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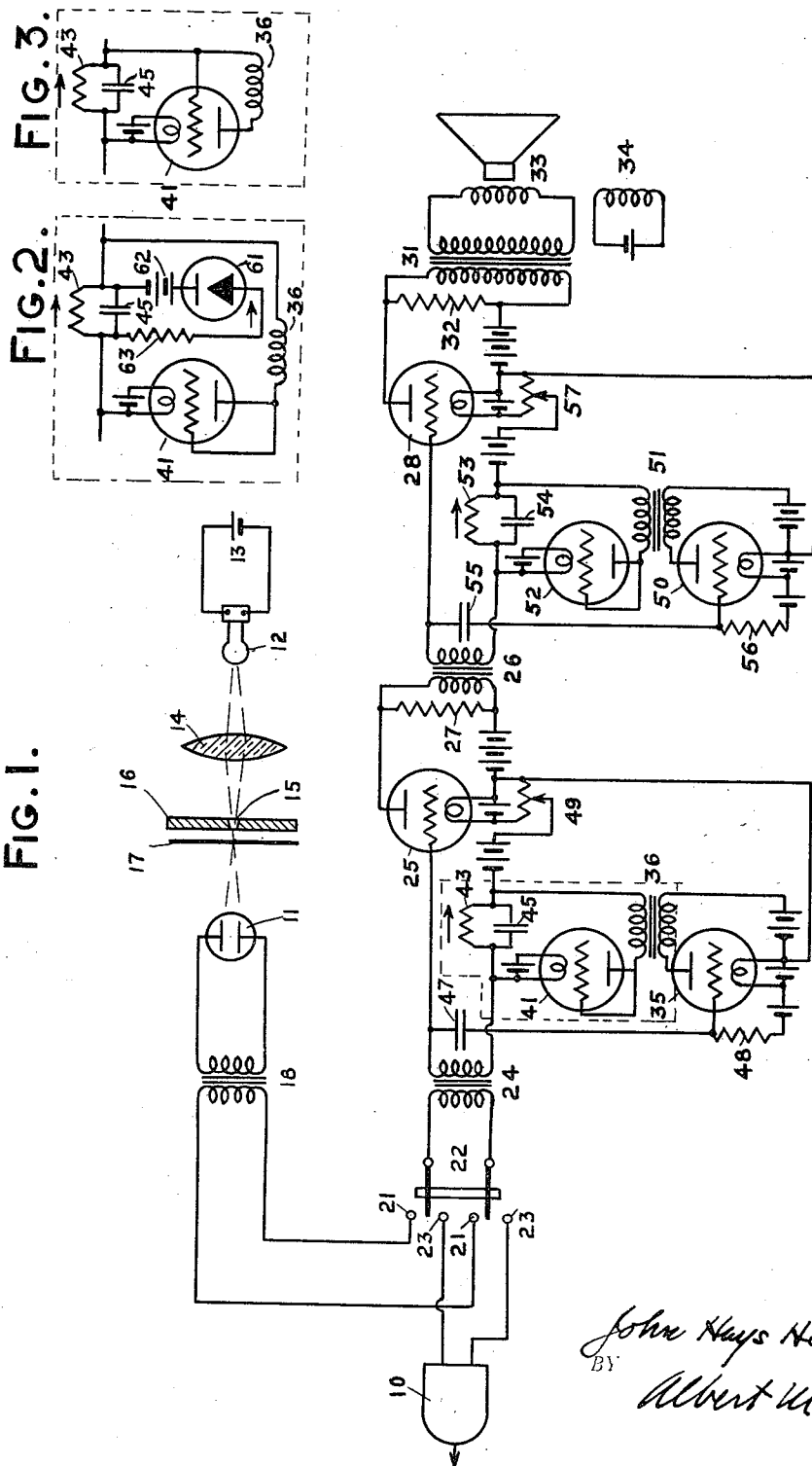
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SERIES DYNAMIC MULTIPLIER

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FIG. 1.



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SERIES DYNAMIC MULTIPLIER

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4 Claims. (Cl. 179—100.4)

This invention relates to amplifying systems and more particularly to an improved method of controlling the amount of amplification in accordance with the strength of the applied signal.

The invention relates particularly to a means of controlling the operating characteristics of space discharge amplifiers in accordance with the strength of the applied signal, so that the amplifying efficiency is greater for strong signals than for weak signals.

