United States Patent

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[33] **Germany**
[31] L55 597

[54] **THYRISTOR-TRIGGERING ARRANGEMENT USING DUAL PULSE TRANSFORMERS HAVING DISSIMILAR CHARACTERISTICS**
8 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** ..... **321/27 R,** 307/252 L, 321/11
[51] **Int. Cl.** **H02m 7/00,** H03k 17/00
[50] **Field of Search** 321/8, 11, 27; 307/252, 53, 252, 54, 305

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ABSTRACT: To promote simultaneous firing of series-connected thyristors, each is controlled by two pulse transformers in series. The first transformer efficiently transmits the initial part of a control pulse having a very steep wave front, and the second transformer efficiently transmits the relatively long body of the pulse.

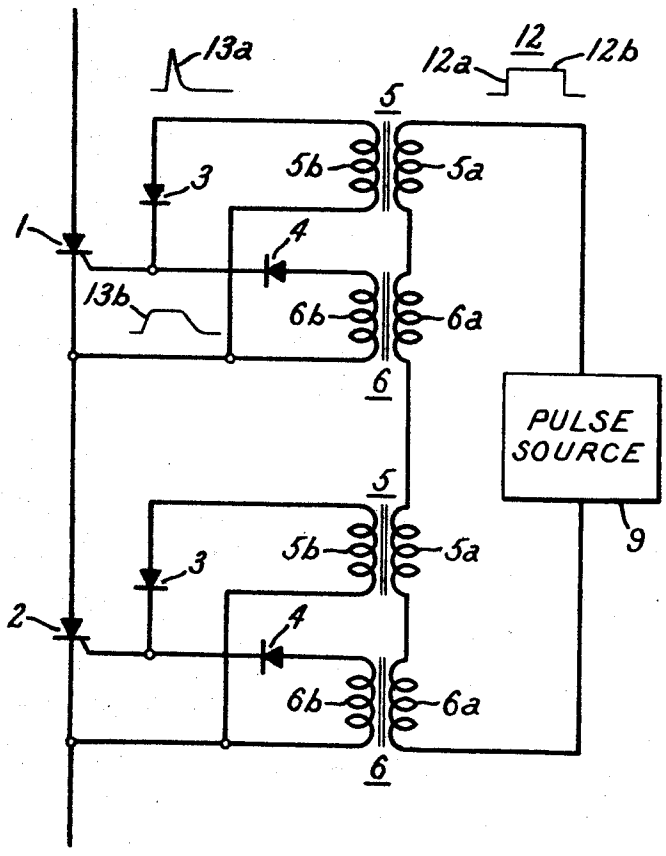

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Fig. 1.

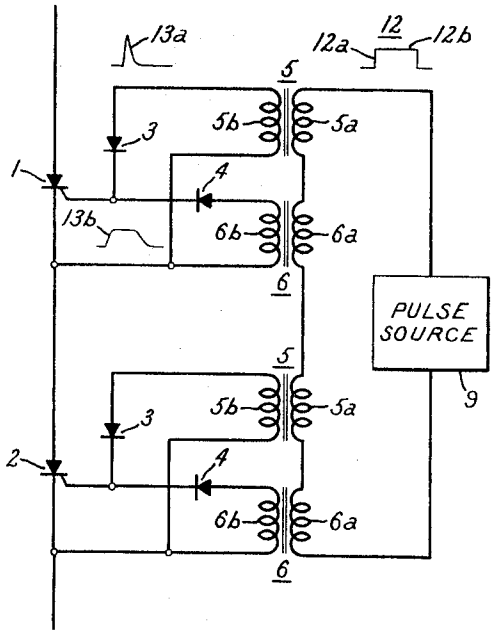


Fig. 2.

