RADIOTRONICS

AMALGAMATED WIRELESS VALVE COMPANY LIMITED

IN THIS ISSUE:

Technical Bulletin No. 59

Issued 24th February, 1936

Class B Output in Battery Receivers

Improved Operation for Types 19 and 30

As a result of tests conducted in the laboratory of Amalgamated Wireless Valve Co. Ltd., we are pleased to be able to give considerably improved operation characteristics for Class B Output in Battery Receivers. The improvement gives:—

(1) More efficient conversion of battery power to audio power, giving greater economy in the output valve.
(2) Less distortion.
(3) Complete elimination of the distortion "peak" at low volume.
(4) Considerable reduction in driver power.
(5) Greater economy due to the smaller plate current in the driver valve.

These operating conditions are designed to give efficient conversion of battery power to audio power, where an audio output limited to 1 watt is desired.

The use of a higher load resistance with both 19 and 30 valves has the following effects:—

The plate circuit efficiency for average volume is much higher, this being obtained at the expense of a limited peak output of 1 watt (which is considered ample) instead of 1.6 watts.

The higher load resistance reduces distortion at all output levels, and is especially effective in that it removes the rise in distortion obtained at low volume levels usually associated with Class B systems. Under these new conditions, the harmonic distortion percentage rises steadily up to the maximum output.

Although both the driver and output stages work into relatively high effective loads, the bass response remains within standard limits in both cases. Care must be taken that the output valves are not driven beyond 1 watt output, as distortion rises quickly beyond this point.

1 WATT POWER OUTPUT CONDITIONS FOR CLASS B 19 - TYPE 30 DRIVER

Driver type 30: (Grid resistor 0.5 megohm)	Plate supply	135	135 volts
	Plate Dropping resistor	0	15000 ohms
	Grid	−10.5	−7.5 volts
	Driver signal	6.1	7.0 volts R.M.S.
	Plate Current	1.4	1.3 mA
	Input Transformer	2·2:1.	Primary to half secondary

Class B 19: (2 units)	Plate,	135 volts.
	Grid,	−4.5 volts.
	No signal plate current	1.3 mA
	Max. signal plate current	14.8 mA
	Max. signal grid current	1.4 mA
	Plate to plate load, 20000 ohms.	
	Power Output, 1 watt.	
	% Distortion* at max. output (Max. distortion.)	— 6%

* Distortion includes 1B5, 30 Driver, 19 Output, with input and output transformers.

With a standard loudspeaker input transformer the output was down 1.3 db. at 50 cycles.

1 WATT POWER OUTPUT CONDITIONS FOR CLASS B 30's WITH TYPE 30 DRIVER

Driver type 30: (Grid resistor 0.5 megohm)	Plate	135 volts
	Grid	−9 volts
	Driver signal	6.7 volts R.M.S.
	Plate Current	2.25 mA
	Input Transformer	1.8/1 Primary to half secondary
Push-pull 30's, Class B: (2 valves)	Plate,	135 volts.
	Grid,	−12 volts.
	No signal plate current	1.6 mA
	Max. signal plate current	15.4 mA
	Max. signal grid current	1.3 mA
	Plate-to-plate load, 20,000 ohms	
	Power Output, 1 watt.	
	% Distortion at max. output, 8%. (Max. distortion.)	

With a standard loudspeaker input transformer the output was down 1.5 db. at 50 cycles.

ADDITIONAL INFORMATION ON 6E5

"The Magic Eye"

Full information on the 6E5 was given in Technical Bulletin No. 55, pages 7 and 8, but a few additional points may well be mentioned.

It is generally preferred to mount the 6E5 with the dark wedge downwards.

There is a distinct advantage through the use of a hood, partially to cover the bulb and to shield it from unwanted reflections.

