

# New Tubes for Class B Audio

## The Type '46 Amplifier and Type '82 Rectifier

By George Grammer, Assistant Technical Editor

ONE of the really "tough" things about the Class B audio amplifier (and modulator) has been the necessity for designing the input circuit so distortion would be minimized in spite of the fact that over part of the cycle the driver tube was furnishing power and over the rest of it it was not.<sup>1</sup> This is particularly discouraging when the tubes used as Class B amplifiers have comparatively low voltage-amplification factors; tubes, for example, such as the Type '10. A second disagreeable feature has been the necessity for providing a low-resistance and constant-voltage bias source, requiring, usually, the use of dry batteries.

With the introduction of the RCA 46 (that's all there is to the number—no 2's or 8's to be lopped off) these two bugaboos of Class B audio are wiped off the slate. For the 46 is a tube which operates *without grid bias*. Its amplification factor and static plate impedance are so high that with 400 volts on the plate and zero grid bias the plate current is only 6 milliamperes. Furthermore,

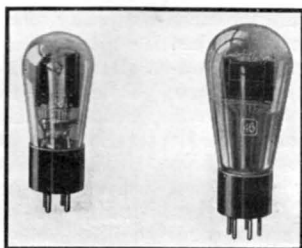
the tubes in a typical Class B set-up will develop 20 watts of audio output continuously, and by slightly reducing the load resistance the output can be increased to 26 watts, practically equivalent to that available from a pair of Type '10's. This last rating, however, is only for intermittent operation—about the type of service one would

have with a 'phone transmitter. Both outputs can be obtained with only 400 volts on the plates. These are not the only interesting features of the 46, however. The tube has *two* grids, although strictly speaking it is a three-element tube. For Class B operation the two grids are connected together (terminals are brought out separately from each grid to the standard 5-prong base) giving a high-mu, high-impedance tube. But by connecting one of the grids to the plate and using

the other as a control grid the 46 will function nicely as a Class A amplifier, developing 1.25 watts of undistorted power output with 250 volts on the plate. One 46 as a Class A amplifier will drive two 46's as Class B amplifiers, to full out-

put. A desire to keep down the number of types of tubes required for the Class B amplifier is the reason for this rather unique design.

The 46 is the same size physically and has the same type of base as the '47 pentode. The filament is oxide-coated, taking 1.75 amperes at 2.5 volts. It is expected that the tube will be in the hands of dealers some time during April. Although at this writing no samples are available for test, we anticipate some interesting r.f. uses, particularly in frequency multipliers, as well as its obvious application to modulation in ham 'phones.



THE 82 AND 46  
New tubes for Class B audio  
amplifiers.

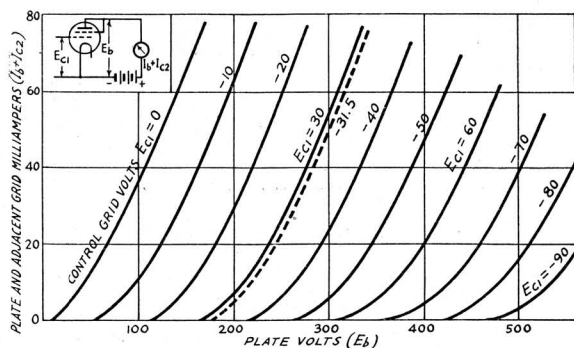


FIG. 1—PLATE CHARACTERISTICS OF THE TYPE '46  
WHEN USED AS A CLASS A AMPLIFIER

since grid current begins to flow at very small signal voltages, the driver tube is working into a more or less uniform load at all times. Two of

<sup>1</sup> For technical details of Class B audio amplifier and modulator operation, see Barton, "The Class-B Modulator," *QST*, Nov., 1931; Lamb and Grammer, "High-Power Performance From the Small 'Phone Transmitter," *QST*, Dec., 1931.

