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ELECTRICAL CONVERTING SYSTEM

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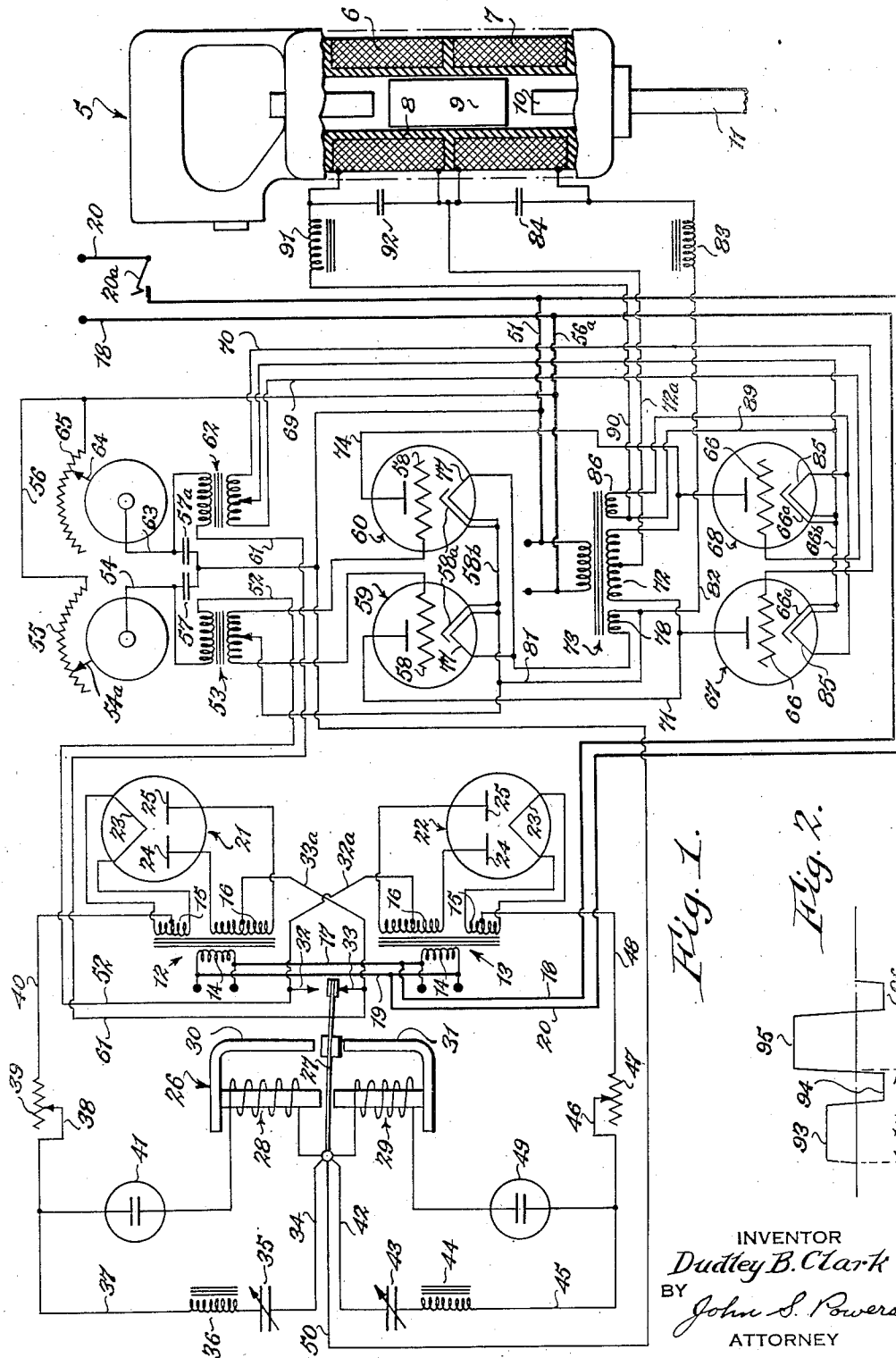
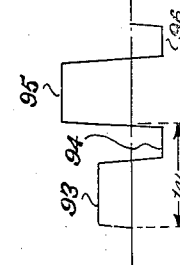


Fig. 1.

Fig. 2.



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ELECTRICAL CONVERTING SYSTEM

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14 Claims. (Cl. 172—281)

This invention relates to improvements in electrical converting systems and more particularly is concerned with a system for translating alternating currents into pulsating currents of predetermined frequencies. Although not limited to such use the system is characterized by features which adapt it particularly for use in connection with industrial vibrators.

