BACKGROUND OF THE INVENTION

1. Field of the invention

The present invention relates to an apparatus for accumulating and storing electromagnetic energy in a superconductor, and more particularly an apparatus which utilizes new materials allowing operation at room temperature and above.

2. Description of related art

Previous superconductor energy storage devices have required cryogenic systems to maintain operating temperatures significantly below room temperature. This has proved cumbersome for small devices and especially expensive for large systems. Heretofore, superconducting energy accumulators such as U.S. Patent numbers 3,019,354, 4,920,095, 4,939,444, 5,011,820, 5,146,383, and 5,473,301, have utilized solenoid type superconducting coils, toroidal designs, rings and disks which are cooled with either liquid helium or nitrogen.

SUMMARY OF THE INVENTION

The present invention overcomes temperature limitations of previous superconducting medium and may utilize all of the previously developed arrangements and shapes of coils, disks and rings, but without the need for cryogenic systems. The superconducting medium of the present invention includes utilizes orbitally rearranged mono-atomic forms of the Noble and rare earth metals; specifically, Cobalt, Nickel, Copper, Silver, Gold, Rhodium, Iridium, Palladium, Platinum, Ruthenium, or Osmium which are constructed into wire coils, or annular shaped structures such as rings toroids, or discs which circulate electric and electromagnetic current. The larger the diameter of the coils, rings or discs, the larger the current that may be stored. These rings could be constructed in association with any number of adjoining superconducting rings which circulate current in alternately opposite directions as a result of mutual induction. This would cancel or reduce the induced magnetic induction so that critical current is not exceeded in the proximity with the superconducting coils, rings or discs in order to further increase the stored energy as long as critical current is not exceeded. These coils rings or discs may be placed above one another with their axes coinciding or arranged in the same plane one within the other, or even woven into nested helical windings.

This invention uses many previously developed techniques for accumulator designs, only with the unique utilization of the above mentioned orbitally rearranged monoatomic elements. It has been found that these materials will superconduct at room temperatures and above. The apparatus of the present invention may utilize all of the previously mentioned shapes, but without the need for cryogenic systems. A current flow is induced directly in the aforementioned carriers electrically or by the application of an electromagnetic field from another current carrying coil, which may or may not be superconducting, by the movement of permanent magnets adjacent to said superconducting coils, or by the induction created by any field which is surrounding or proximate to the superconducting medium. Once induced, this current will flow indefinitely until it is needed.

This invention utilizes orbitally rearranged mono-atomic forms of the Transition or Noble and rare earth metal elements (ORMEs); specifically, Cobalt, Nickel, Copper, Silver, Gold, Rhodium, Iridium, Palladium, Platinum, Ruthenium, and Osmium. These elements normally behave as metals. They normally share an electron in the "d", "s", or "p" orbitals with neighboring metal atoms which is largely responsible for their metallic characteristics. An additional electron may be added to complete this orbital by utilizing a series of reductive processes which break metal aggregates into smaller and smaller aggregates and through the use of reductive Sodium and extensive annealing and refining processes as described in United Kingdom patent # 2219995. These materials have been found to exhibit superconducting properties at room temperatures and above. These elements may also be found in this orbitally rearranged monoatomic state in the rock and soil of the Southwest United States and other areas.

Current understanding is that when the nucleus of said elements has been superdeformed, i.e. the oblate shape of the long axis of the nucleus has been distorted to a factor of about twice the short axis, then the outer electron pair become stable. (as a Cooper pair). When this super deformation occurs the nucleus of the atom moves into the high spin state (high moment of inertia) [see Scientific American October 1991, p.26], and the atom becomes stable as a monoatomic element which no longer behaves as a normal metal and will superconduct at room temperatures and above.

Any known means for inducing and extracting current from the first coils, rings or discs or any number of combinations of coils, rings or discs as in prior art may be used, but without the need for the cryogenic or refrigeration devices which were necessary in prior art.

There are at least five possible means for extracting power from the carrier. One is by the mechanical movement of another coil so as to bring it adjacent to the carrier. The second is by the electronically regulated closure of an otherwise open circuit in an adjacent coil. The third is to extract it directly by regulated electronic connections. The fourth means for extracting power involves having the circulating current oscillating in a resonance induced by the electromagnetic interaction with superconducting buffer layers or shaped field windings adjacent to or surrounding the superconducting ring(s) or solenoid(s). Variations in the proximity, size, shape and density of these windings may be used to produce a corresponding variation in induced magnetic eddy currents, which produce in turn varied current resonance's in the Superconducting ring(s) or solenoid(s). A fifth means for extracting energy is by creating a perturbation in the flow of DC current in said rings or coils by the introduction of short high energy pulses which are delivered electronically.

Energy may be conditioned, and delivered to the superconducting rings, disks, or coils as a regulated direct current, or conditioned in the form of sinusoidally oscillating direct current or in the form of very short energy pulses adjusted in frequency and amplitude so as to insure lowest eddy current losses adjusted according to the size and characteristics of the particular accumulator.

duration may be as great as several seconds down to .0001 ms. The physical size of the invention may cover a range from small enough to replace common batteries used in small electric appliances and automobiles to large enough to provide temporary power requirements of several households.

Manufacture of the superconductor coils or rings may be constructed from a coil of wire composed of ORME materials, or alternately be constructed of ORME materials bound as a solid, or may be or may be a flat or shaped substrate such as alumina onto which the ORME materials have been coated by vacuum evaporation, or other application means and which may be arranged as stacked planes which, by mechanical removal or etching of portions of the larger area, have patterns to simulate wire coils or other configurations. Winding with very fine wire or the local area removal of vapor deposited material stacked in thin layers provides the possibility of increased efficiency with a large number of turns in the coils as well as increased storage capacity per unit length of the accumulator rings or coils. Between the individual superconducting layers there may be disposed insulating intermediate layers which, for example, may be formed by evaporation and may, for example, consist of aluminum oxide. Radially successive layers or coatings may be electrically contacted and terminated.

One means for inducing current in the accumulator is by direct electrical means. Another is by the mechanical movement of permanent magnets adjacent to the ring(s) and/or coil(s) of the accumulator. A third is by induced magnetic excitation from electrical excitation of coil(s) which are either wound in tandem with the main accumulator so as to utilize a transformer affect through various winding ratios or are arranged radially surrounding or adjacent to the longitudinal axis of the accumulator coil or ring and magnetically coupled to this coil or ring. These coils may be wound as a single superconducting filament or may be prefabricated as individual coil segments of any number. These segments may then be connected by electrical switching so as to be wired in series or parallel behaving as one coil or, by means of electrical switching, be wired separately and so as to function individually. This allows the coil segments to function as either current inducing coils or current extracting coils or as both. Further, it is preferred for the many purposes of this invention to be able to pulse the individual coil segments so as to stimulate standing resonant surrounding coils, thus allowing extraction of current through the resultant induction of current flow in the coils which are to be used for extraction.

Electrical switching may occur through high speed, high current switches, which may or may not be superconducting switches. The energy pulses induced or withdrawn from the accumulator can be of such short lengths of time so as to minimize eddy current inefficiencies and deflexion movements in the material of the accumulator and coils.

The accumulator/superconducting battery of the present invention has application in a range of sizes suitable for energy accumulation and storage such as aboard satellites, in motor vehicles, portable appliances and larger stationary appliances, and for storage on a large scale by electric utility providers.

An object of the present invention is to provide an apparatus for storing energy in a superconducting medium at room temperature without the need for cryogenic cooling systems.

Another object of the present invention is the provision of an apparatus for storing energy in a superconducting medium using solenoid coils, toroidal designs rings and discs operating at room temperature.

These and other objects and advantages of the high temperature operation of the present invention may be embodied in but not limited to the devices as illustrated in the drawings and the following specification descriptions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 diagrammatically illustrates a superconducting ring shaped coil constructed of ORME materials and accompanying induction and extraction coils .

FIG. 1a diagrammatically illustrates two superconducting ring shaped coils constructed of ORME materials which are electromagnetically linked in mutual induction and other coils used for inducing and extracting current from the superconducting ring shaped coil.

FIG. 1b diagrammatically illustrates multiple superconducting ring shaped coils constructed of ORME materials stacked in mutual induction.

FIG. 1c. diagrammatically illustrates a superconducting solenoid coil constructed of ORME materials and accompanying coil used for induction and extraction of current.

FIG. 1d. diagrammatically illustrates a side view of a superconducting solenoid coil constructed of ORME materials with accompanying induction and extraction coil and an optional separate resonance inducing coil.

FIG. 1e. diagrammatically illustrates a top view of the superconducting solenoid coil of figure 1d.

FIG. 2 diagrammatically illustrates in section, a single ring shaped superconducting coil constructed of ORME materials with an induction/extraction coil constructed of ORME materials adjacent to superconducting coil, and a final containment layer of high tensile material.

FIG. 2a diagrammatically illustrates in section, a single ring shaped superconducting coil constructed of ORME materials with an induction/extraction coil wrapped around the superconducting coil, and a final containment layer of high tensile material.

FIG. 2 b diagrammatically illustrates in section, a single ring shaped superconducting coil, consisting of layered superconducting material constructed of ORME materials and insulation, with an induction/extraction coil segments surrounding superconducting coil and a final containment layer of high tensile material.

FIG. 2 c diagrammatically illustrates in section, a single superconducting ring shaped coil constructed of layered superconducting ORME materials and insulation, with a high magnetic containment layer of high tensile material.

FIG 2 d. diagrammatically illustrates a cross section of a superconducting ring shaped coil constructed of ORME materials, with a core of high permeability material, and a surrounding induction and extraction coil .

FIG. 3 diagrammatically illustrates in section, two flattened torus shaped superconducting rings constructed of ORME materials, in mutual induction with two flattened high magnetic permeability rings positioned adjacent to the rings.

FIG 3 a. diagrammatically illustrates in section, two D shaped superconducting ring shaped coils constructed of ORME materials surrounded by two D shaped toroidal coils, stacked in mutual induction and surrounded by a high tensile containment material.

