THE ANTENNA TYPE FIELD METER

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Abstract A field meter of simple construction, which can be very conveniently operated on field site, has been constructed for the purpose of measuring the electric field change due to a lightning discharge. The meter consists of a pre-amplifier, a ring-modulator and a tape recorder. Three field meters have been in operation at three field sites respectively this summer.

1. Introduction

In order to know the movement of electric charge producing a lightning discharge, it is very important to measure the earth's electric field change due to that lightning discharge. For this purpose a mill-type field meter was constructed in this institute a few years ago, and subjected to practical use for a few summers. The field measurements last summer were carried on at two field sites, but they were increased to three this summer. These measurements indicate a demand for a meter which has a simple construction and therefore is very easy to handle, since the meters must often be operated by a few temporary employees who have very little knowledge of this field. The antenna field meter has been constructed to satisfy such a demand.

2. Details of the meter

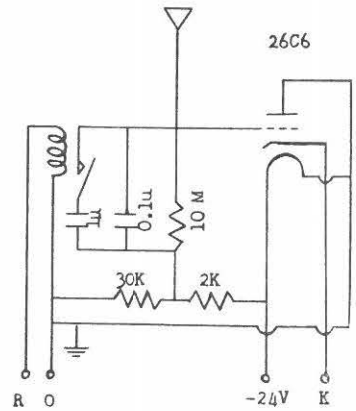

Fig. 1 Pre-amplifier

2. 1 Antenna and pre-amplifier

The circuit diagram of the pre-amplifier is shown in fig. 1. As the vacuum tube 26C6 is not the one especially designed for the purpose of measuring the static electricity, it is unavoidable that there should always be some grid current flowing in the tube. However, no trouble could be brought about by the grid current, for it can be kept constant for a few minutes, and the field change passes off in a few seconds at the longest. The grid resistor, 10 meg-ohms, and the grid condenser, 1 or 10 micro-farads, corresponding to low or high gain, are put

in parallel to the grid circuit. A vinyl covered wire has been used as the antenna, since it indicated a resistance of more than 100 meg-ohms even in water. The pre-amplifier is installed outdoors and connected with a cable to the main part placed indoors. The gain of the meter can be remote-controlled from inside of an observation hut using an electromagnetic relay system.

2. 2 Main part

The circuit diagram of the main part is shown in fig. 2. The field change due to a lightning discharge can easily be converted into the corresponding voltage change by

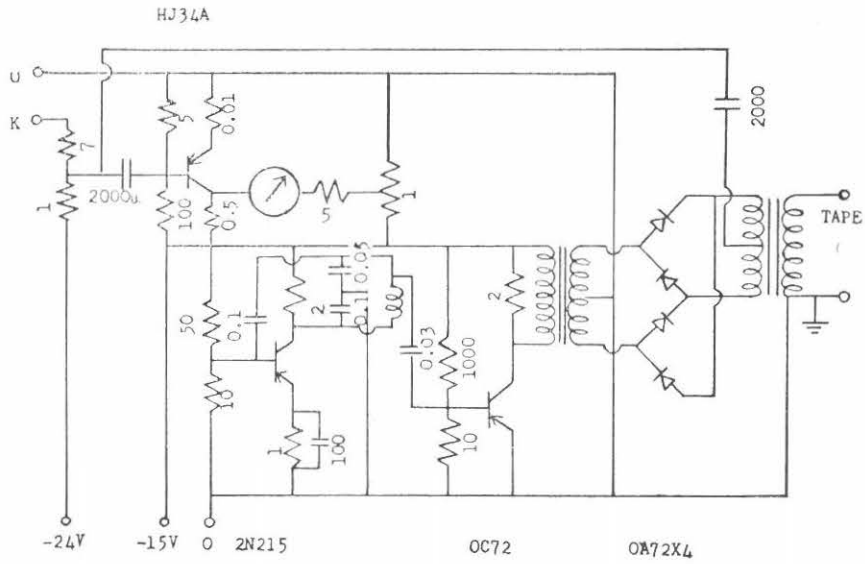

Fig. 2 Main part Resistance : KΩ Capacitance : μF

the use of the pre-amplifier. However, the voltage change thus obtained is usually too slow to be recorded on a magnetic tape-recorder. To get rid of this defect the output of the pre-amplifier is subjected to an amplitude modulation, when it passes through the main part. The carrier wave is generated by the transistor 2N215 and has a frequency of 2 kc/s. This carrier is then amplified and intentionally distorted by the transistor 0C72. The distorted wave is fed to the ring modulator composed of four 0A72's. The sense of the original voltage change after amplitude modulation can be determined by the distortion of the carrier wave. The transistor HJ34A is to operate the monitor ammeter. The amplitude calibration of the field meter is shown in fig. 3. The calibration has been made by applying d. c. voltages between the two ends of a grid resistor to 26C6. The power to the field meter is supplied from a series of connection of four secondary batteries for small type auto-cycle. The tape recorder adopted in the thunderstorm observation had more than two channels, so we could record the field change

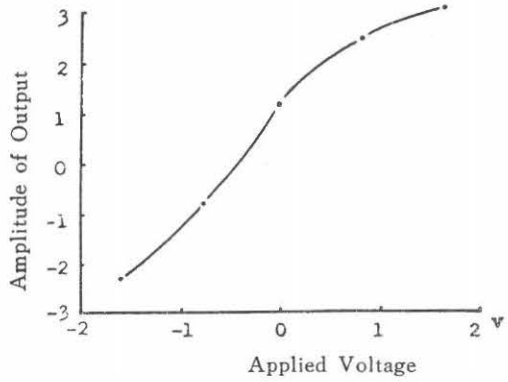

Fig. 3 Amplitude Characteristic

on the first channel and the coinsidence time-mark sent from the master field site, using a wireless telephone, on the second channel. Through this recording technique we could compare the exact coincident records of a field change, respectively obtained, e. g., at three field sites. The tape recorder is driven by a.c. power supply. This is one of the defects of the present meter system, because it could not be operated, if the power supply were stopped by a stroke of lightning on the power line.

3. Acknowledgement

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