

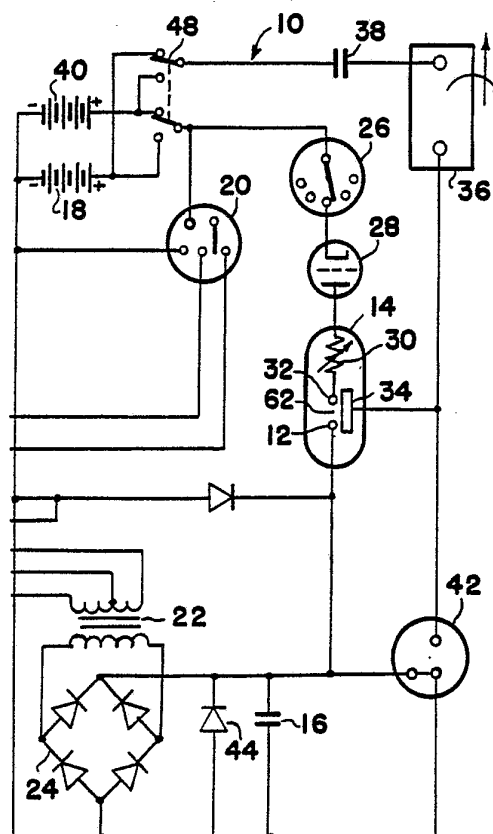


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(54) Title: HIGH FREQUENCY RECOVERY DRIVING SYSTEM**(57) Abstract**

Electrical driving and recovery system (10) for a high frequency environment. Also, a recovery system (10) that can be applied to the present day direct-current or alternating-current loads for better efficiency having a low-voltage source (18) coupled to a vibrator (20), a transformer (22) and a bridge-type rectifier (24) to provide a high-voltage pulsating signal to a first capacitor (16). Where high-voltage source is available couple direct to a bridge-type rectifier (24), causing a pulsating signal to a first capacitor (16). The capacitor (16) in turn is coupled to a high-voltage anode (12) of an electrical conversion switching element tube (14). The switching element tube (14) also includes a low-voltage anode (32) which in turn is connected to a voltage source (18) by a commutator (26) and a switching element tube (28). Mounted around the high voltage anode (12) is a charge receiving plate (34) which in turn is coupled to an inductive load (36) to transmit a high-voltage discharge from the switching element tube (14) to the load (36). Also, coupled to the load (36) is a second capacitor (38) for storing the back EMF created by the collapsing electrical field of the load (36) when the current to the load is blocked. The second capacitor (38) in turn is coupled to the voltage source (40). When adapted to present day direct-current or alternating-current devices the load (36) could be a battery or capacitor to enhance the productivity of electrical energy.



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HIGH FREQUENCY RECOVERY DRIVING SYSTEM

Field of The Invention

The present invention relates to an electrical driving system and a conversion
5 element, and more particularly, to a system for driving an inductive load in a greatly improved and efficient manner.

Description of The Prior Art

In the opinion of the inventor, there is
10 no known device which provides the conversion of energy from a direct-current electric source or an alternating-current electric source to a mechanical force based on the principle of this invention. EXAMPLE: A protable energy source,
15 (1) such as a battery, (2) such as alternating-current, (3) such as the combination of battery and alternating-current, may be used with highly improved efficiency to operate a mechanical device, whose output is a linear or
20 rotary force, with the attendant increase in the useful productive period between external applications of energy restoration for the energy source.

Summary of the Invention

25 The present invention provides a more efficient driving system comprising a source of electrical voltage; a vibrator connected to the low-voltage source for forming a pulsating signal; a transformer connected to the vibrator for
30 receiving the pulsating signal; a high-voltage source, where available, connected to the

bridge-type rectifier; a bridge-type rectifier connected to the transformer having a high voltage pulse output; a capacitor for receiving the voltage pulse output; a conversion element having
5 first and second anodes, electrically conductive means for receiving a charge positioned about the second anode and an output terminal connected to the charge receiving means, the second anode being connected to the capacitor; a commutator connected
10 to the source of electrical voltage and to the first anode; and an inductive load connected to the output terminal where-by a high energy discharge between the first and second anodes is transferred to the charge receiving means and then
15 to the inductive load.

