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SYSTEM FOR REMOTE SELECTION OF VOLTAGE LEVEL

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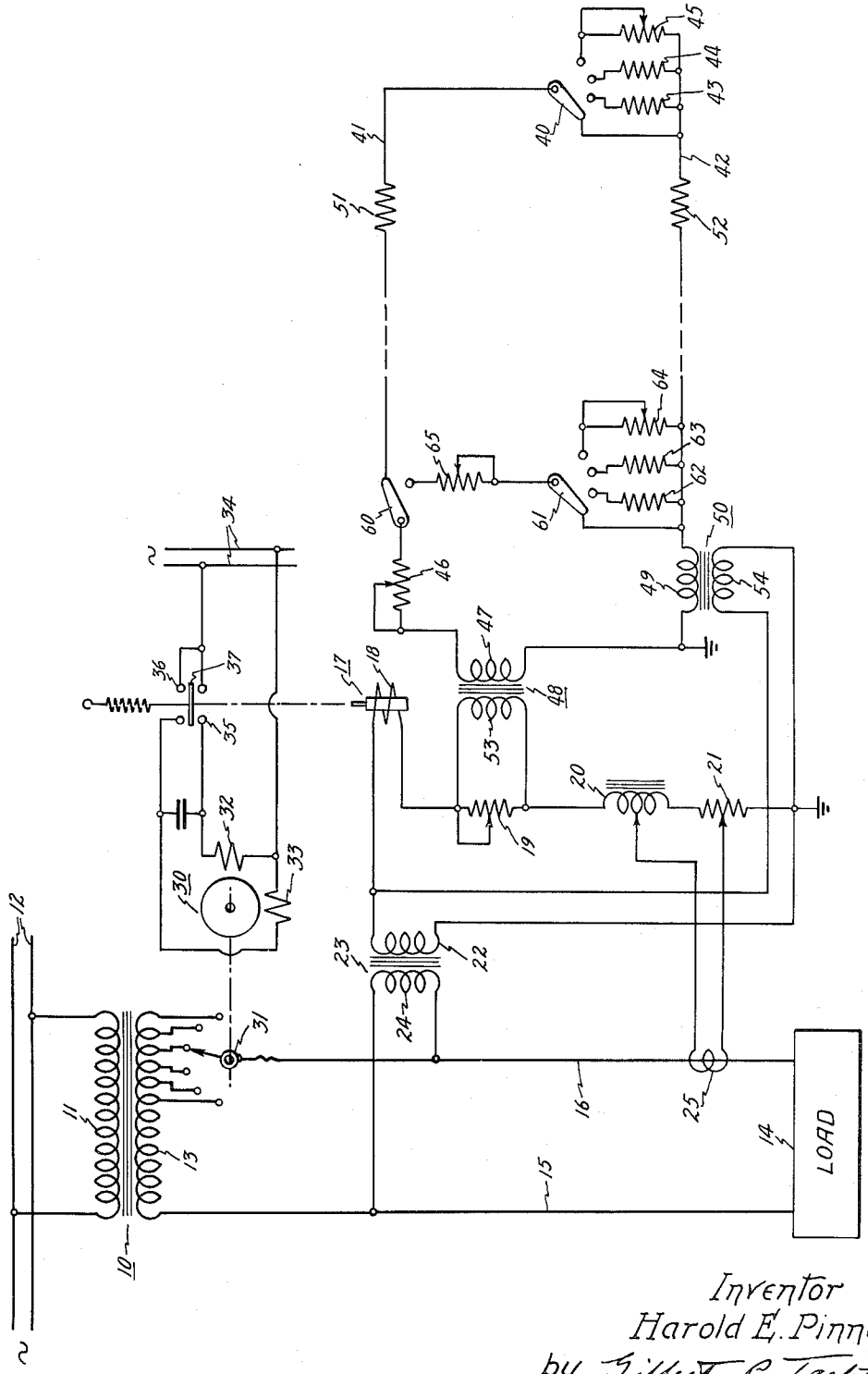

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SYSTEM FOR REMOTE SELECTION OF VOLTAGE LEVEL

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This invention relates to electrical transformer systems, and more in particular to an improved system for remote control of the voltage level of a variable transformer, such as a load tap changing transformer.

