Stancor 20-P Transmitter

The Stancor 20-P Transmitter comes in kit form and when assembled results in a complete phone and C.W. transmitter, including its a-c power supply contained in a cabinet measuring 19" x 13" x 8-3/4" overall. The rated input is 20 watts at all frequencies although this can be increased to 30 watts if desired. The modulator delivers 10 watts of audio-frequency power which is sufficient to modulate the radio-frequency output of the transmitter 100 percent. The transmitter is capable of operation on any frequency from 1.6 to 60 megacycles and is crystal controlled. Practically any type of antenna may be used.

Frequency change can be accomplished in 30 seconds or less by means of two plug-in coils, and a plug-in crystal.

During actual tests the A20-P@ performed very creditably on all the amateur frequencies from 1.75 to 60 MC. Telegraph signals were clean and without Achirps.@ Phone modulation was excellent. Checking the frequency stability showed it to be practically perfect. When used as a phone no frequency modulation was apparent.

General Description of the Circuit

A type 6F6G tube acting as a crystal controlled oscillator drives a type 807 amplifier tube in the radio-frequency section. Split stator type condensers in both the oscillator and the amplifier tank circuits provide proper inductance to capacity ratio for all frequencies. The sections of both condensers are automatically switched when the plug-in coils are inserted. A 2-volt 60 MA pilot light bulb is connected in series with the crystal to indicate the crystal current and also acts as a fuse.

Antenna coupling is by means of a link or by capacity coupling to the amplifier tank circuit.

The tube lineup of the speech amplifier and modulator is as follows: a 6J7 input, 6C5 voltage amplifier, 6N7 driver (Class AA@), and a 6N7 modulator (Class AB@). Different load impedances are available through taps in the secondary of the modulation transformer. Sufficient gain for a crystal microphone or similar high impedance input is provided.

The power filter employs condenser input. A type 5Z3 full-wave rectifier tube delivers approximately 400 volts d-c out of the filter. Power to the three speech amplifier stages is supplied through an additional filter section to insure hum-free operation. A tapped voltage divider of 20,000 ohms (50 watts) provides 300 volts for the speech amplifier and 175 volts to the oscillator screen grid. The screen of the 807 amplifier tube in the radio-frequency section is supplied through a voltage dropping resistor of 50,000 ohms.

The Layout

All controls, including the meter, microphone, and keying jacks, are mounted on the front panel. A built-in meter switch permits the same meter to be used for reading oscillator, amplifier, and modulator plate currents without plugs or jacks.

Reading from left to right across the front of the panel, the controls are as follows: at the top, oscillator plate tank tuning dial, plate circuit meter, and amplifier plate tank tuning dial; at the bottom, microphone jack, gain control, keying jack, meter switch, modulator Aon-off@ switch, filament switch, and plate switch.

Looking at the chassis from above, the parts are arranged as follows, along the panel from left to right: the amplifier tank coil, amplifier tank condenser C12, 807 amplifier tube and shield, oscillator tank coil, and oscillator tank condenser C8. The four metal tubes at the right end of the chassis are those of the speech amplifier and modulator. Along the rear of the chassis from left to right: the power transformer T3, 5Z3 rectifier tube, filter condensers C1, C2, and C4, and the modulation transformer T2. The 6F6G oscillator tube is directly in front of C8 and in back of the modulation transformer. The crystal is at the left of the oscillator tube and the pilot light crystal fuse is between it and the tube.

The layout of each section (r-f, a-f, and power) follows as closely as possible that shown in the schematic circuit diagram. The radio-frequency and audio-frequency sections are spread out so as to prevent feedback and interaction between circuits but at the same time kept close enough together to keep the plate and grid leads reasonably short. The arrangement of the power transformer and filter chokes with respect to the audio transformers is designed so that a minimum of inductive coupling exists and no noticeable hum is induced in the audio system.

