Audio-Facts

by Robert B. Dunham

Figure 1. Top View of Completed Units.

The Williamson Amplifier has become one of the most popular and well-known audio amplifier circuits since its introduction by D. T. N. Williamson in the April and May 1947 issues of Wireless World. The complete commercially built amplifier is available as well as kits and basic components especially designed by major manufacturers for this circuit. Since it is so popular, it no doubt would be worth while to become familiar with its adjustment and operation, as most of us will encounter it sooner or later in installation, repair, construction, or just plain or fancy discussion.

The circuit is basically simple (Figure 2) using triode connected beam power output tubes, an output transformer built to rigid specifications, negative feed-back, push-pull "driver" stage with the first voltage amplifier stage direct-coupled to the "cathodyne" or "kangaroo" phase inverter.

The original circuit used British type KT66 beam power output tubes. Various type tubes have been used to replace the KT66's with, in some cases, a resulting loss in power and increase in distortion, just how much or how little depending upon the type used. The 807 seems to be the most popular with the 1614, 5881, and various other types also employed.

One of the first and best known adaptations of the circuit is the "Musician's Amplifier" as constructed and described by David Sarser and Melvin C. Sprinkle in the November, 1949 issue of Audio Engineering. Their amplifier uses 807 output tubes and American made transformers.

The Radio Craftsman C500 Ultra-Fidelity Audio Amplifier (Figure 3) is an excellent example of a commercially available high quality amplifier based on the Williamson Circuit. Two British made type KT66 tubes are used in the output stage with two