As a sub-combination of the present invention also includes a conversion element comprising a housing; a first low voltage anode mounted to the housing, the first anode adapted to
20 be connected to a voltage source; a second high voltage anode mounted to the housing, the second anode adapted to be connected to a voltage source; electrically conductive means positioned about the second anode and spaced therefrom for receiving a
25 charge, the charge receiving means being mounted to the housing; and an output terminal communicating with the charge receiving means, said terminal adapted to be connected to an inductive load.

The invention also includes a method for
30 providing power to an inductive load comprising the steps of providing a voltage source, pulsating a signal from said source; increasing the voltage of said signal; rectifying said signal; storing and increasing the signal; conducting said signal
35 to a high voltage anode; providing a low voltage

to a second anode to form a high energy discharge;
electrostatically coupling the discharge to a
charge receiving element; conducting the discharge
to an inductive load; coupling a second capacitor
5 to the load; and coupling the second capacitor to
the source.

It is an aim of the present invention to
provide a system for driving an inductive load
which system is substantially more efficient than
10 any now existing.

Another object of the present invention
is to provide a system for driving an inductive
load which is reliable, is expensive and simply
constructed.

15 The foregoing objects of the present
invention together with various other objects,
advantages, features and results thereof which
will be evident to those skilled in the art in
light of this disclosure may be achieved with the
20 exemplary embodiment of the invention described in
detail hereinafter and illustrated in the
accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic circuit diagram of the electrical driving system.

5 FIGURE 2 is an elevational sectional view of the electrical conversion element.

FIGURE 3 is a planned sectional view taken along line 3-3 of FIGURE 2.

FIGURE 4 is a planned sectional view taken along line 4-4 of FIGURE 2.

10 FIGURE 5 is a schematic circuit diagram of the alternating-current input.

DESCRIPTION OF THE PREFERRED EMBODIMENT

While the present invention is susceptible of various modifications and alternative constructions, an embodiment is shown in the drawings and will herein be described in detail. It should be understood however that it is not the intention to limit the invention to the particular form disclosed; but, on the contrary, the invention is to cover all modifications, equivalences and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

There is disclosed herein an electrical driving system which, on theory, will convert low voltage electric energy from a source such as an electric storage battery to a high potential, high current energy pulse that is capable of developing a working force at the inductive output of the device that is more efficient than that which is capable of being developed directly from the energy source. The improvement in efficiency is further enhanced by the capability of the device to return that portion of the initial energy developed, and not used by the inductive load in the production of mechanical energy, to the same or second energy reservoir or source for use elsewhere, or for storage.

This system accomplishes the results stated above by harnessing the "electrostatic" or "impulse" energy created by a high-intensity spark generated within a specially constructed electrical conversion switching element tube. This element utilizes a low-voltage anode, a high-voltage anode, and one or more

"electrostatic" or charge receiving grids. These grids are of a physical size, and appropriately positioned, as to be compatible with the size of the tube, and therefore, directly related to the amount of energy to be anticipated when the device is operating.

The low-voltage anode may incorporate a resistive device to aid in controlling the amount of current drawn from the energy source. This low-voltage anode is connected to the energy source through a mechanical commutator or a solid-state pulser that controls the timing and duration of the energy spark within the element. The high-voltage anode is connected to a high-voltage potential developed by the associated circuits. An energy discharge occurs within the element when the external control circuits permit. This short duration, high-voltage, high-current energy pulse is captured by the "electrostatic" grids within the tube, stored momentarily, then transferred to the inductive output load.

The increase in efficiency anticipated in converting the electrical energy to mechanical energy within the inductive load is attributed to the utilization of the most optimum timing in introducing the electrical energy to the load device, for the optimum period of time.

Further enhancement of energy conservation is accomplished by capturing a significant portion of the energy generated by the inductive load when the useful energy field is collapsing. This energy is normally dissipated in load losses that are contrary to the desired energy utilization, and have heretofore been

accepted because no suitable means had been developed to harness this energy and restore it to a suitable energy storage device.