FIG. 3b diagrammatically illustrates in section, two D shaped superconducting ring shaped coils constructed of ORME materials, each with a high magnetic permeability material in the cores, surrounded by two D shaped toroidal coils, stacked in mutual induction and surrounded by a high tensile containment material.

FIG. 4 illustrates an electrically equivalent circuit diagram of an apparatus with controls of the excitation/extraction coil and the superconducting ring according to the invention as illustrated in FIG. 1.

FIG. 4 a illustrates an electrical equivalent circuit diagram of an apparatus with controls of the excitation/extraction coil and the superconducting ring according to the invention as illustrated in FIG. 1d.

FIG. 4 b illustrates an electrical equivalent circuit diagram of an apparatus wherein current is induced and extracted through direct electrical connection to two segments of the superconducting ring or coil which are also directly connected electrically and are physically arranged so that current flows in opposite directions.

FIG. 5 illustrates an electrical equivalent circuit diagram of an apparatus with controls of the excitation/extraction coil and superconducting rings stacked in mutual induction according to the invention as illustrated in FIG 1a.

FIG. 5 a illustrates an electrical equivalent circuit diagram of an apparatus wherein current is magnetically induced and extracted through a magnetic excitation/extraction coil to two physically arranged so that current flows in opposite directions as in figure 1d.

FIG. 5 b illustrates an electrical equivalent circuit diagram of an apparatus with controls of the excitation/extraction coil and a direct induction circuit for the superconducting rings stacked in mutual induction according to the invention as illustrated in FIG 1a.

FIG. 6 illustrates a pair of D shaped solenoid windings constructed of ORME materials which are placed adjoining one another so that current flows in opposite directions.

FIG. 7 illustrates an electrical equivalent circuit diagram of an apparatus with controls with series wired excitation/extraction coil segments and pulsed direct induction circuit for the superconducting ring according to the invention as illustrated in FIG. 1.

FIG. 7 a illustrates an electrical equivalent circuit diagram of an apparatus with controls with parallel wired excitation/extraction coil segments and pulsed direct induction circuit for the superconducting ring according to the invention as illustrated in FIG. 1.

FIG. 7 b illustrates an electrical equivalent circuit diagram of an apparatus with controls with alternately staggered series wired excitation/extraction coil segments and pulsed direct induction circuit for the superconducting ring according to the invention as illustrated in FIG. 1.

FIG. 7 c illustrates an electrical equivalent circuit diagram of an apparatus with controls with individually wired excitation/extraction coil segments and pulsed direct induction circuit for the superconducting ring according to the invention as illustrated in FIG. 1.

FIG 7 d illustrates an electrical equivalent circuit diagram of an apparatus in which coils are independently wired to a central switching control unit.

FIG. 7 e illustrates a means for charging the accumulator using circulating magnets.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figures 1 to 3 describe various embodiments of coil configurations used with the energy accumulating, storage and extraction apparatus of the present invention.

FIG. 1 illustrates a superconductor ring shaped coil R which preferably is round, but alternately may be oval or flat and constructed of ORME materials preferably in the form of a coil of wire composed of ORME material , but alternately may be bound as a solid, or may be a substrate such as alumina onto which the ORME materials have been coated by vacuum evaporation, or other application means, and are arranged as stacked planes which are continuous or etched in patterns to simulate wire coils or other configurations. A coil C radially surrounds the ring R. Although this drawing only shows the coil partially surrounding the ring, it is intended in this embodiment that the coil radially surrounds the entire ring while other embodiments later described call for different coil configurations as individual segments as described hereinbelow.

A current I is induced by direct electrical means or by induced magnetic excitation into ring R from coil(s) C which are arranged radially surrounding or adjacent to coil or ring R. These coils may be wired in series so as to behave as one coil or be wired separately as described hereinbelow and may be connected by electrical switching so as to function individually or in series so as to function as either current inducing coils or current extracting coils or as both. The flow of current induced in R produces the induced magnetic field ϕ. This condition persists for an indefinite period for as long as the coil remains superconducting.

Power is preferably extracted from the main carrier by the opposite procedure through coil(s) C, which preferably are, but alternately may not be superconducting coil(s). This may preferably be accomplished by the regulated closure of an otherwise open circuit in coil C or alternately directly from coil R through an electrical control circuit or alternately by the pulsed extraction through an electrical control circuit when an electrical switch is opened to allow current flow out of R.

FIG. 1a illustrates a similar embodiment to figure 1 with a pair of superconductor coils or rings R and R' stacked in alignment with their central axis. A current I is induced by direct current flow I' in ring R' in the opposite direction respective to current I in coil R The induced magnetic fields ϕ and ϕ' are opposite and therefore cancel resulting in a net induction which is significantly reduced. This condition persists for an indefinite period for as long as the coils remain superconducting.

Power is extracted from the carrier by the opposite procedure through coil sections C and C', which preferably are superconducting, but alternately may not be superconducting coils. This may preferably be accomplished by the regulated closure of an otherwise open circuit in the adjacent coil C or alternately may be extracted directly from coil R through an electrical control circuit.

FIG. 1b illustrates an embodiment of the invention with stacks of alternately flowing rings or coils R, R', R2, and R2'. In the preferred embodiment these coils, rings or discs are placed above one another as illustrated or alternately with their axes coinciding or arranged in the same plane one within the other, or even woven into nested helical windings. These may be wired as separate entities or wired in series, but physically arranged so that current flows in opposite directions, thus producing magnetic fields which oppose one another and are therefore reduced.

FIG. 1c illustrates diagrammatically a superconducting solenoid coil R constructed of ORME materials, an accompanying induction and an extraction coil C having an air core. Power is stored in solenoid coil R by induction from coil C. Power is extracted from coil R by a reverse procedure through induction into coil C. Alternately the core may be filled with high magnetic permeability materials such as permalloy to increase the storage of energy through an increase in magnetic field strength.. Alternately the positions of coils C and R may be exchanged so that C surrounds R.

Figure 1 d and 1e illustrate a similar embodiment to figure 1c with an additional coil E which is used for the delivery of electrical pulses or waves of oscillating direct current to create through induction temporary perturbations or standing waves in the stored current flow in coil R. These pulses are supplied by a Power Conditioner as later shown in figure 4a.

The surge of current flow in superconducting ring R in turn induces current flow in coil E currents in coil E which in turn induce current flow variations in ring R which continue as temporary perturbations or standing resonant oscillations. Electrical pulses may also be induced in E by an optional controller to further regulate temporary perturbations or standing resonant fields in R as later illustrated in 4a. Power is extracted from R through induced current flow back out through coil C by the regulated closure of an otherwise open circuit in coil C by a power conditioner as later illustrated in 4a.

FIG. 2 illustrates diagrammatically, in section, a single superconducting coil R constructed of ORME materials. Containment for any mechanical stresses induced in the superconductor coils is achieved by a wrapping Y consisting of carbon fiber or other suitably strong material. The core of ring R is preferably continuously wound wire filaments or alternately may be a solid core of ORME materials in the form of a compacted powder or embodied in another medium such as silicon or alumina.

Power is extracted from the carrier by the opposite procedure through coil C, which preferably is a superconducting coil of ORME materials, but alternately may not be. This is preferably accomplished by the regulated closure of a normally open circuit in the adjacent coil C, or alternately by the mechanical movement of coil C proximate to ring R or directly from coil R through an electrical control circuit. Note that while this illustration is a partial sectional view, it is preferred that coil C is adjacent to the ring R continuously around its longitudinal axis. It is further preferred that coil C be wired as individual coil segments of at least 2 sections as in figures 7 through 7c, but may alternately be a single continuous coil. These coil segments may be prefabricated as individual coil segments of any number. Coil segments C function as both current inducing coils and current extracting coils.

FIG. 2a illustrates a similar embodiment to figure 2, using a single ring shaped superconducting coil R constructed of ORME materials, surrounded by current inducing and extracting coils C which preferably are wired as individual coil segments of at least 2 sections as in figures 7 through 7c, but may alternately be a single continuous coil. It will be appreciated that in this embodiment power may not be extracted by mechanical movement of coil C.

FIG. 2b illustrates diagrammatically, in section, a single superconducting coil R constructed of layers of superconducting ORME materials R layered on a substrate of alumina or other suitable material, and an insulation layer A. Ring shaped coil R is wrapped with a containment membrane of high tensile material Y, which is surrounded by induction/extraction coil segment C of at least 2 sections, and a final containment layer of high tensile material Y.

FIG 2 c illustrates diagrammatically a cross section of a superconducting ring shaped coil R constructed of ORME materials, with a core of high permeability material T, which increases the storage of energy through an increase in magnetic field strength. Coil R is surrounded by a layer of containment wrapping Y, consisting of carbon fiber or other suitably strong material, which is then surrounded by an induction/extraction coil segment C, and a final layer of high tensile containment wrapping Y.

FIG 2 d illustrates diagrammatically a cross section of a superconducting ring shaped coil R constructed of ORME materials, with a core of high permeability material T such as permalloy, and a surrounding torus F of high permeability material, and a final layer of high tensile containment wrapping Y. The high permeability materials increase the storage of energy through an increase in magnetic field strength. The surrounding torus also provides containment for mechanical stresses.

FIG. 3 illustrates, in section, a pair of flat rectangular shaped superconductor coils or rings R and R' constructed of ORME materials, adjacent to two high magnetic permeability toruses T and T' maintained in proximity to Coils R and R which act as a toroidal magnetic circuit. Retaining wall Y consisting of carbon fiber or other suitably strong material provides containment for any mechanical stresses induced in the superconductor coils. While not illustrated here, coil segment(s) may also be wrapped around R and R' as illustrated in Figure 2a and 2b.

FIG. 3a illustrates, in section, a pair of superconductor coils or rings R and R' constructed of ORME materials with a D-shaped cross section. Wrapping Y consisting of carbon fiber or other suitably strong materials provides containment for any mechanical stresses induced in the a flat surface in between the two coils to more readily contain magnetic stresses as in prior art US patent 4,920,095.

