

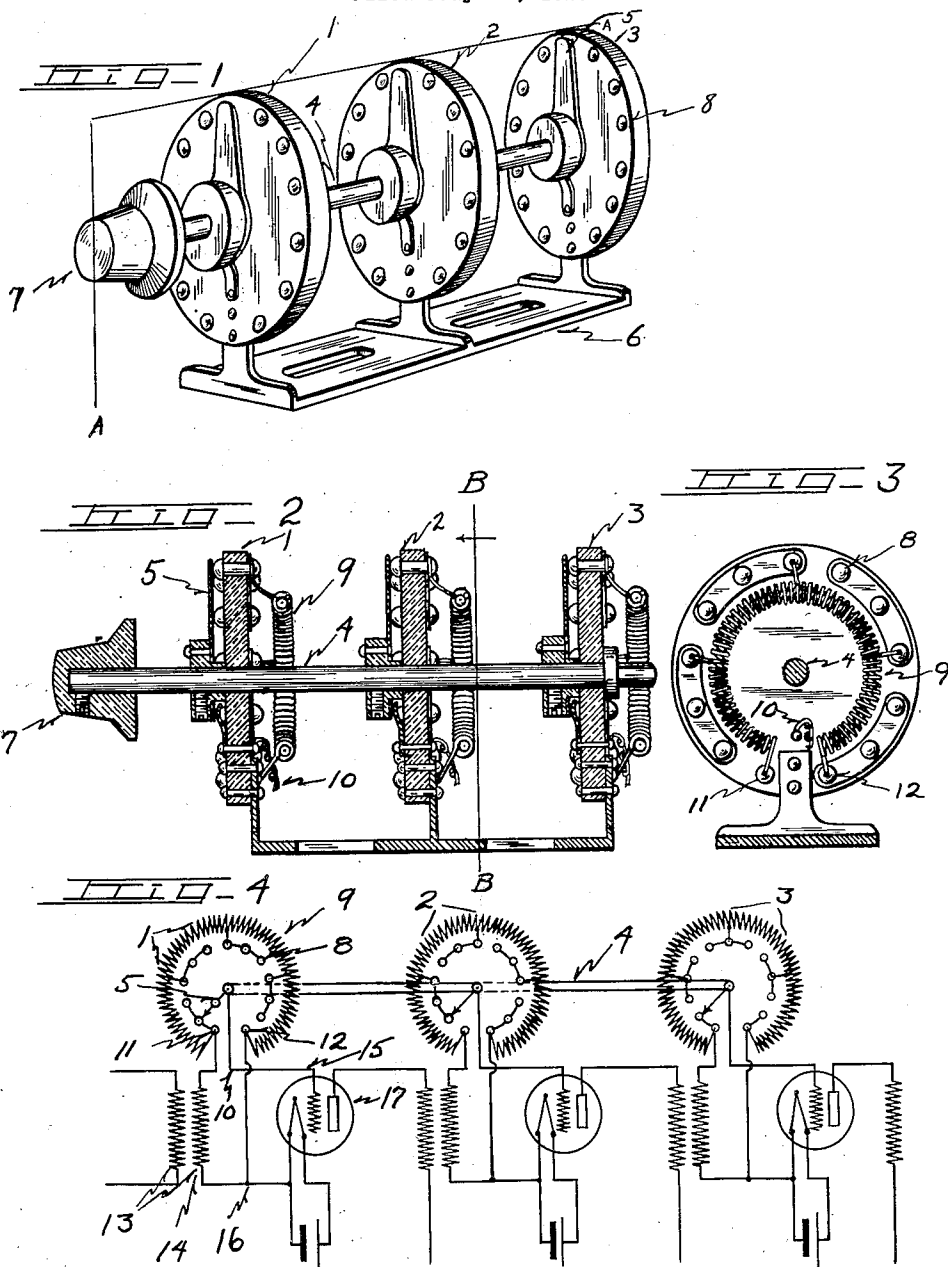
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GAIN CONTROL

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Witness

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## UNITED STATES PATENT OFFICE

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## GAIN CONTROL

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6 Claims. (Cl. 179—171)

This invention relates to a new and improved device for adjusting the amplification of a multi-stage amplifier.

In previous systems the amplification was adjusted ahead of the first amplifier tube, which has the disadvantage of leaving all the stages in a condition sensitive to troubles caused by vibration, tube noises and acoustic feed-back. Another previous system employed, in addition to the control ahead of the first tube, an auxiliary control between the first and second stages. This also has a disadvantage of producing clicks or disturbances due to irregularities in the sequences of inserting the large losses in the particular type of control.

In the proposed new form of control alternate or successive changes are made in front of, or between the stages of the amplifier, these changes being affected by the continuous turning of a single control dial. Two or more control points may be selected, such as in front of the first stage, between the first and second stages, the second and third stages, etc. One step is effected between two of these stages, the next step between the next two stages and so forth until a single cycle has been completed, at which point the process may repeat itself. This may be accomplished by mounting the control potentiometer on the control switch in such a manner that the same knob turns all the brushes; and, by strapping the contact studs together in the proper manner or by using elongated contact studs properly arranged, stepping is accomplished in the proper sequence.

This method can be applied to gain control obtained in any of the well-known ways, such as the use of potentiometers with or without series resistance taps, or by use of transformer or retard coil, equipped with taps.

The main object of my invention is to provide a new gain control for amplifiers such that a plurality of stages may be controlled by one knob.

Another object of my invention is to provide a gain control for multi-stage amplifiers that will operate in a step by step manner in any predetermined sequence.