5 The present invention is concerned with two concepts or characteristics. The first of these characteristics is observed with the introduction of an energizing current through the inductor. The inductor creates a contrary force (counter-electromotive force or CEMF) that opposes
10 the energy introduced into the inductor. This CEMF increases throughout the time the introduced energy is increasing.

 In normal applications of an alternating-current to an inductive load for
15 mechanical applications, the useful work of the inductor is accomplished prior to terminating the application of energy. The excess energy applied is thereby wasted.

 Previous attempts to provide energy
20 inputs to an inductor of time duration limited to that period when the optimum transfer of inductive energy to mechanical energy is occurring, have been limited by the ability of any such device to handle the high current required to optimize the
25 energy transfer.

 The second characteristics is observed when the energizing current is removed from the inductor. As the current is decreased, the inductor generates an EMF that opposes the removal
30 of current or, in other words, produces an energy source at the output of the inductor that simulates the original energy source, reduced by the actual energy removed from the circuit by the mechanical load. This "regenerated", or excess,

energy has previously been lost due to a failure to provide a storage capability for this energy.

In this invention, a high-voltage, high-current, short duration energy pulse is applied to the inductive load by the conversion element. This element makes possible the use of certain of that energy impressed within an arc across a spark-gap, without the resultant deterioration of circuit elements normally associated with high energy electrical arcs.

This invention also provides for capture of a certain portion of the energy induced by the high inductive kick produced by the abrupt withdrawal of the introduced current. This abrupt withdrawal of current is attendant upon the termination of the stimulating arc. The voltage spike so created is imposed upon a capacitor that couples the attendant current to a secondary energy storage device.

A novel, but not essential, circuit arrangement provides for switching the energy source and the energy storage device. This switching may be so arranged as to actuate automatically at predetermined times. The switching may be at specified periods determined by experimentation with a particular device, or may be actuated by some control device that measures the relative energy content of the two energy reservoirs.

Referring now to FIGURE 1, the system will be described in additional detail. The potential for the high-voltage anode 12 of the conversion element 14 is developed across the capacitor 16. This voltage is produced by drawing a low current from a battery source 18 through the

vibrator 20. The effect of the vibrator is to create a pulsating input to the transformer 22. The turns ratio of the transformer is chosen to optimize the voltage applied to a bridge-type rectifier 24. The output of the rectifier is than
5 a series of high-voltage pulses of modest current. When source is high voltage, couple direct to bridge-type rectifier.

By repetitious application of these
10 output pulses from the bridge-type rectifier to the capacitor 16, a high-voltage, high-level charge is built up on the capacitor.

Control of the conversion switching element tube is maintained by a commutator 26. A
15 series of contacts mounted radially about a shaft, or a solid-state switching device sensitive to time or other variable may be used for this control element. A switching element tube type one-way energy path 28 is introduced between the
20 commutator device and the conversion switching element tube to prevent high energy arcing at the commutator current path though the switching element tube is closed, current from the voltage source 18 is routed through a resistive element 30
25 and a low voltage anode 32. This causes a high energy discharge between the anodes within the conversion switching element tube 14.

The energy content of the high energy pulse is electrostatically coupled to the
30 conversion grids 34 of the conversion element. This electrostatic charge is applied through an output terminal 60 (FIGURE 2) across the load inductance 36, inducing a strong electromagnetic field about the inductive load. The intensity of
35 this electromagnetic field is determined by the

high electromotive potential developed upon the electrostatic grids and the very short time duration required to develop the energy pulse.

If the inductive load is coupled
5 magnetically to a mechanical load, a strong initial torque is developed that may be efficiently utilized to produce physical work.

Upon cessation of the energy pulse (arc)
10 within the conversion switching element tube the inductive load is decoupled, allowing the electromagnetic field about the inductive load to collapse. The collapse of this energy field induces within the inductive load a counter EMF. This counter EMF creates a high positive potential
15 across a second capacitor 38 which, in turn, is induced into the second energy storage device or battery 40 as a charging current. The amount of charging current available to the battery 40 is dependent upon the initial conditions within the
20 circuit at the time of discharge within the conversion switching element tube and the amount of mechanical energy consumed by the work load.

