



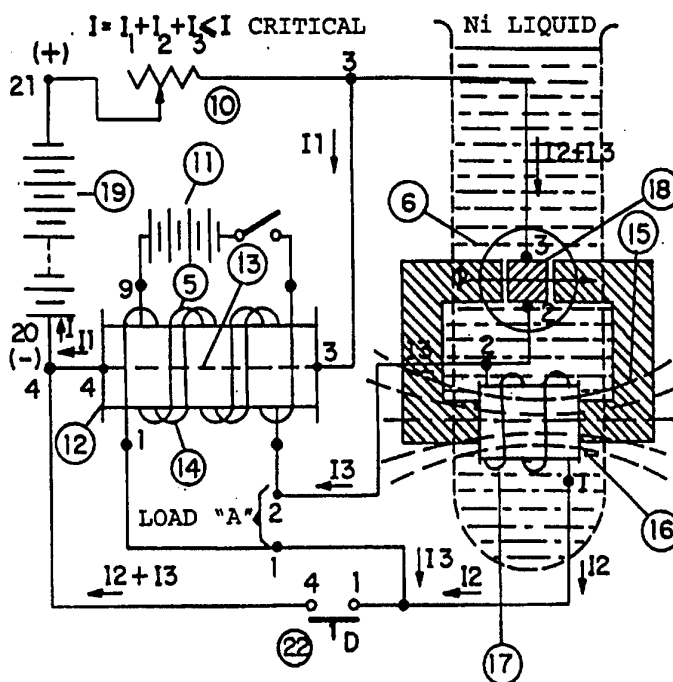
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(54) Title: DEVICES THAT GENERATE MAGNETIC SUPER PULSE (MSP) CREATED BY THE TRANSFORMATION OF THE PULSATING ENERGY CONVERTED ELECTRO-MECHANICALLY (PECEM)

(57) Abstract

This invention refers to the discovery of a new electro-mechanical conversion of electric energy called PECEM, "Pulsating Energy Converted Electro-Mechanically". This conversion of energy is obtained by devices which create a magnetic super pulse. These devices, such as transraptors, transreeds, transjunctors and superjunctors, are classified according to the frequency rate of the MSP generated by the successive and discrete energetic transformations of the PECEM.



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**DEVICES THAT GENERATE MAGNETIC SUPER
PULSE (MSP) CREATED BY THE TRANSFORMATION
OF THE PULSATING ENERGY CONVERTED
ELECTROMECHANICALLY (PECEM)**

5 The present invention refers primarily to the
discovery of a new electromechanical conversion of
electrical energy, which we called "Pulsating Energy
Converted Electro-Mechanically" (PECEM), or simply "PECEM
Transformation," which generates in the devices being
10 patented a "Magnetic Super Pulse" (MSP) that is
responsible for their technological realization, and
whose specifications will be presented later.

 The justification for the inclusion of several
devices in one patent is due to the fact that,
15 essentially, the mechanism used and the technique of
their operation are based on the same discovery, that is,
the energy conversion mentioned above and called "PECEM."
This Pulsating Energy Converted Electro-mechanically
generates for its operation a Magnetic Super Pulse (MSP),
20 though these devices can be of several different types,
they can be used for different purposes and applications
as will be evident in the descriptions that follow.

 The devices which are part of this patent can be
classified according to the "frequency rate" of the
25 Magnetic Super Pulses (MSP) they generate, which is
produced by the successive and discrete transformation of
the "PECEM," allowing for the following nomenclature of
applications:

 1st Application: Devices that are dedicated to
30 operate with one Magnetic Super Pulse (MSP) to turn ON and
another to turn OFF (such as, when used in electrical
switching circuits), that is, at a null frequency rate;
these devices and their major components are:

 1.1 Transruptors: switching contacts, coil
35 with soft iron (ferromagnetic) core.

1.2 Transreeds: switching contacts, coil with air core, inert gas, or vacuum (encapsulated).

5 1.3 Transjunctors: switching contacts and circuit protection (against short-circuits and overloads), using the PERCCCBA effect or UFPASC effect, which will be explained later.

2nd Application: Devices that are dedicated to operate at a low frequency rate of MSP:

10 2.1 Linear Magnetic Motors: Tremacoli or Maglev type trains for transportation.

2.2 Rotative Magnetic Motors: Magnetic Jet Turbines for aircraft.

15 2.3 Automotive Magnetic Motors: Piston and crankshaft type engines used in automobiles, trucks, ships, locomotives, submarines, and etc.

3rd Application: Devices that are dedicated to operate at a high frequency rate of MSP:

20 3.1 Magnetostriction of Plasma; used for control of Thermonuclear Fusion of the plasma of hydrogen (or, isotope).

25 3.2 Nuclear Magnetic Resonance (NMR): Generally known as MRI - Magnetic Resonance Imaging.

It should be observed that devices that depend for their operation, on the high frequency rate of MSP, such as the case of the two applications above mentioned in 3.1 and 3.2, require coupling with another device called
30 SUPERJUNCTOR. As a matter of fact, in applications where the use of metallic contacts, such as those existent on the "Transruptor," is not feasible, the use of the "Superjuncutor" (which has no contacts) is highly recommended, and whose characteristics and detailed

construction will be given later. The Superjuncter is an integral part of this patent.

This new modality of energy transformation (PECEM) introduces a 3rd case of Electro-mechanical conversion of electrical energy, which now is being added to the two known classical cases of energy conversion; the Electric Motors and the Electric Generators. The technological achievement of this 3rd case of energy conversion, came into being, because of new developments in a new technique of switching circuits, called "The 4th technique - Control by Quantified Energetic Pulse," whose technological evolution is shown in Appendix "A", and entitled, "Evolution of the Technique and Technology of Electrical Switching Circuits."

In order to better understand this new technology, a general background consideration is given about the physical nature of the electric and magnetic phenomena.

The well known cause of magnetic phenomena is electric current. That is, if generalized, it is electrical charge (electrons) in movement. The magnetism in a permanent magnet with all probability, is the microscopic result of molecular current movement produced by the orbital movement of electrons within the atomic structure that make up the permanent magnet.

This close relationship between electricity and magnetism was firmly established by the Maxwell's Theory of Electrodynamics, formulated in the middle of the 19th century. The theory states: "A magnetic field is always in relationship with the movement, and in particular with the rotation of an electrical charge."

The electrons which are part of the atomic structure of a conductor are precisely the type of electrical charge in movement and they are associated with magnetic fields in two ways:

a) Through their orbital movement around the nucleus; and

b) By the rotation or spin around their own axis.

5 The actuation of magnetic fields upon electrical currents that generally are generated by an electrical source external to the conductor, as for example one produced by a battery, causes the appearance of mechanical forces (or mechanical force field, or simply,
10 mechanical field).

 That is to say, in principle, that is what happens in certain technological applications by the works performed by electric machines, either as electric motors or as electric generators. These two applications are
15 generically called: Electromechanical Conversion of Energy.

 In a general way, the action of an electrical field inside of a conductor creates a movement of free electrons through its crystalline structure, which in a
20 microscopic form constitutes an electric current. This electric current in turn, creates around itself, that is, outside the conductor wire, a magnetic field of curved lines, closed and circular, centered in the axis of the conductor wire, and whose direction of travel is
25 determined by the direction of travel of the current, where we apply the well known "right hand rule."

 The interaction of the electrical currents in the technological applications cited earlier as examples, is manifested at a distance through electromagnetic forces
30 that constitute a mechanical field of these forces. These electromagnetic forces act upon the electric currents, which in turn act in the fixed and mobile parts of the device, in accordance with the known general laws of electromagnetism.

In the applications cited earlier, since the interaction with the parts fixed and mobile occur at a distance, the concept of magnetic field is introduced, because it becomes the mediator of this interaction between energetic fields. Therefore a simultaneous actuation exists in the three distinct fields: the electric, the magnetic and the mechanical. This simultaneous actuation guarantee intrinsically an operational reversibility of the energetic transformations to take place, and they constitute the classical electromechanical conversions of energy.

There are two distinct ways for this simultaneous actuation to manifest in accordance with the energy transformations taking place, for example, the DIRECT one which is used to obtain Electric Motors (1st case), or the REVERSE one, which in the opposite direction of its reversibility is used to obtain Electric Generators (2nd case).

The simultaneous actuation of these three distinct fields in reality represent two reverse modes to obtain energetic transformations (or electromechanical conversions of energy).

1st Case: Electric Motors (DIRECT)

25	Electric Field	→	Electromagnetic Field (coupling field)	→	Mechanical Field
	↓		↓		↓
	Given:				Results
	Electric Energy		Mediator (Magnetic Energy)		Mechanical Energy

30 2nd Case: Electric Generators (REVERSE)

	Mechanical Field	→	Electromagnetic Field	→	Electrical Field
	↓		↓		↓

Given:				Results:
Mechanical Energy		Mediator (Magnetic Energy)		Electrical Energy

One of the modes is used to obtain Electric Motors,
 5 and the other to obtain Electric Generators, but always
 with the Magnetic Energy as the mediator in the center of
 this energetic coupling (between the Electric Energy and
 the Mechanical Energy and vice versa).

In other words, the electromagnetic field coupling
 10 acts as an intermediary or as a means of conversion of
 energy. It becomes an energy storage medium between the
 electrical and the mechanical fields, as in the case of
 Electric Motors for example, to supply energy to the
 Output System which is the Mechanical Field, as (the
 15 energy storage medium) is recharged by the Input System
 which is the Electrical Field.

This reaction over the input is represented by the
 induced tension through the magnetic field, and
 constitutes an essential part in this process of Energy
 20 Transference as described in Fitzgerald, A.E.,
 Kingsley, C. and Kusko, A.: "Electric Machinery,"
 McGraw-Hill, Inc., 1961.

This way it is guaranteed, as mentioned above, that
 the interaction of the electric currents in those
 25 technological applications are manifested through
 electromagnetic forces that through a certain distance
 act upon these electric currents, which in turn, act upon
 the fixed and mobile parts that are part of the
 conducting wires of their coils, in accordance with known
 30 laws of electromagnetism. On the other hand, each
 movement of matter in the universe can be explained as
 the interaction of four fundamental forces which govern
 this same universe:

1. The gravitational force; whose interactions between "leptons" (electrons) and the "quarks" composed of protons and neutrons, are possibly facilitated by the boson particle "graviton" not yet detected.

5 2. The electromagnetic force whose interactions are facilitated by the boson (particle) "photon," which produces the radiation wave above and below the frequency spectrum of light.

10 3. The molecular force; which unify the atoms that form the molecules, whose weak interactions, are facilitated by three bosons denominated, "w+," "w-" and "zo."

15 4. The nuclear force, which unifies the nuclear components of the atoms, which unify the atomic structures, keeping them together, whose strong interactions are exercised by eight of the bosons denominated, "w+," "w-," and "zo."

20 We still have, other bosons such as the "phonons," which act upon the ionic crystalline network of the "Higgs" atomic structure of the solid state matter. These particles, theoretically proposed by Peter Higgs, but yet to be detected, would permit to explain the transformation of energy into mass and vice-versa, inside of the atom, and others. Obviously, the energetic transformations caused by the simultaneous interactions of these distinct fields (electrical, magnetic and mechanical), in a sense takes us to the classic Electric Motors and in its reverse to the Electric Generators.

25 These simultaneous interactions are the result of a succession of specific works performed by the electromagnetic forces, (the second of the four fundamental forces described above).

30 It is important to remember that the coupling field (which is the electromagnetic force), being the mediator for both directions of the electromechanical conversion

35

of energy, guarantee this reversibility, operating as an energy storage to supply the conversion into electric energy or mechanical energy in accordance with its purpose.

- 5 As far as the balance of the remaining energy after adding together the energy losses of the interaction between the two classic energetic transformations or electromechanical conversions of energy are as follows:

1st Case: Electric Motors

10	Electrical Energy as input	=	Energy storage by electromagnetic coupling	+	Mechanical energy as output
15	(less resistive losses)		(plus electrical and magnetic associated losses)		(plus losses by friction and ventilation)

2nd case: Electric Generators

20	Mechanical energy as input	=	Energy storage by electromagnetic coupling	+	Electrical energy as output
	(less loss by friction and Ventilation)		(plus electrical and magnetic associated losses)		(plus resistive losses)

The energy losses represent in its totality the irreversible conversion into the form of heat, and representing in its composition or parts, the following losses:

1. The loss of electric energy which we called resistive losses, which are converted into heat because of resistance encountered by the electric current.

2. The loss of energy that is absorbed by the coupling field (electromagnetic field), "associated losses," which are converted into heat, part of which as

magnetic energy loss in the nucleus (magnetic coupling part), and the other part as dielectric coil loss (dielectrical coupling part).

3. The loss of mechanical energy developed inside of the device (motor or generator), which is converted into heat, part of which, are losses through the attrition of the bushing stator, and the other part in ventilation caused during its rotative motion.

If we leave aside the group of "energy losses" as detailed above, and take into consideration only the part concerning energy converted into heat, these energetic transformations become part of the three forms of energy:

1st Case: Electric Motors

15	Electrical Energy as input	=	Energy storage in the coupling field (electro- magnetic)	+	Mechanical Energy as output	+	Energy converted into heat
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2nd Case: Electric Generators

	Mechanical	=	Energy storage in	+	Electrical	+	Energy
20	Energy as input		the coupling field (electro- magnetic)		Energy as Output		converted into heat

In the above general description of the two well known modes of transformation of energy (electric motors and electrical generators), we gave references to the central role of the electromagnetic field, but now we introduce "The 4th Technique of Control," no longer as a "New Technique of Switching Circuits," but as a "New Type of Transformation of Energy," (or "Electromechanical Conversion of Energy"), where the simultaneous actuation

of those three force fields (electric, electromagnetic and mechanical) which are traditionally characterized by their operational reversibility, in reality this simultaneity does not occur in the PECCEM (Pulsating Energy Converted Electro-Mechanically). As a consequence, in that New Technology of Switching Circuits called "The 4th Technique," the Transruptor device demonstrated that an interruption on the simultaneous actuation of the three force fields is possible, and completely eliminates the 2nd case (electric generators), and divides (or "breaks") into two separate stages the simultaneity of the 1st case (electric motors), as it will be demonstrated later.

As a matter of fact, when the Transruptor is turned ON, the Electric Energy is simultaneously stored in the induction coil as Magnetic Energy, and at the same time is being transformed into Mechanical Energy of electromagnetic repulsion, until it reaches a value high enough to cause the repulsion of the Transruptor's armature. This is the first stage which is referred to as the "Energetic Charging Stage" of the device (see FIG. 8 for details). It is obvious that in this stage, the value of the energy will be dependent upon the mass of the armature, as it was verified in tests performed with several types of Transruptors and Transreeds used.

The next stage of its operation begins with the repulsion of the armature and therefore with the end of the "Charging Stage." This repulsion of the armature interrupts or cuts the supply of Electrical Energy that occurred in the previous charging stage, provoking the "storage" of Magnetic Energy in the induction coil. As a consequence, in this second stage of this energy transformation, the Magnetic Energy continues its transformation into Mechanical Energy of repulsion, which

is now fed by the induction coil that now function as an Electric Generator.

In this second stage, there is a division (or "break") in that simultaneity, because the electric field
5 (as recorded in our tests) is no longer the original energy, but the magnetic energy stored in the induction coil, now operating as an electric generator that feeds the final stage of that magnetic repulsion. In other
10 words, in this second stage of actuation of this new type of energy transformation, the electric field that exists is not the original one anymore, but the magnetic energy that is been "released" after its partial storage in the induction coil, as it was described above.

Therefore, the 3rd case of energy transformation or
15 PECEM is obtained in the same way as described in the 1st case, except, that it is NON-REVERSIBLE, since the "quantum" of Electrical Energy captured by the "Transruptor" in the beginning of its actuation is transformed into Magnetic Energy. This Magnetic Energy,
20 which is stored in the induction coil provides in the first instance (t_1), the start of the magnetic repulsion of the Transruptor's armature, to become in a second instance (t_2), the remainder of the Mechanical Energy of magnetic repulsion that is sustained by the remaining
25 Magnetic Energy until its total depletion. This Magnetic Energy is created by the "quantum" of Electrical Energy "captured" (from the 1st Stage) to be later on totally depleted (at the end of the 2nd Stage), see FIG. 8 for details.

30 It should be noted that, if the mechanical mass of the armature is small, the resulting residual energy of that "capturing" also will be very small, and in that same smaller scale, the moment the MSP is triggered there will be an even smaller time duration, until the final
35 instant of its total depletion, which could make the MSP

detection very difficult without the aid of high precision instrumentation, such as a high precision oscilloscope.

This "break" on the simultaneity of the actuation as mentioned before, and now introduced in two stages, demonstrates its irreversible characteristics, as it was established through experimentation using different types of Transruptors, which had different mass in their armature.

In the cases of Transruptors, Transreeds and Transjunctors this 3rd case of transformation of energy called PECCEM is obtained through one single MSP, and this transformation of energy is always generated from the stored energy of the electromagnetic field that is coupled between the electrical and the mechanical fields as part of the 1st Stage of its energetic charging, to be later on discharged on the 2nd Stage of its actuation, in a discrete and irreversible way.

This actuation represents a behavior that is contrary to the two classic cases of energy conversion, electric motors and electric generators, since these allow for the reversibility of the electromechanical conversion of energy, and are characterized as systems of energy conversion of the continuous type, (and not of the "pulse" type as discovered in this 3rd case of transformation of energy called PECCEM).

3rd case: The PECCEM Transformation:

1st Stage: From Energetic charging until the MSP Trigger

Electrical Field	→	Magnetic Field
↓		↓
given		I.E.S. (induction Energy Storage)

Electrical		Energetic Charging until the MSP
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MSP Trigger Occurs (Between the 1st and 2nd Stages)

2nd Stage: Energetic discharge of the coil until
its depletion

5	Magnetic	→	Mechanical Field
	↓		↓
	MSP		Result:
			Mechanical work produced by the magnetic repulsion of the armature

The energy losses are as follows:

1st Stage: The energetic charging of the device:

10	Electrical Energy as	=	Energy storage by electromagnetic field coupling
	(less resistive losses)		until the trigger of the device, (plus associated losses)

2nd Stage: The energetic discharge of the device

15	Energy Storage by electromagnetic coupling (E1);	=	Mechanical Energy (E3);	+	Remainder of the stored energy (E2);
20	until the trigger of the device		spent in the trigger of the device		generating the final magnetic repulsion
	(less associated losses)		(plus losses by friction and ventilation)		(plus losses by friction and ventilation)

The first group of the 2nd stage of the above chart,
25 "Energy Storage by electromagnetic coupling," when the
losses are excluded represent the value of the Mechanical
Impulsion of the MSP, which we designated "E3," whose
concept will be introduced later. Since the losses are
very small, as they were verified in the tests conducted
30 with Transruptors. The value of the Mechanical Impulsion

of the MSP ("E3") can be obtained by the difference between the relative measurements of the Stored Energy "E1" represented in the first group, and the Remainder Energy "E2," represented by the second group of the 2nd stage).

MSP Definition:

We introduce here the definition of "Magnetic Super Pulse" (MSP), as a "mechanical kinetic force of magnetic repulsion, attraction, or compression origin," generated by the discharge of the Magnetic Energy, which is "storage" and serve as "mediator," which is not only unique but also characterizes this 3rd Case of energetic transformation PECEM.

The value of the Mechanical Impulsion of the Magnetic Super Pulse (MSP) can be measured by the mechanical magnitudes involved, as it will be demonstrated later. Also it will be shown the possibility of generating the Magnetic Super Pulse (MSP), through a single or repetitive pulses (of low or high frequency), which through the adequate specification and construction of a Superjuntor, will permit its use in applications capable of taking us, under the technical, economic and utilization points of view to important new technological applications.

The single pulse (or low frequency rate) MSP generators are represented by the devices that were being utilized in the tests. When these devices are used in switching circuits they are called Transruptors (induction coils with an iron core); when they are used as relays "type reed," they are called Transreed which has the following parts: induction coils with an air core, and encapsulated in vacuum or inert gas; and when they are used in circuit protection they are called Transjuntors.

The repetitive pulse (or high frequency rate) MSP generator is represented by the Superjuncutor, which can generate extremely high frequency of Magnetic Super Pulses, as required by applications such as; in the
5 energetic field that controls Thermonuclear Fusion or in the Nuclear Magnetic Resonance (NMR) or Magnetic Resonance Imaging (MRI). The Superjuncutor also can generate low frequency MSP for applications in the field of fabrication of new types of motors, (engines and
10 turbines) which we called generically as Magnetic Motors, to differentiate from the present electric motors, (combustion engines and turbines).

FIGS. 1A and 1B shows a graph, where a comparison is made between the two classic cases of reversible
15 energetic transformations (1st and 2nd cases), and the new case (3rd case) of irreversible energetic transformation (PECEM), therefore, expanding the known cases of electromechanical conversion of energy (previously mentioned).

20 Based on the 3rd case of energy transformation, the possibility exists for the following practical applications:

- 1st. Transruptors (Electrical Switching Circuits);
- 2nd: Magnetic Motors;
- 25 3rd: Magnetic Compression of Plasma and Nuclear Magnetic Resonance or MRI.

In the first of these applications, the electromechanical devices described were used during tests conducted in the Instituto de Electrotecnica e
30 Energia da Universidade de Sao Paulo in Sao Paulo, Brazil, and in the Instituto de Pesquisas Tecnologicas S.A. in Sao Paulo, Brazil. The test results will be presented later, and are part of this patent, as well as the following topics that will be described next:

- Transruptorized System of Remote Control (The 4th technique: Control by Quantified Pulse Energy)
- The construction of a special electromagnetic relay: "Three-phase Transruptor type AB-5/TR-64T;
- 5 • The Construction of the "Transreed."
- Tests Conducted with various types of existent "Transruptors"; leading to the discovery of the Magnetic Super Pulse (MSP).
- Tests conducted with the "Transreed" (air core,
- 10 vacuum or inert gas)
- The PERCCCBA effect (or the "UFPASC" effect) meaning: Ultra-Fast Protection Against Short-Circuit, with application in the protection of electric circuits AC (alternating current) and DC (direct current). The
- 15 device used is the "Transjuncor."
- The construction of the "Superjuncor."
- In the second group of applications, we have the combined use of the Superjuncor, operating in low frequency rate (of MSP), giving origin to a new type of
- 20 "motor," referred previously to as Magnetic Motors, which permit us to analyze in principle, the following types of motors:
- The Linear Magnetic Motors (LMM), used on the trains type "Tremacoli" - Electromagnetic Traction with
- 25 Initial Levitation, (the more recent trains of this type are called MAGLEV).
- The Rotative Magnetic Motors (RMM), Magnetic Jet Turbines for aircraft.
- The Automotive Magnetic Motors (AMM), for
- 30 (engines) that use Piston and Crankshaft.

In the third group of these applications, we have the Superjuncor operating in high frequency rate (of MSP), which led to "breakthrough" research in the following fields:

- The Magnetostriction of the Plasma for the control of Thermonuclear Fusion of Plasma of Hydrogen, (or isotope).

- The Nuclear Magnetic Resonance (NMR) or MRI
5 (Magnetic Resonance Imaging)

The Transruptor application:

The technique to turn ON or turn OFF a lamp or any load, until now was made through the switching of a lever, knife key, switch, circuit breaker and eventually
10 using relays and thyristors. Such devices act directly upon the powering circuit, or require special triggering circuits (such as with thyristors). In a general manner, it is known that when it comes to electrical switching circuits, three techniques, whose historical evolution,
15 attest to the development of their technological evolution. However, this technological evolution occurred in two distinct directions, as shown together in Appendix "A."

The Transruptor solve the problems presented by the
20 1st technique called "Control Under Potential (or Tension)," (see Appendix "A"), as a switching device that operates with an advanced system of remote control technique (4th technique), that replaces with advantage the relay, which is a device of the 2nd technique -
25 "Amplified Control," and the magnetic switches, which are devices of the 3rd technique - "Control by Pulses."

The Transruptor does not need any special triggering circuit or pulse generator, as do similar electronic devices, such as transistors (2nd technique) and
30 thyristors (3rd technique).

As a matter of fact, the energetic pulse that controls the Transruptor is the result of its operating characteristics, which permits the easy economic and safe use of the "multiple control" (a load being controlled by
35 any number of locations), and the "combinatory control"

(several loads controlled one to one, two to two, all to all, from any location), in electrical installations and circuits in general.

In other words the Transruptor can be used as a
5 remote control switch, using low tension, with the purpose of controlling electrical loads using small type momentary and reversible switches, and single energetic pulses of very low value (such as 0.1 to 0.3 joules). The Transruptor is a type of electromechanical "Flip-
10 Flop" with bitable position (ON and OFF). Its state changes when a pulse is sent to the proper "gate" terminal. These momentary and reversible contact switches are used for control of the device that in turn controls the load. These switches can be made of durable
15 materials for its electrical and mechanical characteristics and even in different colors as to blend with any environment.

In summary, the following are the major advantages offered by this application of a new advanced system of
20 remote control (the 4th technique), when used for the control of electrical loads):

1st. Allows the control of the same lamp or load from any number of sources desired, through the use of thin wires such as: No.24 AWG and up to 2 kilometers of
25 distance from the momentary reversible switches.

2nd. Allows through a control center, that from the same locations as many luminaries (lights) as desired be turned ON or OFF, and that one knows before hand the state of each (ON or OFF) lamp or load. Also it allows
30 for example that in a control center the inhibition of as many lights as desired from either to be turned ON or to be turned OFF.

3rd. Easily allowing the attainment of various levels of illumination of ambient or environments.

- 4th. Allows the remote control from many locations as desired, through small momentary reversible switches, with three thin wires (for example, loads up to 10 amps, with control wires as thin as 24 AWG and up to 2
5 kilometers); rotative switches motorized or not, with capacity for a great number of transruptors per switch position, for example 48 loads of 10 amperes each, for a low cost remote control of 480 A (528 kW/110 vac or 1056 KW/220 vac.
- 10 5th. Allows turning OFF simultaneously through only one switch as many Transruptors as desired, which also can be controlled individually from other locations (combinatory control).
- 6th. Allows, through a wiring panel, that at any
15 time the original remote control wiring plan be altered.
- 7th. Eliminates the tension surges and power losses that is common in control circuits.
- 8th. Allows the use with protection devices (such as circuit breakers), which could be installed out of reach
20 of any person if necessary.
- 9th. Makes impossible the occurrence of short-circuit along the remote control wiring circuit.
- 10th. Allows the installation of the control circuit separate from the power source circuit because of
25 the thin wires used in the control circuit, the small size of the switches and the impossibility of short-circuit occurrence. This control circuit wiring can even be performed after the construction is completed. The thin wires in certain applications can be of gauge 30 AWG
30 or insulated enameled copper wire, or the cabling type as used in telephone installations.
- 11th. To turn the Transruptors ON for example, (turn ON lamps), the momentary switches are pressed always on the same side, which is not possible when using

switches in parallel (or intermediaries, 2 way or 3 way switches) as with existing conventional systems.

12th. The saving obtained by this system when compared with the conventional, increases with the
5 installation of greater number of controls per lamp (or load).

13th. Greatly facilitates (for example), the control of small motors, such as used in pumps, appliances, compressors, central heating systems, etc.

10 14th. Replaces with advantage the now used three-phase "contactors," and introduces to the industrial electrical installations, economy and savings which are characteristics of the transruptorized system, its non-equal "electric comfort" brought by the excellent
15 "multiple control" and "combinatory control" systems.

15th. Allows the installation of a "Control Center (C.C.)," which consists of a panel conveniently located, having basically, for example, selector keys, motorized or not, with several contacts for each phase,
20 which can perform the following functions:

1. To control the desired lighting;
2. To inform the status of each one, if ON or OFF;
3. To inhibit the control from other locations, in relation to as many lighting systems as desired;
- 25 4. To inform when abnormalities arise in the control wiring system

16th. Allows the installation of a "wiring panel (WP)," which consists of a panel having for example, terminal blocks made of polyester (or other material),
30 mounted on an insulated panel, conveniently located, where all the wires coming from the transruptors and the momentary control, switches are interconnected. The wiring panel allows changes to be made at any time on the control system. It is like a PBX system for lighting
35 control.

The repetitive pulse type applications of the MSP require the use in combination with a Superjunctor, which can be used in the high frequency mode for applications such as the energetic control of Thermonuclear Fusion or the Nuclear Magnetic Resonance (NMR or Tomography), or when used in the low frequency mode for applications, such as in the area of fabrication of new types of motors, which we generically call them Magnetic Motors, as we mentioned before, and to differentiate from the present Electric Motors.

In FIGS. 1A and 1B, the above is made clear by comparing the two classic cases of reversible energetic transformations (1st and 2nd cases), and the new case (3rd case) of irreversible energetic transformation of Pulsating Energy converted Electro-mechanically, called PECCEM, expanding in this manner the known cases of electromechanical conversion of energy. Therefore, as mentioned before, and based on this 3rd case, the FIGS. 1A and 1B shows the following areas of practical applications of the PECCEM:

- 1st: Transruptors, Transreeds and Transjunctors
- 2nd: Magnetic Motors: Linear (trains); Rotative (Jet Turbines); and Automotive (piston and crankshaft type engines).
- 3rd: Magnetic Compression (or Magnetostriction) of the Plasma of Hydrogen (or Isotope), and the Nuclear Magnetic Resonance (NMR-Tomography) or best known as MRI - Magnetic Resonance Imaging.

For what has been said, it is easy to understand how important the discovery of any "new experimental fact," that is related to the subject (PECCEM), makes possible the development of new concepts, and as a result, new techniques that in turn contribute to a better understanding of the subject, resulting in new

technological applications (and equipment), or the upgrading of existing ones.

In these conditions, first of all we built a special electromagnetic relay, a three-phase "contactor" type that is different than the present ones in use, and with clear advantages as we shall see.

The Construction of the Special Relay (Transruptor type):

Conventional relays contain as a rule an armature, hence an armature that contains fixed contacts. These contacts provide the electrical connection with the load and through the energizing of the electro-magnetic coil the armature is activated. It is evident that it is necessary to have a continuous current through the coil winding in order to maintain the load circuit activated. This represents an additional constant consumption of electrical energy and at times, a separate circuit type low voltage, is used for the control of the conventional relay.

Other relays, have their coils activated only when needed to turn ON a circuit (for example, by using a push-button), in such case the fixed contact is kept in the closed position by additional mechanical means, (for example, the remote control relays, such as those manufactured by Siemens and General Electric and used in lighting control). Nevertheless, these type of relays present the disadvantage that, once the circuit is turned ON, the flow of current becomes constant, that is, continuous, unless a failure occurs or a push-button is pressed, or any key controlling the current through the coil interrupts the flow of current. If the coil is not designed for the continuous flow of current, the coil will burn out.

The special relay (transruptor type), whose construction is described below, combine all the

advantages and eliminate the disadvantages of the majority of the known relays, by the fact that the following characteristics can be claimed:

1. The control circuit for activating the Transruptor can be connected using the direct current (DC) or alternating current (AC) wiring systems, which supplies power to the load to be activated, and in the case of AC, it can be 50/60 hertz, monophase, two-phase or three-phase.
2. The two stable states (bistable) of the special relay are maintained through permanent magnets, which means, that, there is no electrical energy consumption during the stable states, also any mechanical devices such as, springs or similar approaches are not used.
3. Once the special relay is activated, it is impossible to have the current go through the same coil again unless the relay is activated again to return to its previous state.

Since we desired a large mass for the armature, which we recommend (for test purposes), and that the device be of the tripolar (three sets of contacts) type, that is, it must have the semi-rigid plate (22) that holds the reversible movable contacts (3a) and (3b) as shown in FIG. 2, which is required for its operation, also will have two more rigid plates that are isolated, (21) and (23), assembled on each side parallel with the reversible plate (22), and each having movable contacts (11a and 12a) that are non-reversible, and closes when the coil is activated. These three contacts, (3a, 11a, and 12 a) must be isolated from each other and allows current in excess of 64 amperes per phase to flow through them. Besides the three plates (21), (22) and (23), the Transruptor also will have two other plates (20 and 24) which are also the rigid type, as shown in FIG. 2, and are assembled transversely to the other blades, These two

plates will not have any electrical contact participation and will form a set of five plates that are mounted transversely onto a bar (18) and a spindle (19) of the armature.

5 FIG. 2 shows a drawing of the armature, where besides the central bar (18) that isolates the five plates, assembled into it, but also the spindle (19) provides partial rotation to the whole assembly. The central plate (22) holds in each of its extremities the
10 contacts (3a) and (3b), but the adjacent plates (21) and (23) only have contacts (11a) and (12a) on the extremity that corresponds to the position that the special relay is activated, because on the other extremity two
15 permanent magnets (11b) and (12b) are glued or epoxied one on the top side and the other on the bottom side, and having their magnetic polarities accordingly opposing each other. The outer plates (20) and (24) which are rigid and magnetically activated does not have any electrical contact participation in both ends, permanent
20 magnets (9a) and (9b), and (10a) and (10b), are glued on both sides, top and bottom of the plates (20) and (24) as detailed in FIG. 2.

These pair of permanent magnets operates together with eight coils, where six of the coils are wired in
25 parallel and with the same polarity in relation to the position of activation of the special relay (Transruptor AB-5 model TR-64T), whereas the other two coils are connected for the deactivation of the Transruptor.

FIG. 3 section CC, shows in cross section, details
30 of the central semi-rigid plate assembly (22); and in section BB, shows the lateral rigid plates (21) and (23); and in section AA the outer rigid plates (20) and (24). The FIG. 3 also shows the actuation state, that is, shows the position of the special relay when activated and
35 deactivated. The FIG. 4, shows the electrical wiring

diagram of this special relay, (which is a Transruptor TR-64T/110v type AB-5 for operation in 64 amperes), and we can observe the six coils that are wired in parallel and with the same polarity, and the other two coils are
5 also wired in parallel with each other in relation to the other six coils. (These coils were made of copper wire #38 AWG, with an inductance of 716 MH and approximately 800 turns of wire for each coil).

From the FIG. 4, we can make the following
10 observations:

- 1) The rigid plates (20), (21), (23) and (24) and the semi-rigid plate (22) move simultaneously because of their attachment to the common bar and spindle (18) and (19) as show in FIG. 2;
- 15 2) The coils (1) and (4) are installed in an angle
- 3) The activated state is shown.

The special relay that we are suggesting is the construction of a Transruptor of 64 amperes, three-phase, type AB-5 model TR-64T (as shown in FIGS. 2, 3 and 4),
20 and it is built with six permanent magnets; (9a), (9b), and (10a) (10b) which are glued (using epoxy) on the extremities of plates (20) and (24), and magnets (11b) and (12b), which are glued (using epoxy) on the extremities of plates (21) and (23), which when the
25 device is activated are magnetically adhered to the iron core of their respective coils, these six coils are electrically wired in parallel and all have the same magnetic polarity. Two other coils (1) and (4) are also wired in parallel and with the same magnetic polarity,
30 but their polarity is the opposite of the other six coils. The permanent magnets (11b) of plate (21) and (12b) of plate (23) are adhered magnetically to the iron core or ferrite of their respective last two coils.

Each conductive rigid plate of the armature is
35 electrically wired to the output of a power source, for

example, 220 vac/60 hz, three-phase, using adequate size conductor wires, flexible and the braided type. The control part of the device could be 110 vac/60 hz, using the ground (or neutro) wire and the central phase of the
5 above electrical source of 220 vac.

It should be observed that following the same energetic principles for the electrical, magnetic and mechanical aspects described above, we can build several other models of tripoles, bipoles, and monopoles, for
10 different nominal tensions (voltages) and currents, whose armatures could have smaller mechanical mass, and made of flexible blades made for example of phosphorous bronze material, where the correspondent magnets and metallic contacts are mounted.

15 The reason as to why we gave preference to the Transruptor TR64T-/AB-5 in the above description and construction plans, rather than to other types of Transruptors, is based on the relevant fact that this Transruptor has on its armature a large mechanical mass
20 that permitted the interpretation of the tests conducted with available oscilloscopes, which resulted in the discovery of this new 3rd Case of transformation of energy, called PECCEM - "Pulsating Energy Converted Electromechanically," which is also part of this patent.

25 In all of these tests, the common characteristic was the fact that all the induction coils had a magnetic soft iron core. For this reason, it was necessary the verification (of the PECCEM discovery) in devices with coils and air core, vacuum, or inert gas. For this
30 reason we are also giving the detailed construction of the "Transreed," which is a device with air core, vacuum encapsulated.

The detailed construction of the Superjuntor will be provided later on, when the description of its use in
35 the 3rd application group of the MSP technology to the

Magnetostriction of the Plasma and to the Nuclear Magnetic Resonance.

Therefore, as mentioned before, in the construction of the special relay (Transruptor TR64T/AB-5), the use of
5 a large mechanical mass in its armature was well justified because it authenticated the discovery of the Magnetic Super Pulse (MSP) as described in this patent. As a matter of fact, the sequence of events of the energetic transformation during the operation to turn OFF
10 the special Transruptor are as follows; the inductive electric energy stored in the six coils generates a magnetic energy that actuating in the iron core of the respective coils, generates a mechanical energy of repulsion that actuates the armature (see FIG. 4).

15 The large moving mechanical mass of the special Transruptor forced the normally fast and microscopic energetic transformation to be revealed in a macroscopic way as if a "slow motion" sequential movement was taking place, allowing its detection by a fast tracking
20 oscilloscope. From the test results we added to the specifications a reference to "coils with ferromagnetic core," when the armature presented a large mechanical mass.

In the case of the tests with the Transreed, which
25 has a very small mechanical mass in its armature, the specifications reference is "coils with air core, vacuum or inert gas." The result of the tests obtained with "coils with ferromagnetic core" will be given later on when we will be dealing with their application to
30 "Magnetic Motors," whereas, the ones obtained with "coils with air core, vacuum or inert gas" will be given later on when we will be dealing with the "Control of Thermonuclear Fusion," and of the "Nuclear Magnetic Resonance."

We obtained from these types of experiments, the sequential behavior of this new irreversible energy transformation (3rd Case: The PECCEM transformation), which, in reality represented a "break" (or interruption) on the simultaneous actuation of the three energy fields previously mentioned (electrical, magnetic and mechanical), we saw the need to construct a special relay, that would have the same characteristics of the Transruptor, but would have a very small armature with a minimum mechanical mass and its coils would have an air core, vacuum or inert gas (instead of the ferromagnetic core). For these reasons, a reversible Reed type relay was obtained, and it was "transruptorized," (that is, modified to operate like a Transruptor).

This new device was called Transreed (AB-5), which is shown in FIG. 6, and is similar in its "transruptorization" to the typical circuit diagram shown for the Transruptor AB-5 in FIG. 7. In this case, for comparison purposes, the load C1, the coil (2) and the "gate" D1 of FIG. 6 are the same as the load C, coil (17) and "gate" C (OFF) of FIG. 7.

