Oct. 30, 1951 P. C. HARRIS 2,573,329

CAPACITATIVE COMMUTATOR

Filed May 24, 1946 2 SHEETS—SHEET 1

Fig. 1.

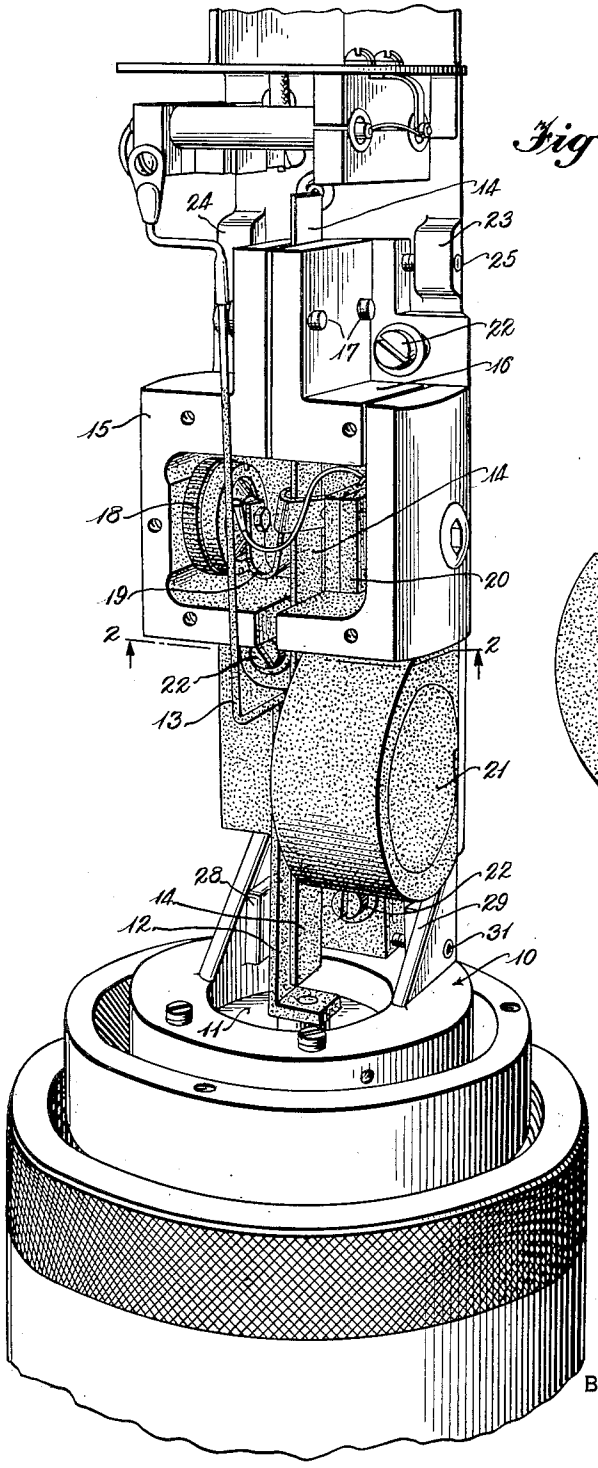
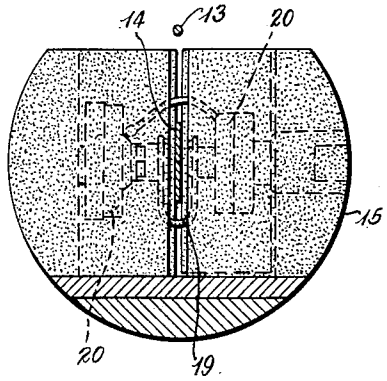


Fig. 2.



INVENTOR
Phil C. Harris
BY James Y. Cleveland
ATTORNEY

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Fig. 3.