Assembling

The sockets are the first parts to mount on the chassis. Bakelite sockets may be used in the audio-frequency and power supply sections. Amphenol sockets are preferable in the radio-frequency circuits. The socket for the 807 tube has five prongs and the 6F6G tube socket has eight prongs, while the socket for the plug-in crystal has six prongs and those for the oscillator coil socket and the amplifier coil socket have five and six prongs respectively. All the tubes in the audio-frequency section use octal sockets and the 5Z3 rectifier uses a four-prong socket. It is important to mount all the sockets so that the shortest leads can be made to adjoining circuits. This not only adds to the appearance of the finished wiring job but is a considerable factor in securing the best operation of the completed unit.

The rubber grommets furnished with the kit are to insulate the wires which pass through the chassis. The six 3/16" grommets are used to insulate the tank circuit leads of the oscillator and amplifier tank tuning condensers and they mount in two rows of three each, just to the right of each condenser. The two 3/8" grommets are for the 110-volt a-c line cord leads where it passes through the back of the chassis, and for the leads to the meter at the center and near the front edge of the chassis. The **2**" grommet mounts in the **2**" hole between the 6F6G and crystal

sockets. The small socket, which holds the bulb connected in series with the crystal, mounts in this grommet.

Each tuning condenser is mounted with four 4-36 screws and four 1" bushings.

The two small porcelain feed-through insulators mount on top of the chassis at the righthand edge of the chassis beside the amplifier coil socket and the power and modulation transformers.

The filter condensers and the 807 tube shield (actually a coil shield with the top sawed off) should be put in their respective places. The shield for the 807 tube should be the same height as the coil forms so that it will shield the 807 from the field of the oscillator coil. Then when the modulation and power transformers have been fastened in place the parts which mount on the panel (except the dials) can be assembled in their proper place. The six parts which mount in a row across the bottom of the panel, hold the latter to the chassis.

The chassis can now be turned over and the wiring started. Other parts, such as the four 5-lug mounting strips, can be added as the wiring progresses. The mounting feet of each strip should be bent in or out to fit the screws already on the chassis.

Wiring

The primary circuit of the power transformer and the filament circuits of all the tubes should be wired first. Needless to say, all connections should be soldered, all leads should be as short as convenient, and all the precautions to be observed in wiring a receiving set should be followed. When the primary circuit of the transformer and the filament circuits have been connected, connect the line cord to the 110-volt a-c and check to see if the proper voltage is present at the filament prongs of each circuit. Then the wiring for the high voltage power supply can be put in place and the supply tested for output with the 5Z3 rectifier tube in its socket.

The wiring of the radio-frequency section should begin with the oscillator and progress to the amplifier. The socket used for the plug-in crystal has six prongs whereas only two are actually required. However, connect three in a row on each side, so that no matter which way the crystal is inserted in the socket, it will always make the proper connections.

All of the radio-frequency leads should be No. 14 B.S. gauge wire and should be raised about 3/4" away from the chassis in order to avoid the losses due to capacitive effects between the wiring and the chassis. The three tank circuit leads for each radio-frequency stage pass through the 3/16" rubber grommets which insulate them from the base. The small parts, such as the radio-frequency chokes, resistors, and fixed condensers, are mounted with their own leads so as to be self-supporting, being mounted about 3/4" away from the chassis in the same manner as the radio-frequency leads. When all of the radio-frequency connections have been made, the meter switching connections can be put in and the wiring between the power supply and the radio-frequency stages put in.

When the dials have been added, the radio-frequency section of the transmitter is ready to be tested. It will be necessary to make up one pair of coils. These are wound on 1-1/2" Hammarlund forms. One 5-prong (No. SWF-5) and one 6-prong (No. SWF-6) are required. It will be necessary to have a pair of coils for each wavelength band. The data given below in the coil chart holds good only for condensers of the capacity given in the parts list. If other types or values are used, changes must be made in the coil data. The schematic circuit diagram and the coil chart show bottom views of the coil sockets.