FIG. 3b illustrates, in section, an apparatus similar to figure 3a with a D-shaped cross section and with a high magnetic permeability material core T, which increases the storage of energy through an increase in magnetic field strength.

Figure 4 illustrates a circuit diagram wherein a current is applied to Coil(s) C from a power source 10 through a power conditioner 12. The power conditioner regulates the delivery of power from the power source to the superconducting coil C, and also regulates the distribution of stored power from the superconducting coil C to a load 14. This conditioner delivers electrical power to the coil C in the form of regulated pulses, with controls for the frequency, pulse or wave shape, and amplitude of these electrical pulses. Regulating the amplitude, duration and wave shape of these pulses limits the mechanical stresses in coils C and R caused by movement generated by induction eddy currents. The delivery of electrical pulses from the power conditioner 12 is also used to induce temporary perturbations in current flow and standing current wave oscillations in ring R through coil C which in turn facilitates the extraction of energy by way of electromagnetic induction in coil C. The power conditioner output is further adjusted by feedback from an optional sensor S.

Coil C is magnetically coupled to and induces a current flow in superconducting coil R which preferably is a ring shaped coil, but alternately may be in the form of a solenoid as represented in figure 1 d. Power is preferably extracted from R through induced current flow back out through coil C by the regulated closure of a normally open circuit in the adjacent coil C by the power conditioner or alternately may be induced by the mechanical movement of C so as to bring it closer or farther away from coil/ring R as in figure 2.

Figure 4 a illustrates a similar embodiment to figure 4 with the addition of another coil E and a separate controller 16a which delivers the electrical pulses and frequencies into coil E so as to induce the temporary perturbations in current flow and standing current wave oscillations in ring

FIG. 4 b illustrates an electrically equivalent circuit diagram of an apparatus wherein current from power source 10b is introduced to rings R and R' from a power conditioner 12b and extracted from rings R and R' through power conditioner 12b and delivered to the load 14b. Power conditioner 12b functions the same as the power conditioner 12 in figure 4, but is in direct electrical connection to superconducting rings R and R' which are wired in series, but physically arranged so that current flows in opposite directions, thus producing magnetic fields which oppose one another and therefore reduce the overall magnetic field produced (as in prior art patent number 5,473,301). R is preferably a ring shaped coil, but alternately may be in the form of a solenoid as illustrated in figure 6.

Figure 5 illustrates a circuit similar to figure 4 with a power source 100, a power conditioner 102, a load 104, and a separate power conditioner 106 for the extraction of power from a coil R directly by electrical means to be delivered to the load 104.

Figure 5 a illustrates a circuit diagram wherein a current is delivered from a current excitation source through a power conditioner 102a to coil C which induces a current flow in superconducting ring shaped coil R which in turn induces a complimentary current flow in coil R'. Ring shaped coils R and R' are stacked in alignment with their central axis as in figure 1a. The power conditioner 102a also delivers electric pulses and wave forms to coil C in order to induce temporary perturbations and standing current wave oscillations in ring R and through mutual induction into ring R'. This electric current is further adjusted by feedback from an optional sensor S. Power is extracted directly from ring or coil R through another power conditioner 106a and distributed to the load 104a. Any number of mutually inductive pairs of rings or coils may be stacked woven or nested together.

Figure 5 b illustrates an apparatus similar to figure 4b with a separate power conditioner 106b for the extraction of power from R and R' directly by electrical means to be delivered to the load 104b. Superconducting rings R and R' are wired in series, but physically arranged so that current flows in opposite directions, thus producing magnetic fields which oppose one another and therefore reduce the overall magnetic field produced. Coils R and R' are preferably ring shaped coils, but alternately may be solenoid shaped coils as illustrated in figure 6.

FIG. 6 illustrates a pair of D shaped solenoid windings constructed of ORME materials R and R' which are wired in series, but placed adjoining one another so that current flows in opposite directions, thus producing magnetic fields which oppose one another and therefore reduce the overall magnetic field produced as in prior art patent number 5,473,301.

FIG. 7 illustrates a circuit diagram for an embodiment of the present invention wherein the excitation/extraction coils C are wound or prefabricated as segments which are symmetrically installed and which are wired in series.

Current is applied to Coil segments C from a power source 200 through power conditioner 202 which supplies excitation power pulses in the form of regulated voltage pulses so as to minimize physical stresses and to set up temporary perturbations and standing resonant oscillating DC electromagnetic fields in R which will later facilitate extraction of current through magnetic induction. The frequency, pulse or wave shape, and amplitude is controlled by this conditioner 202. One or more superconducting high speed high current switches may be used in the conditioner. This electric current is further adjusted by feedback from an optional coil sensor S.

Coil segments C induce current flow in superconducting ring R by pulsed direct induction and power is also extracted from R through induced current flow back out through coils C according to the invention as illustrated in FIG. 1. Extraction is accomplished after current flow is established in R by the regulated closure of an otherwise open circuit in coils C by the Power Conditioner and distributed to the load 204.

FIG. 7 a illustrates an electrical equivalent circuit diagram of an apparatus similar to figure 7 with parallel wired excitation/extraction coil segments C surrounding superconducting ring R according to the invention as illustrated in FIG. 1.

FIG. 7 b illustrates an electrical equivalent circuit diagram of an apparatus similar to figure 7 segments C are series wired from the power conditioner 202b as one staggered loop and are alternated with coils segments C' which are also series wired from the power conditioner 202b as another staggered loop. Each set of coil segments surround the superconducting ring R according to the invention as illustrated in FIG. 1. Coil segments C are used in this embodiment of the present invention only for delivering excitation pulses and current into superconducting ring R. Coil segments C' are used solely for the extraction of current by induction from superconducting ring R and power is delivered through power conditioner 202b to the load 204b.

FIG 7c illustrates an electrical equivalent circuit diagram of an apparatus with a pulsed direct induction circuit and controls as in figure 7 with alternately staggered coil segments C and coil segments E. Coil segments C are series wired from the power conditioner 202c as one staggered loop and are alternated with coils segments E which are also series wired from the controller 206c as another staggered loop. Coil segments C are used for both delivery of current by induction into ring R and for the extraction of power by induction from ring R. Coil segments E deliver shaped pulses and frequencies from the controller 206c into ring R by induction as in figure 4a. Power is delivered from coils C through power conditioner 202c to the load 204c.

FIG 7 d illustrates an electrical equivalent circuit diagram of an apparatus in which coils C are independently wired to a central switching control unit SU. Through the use of high speed high current switches, which may or may not be superconducting, the charging cycle may be either wired in series as in Figure 7, or wired in parallel as in Figure 7 a, or wired alternately for interspersion of induction and extraction coils as in Figure 7 b.

The switching unit SU will also allow for the delivery of charging current in the form of a timed series of voltage pulses sequentially delivered to the coils C through the high speed high current switches so as to set up a standing resonant oscillating electromagnetic field in R which will facilitate extraction of current through magnetic induction.

FIG 7 e illustrates a further preferred arrangement of charging the accumulator coil R which is constructed of ORME materials. A ring of superconducting magnets M, which may be permanent

R. Magnets are labeled N for North pole and S for the south pole. Each time a magnet M passes an induction coil C, magnetic quanta are induced in C and then induced in R, although coils C may also be wired so as to transmit current flow directly through an electrical connection to the torus ring R. See description in prior art patent number 5,011,820. A superconducting accumulator coil of solenoid configuration can be charged in an analogous manner, with the ring of magnets rotating about the rectilinear solenoid axis.

An alternative design for using rotating magnets M is to have the magnets M rotate about an axis perpendicular to the drawing plane and extending through the center of the torus ring R. In this alternative design current flow would be induced directly into the superconducting torus ring R, and the coils C would be unnecessary for inducing current flow in the ring R.

I claim:

1. An apparatus for storing and retrieving energy in a superconducting medium comprising:

orbitally rearranged mono-atomic forms contained in the group of elements including Cobalt, Nickel, Copper, Silver, Gold, Rhodium, Iridium, Palladium, Platinum, Ruthenium and Osmium; means for creating a current flow in said mono-atomic forms and; means for extracting energy from said mono-atomic forms.

2. The apparatus of claim 1 wherein said mono-atomic forms are contained in at least an individual one of said group of elements.

3. The apparatus of claim 1 wherein said mono-atomic forms are contained in a combination of individual elements of said group of elements.

4. The apparatus of claim 2 wherein said mono-atomic forms are combined with electromagnetically inert media.

5. The apparatus of claim 4 wherein said mono-atomic forms are combined with a high magnetic material.

6. The apparatus of claim 5 wherein said high magnetic material is permalloy.

7. The apparatus of claim 2 wherein said mono-atomic forms are a current carrying structure.

8. The apparatus of claim 7 wherein said current carrying structure is a plurality of units being located above each other with planar axis aligned.

9. The apparatus of claim 7 wherein said current carrying structure is a plurality of units in juxtaposition with each other.

10. The apparatus of claim 7 wherein said current carrying structure is combined in at least two pairs of units coupled by mutual induction.

11. The apparatus of claim 7 wherein said current carrying structure is a wire.

12. The apparatus of claim 7 wherein said current carrying structure is a coil

13. The apparatus of claim 7 wherein said current carrying structure is an annular shaped element.

14. The apparatus of claim 1 wherein said mono-atomic forms are a current carrying material and said means for creating and extracting current flow in said forms is a power source and power conditioner for regulating the delivery of power to said current carrying material and an excitation coil in proximity to said current carrying material whereby current is created in said high magnetic material and further including electrical current means for extracting said current flow.

15. The apparatus of claim 14 wherein said current carrying material is a coil structure in proximity with said excitation coil.

16. The apparatus of claim 15 wherein said excitation coil is in physical proximity to and surrounds said current carrying material coil structure.

17. The apparatus of 14 wherein said current carrying material is a plurality of coil structures.

18. The apparatus of 17 wherein said plurality of coil structures are stacked in alignment.

19. The apparatus of claim 16 further including permanent magnets moveable relative to said excitation coil wherein said excitation is induced in said excitation coil by movement of said magnets.

