

ENERGY SCIENCE REPORT NO. 9

**POWER FROM MAGNETISM: OVER-UNITY MOTOR DESIGN**

by

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## ***POWER FROM MAGNETISM: OVER-UNITY MOTOR DESIGN***

### Introduction

This Energy Science Report is one of a series concerned with new energy technology and the fundamental energy science that is involved. In this series of twelve such reports there are three, Nos 3, 8 and 9 of which are of outstanding importance. Report No. 8 was devoted exclusively to the remarkable discovery of Dr. Paulo Correa and Mrs. Alexandra Correa of Concord, Ontario, Canada. In proving that electrical power at normal power voltage can be generated by tapping aether energy by a plasma discharge technique, we have in prospect one solution for our future energy needs. In this Report No. 9 this author now reveals another way forward to tapping aether energy, one which could well replace main electrical power generating installations in the years ahead. In Report No. 3, soon to be issued, the author will describe a technology which, when developed, will serve as a 'free energy' air-conditioning or refrigeration unit. This latter technology does not tap aether energy. It does, however, operate in defiance of the second law of thermodynamics by extracting electricity from ambient heat.

This Report in four parts. Part I outlines the design of a large scale motor such as might become a prime mover in a power generating plant or used to power an ocean liner. Part II concerns the design features of a small prototype motor that can be assembled in a home workshop. Part III is an academic discourse aimed at educating students and even university professors of electrical engineering on some elementary, but unfamiliar, principles of magnetism. Part IV discusses further the scope for research and commercialization. It is aimed at government officials and research directors in industry, with a view to urging action to exploit this new technology.

For the record, the author explains that he has begun writing this Report on October 6th 1996 and aims to publish by November 6th in advance of a New Energy symposium to be held in Rotterdam on November 9th. This Report will be revised and reissued in updated forms periodically thereafter in the light of developments.

[Note added here in this June, 2003 reprint of this Report for placing as a record on the author's website [www.energyscience.co.uk](http://www.energyscience.co.uk) and listing in the paper section of the author's other website [www.aspden.org](http://www.aspden.org) which is where any such commentary as to onward development will be reported. However, it is mentioned here that, at this time, the author's attentions have been more directed at the understanding the scientific physical basis on which energy can be tapped from our aetheric environment, replicating in a sense the process by which our Earth and sun acquired their energy. The future prospect here points towards solid-state technology, rather than the theme discussed in this Report.]

## PART I: Multi-Megawatt Over-Unity Design

There have been many reports of motors incorporating permanent magnets and claiming over-unity performance. By 'over-unity' is meant the generation of output power in excess of the electrical power input. It is important to note that the use of permanent magnets in motor construction is standard practice for many commercial d.c. motors. Usually the motor drive is generated by currents in conductors interacting with the magnetic field to produce lateral forces on the structure supporting the conductors. In this case the resulting motion induces back EMFs which absorb input power to set up the drive force. There is no anomalous energy gain in such machines. An entirely different motor principle involves setting up a magnetic field in a pole gap as the poles come together and weakening the magnetizing field during pole separation. Such machines are known as 'magnetic reluctance' motors. Incorporating permanent magnets in such machines poses problems but offers scope for 'over-unity' performance.

It should not, however, be assumed that energy is being drained from the magnet. The magnet is merely a catalyst in energy conversion. Also, whatever function can be performed by a magnet can also be achieved using an electromagnet, meaning a ferromagnetic core excited by a magnetizing winding, subject to the scale of the system involved.

In large electrodynamic machines used in power generation there is a developing tendency to use superconductive magnets, superconductive coils having no ferromagnetic core. The fact that electric current can be sent around a multi-turn magnetizing winding with no loss that produces heat offers the alternative to a powerful magnet for many scientific applications. This is especially the case now that 'warm superconductors' have been discovered, with the promise of room temperature superconductivity. However, here again, it must be noted that, if the ferromagnetic core is to be used as the catalyst for tapping energy from the aether, the use of superconductive windings must be accompanied by the presence of ferromagnetic cores within those windings. The design of the multi-megawatt power generating machine to be described below does, therefore, use superconductive windings on ferromagnetic cores.

The general principle which forms the basis of the design combines (a) the avoidance of loss by using superconductive magnetizing windings and (b) the minimization of inductive power input by near-to-total enclosure of the complete core circuit of the machine within a single solenoidal magnetizing winding.

The operating principle of the conventional magnetic reluctance motor is easy to understand. One stores energy in the magnetic field within the gaps between the rotor and stator poles. The poles come together by magnetic attraction. That magnetic field energy fed in as inductance is then converted into mechanical work imparting drive torque which delivers output power to a motor drive shaft. All one then has to do is to be sure that the magnetizing current is switched off when the poles come into register as the pole gaps are very nearly closed and then they can separate to step on to the next operating position without there being much magnetic drag arresting the motion. The energy fed in as inductance energy is deployed as mechanical output. There is no power gain, but there is some loss owing to magnetization (hysteresis and eddy-currents) and, unless superconductive windings are used, there is ohmic heating loss attributable to the currents in the magnetizing windings.

Now just reconsider this situation. Firstly one assures that there is energy stored in the magnetic field of the pole gaps. Then one converts virtually all of that energy into mechanical work. Finally one ensures that no further magnetic energy is fed into the pole gaps during their separation. There is no reference to a magnet in this sequence of events. So let us now introduce a magnet and regard the rotor poles as being those of a permanent magnet, with the stator poles being those of an electromagnet, the latter having a magnetizing winding.