In a conventional load tap changing transformer system, a voltage regulating relay is commonly employed to energize the tap changing motor drive. The coil of the voltage regulating relay is generally connected in series with the secondary winding of a potential transformer, and the primary winding of the potential transformer is connected in parallel with the secondary winding of the load tap changing transformer. The contact arm of the voltage regulating relay is spring loaded so that a decrease in voltage of the secondary winding of the load tap changing transformer results in contacting of one set of contacts of the voltage regulating relay to energize the motor drive to make tap changes raising the load tap changing transformer secondary winding voltage, and an increase in voltage of the secondary winding of the load tap changing transformer results in contacting of another set of contacts of the voltage regulating relay thereby energizing the motor drive to make tap changes lowering the load tap changing transformer secondary winding voltage.

It is frequently desirable to provide means for varying the voltage level at which the voltage regulating relay contacts close, and the common adjustment to accomplish this function is in the form of a screw which adjusts the tension of the spring on the contact arm of the voltage regulating relay. In order to adjust the voltage level in this manner, however, it is necessary for an operator to be physically present at the location of the load tap changing transformer. In some instances it is more desirable to be able to control the voltage level of the voltage regulating relay from a remote position, and in order to achieve this result, in the past such adjustment has been provided by a remotely located rheostat wired in series with the coil of the voltage regulating relay. When a remote rheostat is connected in such a manner, however, any accidental open circuit of the wires connecting the rheostat to the coil of the voltage regulating relay will result in complete loss of control of tap changes of the load tap changing transformer, and the motor drive will continuously operate the tap changing mechanism until a limit switch has been contacted.

Another disadvantage occasioned by the use of a remotely located rheostat connected in series with the coil of the voltage regulating relay is that a temperature error may result if the resistance of the rheostat is too great. In such a system, however, the resistance of the rheostat must be sufficiently great with respect to the resistance of the wires connecting the rheostat through the voltage regulating relay coil so that a sufficient amount of adjustment is obtainable. If the distance between the load tap changing transformer and the remote rheostat is very great it is readily seen that such a series connection between the coil of the voltage regulator relay and the rheostat will be impractical due to the errors that may result.

It is therefore an object of this invention to provide an improved system for the remote control of voltage level of a variable transformer system.

It is also an object of means in load tap changing transformer system for minimizing the errors that may result from remote adjustment of voltage level.

A further object of this invention is to provide improved means for remote adjustment of the voltage level of a load tap changing transformer system wherein an open circuit between the load tap changing transformer and the remote control does not result in complete loss of control of the voltage level, and also wherein the voltage level is substantially independent of temperature variations.

Briefly stated, in accordance with one aspect of my invention, I employ a resistance, which may be variable, in series with the coil of the voltage regulating relay of a conventional load tap changing transformer system. This resistor is preferably located in the same location as the voltage regulating relay. The secondary winding of a current transformer is connected in parallel with the resistor, and the primary winding of the current transformer is connected in series with a substantially constant source of potential and remotely located variable resistance means for controlling the current flowing through the primary windings of the current transformer. The current transformer and the substantially constant source of potential are preferably located in the same location as the load tap changing transformer. The potential source may be an auxiliary potential transformer connected across the secondary winding of the load tap changing transformer. The circuit components are so selected that the resistor in series with the coil of the voltage regulating relay is very small with respect to the resistance that would be required for a rheostat connected in the same position to provide the same voltage level adjustment. It is important that the resistance of the resistor in series with the coil of the voltage regulating relay be very small since the greater resistance, used, the larger the temperature error will be.

My invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

The drawing is a circuit diagram of a load tap changing transformer embodying the remote voltage level control of my invention.

Referring now to the drawing therein is illustrated a load tap changing transformer **10** having its primary winding **11** connected to alternating current supply lines **12** and its tapped secondary winding **13** connected to a load **14** by way of lines **15** and **16**. A voltage regulating relay **17** is provided having its coil **18** connected in series with a variable resistor **19**, load drop compensating reactor **20** and resistor **21** and the secondary windings **22** of a potential transformer **23**. The primary winding **24** of potential transformer **23** is connected parallel with the secondary winding **13** of the load tap changing transformer **10**. A current transformer **25** inductively coupled to the line **16** has one end of its secondary winding connected to the tap on the load drop compensating reactor **20** and the other end of its secondary winding connected to a tap on resistor **21**.

