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M. GEIGER

2,178,340

WAVE FORM MODIFYING CIRCUIT

Filed March 29, 1937

Fig. 1

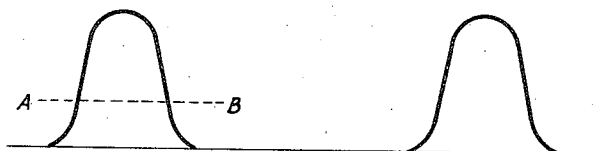


Fig. 2

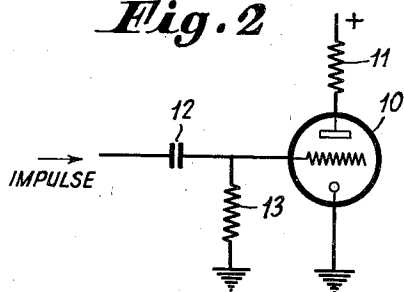


Fig. 3

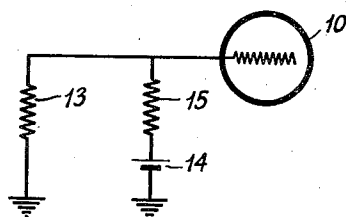


Fig. 4

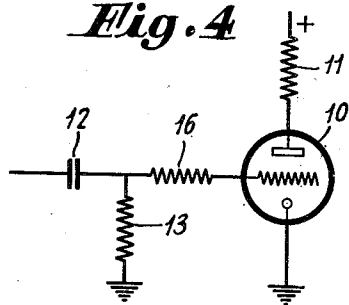


Fig. 5

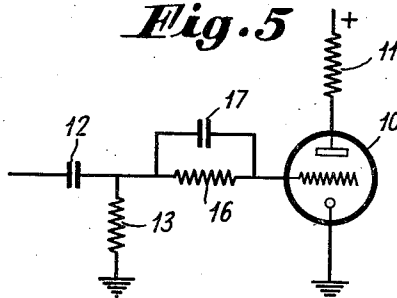


Fig. 6

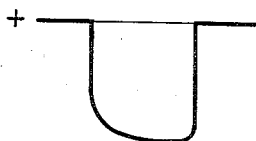
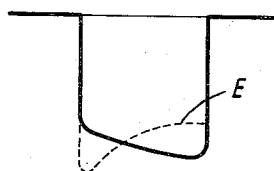


Fig. 7



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WAVE FORM MODIFYING CIRCUITS

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2 Claims. (Cl. 178—44)

My invention relates to electrical wave shape modifying circuits and more particularly to an arrangement whereby electrical impulses having undesired shapes may be modified into impulses having a steep wave front of a desired shape, and such an arrangement is especially adaptable for use in television work.

In television equipment, especially transmitters, the problem of generating electrical impulses having a steep wave front rises continuously, and such impulses for use with television equipment as at present known and used demand the production of impulses or waves having a shape as nearly rectangular as possible. This is especially important in so far as the generation and reception of synchronizing impulses is concerned.

In most instances, the impulses available are those which present a flank or side which is curved in form rather than rectangular both at the top and at the bottom of the curve. In prior practice it has been customary for the purposes of modifying these curved wave forms to use a circuit arrangement wherein several tubes are joined co-operatively, these tubes having a grid bias voltage source or sources which are so set that the steep flank portion of the curved impulses falls within the straight portion of the operating characteristic of the tube. However, the requisite circuit arrangement of such a nature becomes appreciably complicated because of the necessity of providing a plurality of tubes which cut-off a part of the impulse, that is to say, use only the steep flank portion of the impressed impulses and, again, such a circuit arrangement necessitates the use of a distinct grid biasing voltage source for each tube.

In my invention, a circuit arrangement is disclosed of a kind which when impulses having a rounded flank both at the top and bottom, for instance, are impressed onto a single tube, there will be formed in the output circuit of said tube a wave shape in which the bottom curved portion is eliminated without the necessity of providing a grid source of energy for the tube. This is so done by an arrangement in which a condenser through which the available impulses are impressed upon the control grid of the tube and a grid leak resistance for said control grid are so dimensioned that the steep flank portion of the impulse falls inside the straight part of the operating characteristic of the curve.

It has been suggested heretofore that a condenser and grid leak may be availed of of such dimensions that the tube will generate its own

grid bias. However, in such schemes the time constant of the condenser and grid leak was chosen very high in comparison with the frequency of the impressed impulses.

In my invention, however, there is in general provided a circuit arrangement of an unvaried time constant in which the grid leak resistance is of such value that during the time when current flows in the control grid, such a drop of potential results that the grid is so biased that the steep portion of the flank of the impressed wave falls within the straight part of the tube operating characteristic.

My invention will best be understood by reference to the drawing in which

Fig. 1 is an explanatory curve,

Fig. 2 is an embodiment of my invention,

Fig. 3 is an explanatory equivalent circuit,

Figs. 4 and 5 are embodiments of my invention, and

Figs. 6 and 7 are explanatory curves.

Referring to Fig. 1, there is shown two impulses of a general wave shape in which synchronizing impulses used in the television art usually arrive at the receiver or the type of impulses which are usually available for synchronizing purposes.

Referring to Fig. 2, there is shown an exemplified embodiment of my invention in which is a vacuum tube, 11 a resistance connected in the plate circuit thereof, 12 a condenser, 13 the grid leak. The assumption is made that the impressed impulses are derived from a source of low internal resistance and are impressed on the left-hand coat of the condenser.