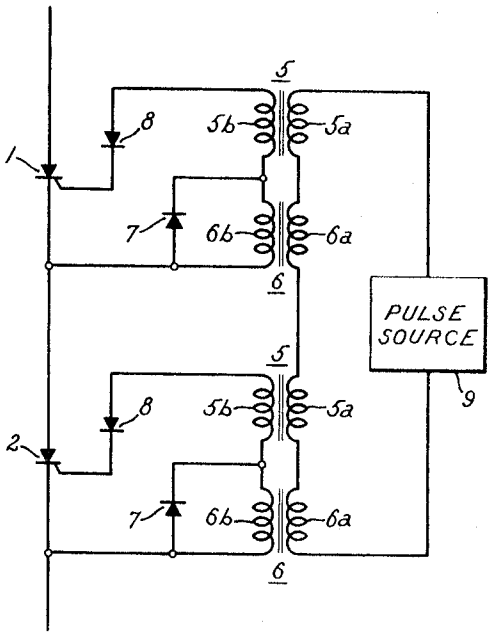
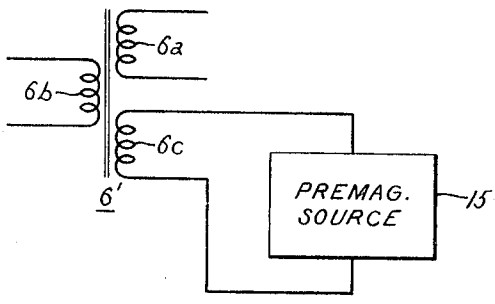


Fig. 3.



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THYRISTOR-TRIGGERING ARRANGEMENT USING DUAL PULSE TRANSFORMERS HAVING DISSIMILAR CHARACTERISTICS

This application is a continuation of my patent application Ser. No. 699,620, filed Jan. 22, 1968; and now abandoned.

In circuit arrangements with several, series-connected, controllable converter valves it is common to associate with each individual converter valve a magnetic pulse transformer, in order to feed to the converter valves the ignition pulses required for ignition. In order to ignite the converter valves simultaneously, the ignition pulses should begin abruptly and have long durations. In view of the required rise time of the pulses the pulse transformers needed for the transmission of such ignition pulses must be designed with relatively few secondary turns. In order to transmit the pulse length required, they must, however, be of particularly large core cross section. Because of the pulse length required, only ring tape core material with high usable induction can be considered for practical purposes, although for the transmission of the steeply rising leading edge of the pulse a low-loss material, such as ferrite, would be substantially more favorable, which however, has only low usable induction. It is seen that the expenditure of material for such a pulse transformer is considerable and that compromises must be made in the design of the transformer because of the different requirements for the transmission of the pulse front and the pulse back.

It is the object of the present invention to create an arrangement for the transmission of a pulse of steep front and long duration that no longer exhibits these disadvantages. Accordingly, the invention is concerned with an arrangement of a control pulse, especially a pulse of long duration with a nearly vertical wave front, for converters with very many, series-connected, controllable converter valves. It is characterized by associating with each controllable converter valve a first and a second pulse transformer.

The first pulse transformer serves for the transmission of the initial pulse peak. In a further development of the invention, the core of the first pulse transformer is therefore made of a material with a loss as low as possible, for instance, ferrite.

The second pulse transformer serves for the transmission of the back of the pulse. In a further development of the invention, the core of this transformer is therefore made of a material with high saturation induction.

In the further development of the invention, the first pulse transformer has only a low number, and the second pulse transformer a relatively high number of secondary turns. Through the choice of few secondary turns, the first pulse transformer can be designed with very low leakage, so that it is also possible to transmit impulses of very fast rise time. Through the choice of a large number of secondary turns, the core cross section of the second pulse transformer can be reduced.

Referring to a drawing, which shows several examples of execution, the invention will be explained in greater detail.

FIGS. 1 and 2 show example of execution in which the ignition pulses are supplied by a single pulse source.

FIG. 3 shows an alternative feature of the invention wherein the transformer cores are premagnetized.

In FIG. 1, two controllable converter valves 1 and 2 (thyristors) are connected in series, but in principle there can be as many as desired. A pulse source 9 supplies the control (gate) pulses required for the ignition of these converter valves. The control pulses, which are here designed as pulses of long continuous duration with steeply rising leading edges, are fed to the controlled valves 1 and 2 in each case via first and second pulse transformers 5 and 6 which are illustrated symbolically in the drawings. The primary windings 6*a* and 5*a* of all pulse transformers are serially interconnected and are connected with the pulse source 9, whereby these transformers will operate contemporaneously. Preferably single turn primaries are used. The secondary windings 5*b* and 6*b* of the pulse transformers, which are associated in each case with one converter valve 1 or 2, respectively, are connected in parallel and are isolated from each other by diodes 3 and 4. In this arrangement, there is only a single pulse source, so that the pulse 12 generated by the source 9 must flow through the primary winding of the first pulse transformer as well as through the primary winding of the second one. The high and fast-rising front 12*a* of the control pulse is efficiently transformed by the low-loss and low-leakage first pulse transformer 5 to a short duration, high magnitude gate pulse 13*a* which is fed to each controlled rectifier valve 1 and 2, respectively, and the pulse back 12*b* is transformed by the second pulse transformer 6 into a longer lasting but less steeply rising pulse 13*b* which is fed to the same valves.