A reversible motor **30** has its shaft mechanically coupled by conventional means to the tap changing arm **31** of load tap changing transformer **10**. The motor has a pair of windings **32** and **33** and a lead common to the two windings is connected to a source of poten-

tial 34. The other ends of the two windings 32 and 33 of motor 30 are connected by way of contacts 35 and 36 respectively to the other terminal of source of potential 34. These contacts are the "raise" and "lower" contacts of voltage regulating relay 17, and are bridged in the conventional manner by means of the arm 37 of voltage regulating relay 17.

A remote selector switch 40 connects line 41 to line 42 or to one end of resistor 43, resistor 44, or rheostat 45, the other ends of resistors 43 and 44 and rheostat 45 being connected to line 42. The remote selector switch 40 serves to select the desired resistance appearing in series with calibrating resistor 46 the primary winding 47 of a current transformer 48 and the primary winding 49 of auxiliary potential transformer 50. The resistors 51 and 52 in lines 41 and 42 respectively represent the resistance of these lines. The secondary winding 53 of current transformer 48 is connected in parallel with variable resistor 19. The primary winding 54 of the auxiliary potential transformer may be connected in parallel with the secondary winding 22 of potential transformer 23, or it may be connected in parallel with the tapped secondary winding 13 of load tap changing transformer 10.

A "remote-local" switch 60, shown in the drawing in the remote position, may be provided in order to obtain control of the voltage level at the location of the load tap changing transformer. This switch is in series with the line 41 in the remote position, and in the local position connects line 41 to the arm of a local selector switch 61. The local selector switch 61 connects line 41 to 42 directly or by way of resistor 62, resistor 63, or rheostat 64. A variable resistor 65 is connected in series with the arm of the local selector switch 61 in order to compensate for the effect of the line resistances 51 and 52 so that the resistor 62, 63 and rheostat 64 may be selected to have values equal to the resistance of resistor 43, resistor 44 and rheostat 45 respectively.

In operation with the switch 60 in the remote position, the magnitude of current flowing through the primary winding 47 of current transformer 48 is determined by the position of the remote selector switch 40, or in other words the voltage delivered by the secondary winding 49 of auxiliary potential transformer 50 causes a current to flow through the primary winding 47 of current transformer 48 that is dependent upon the impedance of the loop. The current induced in the secondary winding 53 of current transformer 48 flows through the resistor 19, which is in series with the coil of the voltage regulating relay. Since changing of the voltage drop across the resistor 19 changes the voltage level held by the voltage regulating relay 17, the voltage level may be changed by changing the current in the primary winding 47 of current transformer 48. When the line 41 is connected directly to the line 42 the maximum current will flow through the primary winding 47 of current transformer 48 and therefore the maximum voltage drop appears across the resistor 19. Since an increase in the voltage drop across resistor 19 of the same phase as the voltage drop thereacross produced by current of the potential transformer 23 has the same effect on the coil of the voltage regulating relay as an increase in the secondary winding voltage of load tap changing transformer, the voltage regulating relay actuates the tap changing mechanism to lower the output voltage of the tap changing transformer. A position may be provided on the remote selector switch 40 to open the circuit between lines 41 and 42 and this will result in the highest obtainable voltage level of the secondary winding of the load tap changing transformer. Intermediate voltage levels may be provided by means of the fixed resistors 43 or 44, or the voltage level may be continuously variable by means of rheostat 45.

If the terminals of one winding of the current transformer 48 are reversed, the voltage drop across the

resistor 19 due to the current of the winding 53 of the current transformer will buck the voltage of the potential transformer secondary winding. In this event an open circuit of the lines 41 and 42 will result in the lowest obtainable voltage level and a direct connection between the lines 41 and 42 will result in the highest obtainable voltage level.