20. The apparatus of claim 14 further including permanent magnets moveable relative to said current carrying material wherein said excitation is induced in said current carrying material by movement of said permanent magnets.

ABSTRACT

An apparatus for storing energy in a superconducting medium utilizing orbitally rearranged monoatomic transition elements stabilized in the high spin state. Specifically, these elements are Cobalt, Nickel, Copper, Silver, Gold, Rhodium, Iridium, Palladium, Platinum, Ruthenium, and Osmium. These orbitally rearranged monoatomic elements will superconduct at room temperature and above and thus simplify construction of the storage devices and allow high current storage capacities with small volume devices.

Figure 1.

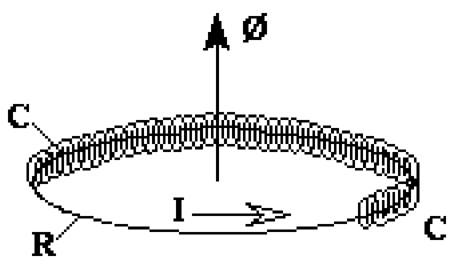


Figure 1a.

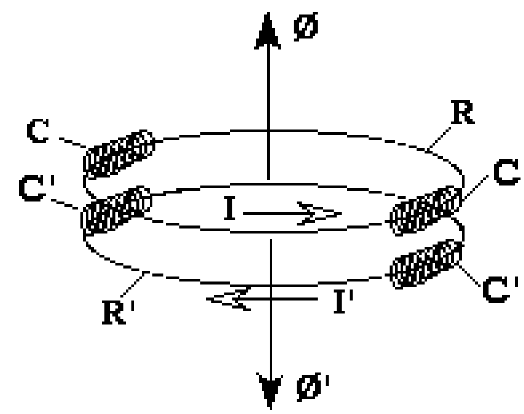


Figure 1b.

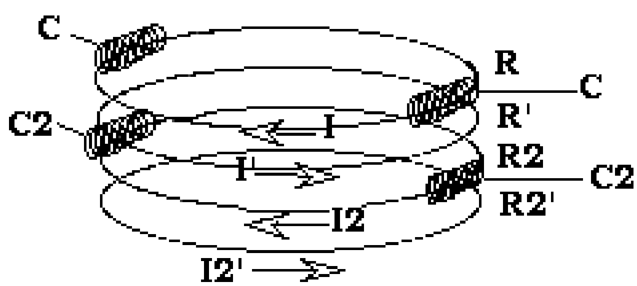


Figure 1c.

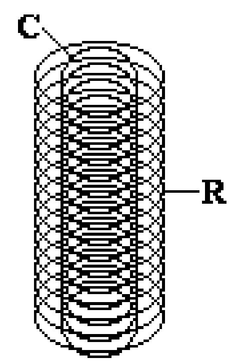


Figure 1d.

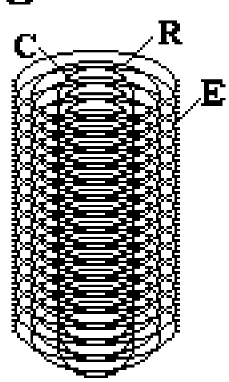
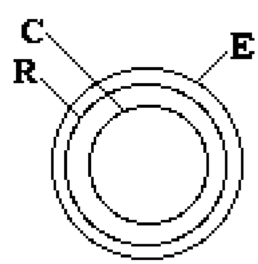


Figure 1e.



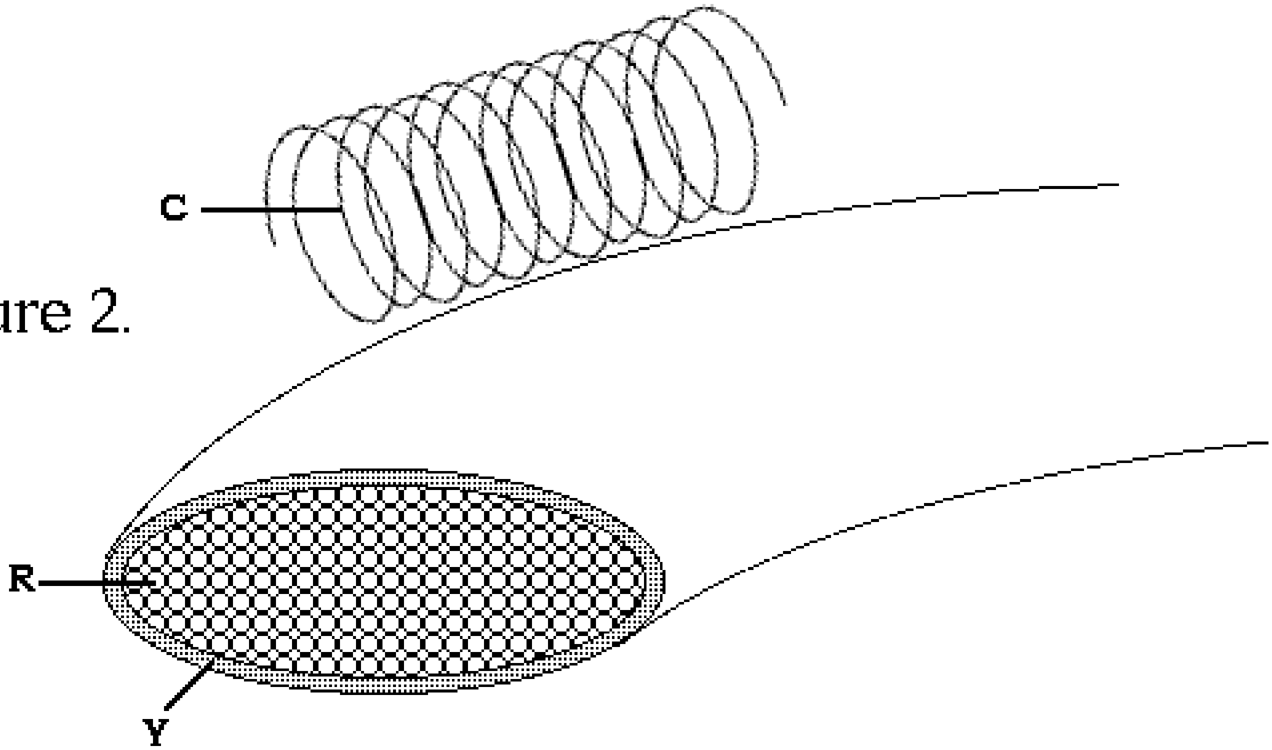
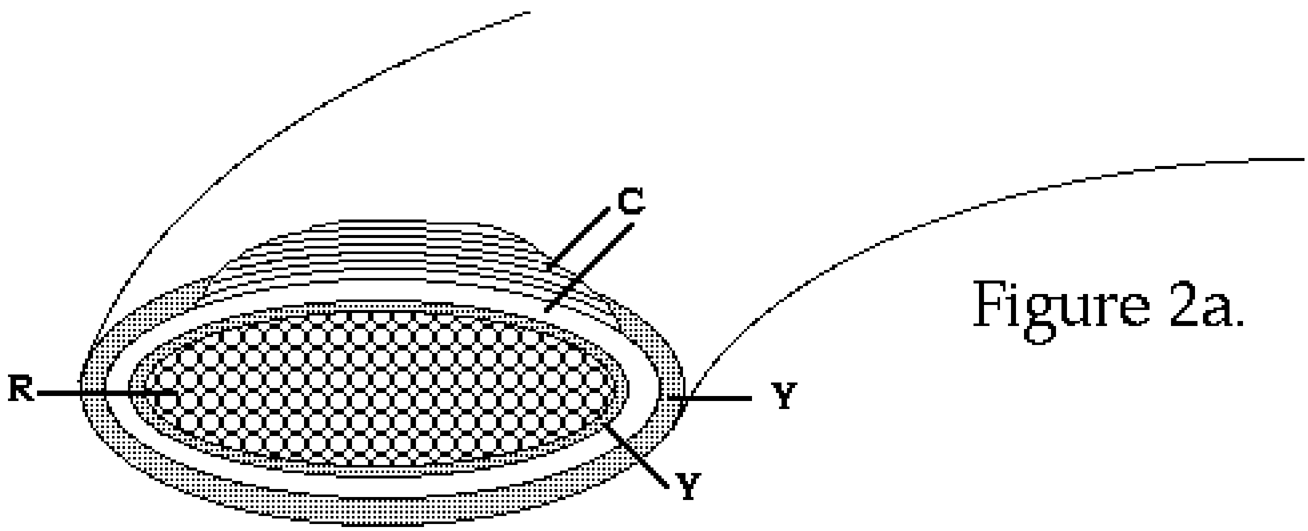


Figure 2.



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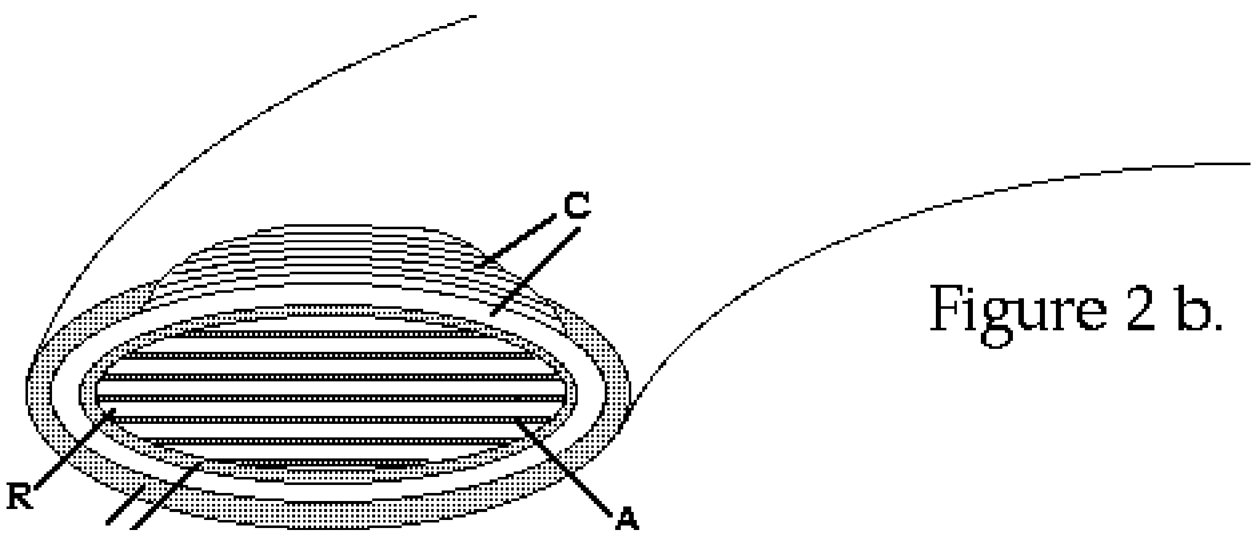


Figure 2 b.