With respect to FIG. 7, (Transruptor Type AB-5 diagram), we make the following observations:

1. The circuit is shown in the ON activated state.
2. The inductor coil (17) which is used for the OFF state activated through terminals (2) and (3) in reality corresponds to the same six coils wired in parallel, as shown in FIG. 4 (coils 2, 8, 13, 14, 15, and 5).
3. The inductor coil (16) which is used for the ON state, activated through terminals (4) and (5), in reality corresponds to the same two coils wired in parallel as shown in FIG. 4 (coils 1 and 2).
4. The diodes located between terminals "4 and 4" and "2 and 2" as shown in FIG. 4 are not shown in FIG. 7.

Since we found difficulty in obtaining the reversible type Reed relay (one that has two contacts, as shown in FIG. 6), we used one that was available, which has only one contact, type normally open, (as shown in FIG. 5), which, also being of the type Reed, satisfied the previous conditions of having a armature of "minimum mechanical mass," thus permitting the construction of induction "coils with core of air, vacuum or inert gas."

The only difference we had to consider is that its "transruptorization" (conversion into a Transruptor type device), was done a little different from the previous special Transruptor TR64T/AB-5, and FIG. 5 shows the wiring diagram for the Transreed type AB-1.

As a matter of fact, in the case of the Transreed, the operation to turn OFF the load "L" of FIG. 5 is similar (or correspond) to the turn OFF of load "C1" of FIG. 6, and also to the turn OFF of load "C" of FIG. 7, as shown in the following Table:

FIG. 5		FIG. 6		FIG. 7
Load "L"	→	Load "C1"	→	Load "C"
The Only Induction coil	→	Induction Coil (2)	→	Induction Coil (17)
Lower Gate (OFF)	→	Gate "D1" (OFF)	→	Gate "D(C)" (OFF)

It should be noted that, even though the Transreed AB-5 of FIG. 6 or the Transreed AB-1 of FIG. 5, can work according to their specifications, either in alternating current (AC) or direct current (DC), but in the tests conducted in this case we only used 6 VDC. The housing of the Reed relay used was the glass vacuum sealed type. The only coil used, has 100 turns of wire 22 AWG, a resistance of "0.25 ohms," and a total reactance of "53 micro-henrys." In order to obtain the tests to which the

Transreed (AB-1) was submitted, the circuit diagram of FIG. 5 was used, and the above construction and operating specifications. In these conditions we used as a power source a 6VDC battery, made of four small batteries type AA, wired in series, and used for the operation of turning OFF the load "L" (see FIG. 5), even though it is the type AB-1, electrically it corresponds to the same operation to turn OFF the load "C" in the type AB-5 (see FIG. 7).

10 The construction of these "transruptors," one with a large mechanical mass and coils with soft iron and type AB-5, and the other with a very small mechanical mass and coil with air core (encapsulated) in a vacuum, which we called Transreed type AB-1, were submitted to special tests, whose results are shown in Appendices "B," "G" and "H," which will be discussed later on.

Each of the tests conducted made use of the oscilloscope Tektronix Model TK2440, that has two independent channels (Channel 1 and Channel 2), the first channel was used to measure the voltage "V," applied between the terminals "2" and "3" of the coil (17) that it is used to turn OFF, and the second channel was used to measure the current "I" (A), through the same coil between the terminals "1" and "2" through the voltage drop across the "shunt" (for example 1 ohm), installed at that location as shown in FIG. 7.

For each test conducted the respective oscilloscope curve graph was selected, and using the existing "firmware" of the calculator Tekmate-2402 which is attached to the oscilloscope TK2440, we calculated the product function "W" correspondent to the independent variables of the "input," which correspond to the electrical power function (in watts) supplied by the source (AC or DC) used for the deactivation of the device. Next, using another part of the "firmware" of

the calculator, we obtained a defined integral of the curve "W(t)," which corresponds to the energy curve "E(t)" (as shown in FIG. 8) These values, for example, measure the inductive energy storage (I.E.S.) which is supplied by the power supply (110 vdc or 110 vac/60 hz) for the desired deactivation of the device. The following equation provides the value for the I.E.S.

$$E(t) = \int_{t_0}^{t_1} W(t) . dt(j) \quad (1)$$

(Value of the I.E.S.)

The methodology used, provided the energetic values that correspond to the fractions of the time period from the instant zero (t0) of the actuation of the trigger key "D" (see FIG. 7), until the final instant "t2" of the transitory pulse observed (see FIG. 8).

The third equipment attached to the oscilloscope was the color plotter Tektronix Model HC 100, which besides allowing calculations in detail of the energetic time "E(t)," also provided the temporary status of all other functions, represented by the basic curves "W(t) and I(t)," and the calculated curves of power and energy, respectively "W(t) and E(t)."

The results obtained are shown in the plotted graphs of the various devices tested (see from FIG. 11 through FIG. 38), also these results are tabulated in Appendices "B", "G" and "H," that will be presented later on.

When we analyze the four curves (presented in graph form in FIG. 8), we have basically the following observations:

1st Curve: (Channel 1): The electric tension or voltage measured in (V) [V=V(t)]: Corresponding to the electric field produced by the Power Supply (DC or AC/ 60 hz) in the ends of the wires of the inductor coils, for

example, in the case of the Transruptor TR-64T/AB-5 where six coils are used, which are made of copper wire #38 AWG, wired in parallel, with an inductance of 716 MH and approximately 800 turns of the wire per coil; this
5 electrical tension "V" was measured during the tests by reading the voltage drop across the two common ends of the wires of the referred coils, (terminals "2" and "3" of FIG. 7);

2nd Curve: (Channel 2): The electrical current
10 measured in (A) [$I=I(t)$]: Corresponding to the velocity of advancement of the free electrons that exist in the ionic crystalline structure, which constitutes the solid state of the copper wire used in the windings of the inductor coils.

15 3rd Curve: Electrical power (in watts) measured in (W) [$W=W(t)$]: Corresponding to the amount of kinetic energy per unity of time that is transferred by the free electrons referred above to the ions of the crystalline structure that constitutes in microscopic form the
20 metallic copper of the conductor used on the winding of the coils. This electrical power (W) was obtained through calculation, using the calculator Tekmate 2402, which is attached to the oscilloscope. The result of this calculation is the product of the series of values
25 represented by the applied tension or voltage (1st curve, channel 1) and the current (2nd curve, channel 2).

4th Curve: The electric energy (in joules) measured
in (J), [$E = E(t)$]: Corresponding to the total of electric energy transferred by the free electrons to the
30 ions of the crystalline structure of the metallic copper of the conductor used on the winding of the coils, this electrical energy is called Inductive Energy Storage (IES). The calculation for this energy was also obtained using the microprogram that exists in the calculator
35 Tekmate 2402. The value of this electric energy is the

integer of the electric power mentioned before,
represented by the 3rd curve above, that is:

$$E(t) = \int_{t_0}^{t_1} W(t) . dt \quad (2)$$

The graph in FIG. 8 also shows the typical configuration of these four curves, obtained during the tests, and they represent the events before, during and after the Magnetic Super Pulse (MSP) triggering event, as a technological characterization of the 3rd Case of the discrete and irreversible energetic transformation, of which the Transruptor is part.

The four curves of FIG. 8 are shown in the two event periods that characterize the 1st and the 2nd Stages of the (Transruptor) operation:

In the 1st Stage, the period of time that takes to energize the induction coil (17) of the Transruptor (FIG. 7) is referred to as the "Full Charge" period.

$$\delta c = t_1 - t_0 \quad (3)$$

In the 2nd Stage, the final period of time for the discharge of the magnetic energy stored in the same induction coil (17) is referred to as the "Discharge" period.

$$\delta d = t_2 - t_1 \quad (4)$$

The instant "t₁" that separates these two stages, represent the instant of the mechanical activation by the strong magnetic impulsions over the armature causing the abrupt interruption of the supply of energy from the 1st stage. This magnetic impulsions uses a great part of the stored magnetic energy. The remainder of this stored magnetic energy is used to continue to pull away the armature until the total discharges is completed in the instant "t₂."

The curve $V(t)$, part "a" of FIG. 8, was obtained through the channel 1 of the oscilloscope, and represent the continuous voltage applied by the external power source to the terminals "2 and 3" of the induction coil (17) of FIG. 7 to turn it OFF from the start of instant " t_0 " until the trigger of the MSP at the instant " t_1 ." After the instant " t_1 " until the end of instant " t_2 ," the curve now represent the tension in the coil, which, from that instant on, it starts to work as an "electric generator" that uses the remainder of the stored magnetic energy that supply the 2nd stage as described above.

The curve $I(t)$, part "b" of FIG. 8, was obtained through the channel 2 of the oscilloscope, and represent the continuous current supplied by the external power source. This current circulates through the same coil (17) of FIG. 7, until the instant " t_1 ," when at that instant the current supplying the coil now operates like an "electric generator" until the end of the 2nd stage.

The curve $W(t)$, part "c" of FIG. 8, was obtained through the calculator Tekmate 2402 (attached to the oscilloscope), and represent the numerical product of the time values of the two previous curves. This curve represents in the 1st Stage, the electrical power supplied by the external power source, and in the 2nd Stage, represents the electrical power generated by the stored part of that energy as magnetic energy, as previously described.

The last curve $E(t)$, part "d" of FIG. 8, was obtained through the same calculator Tekmate-2402, and represent the values of the defined integer of the tension (voltage) referred above, therefore, corresponding to the electrical energy being transferred. In these conditions, in the instant " t_1 " the value of " $E(t)$ " will correspond to the total energy transferred from the external source into the "induction coil (17),"

or the total value of the IES (Inductive Energy Storage). The value $E_2(t)$ from the instant " t_1 " until the end of instant " t_2 ," correspond to the remainder of the magnetic energy stored or MES (Magnetic Energy Storage) in the inductor coil (17). The difference " $E_3 = E_1 - E_2$," represent the energy of magnetic impulsions that repels the armature of the Transruptor. (" E_1 " is the value in "joules" of the I.E.S., " E_2 " is the residual value of the magnetic energy stored as M.E.S).

10 The following important principles were observed:

1st. The electrical power (W) supplied by the power source, can be calculated from the power " w ," supplied by a single electron. As such, we would have:

$$w = Te / \delta t \quad (5)$$

where " Te " is the work exerted by the force of the electric field upon the electron, that travels (" δl ") in the direction of the internal electrical field of the conductor; then we have:

$$Te = q \cdot H \cdot \delta l \quad (6)$$

where, " H " is the internal electrical field, and " q " is the electrical charge of one electron. If we substitute equation (6) in equation (5), we have that:

$$W = q \cdot H \cdot \delta l / \delta t \quad (7)$$

yet, if $v = \delta l / \delta t$, (where " v ") is the average velocity of the electron, we would have:

$$w = q \cdot H \cdot v \quad (8)$$

For " n " electrons cm^{-3} , the total number of electrons for a conductor of transversal section " S " and height " δl " will be:

36

$$N = n \cdot S \cdot \delta l \quad (9)$$

Therefore, the total power "W," becomes:

$$W = N \cdot w \quad (10)$$

Substituting equations (8) and (9) equation in (10) we will have:

$$W = n \cdot S \cdot \delta l \cdot q \cdot H \cdot v \quad (11)$$

yet, the electrical tension will be:

$$V = H \cdot \delta l \quad (12)$$

5 and the electrical current will be;

$$I = N \cdot q / \delta t \quad (13)$$

Substituting equation (9) equation (13), we will have:

$$I = n \cdot S \cdot q \cdot \delta l / \delta t \quad (14)$$

yet, $v = \delta l / \delta t$, therefore equation (14) becomes:

$$I = n \cdot S \cdot q \cdot v \quad (15)$$

Substituting equations (12) and (15) in equation (11), we will have:

$$W = V \cdot I \quad (16)$$

10 which corresponds to the value calculated and described for the 3rd curve mentioned above.

2nd. It should be noted that, when the ends of a conductor wire are connected to the poles of a battery, we establish an electrical field, of which the physical
 15 evidence is the surging of a force that acts upon all particles (ions and electrons) that exists within the metallic conductor wire. This action causes the sensible dislocation of the free electrons contained in the conductor, giving credence, macroscopically, to the

resulting electrical current. The existence of this electric force is due to its inseparability from its electrical mass (or electrical charge), upon which that electrical field acts. The electrical charge of one
 5 electron is of approximately "1.6 x 10⁻¹⁹ coulomb," for the number of free electrons per unit of volume (cm³) for a copper conductor is of approximately " 8.4 x 10²²," and the propagation velocity of this electric field along the conductor wire is actually, equal to the speed of light
 10 (3 x 10⁸ m/s).

Calculation of the MSP:

We have defined the Magnetic Super Pulse (MSP) as a mechanical kinetic force of magnetic origin generated by the discharge of magnetic energy of repulsion, attraction
 15 or compression, divided by the duration of the time "δd" of the magnetic energy discharge, that is:

$$PM = \eta \cdot E_3 / \delta d \quad (17)$$

where,

$$E_3 = E_1 - E_2 \quad (18)$$

therefore we have;

$$PM = \eta \cdot (E_1 - E_2) / \delta d \quad (19)$$

where:

20 "η" is the resulting transformation of energy, from electric (IES) to Magnetic (MES);

"E₁," is the value (in joules) of the electrical energy (IES) supplied by the external supply;

25 "E₂," is the value of the energy stored in the induction coil;

"E₃," is the magnetic energy of impulsions, attraction or compression;

"PM," "Power Mechanics" or Mechanical Power, is a mechanical kinetic force of magnetic origin;

5 "δd," is the value (in seconds) for the period of discharge of the Magnetic Energy Stored (MES), which is transformed into mechanical energy of magnetic repulsion of the armature of the special relay (Transruptor), that was used in the tests described
10 previously.

The value of the mechanical kinetic force of the Magnetic Super Pulse (MSP) can be calculated by the mechanical mass involved. As a matter of fact, the energy that corresponds to this magnetic repulsion can be
15 calculated by the impulsion action realized by the repulsion force "f" along the path "d1," that is;

$$PM \cdot \delta d = f \cdot d1 \quad (20)$$

therefore, will be:

$$PM = f \cdot d1 / \delta d \quad (21)$$

yet

$$d1 / \delta d = v_o \quad (22)$$

substituting equation (22) in (21), we will have:

$$PM = f \cdot v_o \quad (23)$$

20 The expressions of equations (19) and (23), will be used to check the results of the experiments.

The important thing is that, the time of discharge of the MSP, shown as "δd" in FIG. 8, has the tendency to decrease with the reduction of the mass of the armature
25 of the device, as it was observed in the test number IEE-33TR using the device Transreed type AB-1, 6VDC, and

wired not as an ordinary Reed relay, but as a device of the "4th Technique."

FIGS. 8a through 8c shows how the electrical energy is supplied by the external source during the period of time " δc ," which is the energetic charging period.

FIG. 8d, shows the value of the integer curve of the power supplied by the external source, which is the energy "E1" (I.E.S.) previously referred, and it is the following:

$$E1 = \int_{t_0}^{t_1} W(t) . dt \quad (24)$$

10 (I.E.S.)

$$PM = (\eta . \int_{t_0}^{t_1} W(t) . dt / \delta d) \quad (25)$$

(value of the MSP)

It should be observed that during the period that the electrical charge is active and of duration " δc ," the equivalent circuit is a simple circuit with one inductor, (in our test we used the TR-64 T/AB-5 device, which has six coils in parallel), and total auto-inductance "L," and with an equivalent resistance " R_0 ," with its normal value set for room temperature.

Now we can analyze the behavior of a typical circuit, according to variations in its parameter values. In this condition, we could connect in an instant "t" a battery having a voltage "E" to an induction coil having a total high inductance "L," and a total resistance "R," granting that, they are connected in series in a typical "R&L" circuit (see FIG. 9a).

The quotient $T = L/R$ is denominated time constant ("T") of the typical circuit "R&L," whose physics dimension is the Time, because in the System of Electro-

Magnetic Units, "L," has a physics dimension of Length, and "R," has a physics dimension of Velocity.

The Fundamental Differential Equation of this circuit will be:

$$E - d/dt(L.I) = R.I \quad (26)$$

- 5 In the particular case where "L" is a constant, that is, not subject to changes, the equation is simplified:

$$E - L dI / dt = R.I, \text{ or } L.dI / dt + r.I = E \quad (27)$$

We can still introduce the time constant $T = L/R$:

$$dI / dt + I / T = E / L \quad (28)$$

Adopting as an "integration factor" the function:

$$y = e. \int dI / dt \quad (29)$$

- and multiplying both members of equation (28) by "y,"
10 becomes:

$$y. (dI/dt) + y. (I/t) = y. (E0 / L) \quad (30)$$

yet

$$d/dt (I.y) = (dI/dt) .y + I. (dy/dt) \quad (31)$$

where:

$$dy/dt = d/dt(e. \int dI/T) = (1/T) . e. \int dI / T = (1/T) . y \quad (32)$$

Therefore equation (31) becomes:

$$d/dt(I.y) = (dI/dt) .y + (I/T) .y \quad (33)$$

- substituting equation (30) in equation (33), we will
15 have:

$$d/dt(I.y) = y. (E0/L) \quad (34)$$

Integrating equation (34), results in:

$$I. y = \int (EO/L) . y. dt + C \quad (35)$$

where

$$I = (1/y) . [\int (EO/I) . y. dt + C] \quad (36)$$

This last expression (36) represents the General Solution of the Fundamental Equation of the Series Circuit, "R & L," where "R" and "L" represent, respectively, the total resistance and inductance of the circuit.

We will examine certain particular cases of importance for which the equation (36) assumes a simpler form:

10 1st Case: "E" and "L" are constants, the resistance "R" varies suddenly at time zero, from the value "R₀" to the value "R₁," becoming afterwards constant. Since the intensity of the current in that initial instant, which was "I₀," after a certain amount of time, becomes "I₁," we
15 will have then:

$$I_0 = E/R_0; I_1 = E/R_1, \text{ making: } T = L/R_1 \quad (37)$$

We can say that the current "I" at time "t," will be a superposition of the current "I₁" with the extra-current "J," that is:

$$J = I - I_1 \quad (38)$$

20 The induction flux changes from the value "L.I₀" to the value "L.I₁." In such conditions the total quantity of the electrical charge used by the extra-current will be:

$$\int_0^{\infty} J \cdot dt = q = (L \cdot I_0 - L \cdot I_1) / R_1 = L \cdot E / R_1 (1/R_0 - 1/R_1) \quad (39)$$

The equation (27) can be written, for $t > 0$:

$$T \cdot dI/dt + I = E/R_1 = I_1; \text{ or } : T \cdot dJ/dt = -J \quad (40)$$

where:

$$J = J_0 \cdot e^{-t/T} \quad (41)$$

To determine the coefficient, " J_0 ," we calculate the electrical charge " q ," we will have:

$$\begin{aligned} q &= \int_0^{\infty} J \cdot dt = J_0 \cdot \int_0^{\infty} e^{-t/T} \cdot dt = J_0 \cdot T \cdot \int_0^{\infty} (-1/T) \cdot e^{-t/T} \cdot dt = \\ &= J_0 \cdot T \cdot \int_0^{\infty} e^{-t/T} \cdot dt = -J_0 \cdot T (0-1) = J_0 \cdot T = J_0 \cdot (L/R_1) \end{aligned} \quad (42)$$

5 Therefore:

$$q = J_0 \cdot (L/R_1) \quad (43)$$

but, per equation (39), will be:

$$J_0 \cdot (L/R_1) = (L \cdot I_0 - L \cdot I_1) / R_1 \quad (44)$$

Therefore:

$$J_0 = I - I_1 \quad (45)$$

In these conditions, the function of the current in an instant " t ," that is, " $I(t)$," can be obtained the following manner:

From equation (38), we have:

$$I = J + I_1 \quad (46)$$

but, per equations (41) and (45) we will have:

$$I = (I_0 - I_1) \cdot e^{1t/T} + I_1 \quad (47)$$

But as we saw that $I_0 = E/R_0$; and $I_1 = E/R_1$; therefore the equation (47) will become:

$$I = E/R_1 + E(1/R_0 - 1/R_1) \cdot e^{-t/T} \quad (48)$$

In this case, since only the electrical resistance is variable, we will take into consideration the following:

- 5 a) The resistance "R" abruptly goes in an initial instant " t_0 " from an infinite value to the value " R_1 ." This corresponds (FIG. 9a) to the abrupt closing of the circuit through the switch "S1" but keeping the other switch "S2" open. Therefore, resulting, that until the
10 initial instant " t_0 " the current " I_0 " will be null, and per equations (48) and (46), we will have:

$$I = E/R_1 \cdot (1 - e^{-t/T}) = I_1 + J \quad (49)$$

but, if we substitute the equation (45) into equation (41), remembering that $I_1 = E/R_1$, we will have:

$$J = -(E/R_1) \cdot e^{-t/T} \quad (50)$$

- By observing the expressions (49) and (50) we can verify
15 that, FIG. 9b, tells us that, the current "I" will not reach its final value, for a period of time; and that, eventually this value will be reached with a margin of error of less than 1/1000, after the time " $t = 7.T$ " has elapsed; where " $e^{-7} = 0.000912$ "; the shaded portion of
20 FIG. 9b represents the amount of electric charges that constitute the extra-current "J."

- b) The resistance of " R_0 " and " R_1 " are finite. If " R_0 " is greater than " R_1 ," then the extra-current "J" is of opposite direction of the current " I_1 ." If " R_0 " is
25 smaller than " R_1 ," then the extra-current "J" has the same direction of " I_0 " or " I_1 ," because an increase in

resistance produces a decrease in the intensity of the current.

c) The resistance " R_1 " is infinite. This is the case of an "open circuit," where " E " is a constant, while
 5 the variable " R " abruptly goes from a value " R_0 " to infinite. In the circuit of FIG. 9a, switch " S_1 " was closed and " S_2 " was opened in the initial instant (" t_0 "), then assuming the open position, causing the current intensity to drop to zero and, the electromotive force
 10 (emf) of the auto-inductance " $L \cdot dI/dt$," which can assume a very high value. As a consequence, an electrical spark or arc irrupts in the place where the circuit opened (in this case in switch " S_1 "), which extends for a brief period the duration of the current. In these conditions,
 15 the variations in the resistance and in the consequent functions " E " and the integrating function " y ," in relation to time, prevents us from utilizing the general equation (36), which represents the General Solution of the Fundamental Equation for Series Circuit, " R & L ,"
 20 until now under consideration.

2nd Case: We abruptly vary the electromotive force (emf), " E ," without changing either " R " nor " L ." In the case of the circuit presented in FIG. 9a, in the initial instant " t_0 ," which corresponds to the closing of switch
 25 " S_2 ", and with switch " S_1 " already closed, places the power source in short-circuit. As shown in the FIG. 9c, right after the suppression of the power source, the current " I " goes from the value " I_0 " towards the zero value. Since " $E = 0$," we have, that the expression (27)
 30 will be:

$$L \cdot dI/dt + RI = 0 \quad \text{or} \quad T \cdot (dI/I) = -dt \quad (51)$$

where,

$$I = I_0 \cdot e^{-t/T} \quad (52)$$

The graphic representation is seen in FIG. 9c.

The amount induced electrical charge utilized, will be:

$$q = \int_0^{\infty} I \cdot dt = (-T) \cdot I_0 \cdot \int_0^{\infty} (-1/T) \cdot e^{-t/T} = (-T) \cdot I_0 \cdot (0-1) \quad (53)$$

but, $T = L/R$; therefore,

$$q = (L \cdot I_0) / R \quad (54)$$

- 5 This last expression shows that the quantity of induced electrical charge, is the quotient of the initial flux by "R." In this case, we can calculate the inductive energy stored in the induction coil ("Inductive Energy Storage-I.E.S"), assuming the coil has dissipated all the energy
10 into resistor "R." Therefore, this energy "E1," will be:

$$E1 = \int_{t1}^{\infty} R \cdot I^2 \cdot dt = \int_{t1}^{\infty} R \cdot I_0^2 \cdot e^{-2 \cdot (t-t1)/T} \cdot dt =$$

$$R \cdot I_0^2 \cdot \int_{t1}^{\infty} e^{-2 \cdot (t-t1)/T} \cdot dt \quad (55)$$

Making, " $x = 2 \cdot (t-t_1)/T$," then for, " $t = t_1$, $x = 0$," therefore for " $dx = (2/T) \cdot dt$, or, $dt = (T/2) \cdot dx$." The above expression becomes:

$$E1 = R \cdot I_0^2 \cdot T/2 \int_0^{\infty} e^{-x} \cdot dx = R \cdot I_0^2 \cdot T/2 =$$

$$R \cdot I_0^2 \cdot T/2 = 1/2 \cdot L \cdot I_0^2 \quad (56)$$

- Therefore the inductive energy storage (I.E.S.) can be
15 calculated by the following formula:

$$E1 = 1/2 \cdot L \cdot I_0^2 \quad (57)$$

3rd Case: We abruptly vary the coefficient of auto-induction "L," leaving "E" and "R" constant. This is done by abruptly removing in the initial instant "t₀" the soft iron core from the induction coil. In this case,
 5 the coefficient of the auto-induction goes from the value "L₀" to the value "L₁," where it stays. We can make "L₁/R = T," the current before the disturbance, had the value "I₀," after a while the current return to the same intensity. For example, lets make for a generic instant
 10 "t,"

$$I = I_0 + J \quad (58)$$

where, "J," is an extra-current superimposed over current "I₀"

In this condition, we can calculate the electrical charge "q," utilized by this extra-current; which will
 15 be:

$$q = \int_0^{\infty} J \cdot dt = (L_0 \cdot I_0 - L_1 \cdot I_0) / R = (L_0 - L_1) \cdot L_0 / R_0 \quad (59)$$

but,

$$L_0 = E / R_0 \quad (60)$$

therefore:

$$q = (L_0 - L_1) \cdot (E / R_0^2) \quad (61)$$

From the moment when "L" takes its final value "L₁," we have:

$$L_1 \cdot dI/dt + R \cdot I = E, \text{ or } T \cdot dI/dt + I = I_0, \quad (62)$$

or still, $T \cdot dJ/dt = -J$

20 where:

47

$$J = \alpha \cdot e^{-t/T} \quad (63)$$

To obtain the value of the constant " α ," we must calculate the value of its integer, which is the electrical charge " q "; we have:

$$q = \int_0^{\infty} \alpha \cdot e^{-t/T} \cdot dt = \alpha \cdot T = \alpha \cdot L \cdot 1/R = (L_0 - L_1) \cdot I_0/R \quad (64)$$

Therefore, will be:

$$\alpha = (L_0 - L_1) \cdot I_0/L_1 \quad (65)$$

5 but, per equation (58) becomes

$$I = I_0 + (L_0 - L_1) \cdot I_0/L_1 \cdot e^{-t/T} \quad (66)$$

This expression shows, that right after the variation of " L ," the current " I " has the value " $I' = (L_0/L_1) \cdot I_0$," that is, the intensity of the current takes a sudden variation during a very short period of time " θ ,"
 10 (which is necessary for the variation of " L ").

Now, we will demonstrate what happens during this period of time " θ ."

Returning to the generic differential equation (27);

$$d/dt(L \cdot I) + R \cdot I = E \quad (67)$$

becomes;

$$d(LI) = E \cdot dt - R \cdot I \cdot dt \quad (68)$$

15 In this last expression, for " $t < 0$ " and, until " $t = 0$," we will have " $L = L_0$ " and " $I = I_0$ "; from " $t = 0$ " until " $t = \theta$ " (which value is extremely low), " L " varies from " L_0 " to " L_1 "; " I " varies from " I_0 " to " I' ," and the flux " L_1 " varies from " $L_0 \cdot I_0$ " to " $L_1 \cdot I'$ "; therefore calculating
 20 this variation we will have the following expression:

$$\int_0^{\theta} d(L \cdot I) = L_1 \cdot I' - L_0 \cdot I_0 = E \int_0^{\theta} dt - R \cdot \int_0^{\theta} I \cdot dt \quad (69)$$

where:

$$E \cdot \int_0^{\theta} dt = E \cdot \theta \quad (70)$$

which is a negligible quantity.

But,

$$\int_0^{\theta} I \cdot dt = I_m \cdot \theta \quad (71)$$

where "I_m" is the medium value of the current, from the
 5 initial instant "t = 0" to the instant "t = θ"; since
 its value is finite, its product for "θ", which is
 negligible, is also finite. This made us to conclude
 that the flux "L₁" practically did not vary, that is,
 "L₁ · I' = L₀ · I₀," from where we can extract, "I' =
 10 (L₀ · I₀) / L₁."

The variation of this auto-inductance could occur in
 the following two ways:

a) When "L₁" is smaller than "L₀": this will happen
 when the soft iron core of the induction coil is abruptly
 15 removed. In this case the current "I'" can assume a
 considerable high value, that is, the intensity of the
 current can become extremely high, after which, it
 decreases, as shown in fig. 9d;

b) When "L₁" is greater than "L₀": this will happen
 20 when the soft iron core of the induction coil is suddenly
 replaced into the coil. In this case, the current "I,"
 can assume suddenly a considerable low value after which,
 it will increase as shown in FIG. 9e.

The Inductive Energy Storage (IES) will be:

$$E1 = 1/2L.I_0^2 \quad (72)$$

where:

L, is the total induction, in (H); I_0 , is the maximum value of the load current, during the period " δc ."

In the instant " t_1 ," when the 2nd Stage or period
5 " δd " starts, a substantial part of the stored energy " $E1$ " in the magnetic field MES - Magnetic Energy Storage, will be transformed into mechanical energy " $E3$," of magnetic repulsion (and mechanical impulsion) of the armature of the special device. The remaining energy,
10 " $E2$," eventually will continue to maintain that magnetic repulsion, but having part of it dissipated as heat, and having an electrical resistance of normal value " R_0 " in the final instant " t_2 ," when we will have the following:

$$E1 = E2 + E3 \quad (73)$$

where " $E3$ " is the value of that substantial part of
15 energy stored in the magnetic field (MES), which now is transformed into mechanical energy through the magnetic repulsion.

It should be observed that:

1) In expression (73) the second parcel ($E2 + E3$)
20 is representative of this mechanical energy and the greater value should be upon the second member " $E3$," because this last energetic transformation must occur under high efficiency. The first parcel ($E1$) of the equation is representative of the remaining energy, and
25 the losses of this energetic transformation.

2) The value of the power of the Magnetic Super Pulse (MSP), which we designated "PM" (Power Mechanics), or Mechanical Power, can be measured by the values of the mechanical mass involved, and it can be defined as:

50

$$PM = E1/\delta d \quad (74)$$

therefore becomes:

$$E1 = PM.\delta d \quad (75)$$

On the other hand, we have that $E1 = f.d1$, as the impulsion action; if we equalize these two expressions, then we will have:

$$PM.\delta d = f.d1 \quad (76)$$

5 therefore,

$$PM = f.d1/\delta d \quad (77)$$

But,

$$d1/\delta d = v_0 \quad (78)$$

(velocity of the initial mechanical impulsion),
therefore, the final equation becomes:

$$PM = f.v_0 \quad (79)$$

10 This expression (79) shows that, the value of the power of the magnetic repulsion which also corresponds to the value of the Magnetic Super Pulse (MSP) previously defined, can be calculated by the product of the power of the magnetic repulsion "f" by the initial velocity "v₀," imposed upon the armature by this magnetic repulsion.

15 The oscillographs shown in FIGS. 11 through 18, (tests numbers IEE-01TR through IEE-06TR, IEE-07RP and IEE-08RP) were obtained during the tests performed at the IEE-USP (Instituto de Electrotecnica e Energia da Universidade de Sao Paulo), using the device
20 "Transruptor" type TR-64T/AB5. The test results were tabulated and are shown in Appendix "B."

It should be noted that, the first six tests (IEE-01TR through IEE-06TR) were performed with the special

device wired according to the typical circuit shown in FIG. 7. This special device is a Transruptor type AB-5, which is a switching circuit device of the "4th technique" (per Appendix "A").

5 The last two tests, (IEE-07RP and IEE-08RP), were performed in order to compare the results between the two series of tests using the same special device, but this time, "wired" different, that is, for the last two tests the same Transruptor AB-5 was connected as a standard
10 "polarized relay" of the "2nd technique" of switching circuits (see Appendix "A"), as shown in the circuit diagram of FIG. 10, but with the reversible switch turned to the right, thus closing contacts "F and 3" (see FIGS. 7 and 10).

15 For the tests IEE-01TR Through IEE-08TR, this special device of the 4th Technique (Transruptor tripolar TR64T/AB5), was used for switching three-phase circuits with 64 amperes and 220VAC, and using 110 VAC monophase/neutro for the control circuit (see test graphs
20 IEE-03TR/04TR/06TR), and the drawings shown in FIGS. 2 through 4.

 The control to turn OFF the load was done from a 110VDC source, (tests IEE-03TR and IEE-04TR). This same device was utilized to conduct the tests IEE-07RP and
25 IEE-08RP, but with its electrical connections modified to work as a "polarized relay," that is, as a device of the 2nd Technique - Amplified Control (per Appendix "A").

1). The test results obtained with this device (transruptor TR-64T/AB5) are shown in Appendix "B."

30 The inductance of the six coils, connected in parallel is on the order of 716 MH, measured under 1Khz and a factor of depreciation of 0.367. The instruments used for measurements during the tests were the following: Oscilloscope Tektronics model 2440;
35 Calculator Tektronix Tekmate model 2402; and Color

plotter Tektronix model HC100. The results of these tests are shown in the graphs of FIGS. 11 through 19.

These tests were duplicated by the Instituto de Pesquisas Tecnologicas (IPT) located in Sao Paulo. The test results (29TR through 32RP) are shown in Appendix "F," and totally confirmed the tests performed by the IEE-USP (Instituto de Eletrotecnica e Energia da Universidade de Sao Paulo), which are shown in Appendix "B." The IPT used the Oscilloscope Tektronix series 2500 and a PC computer with graphics capability, which are shown in two pages in FIGS. 20 through 27. A comparison was made between the tests performed with the Transruptor as a device of the "4th Technique," (tests numbers 29TR and 30TR), and then "wired" as a "polarized relay" device of the "2nd Technique," (tests numbers 31RP and 32RP). These tests are presented in four sheets where a comparison is made of tests number 29TR with test number 32RP, and another four sheets where a comparison is made of test number 30TR with test number 31RP, (see FIGS. 28 through 35). Also there is a sheet for each of the tests as "polarized relay" device (31RP and 32RP) where a comparison is made between the value of the total time employed in both situations (as a transruptor and as a polarized relay), (see FIGS. 36 and 37).

The computational report of these four tests, conducted by the IPT, are presented on the two sheets of appendices (Appendix "C" and Appendix "D"), where all the parametric values used are specified, as well as, the formulas and derivations of calculations are shown in Appendix "E." The results are presented in Appendix "F."

Given the relevance of these tests, we are providing a detailed characteristics of the devices utilized, with the purpose of facilitating the duplication of these tests by any laboratory, as well as, with the purpose of verifying and authenticating the discovery of this new

energy conversion, that we called PECCEM. Also for the same reason we are providing all the oscillographs that correspond to the eight tests conducted by the IEE-USP (IEE-01TR through IEE-08TR, as shown in FIGS. 11 through 19), and the four last tests conducted by the IPT (29TR through 32TR, as shown in FIGS. 20 through 37), and whose parametric results are shown in Appendices "C" through "E."

The tests conducted with another device called "Transreed type AB1" by the IEE-USP (Instituto de Eletrotecnica e Energia da Universidade de Sao Paulo), are referred to as test "IEE-33TR," and the results are shown in Appendix "G."

As mentioned before, for the Transreed test a "Transreed type AB-1" was used, and it was a Reed Relay (normally open contacts), that was "transrutorized," that is, it was converted from a device of the 2nd Technique to operate as a device of the 4th technique of switching circuits as shown in FIG. 5. The device was tested from the activated state, ("ON" state), to the deactivated state, that is, ("OFF" state), and for control, a power source of 6VDC was used.

The values obtained for the Inductive Energy Storage (IES) at "E1" presented a total of 2,932 mj of energy at the load during the total of $\delta c = 103.0 \mu s$, which is equivalent to the power of 28.466 W (= 28 watts), as it can be seen in Appendix "H," and the oscillograph of FIG. 38.

The devices we have been describing, allowed the discovery of the Magnetic Super Pulse (MSP) that is created by the Pulsating Energy Converted Electro-Mechanically (PECCEM), which is responsible for their operation in the "4th Technique" of electric switching circuits, and these devices correspond to the

nomenclature of the 1st Application mentioned previously.
They are:

1.1 - Transruptors, which has soft iron or ferrite core;

5 1.2 - Transreeds, which has air core, vacuum or inert gas;

1.3 - Transjunctors, which has soft iron or ferrite core.

The application of by the same principle of the MSP
10 technology can be applied for the protection against electrical short circuits, through an effect that we called "UFPASC" (Ultra Fast Protection Against Short Circuits." The third device invented is called
"Transjuntor," which also belongs to the "4th
15 Technique - Control by Quantified Energetic Pulse" (per Appendix "A"), can be used for the purpose of protection against electrical short circuits and overloads.

The construction of the Transjuntor:

The Transjuntor is in essence a Transruptor type
20 AB5, but equipped with a "short circuit sensor." This sensor is a second coil "wound" (compound) over the main coil that provides the "turn off" for the load. This short circuit sensor has fewer turns of a heavy gage wire because the current from the load also circulates through
25 it. The Transjuntor, which also generates the Magnetic Super Pulse (MSP) that characterizes the 3rd Case of energy transformation, can now be used in the technology of protection of electrical installations in general, operating in low, medium or high tensions in AC or DC and
30 all types of frequencies available. The Transjuntor main characteristic, when used as a replacement for today's "circuit breakers," besides its natural higher actuation speed, only spent the energy that comes from its own electromagnetic field and only during its
35 actuation or switching period, either during its

operation as a normal switch or during its operation as a switch for protection of electrical circuits.

In this case we emphasize, the Transjuncor (in the same way as the Transruptor) always utilizes the stored
5 energy that exists in the coupling field where the energetic transformation between an electrical system and a mechanical system takes place in two stages; in its first stage as energy charging period, and in the second stage as energy discharging period (see FIG. 8). This
10 energetic transformation is "discrete and irreversible."

In FIGS. 39 and 40 the typical circuit of the Transjuncor is shown, respectively showing one with multiple control system using momentary contact switches, and the other using individualized "ON/OFF" control
15 switches. As mentioned before, and as it can be observed in those figures, that the Transjuncor is in essence a Transruptor type AB-5, but having an additional wire winding over the main coil used for turning OFF the load, this second winding is built of a heavy gage wire
20 and has few winding turns, and it is called "the short circuit sensor."

In other words, the Transjuncor operates as an Transruptor during its normal operation of turning the load ON or OFF. This control is performed by the
25 individual ON/OFF switches, or by the momentary contact switches previously described, or other equivalent controls such as, timed switches or photoelectric control circuit.

However, there are ways of reducing the cost of
30 isolating the ON/OFF control circuit from the load circuit, for example, in the case of circuits of medium tension (MT), or even high tension (HT), we can introduce an optical isolation that uses fiber-optics as a medium to turn the load ON or OFF, as shown in FIG. 41.