Instead of supplying electric current to set up the magnetic field in the pole gap during the pole closure phase we let that field be that solely attributable to the permanent magnet. The magnet will pull the poles together and supply mechanical drive torque which spin the motor. The electromagnet will be excited during pole separation so as to set up a magnetic field in opposition to that of the magnet, in effect neutralizing the field, or as some might say setting up poles of the same polarity so that they repel whereas there was attraction during the pole closure phase when a magnet pole attracted a non-magnetized soft-iron stator pole piece. Here the situation is that the magnet does the work first to drive the machine and then we do something by which we input power to reset the machine for a repeat cycle. If what we do requires less energy that was delivered by the magnet, then we have 'over-unity' operation.

Whatever we do in feeding that energy into the machine involves the process we call 'magnetic induction'. There has to be a back-EMF set up in the magnetizing winding when we supply current, if there has to be energy input. By our laws of physics there has to be what is termed a rate of change of magnetic flux linkage to set up that back EMF. The question at issue therefore is whether we can set up a current in the magnetizing winding which opposes the magnetic field in the pole gap but does not promote any change in the net magnetic flux linking that winding.

To reduce this to something quite simple, imagine you are sitting at a table in a room and you have a magnet in one hand and a piece of soft iron in the other hand. See Fig. 1.

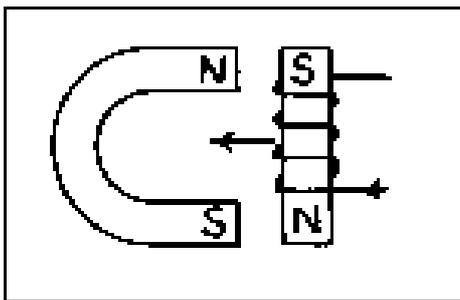


Figure 1

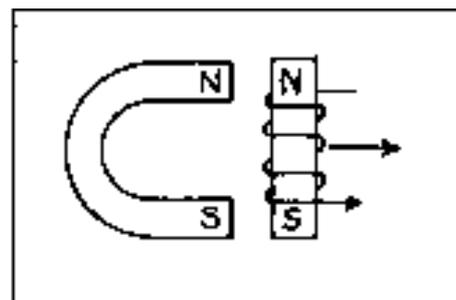


Figure 2

The word 'soft' in this connection merely means that the iron is of normal composition and not an alloy or special substance that is used for making permanent magnets. It means that it readily accepts change of magnetic state and readily loses its magnetic state given a demagnetizing field. A permanent magnet requires an extremely strong demagnetizing field before it suffers any permanent loss of magnetism and it recovers from any temporary reduction of strength promptly upon removal of the less-than-extremely-strong demagnetizing field. You can feel the pull of the magnet towards the soft iron. The two having come together, you try to pull them apart to find that it needs a lot of force. If you

apply current to magnetize the soft iron bridging yoke then, depending upon the current direction, the yoke will be pulled towards the magnet with even greater force (Fig. 1) or that force will be weakened or even reversed (Fig. 2). If you introduce alternating current (Fig. 3) then the force will oscillate and you can contemplate building a motor by fitting a flywheel, connecting rod and crank shaft.

Now there is nothing contrary to simple electrical engineering principles in this method of designing an electric motor. Indeed, for anyone interested in building model steam engines there could be a fascination in using the connecting rod, crank and flywheel arrangement to convert pulsating translational motion into a rotary form of motion. It so happens, however, that the usual design of an electric motor is more suited to producing rotary motion. It is based on the magnetic poles on a rotor and a stator moving owing to a sideways pull which exists even though the interacting rotor and stator pole faces are equidistant whilst altering their areas of overlap.

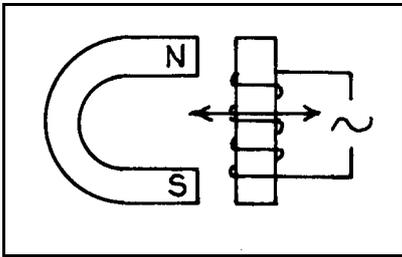


Figure 3

However, staying with our horseshoe magnet and reciprocating engine model, suppose now that, wrapped around the room, running around the perimeter walls, there is a magnetizing winding (or rather a demagnetizing winding) and someone switches a current on in that winding (Fig. 4). Its field acts on the magnet and the soft iron just as it would if the winding were closely wrapped around that soft iron bridging yoke. You would still find you can easily separate the two, thanks to that current in the winding, if it flows in the appropriate direction.

Now you do have a problem. You know enough about magnetism to accept that magnetic flux lines close around their paths in loops quite close to the magnetic source. The flux lines emerging from the magnet and the soft iron are therefore all virtually completely closed well within a metre or so from that table. However, that winding around the room is all embracing and hardly any flux escapes as a linking flux through that winding. There is negligible back EMF induced as it accepts the current which breaks the pull between the magnet and the soft iron. Therefore, one has a situation where power can be generated from the magnetic reluctance action as the poles come together but we input no inductive power to weaken that attraction and so allow the poles to separate to reset them for the next action cycle.

This is a recipe for 'over-unity' operation. We have drawn energy from the thermodynamic system of the quantum power state of the magnet and used it to serve a mechanical purpose and we find that no energy input is needed to reset the system for the next cycle of operation.