The invention consists of a series of amplifying systems arranged in cascade, so that each individual system may be operated at its most efficient gain ratio, thus producing a total gain ratio for the entire system much larger than that obtainable from a single stage.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization may be better understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof, in which

Fig. 1 illustrates diagrammatically one type of circuit for carrying out the present invention,

Fig. 2 illustrates a modified form of the invention including a limiting device, and

Fig. 3 illustrates another form of limiter which may be used in conjunction with the system shown in Fig. 1.

Like reference characters denote like parts in the several figures of the drawing.

In the following description and in the claims parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring more particularly to the drawing, Fig. 1 shows an amplifying system which receives its energy from a phonograph pick-up 10, or a photoelectric cell 11. This cell receives light from a lamp 12, which is energized from a source of power 13. The light from this lamp is focused by a lens 14, through an aperture 15, in an aperture plate 16, upon the sound record of a moving film 17. The light which passes through this film then impinges upon the photoelectric cell 11. This cell is connected through a transformer 18 to two contacts 21, of a double pole double throw switch 22, the other contacts 23 of which are connected to the phonograph pick-up 10.

The blades of the switch 22 are connected to the primary of a transformer 24. The secondary of this transformer is connected to the input

circuit of a space discharge means 25, the output circuit of which is connected to the primary of a transformer 26, across which is a resistance 27. The secondary of the transformer 26 is connected in the input circuit of a space discharge device 28, the output circuit of which is connected to the primary of a transformer 31, across which is a resistance 32. The secondary of this transformer is connected to the moving coil of a loud speaker 33, the field of which is indicated at 34.

Across the secondary of the transformer 24 is connected the input circuit of a space discharge device 35. The output circuit of this device is connected to the primary of a transformer 36. The secondary of this transformer is connected through a rectifier 41 to the input filament lead of the space discharge device 25. In this lead and across the rectifier 41 is a resistance 43 which is shunted by a condenser 45. A blocking condenser 47 is in the grid lead of the space discharge device 35 and a high resistance 48 is connected between the grid and filament of this device. The input filament lead is connected to a potentiometer 49.

Across the secondary of the transformer 26 is connected the input circuit of a space discharge device 50. The output circuit of this device is connected to the primary of a transformer 51. The secondary of this transformer is connected through a rectifier 52 to the grid return lead of the space discharge device 28. In this lead and across the rectifier 52 and secondary of the transformer 51 is a resistance 53 which is shunted by a condenser 54. A blocking condenser 55 is in the grid lead of the space discharge device 50 and a high resistance 56 is connected between the grid and filament of this tube. The grid return lead is connected to a potentiometer 57.

The various space discharge devices have associated therewith sources of filament current, space current, and grid potential which are connected in a manner well-known in the art.

In the operation of the form of the invention shown in Fig. 1 the energy received by the transformer 24 passes to the space discharge amplifier 25. At the same time some of the energy from the secondary of the transformer 24 is passed to the space discharge device 35 where it is amplified and passed through the primary of the transformer 36. The current from the secondary of this transformer is rectified by means of the rectifier 41 which causes current to flow in the direction of the arrow through the resistance 43. The voltage drop of this resistance, which is governed by the amplitude of the signals applied to the control means 35, opposes the steady biasing voltage of the space discharge means 25 thus causing a decrease of bias on this device. As the amplifying characteristics of the space discharge

means 25 are determined by the grid potential, decrease of bias causes an increase of amplification in this device. The amplification ratio is accordingly made greater for strong signals than for weak signals.

The operation of the second stage, comprising the space discharge means 28 and 50 and the rectifier 52, is similar to that just described, the amplified signal from the transformer 26 being further amplified. The signals transmitted through the transformer 31 to the loud speaker 33 are a product of the amplification of the two stages. Hence, a much greater range of gain ratio is obtained in the output circuit than that of the impressed signal.

The resistances 43 and 53 may be either equal or unequal and the capacities 45 and 54 may be either equal or unequal, depending upon the gain ratio and other characteristics desired in each circuit. It will be noted that the gain ratio is controlled by the average sound intensity taken over a given period of time. Since this average intensity is continually changing, it may be called the moving average. Resistances 27 and 32 are of such value that the variation in impedance of devices 25 and 28 respectively is prevented from changing the impedance of the subsequent apparatus and causing signal disturbance.