### THE TYPE '82

Before listing the ratings of the 46 we want to say something about another new tube being produced as a companion to it, the Type '82—a full-wave mercury-vapor rectifier. The necessity for a plate supply with extra-good regulation for Class B audio amplifier is well known; the 82, with a constant tube drop of 15 volts for all reasonable load currents, takes care of the rectifying portion of the power supply. Unlike the

DRIVER STAGE					TRANSFORMER		OUTPUT STAGE WITH 2-46's*				
Tube Type	Number Used	Plate Volts	Grid Bias	Signal Volts RMS	Peak Power Eff.**	Voltage Ratio (Primary 1/2 Sec.)	Plate Volts	Load Plate to Plate	With Signal		
									Average Plate Ma.	Average Grid Ma.	Output Watts
46	1	200	25	15.3	72	2.4/1	300	7800	38	8.0	11.5
46	1	200	25	15.3	54.5	2.4/1	400	6000	55	7.9	19.5
46	1	250	33	21.5	79	2.2/1	300	3500	64	10.5	16.0
46	1	250	33	21.5†	74	2.2/1	400	5300	68	9.0	26.0†
'27	1	200	15.5	10.8	41.5	4.4/1	300	17,000	18.5	5.6	5.0
'27	1	200	15.5	10.8	...	4.4/1	400	17,000	20.5	4.4	6.7
'27	1	250	21	14.2	43	5.5/1	300	17,000	20.5	4.5	6.0
'27	1	250	21	14.2	39	5.5/1	400	19,000	23	3.7	7.7
'27	2‡	250	21	27.0	53.5	4.4/1	300	6400	42	8.0	12.5
'27	2‡	250	21	27.0	58	3.7/1	400	7000	52	8.0	19.5
'45	1	250	50	34.0	65	2.8/1	300	5200	53	10.9	16.0

\* Grid voltage = 0.

† Total distortion = 5%.

\*\* Efficiencies measured at 60 cycles.

† Not for continuous operation.

‡ Push-pull connection.

Perryman Type '80-M described in *QST* about a year ago, however, it is *not* interchangeable with the Type '80. The filament of the 82 operates at 2.5 volts, instead of 5 volts, and takes a current of 3 amperes. It cannot, therefore, be plugged into your broadcast set to replace a defunct '80.

The following tentative ratings and characteristics give about all the information needed about the tube:

Filament voltage, 2.5 volts.

Filament current, 3.0 amp.

Maximum a.c. voltage per plate, 500 volts (r.m.s.).

Maximum peak inverse voltage, 1400 volts. Maximum continuous d.c. output, 125 ma.

Maximum peak plate current, 400 ma.

Either choke or condenser input to the filter may be used provided the ratings listed above are not exceeded. Choke input is recommended.

The 82 is the same size and will have the same type of base as the 201-A.

## TYPE '46 RATINGS

As pointed out above, when the 46 is operating as a Class A amplifier the grid nearest the plate is

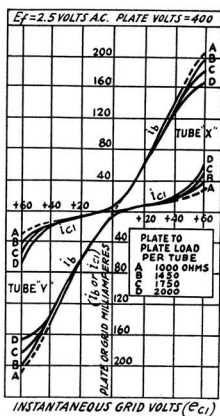


FIG. 2—DYNAMIC CHARACTERISTIC OF TWO TYPE '46'S IN PUSH-PULL AS A CLASS B AMPLIFIER WITH FOUR VALUES OF LOAD RESISTANCE

tied to it, thus becoming, in effect, part of the plate itself. Under these conditions the operating conditions and characteristics are as follows:

Plate voltage, 250 volts max.

Grid voltage, -33 volts

Amplification factor, 5.6

Plate resistance, 2380 ohms

Mutual conductance, 2350 micromhos

Plate current, 22 ma.

Load resistance, 6400 ohms

Max. undistorted power output, 1.25 watts

The load resistance given above is the optimum value for maximum undistorted power output.

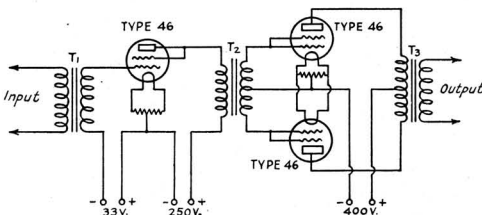


FIG. 3—A TYPICAL AMPLIFIER CIRCUIT USING ONE 46 AS A CLASS A DRIVER AND TWO 46'S AS CLASS B AUDIO AMPLIFIERS

Transformer  $T_1$  is the usual audio amplifying transformer connecting the driver stage to the preceding audio amplifier. The interstage coupling transformer,  $T_2$ , should have a voltage ratio from primary to one-half of secondary of 2.2 to 1, as shown by the table. The turns ratio of the output transformer,  $T_3$ , will be determined by the nature of the load into which the Class B tubes are working. The method of making these calculations is given in the second article referred to in Footnote 1. In this case it will be approximately 1:1 (total primary to total secondary) if the Class B amplifier is being used to modulate a pair of Type '10's with 500 volts at 100 mls.

When the tube is used as a driver for a following Class B stage the effective load resistance should be approximately twice this value.