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ALTERNATING CURRENT MAGNETIC AMPLIFIER

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Fig.1

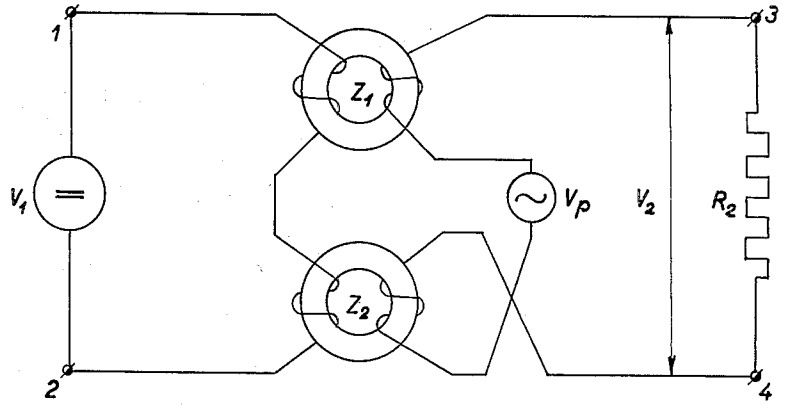
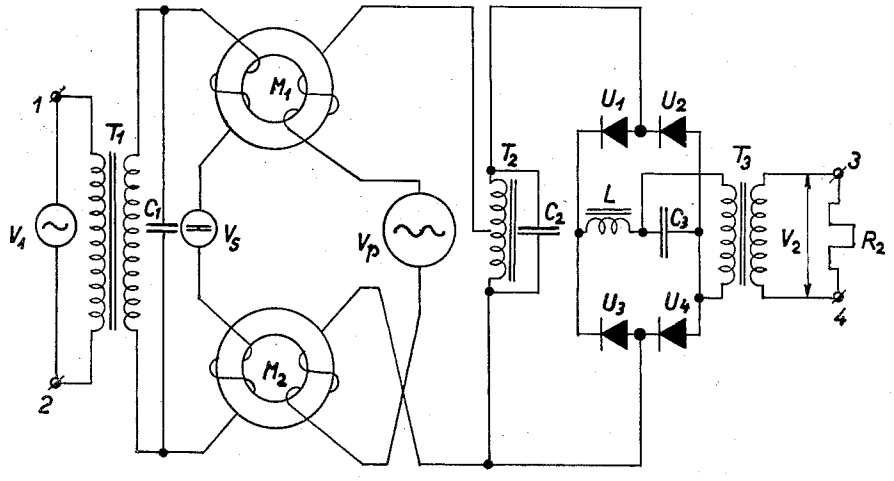


Fig.2



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ALTERNATING CURRENT MAGNETIC AMPLIFIER

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7 Claims. (Cl. 179—171)

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The amplifiers without thermionic valves hitherto known and running on a magnetic principle, are illustrated in Fig. 1 of the accompanying drawing. These devices are consisting of two identically designed amplifying choke coils Z_1 and Z_2 with an enclosed ferromagnetic core. These coils are both on the primary and secondary side switched in such a manner as to prevent the alternating output being transformed from the primary side to the secondary side and vice versa. Their primary circuit is being fed by the inlet D. C. voltage V_1 to be amplified. By such feed a partial presaturation of the ferromagnetic core is brought about changing the value of the secondary reactance of the choke coils. Within the secondary circuit a source of auxiliary alternating voltage V_p and the load R_2 are interposed. By such switching in respect of said source V_p a voltage divider is brought about between the reactance of the chokes and the load, the division ratio whereof may be influenced from the primary side by the inlet voltage V_1. If inside the gate of the choke coil core there is enough space for the magnetising winding, it is possible by a trifling input to influence the output which is being consumed in the load and the device is running like an amplifying apparatus.

These well known amplifiers are characterized by converting the D. C. input into an alternating output and they are therefore appropriate only for amplifying a D. C. input. As they are working without thermionic valves they are suitable for use in automatic devices working without control. However, they are unable to substitute for electronic amplifiers in those cases where it is indispensable for picturing in the output voltage both the phase and the frequency of the input voltage, i. e. if an alternating voltage is to be dealt with.