Another object of my invention is to provide a gain control for a multi-stage amplifier whereby the amplification between stages may be continuously adjusted over a range impractical to cover at a single interstage point.

It is also an object of my invention to provide a gain control for a multi-stage amplifier whereby the amplification of successive stages may be so controlled as to eliminate amplifier disturb-

ances commonly found in previous methods of control.

Further objects and advantages will be apparent with reference to the accompanying drawing in which:

Figure 1, illustrates a possible method of construction, utilizing three stages of control. Potentiometers 1, 2 and 3 are mounted, as shown, on a suitable base 6, a shaft 4 of insulating material, couples the three separate units. A knob 7 serves as a control for the system. Reference to Figure 2 will show further details of construction. This figure is a section taken through A—A of Figure 1. This knob 7 is secured by means of a set screw to the shaft 4. The movable arm 5 is secured to the shaft 4 and makes contact with the studs 8 mounted on the potentiometer plate. The resistance unit 9 is mounted in back of the plate and taps are taken from 9 to make contact with the studs 8 in a manner to be described later. The view of section B—B of Figure 2 is shown in Figure 3. This shows a method of strapping adjacent studs to effect a step by step control schedule. By changing the scheme of strapping of studs, any sequence of control can be obtained. The lead 10 is connected to the movable arm or brush 5. The other two connections to the potentiometer are shown at the extremities of the resistance 9 at 11 and 12.

A typical application of this staggered gain control is shown in Figure 4. A conventional three stage amplifier is shown. The plate circuits are not shown in full since the application of the gain control does not effect the same directly. A potentiometer is connected in parallel with the secondary 14 of the first amplifying transformer 13, and connections are made on the potentiometer at points 11 and 12.

The movable arm 5 makes contact through 10 to the grid 15 of the first amplifying tube 17. The following two stages have similar connections. A probable sequence of operation would be as follows: Starting with the movable arm 5 all on contact stud 11, all three stages would be set for a position of maximum gain. As the arm 5 is turned in a clockwise direction to the second contact stud, the second stage of amplification is effected or the gain is decreased by the first step. Stages three and one are still at maximum gain, due to the fact that the adjacent studs are strapped together. As the contact arm moves to the third stud, stage number three receives a change in gain by one step while two and one remain as before. Another contact step will effect

stage one. The process here repeats itself starting with stage two, which will, on the next contact step, be effected by a second step of decreased gain.

5 Although only four steps in gain control are here shown, any number may be applied to this method. The sequence of operation was chosen as two, three, one, which necessarily does not limit the application to any other that may be practical.

10 A gain control of this type has the advantage of giving continuous control. Turning the knob 7 effects the gain of the amplifier due to successive amplification changes of the various stages. 15 This makes the amplifier more free from inter-stage disturbances as would be present in the case of a single interstage control. The single inter-stage volume control requires nearly as many potentiometer resistances or coil taps as does the 20 multi-stage control and has the disadvantage of a very limited range.

It is to be understood that thus having described a particular multiple staggered gain control for the purpose of illustrating my invention, 25 I do not desire to restrict myself, as various changes may be made without departing from the scope of the appended claims.

I claim:

1. In a gain control of the class described, a 30 plurality of impedance units, a plurality of equally spaced contact studs connected to said impedance units, means including a unitary control for simultaneously engaging said contact studs to effect successive changes of impedance in said 35 units, said contact studs being connected to said impedance units in staggered arrangement so that said impedance changes occur in only one unit at a time.

2. In a multi-stage amplifier having a plurality 40 of audion tubes, a gain control comprising a plurality of variable impedance units connected across the input circuits ahead of and between said tubes, a plurality of equally spaced contact studs connected to each of said impedance units, 45 a revoluble shaft, a plurality of contact arms mounted on said shaft, each associated with an input circuit of said tubes and adapted to simultaneously engage said single contact studs, means for rotating said shaft to successively engage 50 said contact arms with said contact studs to

effect changes of impedance in said units, said contact studs being connected to said impedance units in such a manner so that the impedance changes occur in only one unit at a time.

3. In an amplifier having a plurality of audion 80 tube stages, an impedance unit connected in the input circuit of each audion tube, a plurality of contacts connected to said impedance units in staggered arrangement, a plurality of contact 85 arms adapted to engage said contacts, and means for simultaneously moving said contact arms from one set of contacts to another for varying the impedance of said units singly to effect a continuous variation of the over-all gain of said 90 amplifier.

4. In an amplifier having a plurality of audion tube stages, a multiple stage gain control comprising a plurality of potentiometer impedance units connected in the input circuits of the audion tubes and having a staggered step contact point 95 arrangement, and single control means associated therewith operable at will for simultaneously actuating all of said units and for continuously varying the amplification in small steps ahead of and between stages of the amplifier. 100

5. In an amplifier having a plurality of audion tube stages, a plurality of potentiometer gain control elements, said gain control elements being connected in the input circuit of the audion tubes and having a plurality of contact points in 105 staggered step arrangement, a unitary control associated with said elements operable at will for simultaneously actuating all of said elements whereby the gain of said amplifier may be changed continuously without affecting the gain of more 110 than one stage at a time.

6. In an amplifier having a plurality of audion tube stages, a multiple stage gain control comprising a plurality of variable impedance units connected across the input circuits between the 115 audion tubes and having a staggered step contact point arrangement, and means associated with said contacts having a single control operable at will for simultaneously adjusting the impedance of said units for continuously varying the over-all gain of the amplifier in small steps by successive changes of impedance ahead of and between stages thereof. 120

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