Figure 2 c.

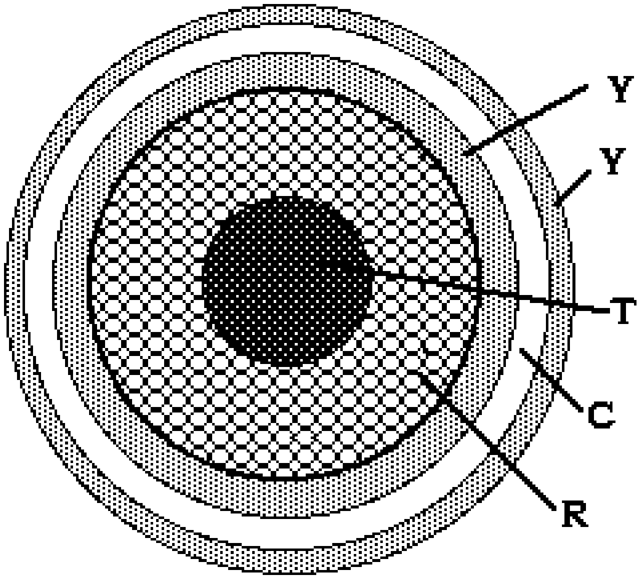
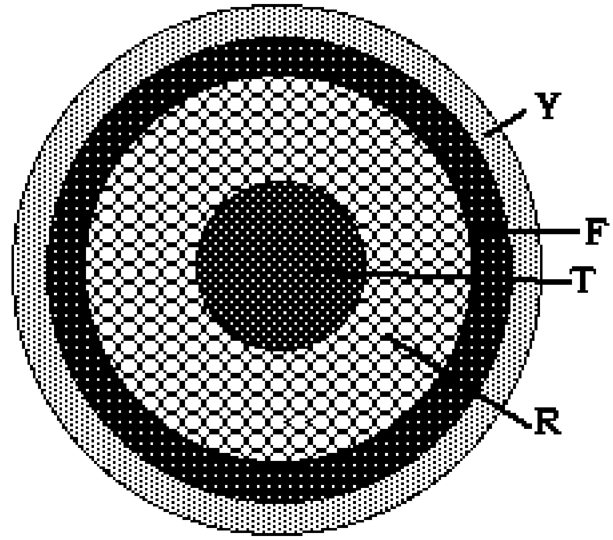


Figure 2 d.



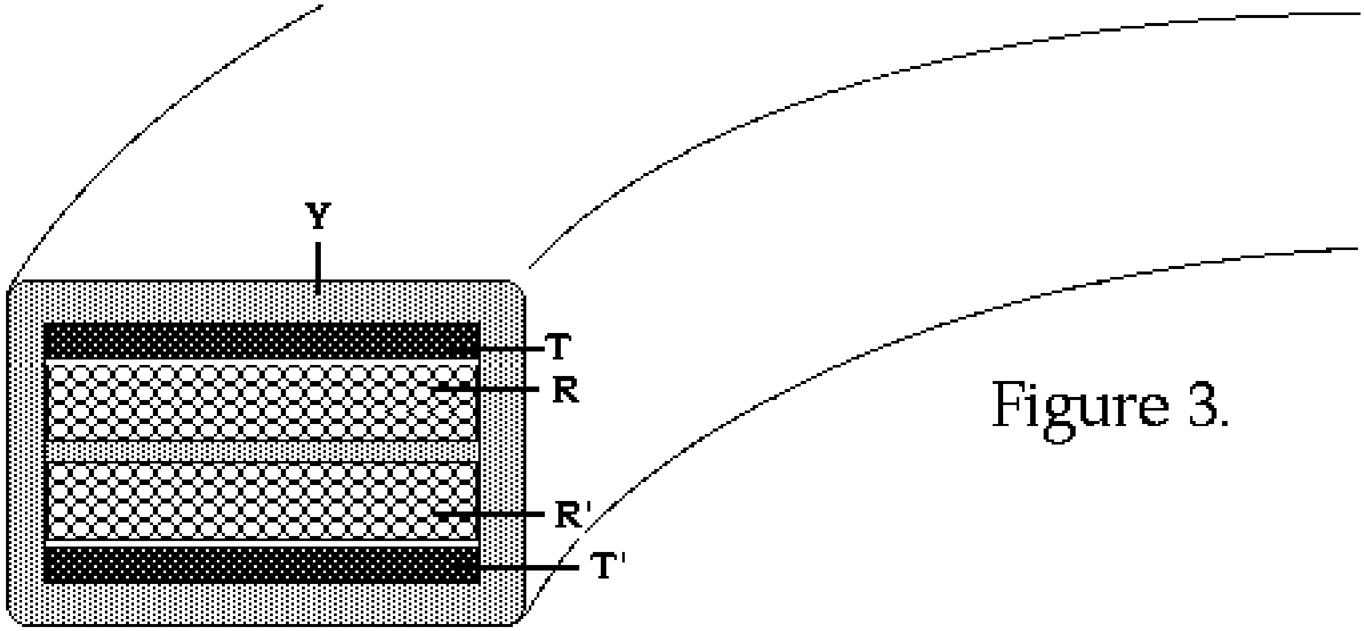


Figure 3.

