Audio-frequency Choke Coils

Their Construction and Uses

By "MEGOHM"

THE chief uses of audio frequency chokes are for smoothing out the ripple in the rectified current of A or B eliminators, or in conjunction with a fixed condenser as an output filter, or as the "impedances" in choke-coupled amplifiers, and in valve plate leads with the object of preventing feed-back through battery or eliminator. This stops the tendency to "motor-boating."

This type of choke coil has invariably an "iron" core, or so it is usually called, though the actual core material now generally used is stalloy. For this purpose it is superior to iron in every respect. Stalloy carries a much greater number of lines of magnetic flux to the inch than does common iron, and this property is of great importance in the construction of chokes, especially those which are to pass current amounting to more than a few milliamperes.

The purpose of an audio choke is to allow the passage of direct current such as that in a valve plate circuit, and at the same time prevent the passage of alternating current such as the speech frequencies imposed upon the plate current. The "choking" of these alternating impulses depends upon the suitable construction of the coil for the purpose, though the latitude in this respect is very great, and offers no stumbling-block in construction.

An audio choke should offer a very high impedance to frequencies between 100 and 5,000, but the resistance of the wire composing the winding must not be so great as to reduce unduly the voltage of the direct current traversing it.

It should be stated here that "impedance" sums up the opposition offered to alternating current, by combining the effects of resistance and "reactance," or "inductance," which latter depends upon magnetic effect, this being greatly increased by the presence of the core material.

Reactance varies according to the frequency applied to the coil, and the lower the frequencies to be held back, the greater must be the impedance of the coil. Thus it is seen that the coil must be large enough to hold back the lowest frequencies (lower notes) handled, otherwise reproduction will be impaired. The inductance of a choke is expressed in units known as "henrys."

Saturation of Cores.

IT is a well-known fact that a direct current flowing in an insulated winding round a bar of iron will cause the iron to become magnetised whilst the current is flowing. This is known as an "electro-magnet." The strength of the magnetic field in the iron increases as the number of turns of wire are increased in number, the current remaining the same, until a certain point is reached, when the iron is said to be "saturated" with magnetism, and no increase of turns or current will further strengthen the electro-magnet.

Exactly the same action takes place in a choke coil. Usually the current used is comparatively small, but the number of turns is large, quite sufficient to "saturate" a core of unreasonably small dimensions. And when the core of a choke is even approaching saturation, its inductive value begins to drop. When saturation is reached, it is seriously impaired. This shows that if a choke is to function properly, means must be taken to prevent magnetic saturation of the core.

The inductance of a choke is increased—

(a) By increasing the number of turns.
(b) By increasing the cross-section of the core.
(c) By reducing the "gap" (if any).

Saturation is produced by—

(a) Passing more than the specified current through the windings.
(b) By using too thin a core.
(c) By too many turns of wire.
(d) By too small a "gap" or none at at all.

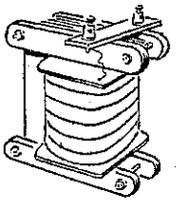
Function of the "Gap."

IT will be seen from the above that to obtain a high value of inductance by increasing the number of turns, there is a danger of approaching the saturation point. A much safer plan is to increase the cross-section of the core, but where much current is to be carried, another means of avoiding saturation is adopted. This consists in having one or more distinct breaks through the core, which is in two or or more separate sections of piled-up laminations. At these breaks or "gaps" the two adjacent sections of the core are not allowed to come into metallic contact, a piece of cardboard or thick paper being introduced, which allows of pressure between the two sections. The "gap" is usually given in specifications in one measurement, but if there is more than one gap, this measurement must be divided equally between the two or more. If 1-32 of an inch is specified for the gap, then two gaps would be made 1-64 each. If a choke is found to be saturating when tested by holding a piece of iron near the gap, the latter can be increased, but at the same time it must be remembered that this decreases the inductance, and cannot be carried very far.

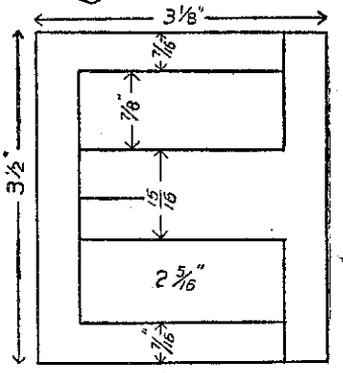
Chokes can be constructed without gaps, but only when the maximum direct current to be passed is known. Such chokes are small and compact, as the absence of a gap greatly reduces the number of turns required for a given value, and if the required inductance is not high, will also allow of a reduction in the size of the core. The reduction of turns is a good feature, because it reduces the direct-current resistance.

It is not recommended that the home constructor should make eliminator smoothing chokes except in the case of a small eliminator for a two-valve crystal amplifier. Output filter, amplifier plate and grid chokes, plate feed chokes, and those for other suitable purposes may be constructed without gaps if made and used according to specification.

Inductance varies as the square of the turns and proportionately to the cross-section of the core. That is to say that if the number of turns is halved the inductance drops to one-quarter the value, but if the cross-section of the core is halved or doubled, the inductive value will be halved or doubled, as the case may be.



Completed Choke



Stalloy Stampings—Half Scale

Completed Choke and Stalloy Stampings

With this short survey of the main points affecting the inductive value of chokes, we will proceed to deal with their construction, especially with a view to the special purpose for which they may be required.

General Construction.

THE general construction of a choke coil is much the same as that of a transformer, and so far as the core is concerned, if no gap is provided, the laminations are built up exactly as in a transformer. If a gap, or usually two gaps are to be provided, then the