

# RADIO SERVICE GUIDE

AND

## Operating Instructions

**FEILER**

**ELECTRONIC STETHOSCOPE**

## IMPORTANT INFORMATION ABOUT YOUR ORDER

Dear Customer:

The critical shortage of materials may have made necessary a few minor changes in your order.

If you have purchased your instrument in kit form, you may find that some of the parts may have slightly different electrical values or may be a little different in physical appearance.

We guarantee that any substitutions which have been made will in no way affect the operation or the efficiency of your instrument. In fact, most parts substituted will be of better quality and of higher wattage rating - at no increase in price to you! All changes are carefully supervised by our engineers. This assures you of the same high quality of design and performance for which Feiler instruments are famous throughout the world.

In order to ship your instrument without delay, it may have been necessary for us to ship your unit less some parts. Any items which were not included with your shipment are listed below. If there are no items listed below, your order was shipped complete with all parts.

We expect to ship any parts listed below in approximately \_\_\_\_\_ days. Thank you for your cooperation.

FEILER ENGINEERING CO.

RADIO SERVICE GUIDE AND OPERATING INSTRUCTIONSTHE FEILER ELECTRONIC "STETHOSCOPE"--MODELS TS-3 AND TS-3A.

Your model TS-3 is a very versatile radio service instrument. In addition to the many uses, described in these instructions, you will find additional applications as you use it in your work. Since the TS-3 is a high impedance device, it can be connected across any point in all radio sets with minimum effect. Thus, it can be used in the grid or plate circuit of any stage--antenna, r.f., i.f., detector, or audio. It may be used in servicing AC/DC, straight AC, battery, or auto sets (makes no difference whether circuit is t.r.f., or super).

A special feature of the TS-3 is the fact that it will pick up the signal as it moves progressively through the set without the necessity of changing test leads, turning controls, etc. Just touch probe to desired point and signal is heard in speaker, or phones, or seen on output meter.

The TS-3 is designed for operation from 105 to 125V. 50-60 cycles A.C. The power transformer is provided with an electrostatic shield to prevent line noise pick-up.

CONTROLS AND JACKS (REFER TO PANEL OF INSTRUMENT)

Power Switch, turns TS-3 "on" or "off". Make certain switch is OFF when unit is not in use.

RF V.T.V.M. Switch and RF Meter Jack, are provided to check for unmodulated RF such as found in the local oscillator of all Superhets. Connect a 0-1 DC Milliammeter to the RF Meter Jack. Connect the positive lead to right side of Jack and the negative lead to left side. Throw switch "on". Read RF amplitude on meter. Larger amplitude indicated by greater dip.

Speaker Switch, is provided to silence speaker when headphones are used. If a quiet tracing job is desired, push speaker switch to "off" and signal is read on output meter also. (See "Output Meter Jack" below).

Headphone Jack, is provided for headphone use to give maximum sensitivity. In some localities and with some sets, the signals picked up may be too weak to hear in the loudspeaker when probe is touched to mixer grid or even mixer plate. The use of headphones will then permit the signal to be heard. Any pair of crystal or magnetic phones (having an impedance of 1000 ohms or more) may be used. It makes no difference which phone tip is inserted in left or right phone jack.

Output Meter Jack, is provided for connection of an audio Output Meter, (sometimes called a "DB" Meter). If output meter is not available you can use any AC Voltmeter such as that included with most Volt-Ohm-Milliameters. Set AC Voltmeter switch to range which gives desired meter deflection. It makes no difference which meter lead is inserted in left or right jack terminal.

Gain Control, is used to vary volume in loudspeaker and/or headphones. Also controls indication on output meter.

DO NOT REMOVE OR REPLACE TUBES UNLESS A.C. PLUG IS REMOVED FROM OUTLET. The first two stages employ D.C. current to light the filaments so as to reduce A.C. hum to a minimum. This current is obtained through a large time-constant resistance-capacity filter, and a special series bleeder network. Removal of any tube (except rectifier) breaks the series circuit causing a high voltage to build up on filament filter condenser. When tubes are again inserted, condenser discharges into filaments causing tube filaments to open. To avoid tube burnouts, remove A.C. plug.

#### TO MINIMIZE HUM PICKUP

In some sets you will notice an audible hum modulation plus the desired signal when the probe is touched to the plate of either the converter or i.f. tube. This is due to poor filtering in the power supply of the receiver. Placing the ear close to the receiver loud-speaker will reveal this hum which is not bothersome when standing away from speaker. To prevent the hum from passing through the TS-3 while permitting the signal to pass, simply connect the probe through a .000005 mfd. ceramic or mica condenser.