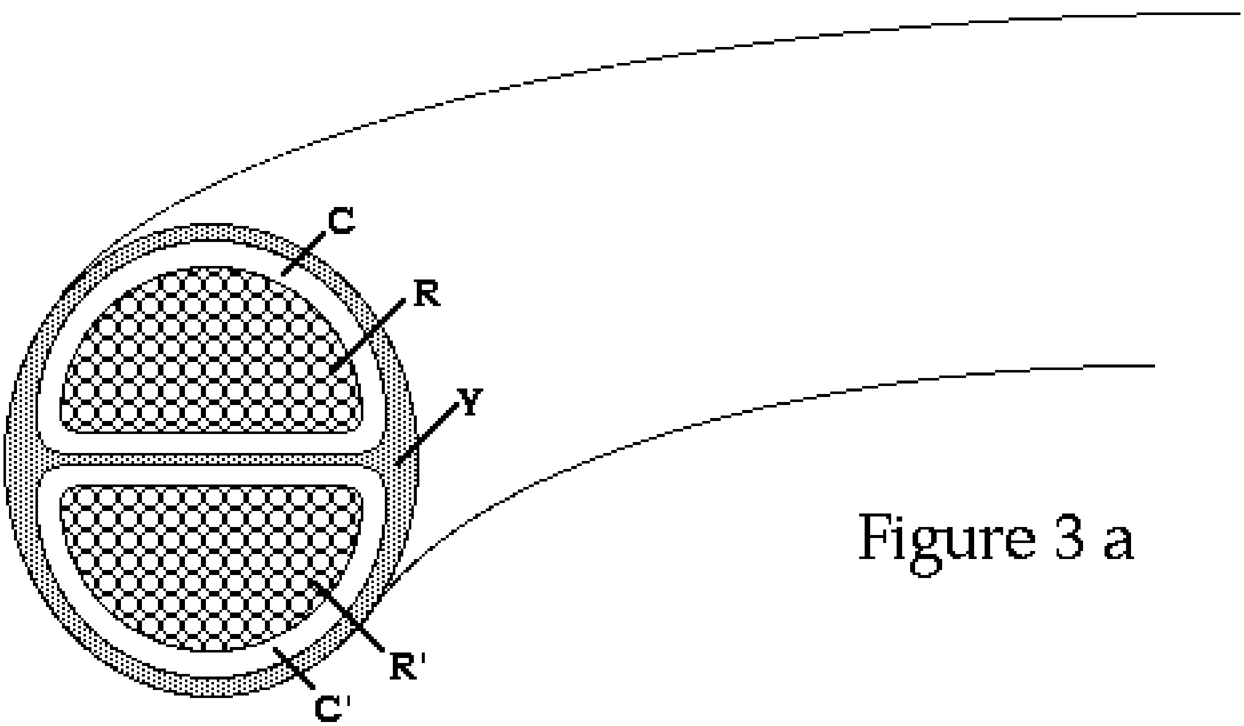


Figure 3 a

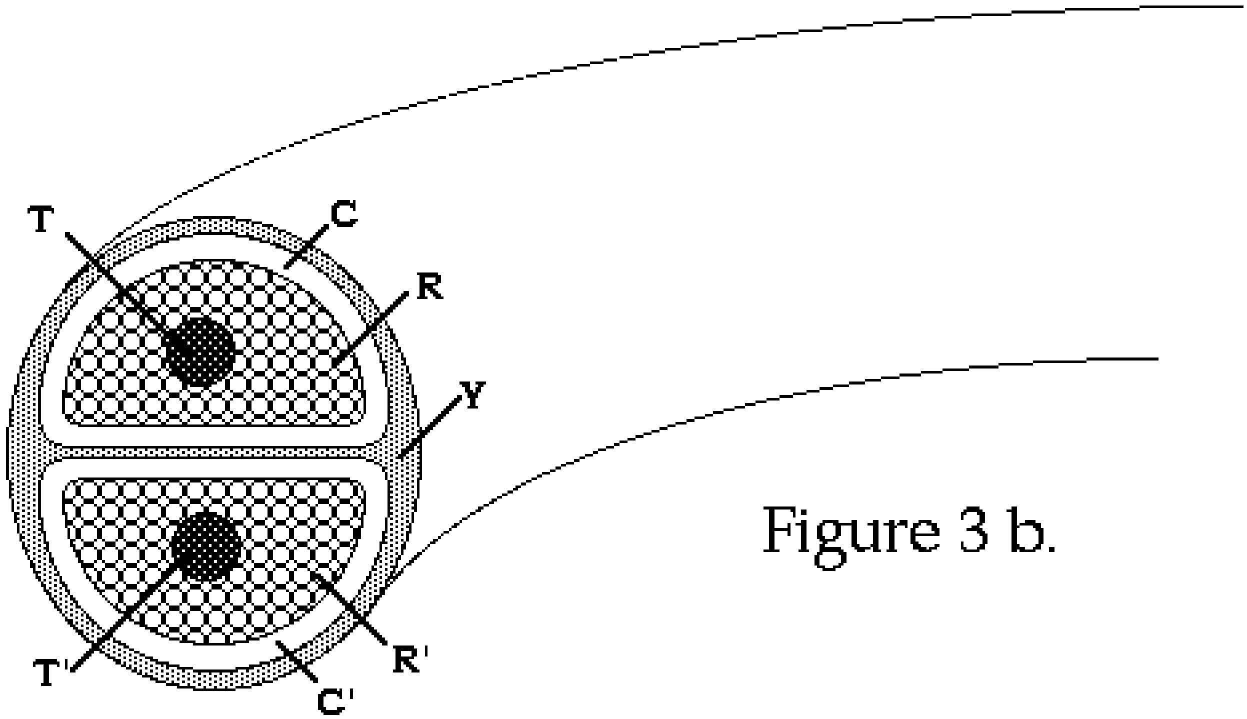


Figure 3 b.

Figure 4.

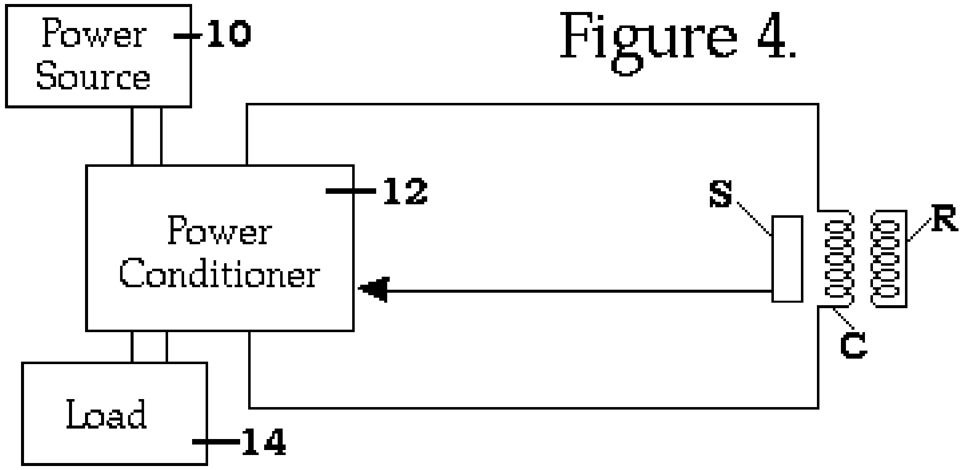
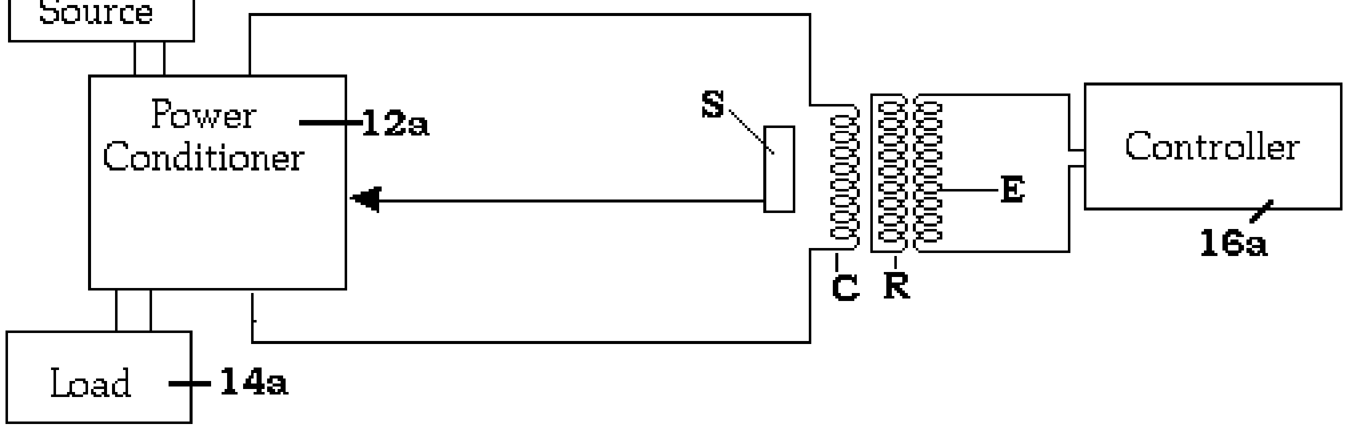


Figure 4 a.



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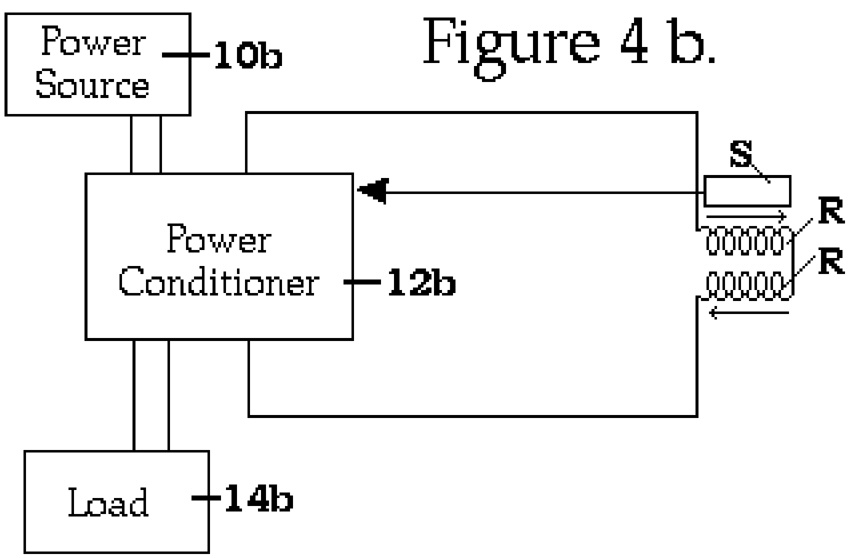


Figure 5.

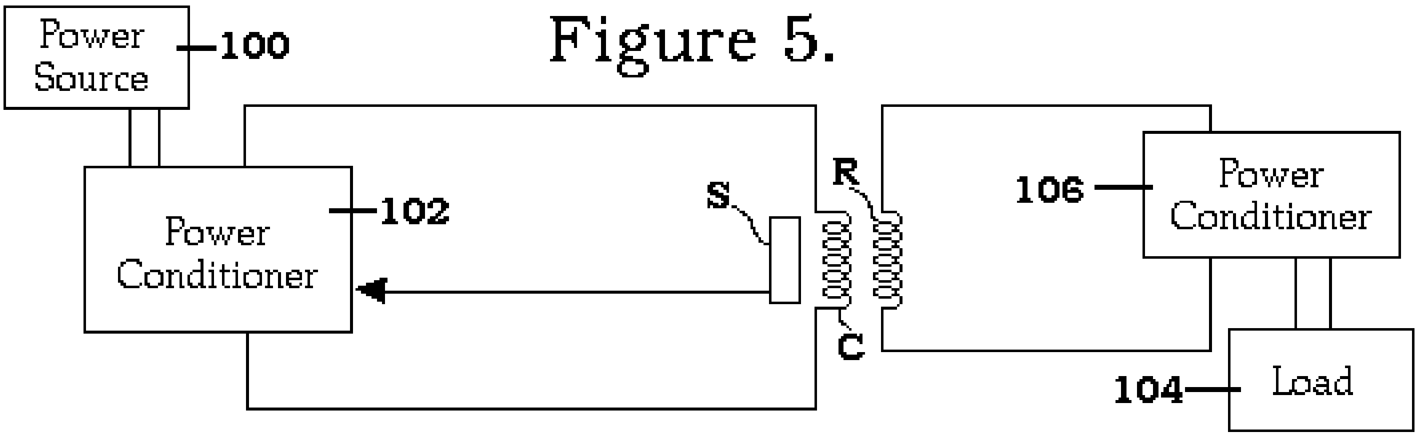
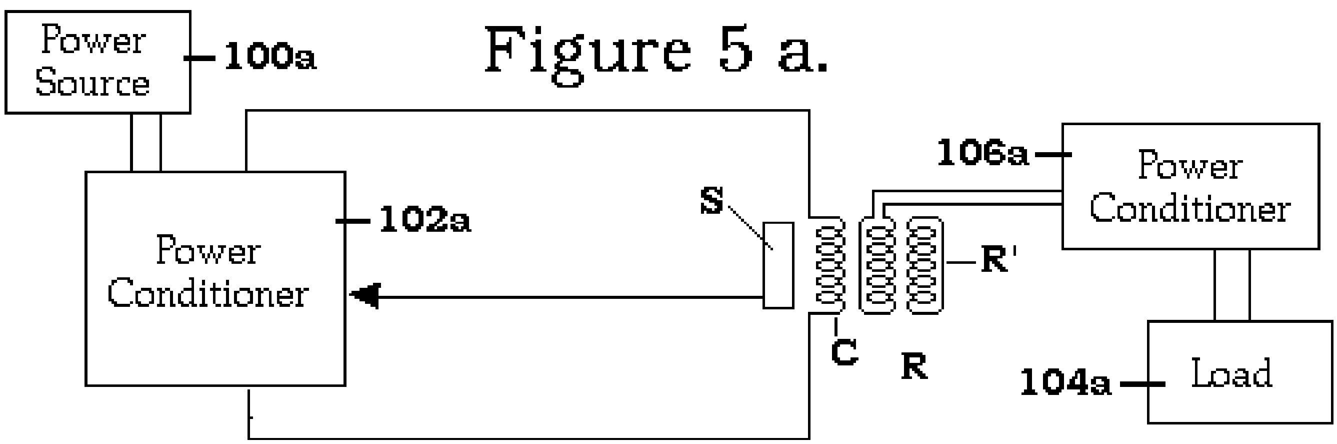


Figure 5 a.



