

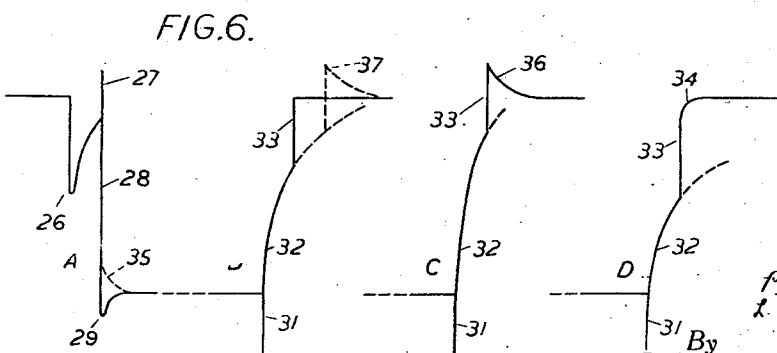
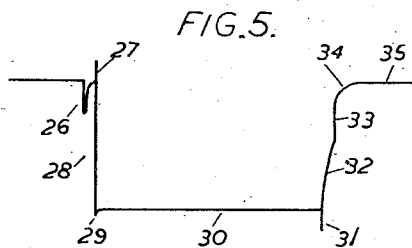
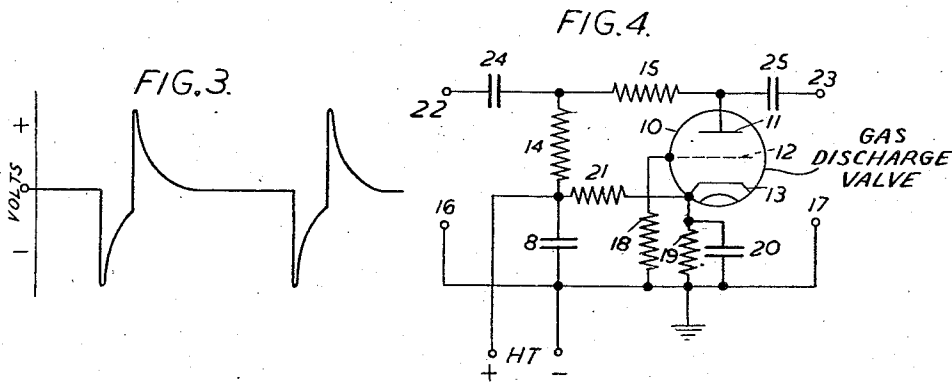
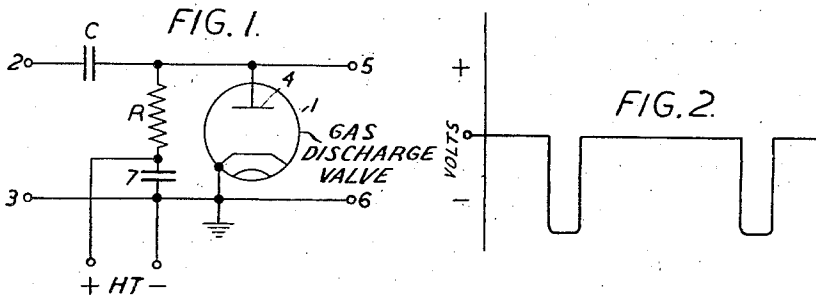
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CIRCUIT ARRANGEMENT FOR PRODUCING ELECTRICAL PULSES

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CIRCUIT ARRANGEMENT FOR PRODUCING ELECTRICAL PULSES

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1

The present invention relates to electrical pulse transmission systems, and particularly to double pulse systems in which the original pulses have to be re-constituted in the receiver of the system. It is of special application to time modulated pulse systems.