In FIGS. 39 and 40, two diodes are shown, installed between the coils and the contacts "2" and "2'," with the purpose of providing a visual indication through LED's, which would indicate the condition, if "ON or OFF," of the load. Since this visual signalization is optional, the diodes are not shown in FIG. 41.

The additional coil called "short circuit sensor," previously referred as the second winding coil over the main coil that controls the turning "OFF" of the load, is part of the load circuit, therefore, it has the same flow of current as the load. Its size is determined not only by the nominal load current but also by the transients values of short circuit currents that could occur during its detection operation.

The typical circuits shown in FIGS. 39 through 41 are representative of circuits for operation in Alternating Currents (AC) and 60 HZ. In such cases, the period of cycle has a duration of approximately 16ms, however the current is zero every 8ms approximately, corresponding to the alternate state of its value as it moves from positive to negative.

Since all that alternating current from the load goes through the "short circuit sensor," there will be in the magnet attracted to its magnetic core an increase followed by a decrease in magnetic attraction every 8ms approximately, in accordance with the cycle of the alternating current, which produces in the core an equal or reversed polarity to the permanent polarity of the magnet used. This reduction in the magnetic attraction should not cause any problems for the normal operation of the device, since it is assumed that all magnetic, electrical and mechanical parameters were properly addressed during the project's design stage.

The Transjuntor operates as a "protection device" in electrical installations. When in an instance "tcc" a

short-circuit occurs, its detection takes place during a semi-cycle of the alternate state, for example, the positive cycle. In this case it causes the actuation of the magnetic repulsion of the magnet. We estimate the time "tcc" to charge the sensor coil as 2ms, for example, during the occurrence of a short circuit, this sensor stores an inductive energy (IES) "E1," which is sufficient to allow from the instance "tcc" to cause the mechanical repulsion of its armature, causing as a consequence the opening of the metallic contacts, thus interrupting the current flow to the load. The above estimated time to charge the sensor coil ("tcc") decreases as the value of the short circuit current increases. On the other hand, since this energy of magnetic repulsion "E3" represents a great part of the inductive energy stored, as it was demonstrated during tests conducted by the IPT (see Appendix "F"). The amount of energy "E1" will be much smaller than the energy employed by conventional and equivalent short-circuit protection devices. This is so, because there will be much less inductive energy to be cut-off by the opening action of the metallic contacts, reducing this way in a great measure the production of electrical "arc" or "spike." We recommend the use of tungsten based material for contacts, in order to resist the exceedingly high temperatures that will be present during the very short lapse of time when the sensor coil is charging.

As an example FIG. 42 shows in graph form the instant "tcc," when a short-circuit of a current "Icc" occurs during the positive alternate cycle, causing that way a fast mechanical repulsion, and as a consequence, the "arc" only will be extinguished, at the end of the positive semi-cycle.

In cases where the Transjuncter is to operate in Direct Current (DC), we suggest the use of the well known

"deflection-bar" connected in parallel with the sensor coil, as shown in FIG. 43. The deflection bar is nowadays used in ultra fast commutators operating in DC. During a short circuit, the deflection bar is capable of
5 diverting approximately $2/3$ of the load current away from the sensor coil. The remaining $1/3$ of the current will produce only a slight reduction on the magnetic attraction of the core of the turn OFF coil. This reduction should be taken into consideration during the
10 project's design stage.

The instant of time "tcc" is applied to AC applications, but it does not apply when using the Transjuncter for DC applications, because the period of "no current" every 8ms approximately does not exist in
15 DC. Only one aspect remain the same, the charging time of the sensor coil when it stores the inductive energy necessary to open the metallic contacts that feeds the load.

FIG. 44 shows in graph form an example of the DC
20 version of when a short circuit occurs if " $\delta t_c = 2\text{ms}$," and if the instant "tcc = 35ms."

The graph in FIG. 42 shows that, the spark (or arc) will be extinguished in a time "t_f," but with a reduced energy in the electric arc in relation to "E₁" which is
25 the energy stored by the sensor coil during that "tcc" interval of time. This property of utilizing the inductive energy of the coupled electromagnetic that exists in the 1st stage of the energy build up is unique to the Transjuncter. In addition, as mentioned before,
30 the estimated charging time " δt_c " has the tendency to decrease with the increase of the value of the short circuit current.

In other words, since this mechanical energy of magnetic repulsion "E₃," represent a great part of the
35 inductive energy stored, as it was demonstrated during

tests conducted by the IPT (see Appendix "F"), the value of the energy "E1" is much smaller if compared to the energy necessary, when used in conventional equivalent circuits. The reason given is that, there will be much less inductive energy to be "cut" by the opening of the metallic contacts, reducing this way in a great measure, the production of electric "arc" (or spike).

What all of this means, is that, the higher and more violent the short-circuit in a direct current circuit, the shorter will be the time to charge " δtc ," needed to store the inductive energy "E1." The larger energy portion "E3" is the part responsible for its transformation in the maximum magnetic repulsion of the magnet of the armature of the Transjuntor, which is associated with the contacts that feeds the load.

The short time " δte ," required to extinguish the "arc," when compared with existing methods is extremely shorter, therefore, should be of greater benefit because of the reduction in the amount of energy that produces the "arc." This fact was determined by the effect we named UFPASC (Ultra Fast Protection Against Short Circuit), when the reduction in the time (" δte ") of "extinction" was calculated using the equation:

$$\delta te = [tf - (tcc + \delta tc)] \quad (80)$$

The devices described above (Transruptors, Transreeds, and Transjuntors), belong to the nomenclature given earlier about the 1st Application, where they operate distinctively as new switching devices and for protection of electrical circuits, when only one energetic pulse called MSP is needed to turn ON or to turn OFF (a given load), operating exclusively on the "4th Technique - Control by Quantified Energetic Pulse." Magnetic Motors:

The devices that belong to the 2nd and 3rd Applications (mentioned earlier), will depend for their operation on the frequency rate of MSP, therefore, requiring, the coupling with another device called
5 "SUPERJUNCTOR," which is also object of this patent. These applications, according to the nomenclature described earlier, when low frequency rate of MSP is required, allow the manufacture of a new type of "motors," which we called "Magnetic Motors," to
10 differentiate from the well known "Electric Motors."

These "Magnetic Motors" as listed before, can be of the following types:

- LINEAR MAGNETIC MOTORS (LMM): Called "Tremacoli"-Electro Magnetic Traction with Starting Levitation,
15 (similar to the existing "MAGLEV" System). Used for magnetic traction in trains.
- ROTATIVE MAGNETIC MOTORS (RMM): Magnetic Turbine for jet aircraft.
- AUTOMOTIVE MAGNETIC MOTORS (AMM): Using piston and
20 crankshaft type engines used in: automobiles, trucks, locomotives, ships, submarines, etc.

In the Linear Magnetic Motors (LMM), the rotor (part of the motor) is placed linearly along the tracks (of a railway) as a "magnetic sleeper layout," which is
25 constituted of sleepers made of concrete and coated on the top surface with a layer of magnetic material adequately polarized in its magnetization. The vehicles or wagons will have in their underside (the stator part of the motor), the induction coils with soft iron or
30 ferrite core connected in parallel with the output of a Superjuncator, which is to be adequately designed and dimensioned to generate the MSP, and be coupled to its frequency time controller. The vehicles or wagons can travel the tracks in the conventional manner, that is,
35 upon iron wheels and a pair of rails, (using the magnetic

motor for propulsion only), or using a permanent magnetic levitation, by using superconductive materials such as the "niobium wire," and the necessary cryogenic medium (such as helium or nitrogen). We called this system

5 "Tremacoli" - Electro-Magnetic Traction with Starting Levitation.

In other words, new types of magnetic linear traction motors are possible and are based on the new PECCEM discovery and the MSP technology, operating in

10 various low frequency rates of MSP that is compatible to the technological realization of the application.

In FIG. 45a and b, and FIG. 46a, b and c, shows a representation of a LMM prototype, with magnetic propulsion and conventional mechanical sustentation.

15 FIG. 45a and b, shows a proposed circular test track, and FIG. 46a, b and c shows the diagram of connections of the field coils, control, and "magnetic sleepers" along the railway. It should be observed that in the control section instead of a Superjuncter, for test simulations

20 only, a Transruptor AB-5 was used, therefore having metallic contacts to generate the necessary MSP, and the "magnetic sleeper" using a circular track, has its polarity in an alternate sequence.

In the Rotative Magnetic Motors (RMM), the main

25 application is the replacement of the combustion fuel energy with the pulsating electrical energy called PECCEM, for the propulsion of jet turbines nowadays in use in most aircraft. In this case, in the space utilized by the combustion chamber, we can attach to the "rotor" part

30 of the turbine magnets with pre-determined magnetic polarity, and adequately installed around the "rotor." The induction coils that discharge the MSP's are installed (facing the rotor) to form a "stator," the coils are positioned in a tangent plane over the magnets

35 that are attached to the "rotor." These induction coils

are all connected in parallel and form a set that discharges the Magnetic Super Pulses that act upon the magnets. The coils are connected to the Superjuncor which is the MSP generator, which in turn is coupled to
5 its frequency tracking controller.

This way, by simply replacing the fossil combustion fuel by the pulsating electric energy called PECCEM, we will save adequately all the existing technology related to the extremely high rotation of these turbines. In
10 FIG. 47 we are clarifying this application. It is shown two sets of magnetic turbines (I and II), coupled to the main axle and located in the Magnetic Repulsion Chamber, other sets of magnetic turbines can be added if more power is required. The set of induction coils form a
15 "crown" of coils (for example, around 30 coils) to form a "stator." These coils are positioned at a 45° angle approximately. When the coils discharge, the soft iron core repels through magnetic energy the magnets with the same polarity, which are also positioned at a 45° angle
20 approximately around the main axle of the magnetic jet turbine. The axle will receive that way its rotation by magnetic repulsion simultaneously throughout the "toroidal combustion chamber," now renamed "Magnetic Repulsion Chamber."

25 In the same main axle there is a fan-rotor, through which the suctioned air is moved towards the compressor, where with adequate compression force the air will be forced to exit through the rear exhaust tube. The escape of the jet of air causes a greater pressure in that area,
30 which because of reaction is responsible for the forward thrust of the aircraft. Since the internal pressure of the air is maintained constant by the fan-rotor-compressor combination, which are attached to the main-axle of the magnetic turbines, this turbine magnetic

propulsion system, will maintain the forward thrust of the aircraft.

In the Automotive Magnetic Motors (AMM), the main application, as in the previous case, is the replacement
5 of the combustion fuel energy such as; diesel oil, combustion oil, gasoline, propane gas, or alcohol by the pulsating electrical energy (PECEM) for the propulsion of vehicles that use the "piston and crankshaft" technology. In this case, the existing "cylinder head" is replaced
10 with another cylinder head that adequately houses the induction coils with soft-iron or ferrite core, that discharges the MSP's. These coils when de-energized, act by magnetic repulsion upon magnetic discs that contain a high concentration of magnetic energy, (such as Samarium
15 Cobalt or Neodymium), these magnets are adequately epoxied or glued on top of the head of the pistons, which, as in the conventional way, through the connecting rods, will activate the crankshaft system (see FIGS. 48a and b, and FIG. 49). The electrical connections of these
20 new induction coils will allow for similar "firing order" of the cylinders as used by the conventional distributors systems presently in use.

In the same way as previously mentioned, these induction coils are connected to the output of a
25 Superjunctor, which is the MSP generator for these induction coils, which in turn is coupled to a frequency tracking controller. This way, as the same as in the previous case, by replacing the combustion system with the electrical system PECEM, most of the remaining
30 vehicle's technology will be maintained.

FIGS. 48 and 49, shows the application of the PECEM to the Automotive Magnetic Motors (AMM). FIG. 48a, shows a side view, and FIG. 48b the frontal view, of this application (showing one piston and crankshaft system).
35 The other drawing, FIG. 49, shows the application to a

four piston engine system. The legend of these two figures are as follows: (1) iron core; (2) induction coil; (3) cylinder block; (4) Pistons and rings; (5) piston pin; (6) connecting rod; (7) crankshaft; (8) oil pan; (9) cylinder chambers at atmospheric pressure; (10) magnets.

In relation to these figures, we can follow the sequence of events; The magnetic repulsion is applied by the soft iron core (1) of the induction coil (2) over the magnet (10) which has a high concentration of magnetic energy (such as, the Samarium Cobalt), which is glued using epoxy on top of the piston head (4), after the piston head passes by at least one degree the "top dead center" (TDC) of the movement of the piston inside the cylinder section of the cylinder block (3), and, with the cylinder chamber at atmospheric pressure (9); the crankshaft (7) will receive adequately the mechanical impulses as a consequence of the MSP's discharged by the induction coils installed in the modified "cylinder head," the crankshaft, then transmit the respective traction force to the vehicle in the same way as it functions today. These AMM- Automotive Magnetic Motors can be called "single stroke" engines, because the classical four stroke internal combustion (intake, combustion, power, exhaust) cease to exist.

The 3rd application of this new PECCEM energy transformation, requires an extremely high frequency rate of MSP. In this 3rd application, it is possible to obtain the heating by "Magnetostriktion" of the hydrogen plasma (or isotope) to tremendously high temperatures, and because of the heat generated by this magnetic compression, which is concentrically concentrated along the cylindrical axis (or toroidal) of the tube where that plasma is formed, makes possible the attainment of a much better control of the Thermonuclear Fusion.

The increased interest in the use of large amounts of pulsating energy in the research for controlling the generation of energy by thermonuclear fusion, made necessary the development of the technology called I.E.S. (Inductive Energy Storage.) The main objective of this type of research, is to obtain a high quantity of energy, which must be discharged through an energetic pulse of extremely short duration. This means, that the search for a tremendously high potential (electrical, magnetic or mechanical) means must be found for its practical realization (of a controlled generation of energy by thermonuclear fusion).

In publications about Plasma Physics, this search is highly evident. Several years ago (1972), the "Inductive Energy Storage Group - I.E.S.G." of the University of Texas at Austin, attained the storage of inductive energy (I.E.S.) through the fast discharge of a homopolar generator, which stored with 95% efficiency the energy equivalent of 10^{10} joules (10GJ - giga joules), with a rate of discharge in fast intervals of time (5 to 30 ms). On the other hand, the source of energy for these pulses of electrical potential, require, not only low cost, but also increasing efficiency, high reliability and for certain a "long repetitive duration."

It is important to observe that the discharge of the homopolar generator (referred above), had an electrical potential of discharge between 333,333 and 2,000,000 MW, that is, between 28 and 167 hydro-electric power stations like "ITAIPU" (which is a 12,000 MW power station, build in Brazil).

In other words, according to Driga et al (02-08), the researches done at that time in the area of thermonuclear fusion, required large amounts of pulsating energy, necessary for the heating and confinement of the plasma of hydrogen, deuterium and tritium (or other

isotopes) in a "TOKAMAK" type generator, in use by the University of Texas, therefore, justifying the research and development of the technology of the I.E.S. (Inductive Energy Storage). However, one of the methods
5 used in these generators "Tokamak," is the pulsating energy generated by "Capacitive Energy Storage -CES," which became too expensive when the required pulsating energy were above 10 Mj/pulse (or 2,7778 KWH/pulse). In those conditions, an I.E.S. system was built to supply
10 the pulsating energy for high temperature heating, it was built by the University of Texas for research with the Tokamak unit installed at that facility. The inductive energy stored (I.E.S), is transferred to the "loop" of plasma when the current that circulates in the primary
15 circuit is interrupted, as shown in FIG. 50.

As we can observe in the schematic representation of FIG. 50, the basic circuit in the primary winding is a switching key "S" and induction coil "Lp," the secondary circuit only has the plasma "loop" or ring (represented
20 in the circuit by the dotted lines), with an ohmic resistance "Rs" and an inductance "Ls."

Normally, in apparatus type Tokamak, the ohmic resistance "Rs" is the result of the "coulomb" collisions between particles electrically charged. However, since
25 the temperature of the particles increases, the frequency of the collisions drop, until the resistance becomes insignificant at temperatures well below the 10 KeV (116,000° K), making that way the "joule's heating" type systems inefficient.

30 However, some other means of heating the plasma has been developed. One of the methods of heating the plasma, often sought, consist in the axial magnetic compression of the plasma, through a coil surrounding the plasma containment unit. This magnetic compression (or
35 magnetostriction) generates a tremendously high

temperature, making the plasma to behave like an "ionized gas" concentrically superheated. Notwithstanding these advantageous characteristics, the heating through magnetic action is not widely used, because it is very
5 difficult to obtain these super high magnetic fields, and mainly the necessity to pulsate with constant repetitiveness.

Another well used method of heating the plasma is the ohmic heating or resistive heating. This type of
10 heating is attained through the "coulomb" collisions between particles electrically charged. But, since the temperature of the particles increase, the frequency of these collisions decrease, causing the resistance to become insignificantly small, and the temperature well
15 below the 10 KeV (116,000° K), making this way the heating through the ohmic process also inefficient.

In the case of the Tokamak at the University of Texas, at that time (1972), the "ohmic" method of heating was used, where the value of the resistance "R2" was
20 limited by the turbulence of the plasma. In that case, the interaction of the plasma and particles with the turbulence in the electric field, generated abnormal frequencies of collisions. When this turbulence is taken into consideration, the total resistance of the plasma
25 became considerably higher than the classical value, thus, showing an improvement in the results when the ohmic heating process is used.

The turbulence is generated by the application of a very high electrical field (about 100V/cm) in the plasma,
30 making the plasma current to exceed a critical value. As a consequence, not only the system I.E.S. was necessary to supply the pulsating energy for heating the plasma, but also this system was made in such a way as to create a turbulence that would generate the desired value for
35 "Rs," necessary for the ohmic heating of the plasma. The

problem however became complicated because of two other factors:

1. Since the heating of the plasma was increasing the value of the critical current also increased, when
5 the heating of the plasma reached the value of the current applied, the turbulence ceased;

2. There was a finite time for the current to penetrate the plasma, due to the "pelicular effect." The interaction between these elements became critical, for
10 the effective determination of the heating by turbulence and as a consequence the configuration of the pulse of the current from the I.E.S. system.

The secondary inductance is calculated, with the assumption that, the "loop" (ring) of the plasma is a
15 simple conductor circuit in a free space,
"Ls = $1,25 \times 10^{-8}$ (H)." Due to this inductance "Ls," a certain fraction of energy is transferred to the plasma, and is stored as magnetic energy in its own "loop" ring.

It is important to observe that nowadays, the
20 majority of the experiments in thermonuclear fusion require large amounts of pulsating energy with duration in periods from 1 to 10ms for the supply of the confinement, and faster pulsating energy duration of less than 1 μ s to 10ms for the supply of heating the plasma.
25 However, this experiment until now has used mainly the C.E.S. (Capacitive Energy Storage) system, but the necessity to increase the energy for new experiments are great, thus, making their feasibility prohibitive in cost and size. This is also aggravated by the tremendously
30 low energetic efficiency.

Even though, there are other ways to store energy that are cheaper and more compact, many of them are not recommended due to restriction to the short time required for discharge. For periods of time in the order of 100 μ s
35 to 10ms, the only alternative to the capacitive type is

the storage of energy in a magnetic field, that is, in an I.E.S. as mentioned previously.

The proposed I.E.S (Inductive Energy Storage) system can be much smaller than the C.E.S (Capacitive Energy Storage) system, because the density of the stored energy in a magnetic field is about 100 times of that of a given electric field, even if the best dielectric material is used. Besides, time of discharge aside, the cost of discharge of an I.E.S., is less expensive than the discharge of a C.E.S. for blocks of energy higher than 10MJ (ten mega joules).

However, the main doubt about the cost of discharge of an I.E.S. system resides in the cost of the switching system "S" (see FIG. 50), which is necessary for the energetic transference. The pulsating potential could free an amount of electric energy in the order of 50 to 200 MJ (12.8 to 55.6 KWH) when the switch "S" is opened, in periods of 10ms or less these conditions are necessary for the purpose of controlling the thermonuclear fusion, and we can conclude that the development of the technology of the I.E.S. systems becomes of tremendous importance and essential.

The main obstacle nowadays for the success to obtain large blocks of energy from I.E.S. systems greater than 10MJ or 2.8 KWH, resides in the development of an adequate substitute for the switch "S." This switch "S" device must interrupt currents in the order of one million amperes (10^6 A) or higher, and resist voltages in excess of one million volts (10^6 V) or higher, and have an impregnated isolation capable of resisting pulses of high tension in the order of 20 to 40 KV/ μ s.

In addition, the switch must be of the direct current type, that is, in one way must comply with the commutation of the current and on the other, it must have the capability of a forced interruption (like the

sectioning key type). Until now the technical literature on the subject says that there is not one switch available nowadays that could perform to the above criteria, with the possible exception of the explosion
5 fuse type switch, but this, as such, is non repetitive.

In brief, the main obstacle for the success in the construction of a large I.E.S. systems with energetic blocks greater than 10MJ, (using the concept described in M.D. Driga, R.E. Rowberg, and H.H. Woodson, "Inductive
10 Energy Storage for a Tokamak Feasibility Experiment," Department of Electrical Engineering, University of Texas, Austin, Texas, p. 249-259) is dependent upon the development of an adequate switch with metallic contacts, or equivalent. Besides, several other aspects of the
15 I.E.S. technology must be considered, such as problems associated with the use of ferromagnetic materials in the coils, joining the energy storage with the load, and limitation on the regimen of tension through the open circuit method of energy absorption in the inductive
20 discharge of the storage coil. Another problem encountered, was the attainment of an optimization of the I.E.S. System, where the number of repetitive discharges would have to be between 18 and 80 times, according to the conditions involved.

25 We know that these experiments in the University of Texas has ceased, and that nowadays they are concentrated in the University of Princeton and in the International Thermonuclear Experimental Reactor - ITER, where the central project coordination is located in the
30 neighborhood of General Atomics in San Diego, California.

In these conditions the elimination of metallic contacts, (referred to in M.D. Driga, S.A. Nasar, H.G. Rylander, W.F. Welton and H.H. Woodson: "Fundamental Limitations and Topological Considerations for Fast
35 Discharge Homopolar Machines," College of Engineering,

University of Texas at Austin, IEEE Transactions on Plasma Science, Vol. PS-3, No.4, December 1975, p. 208-215; M.D. Driga, W.F. Weldon, H.G. Rylander and H.H. Woodson, " The Design of Homopolar Motor-Generators for Pulsed Power Applications," Energy Storage Group, 167 Taylor Hall, The University of Texas at Austin, IEEE - The sixth Symposium of Engineering Problems of Fusion Research, 1976, p. 303-307; M.D. Driga, R.E. Rowberg, and H.H. Woodson, " Inductive Energy Storage for a Tokamak Feasibility Experiment," Department of Electrical Engineering, University of Texas, Austin, Texas, p. 249-259; Mircea Driga, from The Energy Storage Group, and Paul Wild, Stewart Hutchins, from The Fusion Research Center, "Applying a Homopolar Supply to a Tokamak," The University of Texas at Austin; M.D. Driga, J.H. Gully, E. Grant, K.M. Tolks, W.F. Welton, and H.H. Woodson, from The Center for Electromechanics, "Design, Fabrication and Testing of a Fast Discharge Homopolar Machine (FXD)," The University of Texas at Austin, p. 446-449; M.D. Driga, W.L. Bird, K.M. Tolks, W.F. Welton, H.G. Rylander, and H.H. Woodson, from The Center for Electromechanics, "Electromagnetic Torques and Forces due to Misalign Effects and Eddy Currents in Homopolar Generator, Power Supply for Texas EHE, Texas Experimental Tokamak (Text)," The University of Texas at Austin, p. 450-453; M.D. Driga, D.J. Myhall, W.F. Weldon, H.G. Rylander, and H.H. Woodson, from The Center for Electromechanics, "Methods for Producing Plasma Initiation Pulse in Ohmic Heating Circuits in Tokamak Power Reactor: Resistive Dissipation, Transient Inductive Storage and Transient Capacitive Storage," The University of Texas at Austin, p. 473-477), has been a subject awaiting to happen, until the technological development eventually catches up and bring changes to this natural waiting.

The "S" switch and the "Superjunctor":

As a matter of fact, as recent as may of 1989, from the University of Houston in Texas, through the inventor, Dr. Wei-Kan Chu, it was announced the development of a device that has four terminals, made from a
5 superconductive material (see FIG. 51), which has two input terminals "1 and 2" from a superconductive coil "A," whose magnetic core "B" has installed in its "air-gap" a material "C," which is also superconductor, and is connected transversally to the output terminals "3 and
10 4"; since the wires of the coil "A" and the materials "C" are superconductors, the whole assembly must be maintained immersed in a vessel "D" which contains an adequate amount of cryogenic liquid "E." As an alternative to the above, only the superconductive
15 ceramic could be refrigerated at all times, such as - 196°c (if using Liquid Nitrogen as a cryogenic medium). In such a case, the inductor coil "A" can be made of standard copper wire instead of the superconductive type material.

20 In the above conditions, if a small pulsed current "I" is applied at the input "1 and 2" the current then flows through the coil "A" which is made of a superconductor wire, generating in the "air-gap" of the ferrite a super magnetic field. This super magnetic
25 field is able to stop the super current "I" that is flowing between terminals "3 and 4" through the superconductive ceramic "C" (see FIG. 51). When there is no current "i" in the input terminals "1 and 2" the device "C" will be in the "ON" state, that is, the
30 current "I" will freely flow between terminals "3 and 4" until interrupted again by a pulse of current "i" from terminals "1 and 2."

The superconductor materials and the cryogenic medium utilized can be the classically known materials
35 such as niobium and liquid helium, or the most recent

ones, including the new superconductor ceramics of the high-temperature superconductors (which utilizes liquid nitrogen).

The "high-temperature superconductors" (HTS) were
5 discovered by the physics Johannes George Bednorz and Karl Alexander Mueller, of the IBM Research Laboratory in Zurich, Switzerland, when they received the 1987 Nobel Prize of Physics, award by the Royal Academy of Science of Sweden, one year after the publication of their
10 discovery (September of 1986 in the magazine "Zeitschrift für Physik," entitled, "A composite of barium, lanthanum, copper and oxygen, appear to become superconductive at high-temperatures"). This means that with the use of high-temperature superconductive ceramics, and the
15 cryogenic liquid nitrogen, there would be great reduction in the costs.

The first success, allowed Paul C. W. Chu of the University of Houston to include one more element to the mixture of the ceramic compound which was the "itrium,"
20 reaching that way a new mark in higher temperature superconduction to -48°C (or 125°K) critical temperature (t_c). However, in the euphoria motivated by the new discovery predicting incredible new applications, dissipated, when later on was verified that the current
25 flowing through a ceramic superconductor had a limited low value, above which the superconduction would cease.

Paradoxically, even though, the new ceramics as perfect superconductors, they are limited on the amount of current they can carry (up to 100 A/cm^2), as with the
30 "niobium compound" for example that could carry up to 10^6 A/cm^2 (as described in M.D. Driga, W.F. Weldon, H.G. Rylander and H.H. Woodson, "The Design of Homopolar Motor-Generators for Pulsed Power Applications," Energy Storage Group, 167 Taylor Hall, The University of Texas
35 at Austin, IEEE - The sixth Symposium of Engineering

Problems of Fusion Research, 1976, p. 303-307"). In other words, the device invented by Wei-Kan Chu (see FIG. 51) as such, has its drawbacks, it will operate using the superconductive materials immersed in cryogenics, but will operate just like a relay (superconductor) of the 2nd technique - Amplified command or control, without moving parts (or metallic contacts), but will have the restriction of having a very low value for the current (critical value) above which, the current itself would destroy the superconductivity in the ceramic as described above.

The important thing on Wei-Kan Chu discovery was the "new fact" that the device, that has four terminals (see FIG. 51) and belongs to the "2nd Technique" of switching circuits (per Appendix "A") as a relay without contacts, it would eliminate one of the restrictions previously mentioned, that is, the physical existence of the metallic contacts. However, as for the low current capabilities, we see no problem, because the I.E.S. system can be stored in another coil, the induction coil, and can be compensated by the reduced stored energy caused by the low current value by an adequate increase on the number of windings of this induction coil, that when Transruptorized, will operate as a device of the "4th Technique" (see Appendix "A"), as described earlier.

In other words, these limitations in the value of the current "I" would be compensated by a convenient increase in the inductance "L," through the increase in the number of turns of the wire (windings) of the induction coil, this way we could utilize in this process the Magnetic Super Pulse created by the new Pulsating Energy Converted Electro-Mechanically (PECEM), thus becoming an integral part of this patent.

The device of FIG. 51 (developed by Wei-Kan Chu), which has four terminals and operates on the "2nd

Technique," can be modified to operate on the "4th Technique" (per Appendix "A").

Therefore a new device the "SUPERJUNCTOR" was invented, and whose typical circuit is shown in FIG. 52, and it is an integral part of this patent.

In FIG. 52, between the terminals "1 and 2" of the Superjuncutor, an inductive load "A" is connected in parallel with its inductive coil (17), whose purpose is to store, the repetitive pulsating super discharges of magnetic energy that is generated by the Superjuncutor, since the metallic contact that would prevent this repetitiveness has been eliminated.

The repetitively of these magnetic super discharges can be verified if one follows the circuit shown in FIG. 52. An electrical energy is supplied to the Superjuncutor when button "D" is actuated, turning it ON, and at the same time this electrical energy is stored in the induction coil (17) as magnetic energy. This energy supplies the magnetic flux " Φ ," in the ferrite's "air-gap," which crosses perpendicularly the superconductive current that flows through the superconductive ceramic located in the "air-gap." As the intensity of this magnetic flux increases it will become strong enough to interrupt that electrical current, which, because being a superconductive current, does not have that hindrance that is normally brought by the presence of the "Pelicular effect" which exists when associated with the old electric field systems (FIG. 53).

In the instant " t_1 " when the superconductive current is interrupted, there is at that same time the discharge of the MSP, that discharge time " δd ," is now very short since the magnetic repulsion of the armature does not exist, and the magnetic constriction or directly upon the plasma takes place causing its "Magnetostriktion" by axial magnetic compression. The concept of

magnetostriction is normally applied during the fabrication of magnetic materials (Fe-Ni alloys, metallic glass with Co, etc), where the percentile variation of their dimensions occurs during the magnetization process,
5 Vincent, J.H., Thomas, A.P. & Gibbs, M.R.J.,
"Magnetostriction in Surface Crystallized Metallic Glasses," G.E.C. Journal of Research, Vol. 10 No. 3, 1993, p. 179-184. In this present case, we are using the magnetostriction concept to signify the heating up of the
10 plasma by axial magnetic compression through the induction coil surrounding the containment unit.

This magnetic constriction that produces the magnetostriction of the plasma is produced at an extremely high temperature intensity, which causes the
15 plasma to behave like an "ionized gas," adiabatically super heated, whose concentrated heat being axially accumulated by the extremely high frequency of repetition of MSP, causes the temperature to reach the necessary critical values to obtain the thermonuclear fusion and as
20 a consequence its full control.

FIGS. 54 and 55 shows in detail this unique aspect of switching without metallic contacts, through the use of superconductive materials, for example, superconductive ceramic, and the use of the Superjunctor,
25 whose induction coil is connected in parallel with a second coil, which wraps around the containment unit or chamber where a Hydrogen isotope plasma, for example, Deuterium is formed. Since this proposed containment unit has a cylindrical form and not the conventional
30 toroidal form, we decided to call it the "TSIKAMAK," even though, this same MSP technology can be utilized in the existing "TOKAMAK" projects, (see FIGS. 50 through 54).

If we compare the test performed with the Transruptor, which is an electromechanical device with
35 metallic contacts, we have in the 1st stage, which refers

to the energetic charging time of the Superjuncutor, there is also a simultaneity of operations of those three fields (the electric, the electromagnetic coupling and the mechanical). In the instant "t1," the energetic
5 discharge of the MSP takes place, provoking the start of the 2nd stage, which refers to the discharge of pure magnetic energy that induces the magnetostriction of the plasma.

It is important to observe, that, in the instant
10 "t1" with the "interruption" of the superconductive current, the supply of electrical energy to the previous stage is cut-off, causing its "storage" in the induction coil as magnetic energy and to all other coils that eventually could be connected in parallel. This "stored"
15 energy will transform the induction coil and the inductive load momentarily into "electrical generators," that will produce the magnetic discharge (as mentioned previously) until its complete discharge at the end of instant "t2" of the 2nd stage (see FIG. 8).

20 As long as button "D" (FIG. 54) is making contact, the "energy charging" cycle will continue to repeat itself sequentially, as described above as 1st and 2nd stages. The frequency of this "Superpulsation of Pure Magnetic Energy" will depend on the total charging time
25 of the 1st Stage (" δc ") and the subsequent discharging time of the 2nd Stage (" δd ") relative to the generation of the Magnetic Super Pulse (MSP) that determines the periodicity of this frequency.

The period of time of the frequency will be given by
30 the time that takes for the atomic structure of the material to become superconductive (such as the superconductive ceramic), or to return to its "normal state," which takes approximately 1ps or 10^{-12} s. On the other hand, as we observed during the tests performed
35 with Transruptors (either at the IEE-USP or at the IPT),

this period of time will always correspond to the load time " δc " of the Superjuntor, since the Ionic mechanical mass of the "strictioned" plasma is practically null (which is equivalent to the movement of the armature of the Transruptor).

This means, that, the "energetic discharge" that characterize the 3rd Case of energetic transformation, will take place in an instant of time extremely short, much shorter than those "pico seconds" referred above, with the probability of producing extremely high pure magnetic energy for that magnetostriction compression of the plasma. This magnetostriction of the plasma which causes the reduction in its diameter, and at the same time, adiabatically concentrates the resultant heat caused by this magnetostriction along its axis, presenting as a result a thermal effect that is accumulative and crescent due to the high frequency of its repetitivity. Therefore, in view of this new MSP technology, it is highly recommended that the data collected for the high temperature values of the plasma be reviewed and compared with the conventional methods now in use, as the long search for the control of thermonuclear fusion comes to an end.

The application of this new transformation of energy PECEM, extends to NMR (Nuclear Magnetic Resonance), whose principles are very well described in the article "New Images of the Body" (Panepucci, H., Donoso, J.P., Tannus, A., Beckman, N. and Bonagamba, T., "Novas Imagens do Corpo" (New Images of the Body), Ciencia Hoje (in portuguese), (Science Today), vol. 4, No. 20, Sept/Oct. issue, 1985, p. 46-56. The objective in such systems is to replace the magnetic pulses supplied by the radio frequency generator, which provides an oscillation highly stable, by the MSP created by the PECEM, developed for the same rate of high frequency rates requirements, and

as highly stable as the classic radio frequency utilized to generate the NMR signal.

In these conditions, when the MSP generator is installed as replacement for existing pulse generators in NMR or MRI systems, the remaining components of the NMR system remain unchanged. It will have the same components that represent the transmitter where the magnetic pulses are amplified until a certain level of several hundred watts and the receptor unit where these magnetic pulses are adjusted to conform to specific frequencies that might be required according to measurements specified in a computer program.

After the amplification (if necessary), such magnetic pulses are then transferred to the three gradient coils (each has an independent magnetic field) situated tri-orthogonally according to the Cartesian orientation (O,X,Y,Z), and operated under computer control. These coils operating like antennas, excite the protons of the hydrogen nucleus, which in great part are composed of live tissue to be analyzed, and because of the natural properties of these atomic nucleus, would result in a spectroscopy produced by magnetic resonance of these nucleus resulting in the appearance of weak signals. These signals are detected and amplified by a noise detector, that sends the signals to the system's data acquisition, which is capable of digitizing and storing these signals for later processing. All the process of generating and acquiring data is controlled by a complex computer system, which after processing these signals, would provide the final image tomographically.

We Claim,

1. A magnetic super pulse apparatus for developing mechanical energy by pulsating energy converted electro-mechanically, comprising:

5 inductive energy storage means for storing electrical energy supplied thereto to facilitate the generation of a magnetic super pulse;

 movable means including magnet means for interacting magnetically with said inductive energy
10 storage means to enable said movable means to be repositioned;

 wherein said electrical energy is stored as magnetic energy in said inductive energy storage means until said magnetic energy is sufficient to repulse said
15 magnet means; and

 whereby the magnetic super pulse is generated when said magnetic energy repulses said magnet means to drive mechanically said movable means away from said inductive energy storage means and thereby develop the
20 mechanical energy.

2. A magnetic super pulse apparatus according to claim 1, wherein said movable means is responsive to the magnetic super pulse for being driven mechanically between an ON position and an OFF position.

25 3. A magnetic super pulse apparatus according to claim 2, wherein said electrical energy ceases to be supplied to said inductive energy storage means after the magnetic super pulse has been generated.

 4. A magnetic super pulse apparatus according to
30 claim 3, further including another inductive energy storage means for interacting magnetically with said magnet means to reposition said movable conductor means.

5. A magnetic super pulse apparatus according to claim 3, wherein the apparatus is a transruptor.

6. A magnetic super pulse apparatus according to claim 3, wherein the apparatus is a transreed.

7. A magnetic super pulse apparatus according to claim 4, further including a further inductive energy storage means for storing said electrical energy concurrently with the storage of said electrical energy by said inductive energy storage means to position said movable conductor means to said OFF position upon the occurrence of an electrical short circuit.

8. A magnetic super pulse apparatus according to claim 3, wherein the apparatus is a transjunctur.

9. A magnetic super pulse apparatus for developing mechanical energy by pulsating energy converted electro-mechanically, comprising:

inductive energy storage means for storing electrical energy as magnetic energy;

magnetic means having an air gap and being responsive to said inductive energy storage means for generating a magnetic flux in said air gap;

superconductive means disposed in said air gap for conducting a superconductive current, wherein said superconductive current is also conducted through said inductive energy storage means;

wherein a magnetic super pulse is generated when said magnetic flux interrupts said superconductive current.

10. A magnetic super pulse apparatus according to claim 9, wherein the generation of said magnetic super pulse is repeated at a low frequency.

11. A magnetic super pulse apparatus according to claim 10, wherein the apparatus is used in a linear magnetic motor.

12. A magnetic super pulse apparatus according to claim 10, wherein the apparatus is used in a rotative magnetic motor.

13. A magnetic super pulse apparatus according to claim 10, wherein the device is used in an automotive magnetic motor.

14. A magnetic super pulse apparatus according to
5 claim 9, wherein the generation of said magnetic super pulse is repeated at a high frequency.

15. A magnetic super pulse apparatus according to claim 14, wherein the apparatus is used in magnetorestriction of plasma.

10 16. A magnetic super pulse apparatus according to claim 14, wherein the apparatus is used in magnetic resonance imaging.

17. A method of developing mechanical energy from pulsating energy converted electro-mechanically,
15 comprising:

storing electrical energy in an inductive energy storage means to facilitate the generation of a magnetic super pulse;

20 interacting a magnet means magnetically with said inductive energy storage means to enable a movable means to be repositioned;

wherein said electrical energy is stored as magnetic energy in said inductive energy storage means until said magnetic energy is sufficient to repulse said
25 magnet means; and

generating the magnetic super pulse when said magnetic energy repulses said magnet means to drive mechanically said movable means away from said inductive energy storage means, thereby developing the mechanical
30 energy.