A spark-gap protection device 42 is included in the circuit to protect the inductive
25 load and the rectifier elements from unduly large discharge currents. Should the potentials within the circuit exceed predetermined values, fixed by the mechanical size and spacing of the elements within the protective device, the excess energy is
30 dissipated (bypassed) by the protective device to the circuit common (electrical ground).

Diodes 44 and 46 bypass the excess overshoot generated when the "Energy Conversion Switching Element Tube" is triggered. A switching
35 element 48 allows either energy storage source to

be used as the primary energy source, while the other battery is used as the energy retrieval unit. The switch facilitates interchanging the source and the retrieval unit at optimum intervals to be determined by the utilization of the conversion switching element tube. This switching may be accomplished manually or automatically, as determined by the choice of switching element from among a large variety readily available for the purpose.

Figures 2, 3 and 4 show the mechanical structure of the conversion switching element tube 14. An outer housing 50 may be of any insulative material such as glass. The anodes 12 and 22 and grids 34a and 34b are firmly secured by nonconductive spacer material 52, 54, and 56. The resistive element 30 may be introduced into the low-voltage anode path to control the peak currents through the conversion switching element tube. The resistive element may be of a piece, or it may be built of one or more resistive elements to achieve the desired result.

The anode material may be identical for each anode, or may be of differing materials for each anode, as dictated by the most efficient utilization of the device, as determined by appropriate research at the time of production for the intended use.

The shape and spacing of the electrostatic grids is also susceptible to variation with application (voltage, current, and energy requirements).

It is the contention of the inventor that by judicious mating of the elements of the conversion switching element tube, and the proper

selection of the components of the circuit elements of the system, the desired theoretical results may be achieved. It is the inventor's contention that this mating and selection process
5 is well within the capabilities of intensive research and development technique.

Let it be stated here that substituting a source of electric alternating-current subject to the required current and/or voltage shaping and/or
10 timing, either prior to being considered a primary energy source, or thereafter, should not be construed to change the described utilization or application or primary energy in any way. Such energy conversion is readily achieved by any of a
15 multitude of well established principles. The preferred embodiment of this invention merely assumes optimum utilization and optimum benefit from this invention when used with portable energy devices similar in principle to the wet-cell or
20 dry-cell battery.

This invention proposes to utilize the energy contained in an internally generated high-voltage electric spike (energy pulse) to electrically energize an inductive load; this
25 inductive load being then capable of converting the energy so supplied into a useful electrical or mechanical output.

In operation the high-voltage, short-duration electric spike is generated by
30 discharging the capacitor 16 across the spark-gap in the conversion switching element tube. The necessary high-voltage potential is stored on the capacitor in incremental, additive steps from the bridge-type rectifier 24.

When the energy source is a direct-current electric energy storage device, such as the battery 12, the input to the bridge rectifier is provided by the voltage step-up transformer 22, that is in turn energized from the vibrator 20, or solid-state chopper, or similar device to properly drive the transformer and rectifier circuits.

When the energy source is alternating-current, switches 64 disconnect the direct-current transformer 22 and the input to the bridge-type rectifier 24 is provided by the voltage step-up transformer 66, that is in turn energized from the vibrator 20, or solid-state chopper, or similar device to properly drive the transformer and rectifier circuits.

The repetitious output of the bridge rectifier incrementally increases the capacitor charge toward its maximum. This charge is electrically connected directly to the high-voltage anode 12 of the conversion switching element tube.

When the low-voltage anode 32 is connected to a source of current, an arc is created in the spark-gap designated 62 of the conversion switching element tube equivalent to the potential stored on the high-voltage anode, and the current available from the low-voltage anode. Because the duration of the current available from the low-voltage anode (i.e., the duration of the arc) is very short, the instantaneous voltage, and instantaneous current may both be very high. The instantaneous peak apparent power is therefore, also very high. Within the conversion switching element tube, this

energy is absorbed by the grids 34a and 34b mounted circumferentially about the interior of the tube.

Control of the energy spike within the conversion switching element tube is accomplished by a mechanical, or solid-state commutator, that closes the circuit path from the low-voltage anode to the current source at that moment when the delivery of energy to the output load is most auspicious. Any number of standard high-accuracy, variable setting devices are available for this purpose. When control of the repetitive rate of the system's output is required, it is accomplished by controlling the time on connection at the low-voltage anode.