The conditions surrounding such a circuit scheme, at the time grid current begins to flow, may be so conceived that between grid and filament of the tube a source of D. C. voltage is supposed to exist, the latter having an internal resistance equal to the resistance of the grid filament path, and that in the outer circuit of the said source of D. C. voltage the grid leak 13 is indicated. What thus results is the equivalent circuit scheme shown in Fig. 3 where 14 is the source of D. C. voltage, and 15 the inner resistance of the grid filament path. The voltage of the D. C. source 14 becomes divided between resistances 13 and 15 so that the junction of these resistances where the grid is connected assumes a potential which, for a fixed time constant of the resistance capacity mesh 12, 13, may be adjusted by the size of the resistance 13. The time constant of 12, 13, in this scheme, as already pointed out above, has been chosen as high as has here-

tofore been customary for the production of a negative grid voltage, in other words, so high that in the interval of time between two impulses the negative grid biasing voltage is practically preserved unvaried. However, if resistance 13 is chosen correspondingly low (and the condenser 12 correspondingly large to preserve the same time constant) it is possible to make conditions so that the lower end of the plate current grid voltage characteristic comes to fall roughly at a point marked A—B, in Fig. 1, with the result that the impulse arising in the plate current is started at a very steep angle, with an incidental elimination of the lower curvature of the available impulse. When in this shape, the impulse is already far more favorable for practical use than in the originally available shape.

Now, a form of impulse such as made available by a circuit scheme as shown in Fig. 2 may be still further improved for a number of actual purposes by inserting between condenser 12 and the control grid of the tube 10 a resistance.

An exemplified embodiment of this scheme is illustrated in Fig. 4, where the newly added resistance is indicated at 16. Across the said resistance the grid current sets up a fall of potential so that from the very incipency of grid current flow the control grid potential stays nearly unaltered, while the upper flat portion of the impulse front is nearly eliminated. In other words, the plate current will then be rectangular to a higher or marked a degree than what is attainable in a circuit organization, Fig. 2. The resistance 16 may here be low in contrast to resistance 13, though it must be high in comparison with the inner resistance of the grid-cathode path, in other words, high compared with the equivalent resistance 15, Fig. 3.

It has also been discovered experimentally that by paralleling a condenser to resistance 16 it is possible to create plate potential impulses, i. e., variations of voltage at the plate of tube 10 which present a far steeper front than attainable in a circuit organization according to Fig. 4 which, in addition, will exhibit a perfect horizontal limitation. The circuit organization which must be adopted to this end is of the sort as shown by way of example in Fig. 5, where the newly added condenser is indicated at 17.

An explanation why by the addition of condenser 17 a very satisfactory plate potential curve is realizable cannot be suggested in a simple way. What must be kept in mind in this connection is that the grid filament path has both an inner ohmic resistance as well as a capacity between grid and filament. This goes to show that at the instant when flow of grid current sets in, there is present in series to the resistance capacity mesh 16, 17 another similar mesh (grid filament capacitance and shunted thereto the grid filament resistance), while moreover the grid filament resistance, i. e., the time constant of one of the resistance capacity meshes, varies with growth of the grid current. Now, the circuit actions which arise when a D. C. source of potential in the sense of voltage source 14, Fig. 3, is connected with the series arrangement comprising two re-

sistance capacity meshes is not quite simple. The rise of potential of the junction point of both resistance capacity meshes (which point in the circuit organization Fig. 5 corresponds to the control grid potential) may, as a matter of fact, be influenced to a large degree by changes of dimension. However, the situation becomes quite unintelligible when the time constant of the resistance capacity mesh is altered, that is, only altered in the course of the switch action, and this is quite the case in regard to the grid filament path. It is likely that so far as the form of the plate potential is concerned, also the distributed capacities, i. e., the self-capacitance of resistance 11 and the capacitance between plate and grid or filament are playing a certain part.

At any rate, it has been discovered experimentally that the shape of the plate potential, which, in a circuit scheme shown in Fig. 4, has invariably a shape as roughly indicated in Fig. 6, can be altered by a circuit organization as in Fig. 5 by increasing the size of the resistance 16, as indicated in Fig. 7 by the graph C, and by increasing the size of condenser 17, for instance, in a way as indicated by the graph E. If the size of 16 and 17 be chosen suitably, it is possible to secure a perfectly horizontal boundary line or contour for the impulse, in other words, a perfectly rectangular shape of impulse.

What I claim is:

1. A wave form modifying circuit comprising a thermionic tube having anode, cathode and at least one control electrode, a time constant circuit comprising a resistance-condenser combination having a time constant high with respect to the frequency of the wave to be modified connected in the cathode-control electrode circuit of said tube, said resistance and said condenser having such values that the bottom portion of said impulses render said tube non-conducting, and the steep portion of said impulses falls within the straight line portion of the anode current-grid voltage characteristic, and means for impressing said impulses on said control grid circuit comprising a source having a low internal resistance.

2. A wave form modifying circuit comprising a thermionic tube having anode, cathode and at least one control electrode, a time constant circuit comprising a resistance-condenser combination having a time constant high with respect to the frequency of the wave to be modified connected in the cathode-control electrode circuit of said tube, said resistance and said condenser having such values that the bottom portion of said impulses render said tube non-conducting, and the steep portion of said impulses falls within the straight line portion of the anode current-grid voltage characteristic, a second time constant circuit connected in said control electrode-cathode circuit, said latter time constant circuit having a time constant long as compared with the frequencies of the impulses to be modified, and means for impressing said impulses onto the control electrode from a source having a low internal resistance.

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