In these systems, in order to effect an economy in power, the time modulated pulses are frequently not themselves transmitted, but each is represented by two short marking pulses transmitted respectively at the beginning and end thereof. The original time modulated pulse generally has to be re-constituted from the two marking pulses, in the receiver. Various methods of performing this operation have been suggested, generally requiring two or more valves, and are usually of a periodic or additive nature. By the method of the present invention a simpler arrangement becomes possible using only one valve, preferably of the gas-discharge type, or a device having similar characteristics; the arrangement is aperiodic in nature, and thus is independent of the pulse repetition frequency. The invention is however also applicable to some of the known arrangements employing, for example, circuits of the multivibrator type and the like.

Although a time modulated pulse system has been assumed for the purpose of explaining the invention, it is equally applicable in all cases where the transmitted pulses are defined by pairs of marking pulses. For example the synchronizing pulses in a television system might be transmitted this way, and could be reformed by the methods of the invention.

According to the invention, there is provided a receiving arrangement for re-constituting a pulse from two marking pulses in an electrical double pulse transmission system, comprising a device or circuit having two electrically stable conditions, means for deriving two differential pulses of opposite sign from each marking pulse, and means for applying the differential pulses to switch the device or circuit from one stable condition to the other.

The invention will be more clearly understood from the following detailed description and by reference to the accompanying drawings in which:

Figs. 1 and 4 show schematic circuit diagrams of two arrangements according to the invention; and

Figs. 2, 3, 5 and 6 show wave forms of pulses used for explaining the operation of the circuits of the invention.

It is well known that in gas-discharge devices

2

there is a critical plate voltage at which the gas becomes ionized, and a discharge occurs. Before ionization takes place, the plate impedance is generally high, but afterwards it is much lower as indicated by the relatively large discharge current which flows through the device. Moreover, after the discharge has once started the plate voltage must be reduced to another lower critical value at which ionization ceases before the discharge can be extinguished. In gas-discharge diodes of the neon type, for example, there is however, a rather small difference between the ionizing and extinguishing voltages, but this difference can be increased by providing the valve with a suitably placed and biased control electrode or grid.

If a sudden voltage change be applied to a condenser and resistance connected in series, and provided that the time constant of the circuit is relatively small, a so-called differentiation-effect occurs, whereby a voltage pulse is generated across the resistance whose instantaneous amplitude is determined by the rate of change of the applied voltage. Such a pulse may be termed for convenience a "differential pulse."

The invention makes use of such differential pulses preferably in combination with a gas discharge valve of the kind described, to reconstitute the pulses in a time modulation system, for example, from the pairs of marking pulses which define them. The valve is also preferably provided a control grid for increasing the difference between the critical voltages as explained above.

Fig. 1 shows in simplified form the basic circuit arrangement according to the invention. A gas-discharge valve 1 has its plate 4 connected through a resistance R to the positive terminal of the high tension supply, through a condenser C to one input terminal 2, and directly to an output terminal 5. The cathode, and the other input and output terminals 3 and 6 are connected to the negative terminal of the supply and preferably also to earth. A large by-pass condenser 7 is connected across the supply for the purpose of connecting the resistance R effectively to earth for transient currents, so that R may be regarded as connected in parallel with the valve 1.

The voltage applied to the plate 4 of the valve 1 should be just below the critical ionizing voltage, so that the plate circuit impedance will be large compared with the resistance R. As regards transient voltages applied to the input terminals 2 and 3, the circuit connected to the input terminals can accordingly be regarded as

substantially equivalent to a condenser *C* in series with a resistance *R*.

Fig. 2 shows diagrammatically the forms of two short unidirectional negative voltage pulses which may, for example, be the two marking pulses which define one of the time modulated pulses. Fig. 3 shows the corresponding variation of the voltage across the resistance *R*. It will be seen to consist of two pairs of similar differential pulses of opposite sign, the first of each pair being produced by the leading edge of the corresponding Fig. 2 pulse, and the second by the trailing edge. The actual form of these differential pulses is modified by the time constant *CR* of the circuit. The effect of this time constant is seen chiefly in the curved trailing edges of the differential pulses which represent the charge and discharge curves of the condenser *C*.

