

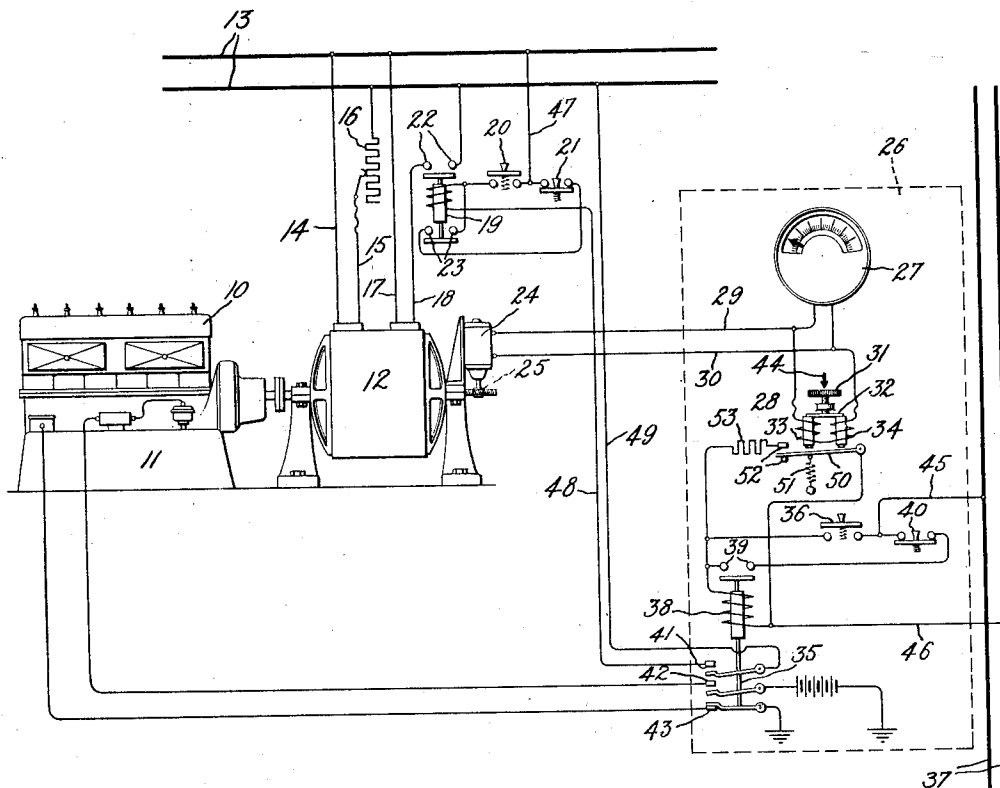
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SAFETY DEVICE FOR DYNAMO ELECTRIC MACHINES

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SAFETY DEVICE FOR DYNAMO ELECTRIC MACHINES

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This invention relates to the protection of machines designed to operate at high speeds and more particularly to the protection of such machines in systems in which a dynamo-electric machine is coupled with an internal combustion machine for effecting certain testing operations of the latter, and has for an object the provision of a simple, reliable and accurate over-speed protective system the operation of which shall be independent of the field current, generated voltage, or developed power of the dynamo-electric machine.

In illustrating my invention in one form thereof, I have shown it as embodied in a testing system in which a dynamometer is employed for carrying out certain tests on an internal combustion engine, such as an airplane or an automobile engine, and in which the dynamometer is coupled with the engine undergoing the test for the purpose of converting the mechanical energy developed by the engine into electrical energy and delivering the same to a consuming device or to a source of electrical supply.

In carrying my invention into effect in one form thereof, I provide a tachometer generator arranged to be driven by the dynamometer and to generate voltage proportional to the speed thereof, together with means responsive to a predetermined voltage of the generator for disconnecting the dynamometer from the supply lines and deenergizing the ignition circuits of the internal combustion engine at a predetermined speed of the dynamometer.

For a better and more complete understanding of my invention, reference should now be had to the following specification and to the accompanying drawing, the single figure of which is a simplified, diagrammatic representation of my invention.

Referring now to the drawing, an internal combustion engine 10, such as an airplane engine or an automobile engine, is suitably mounted upon a testing stand 11. The shaft of a cradle dynamometer 12 is mechanically coupled with the shaft of the engine 10 with a suitable coupling device as indicated in the drawing. The dynamometer is provided

with an armature and with field windings (not shown). A suitable source of electrical supply which may be the shop mains, represented by the numeral 13 on the drawing, is connected to terminals of the field circuit of the dynamometer, through the conductors 14 and 15 and the variable resistance 16. Mechanical energy developed by the internal combustion engine 10 is converted into electrical energy in the armature circuit of the dynamometer 12 and is pumped back into the supply lines 13 through the conductors 17 and 18.

A line contactor of any suitable form such as that represented by the numeral 19 in the drawing, is provided for the purpose of closing and interrupting the armature circuit of the dynamometer at the proper time. A normally open push button 20 and a normally closed push button 21 are provided for respectively establishing or interrupting the energizing circuit of the contactor 19. As shown in the drawing, the contactor 19 is provided with main contacts 22 in the armature circuit of the dynamometer and with auxiliary contacts 23 for establishing a selfholding circuit for the coil of contactor independently of the contacts of normally open push button 20.