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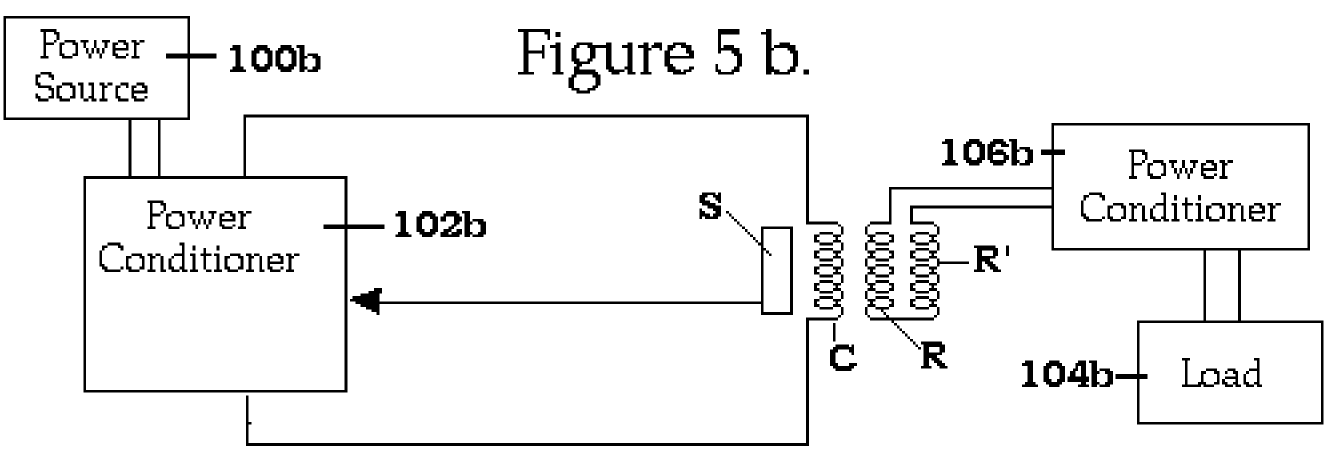


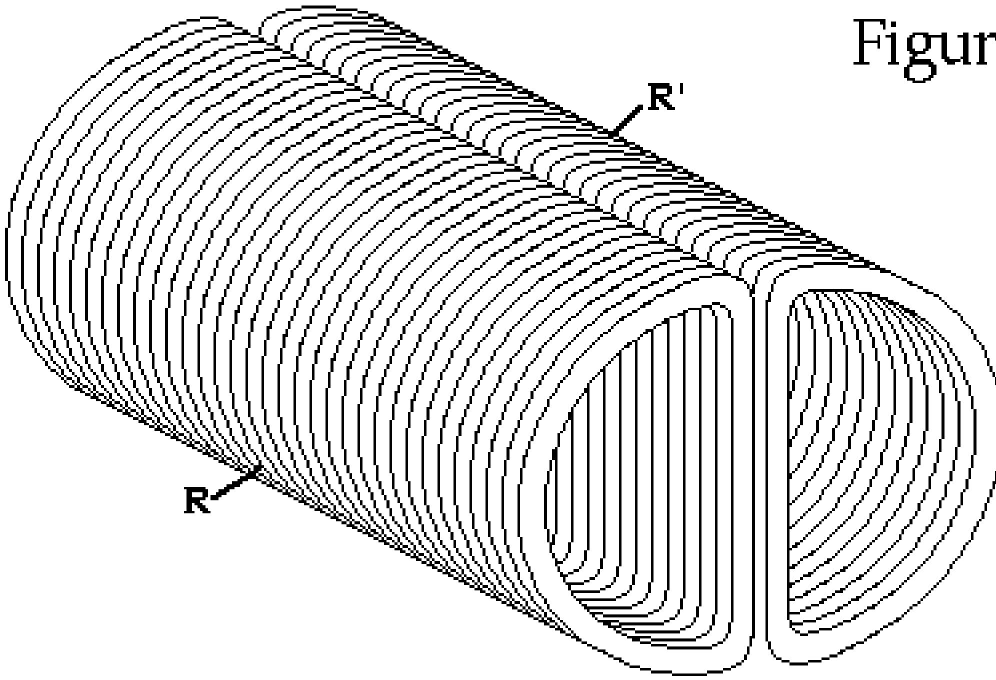


Figure 6

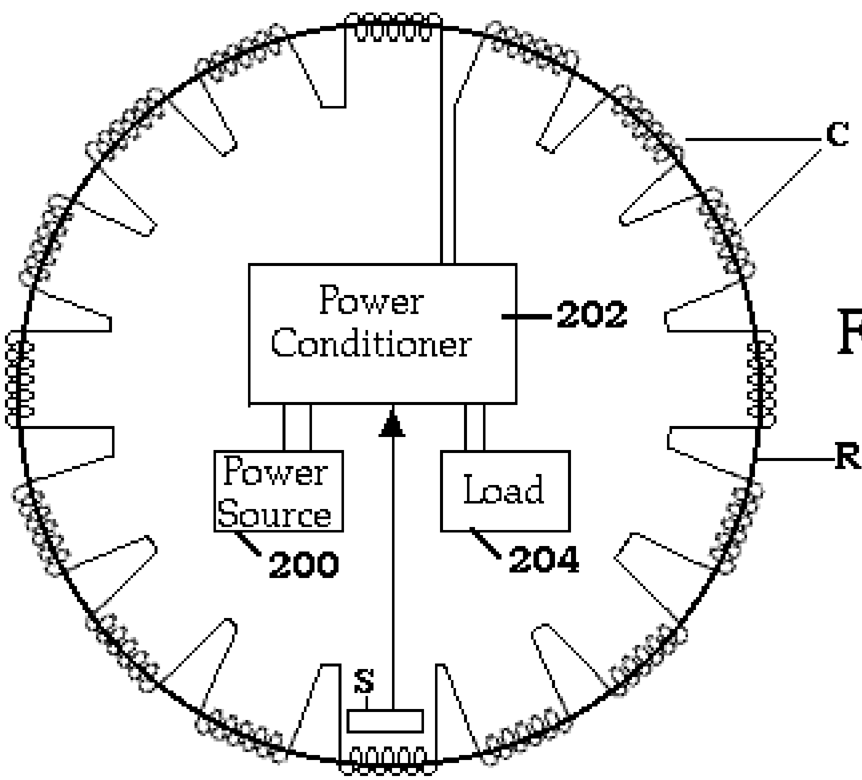


Figure 7.

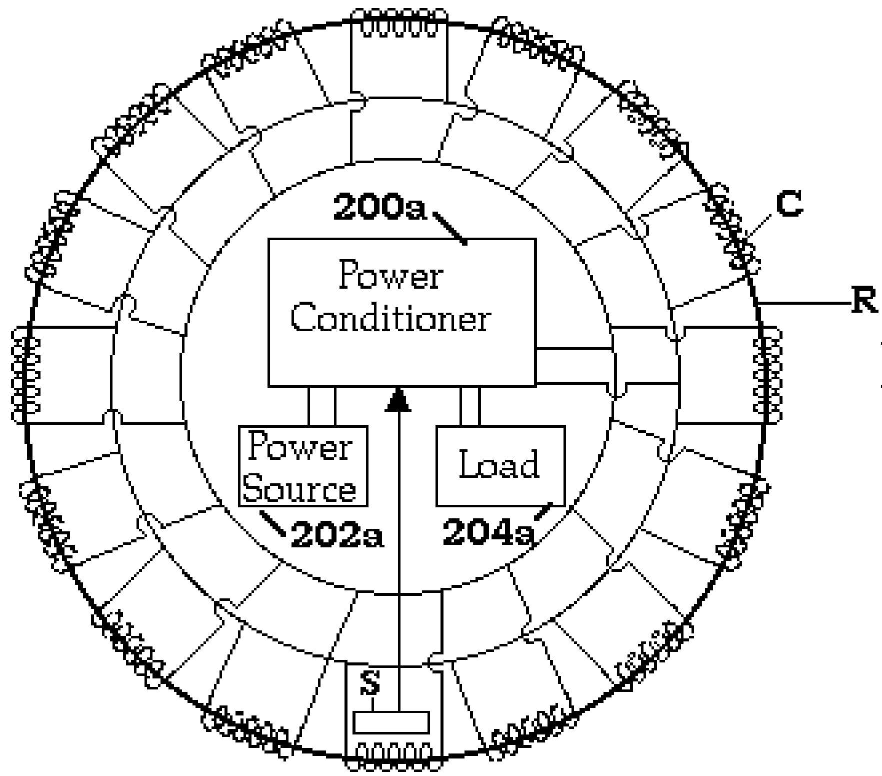
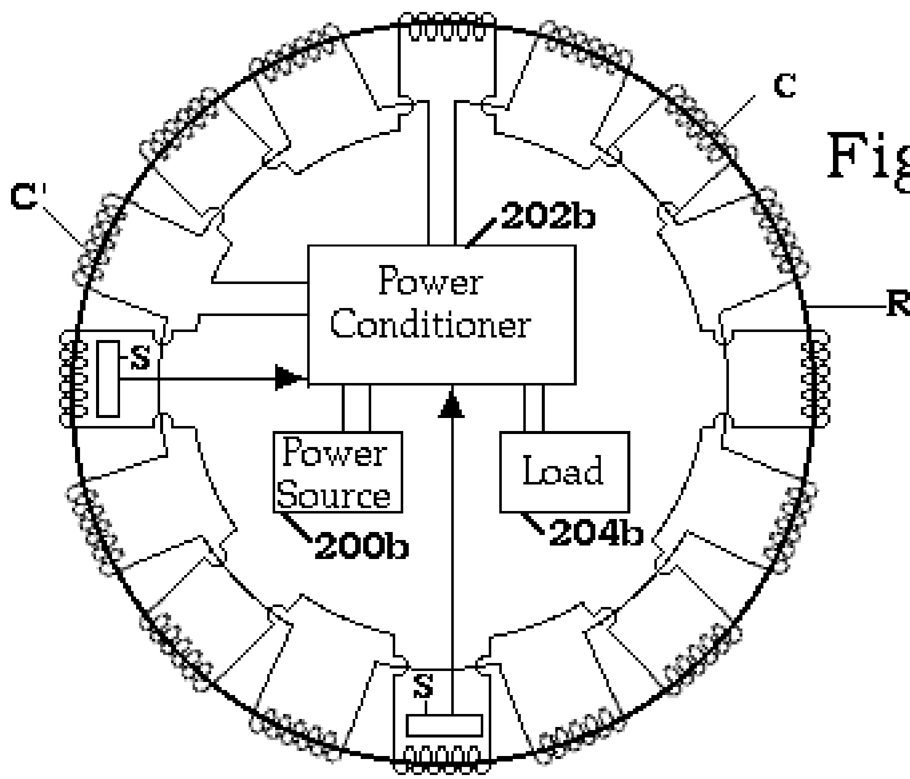