Now it is not realistic to suggest that windings should be placed around the whole room housing a motor but one can so design a motor that the magnetic flux circuit is closed within a solenoidal winding as if that solenoid does house virtually the whole motor. It is also

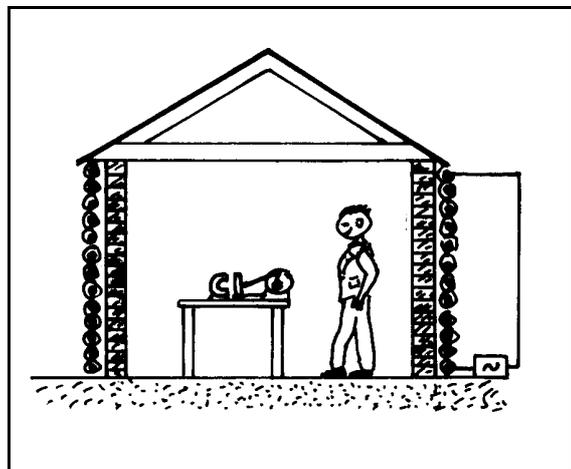


Figure 4

realistic to contemplate the use of superconductive windings to avoid loss of energy by normal joule heating produced by current flow. It is even realistic to build a small prototype machine which does not use superconductive windings and perform tests to verify the principles just outlined. That is described in Part II below. Furthermore, in Part III we will come to understand where that energy that is drawn into the machine to give it 'over-unity' performance enters the machine, though a full understanding of its underlying source, which is within the aether, is beyond our scope here in this Report. For that one needs to study this author's book 'Aether Science Papers' [This was listed as ref. 1996a in the Appended Bibliography that was included in the original version of this Report. That bibliography is not included here as it can be found on website [www.aspden.org](http://www.aspden.org) along with a copy of that book in PDF format.]

To summarize, given that one can design an electrical motor having a magnetizing winding which has no resistance loss and sets up no significant ferromagnetic inductive reaction when carrying an alternating current and given that the motor will run at a synchronous speed set by the pulsation rate of that current, we can design an 'over-unity' motor.

As already indicated the design of a multi-megawatt system will be presented first, before we come to the design of the small bench-type test machine which the author has devised. Of necessity, the latter form of machine has had to use magnetizing windings which are resistive and which do involve inductance, though these are minimized by astute design. However, since the real significance of this effort is the implication for large scale exploitation as power generators in the electrical supply industry, it is appropriate to present the multi-megawatt design next, the object being to arouse interest in government circles and in the electrical power supply industry.

This is done with deliberation, because there have been several claims by inventors asserting that they have 'over-unity' machines. Often the inventors lack the formal technical academic background of the heavy electrical engineering profession. If their machines work they get involved with prospective sponsors who want the secrets of the invention to be kept confidential until they have exploited the rights, but it needs the engineering talents of the established corporate motor manufacturer to develop the technology. The reason is one of scale. The larger the machine, the easier the task of overcoming the power loading involved in breaking through the 'over-unity' threshold.

A dynamo-electric machine rated at tens of megawatts needs to have dimensions for which the rotor diameter would be of the order of a metre and a length of two or three metres. Machines of this size are not built as a speculative experimental exercise. They should be, in this author's opinion, because the research funding is negligible when compared with the expenditure which governments waste on high energy particle accelerators and reactors aimed at hot fusion power generation.

The problem, of course, is that scientists think they know all there is to know about the way in which the dynamo-electric machine operates. They devote their research efforts to writing programs for computer-aided design and thereby underline the point that the basis of their formulations is sound and beyond any dispute.

About ten years ago I asked a university lecturer, who specialised in teaching electric machine design and was active in creating computer programs for that purpose, how he allowed for the 'eddy-current anomaly' in his calculations. His response to me was that he had never heard of the 'eddy-current anomaly'. I was surprised because I had spent three years of my life doing Ph.D. research on that very subject in the Department of Electrical Engineering at Cambridge University in England. I knew that the precise way

magnetic flux density  $B$  in iron varies with the magnetizing field  $H$  is not something one relies upon from electrical steel manufacturers' specifications. I will not bore the reader here by enlarging on that theme. If you are interested then do refer to Energy Science Report No. 3 in this series, but take my word here for the fact that the machine design I shall describe below would not be something that could perform in the manner predicted by use of those programs for computer-aided design. Ask yourself, "Could such a program offer commercially today really predict the 'over-unity' performance of an electrodynamic machine?"

You see, I know of two fundamental processes that are at work in such machines, either of which has 'over-unity' implications. One is the process that undermined by Ph.D. research effort. I found that the eddy-current induction losses in electrical sheet steels could be six times greater than theory predicted, albeit only over a limited portion of the  $B$ - $H$  hysteresis cycle. I attributed this to a loss mechanism as if there was a mystery time delay in the flux transitions accompanying change of magnetic state. I was not, in those Ph.D. research years (1950-1953), aware of the possibility of breaching the second law of thermodynamics. Otherwise I would have been writing about 'over-unity' machines and 'free energy' power sources in my early career, rather than now in my retirement. The mystery which underlies the 'eddy-current anomaly' is the regeneration of electrical power from heat wasted by ohmic resistance loss! That six-fold factor I measured, later to be surpassed by researchers who found that a factor of 10 was in evidence in some steels magnetized across the direction in which the steel had been rolled to form into sheets, tells me that there is thermodynamic regeneration of power on a mammoth scale. It exceeds by far any level set by the Carnot criteria and I see in that the basis of a new technology. That may explain why I deem Energy Science Report No. 3 to be very important.

Now, in the design of the multi-megawatt machine under discussion here, I need to keep that 'eddy-current anomaly' in mind, while aiming to tap energy from that quantum world which powers the ferromagnet. The energy source is thermodynamic, but whereas the 'eddy-current anomaly' draws on normal heat energy generated in the steel by resistance loss, the quantum activity taps entropy of the underlying vacuum medium, or aether, which is where the quantum (Planck's constant) is determined.