A small electric tachometer generator 24 is suitably mounted upon the pedestal of the dynamometer and is arranged to have its armature member driven by the shaft of the dynamometer through suitable gearing such as worm gearing 25. As will be understood by those skilled in the art, a tachometer generator is an especially designed generator, the generated voltage of which varies in direct proportion to the speed at which its armature member is rotated.

Associated with the dynamometer is a control panel 26 upon which are mounted a tachometer instrument 27 and a control relay 28, the energizing coils of both of which elements are connected to the terminals of the armature member of tachometer generator 24, through the conductors 29 and 30. The setting of relay 28, that is to say the voltage to which the relay 28 may be made to respond, may be varied by turning an adjustable

thumb nut 31 provided for the purpose of varying the air gap between a magnetic member 32 and the core members 33 and 34 of the relay.

5 Also mounted upon the panel 26 is a control contactor 35 the function of which is to control the energizing circuit of line contactor 19 and the ignition circuits of internal combustion engine 10. A start contactor 36, 10 which may be of any suitable type, but which is indicated in the drawing as a normally open push button, is provided for establishing an energizing circuit from the supply lines 37 to the coil 38. The contactor 35 is 15 provided with auxiliary contacts 39 for the purpose of establishing a selfholding circuit for the coil 38 independent of the start push button 36. Likewise, a stop contactor 40 which may be of any suitable type but which 20 for the purpose of illustration is shown in the drawing as a normally closed push button is provided in the selfholding circuit of the coil 38 and serves when depressed to its lower or open position to interrupt the energizing 25 circuit of the contactor 35.

The control contactor 35, as shown in the drawing, is provided with normally open contacts 41 and 42 and with normally closed contacts 43. Normally open contact 41 is located in series with the coil of line contactor 19 and must be operated to the closed position before the line contactor 19 can be closed. 30 Similarly, normally open contact 42 is connected in the battery ignition circuit of the internal combustion engine 10 and must be 35 operated to the upper or the closed position before the internal combustion engine can be started. Normally closed contact 43 controls the magneto ignition circuit of the internal 40 combustion engine and when operated to the upper or open position, this contactor removes the ground from the magneto circuit for the purpose of rendering the magneto circuit operative.

45 With the above understanding of the elements comprising my invention and the manner in which they are associated with each other, the operation which will now be described in detail will be readily understood.

50 Before starting up the testing apparatus, the knob 31, which is provided with graduations corresponding to the speeds of the dynamometer, should be adjusted by turning the same until the graduation at which it is desired that the protective apparatus should 55 function to shut down the engine undergoing test is opposite the arrow 44. The control contactor 35 may now be operated to the closed position by depressing start button 36 60 to bridge its normally open contacts thereby establishing an energizing circuit for the coil 38 of the contactor that may be traced from the left hand supply line 37, over conductor 45, through the contacts of start button 36, 65 thence through the coil 38, and through con-

ductor 46 to the right hand supply line 37. In responding to the energization of its coil, contactor 35 moves to the upper or closed position in which position the auxiliary contacts 39 are bridged by the movable bridging member to provide a selfholding circuit for the coil 38 through the normally closed contacts of stop push button 40 independently of start push button 36 which may now be released. 70

In the closed position of contactor 35 normally open contact 42 is closed thus establishing the battery ignition circuit for the internal combustion engine 10 whilst normally closed contact 43 is now open thereby removing the ground from the magneto ignition circuit for the internal combustion engine. 75 The engine may now be started up by a suitable starter (not shown), or by operating the dynamometer as a motor from the supply lines 13 as is well understood by skilled 80 workers in the art.

To start the engine by utilizing the dynamometer 12 as a motor it is only necessary to depress the push button 20 to bridge its normally open stationary contact members, the result of which is to establish an energizing circuit for the coil of contactor 19 extending 85 from upper supply line 13, over conductor 47, through the contacts of push button 20, to and through the coil of contactor 19, over conductor 48, through contacts 41 of control contactor 35, and thence by way of conductor 49 to the lower supply line 13. Line contactor 19 will now move to the upper position in response to the energization of its coil 90 thereby closing the main contacts 22 in the armature circuit of the dynamometer and also closing its auxiliary contacts 23 to establish a selfholding circuit for the coil of the contactor, through the contacts of normally closed push button 21 independently 95 of the normally open contacts of push button 20 which may now be released.

As pointed out above the normally open contact 41 of the ignition contactor 35 is included in the energizing circuit of the line contactor 19 thus preventing the connection of the dynamometer 12 to the source 13 prior to the establishment of the ignition circuit of the engine 11 and on the other hand insuring the establishment of the ignition circuit of the engine 11 prior to the operation of the dynamometer 12 as a motor to start the engine. This insured sequence in the starting operation provides a very important 100 safety feature since it effectually prevents the engine 11 from exhausting charges of an explosive mixture into the exhaust line and thus prevents disastrous explosions that might otherwise occur in the exhaust line 105 due either to the ignition of these unexploded charges by its own heated exhaust gases following a subsequent establishment of the ignition circuit or by the heated gases of other engines simultaneously undergoing a 110 115 120 125 130

test in the laboratory and exhausting into the same line.