The condenser C25 shown in the amplifier chart but not in the circuit diagram is used only in the four lower frequency bands. It is mounted inside the coil form for each of these bands and is automatically plugged in or out of the circuit with each coil.

To test the radio-frequency section, insert an oscillator coil, crystal, rectifier, and radio frequency tubes, plug in the line cord, and turn on the filaments. When the tubes have warmed for two or three minutes, switch the meter to the oscillator plate circuit. Then turn the plate voltage switch on and tune the oscillator plate tank until the meter indicates resonance by a current dip. The current should drop to 20-40 ma. The actual value will depend upon a number of factors, such as frequency, tube, crystal, voltage, etc. When the oscillator has been tuned, insert the amplifier coil and switch the meter to the amplifier plate circuit. Tune the amplifier circuit to resonance as indicated by a dip to 5-15 ma. When loaded, the amplifier plate current should be from 50-75 ma.

In making up the oscillator and amplifier coils, it is a good idea to use a calibrated absorption type wavemeter to check them, to be sure that the proper harmonic is being picked off when doubling or quadrupling. Frequency doubling or quadrupling can be employed in both stages of this transmitter, making it possible to cover all bands with 160, 80 and 40 meter crystals. The value of the small condenser indicated as C3 in the schematic diagram of the radio-frequency section is fairly critical and can be varied either way to obtain the greatest harmonic output. The best value to use with a type 6F6G tube is approximately .00035 to .00037 mfd.

The resonant points are rather sharp in both tuned circuits and care must be used in tuning them, especially when doubling or quadrupling. The pilot light bulb in series with the crystal control indicates crystal current. This should be kept to the lowest value consistent with good output.

In wiring the speech amplifier and modulator, most of the connections can be made with the resistors and condensers themselves, thus helping to maintain short leads. When the connections to the driver transformer T1 are made, the primary center tap lead can be taped up or cut off. It is not needed. The total primary winding is used.

The grid and plate leads of the three speech amplifier stages should be shielded to prevent feedback and pickup. The leads going to the gain control should also be shielded.

The amplifier can be tested before it is connected to the modulator by placing a pair of phones in the plate circuit of the 6N7 driver stage in place of the primary winding of the driver transformer. The total plate current drain of these three stages should be approximately 15 ma.

When the amplifier has been checked, the 6N7 Class B modulator may be connected. It should draw about 30 ma when idling and up to 100 ma on peaks. The audio output can be checked by means of a load in the form of a 10-watt lamp connected across the secondary of the modulation transformer. The proper tap to use on the secondary of transformer T2, depends upon the load impedance of the 807 amplifier stage. Use the tap which will give a transformer impedance which will most nearly match the load impedance. The load impedance is equal to the plate voltage on the 807 tube divided by the current that it draws when loaded to the point at which it will be operated.

The two brass couplings and section of Bakelite rod which are included in the kit are used as insulating tuning shaft extensions. The tuning dials are fastened to the Bakelite shafts, which project through the front panel and couplings connect the other end of these shafts to the condensers.

Microphone and Key

The leads from the microphone and key are connected to the transmitter by telephone plugs inserted in the jacks. The keying jack (J1) is in the oscillator circuit. The microphone jack (J) is in the amplifier circuit.

Use a piezo-electric or crystal microphone of the amateur communication type. Unlike other microphones, the crystal type requires no separate source of current, polarizing voltage, or magnetic field. The sensitivity of this type of microphone is affected by the length of the leads connecting it to the input of the first amplifier stage. For amateur work, the leads should not be over 6 or 7 feet long. Wide frequency response is not required for voice transmission, it is therefore satisfactory to choose a microphone intended particularly for speech transmission rather than one designed for broadcast programs. Program transmission requires a uniform response over a range of audio-frequencies up to 10,000 cycles or more, but in amateur phone work audio-frequency responses over 3000 cycles are largely wasted.