Moving on, I stress that those who will be consulted in the evaluation of what I say here will not find they can use their computer-aided design techniques to verify in advance whether or not my machine will work to deliver 'over-unity' performance. They need to understand rather more about 'magnetic flux leakage' than they do at present, before they can even adapt those programs to face this new task. Furthermore, they need first to understand inductance and the 'half-field reaction' phenomenon that I describe in Part III of this Report. The only way forward is to bite the bullet and spend the money needed to build the test prototype machine I now describe. They can by all means debate the pros and cons of my proposal, but they will not be able to deny the validity of my overall conclusion, because of what I say above by reference to Fig. 4 and what I shall describe below in Part II.

Fig. 5 shows the sectional side elevation of the machine and Fig. 6 shows the sectional end view from the position indicated by the outer arrow markings. The machine comprises a solid steel rotor having a laminated set of toothed electrical steel stampings at each end. The teeth on these stampings form rotor poles which interact with the six stator pole members. These have the form of laminated electrical steel stampings

assembled in a stator support frame (not shown) and forming bridging yokes. The structure is comparable functionally with the simple arrangement depicted in Fig. 3.

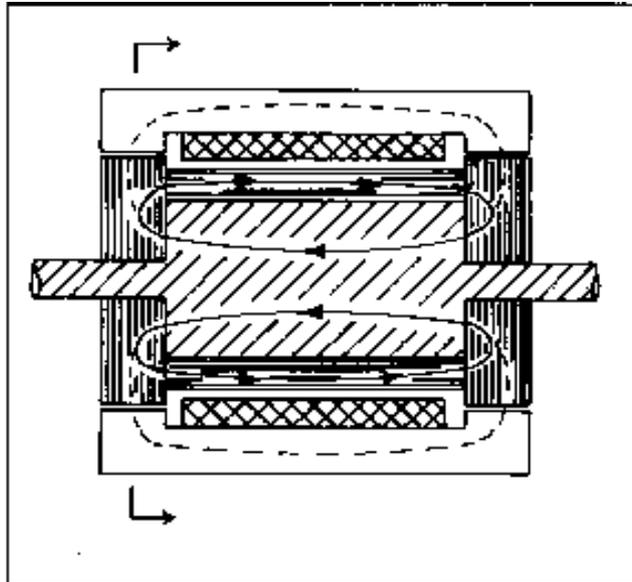


Figure 5

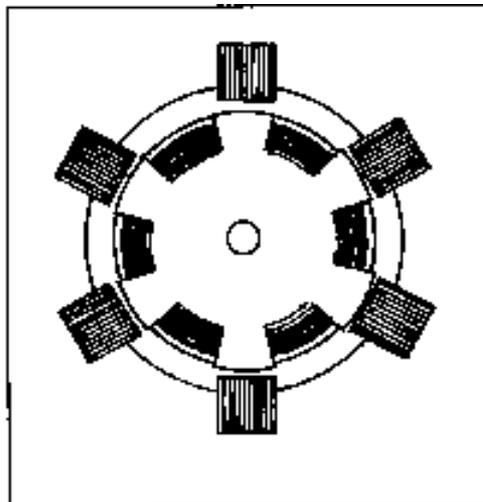


Figure 6

However, there is a fundamental difference in the way in which the magnetizing winding is incorporated. The main magnetizing winding is solenoidal and shown as the cross-shaded stator-mounted structure in Fig. 5. It is superconductive. There is, however, an additional magnetizing winding (not shown in Figs. 5 and 6) that is positioned in slots around the perimeter of the solid steel rotor. See Fig. 7 for an outline of constructional

detail. This winding is a normal copper winding connected between slip rings mounted on the rotor spigots.

Between adjacent pole teeth on the rotor laminations there are blocks of electrical steel laminations interfacing with the sides faces of the teeth to guide magnetic flux from the pole teeth around a closed circuit shown by the three arrow markings on the full line curves in Fig. 5. The path is through a spiral wrapping of laminated electrical sheet steel

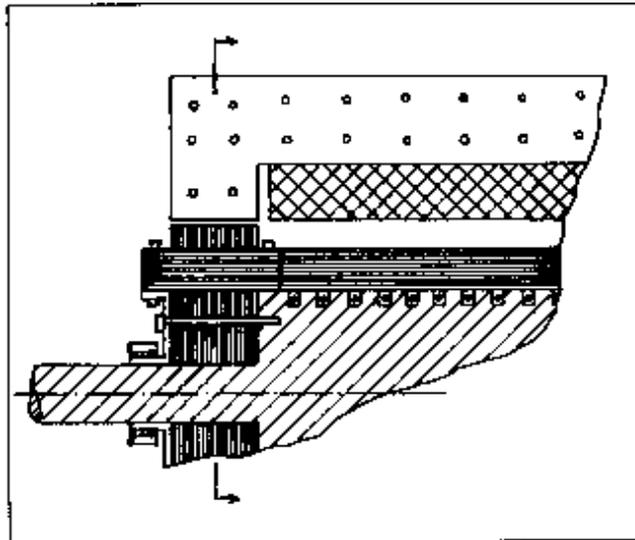


Figure 7

providing infill between the inter-teeth blocks. As can then be seen there is a closed flux path through the body of the rotor and this spiral wrapping, so that very little magnetizing current in the rotor winding can produce a flux density near to magnetic saturation around that rotor circuit. For design purposes one can assume a magnetic permeability of several thousand so that 15,000 gauss can be developed by a few ampere-turns per cm. length of the rotor.