The principal object of the invention is a system wherein provision is made for varying either independently or conjointly the frequencies, amplitudes and periods of the pulsating currents.

The invention is illustrated in the accompanying drawing in which:

Figure 1 is a diagrammatic illustration of a system embodying the features of the invention.

Figure 2 is a graphical representation of pulsations produced by said system.

The system is illustrated, by way of example, in connection with a magnetic hammer 5 of conventional design. It is adapted when so employed to energize in alternation coils 6 and 7 which are arranged around a barrel 8 to reciprocate a piston 9, thereby to cause the latter to strike a member 10 through which the force of the blows is transmitted to a tool 11.

As shown, the system includes transformers 12 and 13, each of which is provided with a primary 14 and secondaries 15 and 16. One side of each of the primaries 14 is connected by a wire 17 to a power line 18 while the other side of each of the said primaries is connected by a wire 19 to the other power line 20, there being a switch 20a connected in the line 20. Alternating current of an available frequency is supplied to the power lines 18 and 20. A full-wave rectifying tube 21, therefore, is employed in connection with the transformer 12 while a similar tube 22 is employed in connection with the transformer 13. The filaments 23 of the tubes 21 and 22 are energized by the secondaries 15, the plates 24 and 25 of the said tubes being connected to the opposite sides of the secondaries 16.

The rectified current from the tubes 21 and 22 is utilized to operate a vibrator 26. The latter includes an armature 27 which is arranged between electromagnets 28 and 29 and permanent magnets 30 and 31. The free end of the said armature co-operates with spaced contacts 32 and 33, the former being connected by a wire 32a to a center tap on the primary 16 of the transformer 13 while the latter is connected by a wire 33a to a center tap on the primary 16 of the transformer 12. The electromagnet 28 is operative when energized to move the armature 27 into engagement

with the contact 32, the permanent magnet 30 being adapted to hold the said armature in such position until the electromagnet 29 is energized. The latter is thereupon operative to move the armature 27 into engagement with the contact 33, in which position it is held by the permanent magnet 31 until the electromagnet 28 is again energized. The armature 27 is connected by a wire 34 to one side of a variable condenser 35. The latter is in series with an inductance 36 which is connected by a wire 37 to a contact 38, the said contact being adjustable along a resistance 39 which is connected by a wire 40 to a center tap on the secondary 15 of the transformer 12. The coil of the electromagnet 28 is in series with a glow discharge tube 41, the said coil and tube being connected across the condenser 35 and inductance 36. The armature 27 is connected by a wire 42 to one side of a variable condenser 43. The latter is in series with an inductance 44 which is connected by a wire 45 to a contact 46, the said contact being adjustable along a resistance 47 which is connected by a wire 48 to a center tap on the secondary 15 of the transformer 13. The coil of the electromagnet 29 is in series with a glow discharge tube 49, the said coil and tube being connected across the condenser 43 and inductance 44.

It will be apparent that when the switch 20a is closed, assuming the armature 27 of the vibrator to be held against the contact 33, direct current will flow to the condenser 35 through the resistance 39 and inductance 36. A charge is thus caused to build up on the said condenser until an E.M.F. is attained which is high enough to cause the glow discharge tube 41 to become conductive. When this occurs a circuit is established through the coil of the electromagnet 28 and the armature 27 is moved away from the contact 33 and into engagement with the contact 32, thereby breaking the circuit through the tube 41 and closing the circuit which includes the condenser 43 and inductance 44. A charge is thus caused to build up on the said condenser until an E. M. F. is attained which is high enough to render the tube 49 conductive. Thereupon a circuit is established through the coil of the electromagnet 29 and the latter is operative to move the armature 27 away from the contact 32 and into engagement with the contact 33, thereby to break the circuit through the glow tube 49 and re-establish the circuit which includes the condenser 35 and inductance 36. The armature 27 of the vibrator is, therefore, caused to move back and forth between the contacts 32 and 33 in the manner de-

scribed so long as the switch 20a remains closed. The frequency at which the said armature is caused to vibrate may be varied by adjusting the resistances 39 and 47 and the condensers 35 and 43, it being noted in this connection that the said resistances and condensers may be availed of to cause the armature 27 to be held longer against one of the contacts 32 and 33 than against the other.