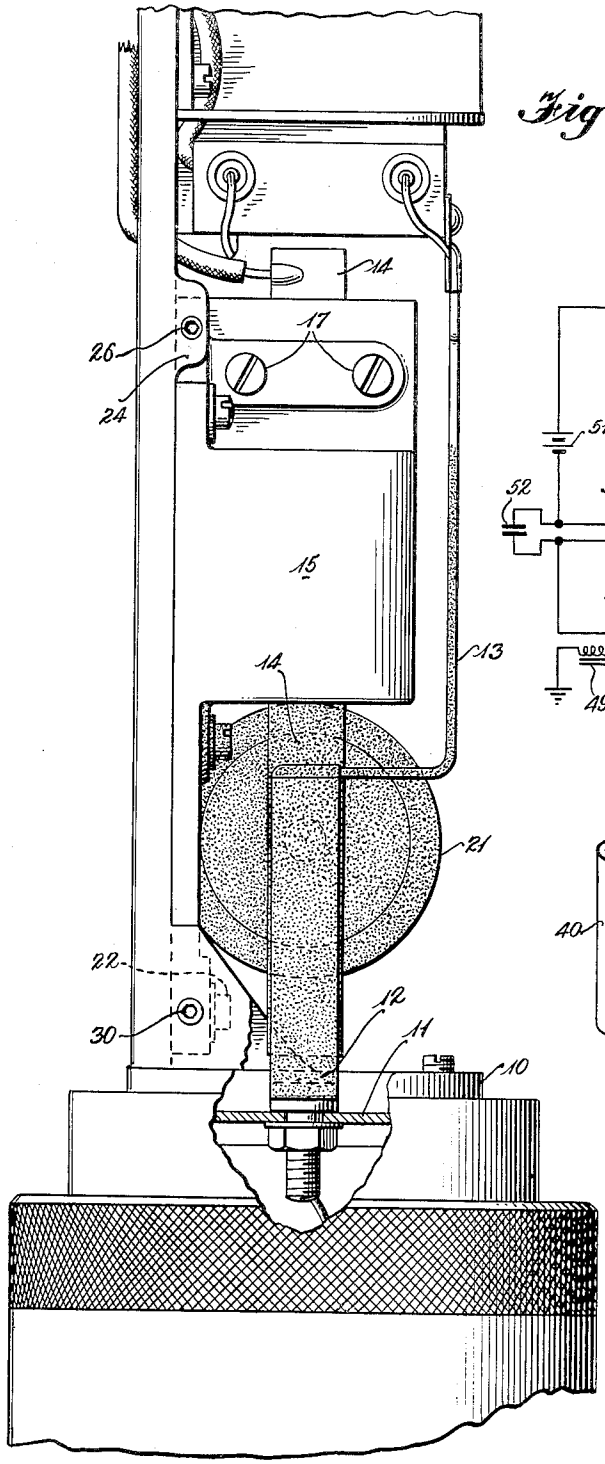
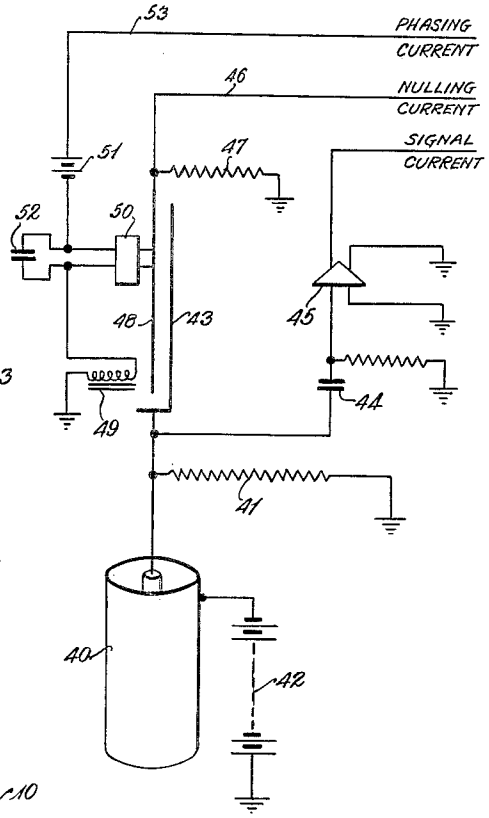


Fig. 4.



INVENTOR
Phil C. Harris
BY James Y. Cleveland
ATTORNEY

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CAPACITATIVE COMMUTATOR

Phil C. Harris, Houston, Tex., assignor to Well Surveys, Incorporated, Tulsa, Okla., a corporation of Delaware

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2 Claims. (Cl. 321—44)

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This invention relates to variable condensers and more particularly to a condenser that is adapted to be varied cyclically for the purpose of converting very small direct currents or direct current potentials into proportional alternating currents or alternating current potentials. Such a condenser may be considered to be a capacitative commutator.

It is well known that if a direct current potential is placed across the plates of a condenser and the capacity of the condenser rapidly varied, that an alternating current potential will be developed across the condenser plates. This affords a means of converting a direct current potential into an alternating current potential and since the potentials may be derived from or converted into currents, it also provides a method for converting direct currents into alternating currents, direct currents into alternating current potentials, or direct potentials into either alternating current potentials or alternating currents.

When very small direct currents or direct current potentials are to be measured, it is often found difficult to accomplish because of the instability of the direct current amplifiers that would normally be used in the process. Accordingly, it has been found desirable in many instances to convert the very small direct currents or direct current potentials into corresponding alternating currents or potentials.