Very little power is therefore expended in introducing the priming magnetic condition of the rotor. So far as induction is concerned, note that the rotor body comprises solid steel. Once the magnetic flux is set up in it the rapid fluctuations of any externally-applied field will have no effect on the rotor body. Eddy-current screening will confine related flux changes to a very small penetration depth and losses arising from that at the surface of the rotor body will be negligible. However, in resisting inductive flux change through the body of the rotor, the flux has to remain constant and that means that, external to the core body of the rotor, it must find a through path regardless of the varying position of the poles of the machine.

The task in operating the machine is, therefore, that of ensuring that the magnetic flux from the solid body of the rotor either finds its way back through the spiral laminar steel wrapping on the rotor or diverts through the outer perimeter faces of the rotor poles and finds its closure path through the bridging yokes of the stator. The latter route is indicated by the broken line curves shown in Fig. 5.

With no current in the superconductive winding the paths of least reluctance are those shown by the full line curves. The 15,000 gauss flux density of the core body will,

by appropriate design in determining the ratio of the cross-sectional areas of the solid and laminar portions of the rotor, be such that 8,000 gauss, say, applies in the right-hand direction within the laminated portion. However, when current flows in the superconductive winding in a sense that reverses this flux direction, the design requirement is that the combined effect should produce a 20,000 gauss flux density in the stator bridging yoke members.

The plan is to operate the machine by feeding current pulses into the solenoidal winding to divert the rotor core flux across the pole gaps as the rotor and stator poles come into register and have no current in that winding as the poles separate. What is so special about this machine design is the fact that we have built into the machine a basic polarization bias which allows us to use a solid-bodied rotor construction, needed for strength in withstanding rotation at, say, 3,600 rpm and have located a single solenoidal stator winding in a structure that is easy to cool to assure the superconductive condition.

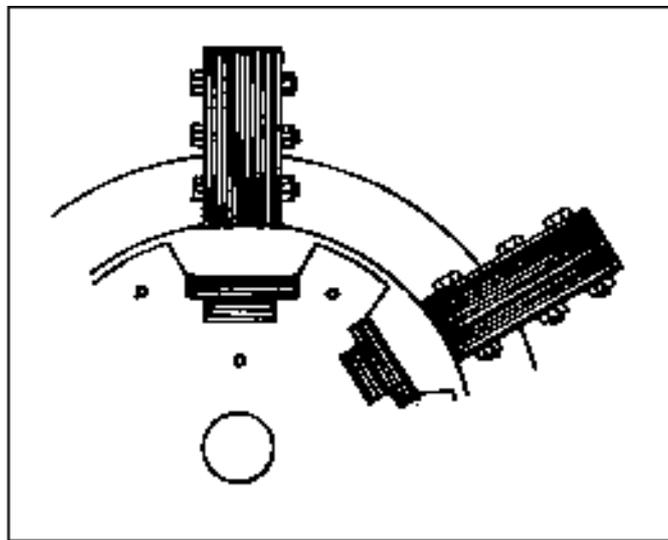


Figure 8

It is special also because we have a ferromagnetic core subjected to pulsating magnetic flux conditions by a unidirectional current pulse fed to that superconductive winding. Note further that the flux density range of change in the spiral laminar wrapping around the rotor is between, say,  $\pm 8,000$  gauss, which is very moderate in electrical machine design terms, whereas the flux density range of change in the bridging yoke members of the stator is between, say 5,000 and 20,000 gauss in the same direction.

The thickness of the latter members can, as one sees from Fig. 8, be made such that this 20,000 gauss level of flux density is assured, given that the 15,000 gauss of the solid rotor core portion will be sustained by induced reaction currents if the current excitation of the superconductive winding is not perfectly matched to the load conditions. Also, in the design of this machine an important factor is the retentivity or residual magnetism trapped in the stator bridging yoke members. This residual magnetism makes it easier for the basic level of stator flux density to be maintained at 5,000 gauss.

Now, although we have, by reference to Figs. 1 to 4, seen that it is possible to operate a motor with 'over-unity' performance, we have not explained how the energy is

drawn in from the aether to balance that gain. As we shall see presently from Part III of this Report, we need to activate a magnetic core over a range of magnetization where the ferromagnetic domains in the steel begin to turn owing to the action of a magnetic field, as distinct from flipping spontaneously by trigger action involving a weak magnetic field. The latter is what happens at low flux density.

Fortunately, from the viewpoint of our machine design, that 'flipping' of flux direction is avoided in the solid portion of the rotor and is very much reduced in the stator owing to the magnetization cycle being centred on a flux density of 12,500 gauss. Hysteresis loss which is associated with those spontaneous flips of the magnetism in the domains within the steel is very much reduced under these conditions. So far as the hysteresis loss in the spiral wrapped laminated portion of the rotor is concerned the 8,000 gauss range limit keeps that loss below normal levels prevalent in transformers and dynamoelectric machines. It follows that the primary loss would be the ohmic resistance loss in the main winding, but we have avoided that by using the superconductor in its construction. Note, further, that the strong magnetic flux densities we see in the steel are not required to penetrate the superconductor material and that the use of a 'warm superconductor' substance is likely to prove commercially viable as the machine design suggested here is implemented.

It will be apparent to experts in electric motor design who may come to read this Report that the machine depicted in Figs. 5 to 8 does not exploit the feature by which inductance of the magnetizing winding is reduced. Yet it does, in a sense and indirectly. The superconducting winding has to reverse the magnetic flux in the spiral laminar portion of the rotor. This means that we must supply energy as input to match that stored by inductance in the pole gaps of the machine. We intend to use that energy priming condition to develop machine drive torque but, owing to the bias polarization, we intend to draw in some extra energy into that gap, as will be explained in Part III. This augments the drive torque. Now, if we were to wait until the machine had used its magnetic drive fully as its poles reach their in-register condition, before we switch the current off, we would not get much of that input energy back. However, if the machine is operating under 'over-unity' conditions, we can target a moment to reduce that current so as to get substantially the whole of that input energy returned from the inductance. In effect, therefore, though we have to contend with the back EMF attributable to inductance, we have in sight the design criteria for a machine which possibly might have the merits of the notional motor arrangement shown in Fig. 4.