A Word About Operating

One of the best ways to learn how to operate and how not to operate a radio transmitter is to be a good listener. The fellow who sits down and listens in, covering the whole amateur spectrum thoroughly, will soon notice the mistakes of the other fellows. He will learn that it is applied common sense:

1. Not to operate too near the edge of any amateur band
2. To check frequency often
3. Not to make a plaything of a radio transmitter
4. Not to CQ fifty times and sign twice
5. To send clean-cut steady stuff rather than try to show speed

Some people only obey the traffic laws because they are afraid of a traffic cop. If you are that kind of person it would be beneficial to everyone else if you would stay off the air. However, it is only a matter of time before one of the checking stations maintained by the Federal Communications Commission will catch you if you are off frequency or a smart alec. You will be cited and under certain circumstances you may cease to be a radio operator by order of your Uncle Sam.

Watch Your Frequency

Don=t work too close to the edge of an amateur band. If you do not own a frequency meter check your spot with your own receiver. There is a commercial station at the end of each band. Tune for it. It will give you a good idea of the band limits.

If you want to calibrate your receiver or a homemade frequency meter, you can use the commercial broadcasting stations as a standard for some of your calibrations. A broadcasting station must maintain very close frequency adjustment. It must keep within a few cycles of its assigned frequency, hence its signals are always dependable markers for the amateur.

A Reminder

This is undoubtedly a good place to remind the constructor that the radio law of the United States demands that anyone operating a radio transmitter of any type must possess a license for the transmitter or station. Furthermore, if he operates it himself, an operator=s license is necessary. The owner of a station may obtain the services of a licensed operator for his station, but if the operator is an amateur, he must not be paid.

It makes no difference whether the transmitter is of very low power with signals that can be heard for a few feet only, or whether the transmitter is put on the air for a second or for a long period of time. A license must be obtained. Operating without it subjects the offender to a penalty of up to $5,000 and imprisonment.

Caution

A radio transmitter is not a plaything. If misused it can cause a great deal of interference with other stations. If carelessly handled, transmitter power can electrocute. Every year radio experimenters are killed because they did not take proper precautions for their own safety.

The constructor or operator should be absolutely certain that the current is shut off before making any major adjustments. Not only can transmitter power electrocute under some conditions but the radio-frequency currents from the tank coils of buffers and power amplifiers can cause severe burns. These burns are deep and difficult to cure. If burned by radio, apply oil or grease as first aid treatment and put the case in a doctor=s hands.

A radio transmitter converts low-frequency alternating or direct current into high-frequency power and radiates it through a suitable radiating system. By controlling the transmitter with a key, it will send telegraph signals. If the radiating is properly modulated at voice frequencies the transmitter becomes a radiotelephone transmitter.

Building and operating an amateur transmitter is not a job for a youngster. It is a hobby for older boys and men possessed of proper engineering knowledge and mechanical ability.

A transmitter must be designed and operated so as to comply with certain requirements imposed by present-day regulations and operating conditions; the frequency which it generates must not vary appreciably, its radiation must be free from the effects of an a-c power supply.

Government regulation limits the power of amateur transmitters to one kilowatt input. It requires an elaborate, expensive apparatus to convert 1,000 watts of a-c or d-c power into radio frequency current, keep the frequency constant and modulate it properly. A one K.W. ARig@ is for the advanced amateur whose knowledge qualifies him as a professional and who can also pay for costly Abottles@ (tubes) and other equipment.