Capacitative commutators have already been utilized to make this conversion, but serious difficulties have been encountered because the capacitative commutators heretofore used were not reliable in operation and because they generated spurious voltages that introduced errors into the measurements being made.

In accordance with the principles of this invention, a capacitative commutator has now been produced which not only operates reliably but in which the generation of spurious voltages has been reduced so greatly that it is now negligible.

The capacitative commutator of this invention consists of a fixed or stator plate and a movable or flexor plate. The flexor plate is so mounted that it can vibrate toward and away from the stator plate and is driven by an electromagnet. The current which operates the electromagnet is controlled by the oscillation of the flexor plate in a manner similar to that ordinarily used in electrical bells or buzzers. These details of construction are already known and are described in Patent No. 2,349,225 granted May 16, 1944, to Serge A. Scherbatskoy et al.

In accordance with this invention, it has been

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found desirable to incorporate a number of special features in a device of the kind described above, in order to make the instrument, sturdy, reliable, and easy to adjust, and to prevent the generation of spurious currents. In any device of this kind in which one element is vibrating and another is fixed, there is a tendency for the fixed element to vibrate also. In the present construction this tendency has been greatly reduced by mounting the fixed element and the vibrating element at relatively remote points on a relatively heavy frame. Thus, little or no vibration will be carried from the vibrating element through the frame into the fixed element.

Next, in order to provide reliability of operation, it is desirable to have the stator and flexor plates firmly clamped into position, but in order to provide for adjustment it is desirable to have their positions relatively adjustable. Means to accomplish this have been provided in accordance with the principles of this invention.

The generation of spurious currents by induction has also been prevented by the enclosing of the electrical operating circuit in sufficient shielding to prevent any possible induction of currents from the operating circuit into the measuring circuit.

Further in accordance with this invention, and perhaps most important, the generation of spurious currents, as a result of contact potentials, has been reduced to a negligible amount. This has been accomplished by the covering of the flexor and the stator plates with a very stable coating that does not, under the conditions of use, undergo any change that will alter the contact potential of one plate relative to the other. Preferably, the coating of parts with a stable coating is carried even further than merely coating the flexor and stator plates and all other parts from which spurious currents might possibly be induced into the measuring circuit are also coated with the same stable coating material.

It has been found that a satisfactory stable coating material is a colloidal suspension of graphite.

For a more detailed understanding of the principles of this invention reference may be had to the appended drawings in which the preferred embodiment is illustrated, and to the following detailed description thereof.

In the drawings:

Figure 1 is a perspective view of a section of a well logging apparatus, with the casing removed, to show the details of a capacitative com-

mutator constructed in accordance with the principles of this invention;

Figure 2 is a cross-sectional view of the device shown in Figure 1, the view being taken along lines 2—2 of Figure 1;

Figure 3 is a side view of the structure illustrated in Figure 1, with certain parts being cut away to more clearly illustrate the construction of the device;

Figure 4 is a schematic illustration of one method of inserting the capacitative commutator of this invention in a measuring circuit.

As illustrated in Figures 1 to 3, inclusive, the capacitative commutator of this invention forms a part of a well logging device which is generally of the shape of an elongated capsule containing a detector for detecting some phenomena that it is desired to measure and an electrometer circuit which in cooperation with equipment normally located outside of the well, acts to record a measurement of the detected phenomena. The capacitative commutator of this invention forms a part of the electrometer circuit.

As illustrated, a main frame 10 is provided for the purpose of supporting the electrometer circuit including the capacitative commutator. In a circular opening in the lower end of this frame there is mounted an insulating disc 11 and upon this disc is mounted the stator plate 12 of the capacitative commutator, which is thus insulated from the frame. One of the leads from the detector is connected to the stator plate below the insulator plate 11 and the other may be grounded to the frame. The output from the stator side of the commutator may be carried on upward into an amplifier by a lead 13.

The flexor or moving plate of the commutator 14 is mounted adjacent the stator plate 12 and spaced slightly therefrom and so arranged as to vibrate toward and away from the stator plate. The mounting for the flexor plate 14 consists of an auxiliary frame 15 and a clamping block 16 which is bolted to it by cap screws 17 in such a manner as to clamp the flexor plate between it and the auxiliary frame. The auxiliary frame 15 serves an additional purpose by forming an enclosure which surrounds the upper end of the flexor plate and furnishes a housing for the electrical circuit that controls the action of the electromagnet which in turn drives the flexor plate. A cover plate, not shown, is provided to close the housing formed by the auxiliary frame 15 so as to completely enclose the elements therein.