It will be easier to understand the technical points involved in this proposition if some of the design details for operation of the multi-megawatt machine are deferred until Part IV of this Report. This is because the analysis in Part III will provide a foundation for understanding the way in which the machine functions to tap aether energy and because there will be some reference to patents bearing upon the subject and these patents warrant inspection for their commercial significance. Accordingly, attention is now turned to the bench-type motor which implements the principle introduced in the above discussion of Figs. 1 to 4.

## PART II: The ASPDEN Motor

The ASPDEN motor is based on an evolving design principle which encompasses several technical features implicit in the name just given. Although ASPDEN is this author's surname, it can serve as an acronym for:

Asymmetric Shaded-Pole Dynamo-Electric Negentropy machine.

The expression 'negentropy' signifies 'over-unity' operation, because the usual expectation in energy science is that entropy, which is a notional quantity representing an amount of heat  $Q$  as degraded by temperature  $T$ , or  $Q/T$ , always increases. The term 'negative entropy' or 'negentropy' implies the reversal of this process and signifies a regenerative action.

The 'asymmetric property' is a subject discussed in Energy Science Report No. 7. It is introduced by tilting the laminar assemblies constituting the stator poles, the object being to cause the machine to operate more efficiently when rotating in a specific direction. The orthogonal relative disposition of the laminar planes as between the stator and rotor poles accounts for the 'shaded-pole' aspect, but this is not strictly a shaded-pole design in the normal sense. The reason is that the 'shaded-pole' feature aims to preclude magnetic flux from leaving the poles in a direction that retards the drive, whereas the conventional 'shaded-pole' design relies on magnetic flux penetration and that generates unwanted inductive heating. The current giving that heat shifts the phase of the emergent flux and creates the drive. The latter is an inefficient process. The former can be quite effective in supplementing the efficiency of the machine.

From what has been said by reference to Figs. 1 to 4 it will be understood that the machine must have a single solenoidal winding mounted externally with respect to the whole operating magnetic circuit, so that it is not restricted in dimensions to the small aperture space that allows it to fit onto individual pole pieces. Furthermore, we want the winding to be so positioned on the machine that it acts only indirectly on the pole gap and lets the magnet system do the work of feeding energy to that pole gap region.

Contrary to the design shown in Fig. 5, we will set the solenoidal magnetizing winding so that when it is powered to oppose flux in the pole gaps it assists the magnetism of the magnet. Alternatively, when it is powered to assist the flux in the pole gaps, it opposes the magnetism of the magnets. This poses no problem, however, because the magnets are virtually immune from the effects of fields of the strength needed to run the motor. By putting the magnets into the rotor assembly, it is the soft iron bridging yokes forming the stator that 'see' the power of the field we apply to that magnetizing solenoid. The magnets set up the basic polarization which develops demagnetizing effects in those bridging yokes, making it an easy task then for the magnetizing (or rather demagnetizing) current to reduce the magnetic flux across the poles gaps as they separate. However, running in the alternative mode with current assisting the pole gap magnetization, the effective permeability of the iron in the bridging yokes is still of the order of 100, whereas the effective permeability of the magnets in the rotor is close to unity. It is feasible, therefore, to run a motor by using a single magnetizing winding wrapped around the whole body of the machine so as to surround virtual all of its internal flux path.

Inevitably, of course, since we are not talking about the notional embodiment shown in Fig. 4, we will have some flux leakage that escapes from the winding. Also, there will be a reduction of magnetic flux through the magnet as the poles separate. This will not involve significant eddy-current losses if the magnet is of a composition that is non-

conductive, such as a ferrite. It would be a problem if one uses an alloy such as Alnico as a magnet. At least, it is feasible to build and test a small motor that operates by using a single solenoidal magnetizing winding in the manner just described.

Fig. 9 illustrates the second test machine built by the author. It dates from April 1995.

It uses loudspeaker-type barium ferrite magnets of 60 cm outside diameter, 24 mm internal diameter and 8mm thickness. The rotor laminations of 90 mm external radius have 8 poles and an internal diameter of 19 mm permitting a tight fit on a slightly reduced 3/4 inch diameter brass spindle. There are 8 bridging yokes which comprise small rectangular transformer laminations of 3 inch by 1/2 inch dimensions.

The machine was fitted with a d.c. drive motor that could serve equally as a generator and was intended to bring the machine up to speed before current was applied to the test machine. The decision to use 8 poles proved to be a problem, because it was not feasible, given the author's circumstances, to assemble a suitable commutator and the author opted to control the machine electronically.