18. A method according to claim 17, further including driving mechanically said movable means between an ON position and an OFF position in response to the generation of said magnetic super pulse.

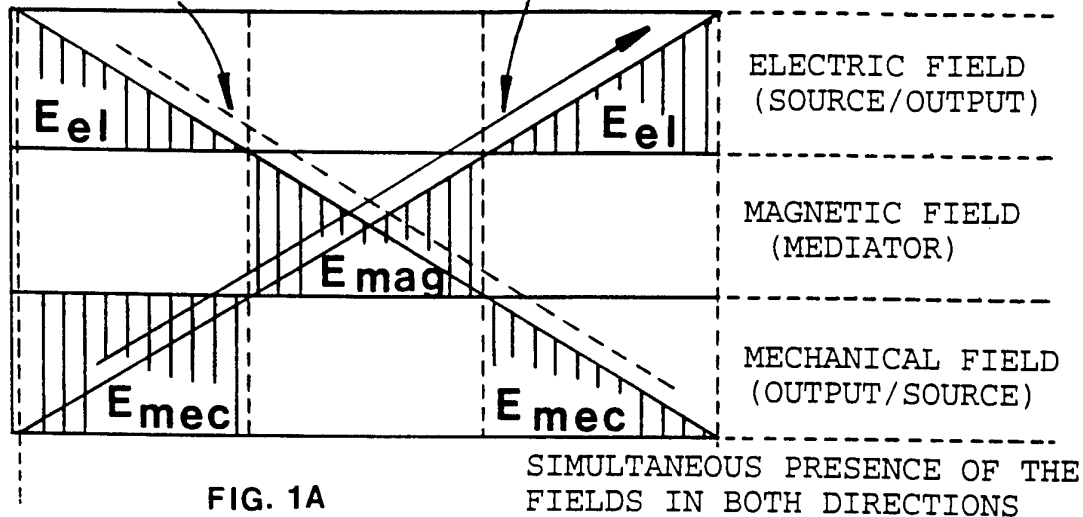
19. A method according to claim 18, further including ceasing to supply said electrical energy to said inductive energy storage means after the magnetic super pulse has been generated.

- 5 20. A method according to claim 19, further including interacting magnetically another inductive energy storage means with said magnet means to reposition said movable conductor means.

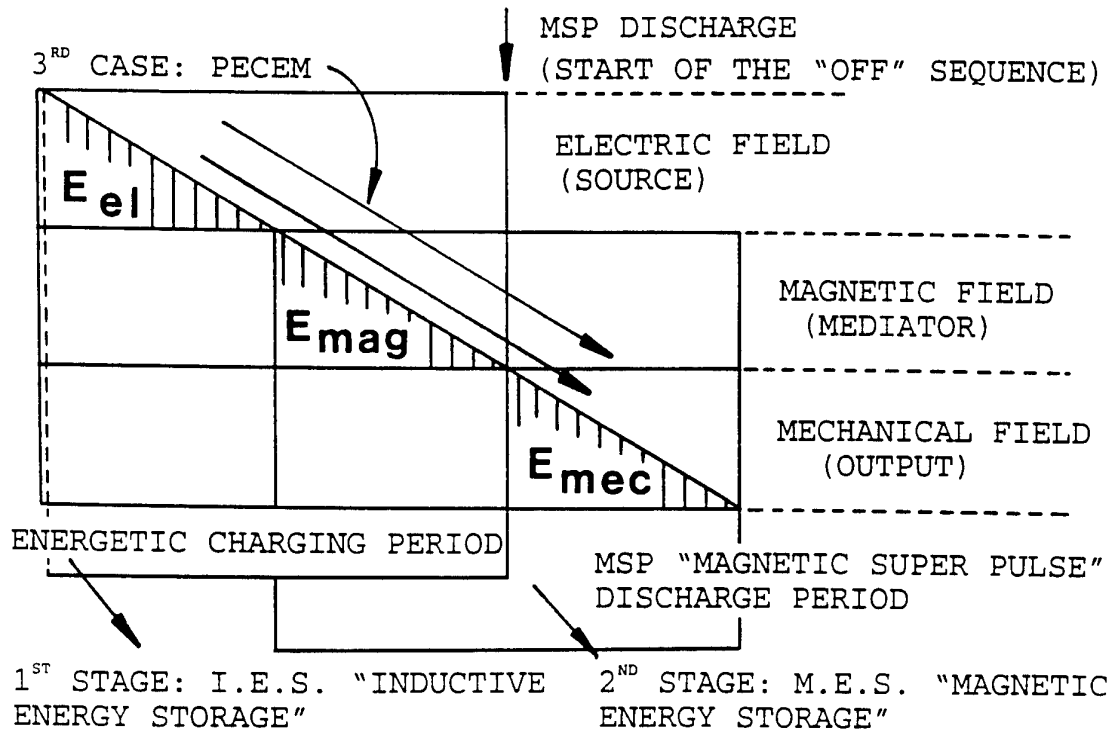
ENERGETIC TRANSFORMATION CAUSED BY ELECTROMAGNETIC FIELD INTERACTIONS

REVERSIBLE AND CONTINUOUS "REVERSIBLE TRILOGY"

1ST CASE: ELECTRIC MOTORS 2ND CASE: ELECTRIC GENERATORS



REVERSIBLE AND DISCRETE "BREAK IN THE REVERSIBLE TRILOGY"



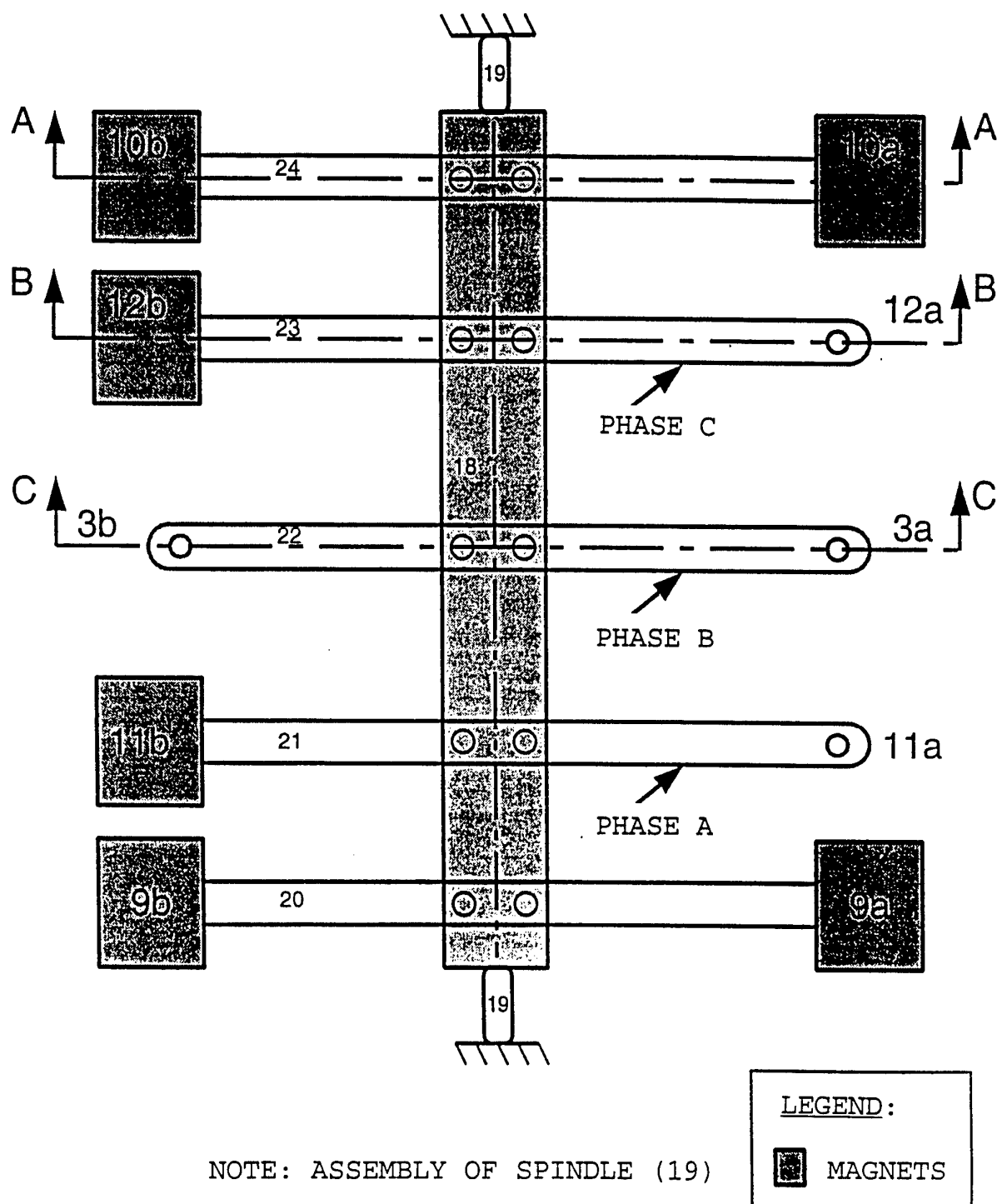


FIG. 2

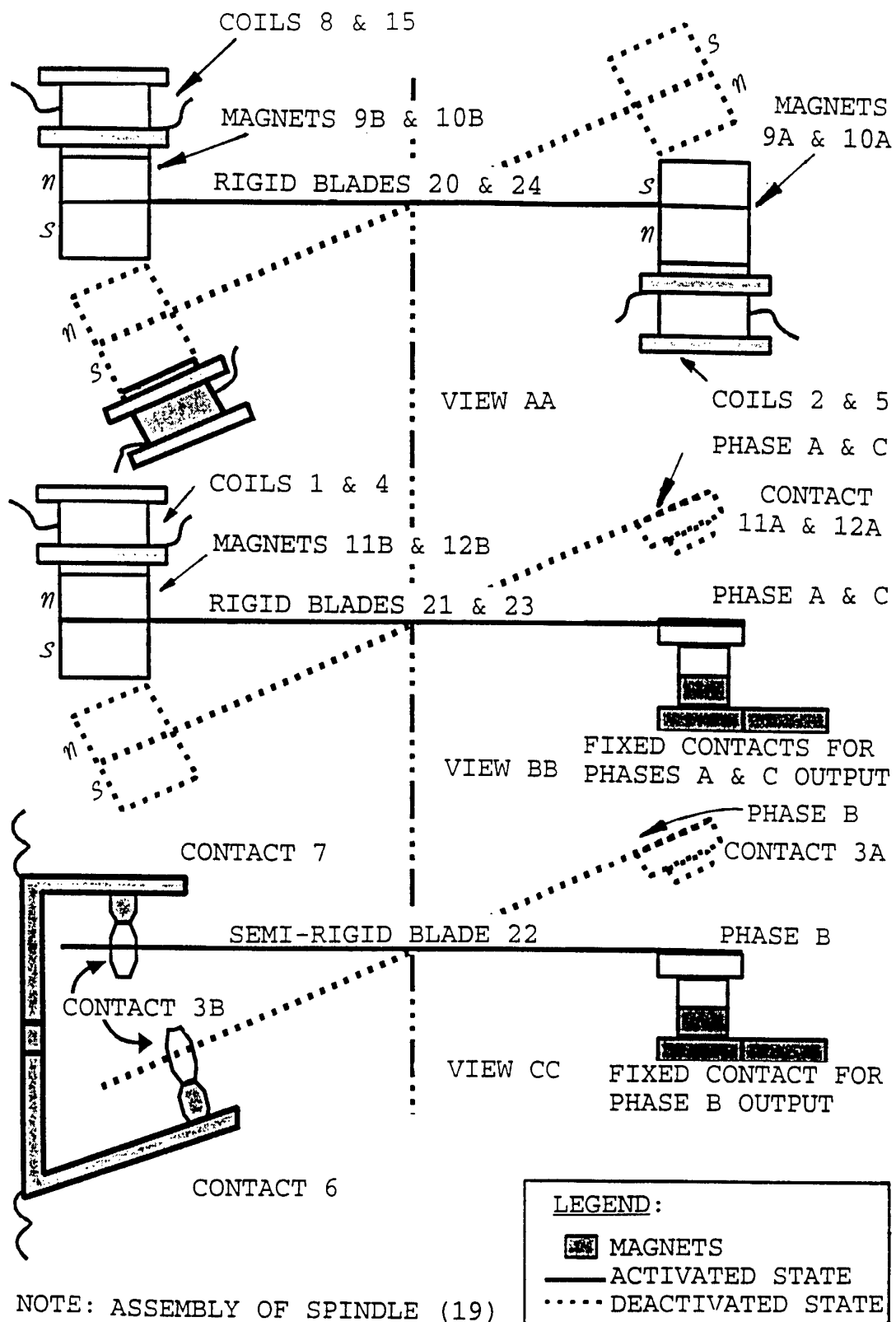


FIG. 3

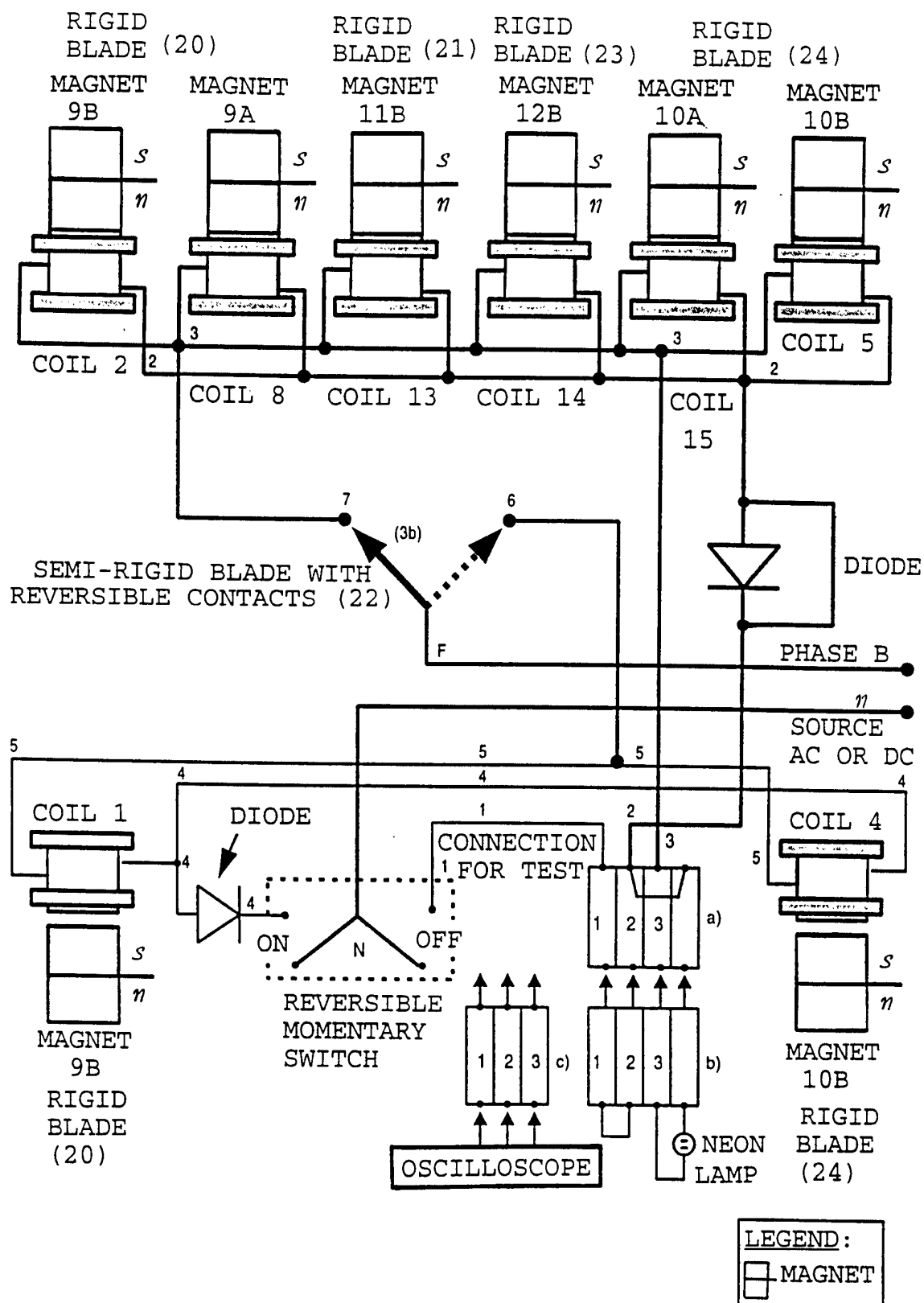


FIG. 4

DIAGRAM OF THE TRANSREED (AB-1)

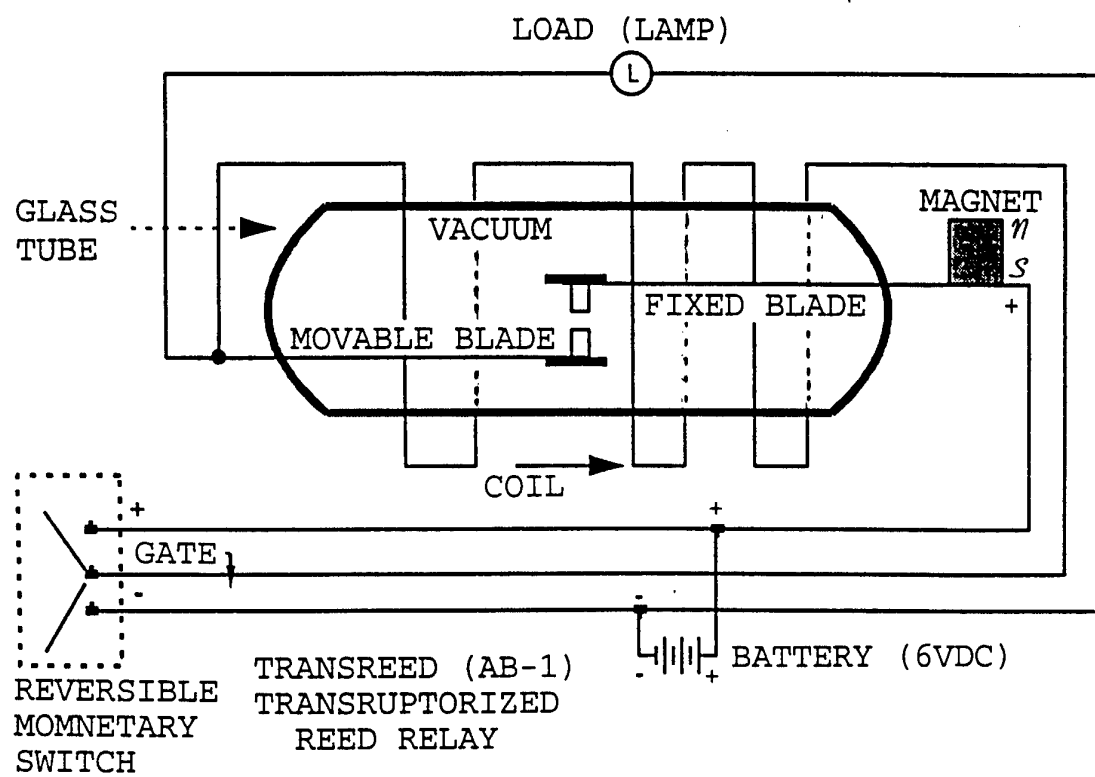


FIG. 5

DIAGRAM OF TRANSREED (AB-5)

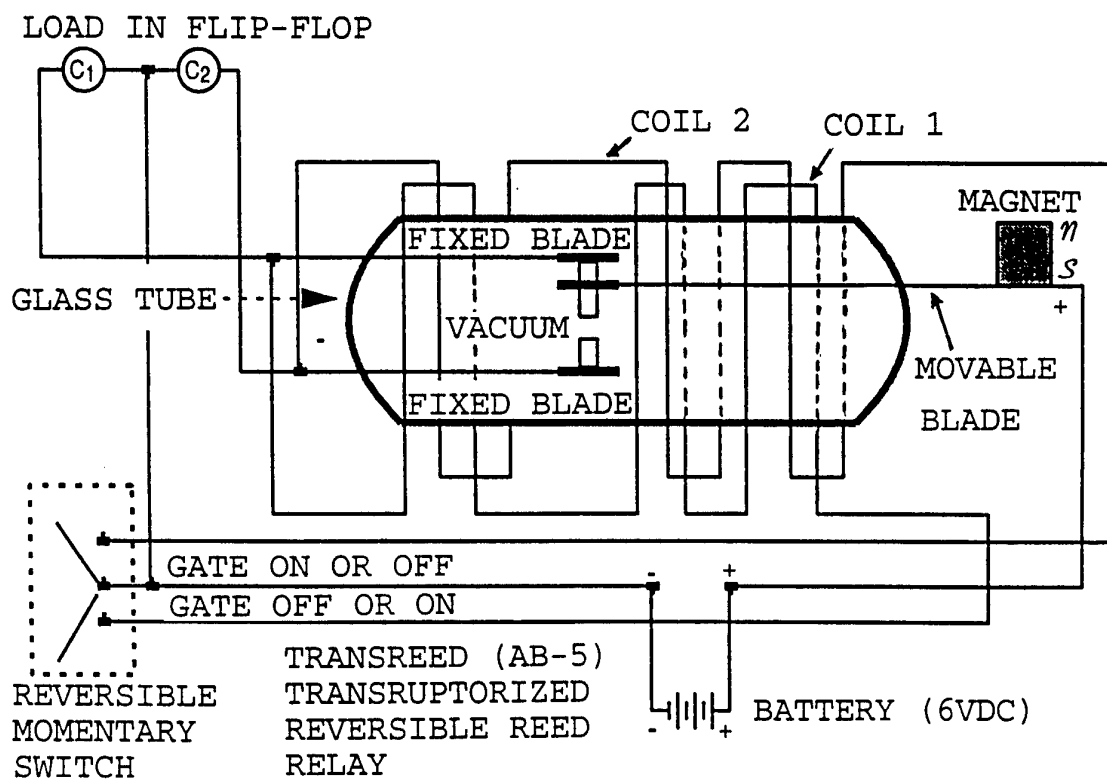


FIG. 6

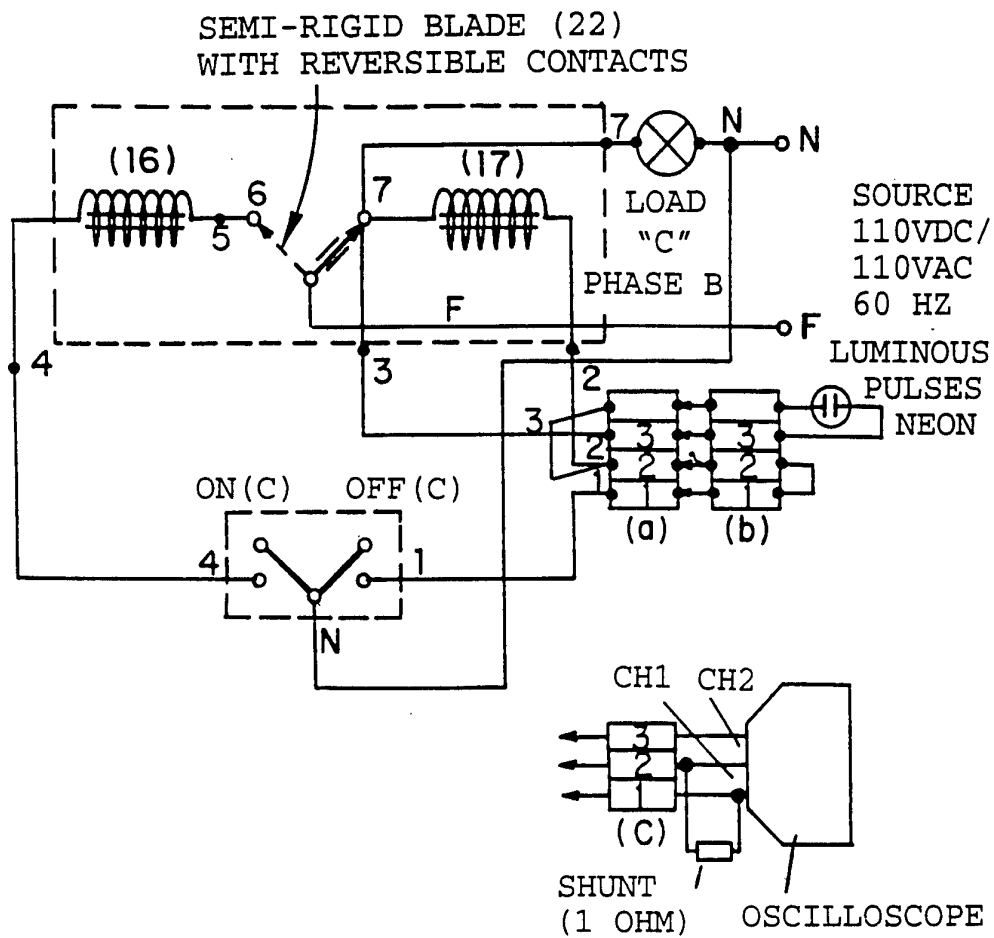


FIG. 7

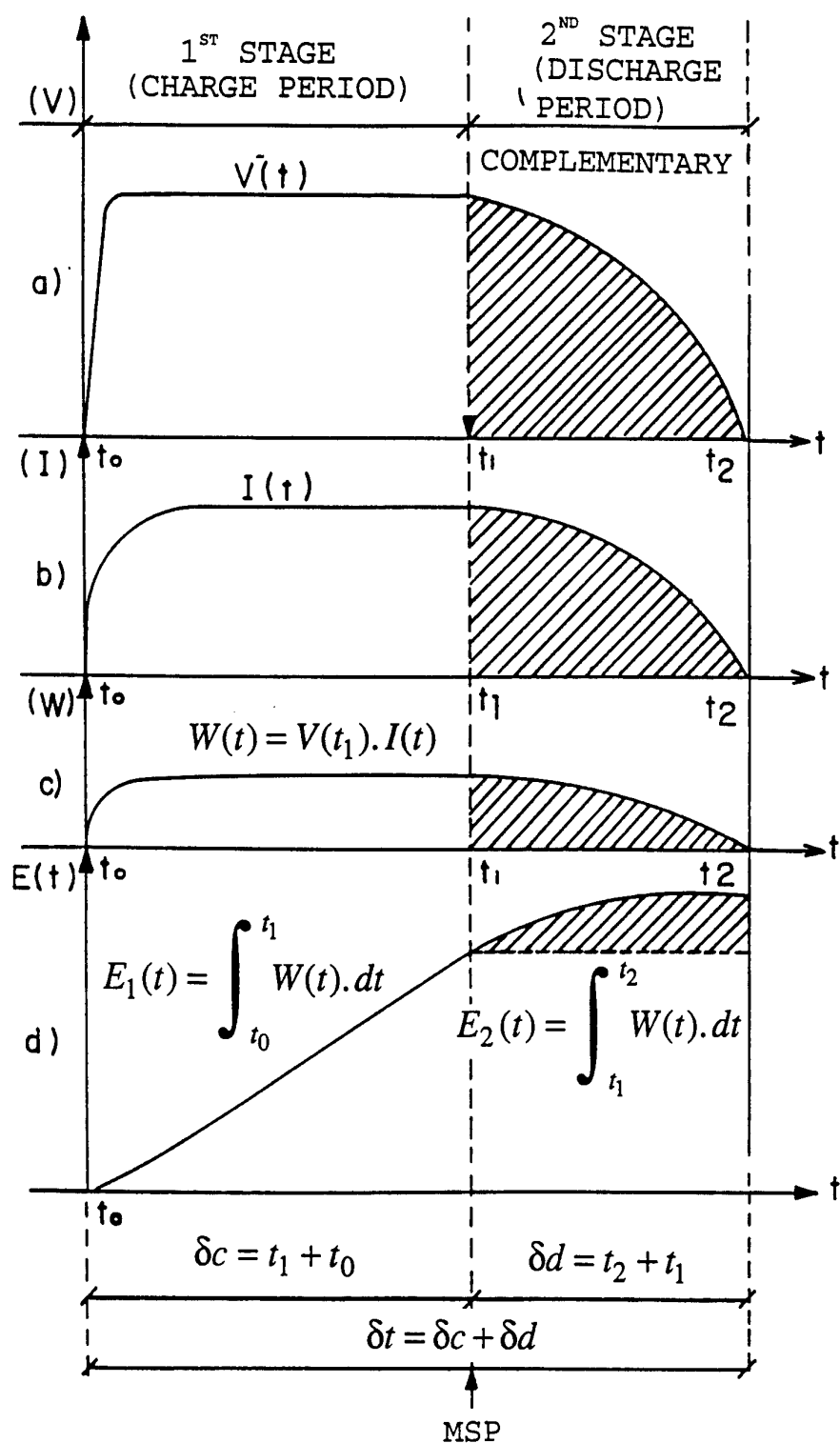


FIG. 8

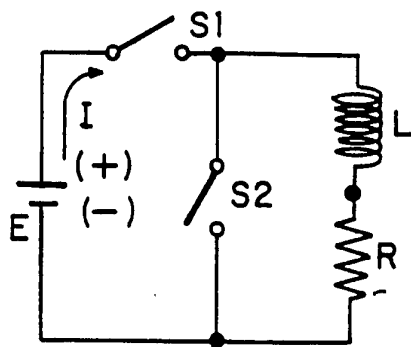


FIG. 9A

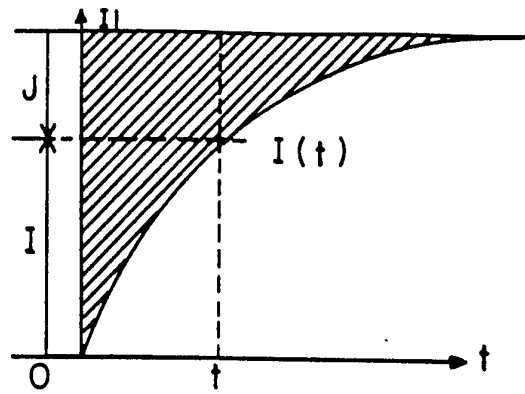


FIG. 9B

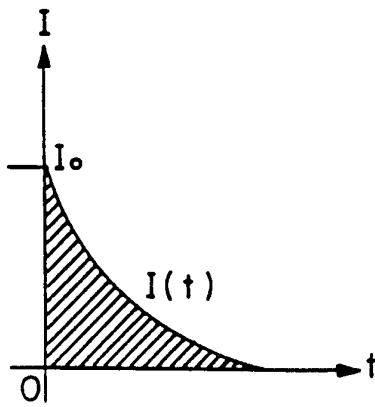


FIG. 9C

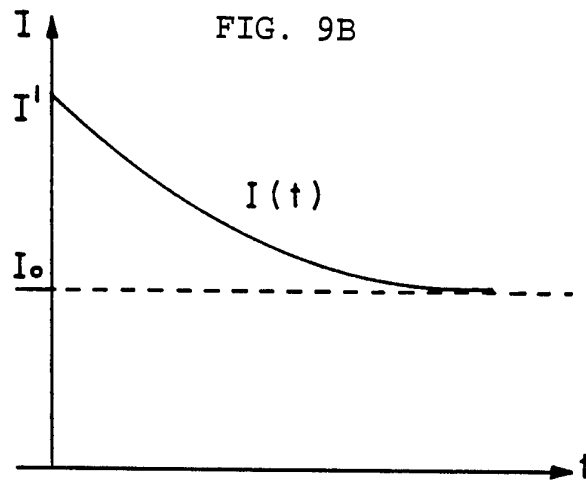


FIG. 9D

FIG. 9

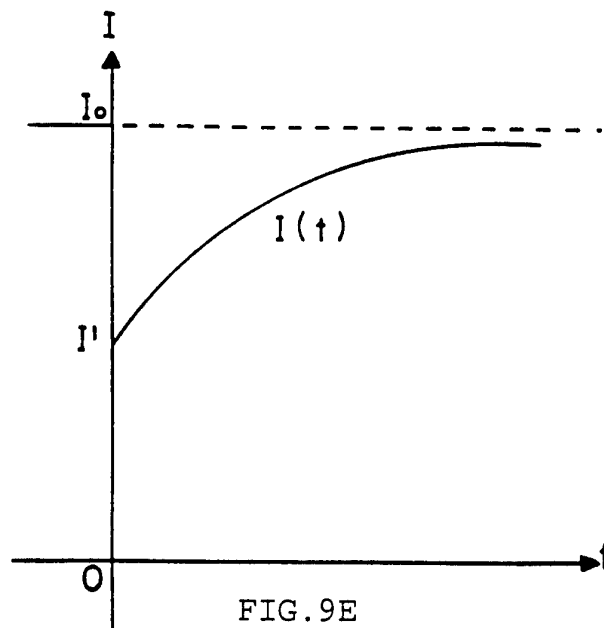


FIG. 9E

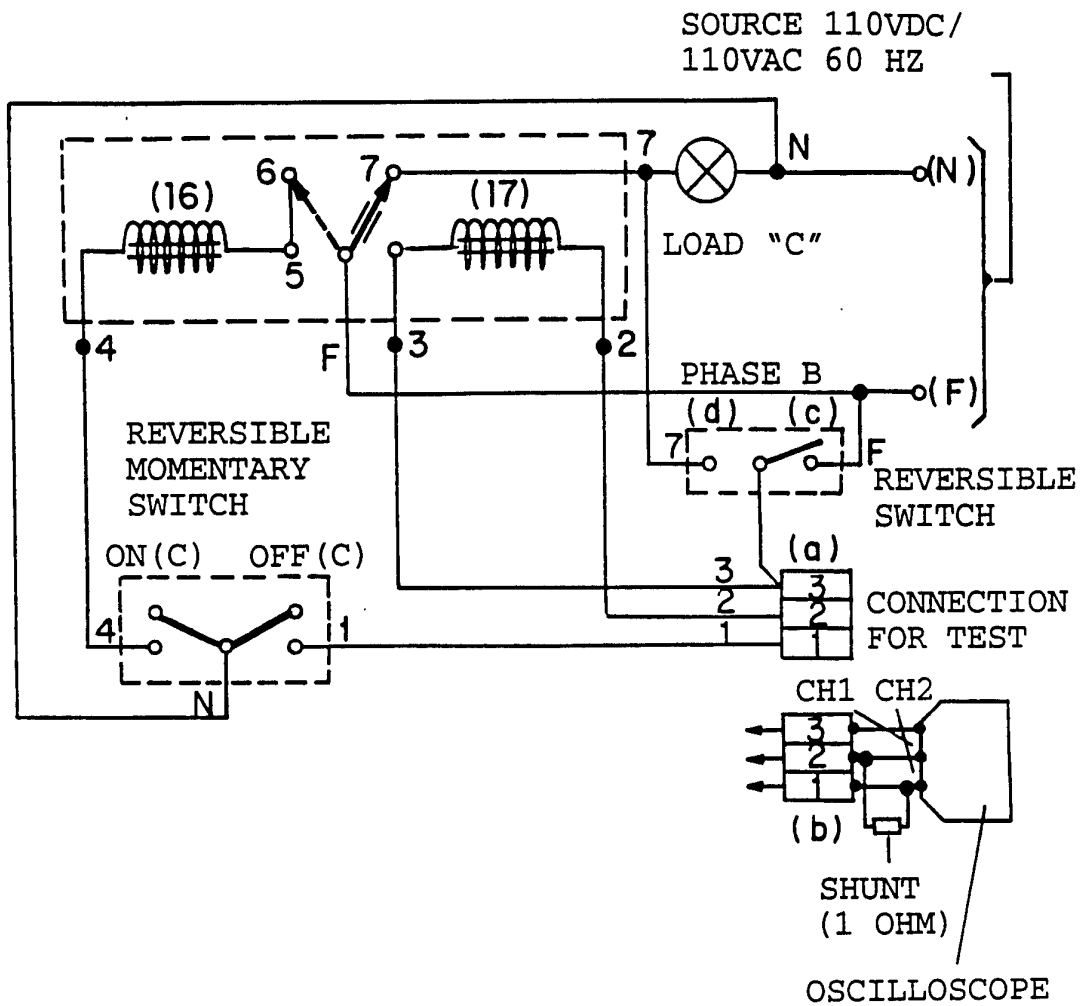


FIG.10

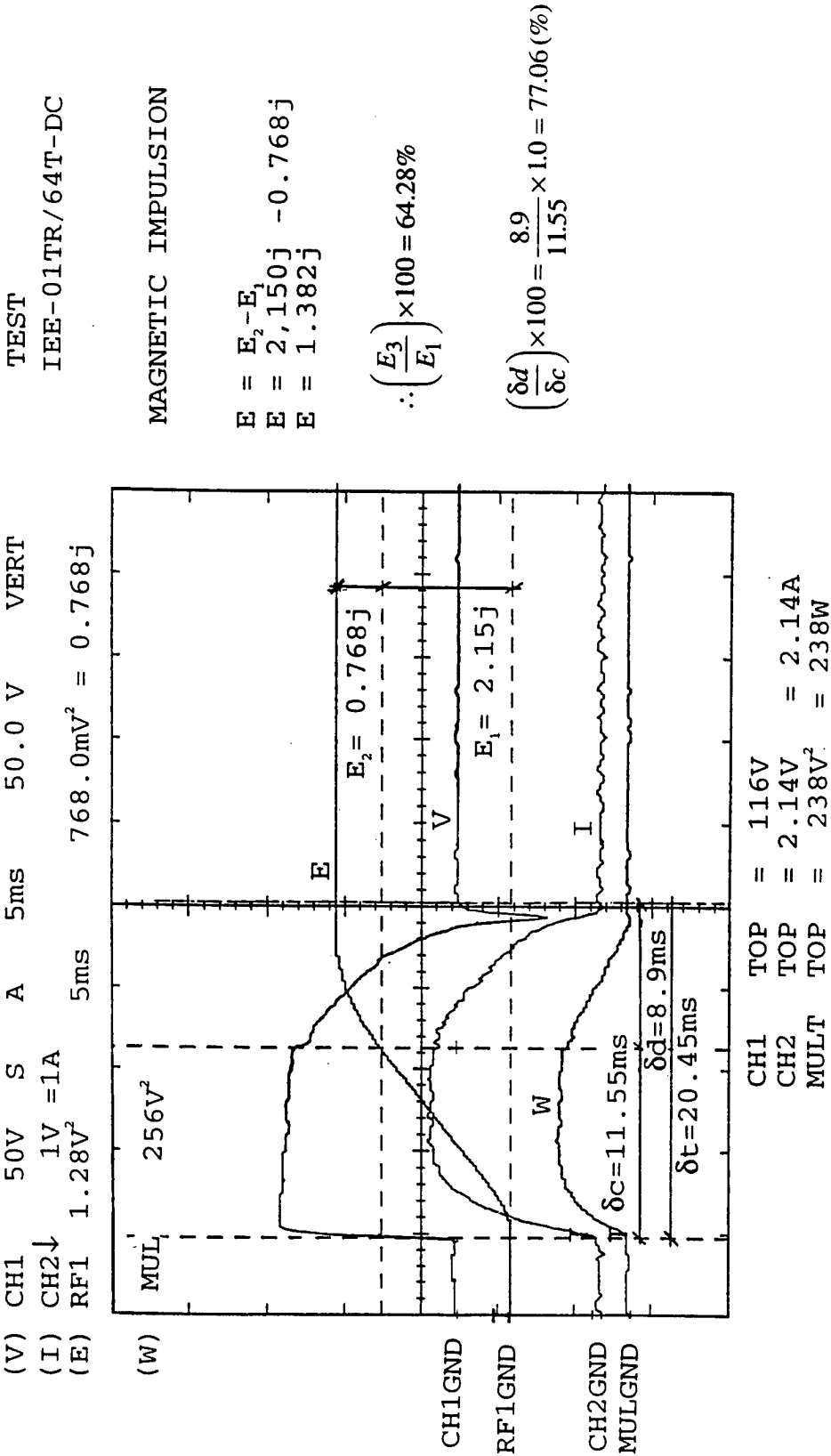
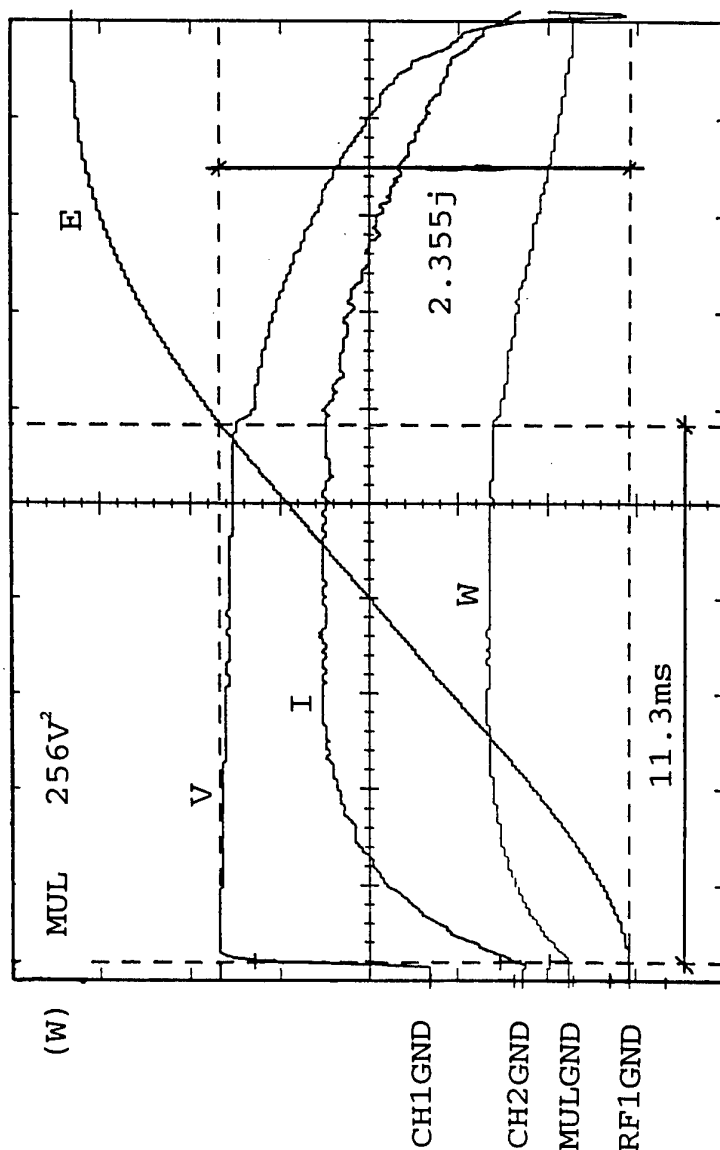