♦ ♦ Please turn to page 71 ♦ ♦

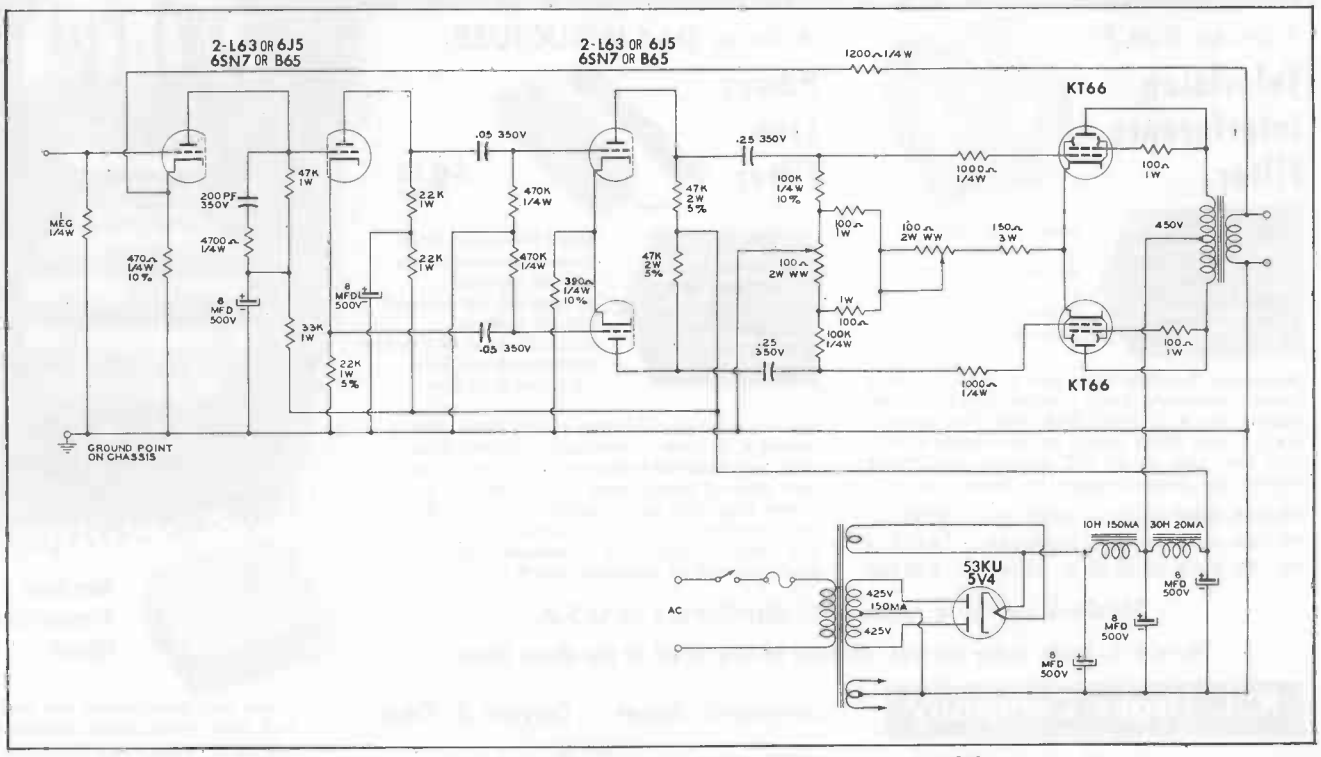

Figure 2. Schematic Diagram of Basic Williamson Amplifier.

"AUDIO FACTS" (Continued from page 41)

Figure 3. The Radio Craftsman Model C500 Amplifier.

American made 6SN7GTA and one 5V4G in the remaining stages. Constructed on a single chassis with no gain or tone controls the amplifier can be mounted in a convenient, sufficiently ventilated location and controlled from the associated tuner or preamplifier.

The published specifications for the Radio Craftsman Model C500 are:

Response: at 2 watts ± 0.1 Db 20-20,000 cps
and ± 2 Db 5-100,000 cps
at 12 watts ± 2 Db 10-50,000 cps

Harmonic Content: Less than 0.1% at 10 watts.

Intermodulation Content: (With 7KC and 60 cycle tone, 4:1 ratio). Less than 0.5% at 10 watts.

Hum and Noise: 90 Db down from 15 watt nominal output.

Figure 4. Stancor Components Used in the Williamson Circuit.

Gain: 1.5 volts (rms) required for driving to full output.

Damping Factor: 32:1.

Speaker Outputs: 8 and 16 ohms.

Wishing to construct a Williamson Amplifier for experimental and checking purposes, we obtained the following basic component parts (see Figure 4) furnished by the Standard Transformer Corporation for this circuit:

1 - A8054 Output Transformer.
1 - PC-8412 Power Transformer.
1 - C-1411 Filter Choke.
1 - WM8 Set of Two prefabricated Chassis.

With these and other components appearing in the parts list, and by following the schematic fur-