Note that, to operate with the current assisting the drive as the poles close, one can expect the machine to be self-synchronizing with the pulsed input. However, in the

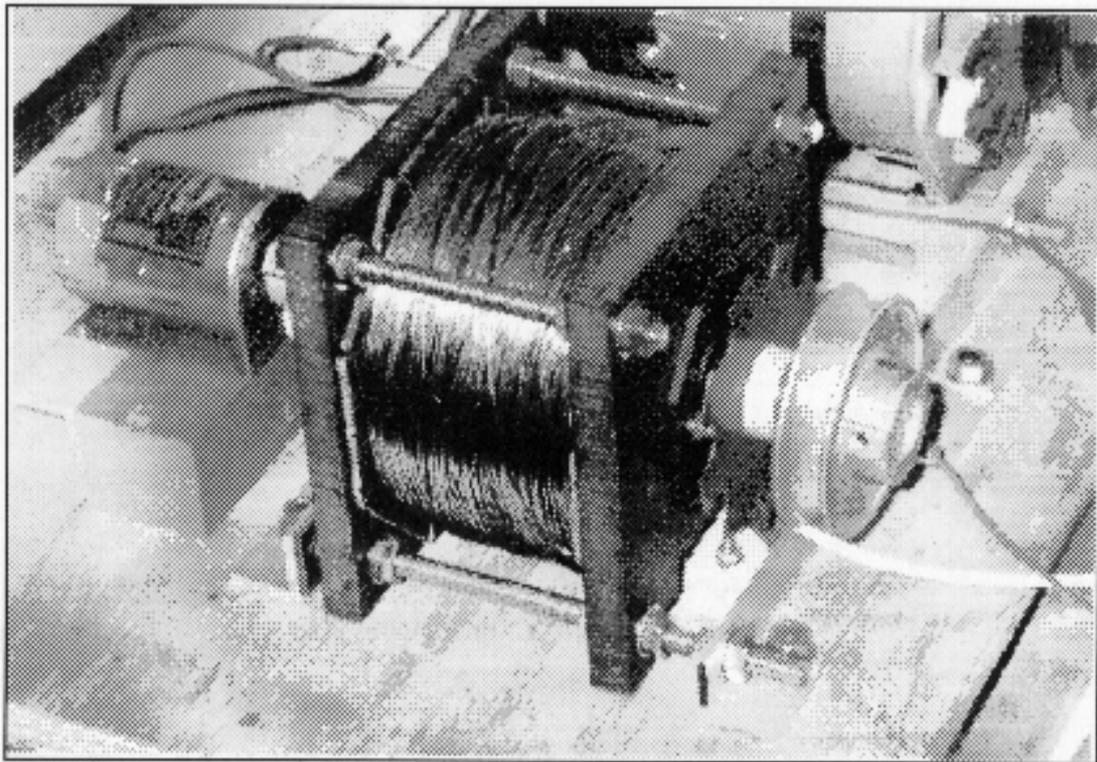


Figure 9

opposition mode, unless the pulses have to be correctly timed according to the position of the motor shaft, otherwise it will lose synchronism.

To the extent that these problems could be overcome, the plan then was to apply power to the test machine and relieve the load on the drive motor gradually to see whether the energy input to the test machine was less the energy saving in feeding the drive motor.

In short, the question was whether any drive at all could be provided by that single external magnetizing winding, because it was quite unorthodox to configure a motor so that the only winding did not link the magnetic circuit traversing the pole gap. Instead, the motor shown in Fig. 9 was designed with a magnetizing winding that was linked only by stray leakage flux and there could be no doubt owing to its outer position on the perimeter of the stator bridging yokes that most of the flux diverted from the pole gaps had still to find its return passage confined within the magnetizing winding.

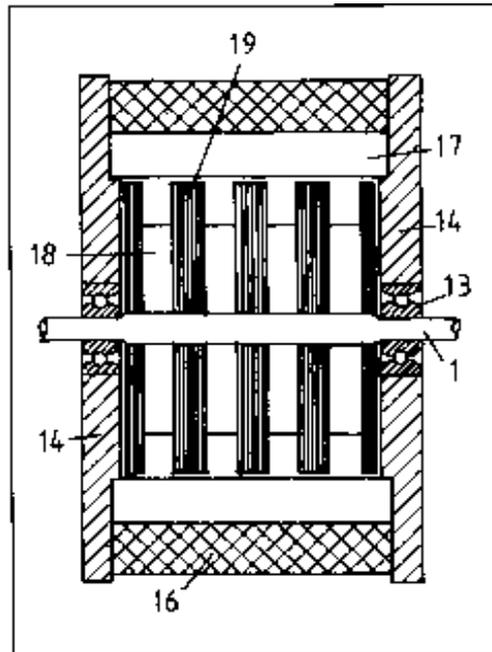


Figure 10

Note further that the essential issue of concern was, not the amount of loss caused in the winding owing to  $I^2R$  heating effects, but whether the energy lost as inductive power input to drive the machine was less than the mechanical energy gained. Keep in mind that, whether working in the supporting drive mode or the opposing drive mode, the object is to draw more mechanical power from the closure of the pole gaps than is supplied as irretrievable inductive power input, either to augment the gap flux during pole closure or to weaken the gap flux during pole separation.

One troublesome question faced by the author during these tests of the opposed mode excitation was that of being sure that the current applied did not exceed that needed to suppress the pole gap flux, because if it was too large it could simply divert the flux from the magnet into the ends of the bridging yokes and so through an external leakage closure path. The leakage had, so far as possible, to be from the sides of the rotor poles and confined close to the rotor core. That is why the design of the machine was as illustrated by the sectional drawing shown in Fig. 10.

Note that in Fig. 10 and Fig. 11, which shows more detail, there are numerals which are used because these illustrations are copied from one of the author's pending U.K. Patent Applications.