FIG.11

TEST
IEE-02TR/64T-DC

(V) CH1 50V S A 2ms 50.0 V VERT
(I) CH2↓ 1V = 1A
(E) RF1 512mV² 2ms 2.355V² = 2.355j



CH1 TOP = 117V
CH2 TOP = 2.18V = 2.18A
MULT TOP = 246V² = 246W

FIG.12

TEST
IEE-03TR/64T-DC

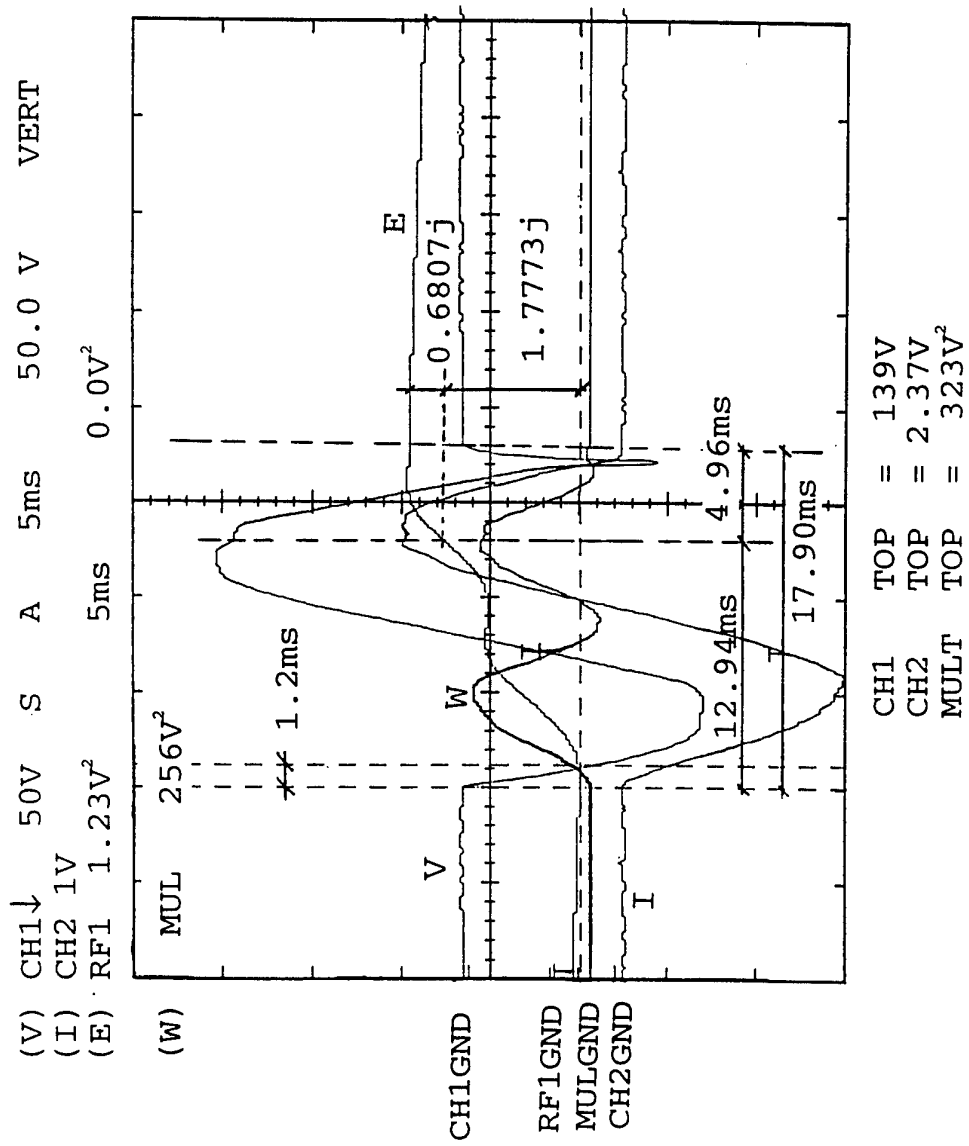


FIG.14

TEST
IEE-04TR/64T-DC

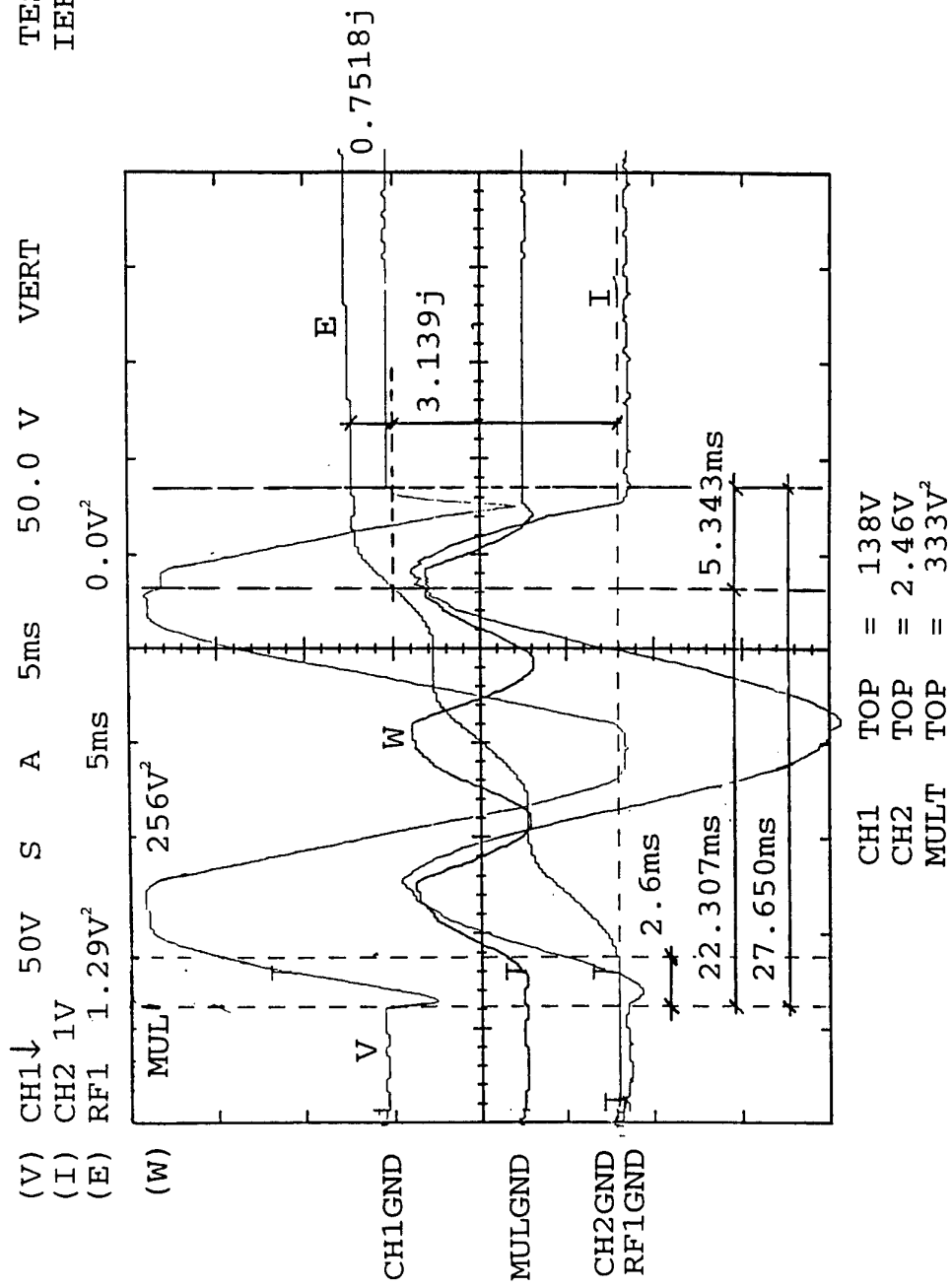


FIG.15

TEST
IEE-05TR/64T-DC

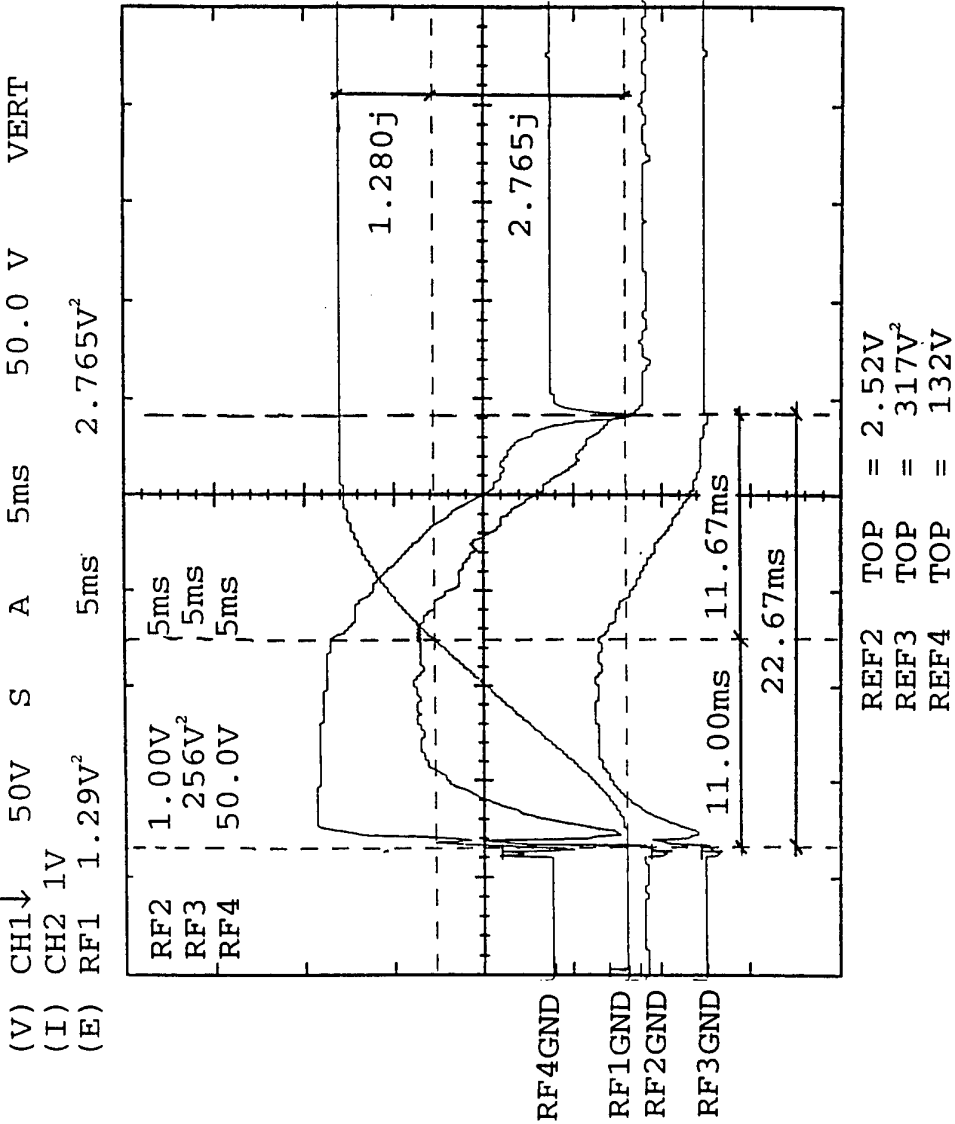
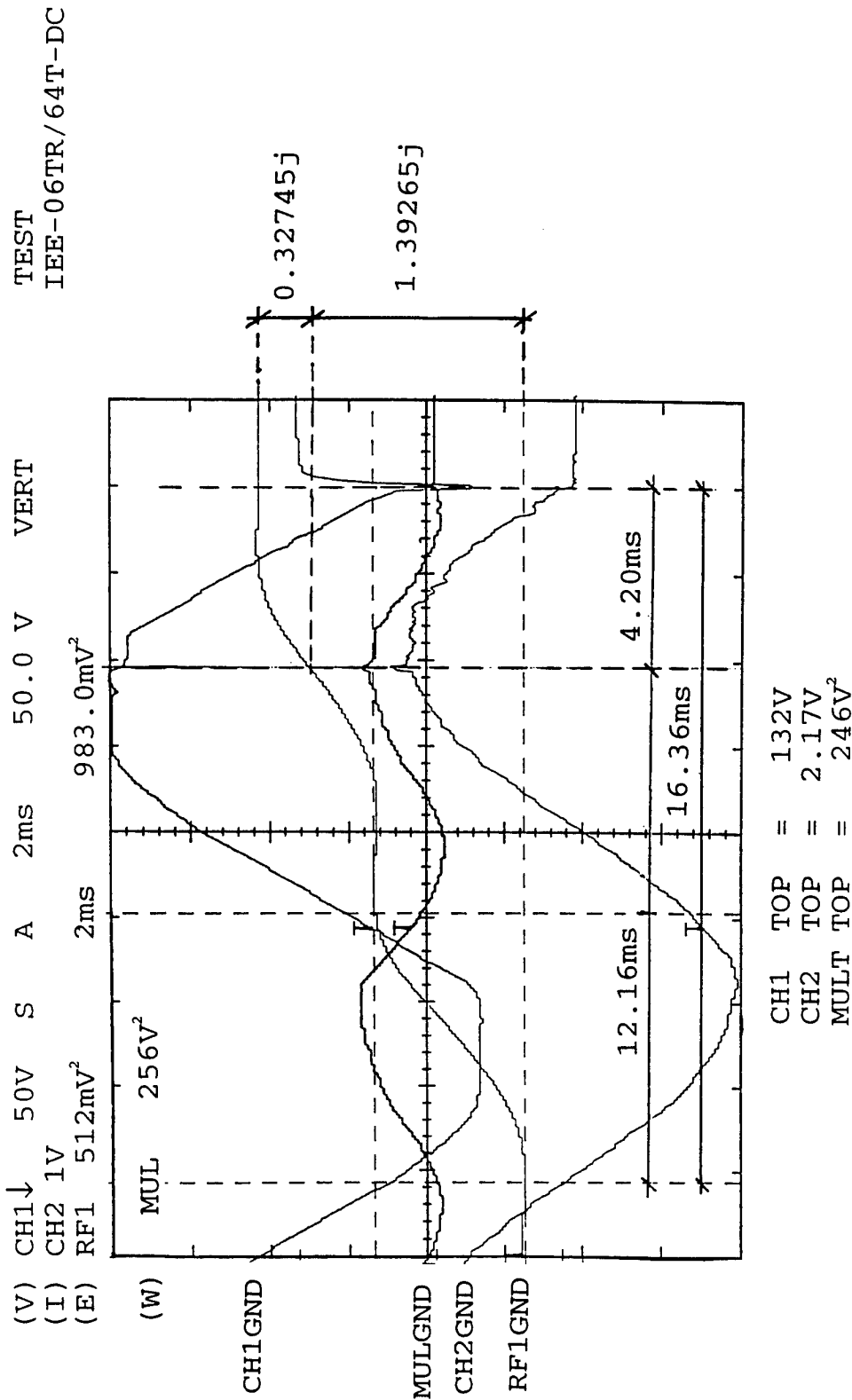


FIG.16



TEST
IEE-07TR/64T-DC

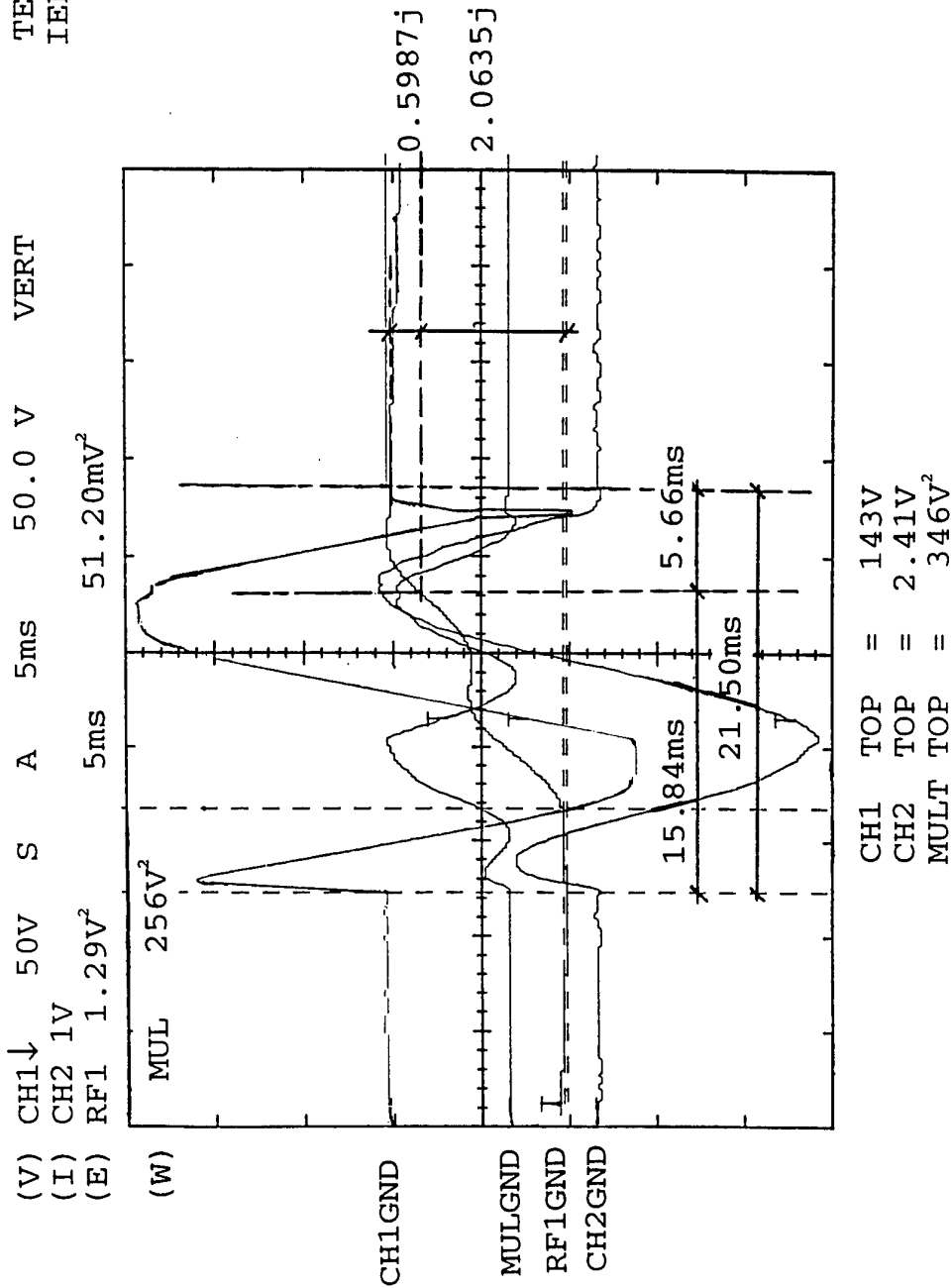


FIG.18

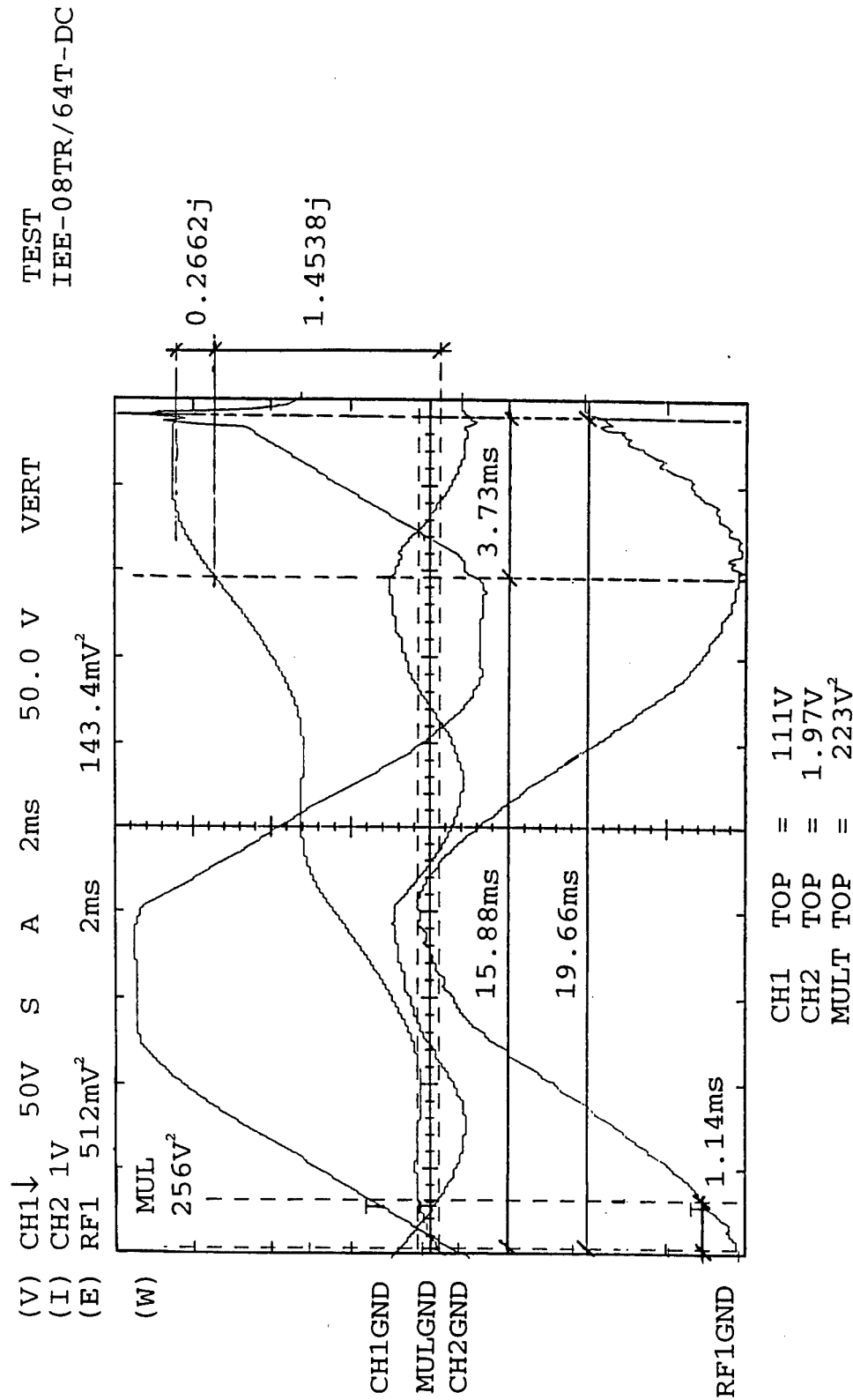
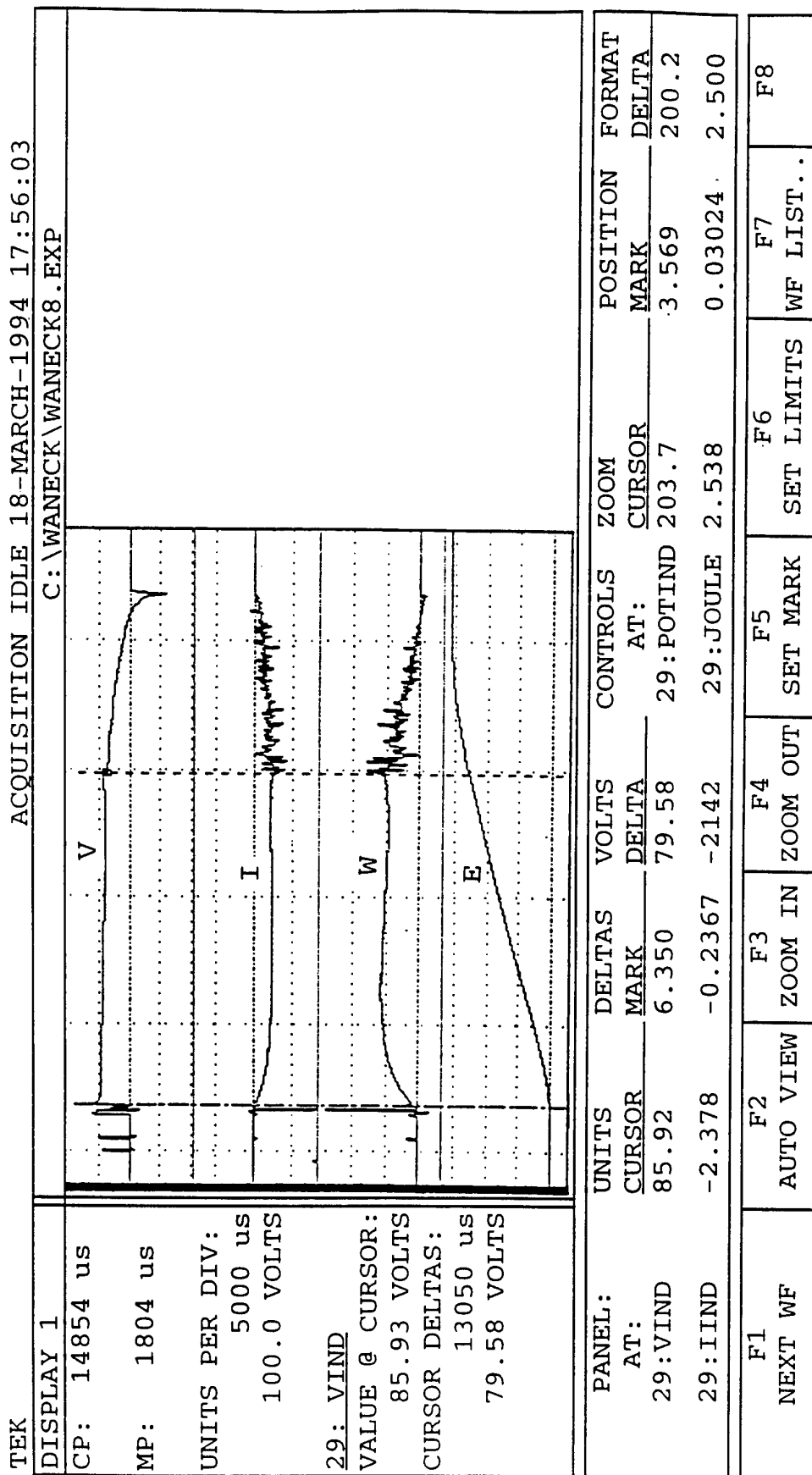


FIG.19

TEKTRONIX 2500 TESTLAB PRINT SCREEN
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FIG. 20



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FIG. 21

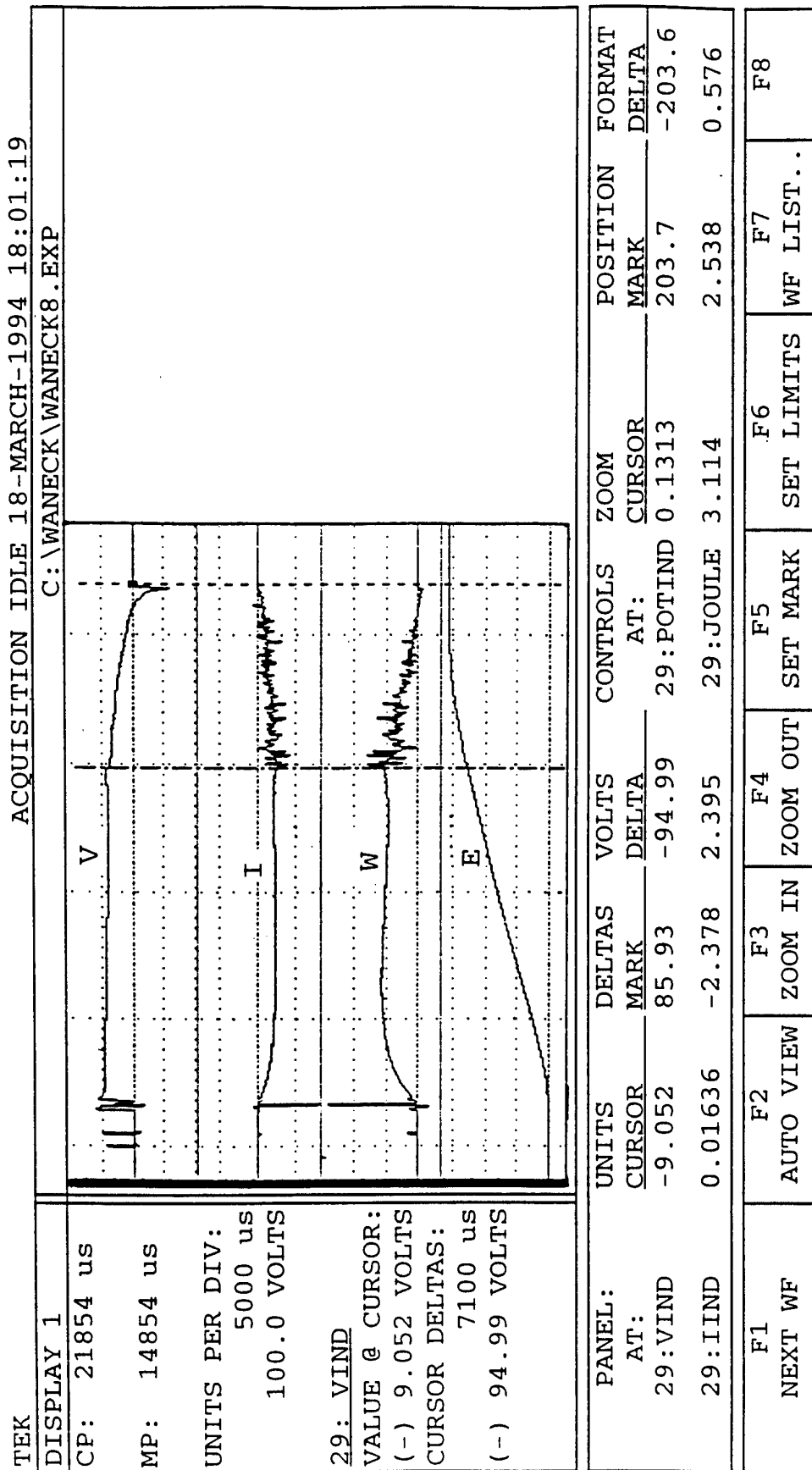
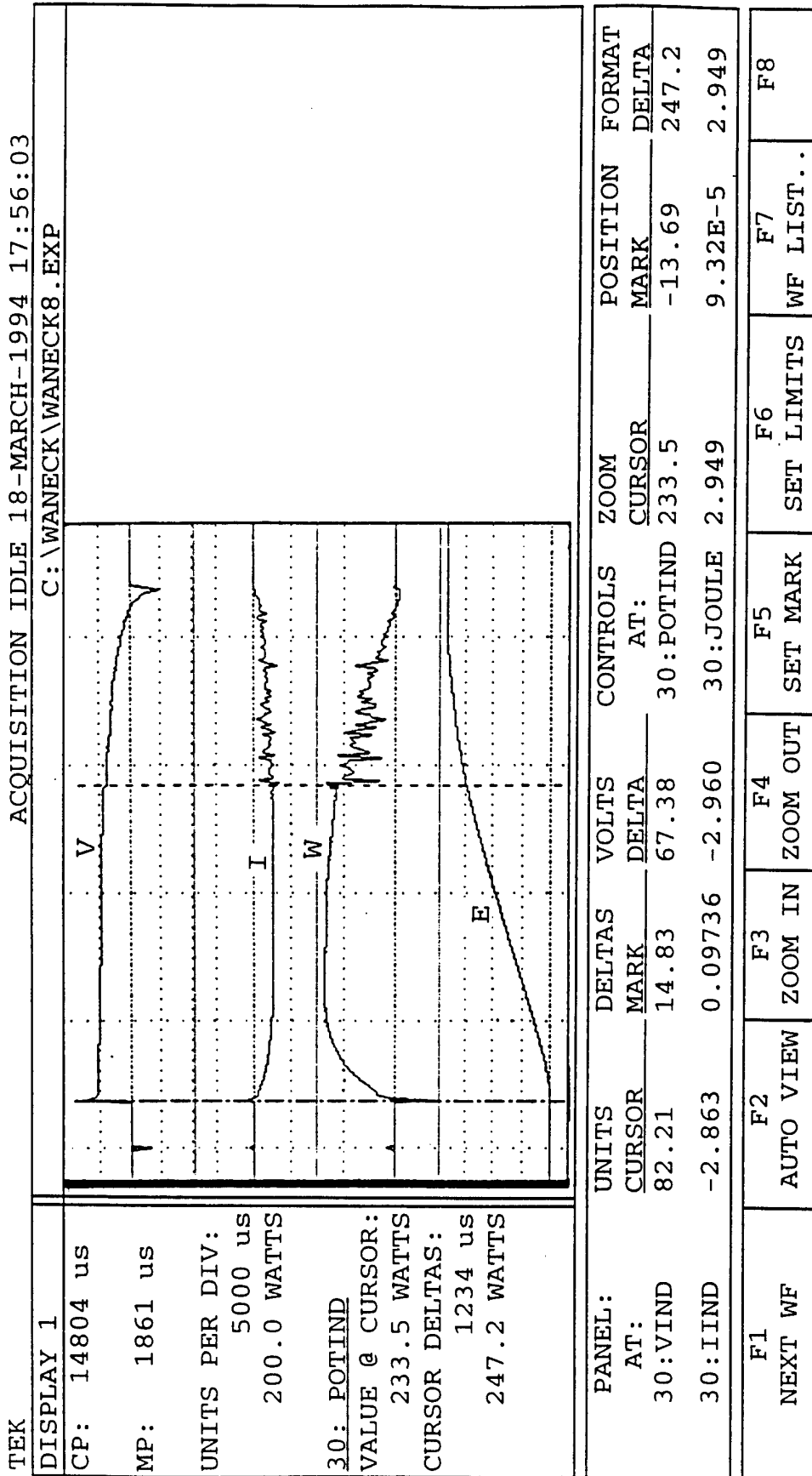
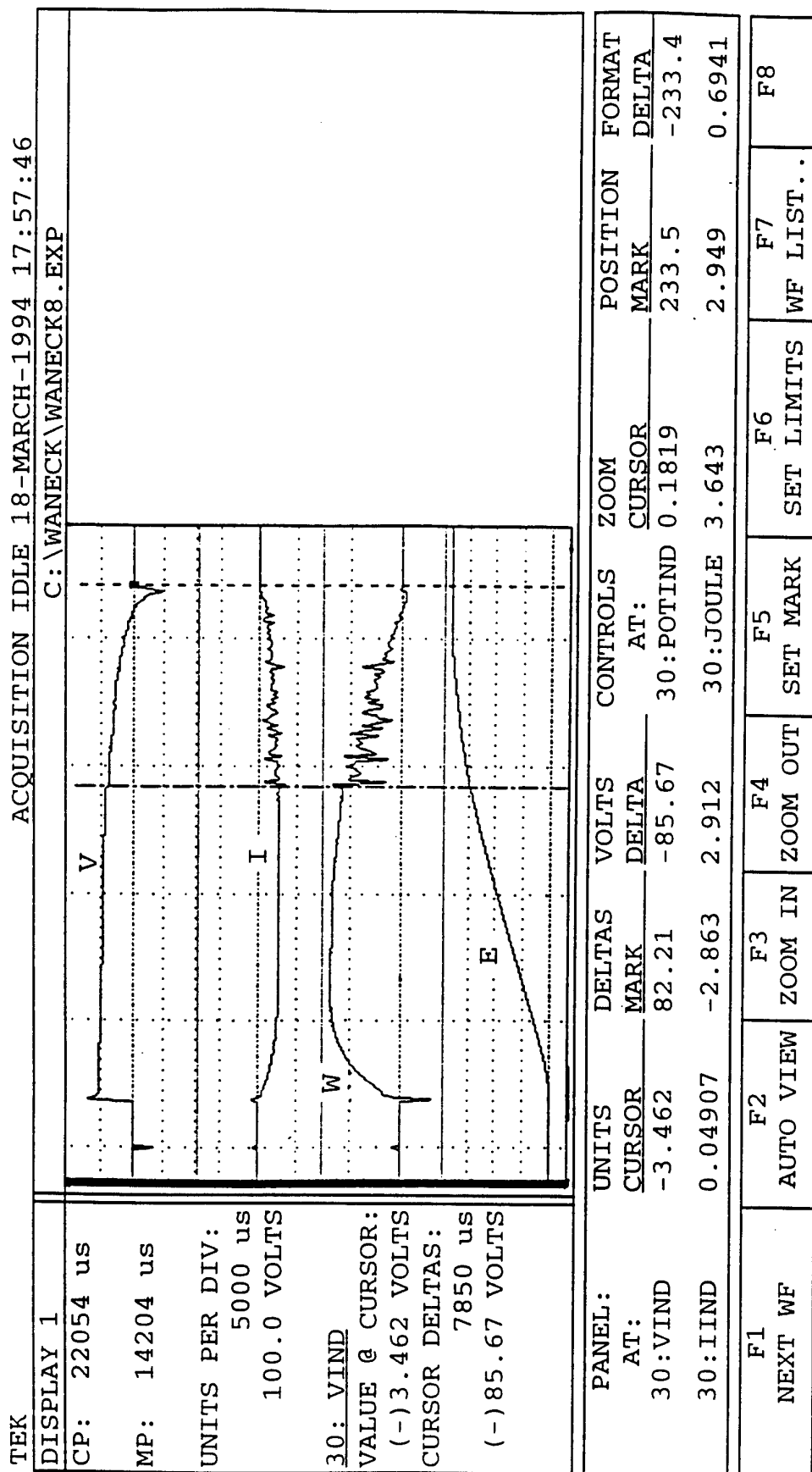