The voltage variation of the differential pulses shown in Fig. 3 will be added to the steady voltage applied to the plate of the valve 1 from the high tension supply, and accordingly the first effect of the first marking pulse will be a reduction in the total plate voltage, produced by the first differential pulse. When the second differential pulse arrives, the plate voltage will be increased, and the conditions can be so chosen that this increase is sufficient to initiate a discharge in the valve 1. A relatively large current flows, and the impedance of the valve falls to a much lower value, and at the same time the plate voltage also falls, and will remain at a lower value until the second marking pulse arrives.

The change in impedance of the valve will reduce the effective value of the resistance connected in series with the condenser *C*. However, the new value of this resistance is arranged to be such that when the second marking pulse arrives, two more differential pulses will be formed. The first of these differential pulses will be used to extinguish the discharge and to restore the peak voltage to its original value. Its amplitude must therefore be sufficient to reduce momentarily the plate voltage below the lower critical voltage.

It is also to be noted that the second positive differential pulse must not raise the plate potential above the upper critical voltage, otherwise the valve will ionize again. Actually when the discharge is extinguished the voltage of the plate 4 does not immediately rise to the original value on account of the time constant of the circuit comprising the condenser *C*, and the combined resistance of *R* and of the circuit connected to the input terminals 2 and 3. This time constant must accordingly be sufficiently large so that when the second differential pulse arrives, the plate voltage has not reached a value high enough to enable the pulse to start another discharge.

The requirements which have been outlined can be easily satisfied by suitable choice of the resistance *R*, condenser *C* and the type and operating conditions of the valve.

It will thus be seen that the effect of the two marking pulses is to change the plate voltage of the valve 1 (and therefore also the voltage across the output terminals 5 and 6) from a high value to a low value for the interval between the pulses and to restore it afterwards to the original high value. In other words, a pulse similar to the original time modulated pulse is produced at the output terminals 5 and 6.

Details of a preferred form of the basic circuit are shown in Fig. 4. The gas-discharge valve 10 comprises a plate 11, a cathode 13 and a control

grid 12. The plate 11 is connected to the positive terminal of the high tension supply through two resistances 14 and 15, the junction of which is connected to the input terminal 22 through a condenser 24. The cathode 13 is biased positively from a potentiometer comprising resistances 19 and 21 connected across the high tension supply, the usual by-pass condenser 20 being provided.

The grid 12 is connected to earth through a resistance 18 and the output terminal 23 is connected to the plate 11 through a blocking condenser 25. A large condenser 8 is connected across the high tension supply for earthing the resistance 14 as regards transient currents. The input and output terminals 16 and 17 are each connected to ground.

In this circuit, the condenser 24 and resistance 14 correspond respectively to *C* and *R* in Fig. 1. Resistance 15 is provided for limiting the discharge current, and could be omitted if desired. It is however useful for assisting in fulfilling the necessary operating conditions outlined above. The by-pass condenser 20 is also not essential and may in some cases be omitted with advantage, but in general it has a stabilizing effect on the circuit.

The value of resistance 18 is not critical, but it should be large enough to limit the grid current, but not so large that it prevents the grid potential from returning to the initial value more quickly than the plate potential when the discharge is extinguished.

The circuit of Fig. 4 operates substantially in the same manner as described in connection with Fig. 1, and differs only in the provision of the control grid with its associated arrangements, and in the addition of the optional resistance 15.