Thus there can be provided an electrical driving system having a low-voltage source coupled to a vibrator, a transformer and a bridge-type rectifier to provide a high voltage pulsating signal to a first capacitor. Where high-voltage source is available, couple direct to a bridge-type rectifier, causing a pulsating signal to a first capacitor. The capacitor in turn is coupled to a high-voltage anode of an electrical conversion switching element tube. The element also includes a low-voltage anode which in turn is connected to a voltage source by a commutator, a switching element tube, and a variable resistor. Mounted around the high-voltage anode is a charge receiving plate which in turn is coupled to an inductive load to transmit a high-voltage discharge from the element to the load. Also, coupled to the load is a second capacitor for storing the back EMF created by the collapsing

electrical field of the load when the current to the load is blocked. the second capacitor in turn is coupled to the voltage source.

WHAT IS CLAIMED IS:

1. An electrical driving system comprising:
a source of electrical voltage;
5 a vibrator connected to said source for forming a pulsating signal;
a transformer connected to said vibrator for receiving said pulsating signal;
a rectifier connected to said transformer
10 having a high-voltage pulse output;
a capacitor for receiving said voltage pulse output;
a conversion switching element tube
having a first and second anodes, electrically
15 conductive means for receiving a charge positioned about said second anode and an output terminal connected to said charge receiving means, said second anode being connected to said capacitor;
a commutator connected to said source of
20 electrical voltage and to said first anode; and
an inductive load connected to said output terminal whereby a high energy discharge between said first and second anodes is transferred to said charge receiving means and
25 then to said inductive load.

2. A system as claimed in claim 1, including
a second capacitor for receiving a charge from said load.

30 3. A system as claimed in claim 2, including

a switching element tube positioned in series between said commutator and said first anode.

4. A system as claimed in claim 3,
5 including
a second source of voltage and a switch for receiving a signal from said second capacitor.

5. A system as claimed in claim 4
wherein:
10 said conversion switching element tube includes a resistive element in series with said first anode; and
said charge receiving means is tubularly shaped.

15 6. An electrical conversion switching element tube comprising:
a housing;
a first low-voltage anode mounted to said housing, said first anode adapted to be connected
20 to a voltage source;
a second high-voltage anode mounted to said housing, said second anode adapted to be connected to a voltage source;
electrically conductive means positioned
25 about said second anode and spaced therefrom for receiving a charge, said charge receiving means being mounted to said housing; and
an output terminal communicating with
said charge receiving means, said terminal adapted
30 to be connected to an inductive load.

7. An element as claimed in claim 6,
including:

a resistive element in series with said
first anode.

5 8. An element as claimed in claim 6
wherein:

said charge receiving means is tubularly
shaped.

10 9. An element as claimed in claim 8,
including

a second tubularly shaped charge
receiving means positioned about said first
mentioned charge receiving means.

15 10. A method for providing power to an
inductive load comprising the steps of:

providing a voltage source;
pulsating a signal from said source;
increasing the voltage of said signal;
rectifying said signal;
20 storing and increasing said signal;
conducting said signal to a high-voltage
anode;

providing a low-voltage to a second anode
to form a high energy discharge;

25 electrostatically coupling said discharge
to a charge receiving element;

conducting said discharge to an inductive
load;

30 and
coupling a second capacitor to said load;

coupling said capacitor to said source.

11. A multiple switch which is a method for selecting:

Direct-current or Alternating-current high voltage power supply.