FIG. 22
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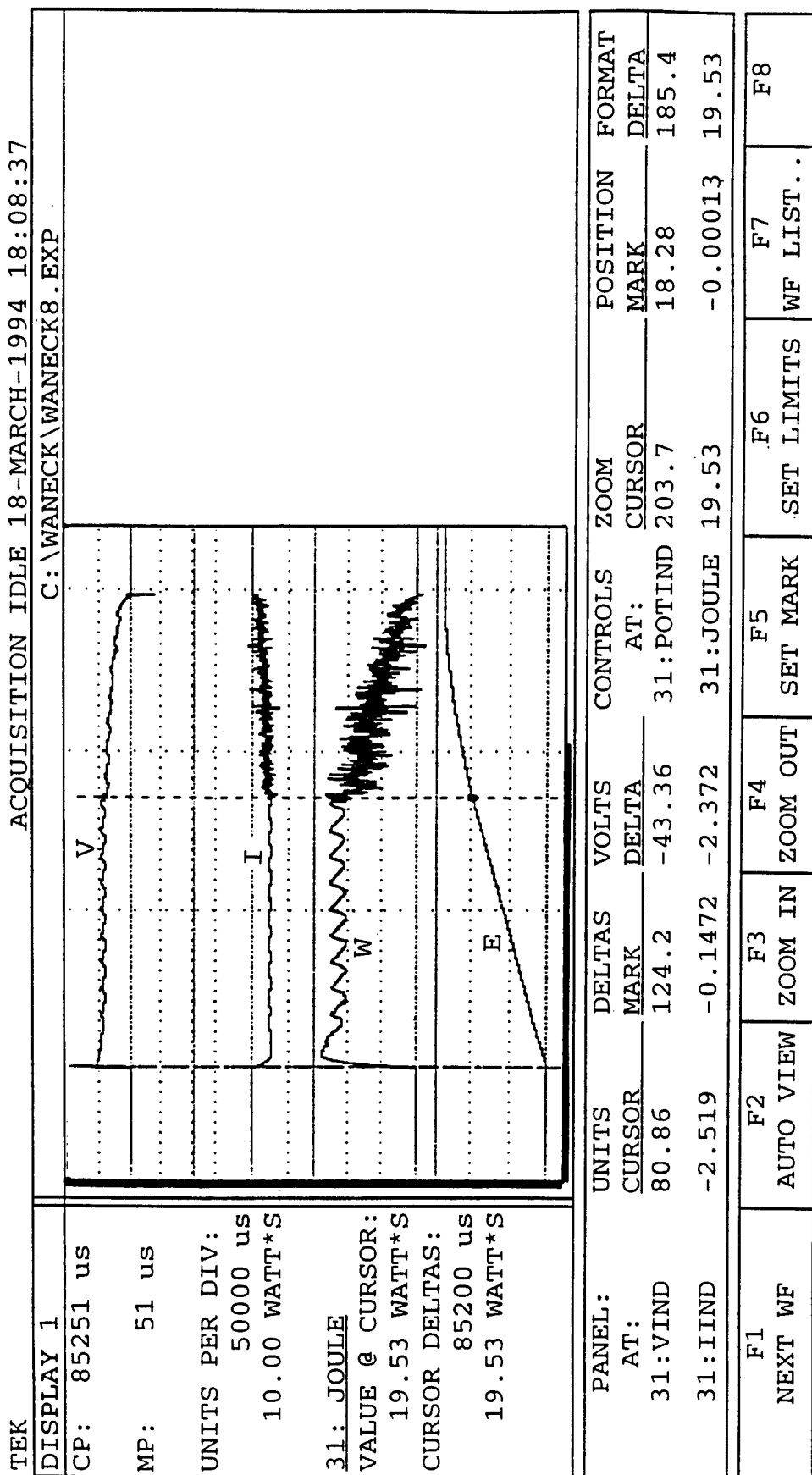
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FIG. 23



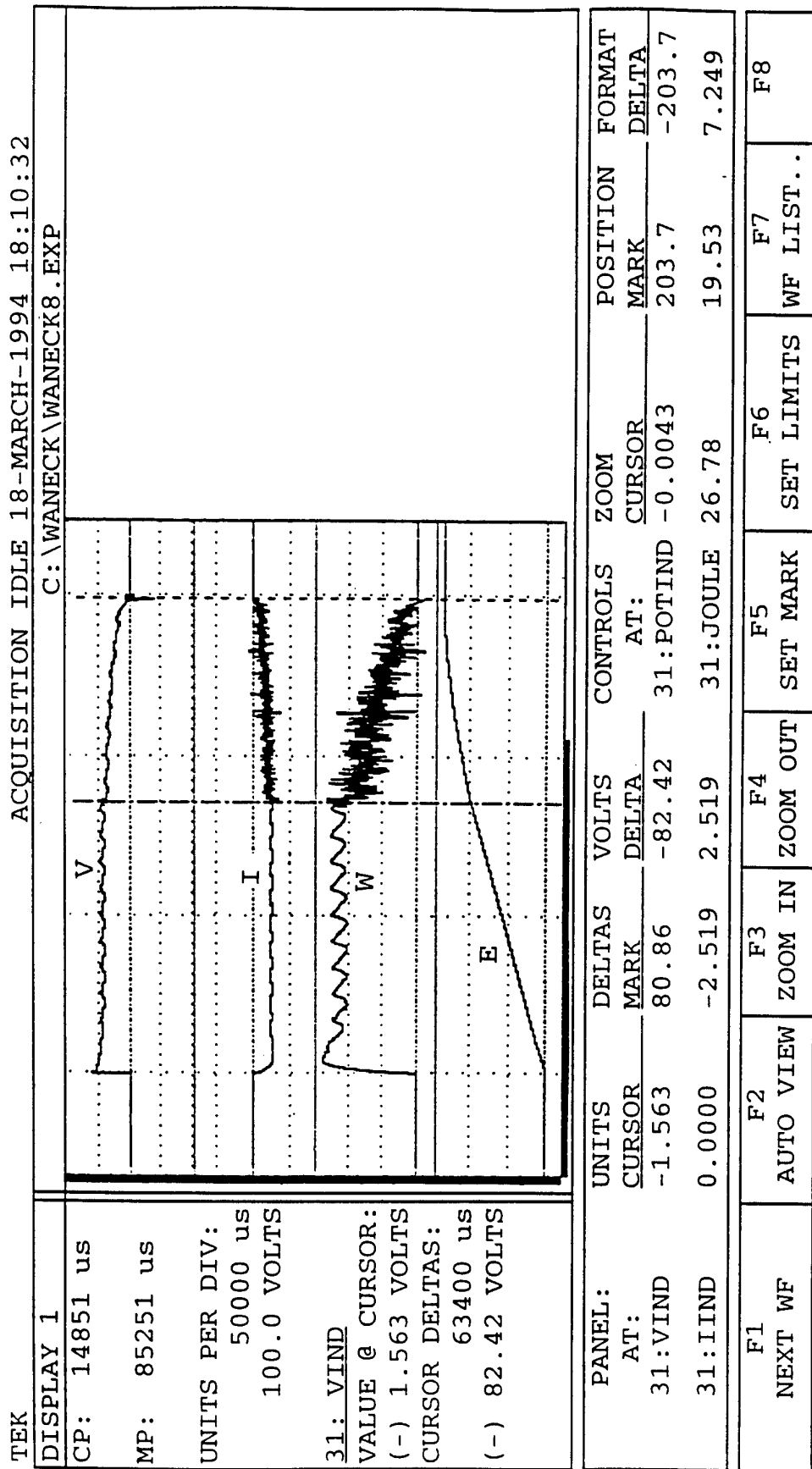
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FIG. 24



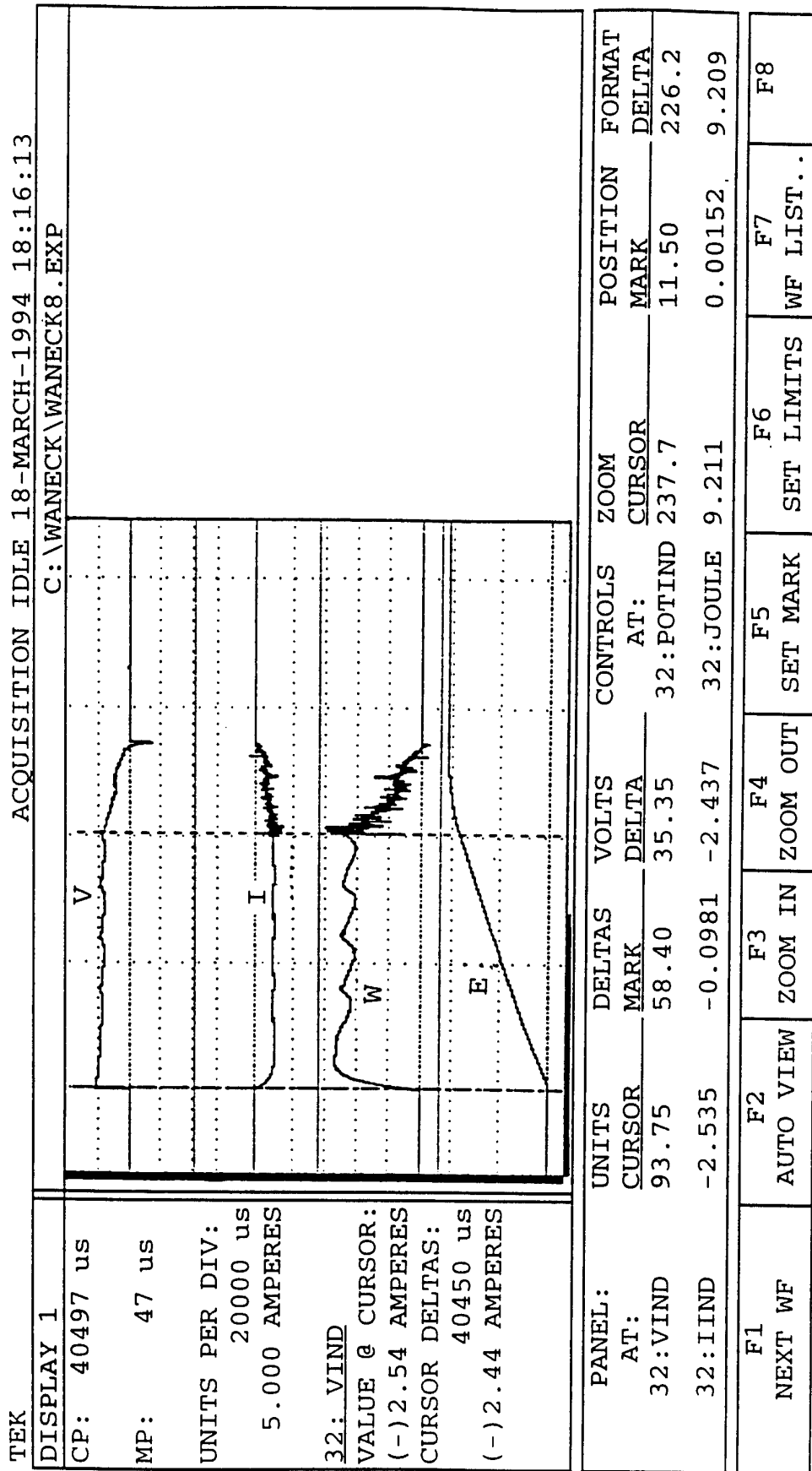
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FIG. 25



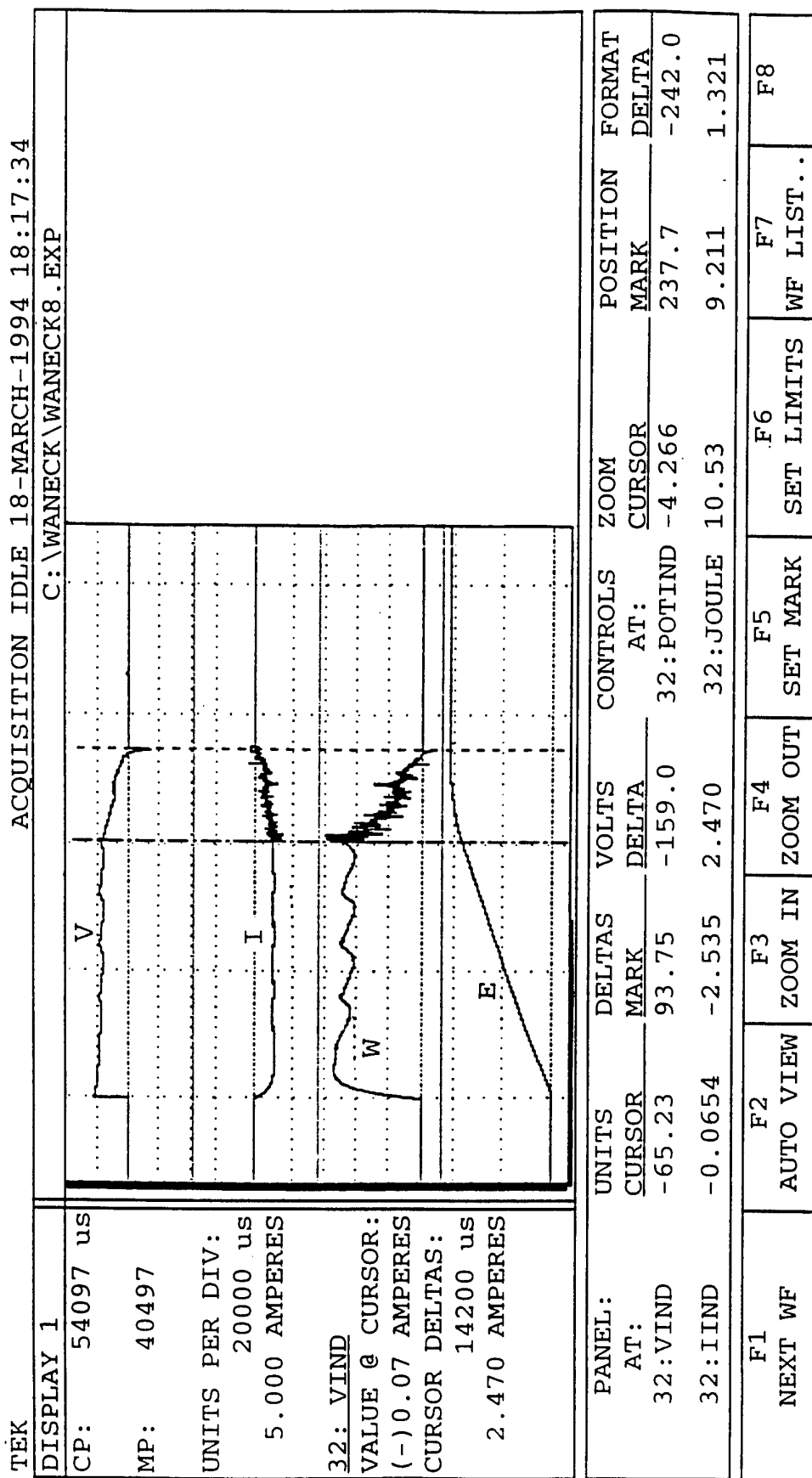
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FIG. 26



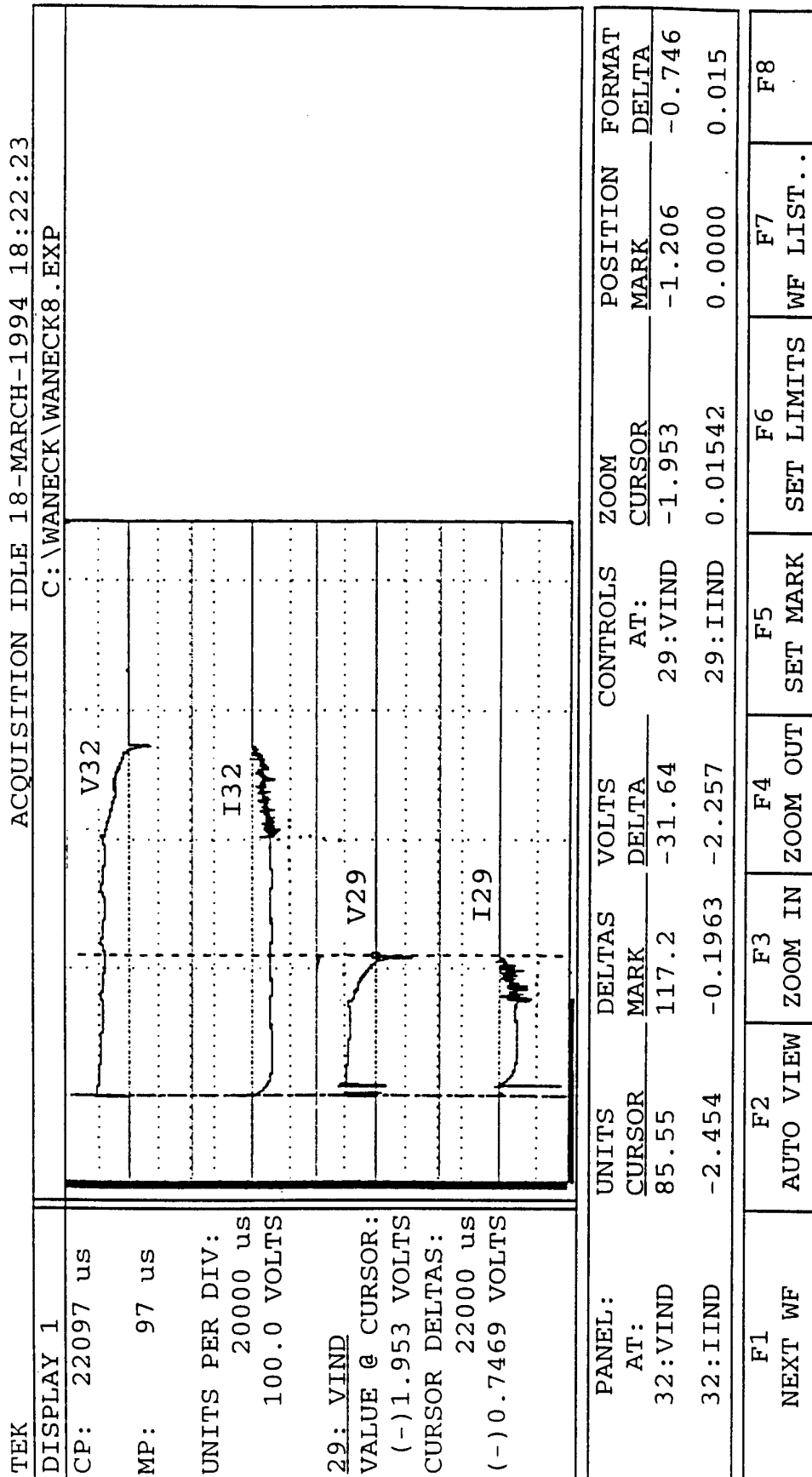
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FIG. 27



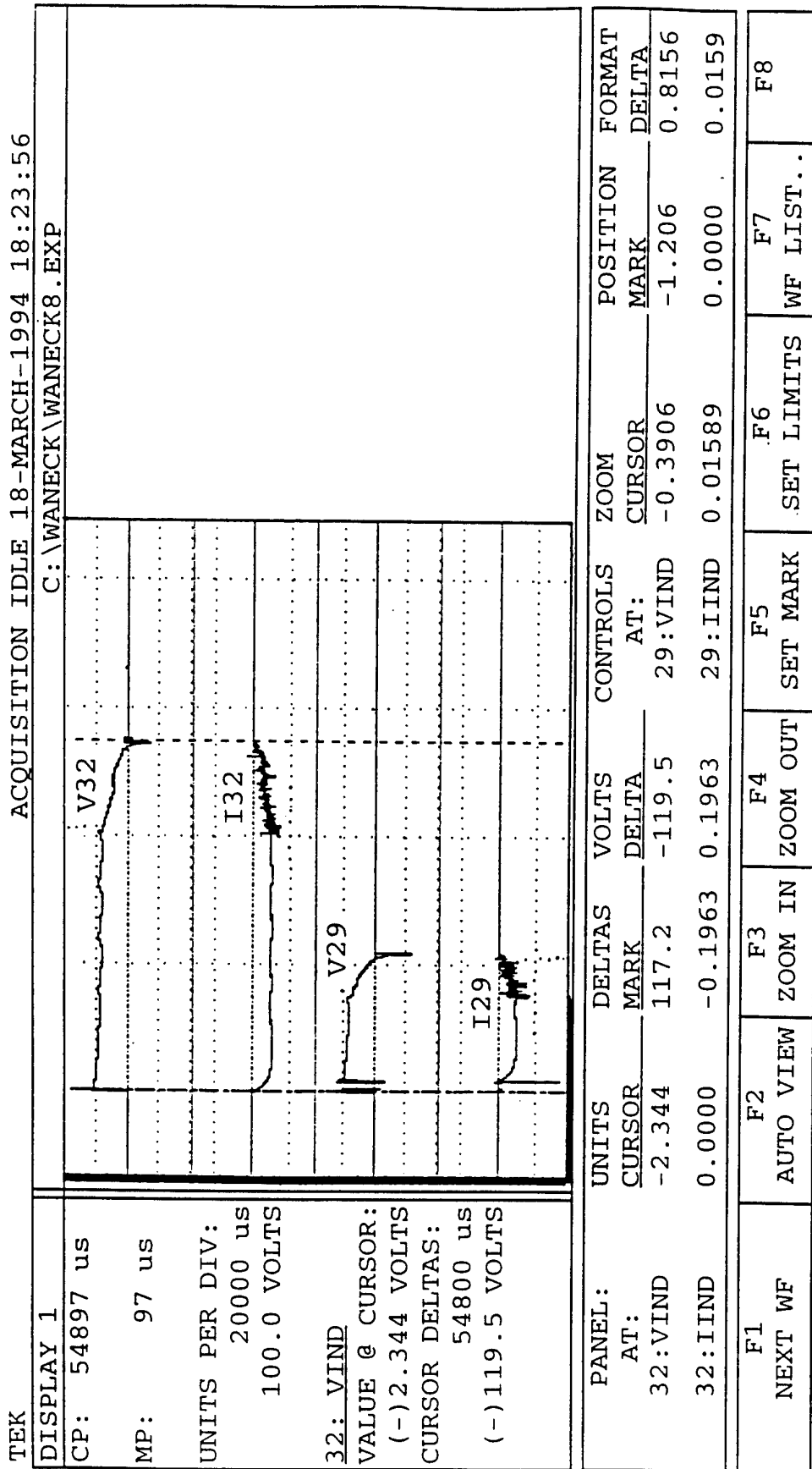
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FIG. 28



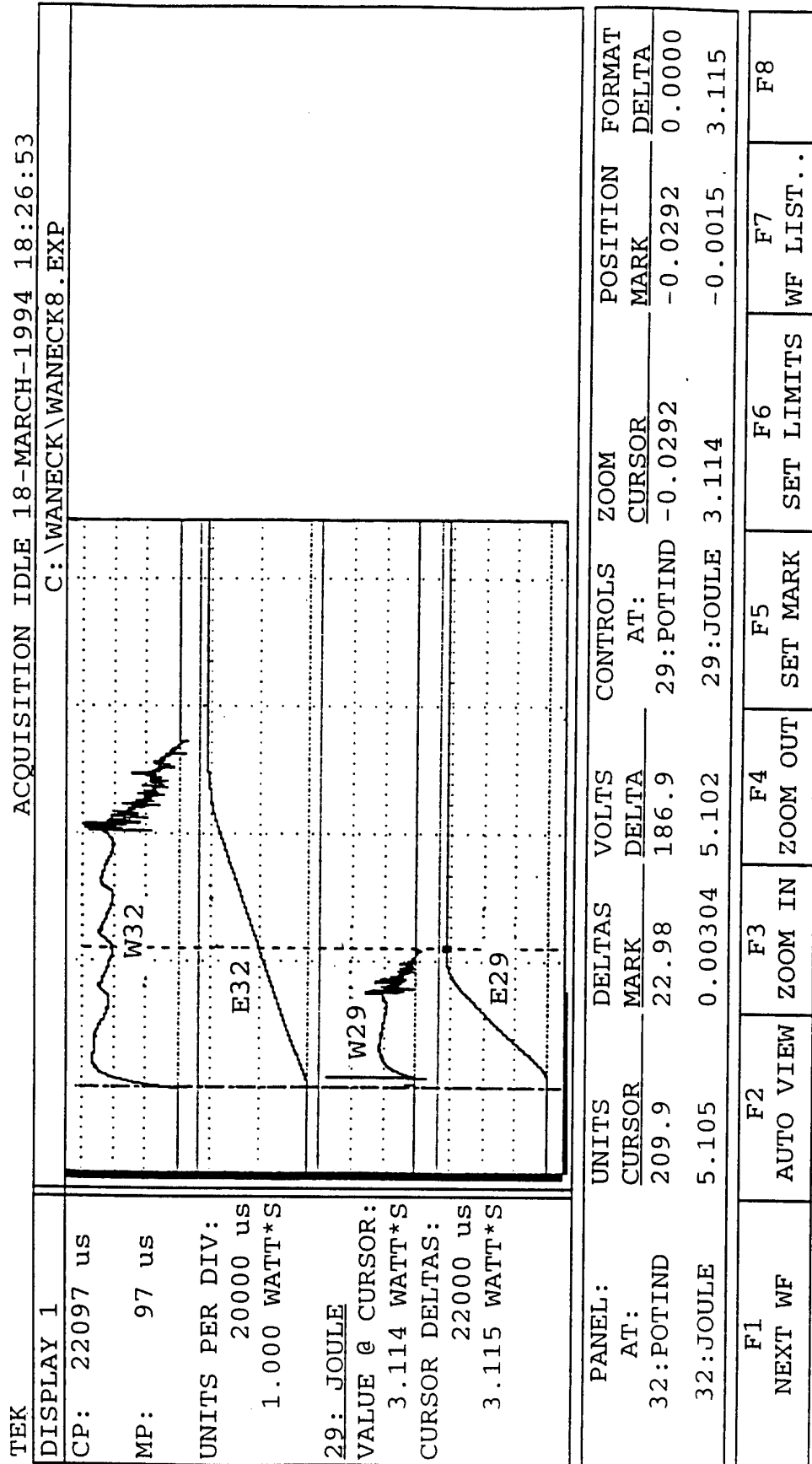
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FIG. 29



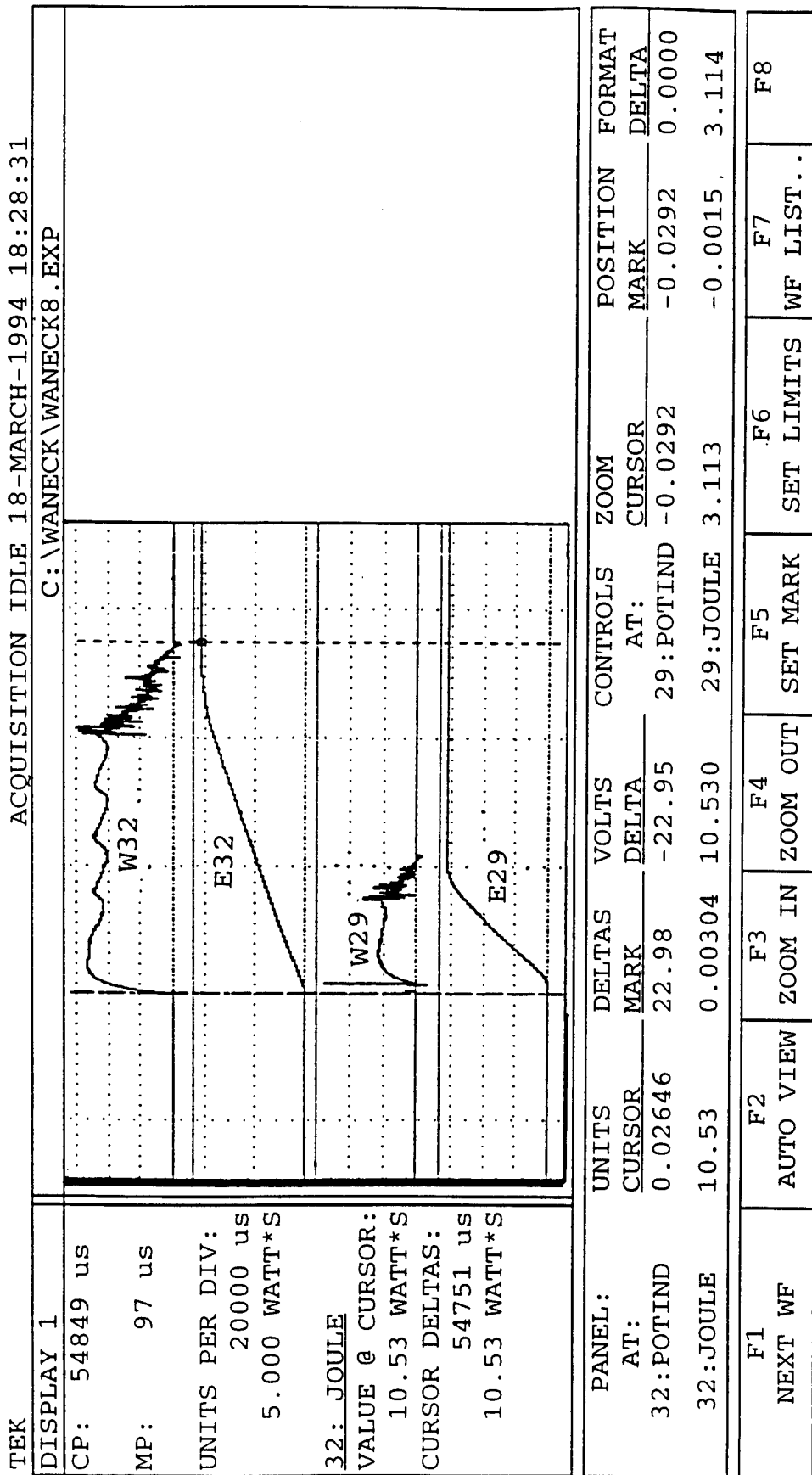
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FIG. 30



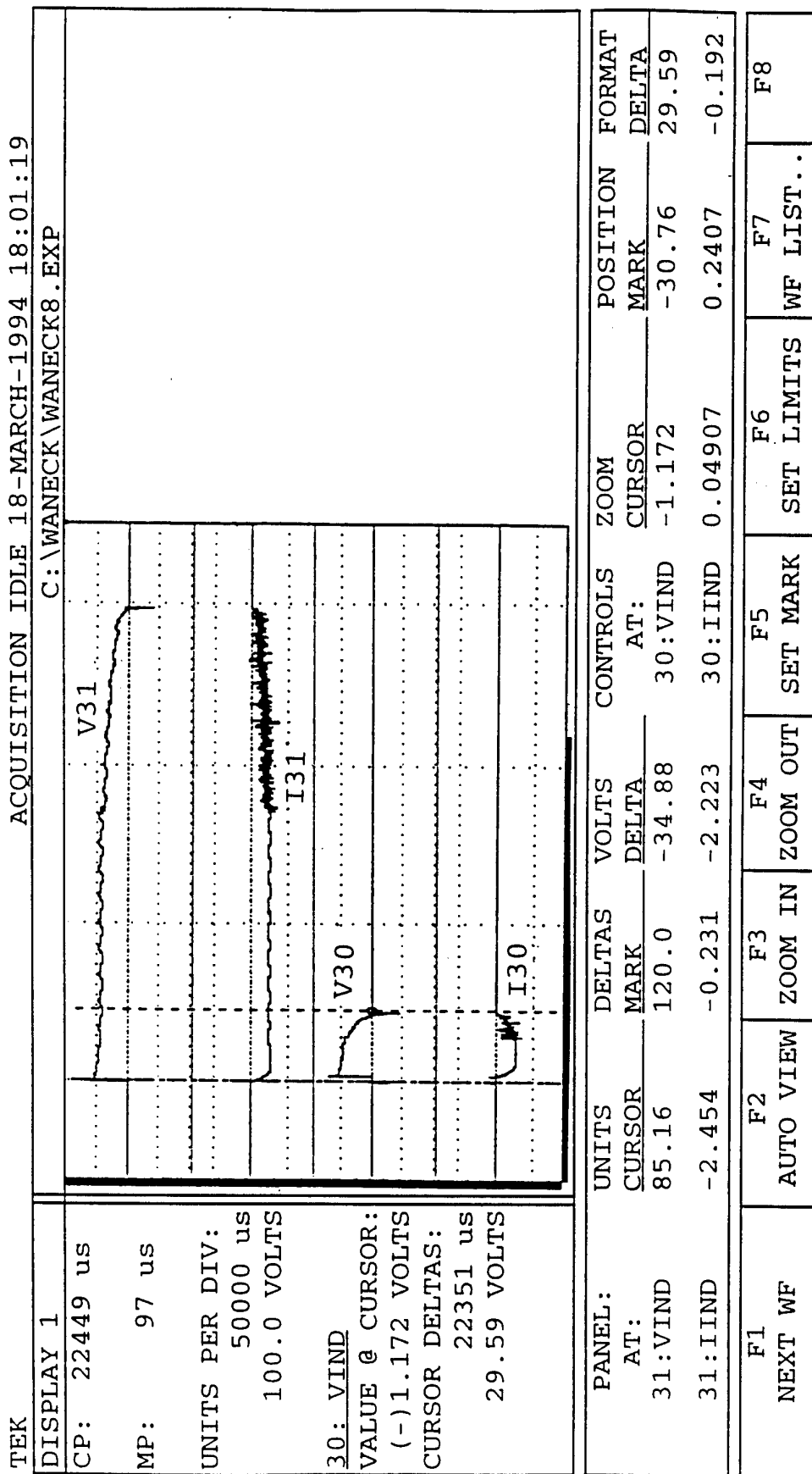
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FIG. 31



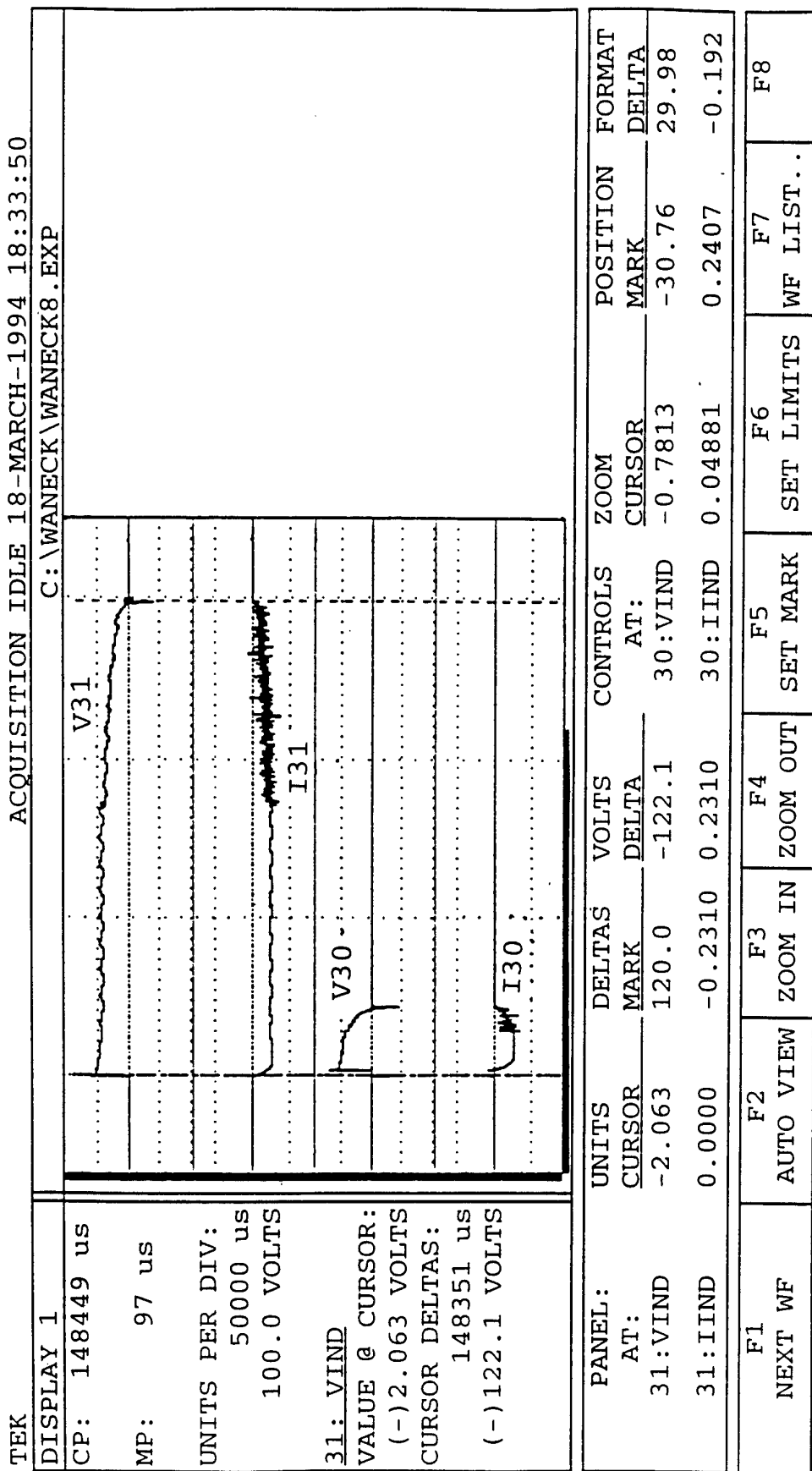
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FIG. 32