Fig. 5 shows in detail the shape of the re-constituted time modulated pulse obtained at terminals 17 and 23. In this wave-form 26 is the first differential pulse which has no effect on the valve. 27 is the second differential pulse which ionizes the valve, so that the voltage of the plate 11 falls rapidly at 28 and reaches the lower level at 30 with possibly a small differential pulse as indicated at 29, which however must not be great enough to extinguish the discharge. When the second marking pulse arrives the first of the corresponding differential pulses extinguishes the discharge as indicated at 31, and the plate voltage rises rapidly. It does not however immediately return to its original value on account of the time constant of the circuit comprising the condenser 24 and the resistance 14 (including also the effect of the impedance of the circuit connected to the input terminals 16 and 22) as already mentioned. The voltage change follows the curve 32 until the second differential pulse reduces the voltage again suddenly at 33. The condenser then finally discharges as shown by the curve at 34 until the plate voltage reaches the final value at 35.

The details of the leading and trailing edges of the re-constituted pulse depend on the values of the circuit-elements and also on the duration of the marking pulses. These details are shown on a larger time scale in Fig. 6. At A in Fig. 6 is shown the leading edge with the various portions designated as in Fig. 5. If the resistance 15 in Fig. 4 should be too large, the lower corner may appear as the dotted line 35. At B, Fig. 6 is shown the preferable form of the trailing edge. The time constant of the condenser circuit should be such that when the second differential pulse arrives at 33, it brings the plate voltage just to

5

the final value so that the upper corner will be substantially square, as shown by the full line. If the time constant is too small (Fig. 6C), the voltage of the plate will have risen too high on the arrival of the differential pulse, which will carry the voltage beyond its final value, and may even initiate another discharge. If a new discharge does not occur, the voltage will return to the final value on the curve 36. A similar effect will be produced if the marking pulse is too long as shown by the dotted lines 37 in Fig. 6B. If the time constant of the circuit is too large, the plate voltage will not have risen high enough on the arrival of the second differential pulse, and the condenser will afterwards continue its discharge along the curve 34 (Fig. 6D).

It will be evident that the various details which have just been described will tend to have a distorting effect on the re-constituted pulse. Actually, of course, the duration of the marking pulses will always be chosen to be small compared with that of the original time modulated pulse, and so the actual distortion produced will be negligible. Accordingly although it is preferable to aim to produce a form such as is shown in Fig. 6B, small departures as shown in Figs. 6C or D will be permissible without much undesirable effect, so that the requirements are not very critical. Likewise, the resistance 15 (Fig. 4) is preferably chosen so that a substantially square corner is obtained at 35 in Fig. 6A, though a small amount of rounding will be of no consequence.

It will be appreciated that, according to the invention, each marking pulse is converted into the two differential pulses which are then used to switch a gas discharge valve between two stable electrical conditions.

It will be evident that the marking pulses may be amplified or otherwise treated in any suitable way before application to the arrangements described.

Various other modifications of the circuits according to the principles explained will occur to those skilled in the art.

What is claimed is:

1. A receiving arrangement for reconstituting a time modulated pulse from two pulses marking its leading and trailing edges respectively, com-

6

prising a differentiating circuit, means for applying said two marking pulses to said differentiating circuit, means for deriving from said differentiating circuit two differential pulses of opposite sign for each marking pulse, a gas discharge valve including a plate and a cathode, a steady high tension potential source connected between said plate and said cathode to make said plate positive, means for applying said differential pulses to the input of said valve to initiate a discharge in response to the first marking pulse and subsequently to extinguish such discharge in the valve in response to the second marking pulse the time intervals between successive initiation and extinguishment of the said discharge being fixed by the interval between corresponding successive pairs of differential pulses, and an output circuit for said valve.

2. An arrangement according to claim 1, wherein said differentiating circuit comprises a condenser connected in series with a resistance, means for applying said positive potential to said plate over said resistance and means for applying said marking pulses between said cathode and said plate in series with said condenser.

3. An arrangement according to claim 1 wherein said gas discharge valve is provided with a control grid connected through a leak resistance to the negative terminal of the high tension supply.

4. An arrangement according to claim 1 further comprising a limiting resistance connected between said differentiating circuit and said plate.

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