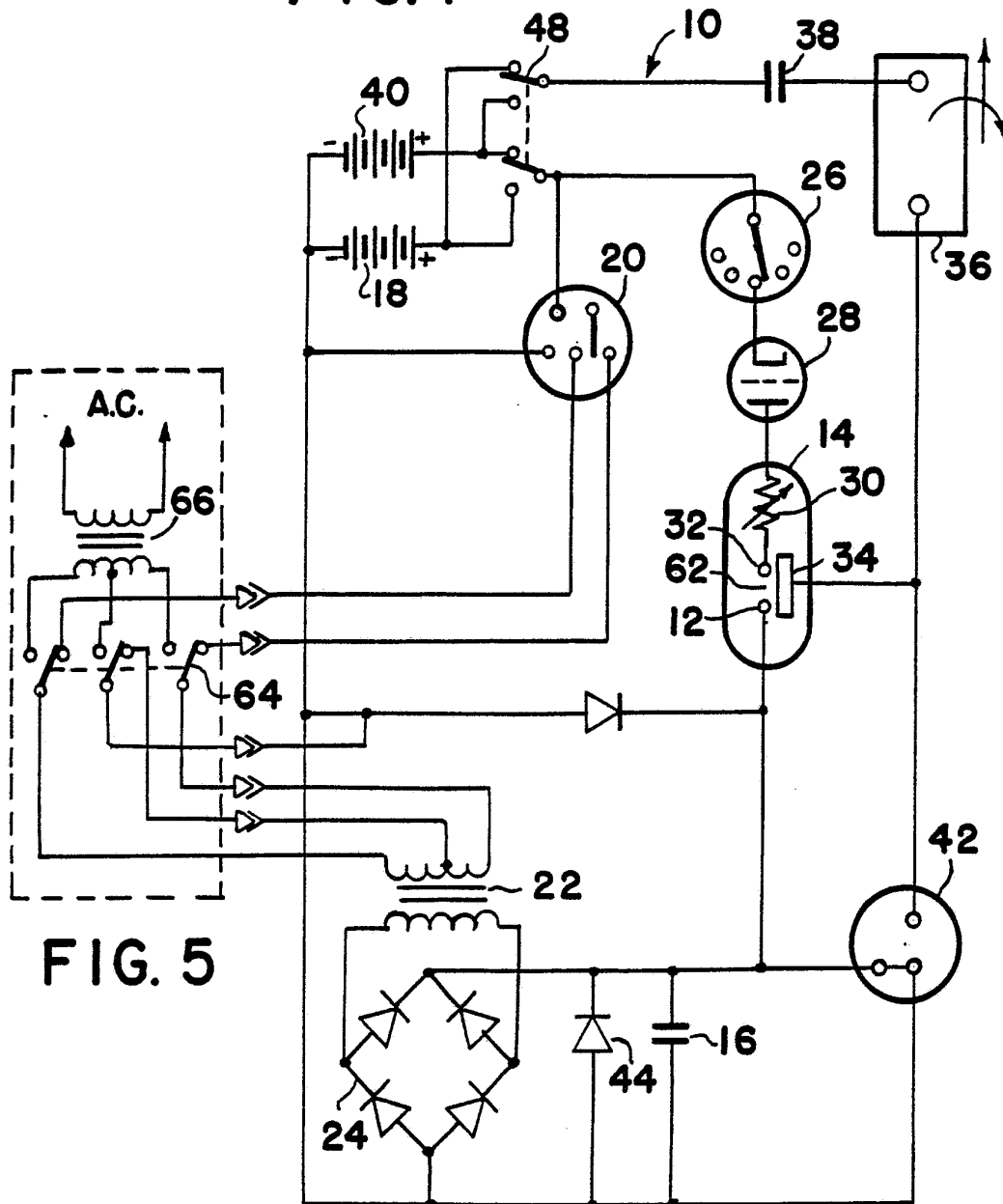
5 12. Alternating-Current operating Power Supply as claimed in claim 11:

allows the system to function as in claims 1 through 11.

10 13. High-voltage to bridge-type rectifier to first capacitor allows system to function as in claims 1 through 12.