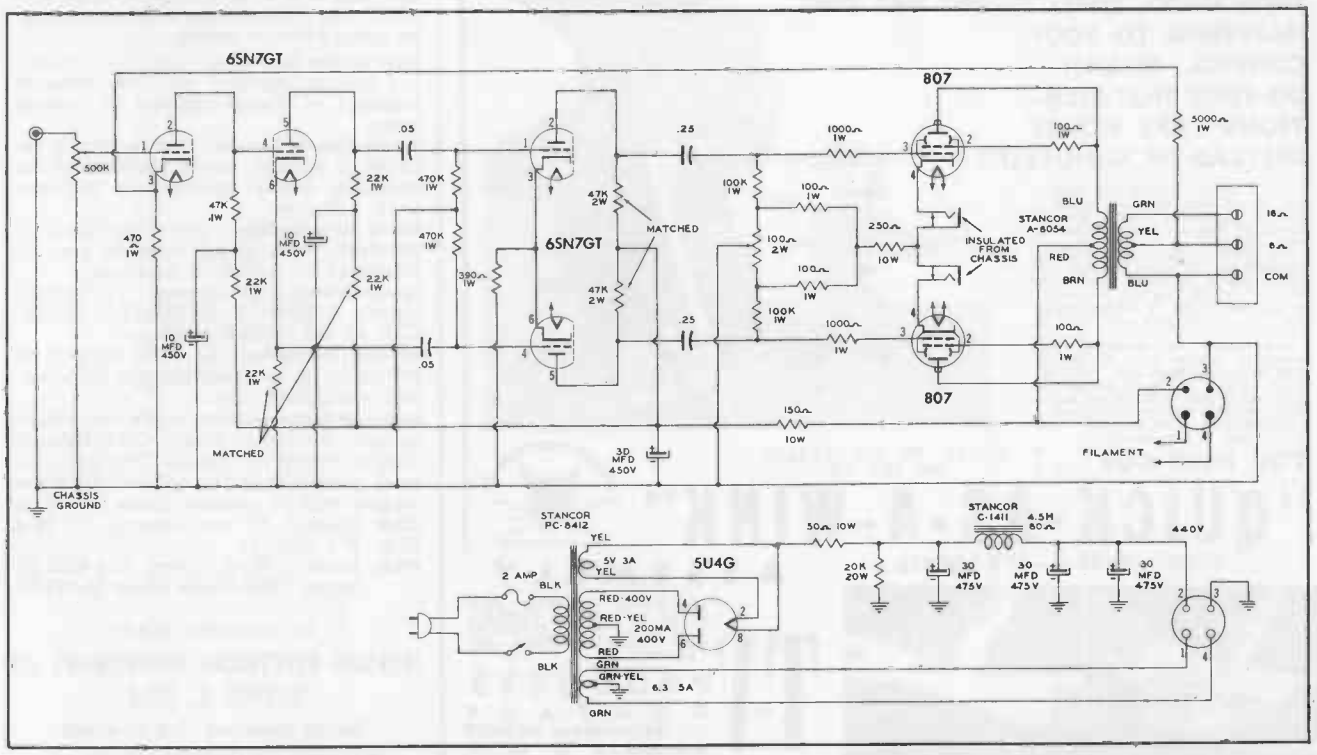

Figure 5. Schematic Diagram of the Stancor-Williamson Amplifier.

nished by Stancor (Figure 5), the amplifier as shown in Figures 1 and 6 was completed.

The circuit is not complicated, which simplifies assembly and wiring, but as is true with any high quality amplifier such as this, some requirements must be met when selecting parts and tubes. This is also true when replacing any parts or tubes in servicing this equipment. The two 22K phase inverter load resistors should be a matched pair as should the two 47K driver load resistors.

These resistors should be of high enough wattage so use will not tend to change their characteristics to too great a degree. The 6SN7GT driver tube should have matched triode sections so the drive on each 807 output tube is equal. The 807 tubes should also be a matched pair to make it possible to balance the output stage easily.

Balancing of the output stage is important and is easily accomplished by means of the 100 ohm, 2 watt potentiometer, and the closed circuit jacks in the 807 cathode circuit. Plugging a DC milliammeter into one of the jacks, by means of a standard telephone plug, and then into the other, an identical current drain for each output tube can be obtained by adjusting the 100 ohm potentiometer. A current reading of 56 ma. with no signal for each 807 was normal for the amplifier constructed here.