Parts List for Stancor 20-P Transmitter

Condensers

Condenser	Capacity	Working Voltage	Manufacturers	No.
C1-C4	8-8 mfd.	450	Solar	D-820
C2	16 mfd.	450	Solar	D1-859
C3	.00037 mfd.	1000	Aerovox	1450
C5-C7-C25	.002 mfd.	1000	Aerovox	1450
C6-C11-C21	.1 mfd.	400	Solar	S-0238
C8	100-100 mmfd.	.....	Cardwell	EU-100AD
C9-C24	.0001 mfd.	1000	Aerovox	1450
C10	1.0 mfd.	400	Solar	S-0267
C12	50-50 mmfd.	.....	Cardwell	ER-50-AD
C13-C15-C18-C22	10 mfd.	25	Solar	DT-879
C14-C17-C20	4.0 mfd.	450	Solar	DT-858
C16-C19-C23	.01 mfd.	400	Solar	S-0219

Resistors

Resistor	Resistance Value	Wattage	Manufacturers	No.
R1-R9	50,000 ohms	1	IRC	BT-1
R2	50,000 ohms	2	IRC	BT-2
R3	1,250 ohms	10	Ohmite	Wirewound
R4	50,000 ohms	10	Ohmite	Wirewound
R5	1 megohm	**2**	IRC	BT-1/2
R6-R11	3,000 ohms	1	IRC	BT-1
R7	2 megohms	**2**	IRC	BT-1/2
R8-R14	250,000 ohms	1	IRC	BT-1
R10	500,000 ohms	.....	Centralab	N-103
R12	100,000 ohms	1	IRC	BT-1
R13	20,000 ohms	1	IRC	BT-1
R15	1,000 ohms	1	IRC	BT-1
R16	100 ohms	10	Ohmite	Wirewound
R17	20,000 ohms	50	Ohmite	Wirewound

Transformers

Transformer	Description	Manufacturers	No.
T1	Driver Transformer	Stancor	A-4712
T2	Modulation Transformer	Stancor	A-3845
T3	Power Transformer	Stancor	P-4004

