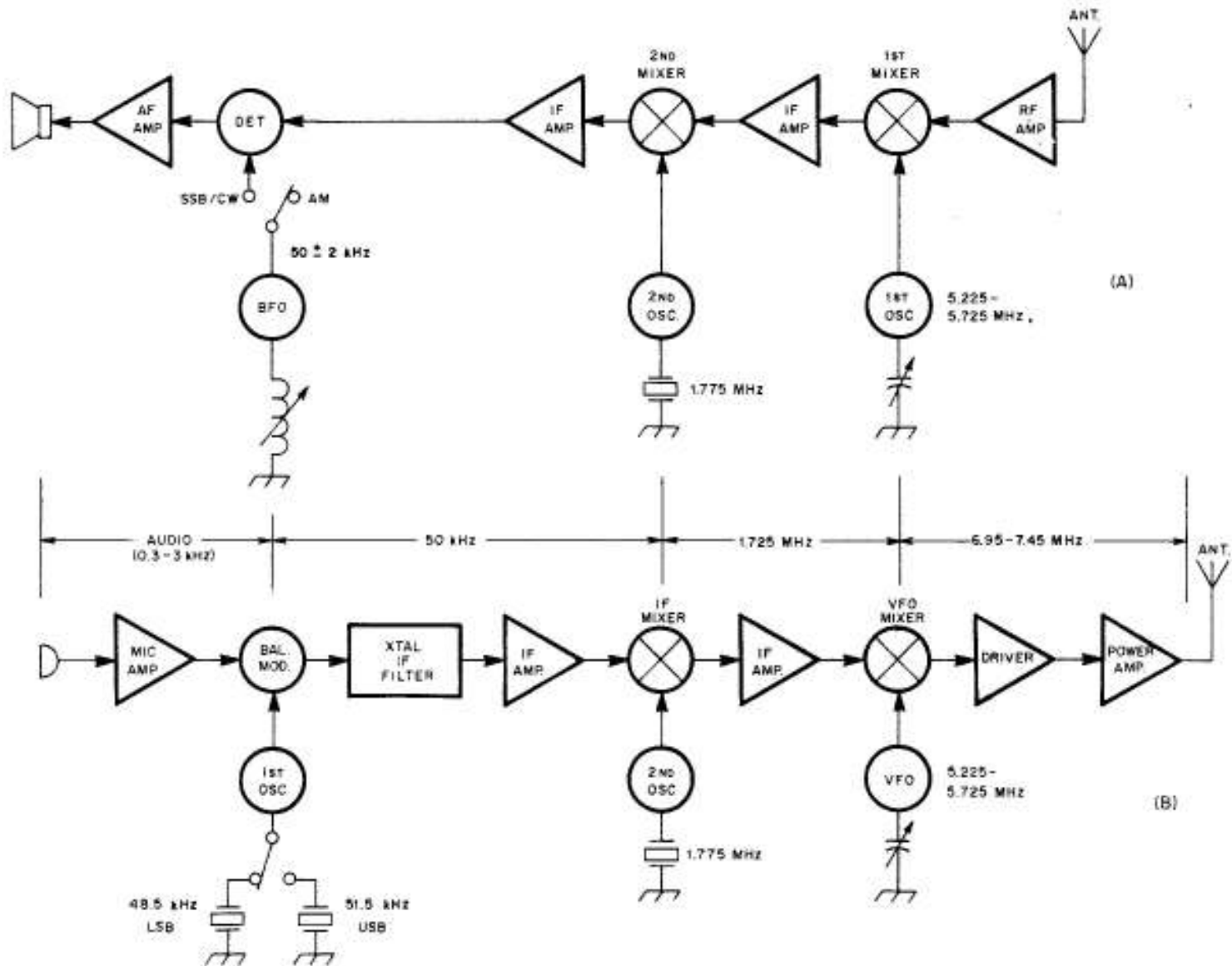
***SIGNAL OUT OF THE MIXER IS THAT WHICH WILL BE
TRANSMITTED: NO OTHER CHANGES POSSIBLE***

PA MUST BE LINEAR

Example of a Two Band Simple SSB Transmitter



SIMILARITIES: SSB TRANSMITTER & RECEIVER



DIGITAL MODES

AT LEAST 16 DIFFERENT MODES IN USE

ERROR-FREE COMMUNICATION

COMPUTER SOUND CARD+INTERFACE+SOFTWARE

DIGITAL SIGNAL PROCESSING (DSP)

SOUNDS

AMTOR FSK



PACTOR FSK



RTTY FSK



PSK31



HF PACKET FSK



RELATIVELY NARROW BAND MODES

LOW-POWER USED EXTENSIVELY

DESIGNATED SEGMENTS OF EACH AMATEUR BAND

GROWING POPULARITY TODAY

***DEVELOPMENTS IN ELECTRONICS & NEW DIGITAL
MODES NOT POSSIBLE 10 YEARS AGO***

***MANY MODERN TRANSCEIVERS HAVE RTTY and
OTHER DIGITAL MODES BUILT IN***