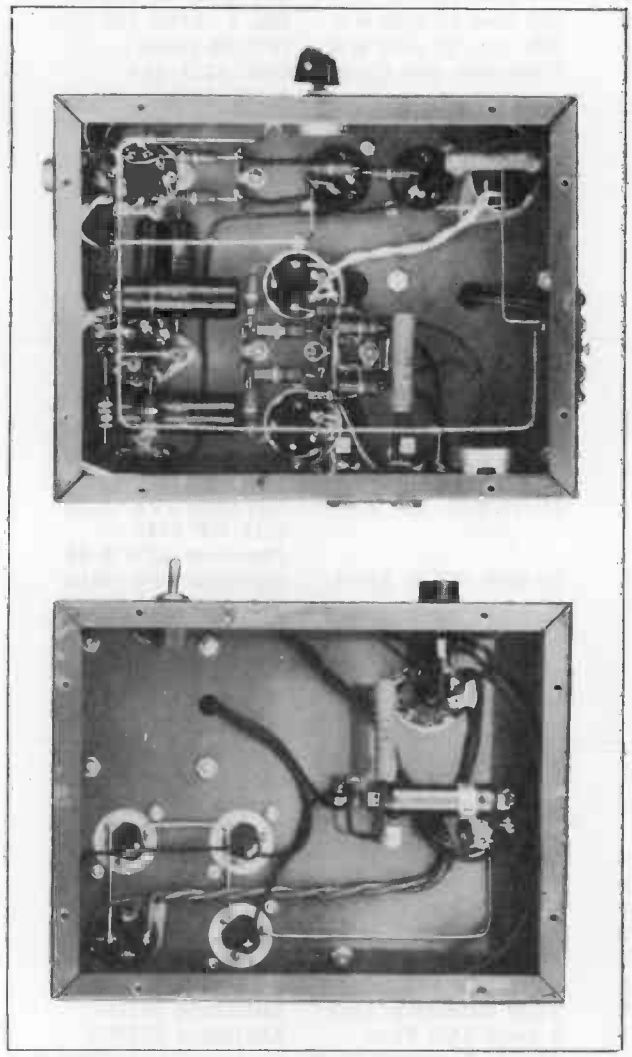

Figure 6. Bottom Chassis - Stancor-Williamson Amp.

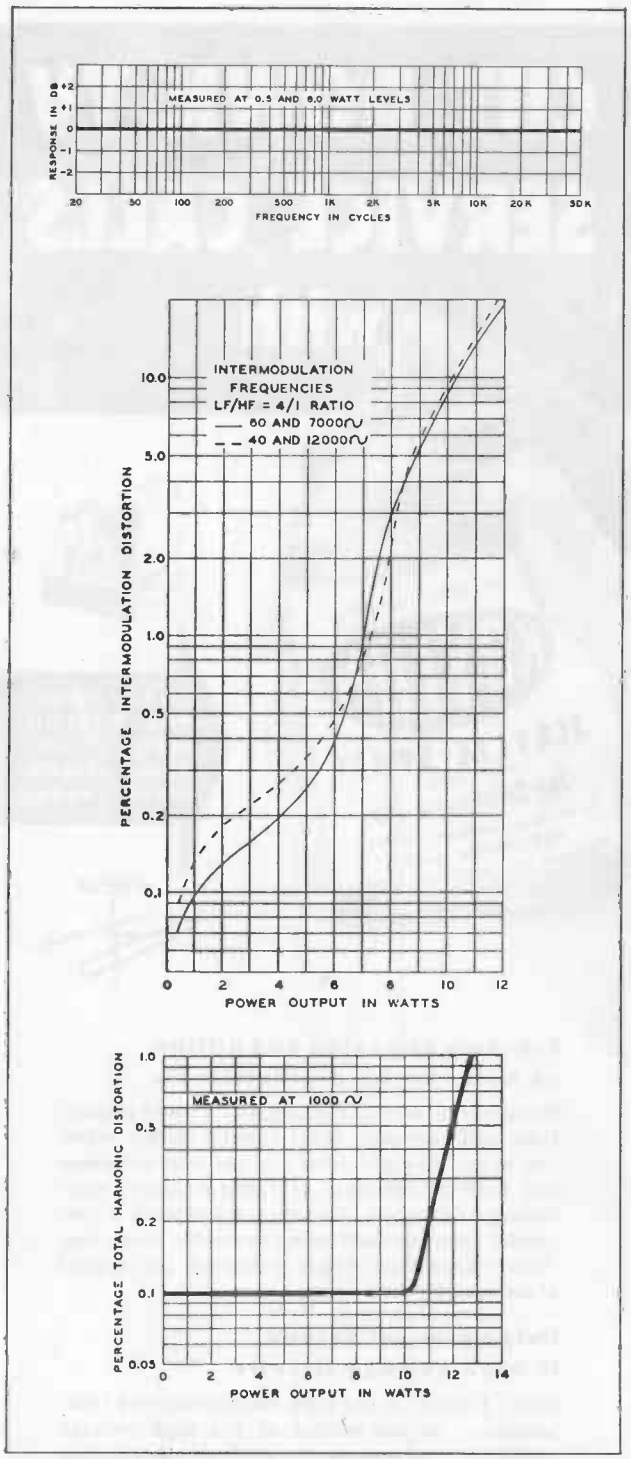

Figure 7. Frequency Response, Percentage Intermodulation, and Harmonic Distortion Curves of Stancor-Williamson Amplifier.