#### SERVICING "DEAD SETS"

Basically, the process of locating faults in a radio set is one of localization. That is, tests are made to determine which portion of the set may be at fault. The TS-3 is an ideal instrument for this purpose. We shall see why in the following description.

Clip the ground lead (on the probe) to the chassis of the set. Make certain the "Speaker" switch on TS-3 is at "on" and the "RF Meter" switch is "off" Push "Power" switch on TS-3 to "on". Touch the probe to the diode plates of the second detector tube (assuming we are testing a superhet). The second detector is usually a diode-- a tube type ending in "Q7". Refer to any tube manual to locate the socket terminal corresponding to the diode plate. Now, rotate the tuning dial across its travel and try to tune in a signal. (If you have a signal generator, connect it to the antenna and tune to 1,000 KC. Tune set to 1,000 KC., also. Turn on modulation in generator).

If you hear a signal, this indicates that the entire r.f. and i.f. portion is working. You have now localized the trouble to the detector and audio sections. To locate stage that is dead touch probe to hot side of diode load, then to grid of audio tube, then to grid of output stage. Continue on through set to speaker voice coil until a point is found at which signal disappears. (Be sure to turn up volume control of radio when checking audio portion). By checking the components of the circuit between that portion of set at which signal is last heard, and that at which signal disappears, the faulty component may be located. Verify by checking component with ohmmeter.

Now, let us assume that you did not hear a signal at the diode plates, this indicates that the r.f., oscillator, or, i.f. section of the set is probably at fault. If so, first check voltage at output of power supply with a voltmeter. If there is voltage at this point, proceed by touching probe to the i.f. tube plate and grid; mixer plate and grid, etc., localizing the stage at fault as described above.

(see other parts of these instructions for details on checking oscillator, condenser gang, antenna coil, loop, etc.)

### SERVICING WEAK SETS

If a set is operating correctly, the signal should grow stronger progressively as you proceed from the antenna to the output stage using the probe. Therefore, to find the cause of weak sets, touch probe to various points in set and note the volume level in the TS-3 speaker. If the volume at one point is lower than at a preceding point, the point tested previously should be investigated. In some localities, and on some sets, the signal picked up may be too weak to hear in the loudspeaker when the probe is touched to the mixer grid, or even the mixer plate. For these sets, first try using the phones; then if necessary feed a signal generator into the antenna connection to get an audible signal. It should be remembered, further, that the voltage on the plate of the output tube is greater than the voltage across the voice coil of the set speaker. However, the power is nearly the same. Since the probe is a device which is responsive to voltage and not to power, the volume will be less with the probe connected to the voice coil. This is not the cause of a weak set, but is a normal condition.

### INTERMITTENT SETS

To locate the cause of an intermittent set the process of "localization" described under "DEAD SETS" is particularly helpful. That is, the exact stage, or group, of parts should be located which are causing the intermittent. Therefore, the first step is to determine whether the fault lies in the r.f./i.f. section, or in the det/audio section. Touch probe to diode plates and listen to signal. Turn radio set on-and-off quickly. Then, using an insulated rod, push against the various soldered connections. If the intermittent can be heard in the TS-3, the trouble lies in the r.f., or i.f. amplifier, or oscillator. To locate exact stage, touch probe to various points until intermittent is located.

In some cases of intermittents, the set will play for several hours and then cut off. To locate fault in these sets, connect probe to points in question. Turn down volume control in set being tested. "Listen-in" on any part of the set under test, and proceed with other work. You can then hear that part of set which is acting up.

If a "step up", 110 V. transformer, or a "Variac", is available, try operating the intermittent set at a line voltage of 130 to 150 volts. This will, quite often, cause the questionable set to "act up" even though it does not at normal line voltage. On auto sets, or battery sets, additional batteries should be used for the same purpose.

### NOISE, HUM OR DISTORTION

Touch probe to various points in set beginning with speaker and proceeding toward antenna until noise, hum or distortion is not heard in Signal Tracer. Investigate point at which fault was last evident. To investigate, after faulty stage has been located, replace tube; then measure voltages and resistance values. Noise is usually due to faulty tubes, loose connections or noisy resistors. Distortion is usually due

to incorrect voltages, leaky coupling condensers, shorted by-pass condensers, or resistors which have changed in value. Hum is usually caused by defective filter condensers. Check by connecting a 20 mfd. electrolytic in parallel with condenser suspected.