In the modified form of the invention shown in Fig. 2, the resistor 43 and condenser 45 are shunted by a rectifier 61 which is in series with a battery 62 and a resistance 63. It is understood that the resistor 43 and the condenser 45 are connected in the circuit shown in Fig. 1, and the parts shown in Fig. 2 are given the same reference numerals. In the operation of this form of the invention, when current passes through the resistor 43 from the rectifier 44 it will build up a potential difference across this resistance which is proportional to the strength of this current. This potential will oppose that of the battery 62 until it exceeds this potential, at which time current will flow through the rectifier 61 in the direction of the arrow, thus discharging the condenser 45. This prevents the potential across the resistor 43 and, therefore, the decrease of bias on the space discharge means 25, from exceeding the potential drop determined by the battery 62, rectifier 61, and resistance 63. This device, therefore, acts as a limiter to prevent too great a decrease in the bias of the space discharge means 25, when signals of excessive volume are being amplified.

Referring to the modified form of the invention shown in Fig. 3, the system illustrated is similar to that shown in Fig. 1 except that the grid of the space discharge means 41 is connected to the resistor 43 in such a manner that said resistor is in the grid filament circuit.

In the operation of this form of the invention, a potential difference is built up across the resistor 43 as already described in connection with Fig. 1. As this potential difference increases, the grid of the space discharge means 41 will become increasingly negative, thus acting to limit the current passing through the resistor 43. This in turn acts to prevent the bias of the space discharge means 25 from decreasing too greatly.

It will be understood that while these limiters have been shown in connection with the space discharge means 25, they may also be used in connection with the space discharge means 28 if desired.

In the present system it is possible to keep the range of gain ratio for each stage comparatively

low, say 3 to 1, to give an overall gain ratio range 9 to 1 for two stages, so that much more satisfactory operation is obtained and the circuits will not be so sensitive to slight variations of normal grid bias voltage as they would be with a higher gain ratio. It is thus possible to make permanent adjustments of the potentiometers 49 and 51, as slight changes of battery voltage will not have an appreciable effect.

If desired, however, the range of gain ratio of each stage could be increased to the maximum of say 9 to 1 in which case the total gain ratio range would be 81 to 1. This would necessitate that the space discharge means be operated at a more sensitive point and would probably necessitate frequent voltage adjustment to maintain them in the proper condition.

Although only a few of the various forms in which this invention may be embodied have been shown herein, it is to be understood that the invention is not limited to any specific construction but might be embodied in various forms without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a sound reproducing system, a sound record, a pick-up device associated therewith, a multi-stage amplifier fed by said pick-up device, a sound translating device fed by said amplifier, said amplifier comprising a plurality of stages connected in series, a first control circuit fed by the input of the first stage for varying the gain ratio of the first stage in accordance with the envelope of the input sound strength, a second control circuit at the input of the second stage for varying the gain ratio of the second stage according to the envelope of its input sound strength, whereby the overall gain ratio range is equal to the product of the gain ratio ranges of said individual stages.

2. In a sound reproducing system, a sound record, a pick-up device therefor, a multi-stage amplifier fed by said pick-up device, separate control circuits, one for each stage, each control circuit having means for varying the gain ratio of that stage automatically in accordance with the envelope of the signal strength in that stage, whereby the overall gain ratio range is equal to the product of the gain ratio ranges of each stage.

3. In a sound reproducing system, a sound record, a pick-up device therefor, a multi-stage amplifier fed by said pick-up device, separate control circuits, one for each stage, each control circuit having means for varying the gain ratio of that stage automatically in accordance with the signal strength in that stage, whereby the overall gain ratio range is equal to the product of the gain ratio ranges of each stage, and separate limiting devices, one for each stage, for limiting the gain ratio of that stage.

4. In a sound reproducing system, a sound record, a pick-up device therefor, an amplifier fed by said pick-up device, a control circuit also fed by said pick-up device, means in said control circuit for varying the gain ratio of said amplifier according to the energy volume received from said pick-up device, a rectifier tube in said control circuit, a control element in said tube for limiting the effect of said control circuit on said amplifier, and a translating device fed by said amplifier.

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