1 / 2

FIG. 1



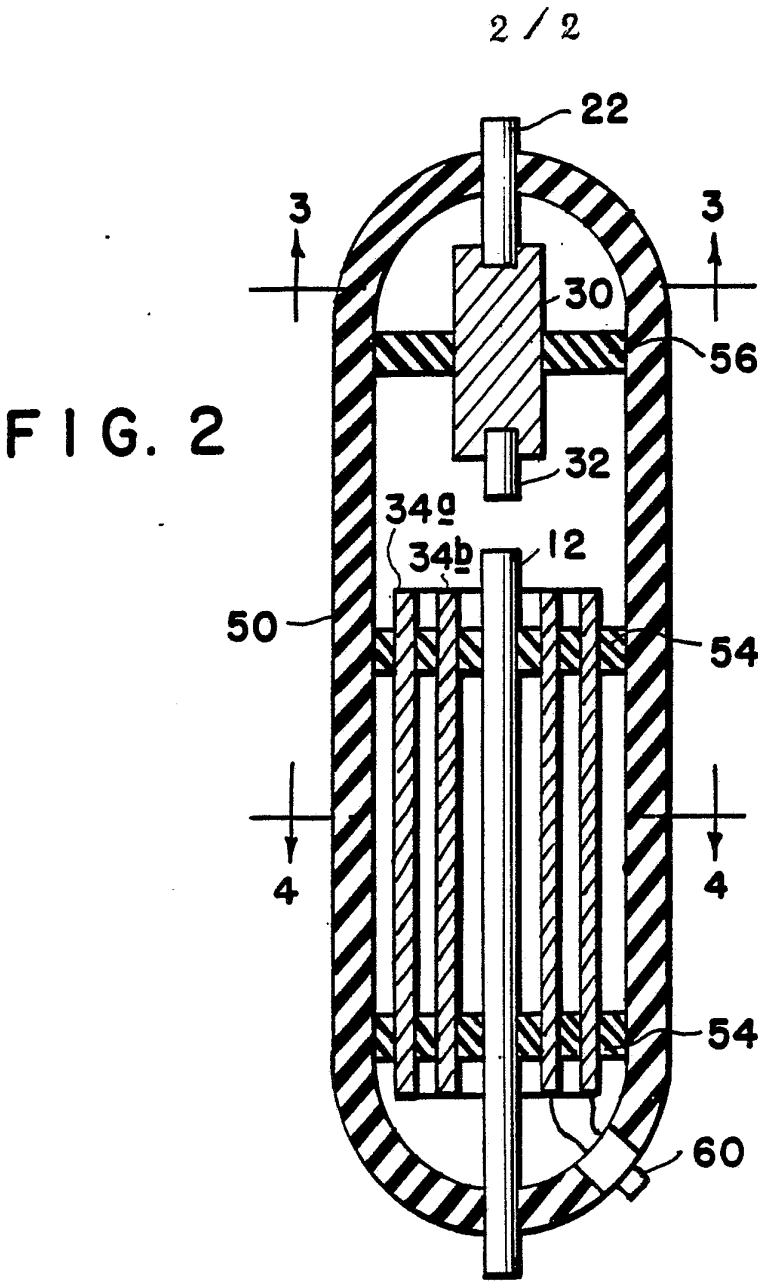


FIG. 3

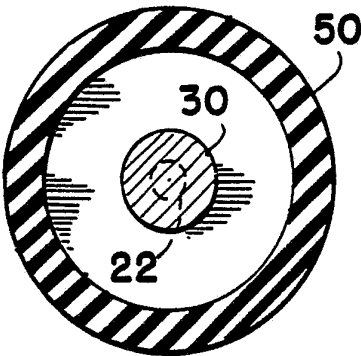
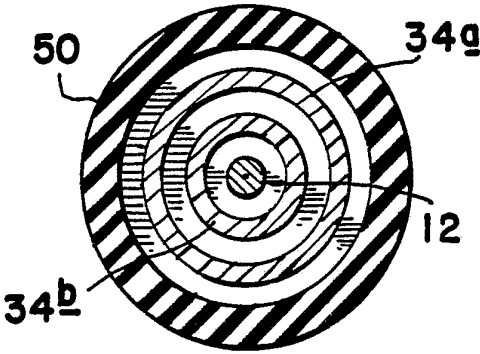


FIG. 4



INTERNATIONAL SEARCH REPORT

International Application No PCT/US84/02061

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC: H02M 7/00		
U.S.: 363/13		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
U.S.	363/13, 32, 33, 121, 122 307/109, 110	320/1 328/63, 67, 251
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
A	US, A, 2,959,723 Published 8 Nov 1960 Lordo	
A	US, A, 3,215,939 Published 2 Nov 1965 Boucher	
A	US, A, 3,355,626 Published 28 Nov 1967 Schmidt	
A	US, A, 3,217,310 Published 9 Nov 1965 Pearson et al.	
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search ²	Date of Mailing of this International Search Report ²	
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