#### OPEN, OR SHORTED, ANTENNA COILS, OR LOOPS

If the set uses a loop, you may use the signal from a strong broadcast station for testing. Touch probe to hot side of loop and turn dial of set to correct point at which the broadcast station would normally appear if set were operating correctly. With some sets, and in some localities, the loop may not pick up a strong enough signal to be heard. In these cases, use a signal generator with a single turn loop on its output. Loop can be about 1 ft. in diameter made up of No. 10 solid wire. Space loop from 3" to 5" from loop of radio.

If no signal is heard in the Signal Tracer, disconnect loop and test tuning condenser with ohmmeter to make certain it is not shorted. If tuning condenser is all right, the loop is either open or shorted.

If the radio uses an antenna coil, tune in a strong local station by setting tuning dial to correct frequency. Touch probe to secondary of antenna coil; if no signal is heard, first check tuning condenser as above. If O.K., this indicates an open, or shorted antenna coil. Check with ohmmeter to verify. In cases where signal pickup is weak, use a signal generator connected to the antenna terminal.

#### OPEN, SHORTED OR MIS-TUNED I.F. COILS

To test second i.f. coil, tune dial to frequency of strong broadcast station. Touch probe to plates of diode. If no signal is heard, but signal is heard when probe is touched to plate of i.f. tube, secondary of coil is open, shorted or mis-tuned. Try tuning trimmer condenser on i.f. coil; if there is still no signal, the coil is open, or shorted. Check with ohmmeter to verify. The primary of the second i.f. coil, and both windings of the first i.f. coil, may be checked in a similar way. A signal generator (tuned to 456 or 465 KC) may be used also. If you are in a locality where the signal pickup is weak, a signal generator is recommended.

#### I. F. AND R. F. ALIGNMENT

The TS-3 may be used in place of a volume indicator when aligning a receiver. Touch probe to hot side of the audio volume control. Turn volume control to minimum so that signal does not come through set loudspeaker. Tune in a weak station, (or use a signal generator connected to the converter grid), by listening to the output of Signal Tracer. A weak station should be used to prevent A.V.C. action which tends to keep the volume constant. Now proceed to adjust the r.f. and i.f. trimmers for maximum volume. If you wish to determine the effect of adjusting each trimmer alone, connect probe through a 2 Meg., 1/4 watt resistor to the coil terminal for that particular trimmer condenser. Vary trimmer and leave at setting which gives loudest signal

SHORTED VARIABLE CONDENSERS

At times a tuning condenser will warp and short out over part of its rotation. To check, touch probe to condenser and tune in stations across the dial. Shorted section will be indicated by dead spot on dial. If stations are too weak, or not available at correct frequencies needed, connect a signal generator to the antenna. It will then be necessary to set signal generator to one frequency, tune in signal, then set to another frequency, etc.

POOR SENSITIVITY OVER PART OF DIAL - MISTRACKING

Connect probe to plate of mixer tube. Set signal generator to frequency corresponding to portion of dial that gives weak sensitivity. Connect signal generator to antenna of set. Tune set for loudest signal in TS-3. (Probe on plate of mixer tube.) Now connect probe to the hot side of variable condenser through a 1 megohm resistor or .000005 mfd. condenser. Turn tuning dial first to one side, and then to the other. If signal increases, this indicates mistracking and set should be realigned. If sensitivity does not improve after realignment, bend plates of tuning condenser in, or out, to get loudest signal, or check oscillator output as described below.

CHECKING OSCILLATOR OUTPUT

Connect a 0-1 D.C. Milliammeter into the "R.F. Meter" jack. Push "R.F. Meter" Switch to "on" position. Touch probe to "hot" side of oscillator section of tuning condenser. If the oscillator is working, a dip in the reading of meter will be obtained. Tune the set across the dial slowly. Dip should remain constant. If there is a large variation in oscillator output, replace oscillator tube, check voltages on tube, etc.

FAULTY VOLUME CONTROLS

Tune in a strong broadcast station. Disconnect center lead of volume control from grid of audio tube. Touch probe to center lead. Vary control. Volume should vary smoothly. If control is noisy, noise will be heard in output of TS-3 as control is varied. To correct, replace volume control with a new one.

OPEN COUPLING CONDENSERS

To test, disconnect coupling condenser from grid of tube. Touch probe to plate of tube to which other end of coupling condenser is connected. Tune in a radio station. Now touch probe to disconnected end of condenser. No signal at this point indicates that the condenser is open.

