

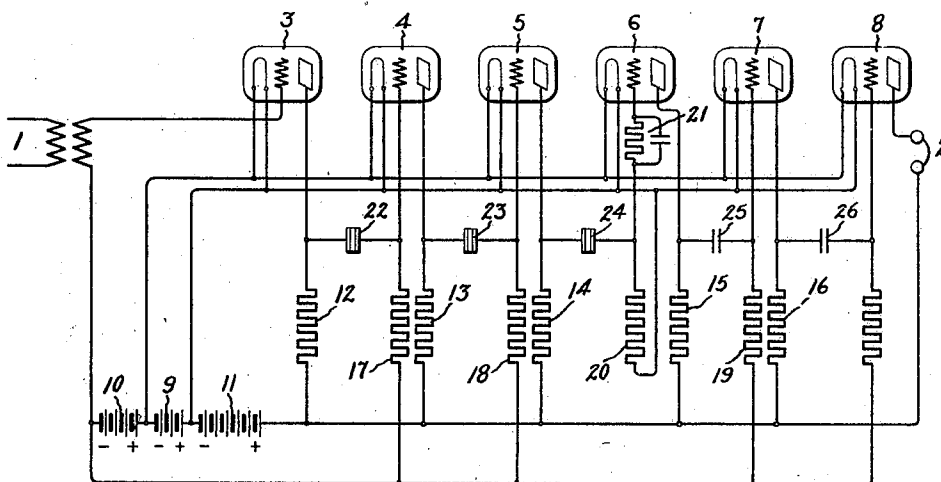
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AMPLIFICATION OF ELECTRICAL IMPULSES

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UNITED STATES PATENT OFFICE

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AMPLIFICATION OF ELECTRICAL IMPULSES

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My invention relates to the amplification of electrical impulses, and has for its principal object the provision of an improved amplifying apparatus of the type which comprises a plurality of space discharge devices coupled together through means comprising a piezo-electric element, such as a Rochelle salt crystal or the like.

Various apparatus have been used in the past to select and amplify electrical impulses which have frequencies within a predetermined range. Many of these apparatus comprise space discharge devices connected in cascade with one another and provided with input and output circuits tuned to the frequencies of the impulses to be amplified and with means for coupling the output circuit of each device either to the input circuit of a succeeding device or to a circuit wherein the amplified impulses are utilized. The operation of these apparatus have had certain disadvantages due both to iron losses and to the tendency of the space discharge devices to operate regeneratively. In accordance with my invention, these difficulties are avoided by the provision of an amplifying apparatus comprising a plurality of space discharge devices coupled together through piezo-electric elements which only permit the amplification of impulses having frequencies within a predetermined range.

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

The drawing illustrates an amplifying apparatus wherein my invention has been embodied.

This apparatus comprises a radio frequency input circuit 1 and a translating device, shown as a telephone 2, which are interconnected through means comprising radio frequency amplifiers 3, 4 and 5, a detector 6, and audio frequency amplifiers 7 and 8 connected in cascade with one another. Current for heating the cathodes of the devices 3 to 8 is supplied from a source 9, and a source 10 is provided for maintaining the grid potentials of the devices 3, 4, 5, 7 and 8

at values which ensure proper operation of these devices. The plate or anode currents of the devices 3 to 8 are supplied from a source 11 which is connected to the anodes of these devices respectively through resistors 12 to 16 and the telephone 2. Impedance elements 17, 18 and 19 are connected in the respective grid circuits of amplifiers 4, 5 and 7, and the grid and cathode of the detector 6 are interconnected through an impedance element 20 and a grid leak device 21.

It will be observed that the plate circuit of the amplifier 3 is coupled to the grid circuit of the amplifier 4 through a piezo-electric element 22; that like couplings 23 and 24 are provided between the amplifiers 4 and 5, and 5 and 6 respectively; and that devices 6, 7 and 8 are coupled together by means of condensers 25 and 26. The piezo-electric elements 22, 23 and 24 each comprise a Rochelle salt crystal, or the like, interposed between two electrodes through which these elements are subjected to an electrostatic field.

It is well known that such a piezo-electric element is capable of transforming mechanical energy into electrical energy, or vice versa, due to the electrical charges of different polarity produced at opposite faces of the element when it is subjected to mechanical stress, or due to the compression waves set up in the body of the element when it is subjected to the electrical stress of an alternating electrostatic field. Because of the fact that mechanical resonance in the mechanical vibration of the element is established when the frequency of the alternating electrostatic field corresponds to the frequency of the compression waves set up in the element, it is possible to utilize the element as a means of selecting electrical impulses which have frequencies within a predetermined range.

The frequencies selected are determined by the dimensions of the piezo-electric element, and the range of selected frequencies is dependent on material of which the piezo-electric element is made. It has been found that a piezo-electric element made of quartz will select frequencies within a range of something like ten cycles, and that an ele-

ment made of a Rochelle salt crystal will select frequencies within a range of something like seven kilo cycles.

When utilized as a coupler between the different stages of an amplifying apparatus, the Rochelle salt crystal is particularly desirable for the reason that it selects a definite and fairly wide band of frequencies. Thus, assuming the connections of the apparatus to be as illustrated and each of the elements 22, 23 and 24 to comprise a Rochelle salt crystal interposed between a pair of electrodes, current will be transmitted to the detector 6 only when impulses within a range of approximately seven kilo cycles are applied to the input circuit 1. This arrangement thus has the advantages that only impulses selected by the elements 22, 23 and 24 are amplified by the devices 3, 4 and 5, and that the tendency of these devices to operate regeneratively is avoided.

The embodiment of the invention illustrated and described herein has been selected for the purpose of clearly setting forth the principles involved. It will be apparent, however, that the invention is susceptible of being modified to meet the different conditions encountered in its use and I therefore aim to cover by the appended claims all modifications within the true spirit and scope of my invention.

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

1. The combination of a plurality of space discharge devices each provided with an input circuit including a resistor and with an output circuit including a resistor, and means including a piezo electric element arranged to connect said devices in cascade with one another.

2. The combination of an amplifier provided with input and output circuits, means for applying electrical impulses to said input circuit, a resistor connected in said output circuit, a second amplifier provided with an input circuit including a resistor, and a piezo-electric element connected between said resistors.

3. The combination of an amplifier provided with input and output circuits, means for applying electrical impulses to said input circuit, an impedance connected in said output circuit, a second amplifier provided with an input circuit including an impedance, and a piezo-electric element connected between said impedances.

In witness whereof, I have hereunto set my hand this 17th day of January, 1927.

DOW O. WHELAN.