10 The armature 27 of the vibrator is connected by wires 50 and 51 to the power line 20. Hence when it is moved to engage the contact 32 as described it establishes a circuit which includes wire 52, primary of a transformer 53, wire 54, adjustable contact 54a, resistance 55 and wires 56 and 15 56a to the power line 18. The said circuit includes a condenser 57 which is connected in series with the resistance 55 across the power lines 18 and 20 and is utilized to control the bias upon the grids 20 20 58 of power tubes 59 and 60. To this end one side of the secondary of the transformer 53 is connected to the grid of the tube 59 while the other side is connected to the grid of the tube 60, the cathodes 58a of the said tubes being connected 25 by a wire 58b to a center tap on the said secondary. When the armature 27 of the vibrator is moved to engage the contact 33 it establishes a circuit which includes wire 61, primary of a transformer 62, wire 63, adjustable contact 64, resistance 65 and wires 56 and 56a to the power line 18. 30 The said circuit includes a condenser 57a which is connected in series with the resistance 65 across the power lines 18 and 20 and is utilized to control the bias upon the grids 66 of power tubes 67 and 68. To this end one side of the secondary of the transformer 62 is connected by a wire 69 to the grid of the tube 68 while the other side is connected by a wire 70 to the grid of the tube 67, the cathodes 66a of the said tubes being connected by 35 a wire 66b to a center tap on the secondary.

It will be apparent from the foregoing that as the armature 27 of the vibrator moves back and forth between the contacts 32 and 33 a bias will be impressed first upon the grids of the tubes 45 59 and 60 and then upon the grids of the tubes 67 and 68. Each pair of tubes provides a full-wave rectifier, the plate of the tube 59 being connected by a wire 71 to one side of a secondary 72 of a transformer 73 while the plate of the tube 60 50 is connected by a wire 74 to the other side of the said secondary. A wire 72a connects a center tap on the secondary 72 to the inner ends of the coils 6 and 7 of the electric hammer. One side of the primary of the transformer 73 is connected 55 by the wire 56a to the power line 18, the other side of the said primary being connected by the wire 51 to the power line 20. The filaments 77 of the tubes 59 and 60 are energized by a secondary 78 of the transformer 73. The cathodes 58a of the said tubes are connected by the wire 58b and wires 81 and 82 to the outer end of the coil 7, there being an inductance 83 in series with the said coil and a condenser 84 connected across it. The plate of the tube 67 is connected 60 by the wire 71 to one side of the secondary 72 of the transformer 73 while the plate of the tube 68 is connected by the wire 74 to the other side of the said secondary. The filaments 85 of the said tubes are energized by a secondary 86 of the transformer 73 and the cathodes 66a are connected 65 by the wire 66b and wires 89 and 90 to the outer end of the coil 6, there being an inductance 91 in series with the said coil while a condenser 92 is connected across it.

75 It will be apparent that in the operation of the

system the tubes 59 and 60 are adapted, so long as the armature 27 of the vibrator engages the contact 32, to rectify the current from the transformer 73 and permit its passage to the coil 7 of the electric hammer. On the other hand the 5 tubes 67 and 68 are operative, so long as the armature 27 of the vibrator engages the contact 33, to rectify the current from the transformer 73 and permit its passage to the coil 6 of the said hammer. Hence as the armature 27 is caused to vi- 10 brate in the manner described direct current pulsations are caused to flow in alternation through the coils 6 and 7. The frequency of the said pulsations is determined by the frequency of the armature 27; it is independent of the frequency 15 of the current delivered to the power lines; and it may be varied by varying the frequency of the armature of the vibrator 26.

From the foregoing it will be apparent that when, as illustrated, the converter system is em- 20 ployed in connection with an electric vibrator such as a magnetic hammer it is available to vary, at will, the frequency at which the piston of the hammer is caused to reciprocate. In a hammer such as the type shown power is required 25 over a longer period during the working strokes of the piston than during the return strokes. The period of the pulsations which produce the working strokes of the piston may, therefore, and preferably are, increased with respect to the periods 30 of the pulsations which retract the said piston. Thus, assuming for example, that the working strokes of the piston 8 are produced by the solenoid 7 while the return strokes are effected by the solenoid 6, the vibrator 26 is adjusted so that 35 the engagement of the armature 27 with the contact 32 is accompanied by the production of a pulsation 93 (Figure 2) having a relatively long period while the engagement of the contact 33 is accompanied by the production of a pulsation 94 40 having a relatively shorter period. The system described, therefore, has the advantage that it enables power to be applied to the coil which produces the working strokes for periods which 45 render such strokes most effective without the necessity of applying power for the same length of time to the coil whose only function is to return the piston to its original position.