FIG. 2 shows an arrangement constructed similarly as FIG. 1. In contrast to it, the secondary windings 5*b* and 6*b* of the pulse transformers associated in each case with a controlled converter valve 1 or 2, respectively, are connected not in parallel but in series. In parallel to the secondary winding 6*b* of the second pulse transformer is connected a diode 7 which has such polarity that the high, fast rising impulse supplied by the secondary winding 5*b* of the first pulse transformer need not flow through the secondary winding 6*b*, which consists of many turns, of the second pulse transformer. The arrangements according to FIGS. 1 and 2 are equivalent as to expenditure and operation.

In accordance with common practice in the art, the operation of the source 9 would, of course, be synchronized with the alternating voltage power system to which the valves 1 and 2 are coupled.

Through the arrangement according to the invention the possibility is provided to optimize to a large extent the pulse transformers for their task: the pulse transformer provided for the transmission of the steep pulse front is constructed of low-loss material and preferably with few secondary turns; the pulse transformer provided for the transmission of the pulse back, on the other hand, is constructed of core material of high saturation induction and preferably with many secondary turns, in order to achieve a large voltage-time area. In order to increase the usable induction of the transformer cores, premagnetization on the primary side can be used in all circuit variants given. By way of example, FIG. 3 shows a premagnetizing source 15 connected to a third winding 6*c* and thereby inductively coupled to the primary winding 6*a* of one of the pulse transformers 6'. Alternatively, the primary windings of the pulse transformerscouldbeconductively paralleledbypremagnetizingmeans comprising the series combination of a DC source, a resistor, and a choke. To the extent that transformer material with rectangular hysteresis loop is used, premagnetization is even mandatory.

An arrangement according to the invention makes possible a reduction of the expenditure of material in the construction of the transformer of the pulse stage while simultaneously fulfilling the required conditions optimally.

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

1. Improved control means for substantially simultaneously firing a plurality of series-connected controllable converter valves, the control means including a common source of periodic control pulses of long duration with steeply rising leading edges, wherein the improvement comprises for each valve 1, 2 the combination of:

a. first pulse transforming means 5 having a primary winding 5*a* conductively connected to said common source 9 and a secondary winding 5*b* connected to the associated valve for transmitting an initial part of each control pulse to that valve, and

b. second transforming means 6 having a primary winding 6*a* connected in series with said common source and with the primary winding 5*a* of said first transforming means so that each of said control pulses must flow through both of said primary windings, said second transforming means

having a secondary winding *6b* connected to the associated valve and being contemporaneously operative with said first transforming means for transmitting the remainder of each control pulse to the same valve, and said first and second transforming means having appreciably dissimilar characteristics.

2. The arrangement according to claim **1** in which the first pulse transformer **5** has a low-loss core, and the second transformer **6** has a core consisting of material with high saturation induction compared to said low-loss core.

3. The arrangement according to claim **1** in which the secondary windings of the first and second transformers **5, 6** are connected in series to the control electrode of the associated valve, and the secondary winding *6b* of the second transformer **6** is shunted by a diode **7**.

4. The arrangement according to claim **1** in which both transforming means have magnetizable cores and means is provided for premagnetizing the transformer cores.

5. The arrangement according to claim **1** in which the secondary winding of said first transforming means **5** has a

relatively low number of turns, and the second transforming means **6** has a higher number of secondary turns, and in which the primary windings of both of the first and second transforming means associated with a first one of said series-connected valves are connected in series with the primary windings of both of the first and second transforming means associated with another one of said valves.

6. The arrangement according to claim **5** in which the first pulse transformer **5** has a low-loss core, and the second transformer **6** has a core consisting of material with high saturation induction compared to said low-loss core.

7. The arrangement according to claim **5** in which each of said primary windings *5a, 6a*) has a single turn.

8. The arrangement according to claim **5** in which the secondary windings of the first and second transformers **5, 6** are connected in parallel to the control electrode of the associated valve and are isolated from one another by diodes **3, 4**.