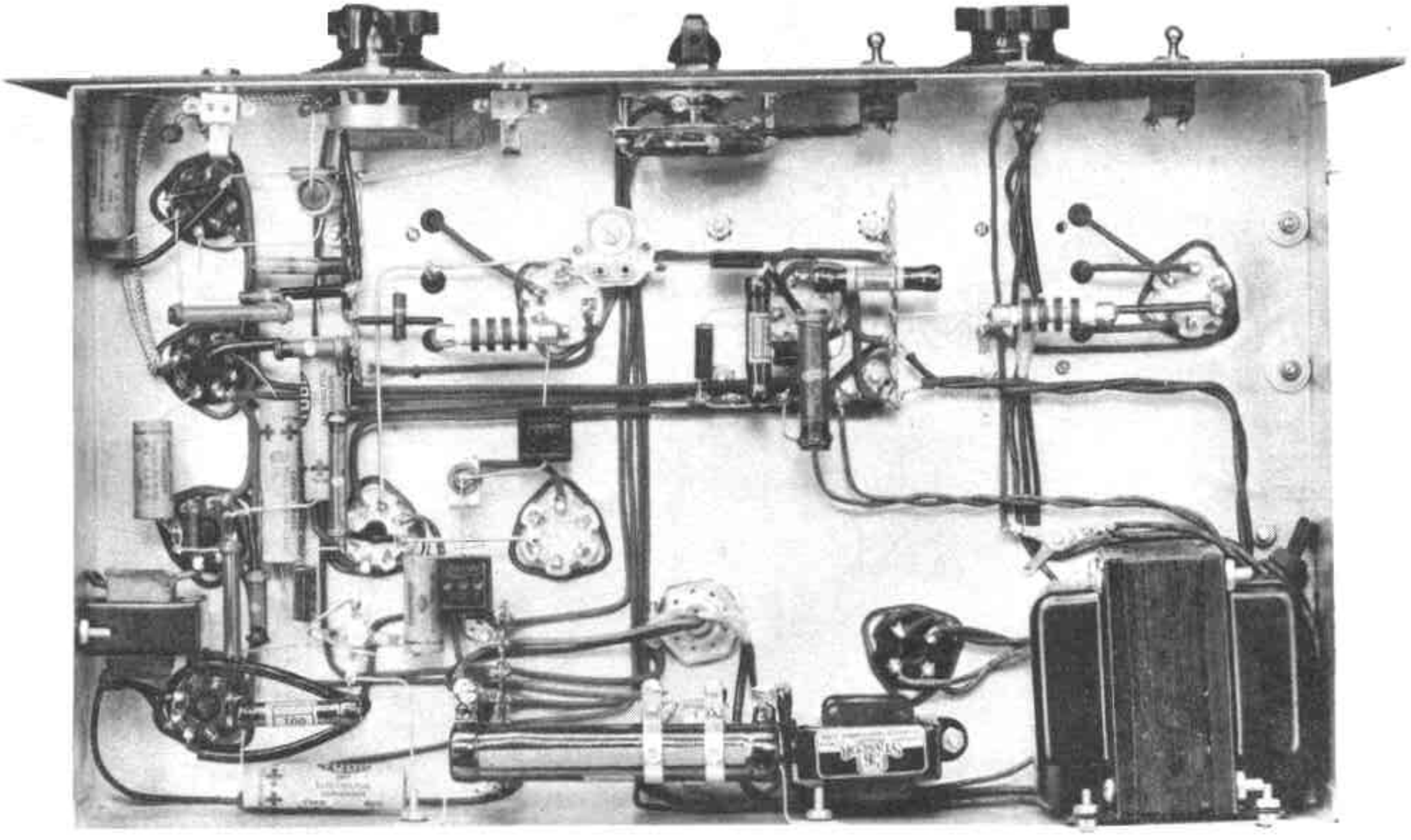
Chokes

Choke	Description	Manufacturers	No.
CH1	Filter Choke	Stancor	C-1412
CH2	Filter Choke	Stancor	C-1515

Miscellaneous Parts

Quantity	Part	Manufacturers	No.
3	S.P.S.T. Toggle Sws	Bud	1003
1	Open Cir. Jack (J)	Yaxley	A-1
1	Closed Cir. Jack (J)	Yaxley	A-2
1	0-200 ma.-D.C.-2" meter	Triplett	221
4	2.5 mh. R.F. Chokes	Hammarlund	CHX
2	1-1/4" Bar Knobs	Yaxley	366
1	4 prong socket	Amphenol	S-4
2	5 prong socket	Amphenol	RSS-5
2	6 prong socket	Amphenol	RSS-6
5	Octal socket	Amphenol	S-8
2	Nameplates	Gordon	...
2	2-3/4" dials	Gordon	294
2	Feedthru Insulators	Johnson	44
1	Tube Shield (Special)	National	J-30
1	Pilot Lamp Socket	Drake	317-H
1	2V. 60 ma Bulb	Mazda	48
1	3 Pos. 3-circuit switch	Yaxley	1313-L
1	6 ft. cord and plug	.....	.....
1	Small grid cap	Amer. Rad. Hdw.	92
1	5 prong 1-1/2" coil form	Hammarlund	SWF-5
1	6 prong 1-1/2" coil form	Hammarlund	SWF-6
1	Metal Cabinet	Par-Metal	SC-128
1	Set of Hardware	Stancor	20-P
1	No. F-20 Foundation kit (drilled panel and chassis) with complete instructions	Stancor	F-20