Figure 7 a.



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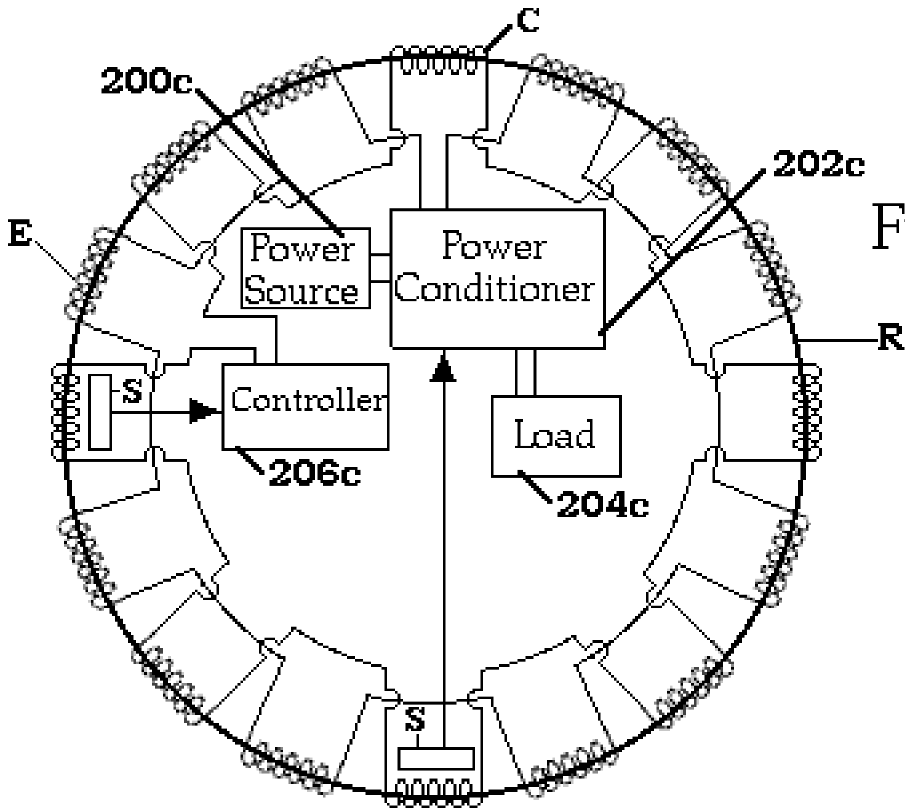

Figure 7 c.

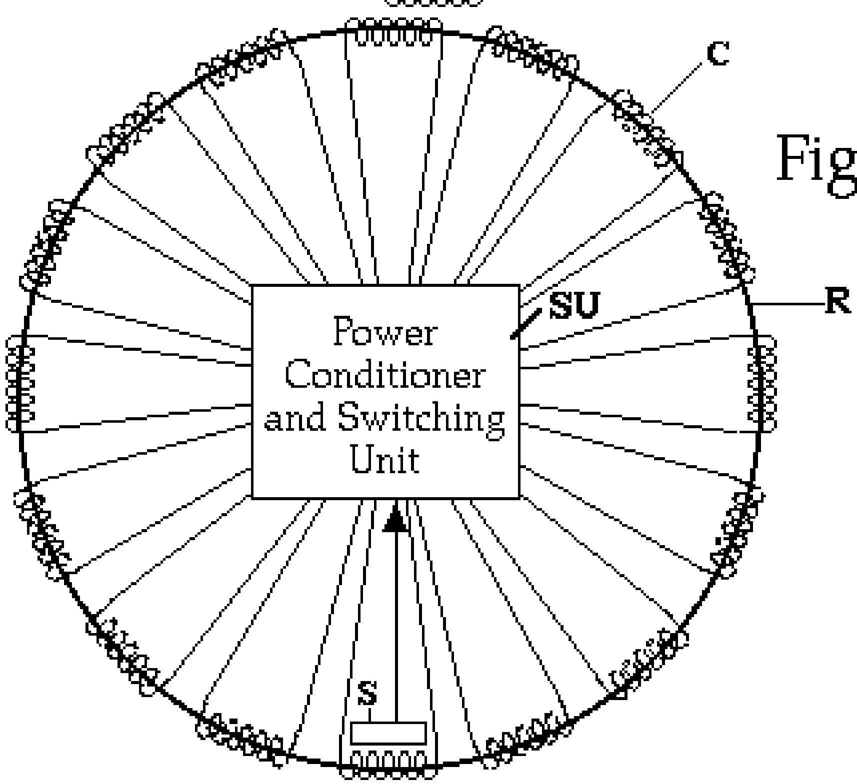

Figure 7 d.

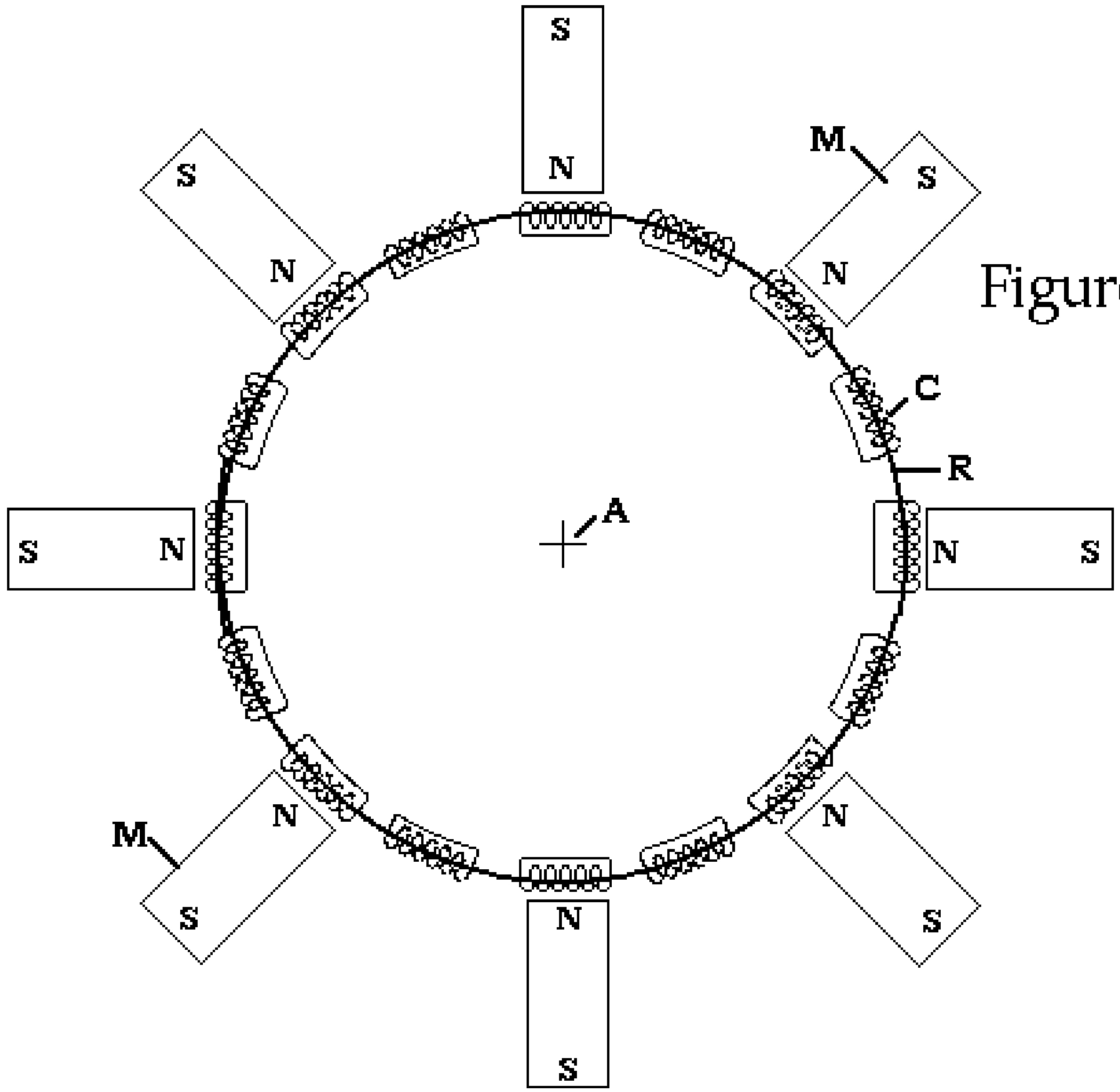

Figure 7 e.