The subject-matter of the present invention is an improvement of the design of the hitherto known magnetic amplifiers whereby an apparatus is obtained running as an amplifier of the alternating input and being more particularly appropriate for use in the art of measuring alternating currents and voltages. The present invention is based on a new discovery made by the applicants, viz. that the combination of a modulating magnetic system with a demodulating system in a single apparatus presents an amplifying effect. An example of a basic wiring diagram of an apparatus according to the present invention is illustrated in Fig. 2 of the accompanying drawing. The modulation system consists of two modulating coils M_1 and M_2 with an enclosed ferromagnetic core (termed hereinafter the first and second cores, respectively) made of a material having a high permeability, said coils being switched on both the primary and secondary sides so as to prevent an alternating output being transformed between the primary and secondary sides and vice versa. The core of said coils is permanently premagnetized by an auxiliary D. C. voltage V_s, the current of which is superseded to the transformed A. C. current with V_1 inlet voltage. The insulating transformer T_1 (termed hereinafter the first transformer) interposed between both voltages and having an air gap prevents the D. C. component entering the inlet circuit. It is tuned by a capacity C_1 to the frequency of the inlet voltage V_1. The secondary choke coil circuit is being fed by an auxiliary alternating voltage V_p (termed hereinafter the A. C. source) having a higher frequency than the V_1 inlet voltage. Such voltage of a higher frequency is obtained either from a particular rotating generator or by a static multiplier of the mains frequency running either on the principle of a supersaturated ferromagnetic core or on unlinear resistors like those of the dry rectifier type. The secondary choke circuit is being closed over an intermediate or second transformer T_2 to the secondary side of which a demodulator is connected. The latter is composed of four dry rectifiers U_1 to U_4, of a filter consisting of a choke coil L and of the capacitors C_2, C_3 and output transformer T_3 provided with an air gap and having for its purpose to eliminate the D. C. component of the demodulated current from the outlet voltage V_2 fed to the load R_2. The filter eliminates from the outlet voltage V_2 the remnants of the auxilary voltage of a higher frequency. The intermediate transformer T_2 is for adjusting the impedance of the circuit of the choke coil system to the demodulation system.

The technical data of an embodiment of the principle disclosed by the invention as designed in a laboratory will be given hereinafter. The

apparatus has been designed for a single-stage amplification amounting in this case to 150–200. The input was within the limits of 1.8 to 2.4 milliwatt, the output amounted to 0.36 watt. The components used in this embodiment had the following electrical values:

Reference	Electrical values
T_1, T_3	Insulating transformer 1 to 1, 2 x 1800 turns, core 12.25 sq. cm. highly alloyed silicon sheet 0.35 mm.
C_1	Capacity 30μf, 1500 v.
C_2	it. 0.1μf, 1500 v.
C_3	it. 1.0μf, 1500 v.
M_1, M_2	Modulation coils, mu/metal, core, 3 sq. cm., length of lines of force, 27 cm., primary winding consisting of 500 turns of a ϕ=0.5 mm. wire, the secondary winding of 100 turns of a ϕ=0.8 mm. wire.
T_2	Intermediate transformer 1 to 2; designed as auto-transformer, core 16 sq. cm., in all 3600 turns of a ϕ=0.5 mm. wire.
U_1 to U_4	Dry selenium rectifiers, max. 220 v., max. 0.15 a.
L	Filter choke 0.5 h., D. C. resistance 5 ohm.
R_2	Load resistor 205 ohm, max. 10 w.
V_s	Auxiliary battery D. C.; the value of voltage to be adjusted by voltage divider to 1.55 v., maximum current supply 0.3 a.
V_p	Rotary generator for frequency f=530, 105 v., 0.5 a.

What I claim is:

1. A valveless A. C. amplifier comprising in combination, a first closed ferromagnetic core; a first primary winding and a first secondary winding arranged on said first core, respectively; a second closed ferromagnetic core; a second primary winding and a second secondary winding arranged on said second core, respectively; an A. C. input and a D. C. source connected in series to said primary windings arranges on said first and second cores, respectively, said D. C. source presaturating said first and second cores, said A. C. input being adapted to supply an alternating current having a predetermined frequency to said primary windings; an A. C. source having a substantially higher frequency than said predetermined frequency and connected in series to said secondary windings arranged on said first and second cores, respectively, said windings arranged on one of said cores being wound in the same sense and said windings arranged on the other of said cores being wound in opposite sense; and a load circuit connected to said secondary windings and said A. C. source.

2. A valveless A. C. amplifier comprising in combination, a first closed ferromagnetic core; a first primary winding and a first secondary winding arranged on said first core, respectively; a second closed ferromagnetic core; a second primary winding and a second secondary winding arranged on said second core, respectively; an A. C. input and a D. C. source connected in series to said primary windings arranged on said first and second cores, respectively, said D. C. source presaturating said first and second cores, said A. C. input being adapted to supply an alternating current having a predetermined frequency to said primary windings; an A. C. source having a substantially higher frequency than said predetermined frequency and connected in series to said secondary windings arranged on said first and second cores, respectively, said windings arranged on one of said cores being wound in the same sense and said windings arranged on the other of said cores being wound in opposite sense; a transformer having a primary winding connected to said secondary windings and said A. C. source; a secondary winding forming part of said transformer; and a demodulator connected to said secondary winding of said transformer.