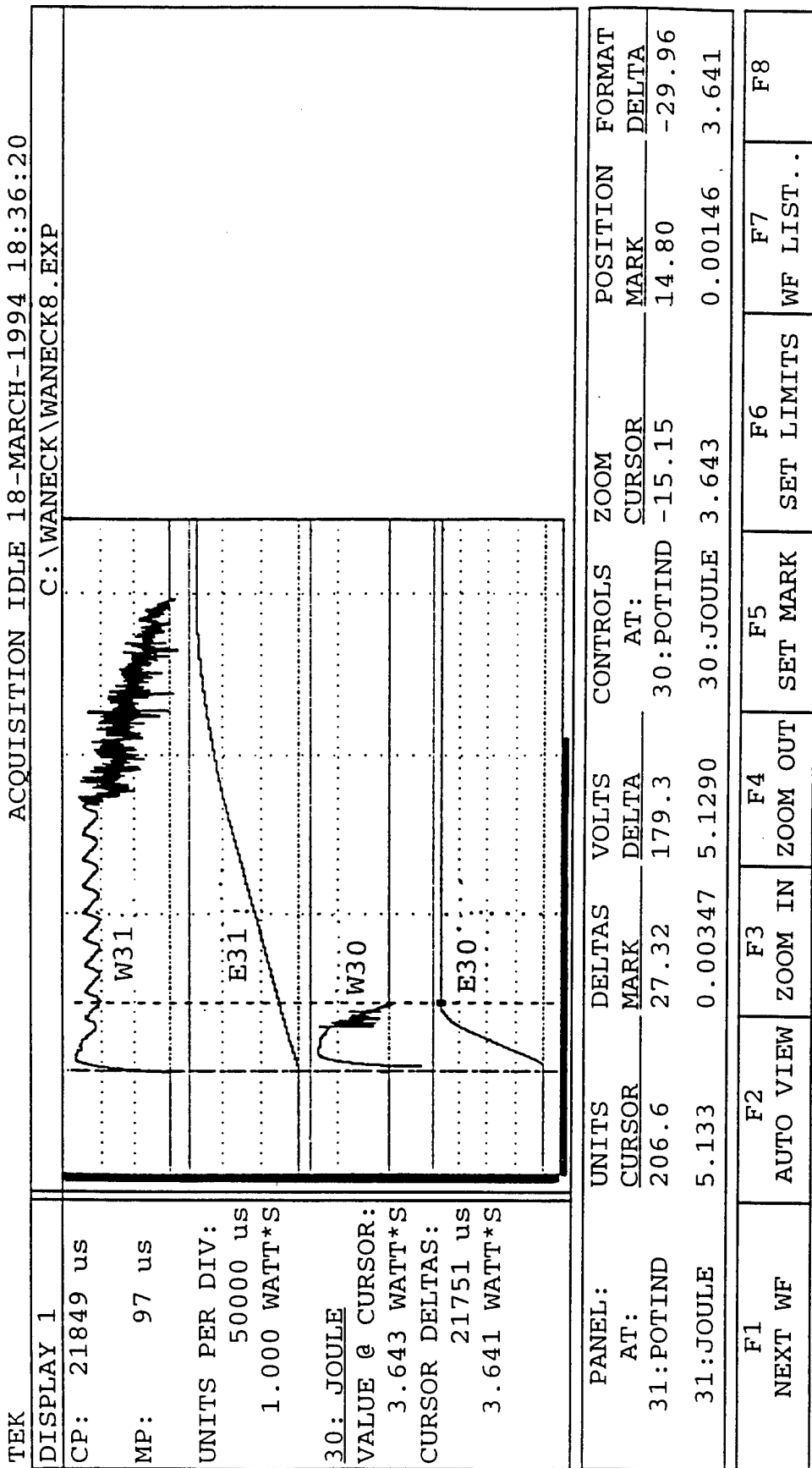
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FIG. 33



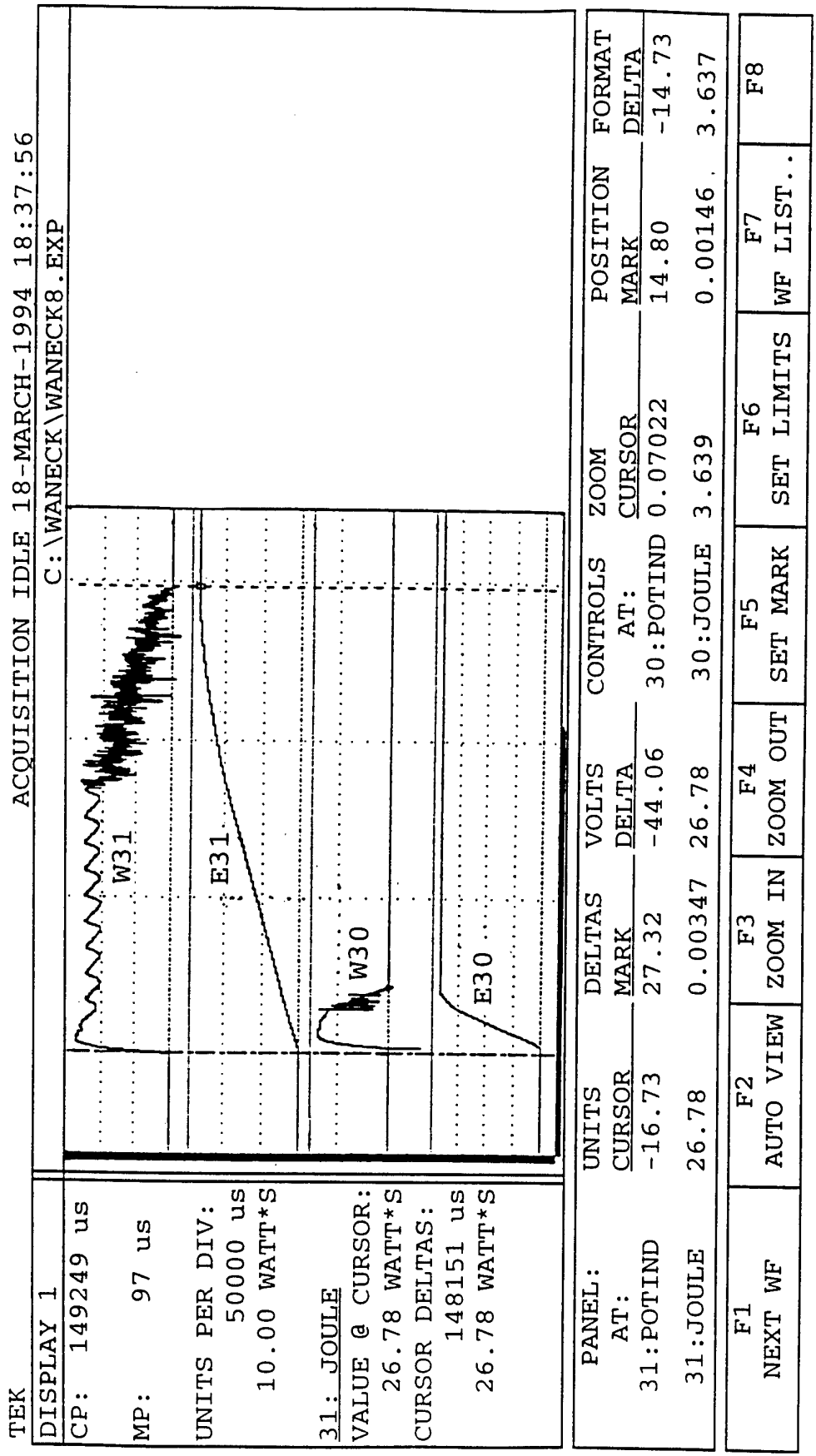
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FIG. 34



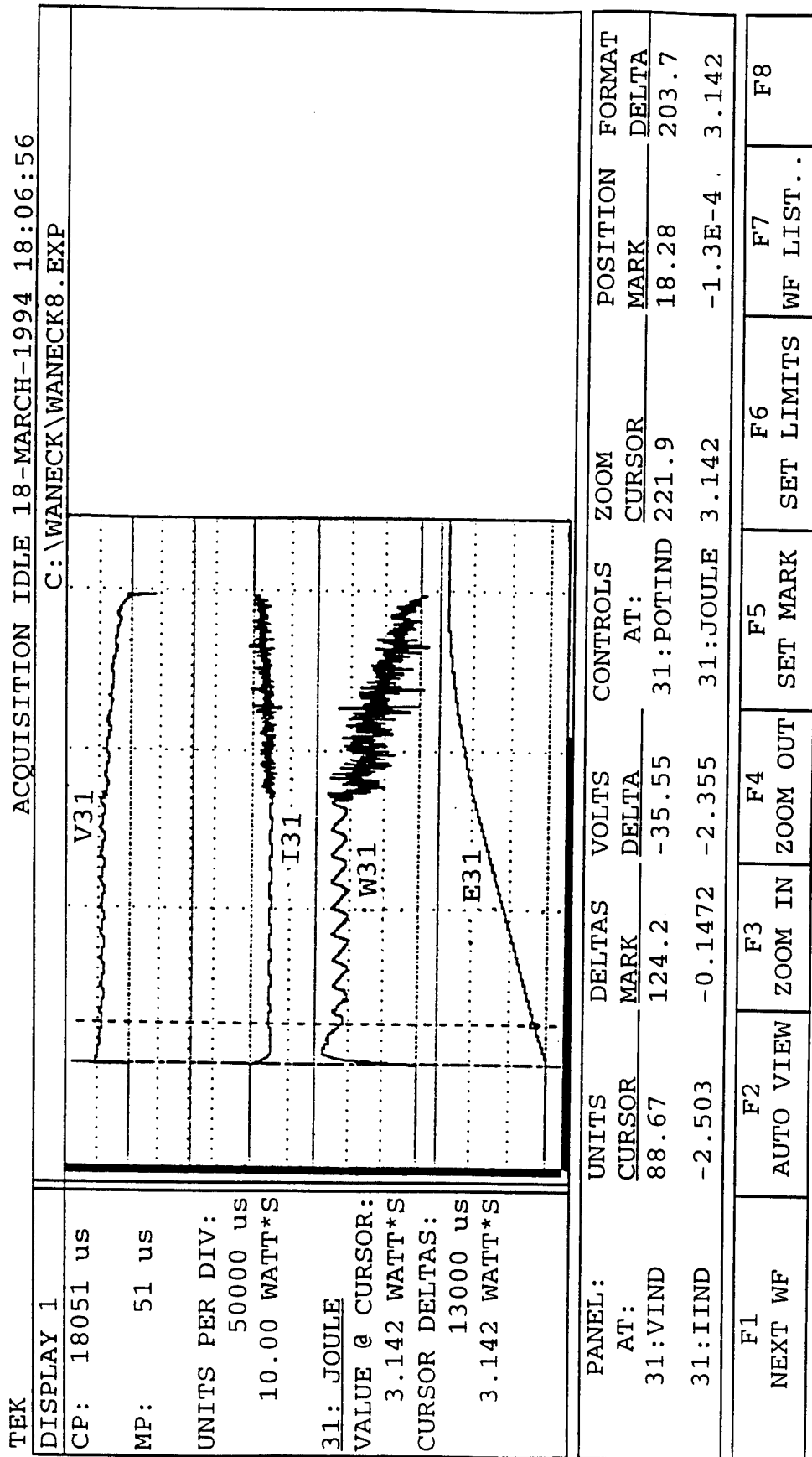
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FIG. 35



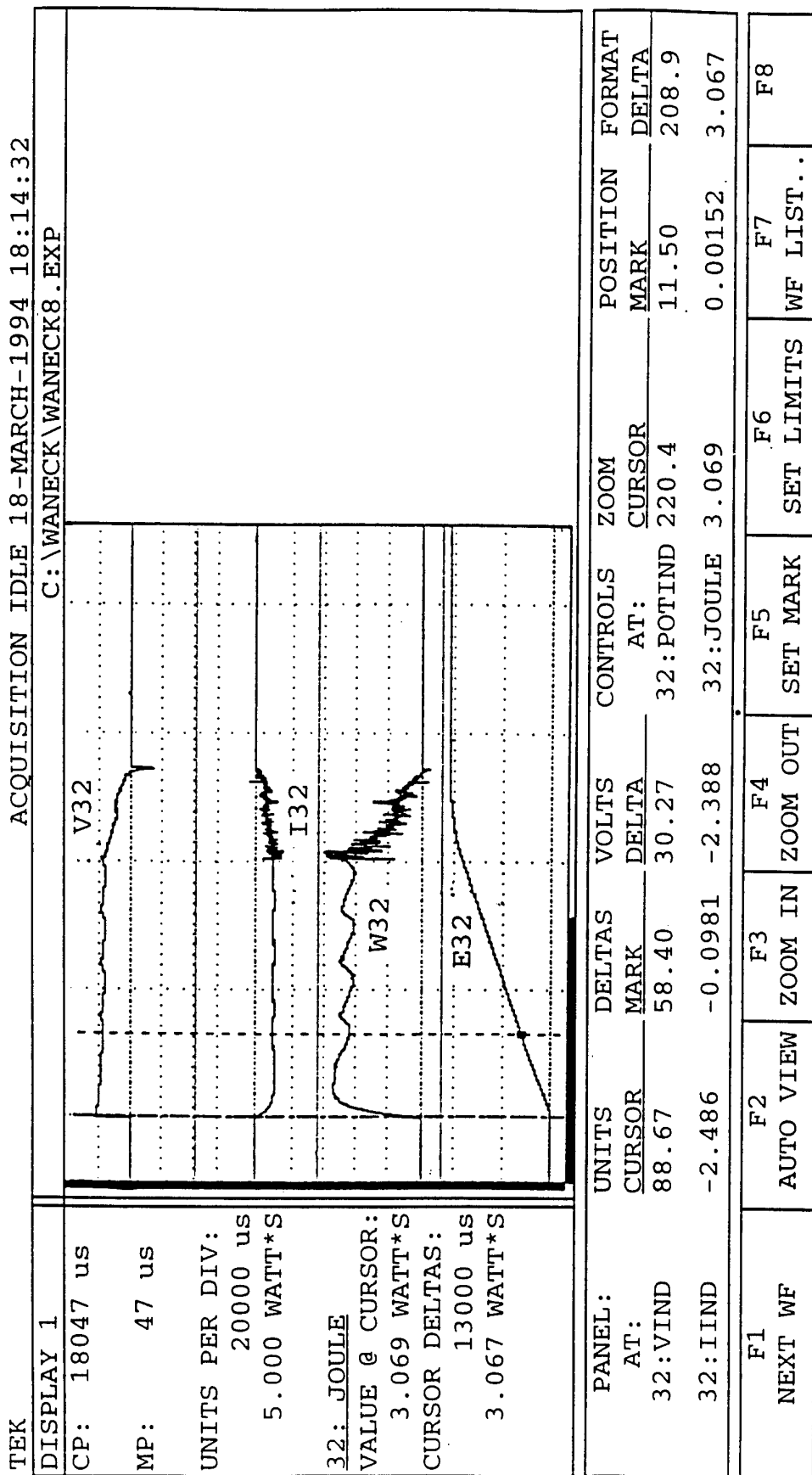
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FIG. 36