The data on response and distortion, published by Stancor in their bulletin 382, describing their Williamson Amplifier, is shown in Figure 7. The frequency response is excellent and does not change from the curve recorded at 8 watts output when the output is reduced to 0.5 watts. The intermodulation distortion measures only 3% at 8 watts output and the total harmonic distortion at 1000 cycles per second is very low and practically does not exist at a power output of 10 watts or less. The "listening" quality using a good sound source and speaker system is remarkable. (For Parts List - see Page 74.)

STANCOR KIT OF COMPONENTS

1 - A -8054 - Stancor Output Transformer
1 - PC -8412 - Stancor Power Transformer
1 - C -1411 - Stancor Filter Choke
1 - WM-8 - Set of 2 Stancor Prefabricated Chassis or, 2 - 7" X 9" X 2" Chassis

WILLIAMSON AMPLIFIER PARTS LIST

Tubes

2	807	Sylvania or Equivalent
2	6SN7GT	Sylvania or Equivalent
1	5U4G	Sylvania or Equivalent

Resistors

4	100 ohm 1 watt 10%	IRC BTA 100
1	390 ohm 1 watt 10%	IRC BTA 390
1	470 ohm 1 watt 10%	IRC BTA 470
2	1000 ohm 1 watt 10%	IRC BTA 1000
1	5000 ohm 1 watt 10%	IRC BTA 5000
4	22K ohm 1 watt 10%	IRC BTA 22000
1	47K ohm 1 watt 10%	IRC BTA 47000
2	47K ohm 2 watt 10%	IRC BTB 47000
2	100K ohm 1 watt 10%	IRC BTA 0.1 meg.
4	470K ohm 1 watt 10%	IRC BTA 0.47 meg.
1	50 ohm 10 watt WW	IRC 1 -3/4A 50
1	150 ohm 10 watt WW	IRC 1 -3/4A 150
1	250 ohm 10 watt WW	IRC 1 -3/4A 250
1	20K ohm 20 watt WW	IRC 2D 20000
1	500K ohm Vol. Cont.	(IRC Q13-133 (CRL B60 (Clarostat AG-60-Z (FS3
1	100 ohm 2 watt Pot.	(IRC W100 (CRL V121 (Clarostat 43-100

Capacitors

2	.05 mfd. 600 V	(Sprague 6TM-S5 (CD PTE 6S5 (Aerovox P688-05
2	.25 mfd. 600 V	(Sprague 6TM-P25 (CD GT6 P25 (Aerovox 684-25
1	10/10 mfd. 450 V Elect.	(Sprague TVL-2750 (CD UP 1145 (Aerovox AFH 2-47
4	30 mfd. 475 V Elect.	(Sprague TVL-1810 (CD UP 3050 (Aerovox AFH 1-56

Hardware

1	4 Prong Connector	Amphenol 78-PF4
1	4 Prong Connector	Amphenol 86-PM4
1	Input Connector	Amphenol 75-PC1M
1	4 Prong Plug	Amphenol 86-CP4
3	Octal Socket	Amphenol 78-S8
2	5 Prong Socket	Amphenol 78-S5
1	4 Prong Socket	Amphenol 77-M1P4
2	Closed Circuit Jacks	
2	Plate Caps 3/8"	
1	Toggle Switch, Single Pole Single Throw	
1	Fuse Extractor Post	Littlefuse 341001
1	2 amp. 3AG Fuse	Littlefuse 312002

Output Terminal Strip, AC Line Cord, Terminal Tie Lug Strips, 4 Wire Cable, etc.