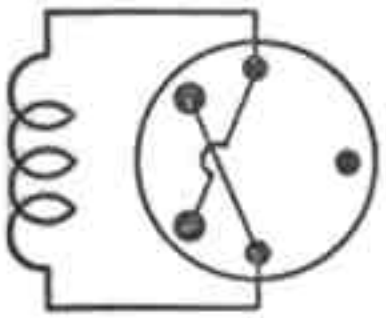
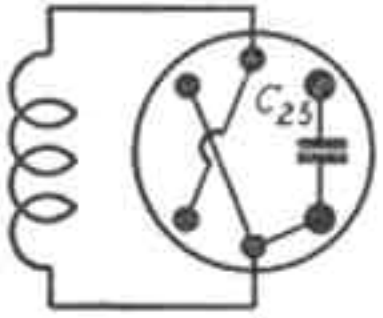
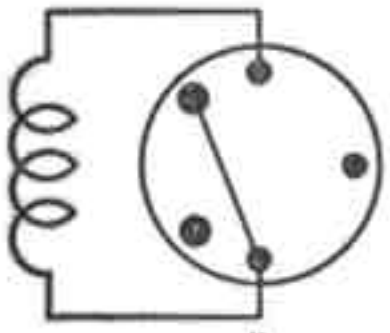
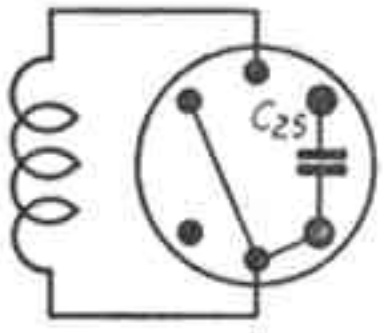
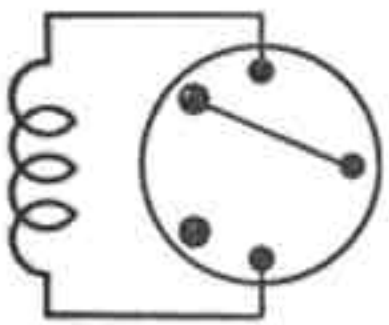
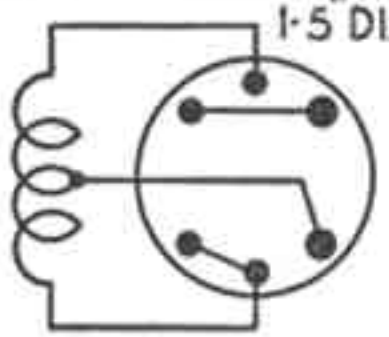
Note: The parts used in the original model are shown above. Parts having identical electrical and physical characteristics may be substituted. This applies to all but the variable condensers, sockets, meter, transformers, and chokes.