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FIG. 37



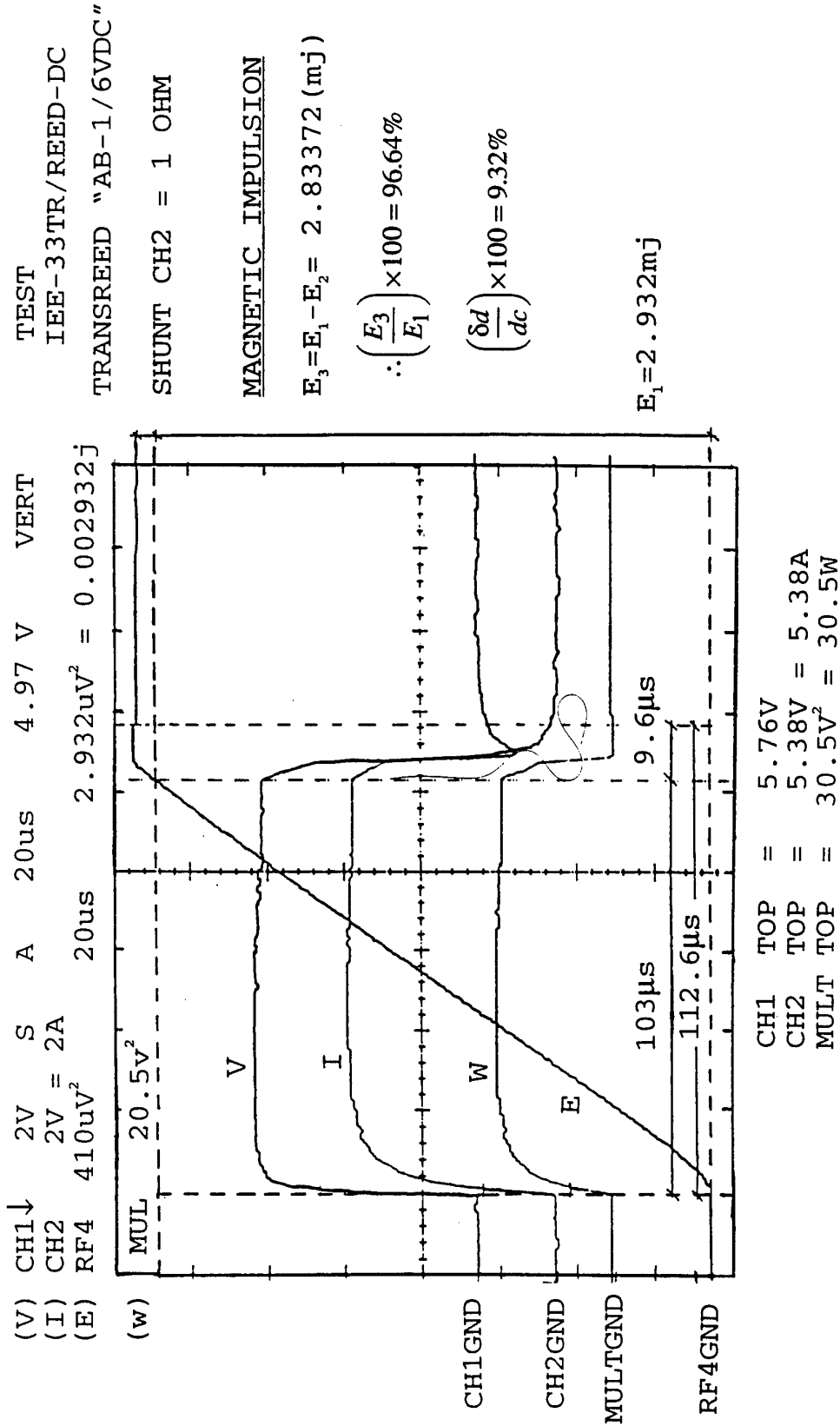


FIG.38

TRANSJUNCTION

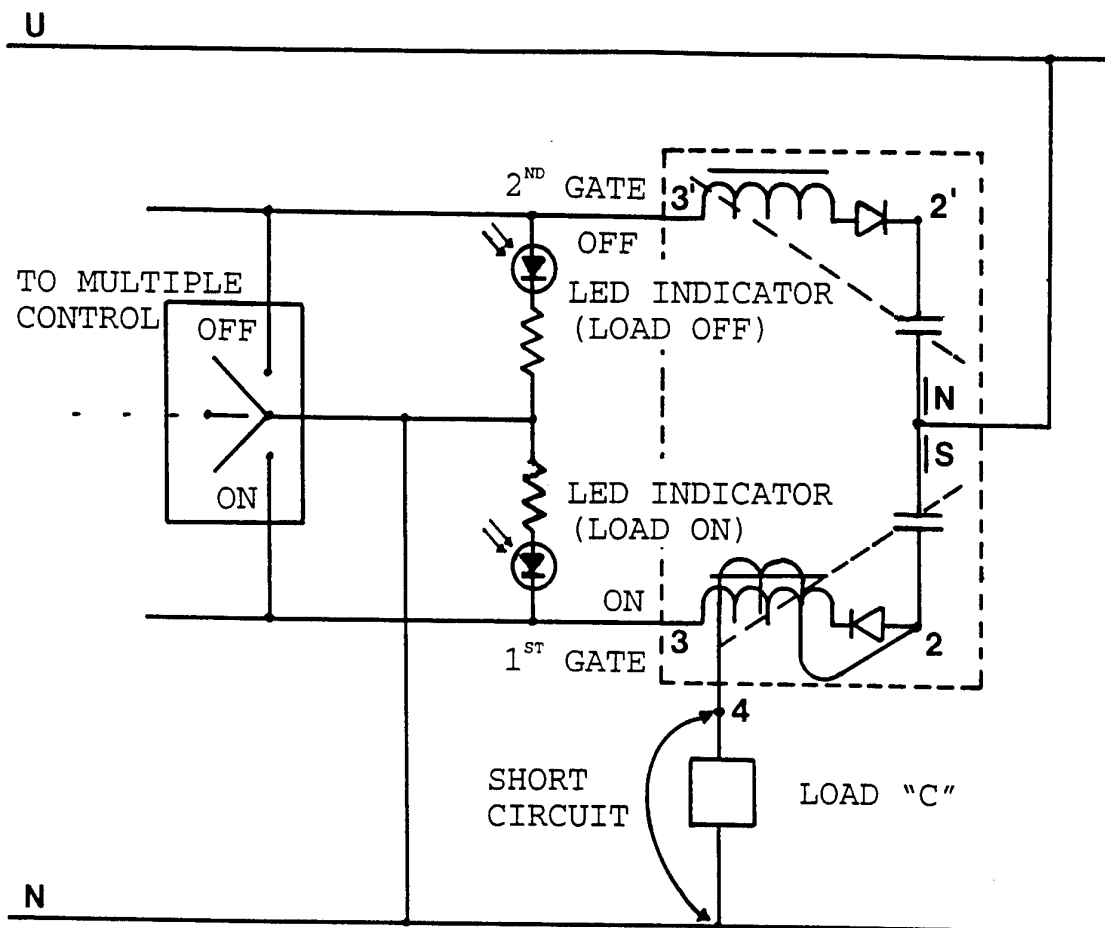


FIG. 39

TRANSJUNCTION

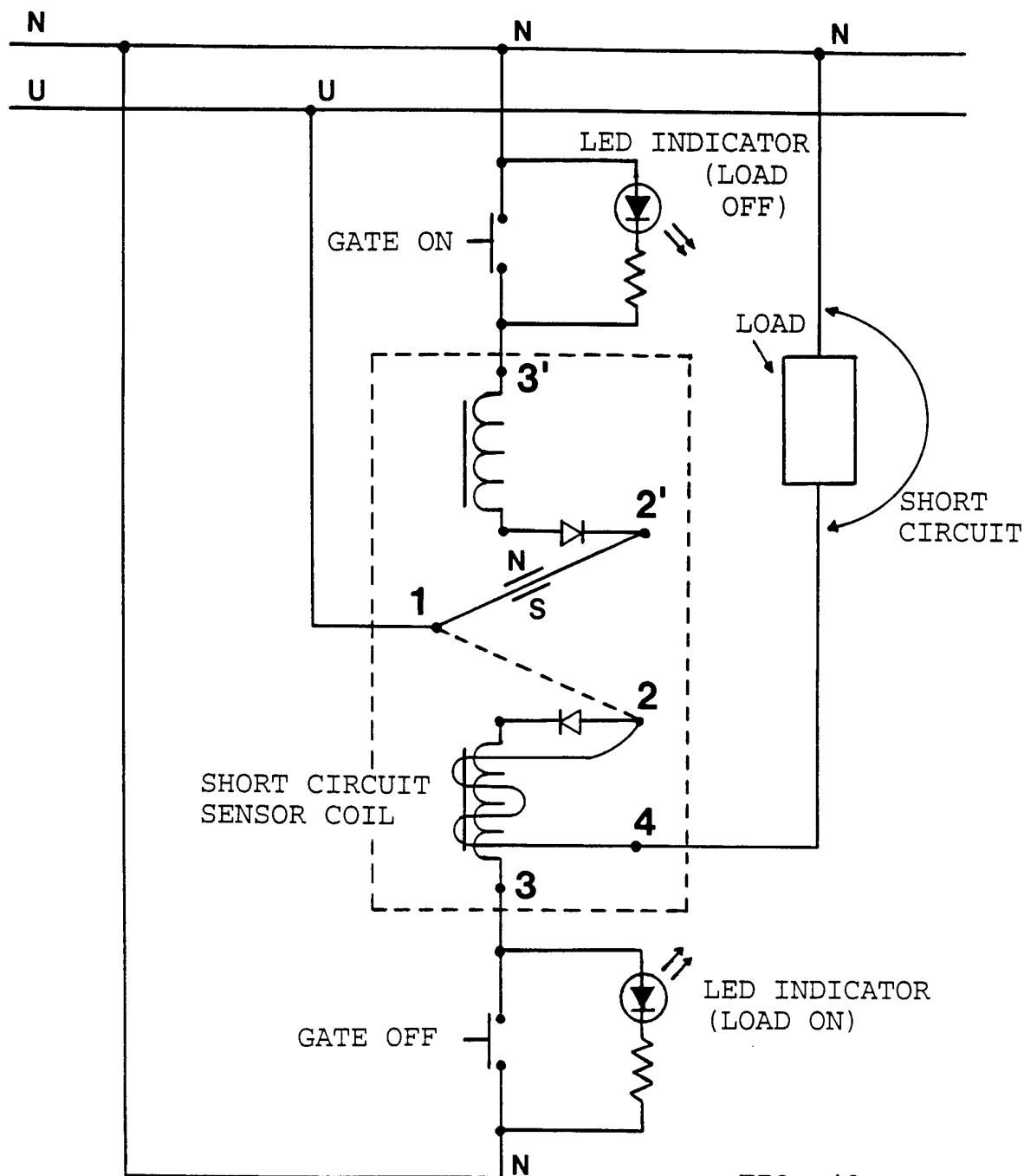


FIG. 40

TRANSJUNCTION

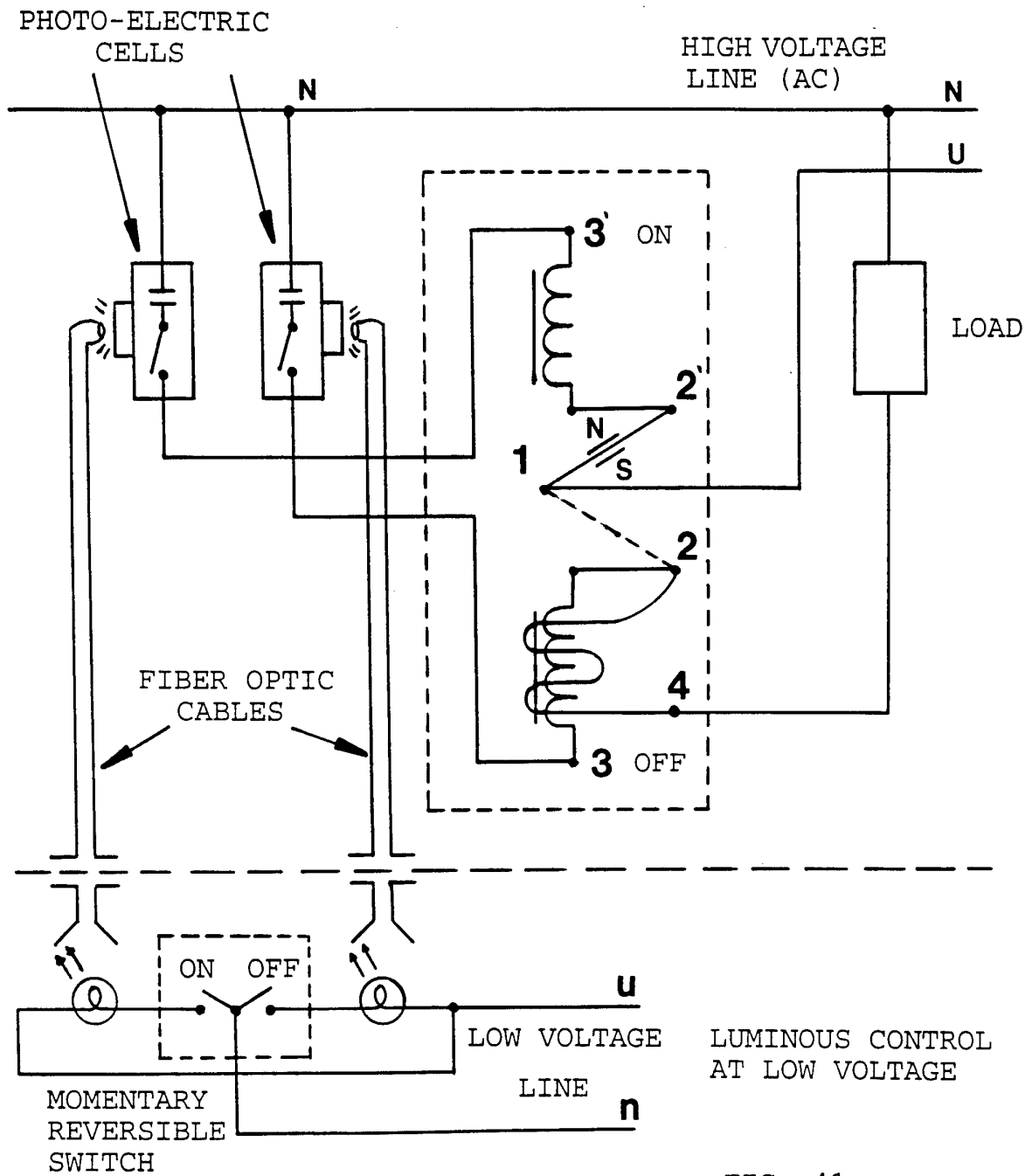


FIG. 41

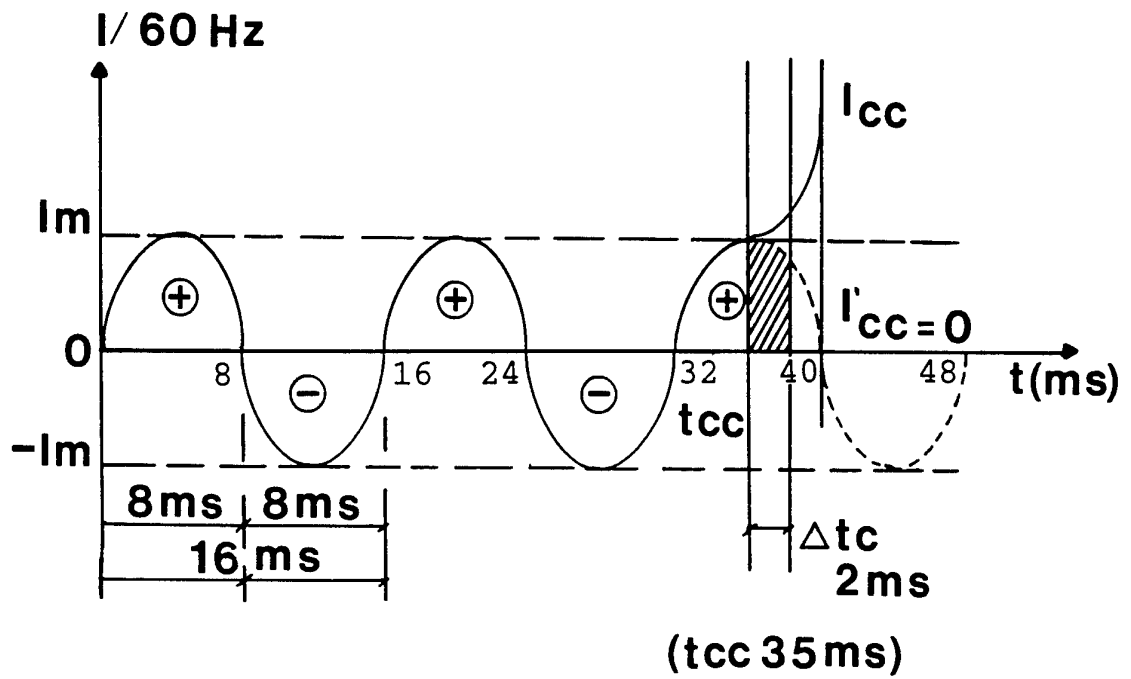


FIG. 42

TRANSJUNCTION

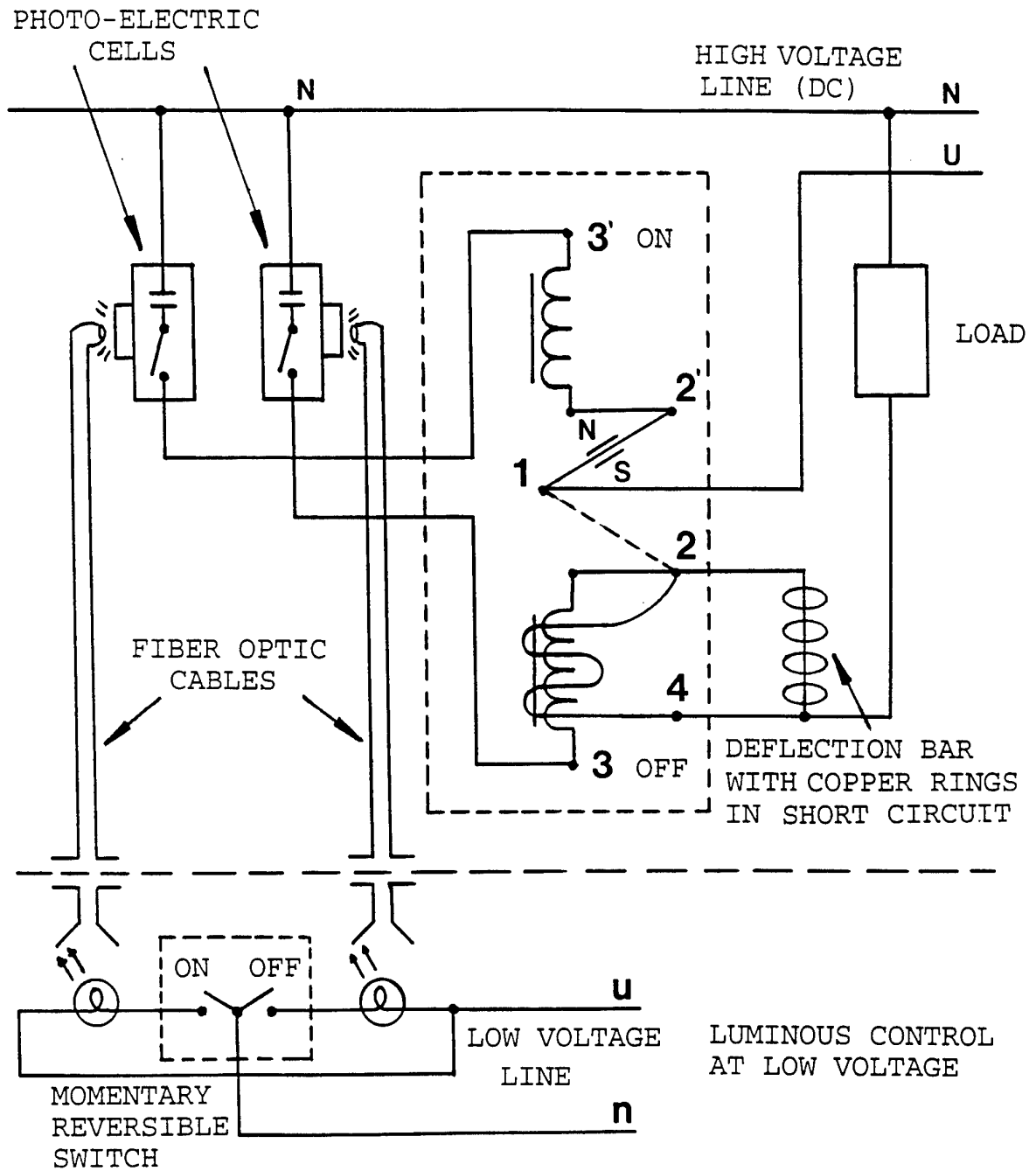


FIG. 43

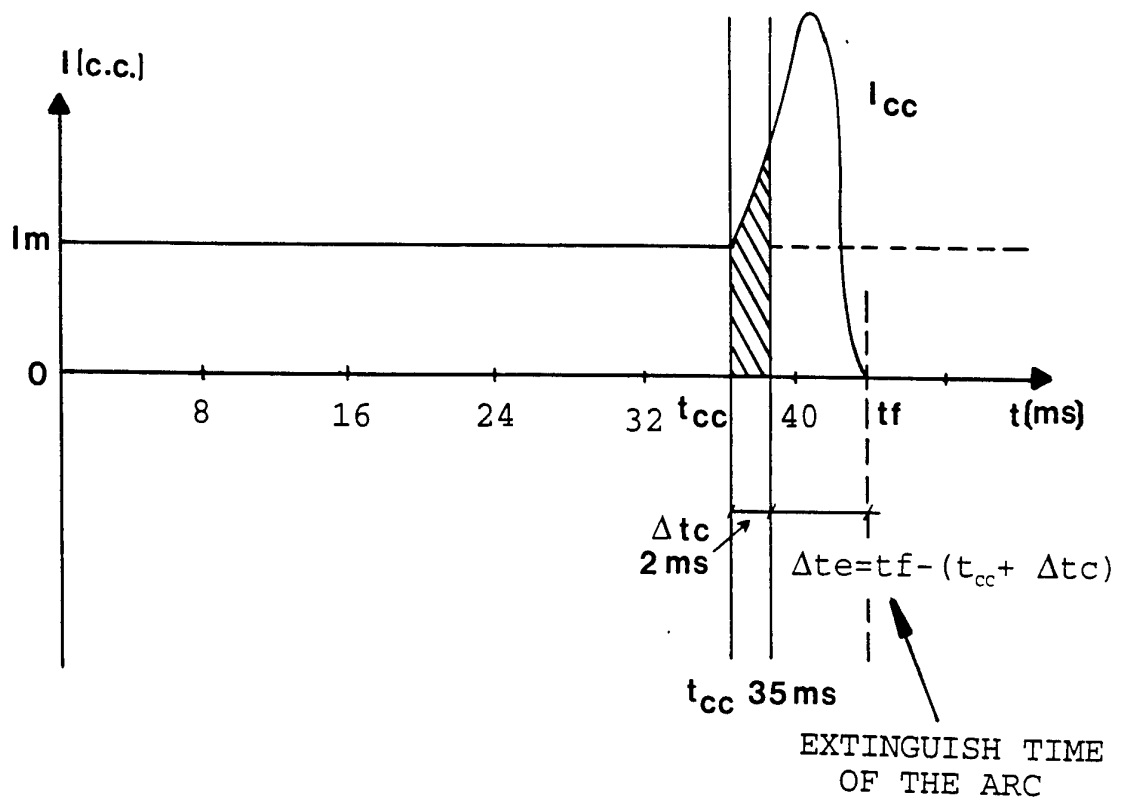


FIG. 44

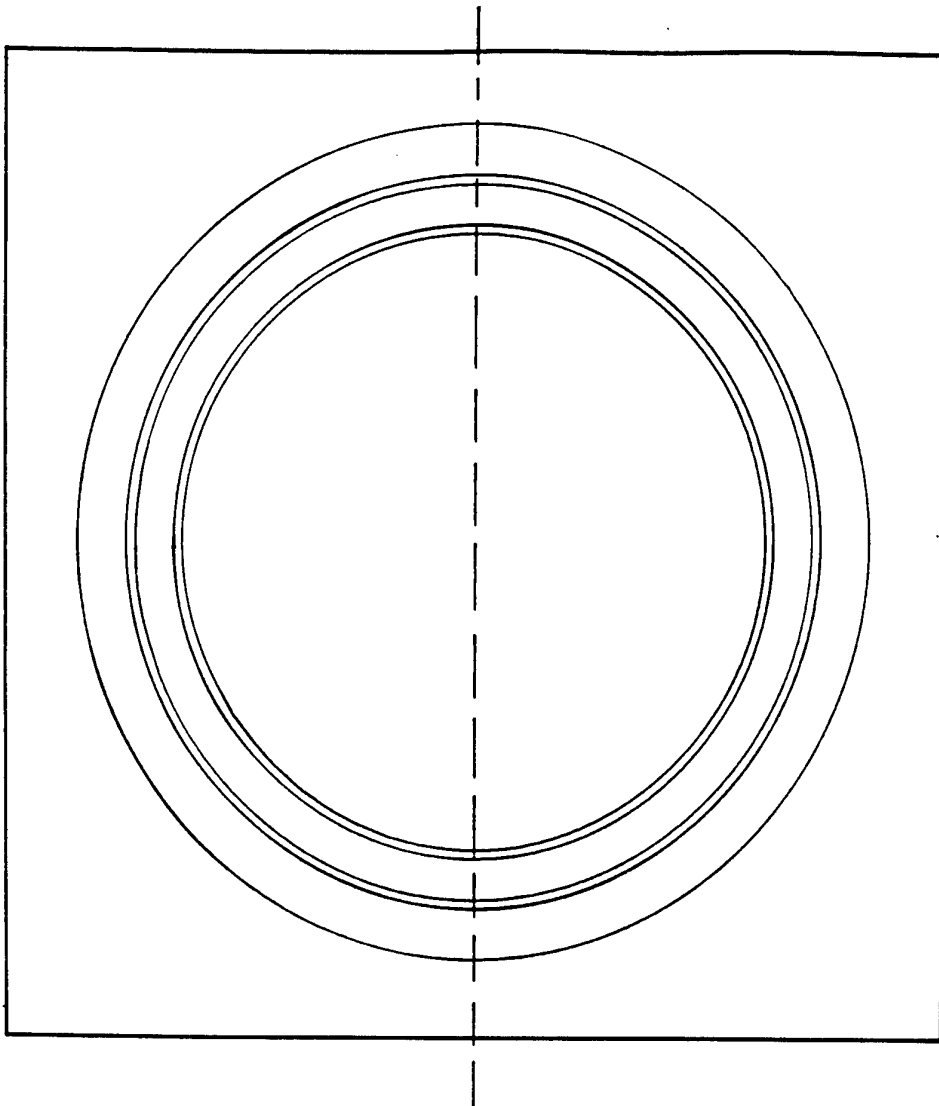


FIG. 45 A

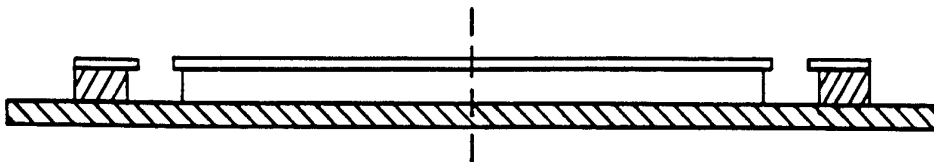


FIG. 45 B

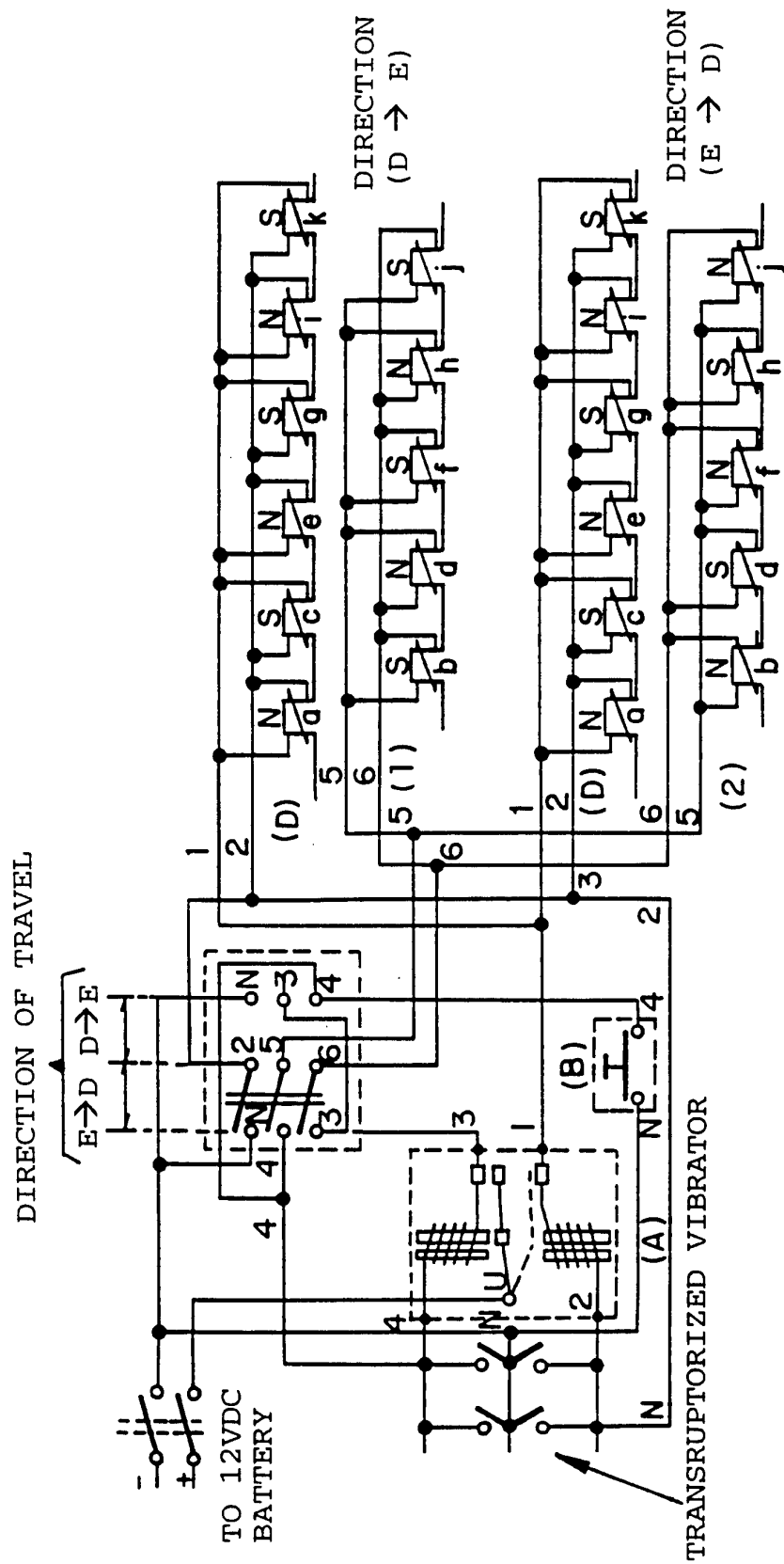
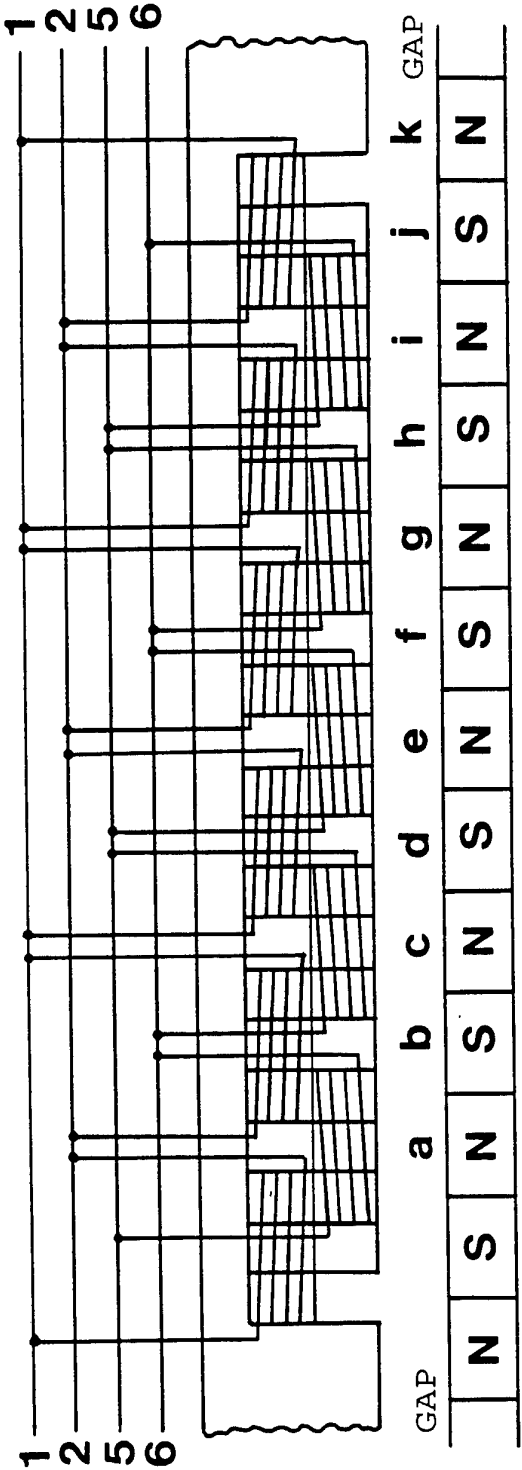


FIG. 46A

CROSS-SECTION OF THE VEHICLE



(PERMANENT MAGNET SLEEPER RAILWAY)

FIG. 46B

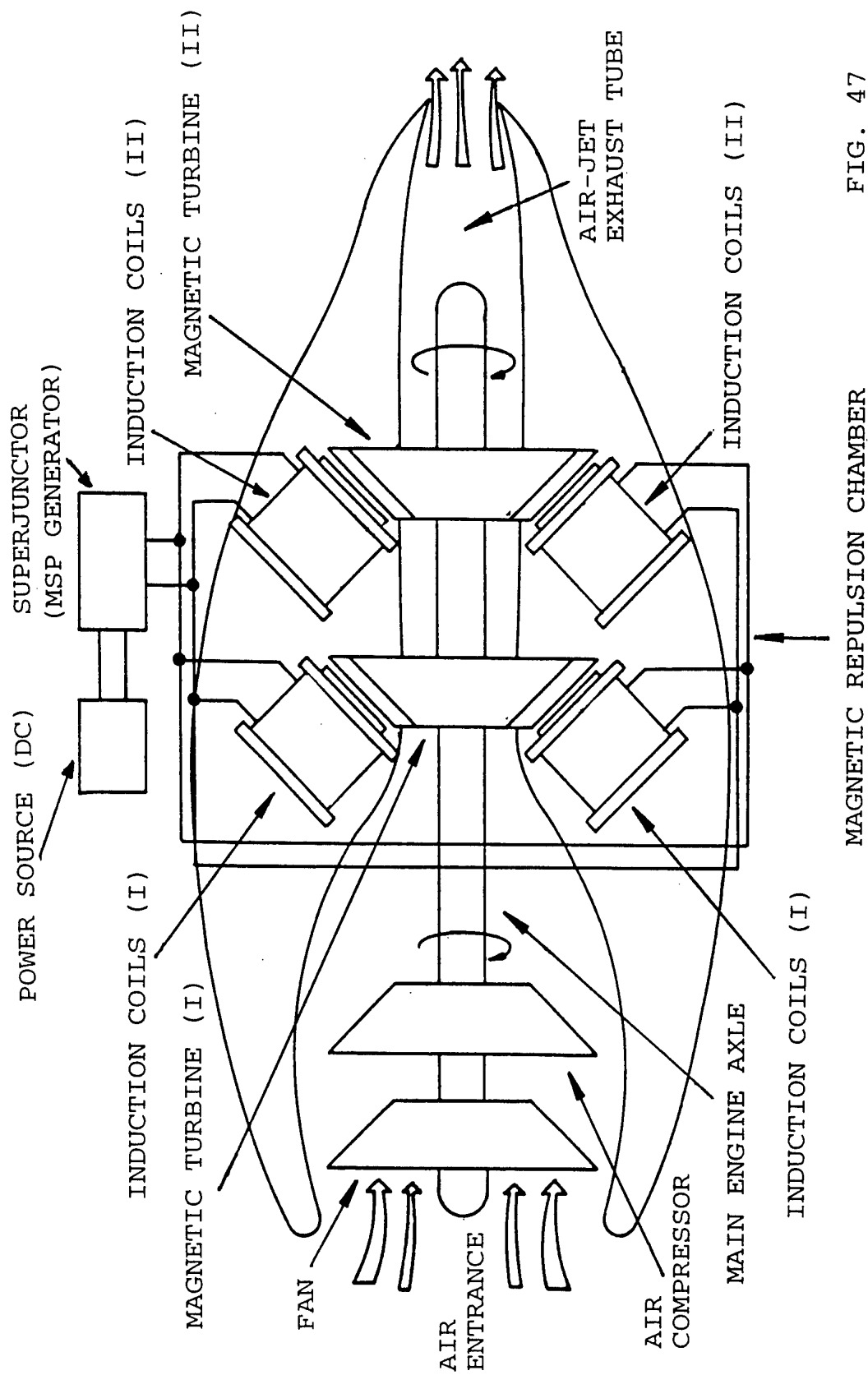


FIG. 47

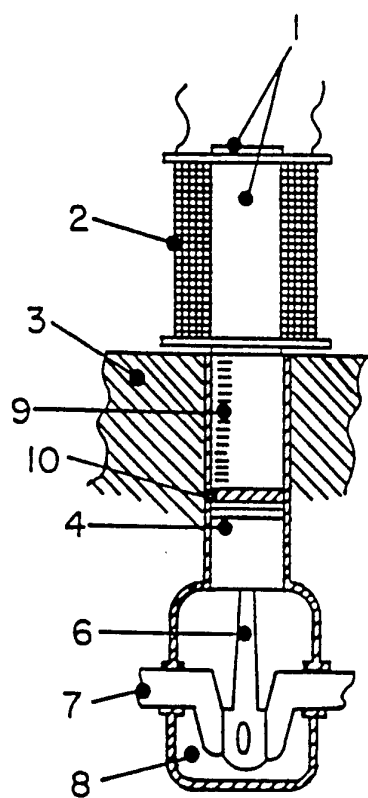


FIG. 48 A

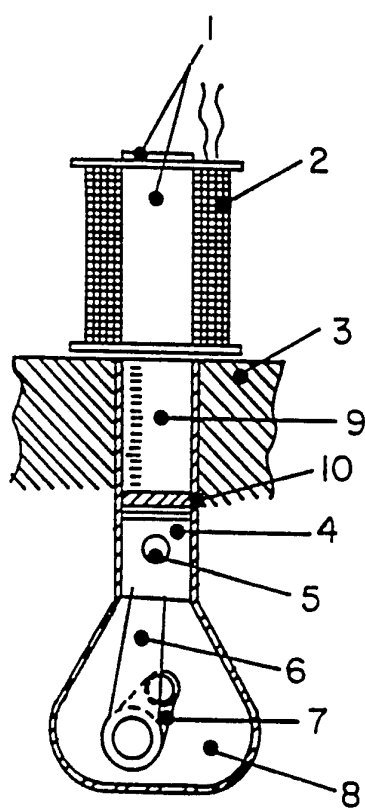


FIG. 48 B

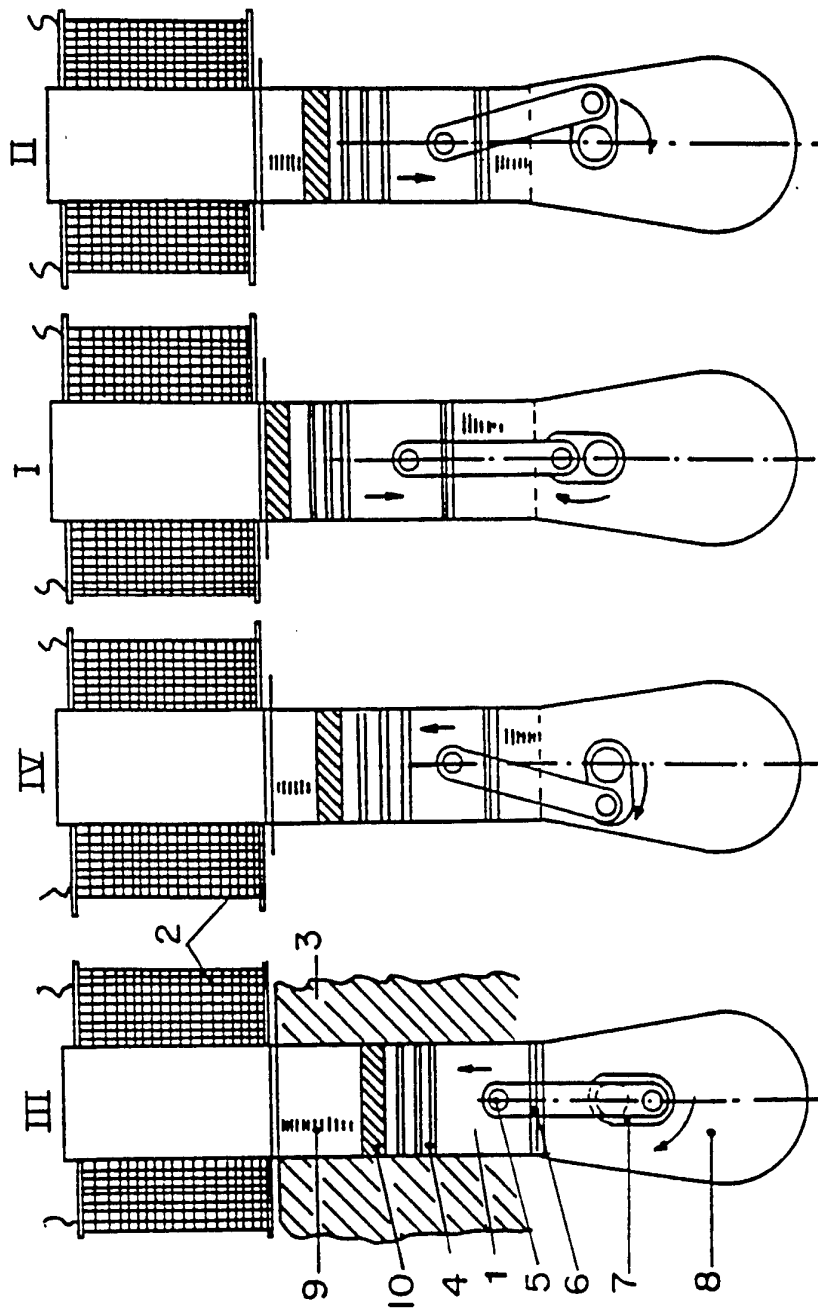
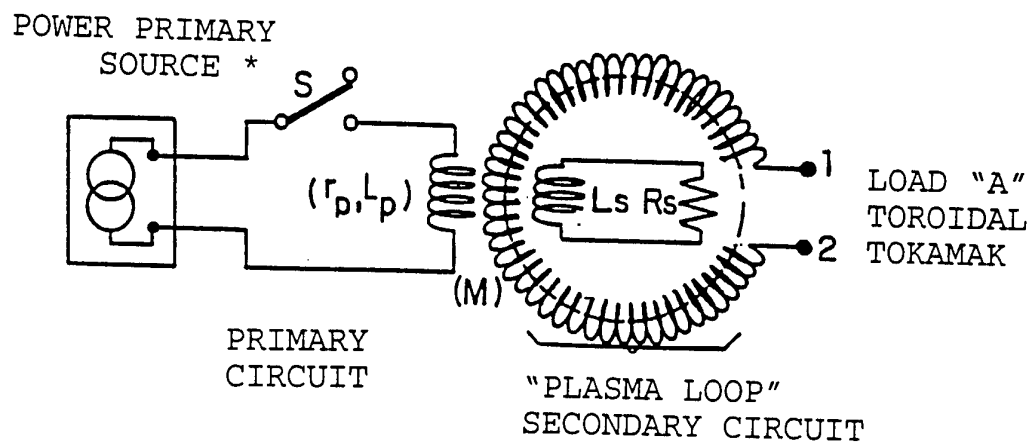


FIG. 49



* HIGH FREQUENCY PRIMARY SOURCE
FOR THE OHMIC HEATING OF THE PLASMA

FIG. 50

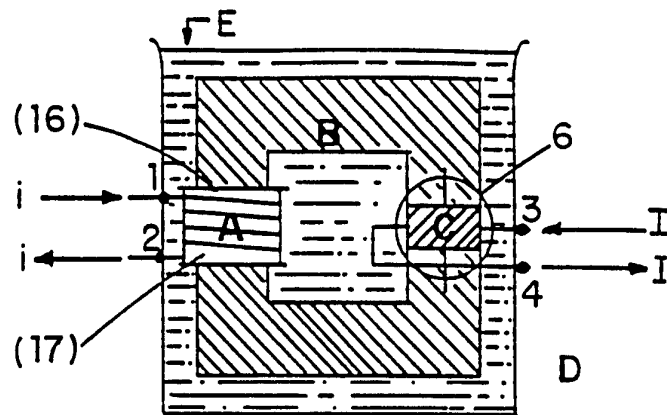


FIG. 51

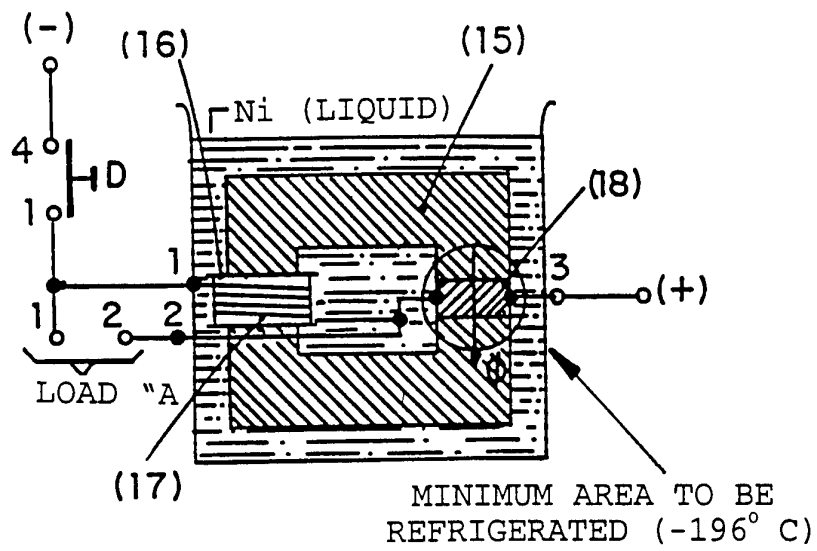


FIG. 52

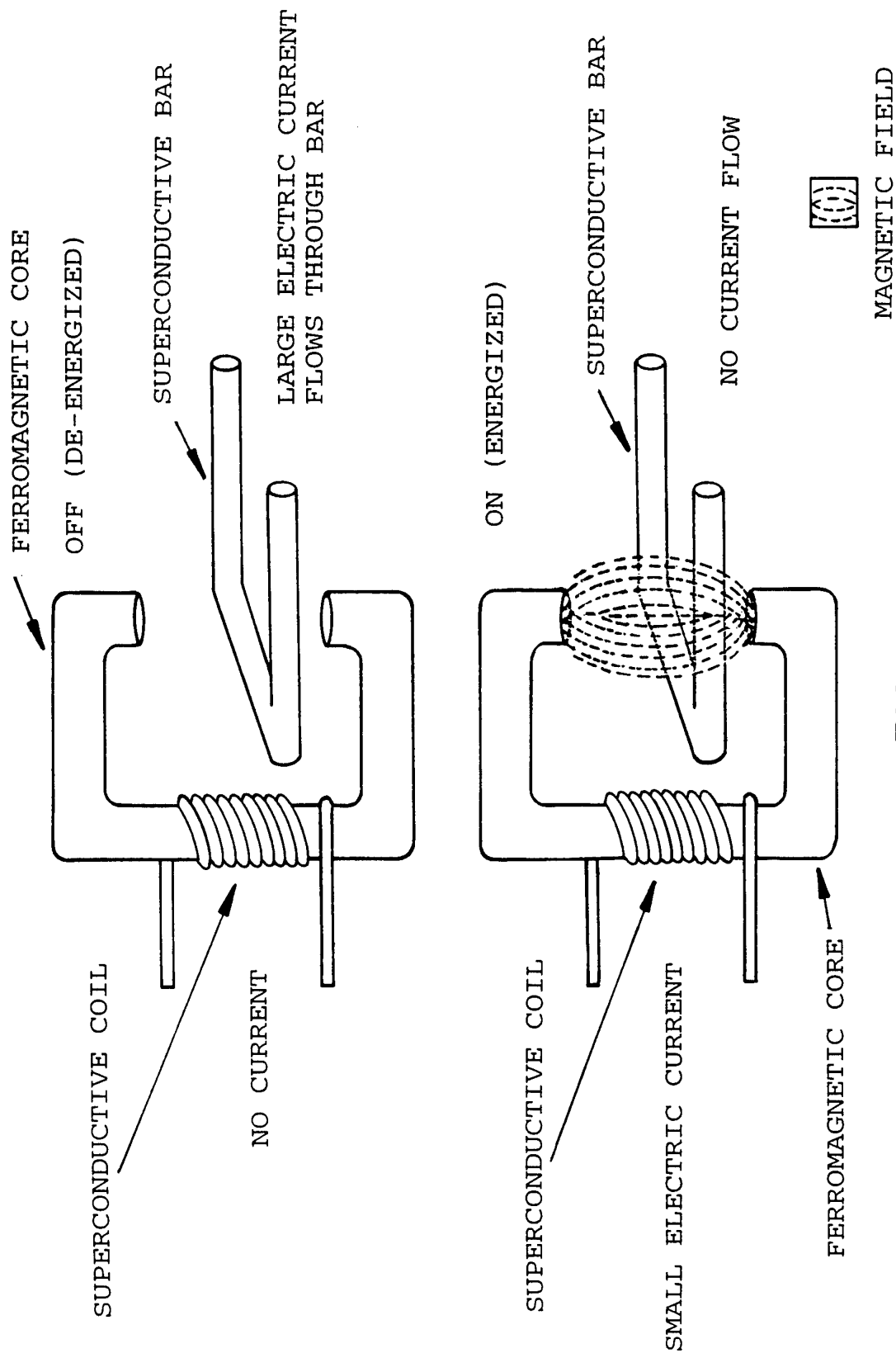


FIG. 53

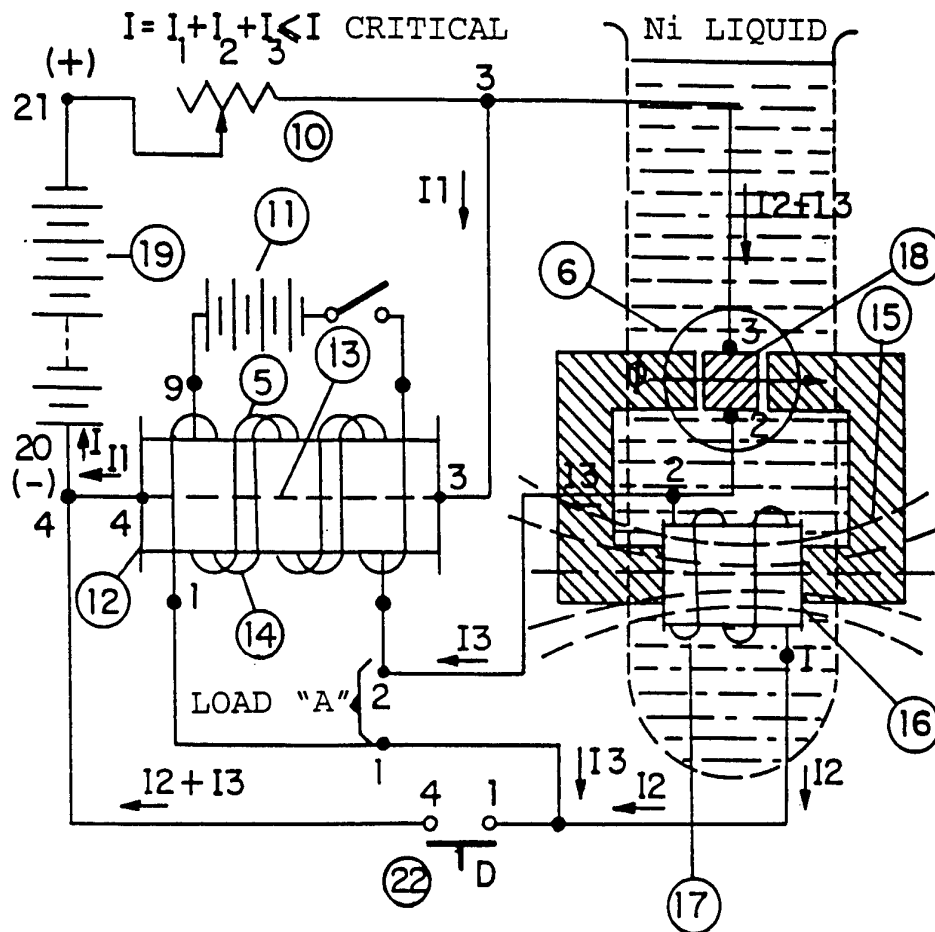


FIG. 54

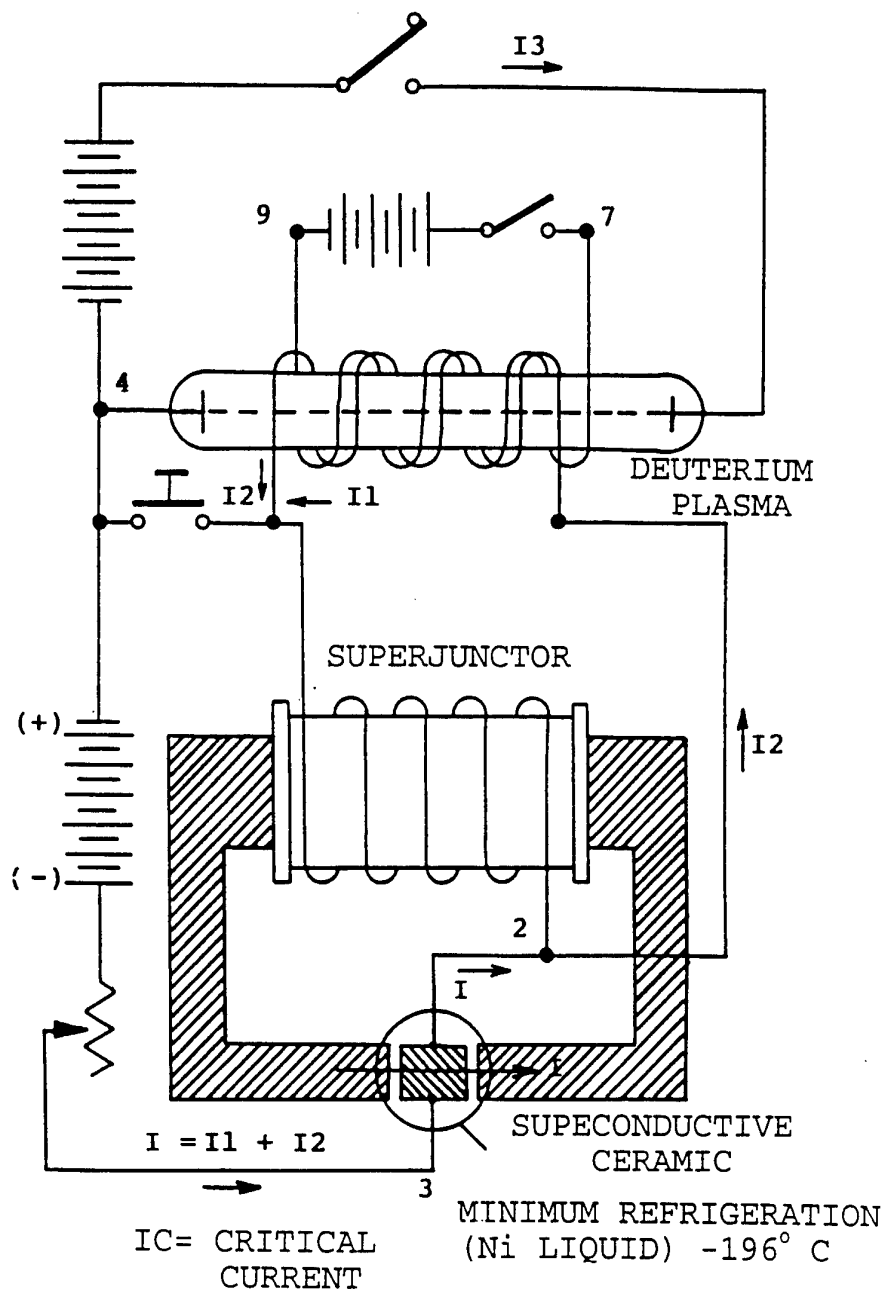


FIG. 55

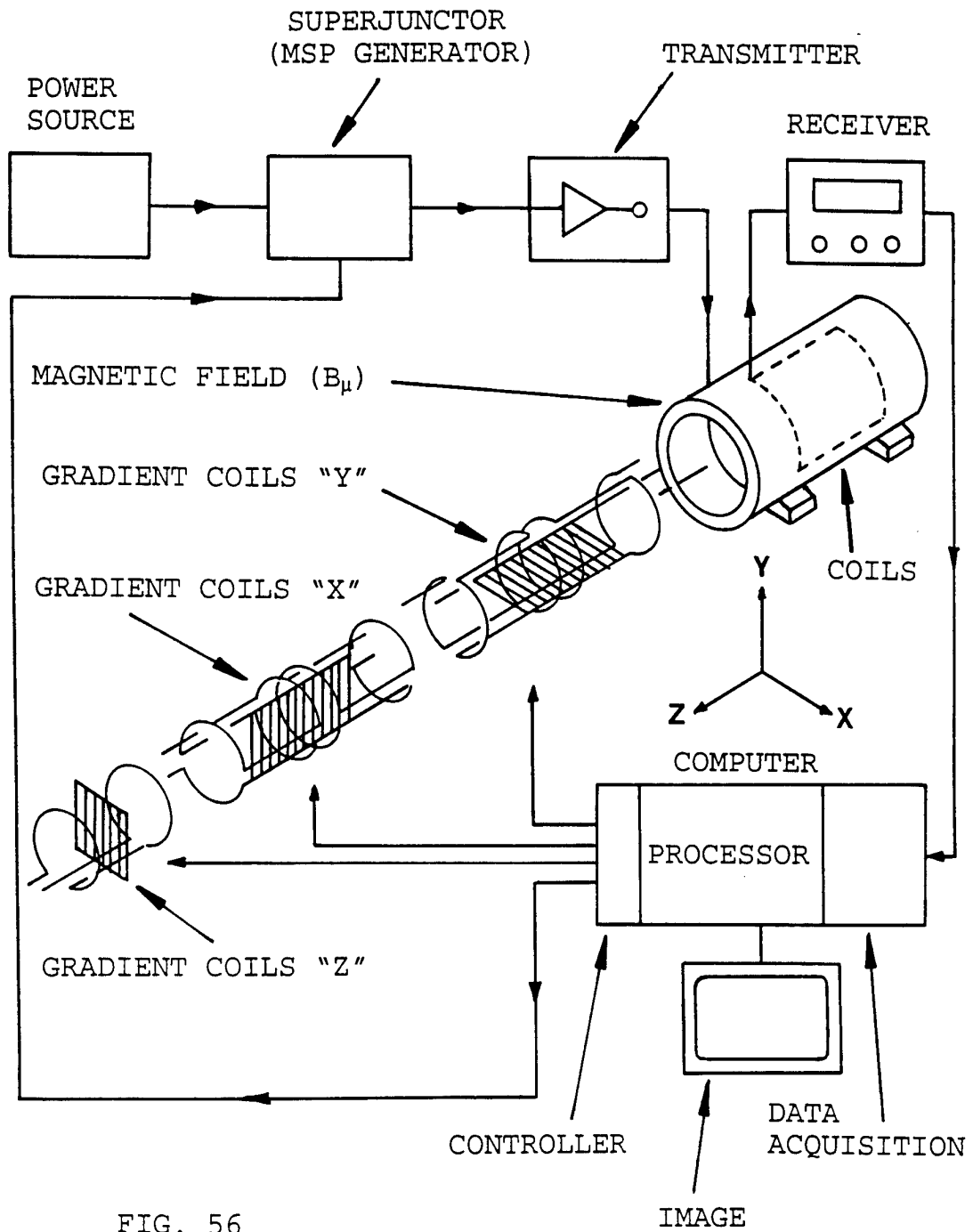


FIG. 56

INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US96/07339**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : HO2K 41/00, 21/00

US CL : 310/12,152

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 310/12,152,168,254,261,162

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 5,146,123 (YARR) 08 SEPTEMBER 1992, col. 1.	1-8, 17-20
A	US, A, 3,883,633 (KOHLE) 13 MAY 1975, figs. 1 and 13.	1-8, 17-20.
A	US, A, 4,151,431 (JOHNSON) 24 APRIL 1979, col. 2, line 55 - col. 4, line 3.	9 -16
A	US, A, 5,047,680 (TOROK) 10 SEPTEMBER 1991, col. 3, line 21 - col. 6, line 58.	9-16



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

12 AUGUST 1996

Date of mailing of the international search report

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