After the engine has been started by the operation of the dynamometer 12 as a motor and has come up to a speed sufficient to increase its electro-motive force above that of the supply lines 13 the dynamometer will no longer take energy from the line, but will reverse its operation and function as a generator.

The desired tests may now be performed upon the internal combustion engine 10 and the mechanical energy which it develops will be converted into electrical energy and pumped into the supply lines 13 by the dynamometer 12 as is well understood by those skilled in the art. The speed at which the rotor of the dynamometer is rotated which is also the speed at which the internal combustion engine 10 is running may be directly observed upon the tachometer 27. Should either the field or the armature circuit of the dynamometer fail thus causing the speed of the internal combustion engine 10 to increase unduly or should the speed of the internal combustion engine 10 for any reason exceed the permissible value, the control relay 28 will respond to the increased voltage generated by the tachometer generator 24 and will attract its armature member 50 against the bias of its spring 51 to the upper position in which the contacts 52 will be closed to establish a short circuit about coil 38 of control contactor 35, through a resistance 53 which is provided to prevent a short-circuit to the supply lines 37. The short-circuit resulting from the closing of contacts 52 is sufficient, however, to deprive coil 38 of the current necessary to maintain the contactor 35 in the closed position. Therefore, contactor 35 will drop to the lower position in which position contact 41 will open and deenergize the line contactor 19 permitting it in turn to open and disconnect the armature of dynamometer 12 from the supply lines 13. Likewise, contact 42 will be opened and the battery ignition circuit of the internal combustion engine 10 will be deenergized whilst contact 43 will be in the closed position in which the magneto ignition circuit of the engine 10 will be grounded.

This invention is particularly advantageous in the event that the dynamometer is run as a motor for the purpose of taking friction losses of the internal combustion engine immediately after a high speed low horsepower test with the dynamometer operating as a generator, with reduced field. Should the operator fail to increase the field before operating the dynamometer as a motor, it will be prevented from attaining a dangerous speed with disastrous results.

Although I have described my invention as comprising specific elements associated with each other in a particular manner and as op-

erating in a specific way, I would have it distinctly understood that the invention is nowise limited to the particular elements disclosed for the purpose of illustration, nor to the specific connections since persons skilled in the art will be able to make alterations and changes without departing from the spirit of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a testing system for an internal combustion engine provided with an ignition circuit, a main dynamo electric machine driven by said engine and provided with an armature circuit, a contactor for connecting said armature circuit with a source of supply, a second contactor for controlling the operation of said first contactor and for controlling said ignition circuit, and means including an auxiliary dynamo electric machine for generating an electromotive force proportional to the speed of said main dynamo electric machine for causing said second contactor to render said ignition circuit inactive and to cause said first contactor to open said armature circuit when the speed of said main dynamo electric machine reaches a predetermined value.

2. A control system for an internal combustion engine provided with an ignition circuit comprising a main dynamo electric machine having an armature circuit, means including a contactor for connecting said armature circuit to said source, means including a second contactor for controlling said ignition circuit and having a normally open contact in the energizing circuit of said first mentioned contactor to prevent the establishment of said armature circuit prior to the establishment of said ignition circuit, and means including an auxiliary dynamo electric machine for responding to a predetermined speed of said main dynamo electric machine to cause said contactors to deenergize said armature and ignition circuits.

3. In a testing system for an internal combustion engine provided with an ignition circuit, a dynamometer mechanically connected to said engine and provided with an armature circuit, means including a contactor for controlling the connection of said armature circuit to a source of supply, means including a second contactor for controlling the continuity of said ignition circuit and having a normally open contact in the energizing circuit of said first mentioned contactor to insure the establishment of said ignition circuit prior to the establishment of said armature circuit, and means including an auxiliary dynamo electric machine for generating an electromotive force proportional to the speed of said dynamometer and an adjustable electroresponsive device controlled thereby for responding to a predetermined speed of said dynamometer to cause said con-

tactors to deenergize said armature and ignition circuits.

4. In a testing system, an internal combustion engine provided with a battery and magneto ignition circuits, a dynamometer connected to be driven by said engine, a supply line and a contactor arranged when energized to connect the armature of said dynamometer with said supply line, a second contactor for controlling the energization of said first contactor and said battery and ignition circuits, a tachometer generator driven by said engine and arranged to generate a voltage proportional to the speed thereof, and control relay adjustable to respond to a predetermined voltage to control said second contactor to open said battery circuit and ground said magneto circuit, and to deenergize said first contactor at a predetermined speed of said engine.

In witness whereof, I have hereunto set my hand this 12th day of April, 1929.

GEORGE E. PLATZER.

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