

## Description

Circuit arrangement for limiting the switch-on current for a transformer

5           The invention relates to a circuit arrangement for limiting the switch-on current for a transformer.

          For a brief moment after switching on, a transformer loads a power source only with the ohmic portion of the wire resistance of its primary winding.  
10   The lower the impedance of the primary winding, the greater the switch-on current peak, and the greater the iron core to be magnetized the longer this power peak is, that is to say the greater its amount of energy. As a result, the network voltage may collapse or fuses may  
15   be triggered. For this reason, it is necessary to limit the switch-on current.

          Methods are known in which ohmic resistors are arranged between the input of the primary winding of the transformer and the power source so that the  
20   switch-on current is reduced. After the switching on, these resistors have the undesired effect that an additional voltage drop occurs across them. In addition, the resistors heat up during operation and can be destroyed by the generation of heat.

25           It is also known to bypass the resistors after a permanently predefined time, after which sufficient premagnetization of the transformer is assumed. The bypassing is carried out for example by means of a timed relay. However, as a result of the permanent  
30   predefinition of the time, functional checking of the transformer does not occur so that in the event of a short circuit in the transformer a system collapse may also occur after the permanently predefined time.

          The object of the invention is

to specify a simple circuit arrangement for limiting the switch-on current for transformers which does not make available the full operating voltage until after a functional checking of the transformer.

5           The object is achieved with a circuit arrangement as claimed in patent claim 1.

          Here, firstly, by means of a test winding on the secondary side of the transformer it is checked whether the transformer is switched on. In the event of  
10   successful switching on, a contactor switches between the operating voltage source and the transformer and as a result the resistors are bypassed. In addition, PTC thermistors are provided which ensure that the resistors are not overloaded when the contactor circuit  
15   fails.

          In a secondary winding composed of multiphase windings, a rectifier is advantageously connected downstream of the test winding.

          In one advantageous refinement of the circuit  
20   arrangement as claimed in patent claim 3, the triggering voltage for the contactor can also be derived from a single-phase winding. The rectifier is then omitted when the circuit is driven with alternating voltage.

25           An optimum drive voltage for the contactor is set by means of an auxiliary contact as claimed in claim 4 which initially bypasses the further resistor during switching on and which is interrupted after the contactor is switched on.

30           Exemplary embodiments of the invention are illustrated in the figures of the drawing, in which Figure 1 shows a circuit arrangement for limiting the switch-on current for a transformer, and Figures 2a to c show various exemplary embodiments for  
35   determining a triggering voltage for the contactor from a test winding of the secondary side of the transformer.

Figure 1 illustrates how a transformer 1 is connected with a primary winding 2 and a secondary side 3 to an operating voltage 4. Here, a contactor 5 whose switches 6 are open before switching on occurs are connected between the operating voltage 4 and the primary winding 2. The switches 6 do not close until a supply voltage is applied to the supply input 7 of the contactor 5 and the supply output 8 of the contactor 5, with the result that the operating voltage 4 is applied to the primary winding 2. If the switches 6 are open, after the operating voltage 4 is switched on the current flows via the resistors 10, connected in parallel to the contactor 5, and the PTC thermistors 11 which are connected in series with the latter. The PTC thermistor used here is a resistor which has a positive temperature coefficient (PTC). The resistance increases here as the temperature of the PTC thermistor 11 rises. The ohmic resistors limit the switch-on current which must be selected to be of at least such a magnitude that an induced voltage can build up on the secondary side at a test winding 14 of the transformer 1. The test winding 14 here may be a selected secondary winding. The induced voltage is applied to the supply input 7 of the contactor 5 via a further resistor 12. If this voltage exceeds the switching threshold of the contactor 5, the conductor tracks of the switching contacts 6 bypass the resistors 10 and the PTC thermistors 11. The current limiting becomes ineffective as a result of this and the transformer 1 can be loaded. At the same time as the bypassing of the current limiting means, an auxiliary contact 13 interrupts the bypass via the further resistor 12 and thus sets the optimum drive voltage for the duration of operation of the contactor 5.

If the contactor 5 does not switch owing to a functional fault (line break etc.), the PTC thermistor 11 which is connected in series with the resistors 10 heats up. Said PTC thermistor 11 goes into a high-impedance state and throttles the current down to

a small residual current, precisely to such an extent that the PTC thermistor 11 remains hot and therefore at a high impedance. The resistors 10 are thus

protected against overloading. This residual current is, however, not sufficient to magnetize the transformer 1. In this fault situation, intended loads cannot be put into operation.

5           As is illustrated in Figure 2c, the triggering voltage for the contactor 5 can also be derived from a single-phase winding 18. When driving is performed with an alternating voltage, the rectifier 15 is then eliminated.

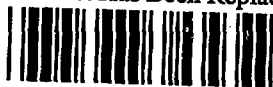
10           The circuit arrangement according to the invention thus ensures that the switch-on current for a transformer is reduced and resistors 10 which are provided for it are not overloaded.



## Patent Claims

1. A circuit arrangement for limiting the  
5 switch-on current for a transformer (1)  
having a contactor (5) to whose inputs the operating  
voltage (4) for the transformer (1) is applied and  
whose outputs are connected to the primary windings (2)  
of the transformer (1),  
10 having ohmic resistors (10), connected in series, and  
PTC thermistors (11) which are connected parallel to  
the contactor (5),  
having a test winding (14) on the secondary side (3) of  
the transformer (1) with at least two terminals (16,  
15 17), with a further resistor (12), the further resistor  
(12) being connected between a first terminal (16) of  
the test winding (14) and the supply input (7) of the  
contactor (5),  
the supply output (8) being connected to a second  
20 terminal (17) of the test winding (4).
2. The circuit arrangement as claimed in claim 1,  
characterized in that a rectifier (15) is connected  
between the outputs (16, 17) of the test winding (14)  
and the further resistor (12).
- 25 3. The circuit arrangement as claimed in claim 1,  
characterized in that the test winding (14) is embodied  
as a single-phase winding.
4. The circuit arrangement as claimed in one of  
claims 1 to 3, characterized by  
30 an auxiliary contact (13) in the contactor (5) which is  
connected parallel to the further resistor (12) and is  
connected to the switches (6) of the contactor (5) in  
such a way that the auxiliary contact

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(13) is closed when the switch is in the open position,  
and vice versa.