The system has the further advantage that it enables the amplitude of the pulsations to be 50 varied as required. Such variations may be effected by adjustment of the contacts 54a and 64 along their respective resistances 55 and 65 to vary the phase of the current applied to the grids of the power tubes with respect to the phase of 55 the current applied to the plates. The varying of the amplitude of the pulsations is of particular advantage. In a magnetic hammer, for example, maximum power is required during the working strokes of the piston 9 while minimum power is 60 required to return the piston to its original position at the completion of such strokes. The contact 54a in such case may be adjusted so that the pulsation 95 (Figure 2) produced while the armature 27 of the vibrator engages the contact 32 has 65 a relatively large amplitude while the contact 64 may be adjusted so that the pulsation 96 which is produced while the said armature engages the contact 33 is of relatively small amplitude, the amplitude of the pulsation 95 being predeter- 70 mined with respect to the power required by the hammer during a working stroke while the amplitude of the impulse 96 is predetermined with respect to the power required to restore the piston to its original position upon completion of such 75

stroke. The proper power is thus applied to the piston of the hammer during working and return strokes and loss of power is, therefore, prevented.

5 The pulsating currents produced by the converting system may also be availed of, if desired, to provide variable frequency currents. In such case the coils 6 and 7 serve as primaries of a transformer and are employed in connection with
10 a single secondary, the pulsations traversing the coil 6 inducing a flow of current in one direction through the secondary while the pulsations traversing the coil 7 induce a flow of current through the secondary in the opposite direction.

15 I claim as my invention:

1. The combination with a source of alternating current and a plurality of outlet circuits, of a converting system including thermionic valves, said valves having control electrodes, circuits for impressing a bias upon said electrodes, means for making and breaking said last named
20 circuits to render said valves conductive in alternation, whereby to produce pulsations of a predetermined frequency, means for varying the amplitude of alternate of said pulsations and means for connecting said valves to said output
25 circuits so that pulsations of one amplitude are supplied to one of said output circuits and pulsations of another amplitude are supplied to another of said output circuits.

2. The combination with a source of alternating current, of a converting system including thermionic valves, said valves having control electrodes, circuits for impressing a bias upon
35 said electrodes, a vibrator, said vibrator having an armature for making and breaking said circuits in alternation, whereby to produce pulsations of a predetermined frequency, and means for actuating said armature, said means including
40 opposed electromagnets, glow discharge tubes in series with the coils of said electromagnets and condensers which are connected across said tubes and coils and which are charged to render said tubes conductive.

3. The combination with a source of alternating current, of a converting system including thermionic valves, said valves having control electrodes, circuits for impressing a bias upon
45 said electrodes, a vibrator, said vibrator having an armature for making and breaking said circuits in alternation, whereby to produce pulsations of a predetermined frequency and means for actuating said armature, said means including
50 opposed electromagnets, glow discharge tubes in series with the coils of said electromagnets, condensers which are connected across said tubes and coils and which are charged to render said tubes conductive and adjustable resistances in series with said condensers for varying the
55 charging rate of the latter.

4. The combination with a source of alternating current, of a converting system including thermionic valves, said valves having control electrodes, circuits for impressing a bias upon
60 said electrodes, a vibrator, said vibrator having an armature for making and breaking said circuits in alternation, whereby to produce pulsations of a predetermined frequency and means for actuating said armature, said means including
65 opposed electromagnets, glow discharge tubes in series with the coils of said electromagnets, condensers connected across said tubes and coils, means for rectifying current for charging said condensers to render said tubes conductive and
70 adjustable resistances in series with said con-

densers for varying the charging rate of the latter.

5. The combination with a source of alternating current, of a converting system including thermionic valves, said valves having control electrodes, circuits for impressing a bias upon said
5 electrodes, a vibrator, said vibrator having an armature for making and breaking said circuits in alternation, whereby to produce pulsations of a predetermined frequency and means for actuating said armature, said means including
10 opposed electromagnets, permanent magnets for holding said armature in the positions to which it is moved by said electromagnets, glow discharge tubes in series with the coils of said
15 electromagnets, condensers connected across said tubes and coils, means for rectifying current for charging said condensers to render said tubes conductive and adjustable resistances in series with said condensers for varying the charging
20 rate of the latter.