By means of the above-disclosed circuit the resistance in series with the coil of the voltage regulating relay may be reduced to a minimum value by correspondingly increasing the current output of the current transformer 48. This results in minimizing the effect of temperature error in the resistor 19. It is obvious that the minimum value of the resistor 19 is not determined by the value of the resistances 51 and 52 of the lines connecting the load tap changing transformer to the remote control circuit. If one of the lines 41 or 42 is open-circuited, the load tap changing transformer will seek a voltage level determined by the resistance of the resistor 19, and will thus not continuously run until it reaches a limit.

Similar control over the voltage level of the load tap changing transformer may be provided at the location of the load tap changing transformer, when the switch 60 is in the local position, by means of the local selector switch 61.

It will be understood, of course, that while the form of the invention herein shown and described constitutes a preferred embodiment of my invention, it is not intended herein to illustrate all of the possible equivalent forms or ramifications thereof. It will also be understood that the words used are words of description rather than of limitation, and that various changes may be made without departing from the spirit or scope of the invention herein disclosed, and it is aimed in the appended claims to cover all such changes as fall within the true spirit and scope of the invention.

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

1. Means for remotely controlling the voltage level of a variable electrical transformer system of the type employing a voltage regulating relay responsive to the winding voltage of the variable transformer to actuate a motor drive for controlling the voltage of the variable transformer comprising a voltage regulating relay having a coil coupled to a winding of said variable transformer, a first resistor in series with said coil, and circuit means including a substantially constant source of potential and variable resistor means connected in parallel with said first resistor for controlling the current flowing through said first resistor.

2. Means for remotely controlling the voltage level of a variable electrical transformer system of the type employing a voltage regulating relay responsive to the winding voltage of a variable transformer to actuate a motor drive means for controlling the voltage of the variable transformer comprising a voltage regulating relay having a coil inductively coupled to the secondary winding of said variable transformer, a first resistor connected in series with said coil, and circuit means including a substantially constant source of potential and variable resistance means positioned at a distance from said variable transformer connected in parallel with said first resistor for providing a controlled flow of current through said first resistor.

3. Means for remotely controlling the voltage level of a variable electrical transformer system of the type employing a voltage regulating relay responsive to the winding voltage of a variable transformer to actuate a motor drive means for controlling the voltage of the variable transformer comprising a voltage regulating relay having a coil inductively coupled to the secondary winding of said variable transformer, a first resistor connected in series with said relay coil, a current transformer having a secondary winding connected in parallel with said first

resistor, and a substantially constant source of alternating potential and a variable resistance means connected in series with the primary winding of said current transformer to provide a controlled flow of current through said primary winding, said variable resistor means being positioned at a distance from said variable transformer.

4. Means for remotely controlling the voltage level of a variable electrical transformer system of the type employing a voltage regulating relay responsive to the winding voltage of a variable transformer to actuate a motor drive means for controlling the voltage of the variable transformer comprising a voltage regulating relay having a coil inductively coupled to the secondary winding of said variable transformer, a first variable resistor connected in series with said relay coil, and a current transformer having a secondary winding connected in parallel with said first variable resistor, a substantially constant source of alternating potential and a second variable resistor means connected in series with the primary winding of said current transformer to provide a controlled flow of current through said primary current transformer winding, said second variable resistor means being positioned at a distance from said variable transformer, said voltage regulating relay having contacts to selectively operate said motor drive means to raise or lower the secondary winding voltage of said variable transformer.

5. Means for remotely controlling the voltage level of a tap changing transformer system of the type employing a voltage regulating relay responsive to the load voltage of a tap changing transformer to actuate a motor drive means for maintaining the load voltage of said tap changing transformer at a constant value comprising a voltage regulating relay having a coil inductively coupled to the secondary winding of said tap changing transformer, a first variable resistor connected in series with said relay coil, a current transformer having a secondary winding connected in parallel with said first variable resistor and a primary winding connected in series with the secondary winding of a potential transformer and second variable resistor means, the primary winding of said potential transformer being connected to the secondary winding of said tap changing transformer, said second variable resistor means being positioned at a distance from said tap changing transformer to provide remote control of the current flowing through the primary winding of said current transformer, and contacts on said voltage regulating relay to selectively operate said motor drive means to raise or lower the secondary winding voltage of said variable transformer.

No references cited.