

# The Five Way Valve

## The Pentode in Action

by

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NE of the greatest radio inventions is certainly the pentode valve, the appearance of which revolutionises receiver construction, and sets a new standard for quality of radio reproduction.

Being a special type, intended primarily for use as a power valve in radio sets and amplifiers, the pentode presents many advantages over normal valves. It was first designed and developed during 1926-1927 in the huge research laboratories of Philips Radio, where further outstanding improvements to it have since been evolved.

### The Name.

THE word pentode is derived from the Greek word penta, five, hodos way, so its significance—five-way valve. The word "way" should be understood as an electrical term, being synonymous with "circuit." In fact, with a pentode valve there are five actual circuits associated with the valve. Not infrequently the word is spelt "pentode."

In a normal thermionic valve, there are three fundamental circuits with three different elements; the filament, the grid, and the plate. When the filament is heated electrically (by

means of an "A" battery or heating transformer) electrons are emitted, which being negative, are attracted by the positively charged plate or anode, and moved toward it, forming in this way the plate current. As the grid is placed between filament and plate, the stream of electrons must pass through its meshes, making it possible to control the electronic current by applying electric charges to the grid.

In common with the normal valve, the pentode has the usual filament, which is surrounded by the control grid on which is impressed the input signal voltage variations. Surrounding this normal control grid is another called the screen grid.

If the valve then contained only one more electrode (an anode or plate) it would be similar to the normal 4 electrode valve commonly known as the "screen grid valve."

The pentode does contain this anode or plate, but in addition it contains yet another element—a third grid, which is situated between the screen grid and the anode.

Before discussing in detail the advantages of the pentode, it is necessary to have an understanding of basic operating principles.

A clear conception should be had of the real difference between the func-

tions of the normal 1st stage A.F. amplifier, and those of the power valve.

### The First Stage A.F. Amplifier.

THE first is purely a voltage amplifier, which raises the applied grid voltage, such as a step-up transformer does. However, a transformer, having a sufficiently high ratio to function without a valve would by no means give uniform or pleasing amplification. The normal first stage a.f. amplifier is then necessitated purely by the fact that the l.f. voltage supplied by the detector valve is insufficient to operate the power valve.

### The Power Valve.

THE whole purpose of this valve is to translate the applied grid voltages into adequate anode current variations, so that the requisite amount of energy may be applied to operate the loudspeaker.

As modern usage decrees a relatively high volume of sound from the loudspeaker, it follows that the input to the power valve must be sufficient to produce this.

### Fidelity of Reproduction.

THIS is an extremely important point, and put broadly means that all note frequencies occurring in speech and music (say, from 50 to 10,000 cycles per second) should be amplified equally, that there should be no distortion of the waveform, and that relative amplitudes are preserved at all signal levels.

It will be shown later how the pentode obtains its outstanding fidelity characteristics.

### The Operating Principle of the Pentode.

IN the case of the normal three electrode valve, the electrons, liberated from the heated filament, are attracted at great velocity toward the anode, eventually striking it. Assuming no grid current to flow, the thermionic current equals the anode current.

Now, suppose the anode is of mesh construction; consequently its attractive effect is not large enough to gather all the available electrons on its surface, and a number of them shoot through the meshes into the space beyond.

If now there is in this particular space a positively charged plate connected to the same anode voltage, this anode will then collect the electrons which have passed through the meshes.

As the meshed element (actually the screen grid) is closer to the filament than the real anode, its effect upon

the thermionic current is much greater than that of the anode, and by special construction of the screening grid the influence of the anode on the thermionic current can be reduced to a negligible value.

As the amplification factor value is a measure of the relative (plate current controlling) effects of the control grid and anode, it follows that if the effect of plate voltage on plate current is negligible the valve must have a very high amplification factor.

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