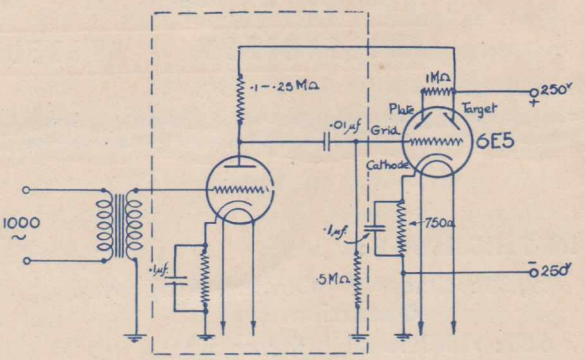
Operation on less than 200 volts is not desirable, and if possible the full 250 volts should be used.

With some systems the A.V.C. voltage may exceed 8 volts on a strong signal. In such a case "overlapping" may occur in the 6E5. This is not detrimental in any way to the valve, but it should be avoided if possible, since it is confusing to the user. In some receivers it may be necessary to reduce the A.V.C. voltage applied to the grid of the 6E5.

6E5 NULL INDICATOR

"The Magic Eye"

Many other applications than as a Tuning Indicator are possible with "The Magic Eye." One of these is as a Null-Point Indicator for use with A.C. bridges. For such purposes the



6E5 "Null Indicator"

6E5 is preferable to headphones, since it may be used without disturbance from external noises. For some applications the 6E5 may be used without an amplifier, its sensitivity with a step-up transformer being comparable with headphones, but it may also be used with a high-gain amplifier. The outstanding advantage of the 6E5 when used with an amplifier is its ability to withstand tremendous overload without damage, and yet be in a very sensitive condition as the null-point is approached. Any indicating device, such as a milliameter in the plate circuit of a detector, is either very sensitive to overload or is insensitive near the null-point.

The sensitivity of the 6E5 is 0.1 volt R.M.S. for a very clearly marked indication, the voltage being measured between grid and cathode. When used as a null-point indicator the 6E5 grid is biased approximately 4 volts negative and the A.C. (400 or 1000 cycle) voltage is applied between grid and cathode. The circuit shows a single stage amplifier feeding a 6E5, but the portion inside the dash line may be omitted or may be replaced by any other suitable amplifier. In this circuit the amplifying valve may be a 75 (triode), 79 (one unit or both units in parallel), or a 6F5 (high-mu metal valve).

When an A.C. voltage is applied, the sharp image will change to a blurred half-tone, and as the null-point is reached, the image will reach its original sharpness. A heavy overload may cause overlapping of the two sides, but this is not detrimental to the valve.

IMPROVED 1C6

All 1C6 valves now have an improved filament which should prove more robust, both mechanically and electrically. Better emission is obtained and an improvement in oscillator performance will be noticed, particularly on short waves.

REVISED CHARACTERISTICS RADIOTRON 43

The maximum plate voltage of the 43 has been increased from 135 to 180 volts, and the characteristics for both conditions are given for reference:—

Operating Conditions

		CLASS "A" AMPLIFIER:		
Plate	95	135	180	volts
Screen	95	135	135	volts
Grid	−15	−20	−20	volts
Amplification Factor:	90	80	96	(approximate)
Plate Resistance ..	45000	35000	40000	(approx.) ohms
Mutual Conductance:	2000	2300	2400	omhos
Plate Current	20	34	40	mA
Screen Current	4	7	8	mA
Load Resistance ..	4500	4000	5000	ohms
Power Output	0.9*	2.0†	2.75‡	watts

* 11 per cent. total harmonic distortion.
† 9 per cent. total harmonic distortion.
‡ 10 per cent. total harmonic distortion.
Maximum allowable grid resistor = 0.30 megohm.

SWITCHING-ON BATTERY RECEIVERS

With some circuit arrangements it is possible for a surge to be created during switching on, which may seriously affect the valves, and in some extreme cases may completely paralyse one of the valves. Although these surges are generally harmless, and the valves are sufficiently robust to handle a large positive voltage for a short time, it is recommended that precautions be taken where possible.

The phenomenon usually occurs in a grid circuit coupled to the preceding valve by a condenser; for example, with a 1B5 resistance-capacity coupled to a 1D4. In this case, switching on the B battery causes a positive surge on the grid of the 1D4.