OPEN, OR SHORTED, AUDIO AND OUTPUT TRANSFORMERS

Touch probe to cathode side of bias resistor on output tube. If the resistor has a by-pass condenser, disconnect it. Tune in a station. A signal should be heard here. Disconnect speaker voice coil from output transformer. Touch probe to plate of output tube. If signal is not heard, or is very weak, either/or both windings of output transformer are open, or shorted. If the set has a by-pass condenser between plate of output tube and ground, remove this condenser. If signal then appears, this condenser is shorted.

SPEAKER DEFECTS - OPEN, OR SHORTED VOICE COIL, RATTLES, DISTORTION

To check speaker for open voice coil, touch probe to secondary of output transformer. If signal is heard in TS-3, but not in radio speaker, the voice coil is open. To check for a shorted voice coil, disconnect radio speaker from output transformer. Touch probe to transformer. If signal is loud when radio speaker is removed and then disappears or is weak, when speaker is connected, voice coil is shorted. Usually, one side of voice coil is grounded. Then the probe clip lead can be connected to chassis, but in some sets the voice coil is not grounded, then clip should be connected to one voice coil lead and probe touched to the other.

To check speaker for rattles and distortion, connect probe across voice coil. If signal is clear in TS-3, but distorted or rattles in speaker of set, replace speaker cone or entire speaker. Keep set speaker volume at low level so that signal can be heard on TS-3.

CHECKING HUM

Touch probe to various B+ points and note the amount of hum. A slight amount of hum is tolerable, but excessive hum at any point indicates a poor filter condenser. To check filter condensers, touch probe to point at which condenser is connected. Note hum. Remove condenser lead. Hum should become much louder, if it does not, condenser is defective and should be replaced.

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TUBE REPLACEMENTS- The following tubes are used in the TS-3 - Probe tube, 1T4 or 1L4; High gain voltage amplifier, 1T4 or 1L4; Power output tube, 6K6 or 6F6; Rectifier, 6X5. The probe contains a miniature vacuum tube. Although designed to withstand normal handling, dropping of probe and unusually rough handling should be avoided to insure maximum tube life.

The TS-3A is identical to the TS-3 except for the tubes used. The tubes used in the Model TS-3A are as follows: Probe tube, 6C4; High gain voltage amplifier, 6BA6; Power output tube, 6K6 or 6F6; Rectifier 6X5.

The filament of probe tube may be tested with any ohmmeter. Use high resistance scale since most low resistance scales operate with large currents at low voltage which may burn out the filament. Connect ohmmeter between terminal No. 1 of miniature socket (on chassis) and ground. A good tube is indicated by a low resistance reading. (Check term. No. 4 on TS-3A)

If it becomes necessary to replace probe tube, proceed as follows: Insert metal extension of probe into vise between two small pieces of wood. Make certain that grip of vise is well back on larger portion of metal prod. Grasp probe housing, and gently work from side to side. This will loosen adhesive holding end disk into probe housing. After front end disk is loosened, pull forward, feeding large cable and ground lead through holes on back of probe until tube is accessible.