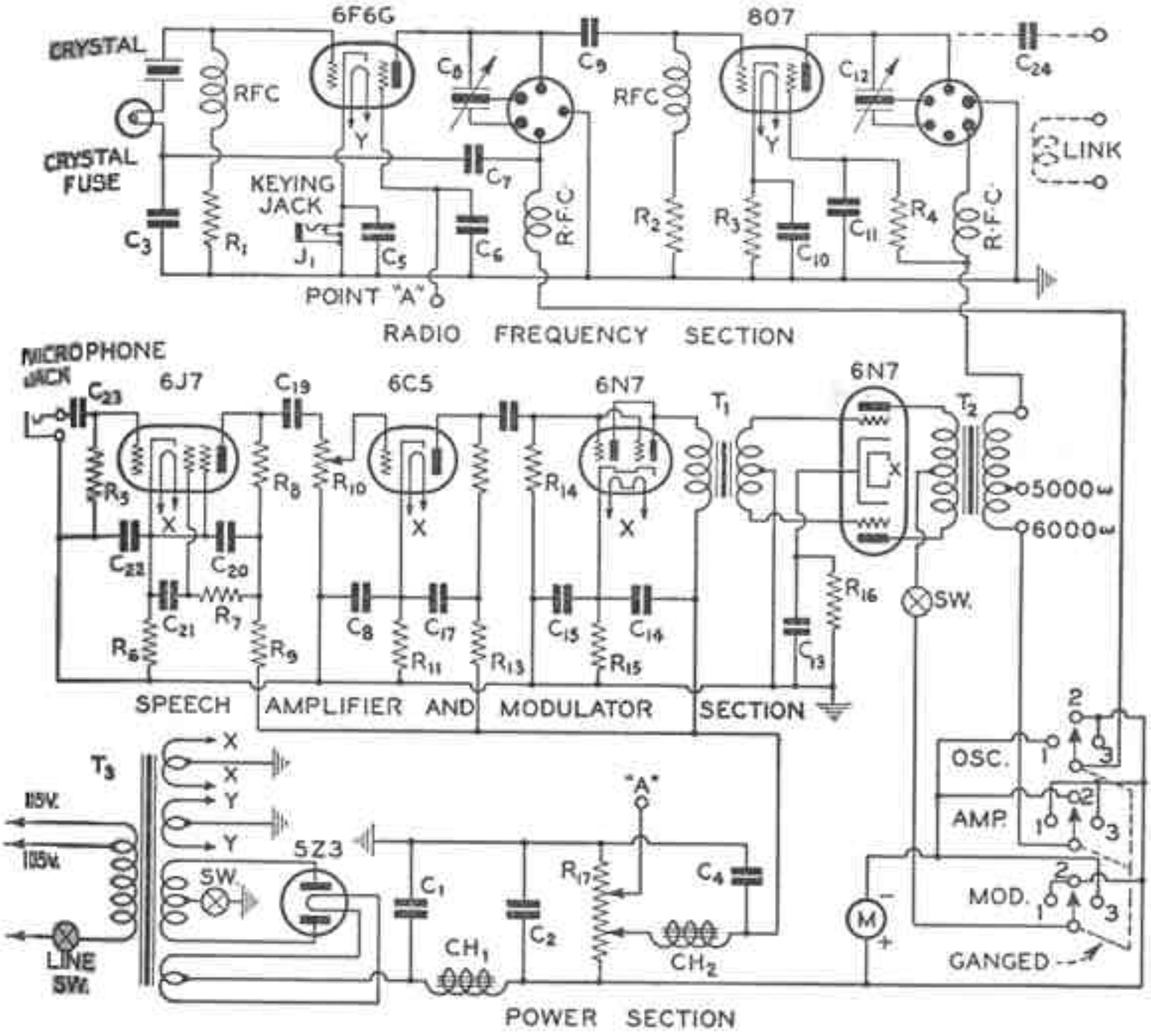
The underside of the chassis of the Stancor 20-P Transmitter

Rear view of Stancor 20-P Transmitter with cabinet removed

The completed Stancor 20-P Transmitter

OSCILLATOR COILS	AMPLIFIER COILS
 1·5" DIA. 160 METERS *60 TURNS CLOSE WOUND* *Nº 20 ENAMEL*	 2·5" DIA. 160 METERS *70 TURNS CLOSE WOUND* *Nº 18 ENAMEL* 80 METERS *40 TURNS CLOSE WOUND* *Nº 18 ENAMEL*
 1·5" DIA 80 METERS *32 T. CLOSE WOUND* *Nº 20 ENAMEL* 40 METERS *20 T. SPACED WIRE DIA.* *Nº 20 ENAMEL*	 1·5" DIA. 40 METERS *18 T. SPACED WIRE DIA.* *Nº 18 ENAMEL* 20 METERS *12 T. SPACED WIRE DIA.* *Nº 18 ENAMEL*
 1·5" DIA. 20 METERS *8 TURNS SPACED 1/8"* *Nº 18 ENAMEL* 10 METERS *3·5 TURNS SPACED 1/4"* *Nº 18 ENAMEL*	1·5" DIA.  0·75" DIA. 10 METERS *5·5 TURNS SPACED 3/16"* *Nº 18 ENAMEL* 5 METERS *5 TURNS SPACED 1/4"* *Nº 18 ENAMEL*

Details of the oscillator and amplifier coils for the Stancor 20-P transmitter



Schematic circuit for **Stancor 20-P** radiotelephone and c. w. transmitter