6. The combination with a source of alternating current, of a converting system including thermionic valves, said valves having control electrodes, alternating current circuits for impressing a bias upon said electrodes, means for
25 making and breaking said circuits to render said valves conductive in alternation, whereby to produce pulsations of a predetermined frequency and means for throwing the current in one of said circuits out of phase with respect to the
30 current in the other so that alternate of said pulsations are of a greater amplitude than the intermediate pulsations.

7. The combination with a source of alternating current, of a converting system including thermionic valves, said valves having control electrodes, alternating current circuits for impressing a bias upon said electrodes, means for
35 making and breaking said circuits to render said valves conductive in alternation, whereby to produce pulsations of a predetermined frequency and means for throwing the current in one of said circuits out of phase with respect to the current
40 in the other so as to produce variations in the amplitude of said pulsations, said last named means including a resistance and a condenser connected in series across the lines of one of said circuits.

8. The combination with a source of alternating current, of a converting system including thermionic valves, said valves having control electrodes, alternating current circuits for impressing a bias upon said electrodes, a vibrator for making and breaking said circuits to render said valves
45 conductive in alternation, whereby to produce pulsations of a predetermined frequency, means for varying the frequency of said vibrator and means for throwing the current applied to said electrodes out of phase with respect to the current applied to the plates of said valves so as
50 to reduce the amplitude of said pulsations, said last named means including resistances and condensers which are connected in series across the lines of each of said circuits.

9. The combination with a source of alternating current and a plurality of output circuits, of a converting system, said system including a plurality of rectifiers, each of which is connected
55 to said source of alternating current and one of said output circuits, means for making and breaking the circuits through said rectifiers in alternation to supply direct current pulsations to said output circuits and means whereby the
60 amplitude of the pulsations supplied to one of

said output circuits is greater than that of the pulsations supplied to the other of said circuits.

10. The combination with a source of alternating current, of a converting system including thermionic valves, said valves having control electrodes, circuits for impressing a bias upon said electrodes, a vibrator for making and breaking said circuits to render said valves conductive in alternation to produce pulsations of a predetermined frequency and gaseous conduction means through which current is supplied to said vibrator.

11. The combination with a source of alternating current, of a converting system including thermionic valves, said valves having control electrodes, circuits for impressing a bias upon said electrodes, a vibrator for making and breaking said circuits to render said valves conductive in alternation to produce pulsations of a predetermined frequency, gaseous conduction means through which current is supplied to said vibrator and means for regulating the current supplied to said gaseous conduction means, whereby to control the frequency of said vibrator.

12. The combination with a source of alternating current and a plurality of output circuits, of a converting system including thermionic valves, said valves having control electrodes, biasing circuits for said electrodes, means for making and breaking said biasing circuits to render said valves conductive in alternation, whereby to produce pulsations of a predetermined frequency, means for throwing the current in one of said biasing circuits out of phase with respect to the current in the other so that alternate of said pulsations are of a greater amplitude than the intermediate pulsations and means for connecting said valves so that pulsations of one amplitude are supplied to one of said output circuits and pulsations of another amplitude are supplied to another of said output circuits.

13. The combination with a source of alternating current and a plurality of output circuits,

of a converting system including two sets of thermionic valves, said valves having control electrodes, alternating current circuits for biasing said electrodes, the control electrodes of each set of valves being connected so that the potentials applied to them are opposite in phase, means for making and breaking said biasing circuits to render said sets of valves conductive in alternation, whereby to produce pulsations of a predetermined frequency, means for throwing the current in one of said biasing circuits out of phase with respect to the current in the other so that alternate of said pulsations are of a greater amplitude than the intermediate pulsations and means for connecting said valves so that the pulsations of one amplitude are supplied to one of said output circuits and pulsations of another amplitude are supplied to another of said circuits.

14. The combination with a source of alternating current and a plurality of output circuits, of a converting system including two sets of thermionic valves, said valves having control electrodes, alternating current circuits for biasing said electrodes, the control electrodes of each set of valves being connected so that the potentials applied to them are opposite in phase, means for making and breaking said biasing circuits to render said sets of valves conductive in alternation, whereby to produce pulsations of a predetermined frequency, means for throwing the current in one of said biasing circuits out of phase with respect to the current in the other so that alternate of said pulsations are of a greater amplitude than the intermediate pulsations, said last named means including a resistance and a condenser connected in series across the lines of each of said biasing circuits and means for connecting said valves so that pulsations of one amplitude are supplied to one of said output circuits and pulsations of another amplitude are supplied to another of said circuits.

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