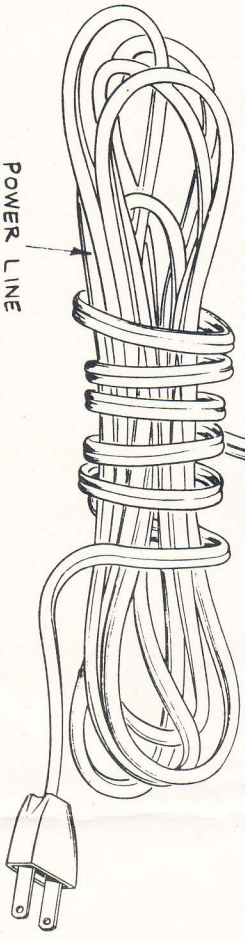
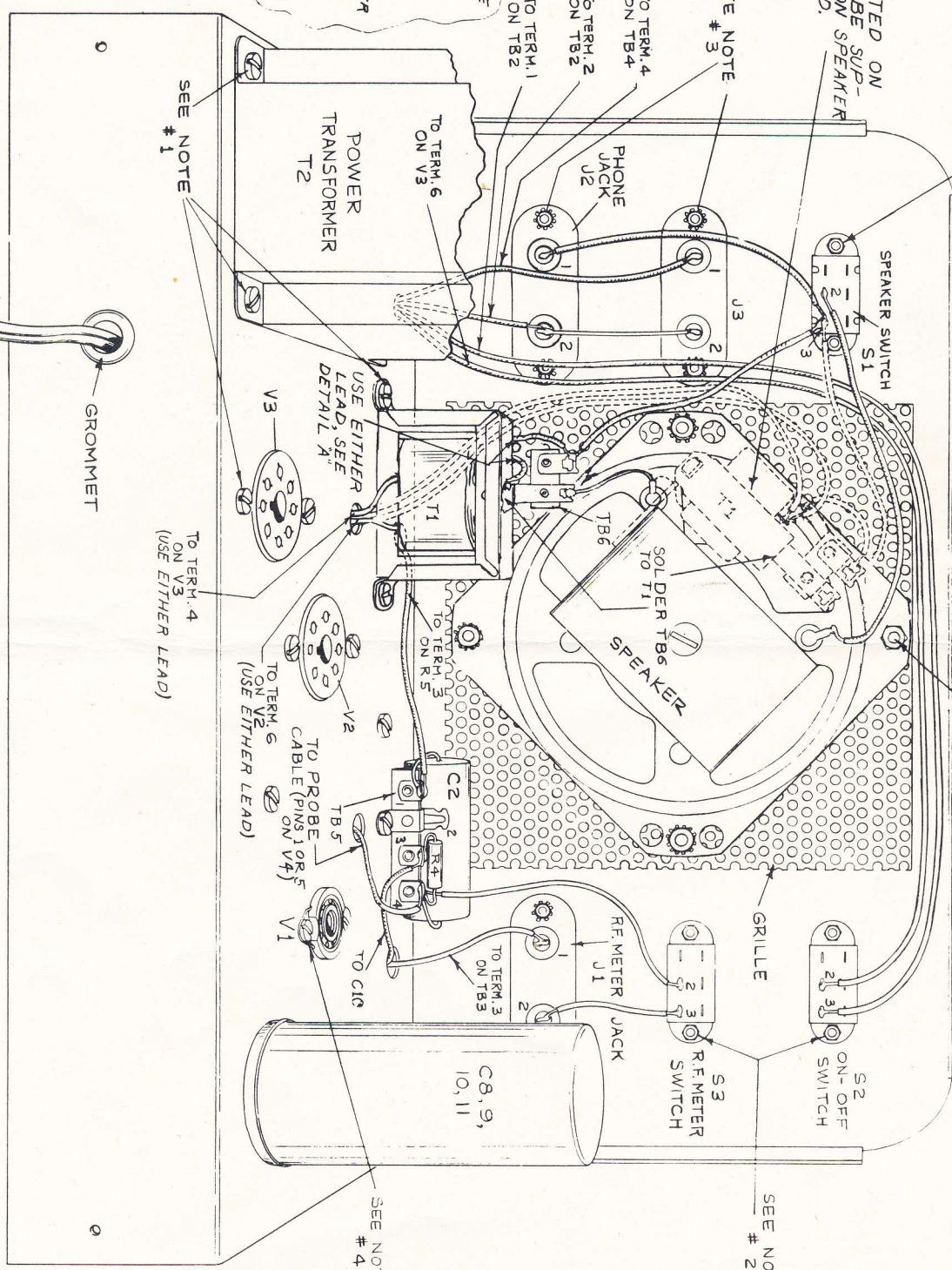
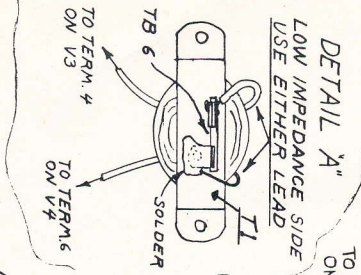


NOTE:  
 T1 USUALLY MOUNTED ON CHASSIS BUT MAY BE SUPPLIED MOUNTED ON SPEAKER AS SHOWN DOTTED.