Valves are most sensitive to surges when their filaments are below the normal temperature, as when warming up. It is preferable to switch on the B battery *before* switching on the filaments, if this can be done. If switching arrangements permit, contacts should preferably be arranged so that the plate voltage is applied before the filaments are lit. An alternative arrangement, which may be adopted, if not otherwise detrimental, is to have the plate resistor of the 1B5 (in the example given) permanently connected to the B battery, so that no surge occurs on the grid of the 1D4. Another arrangement, but one which is not completely satisfactory, is to arrange for the filaments to be lit before the plate voltage is applied.

This phenomenon may occur on any type of valve, but is only apparent when the grid circuit resistance is high and the plate or screen circuit resistance is low. In receivers using both filament type and indirectly-heated valves, a similar effect may be observed. In all cases the effect is shown by only a small percentage of valves, and for this reason it is desirable to eliminate the cause of the trouble, since it might not appear during laboratory tests.

HOW TO OBTAIN ECONOMY WITH PENTODES

With any pentode valve it is advisable to operate the plate at the highest voltage available, provided that this does not exceed the maximum permitted plate voltage of the valve.

The control grid should be operated at the minimum bias possible without running to grid current. If economy in plate and screen currents is desired, it is most satisfactorily obtained through a decrease in screen voltage —this applies both to radio frequency and power pentodes. If the plate voltage were decreased and the screen kept at the original value, the decrease in current consumption would be negligible. On the other hand, if

both plate and screen voltages were decreased, the maximum capabilities are frequently not obtained from the valve, but by operating with normal plate voltage and reduced screen voltage the utmost is obtained for the limited drain permitted.

In all pentode valves such decrease in screen voltage (not accompanied by a decrease in plate voltage) results in higher plate resistance, higher amplification factor, and lower mutual conductances, the latter being due to the decreased plate current.

If a power pentode were over-biased to obtain economy in current consumption, the economy would be obtained with considerable loss of efficiency, and this method is not recommended where it can be avoided.

FLUORESCENCE AND BLUE GLOW

With modern valves a blue colour is frequently observed (either steady or flickering) on portions of the bulb wall; this is a phenomenon known as "fluorescence" and is somewhat akin to X-ray fluorescence and is due to electron bombardment of the glass. The colour of this glow and its intensity depend on the nature of the glass, the voltages employed, and the design of the valve. It has no deleterious effect, however, and actually is a sign of an extremely high vacuum. It is particularly prominent with type 42, but may also be observed on other types, such as 6A7, 6C6, 6D6, but since in these types a black coating is used inside the bulb the fluorescence is rarely noticed.

Blue glow is a glow between the electrodes caused by ionised gas. It is never observed in a really hard valve, but there are certain types in which a very slight glow may be observed which, although indicating a very small amount of gas, is not deleterious to the valve; for example, this sometimes applies to type 50. When any appreciable glow is observed inside the plate, the valve is definitely defective, due to gas, and a negative grid current will be observed if a micro-ammeter is placed in the grid return circuit. A valve reading less than 1 microampere for each 10 milliamperes of anode current is quite satisfactory, and even two to three times this amount of negative grid current is usually quite permissible. When a valve becomes very gassy, the blue glow frequently extends in the shape of streamers radiating from the ends of the anode, and the valve in this condition is completely unusable.

In high vacuum rectifiers used at voltages not exceeding 400 volts, a small amount of blue glow is not detrimental and may be rather beneficial. High voltage rectifiers, on the other hand, must have an absolute minimum of gas.

Occasionally fluorescence may be seen on the inside surface of the anode or grid; this fluorescence may be easily distinguished from blue glow by the fact that it is a thin film and does not spread through the space between the electrodes.

All types of fluorescence are completely harmless.

BLACK COATING ON BULBS

Many modern valves are given a black coating on the inside surface of the bulb whose purpose has frequently been queried by engineers.

The real purpose of this coating is to provide a conducting surface so that electro-static charges may be spread uniformally over the inside surface of the bulb; if the coating were not present charges would tend to accumulate on small areas of the inside surface of the bulb and these charges would lead to erratic performance of the valve, especially at high frequencies, and cause noisy operation. The black coating used with Radiotron valves is effective in preventing this trouble.