The elements within the housing formed by the auxiliary frame 15 consists of a variable resistor 18 of the carbon button type, a mechanical connection 19 for operating this resistor in accordance with the movements of the flexor plate, and a condenser 20 connected across the resistor so as to emphasize the electrical pulses generated by its change in resistance. The carbon button and condenser are ordinarily connected between an incoming conductor of the power and ground, and an electromagnet 21, mounted on the main frame just below the auxiliary frame 15 and opposite the stator, is connected either in series or in parallel with the resistor 18 and the condenser 20 so as to be operated in accordance with the variable current which they produce.

In order to provide for the adjustment of the position of the flexor plate relative to the stator plate the entire auxiliary frame 15 is mounted on the main frame by means of four cap screws 22 which pass through slots in the auxiliary frame 15 and screw into the main frame 10. Four lugs 23, 24, 28, and 29 on the main frame carry set screws 25, 26, 30, and 31, which bear against the auxiliary frame 15 so that by adjusting them the position of the auxiliary frame may be varied.

As illustrated in Figures 1, 2 and 3, the stator and flexor plates are both coated with colloidal graphite. The most satisfactory method of accomplishing this coating has been found to consist of nickel-plating the parts to be coated to give them a dull nickel finish, carefully cleaning the coating, and applying one or more of "aquadag" paint. Each coating applied should be dried thoroughly, preferably by the use of infrared heat. "Aquadag" paint is a substantially pure colloidal suspension of colloidal graphite in water.

It has also been found desirable to coat the inside of the housing formed in the auxiliary support 15 with "aquadag" paint and to coat all other parts that lie close to the stator or flexor plates with this paint. While these parts are not theoretically a part of the varying condenser, there is nevertheless a sufficient relative motion so that differences in contact potential between any of these parts and the flexor and stator plates are likely to cause the generation of spurious currents.

To illustrate in a general way the type of circuit in which the capacitative commutator of this invention may be used, an example of such a circuit is shown in Figure 4. As illustrated in this circuit, the measurement to be made is the potential produced across a resistor by the action of an ionization chamber. Thus an ionization chamber 40 is shown as connected in series with a relatively high resistance resistor 41 and a battery 42. One side of the resistor and one side of the battery are connected to ground. The other side of the resistor is connected to the stator plate 43 of a capacitative commutator of the type described above, and this stator plate is also connected thru a condenser 44 to an amplifier 45, which produces a signal current which is sent to the surface of the earth to govern the amount of nulling current that is sent back to balance the output of the ionization chamber. The nulling current, which returns via a conductor 46, is shunted to ground through a resistor 47, and the potential developed across this resistor is applied to the flexor plate 48 of the capacitative commutator.

The flexor plate of the capacitative commutator is driven by an electromagnet 49 connected in series with a carbon button 50 and a source of potential 51. A condenser 52 is placed across the carbon button 50 to accentuate the action of the carbon button. A phasing current passes to the surface of the earth through a lead 53 where it acts to orient the signal current so as to change the nulling current in the proper direction.

Obviously, many modifications in the circuit in which the capacitative commutator is used may be made, the above being but one example, and the circuit shown in Scherbatskoy et al. Patent 2,349,225, granted May 16, 1944, being but another. The principles of this invention may also be applied in any similar situation in which it is desired to have a rapidly varying capacity that is stable and does not generate spurious currents or potentials.

What is claimed is:

1. A device of the type described which comprises a frame, an insulator mounted in said frame, a stator plate mounted on said insulator, an auxiliary frame mounted on said first-mentioned frame in such a manner as to be adjustable as to position thereon, a flexible plate mounted on said auxiliary frame, an electromagnet mounted adjacent said flexible plate, means for controlling the current to said electromagnet in accordance with the motions of said flexible plate, said means being mounted with said auxiliary frame so as to be electrically shielded thereby, and a colloidal graphite coating covering the surfaces of said stator blade and said flexible plate.

2. A device of the type described which comprises a frame, an insulator mounted in said frame, a stator plate mounted on said insulator, an auxiliary frame mounted on said first-mentioned frame in such a manner as to be adjustable as to position thereon, a flexible plate mounted in said auxiliary frame, an electromagnet mounted adjacent said flexible plate,

means for controlling the current to said electromagnet in accordance with the motions of said flexible plate, said means being mounted within said auxiliary frame so as to be electrically shielded thereby, and a colloidal graphite coating covering the surfaces of said stator plate and said flexible plate and also all of the surfaces which lie closely adjacent the stator and flexible plates.

PHIL C. HARRIS.

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