SEE NOTE # 2

SEE NOTE # 1

SEE NOTE # 2



- NOTE # 1- USE # 6-32 SCREW, EXTERNAL TOOTH LOCKWASHER AND NUT.
- NOTE # 2- USE # 4-40 SCREW, MEDIUM SPRING LOCKWASHER AND SMALL NUT
- NOTE # 3- USE # 4-40 SCREW, EXTERNAL TOOTH LOCKWASHER AND NUT
- NOTE # 4- USE # 4-40 SCREW, MEDIUM SPRING LOCKWASHER AND NUT





<u>SYMBOL</u>	<u>QUAN.</u>	<u>DESCRIPTION</u>
<u>MISCELLANEOUS</u>		
	1	Cabinet, painted ✓
	1	Front panel, lettered ✓
	1	Chassis, plated & punched ✓
	1	PM speaker with Alnico III magnet ✓
T1	1	Power transformer ✓
T2	1	Output transformer ✓
C8,9,10,11	1	Filter condenser (Multiple unit) 20/20/20 Mfd. 500 V; 20 Mfd. 25 V. NOTE: Higher capacities and voltage ratings may be supplied. ✓
	1	A.C. Line cord & plug ✓
	1	Set of Assembly & Operating Instructions ✓
	1	Speaker gasket ✓

BAG # 1 - PARTS

	1	Handle ✓
	1	Bar Knob ✓
	1	Miniature tube socket ✓
	2	Octal tube sockets ✓
S <sup>1</sup> 2,3	3	Slide switches ✓
A <sup>1</sup> 2,3	3	Phone jacks ✓

BAG # 2 - PARTS for PROBE

	1	Probe housing ✓
	1	End disc, front 1-hole ✓
	1	End disc, back 2-hole ✓
	1	Solderless phone tip & nut ✓
	1	Alligator clip ✓
	1	Shield foil ✓
	1	1" length vinylite insulation ✓
V4	1	6C4 tube ✓
	1	Miniature tube socket ✓
C1	1	200 Mmfd. condenser ✓
R1	1	1 Meg. 1/3 watt resistor ✓
	1	1-lug terminal strip OR large ground lug ✓
	1	9" length ground lead ✓
	1	6" length bare wire ✓

BAG # 3 RESISTORS & CONDENSERS

R2	1	22K ohms 1/4 W. ✓
R3	1	68K ohms 1/4 W. ✓
R4	1	100K ohms 1/4 W. ✓
R5	1	Control, 1 Meg. to 3 Meg. ✓
R6	1	2.2 Meg. 1/4 W. ✓
	2	2200 ohms 1/4 W. ✓
R7	1	3.3 Meg. 1/4 W. ✓
R8	1	560K ohms 1/4 W. ✓
R9	1	470K to 560K ohms 1/4 W. ✓

BAG # 5 (CONT'D.)

R10	1	1000 ohms, 1 W. ✓
C2,5,6,7,12,13	6	.005 Mfd. 400V condensers ✓
C3,4	2	.1 Mfd. 400V condensers ✓

BAG # 4 - WIRE

	1	40" length, 2-conductor shielded cable for probe ✓
	10"	Hook-up wire ✓
	12"	Solder ✓
	1	6" length spaghetti ✓

BAG # 5 - HARDWARE

TB6	1	2-lug terminal strip ✓
TB2,3	2	3-lug terminal strip ✓
TB1,4,5	3	4-lug terminal strip ✓
	1	Cable clamp ✓
	1	Palnut ✓
	2	Rubber grommets
	2	10/24 screws (Use for mounting handle only) ✓
	8	6/32 by 3/8 screws (Use for mounting speaker & power transformer) ✓
	8	Star-type lock washers ✓
	8	6/32 Nuts ✓
	25	4/40 screws ✓
	25	Spring type lock washers ✓
	25	4/40 nuts ✓
	9	No. 6 sheet metal screws (self-tapping) ✓

BAG # 6 - TUBES

V1	1	6BA6 OR 6AU6
V2	1	6X6 OR 6V6
V3	1	6X5

NOTE: CONDENSERS AND RESISTORS MAY BE SUPPLIED AT HIGHER VOLTAGE AND WATTAGE RATINGS THAN ARE SPECIFIED.

Stock No. 19-1330-2  
9-23-52

COLOR CODE FOR TRANSFORMERS USED IN FELLER MODEL TS-3K KIT

POWER TRANSFORMER

<u>No. of Leads</u>	<u>Wire Color</u>	<u>Winding</u>	<u>Voltage</u>
2	Black	Primary	117 V. (A.C.)
2	Red	Secondary	High Voltage
1	Yellow OR Yellow/Red	Secondary	H.V. Center Tap
2	Green	Filament	6.3 V. (A. C.)

OUTPUT TRANSFORMER

<u>No. of Leads</u>	<u>Wire Color</u>	<u>Winding</u>
2	Black OR Bare Leads	Secondary (Voice Coil Side)
2	1 Blue and 1 Red OR 2 Blue	Primary (Plate Side)