3. A valveless A. C. amplifier comprising in combination, a first closed ferromagnetic core; a first primary winding and a first secondary winding arranged on said first core, respectively; a second closed ferromagnetic core; a second primary winding and a second secondary winding arranged on said second core, respectively; an A. C. input and a D. C. source connected in series to said primary windings arranged on said first and second cores, respectively, said D. C. source presaturating said first and second cores, said A. C. input being adapted to supply an alternating current having a predetermined frequency to said primary windings; an A. C. source having a substantially higher frequency than said predetermined frequency and connected in series to said secondary windings arranged on said first and second cores, respectively, said windings arranged on one of said cores being wound in the same sense and said windings arranged on the other of said cores being wound in opposite sense; a transformer having a primary winding connected to said secondary windings and said A. C. source; a secondary winding forming part of said transformer; a demodulator connected to said secondary winding of said transformer; a filter connected to said demodulator for attenuating any high-frequency components in the secondary current of said transformer; and an output circuit connected to said filter.

4. A valveless A. C. amplifier comprising in combination, a first closed ferromagnetic core; a first primary winding and a first secondary winding arranged on said first core, respectively; a second closed ferromagnetic core; a second primary winding and a second secondary winding arranged on said second core, respectively; an A. C. input and a D. C. source connected in series to said primary windings arranged on said first and second cores, respectively, said D. C. source presaturating said first and second cores, said A. C. input being adapted to supply an alternating current having a predetermined frequency to said primary windings; an A. C. source having a substantially higher frequency than said predetermined frequency and connected in series to said secondary windings arranged on said first and second cores, respectively, said windings arranged on one of said cores being wound in the same sense and said windings arranged on the other of said cores being wound in opposite sense; a transformer having a primary winding connected to said secondary windings and said A. C. source; a secondary winding forming part of said transformer; a demodulator connected to said secondary winding of said transformer; a filter connected to said demodulator for attenuating any high-frequency components in the secondary current of said transformer; and an output transformer connected to said filter, whereby said output transformer attenuates any D. C. components in the secondary current of said transformer and yields a current having a high wattage in comparison to, and the same frequency and similar amplitude and phase characteristics as, the A. C. supplied by said A. C. input.

5. A valveless A. C. amplifier comprising in combination, a first closed ferromagnetic core; a first primary winding and a first secondary winding arranged on said first core, respectively; a second closed ferromagnetic core; a second primary winding and a second secondary winding arranged on said second core, respectively; an A. C. input; a transformer having a primary winding connected to said A. C. input and a secondary winding a D. C. source connected in series to said secondary winding of said transformer

and said primary windings arranged on said first and second cores, respectively, said D. C. source presaturating said first and second cores, said A. C. input being adapted to supply an alternating current having a predetermined frequency to said primary windings; an A. C. source having a substantially higher frequency than said predetermined frequency and connected in series to said secondary windings arranged on said first and second cores, respectively, said windings arranged on one of said cores being wound in the same sense and said windings arranged on the other of said cores being wound in opposite sense; and a load circuit connected to said secondary windings and said A. C. source.

6. A valveless A. C. amplifier comprising in combination, a first closed ferromagnetic core; a first primary winding and a first secondary winding arranged on said first core, respectively; a second closed ferromagnetic core; a second primary winding and a second secondary winding arranged on said second core, respectively; an A. C. input; a first transformer having a primary winding connected to said A. C. input and a secondary winding a D. C. source connected in series to said secondary winding of said first transformer and said primary windings arranged on said first and second cores, respectively, said D. C. source presaturating said first and second cores, said A. C. input being adapted to supply an alternating current having a predetermined frequency to said primary windings; an A. C. source having a substantially higher frequency than said predetermined frequency and connected in series to said secondary windings arranged on said first and second cores, respectively, said windings arranged on one of said cores being wound in the same sense and said windings arranged on the other of said cores being wound in opposite sense; a second transformer having a primary winding connected to said secondary windings and said A. C. source; a secondary winding forming part of said second transformer; and a demodulator connected to said secondary winding of said second transformer.

7. A valveless A. C. amplifier comprising in combination, a first closed ferromagnetic core; a first primary winding and a first secondary winding arranged on said first core, respectively; a second closed ferromagnetic core; a second primary winding and a second secondary winding arranged on said second core, respectively; an A. C. input; a first transformer having a primary winding connected to said A. C. input and a secondary winding a D. C. source connected in series to said secondary winding of said first transformer and said primary windings arranged on said first and second cores, respectively, said D. C. source presaturating said first and second cores, said A. C. input being adapted to supply an alternating current having a predetermined frequency to said primary windings; an A. C. source having a substantially higher frequency than said predetermined frequency and connected in series to said secondary windings arranged on said first and second cores, respectively, said windings arranged on one of said cores being wound in the same sense and said windings arranged on the other of said cores being wound in opposite sense; a second transformer having a primary winding connected to said secondary windings and said A. C. source; a secondary winding forming part of said second transformer; a demodulator connected to said secondary winding of said second transformer; a filter connected to said demodulator for attenuating any high-frequency components in the secondary current of said secondary transformer; and an output transformer connected to said filter, whereby said output transformer attenuates any D. C. components in the secondary current of said second transformer and yields a current having a high wattage in comparison to, and the same frequency and similar amplitude and phase characteristics as, the A. C. supplied by said A. C. input.

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