The assembly comprises a spindle 1 mounted in bearings 13 in end frame members 14. The latter have shoulders which located stator bridging yokes 17 around which there is a helically wound coil or solenoid 16. Mounted on the spindle is an interleaved assembly of ring magnets 18 and electrical steel rotor laminations 19, the latter having 8 poles uniformly spaced around the perimeter. The angular spacing between the pole teeth is the same as the pole width. The current pulses fed to the winding 16 are assumed in this case to produce a field  $H$  acting to oppose the tendency of the magnetic flux developed in the magnets from producing a full measure of magnetic flux through the stator yokes 17. When no current pulse is present then the magnets can promote magnetic attraction between the poles on rotor laminations 19 and the stator yokes 17. Otherwise, when current

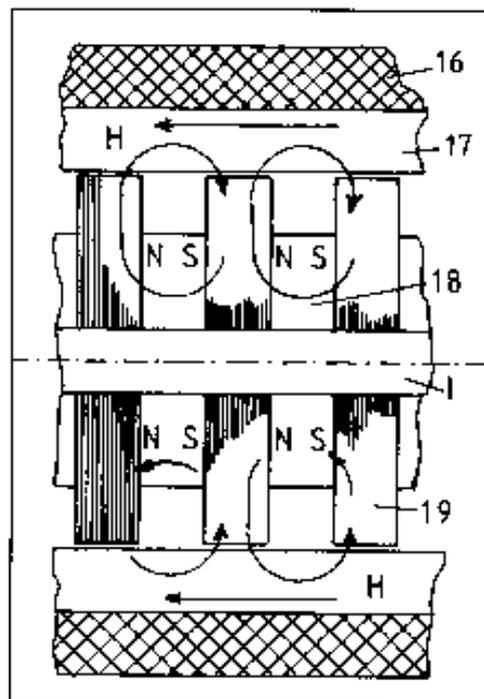


Figure 11

is present, that attraction is weakened. As a result, by pulsing the winding 16 at the right timing, the motor will develop a drive torque. Now, although it is not easy to see from these figures, at times when the current is on and blocking some passage of magnetic flux through the stator, there is a diversionary route for flux closure from the magnet. The inner side faces of the rotor pole teeth allow leakage of magnetic flux lines across the axial gap between adjacent sets of rotor laminations. This is an easier flux leakage route than passage from the ends of the machine and around a path external to the winding 16. What happens is that the intensity of the flux through the magnet diminishes somewhat during the current pulse periods and, of course, at times when the rotor and stator poles are out of register with one another. The magnets, being of ferrite composition, offer negligible eddy-current reaction to such flux change. However, in penetrating across the faces of the rotor laminations the flux from the magnet does encounter such a reaction because currents are induced in those laminations. This has the effect of tending to keep the flux passing

through a magnet and reaching the rotor teeth at a constant level. This enforces the flux switching between the leakage paths and the stator and means that the flux across the radial pole gaps varies as the rotor turns in step with the current pulses.

The essential question one confronts is that of knowing how effective the current can be in driving magnetic flux from the stator. The answer to this is best found by experiment and the evidence of operation of the machine.

It is found that the pulsing of that helical winding wrapped around the whole stator assembly will, in fact, impart drive torque to the machine. This means that we can contemplate making the machine larger in size and making the helical winding so large in cross-section that its  $I^2R$  loss is very small. Furthermore, if we examine the efficiency of the machine, measured with that  $I^2R$  loss discounted, we should find that it exceeds unity or 100%, if our assumptions are correct and much of the flux switching occurs within the confines of the winding, with little flux escaping from the ends.

The following data is an extract from what was reported in the first report on this subject submitted to the DTI, the U.K. Department of Industry in July 1995. The full text of that first report is provided in Energy Science Report No. 7 of this series. As there acknowledged, the DTI have funded the initial stage of this research project as part of their SMART Award system for technological innovation.

"The first test on the machine was a test using half-wave rectified 50 Hz a.c. This meant running the machine at low speed (375 rpm), not enough to test the shaded-pole feature, which was the dominant interest owing to the funding arrangements. These tests were, therefore, of a cursory nature just to see if half-wave current pulses did affect the machine in the manner expected, but more particularly to get a measure of the induced back-EMF and so the level of flux activity across the pole gaps and to see how the pulse input relieved load on the drive motor."

"It proved extremely difficult to get the adjustments of the controls just right with the motor running at 375 rpm for the expected synchronization to establish itself. Then, and only then, was it possible to reduce slowly, stage by stage, the current input to the d.c. drive motor whilst holding that 375 rpm speed. In spite of this, several such tests were performed and the a.c. magnetizing current and voltage were measured as the power input to the d.c. motor progressively reduced."

"Each such test proved very satisfying, because the saving in d.c. power input to the drive motor far outweighed the a.c. input as measured in VA (volt-amps), without regard to power factor. Effort was made to run the system with the test machine driving the d.c. motor as a generator, but with this test arrangement the system lost the 50Hz synchronism once the d.c. input current had reduced to about one third of its original value."

"The problem here arose because the d.c. power supply used was a stabilized voltage supply and it could not drop below 4.5 volts, which is why a load resistor had been put in series with the motor. Although some time was spent in effort to overcome this, the author was more anxious to develop a control system for running the machine at much higher speed and so these 50Hz tests were abandoned."

"One important aspect of the test was, however, the monitoring of the current waveform as supplied to one test machine winding in relation to the voltage waveform induced in the unloaded magnetically-coupled and near-identical second winding." (Note that the winding seen in Fig. 9 is really a two-part winding, each section having 200 turns.) This gave some versatility for testing and operation, even though both windings are

wrapped around the same core system. "Together these waveforms gave an insight into the inductive power fed in and returned from the machine over the cyclic period of pole closure and separation."

"It was then very evident that the power factor governing the a.c. power input was such as to indicate a quite significant excess power, even assuming that the d.c. drive motor was only 50% efficient. Ostensibly, it seemed that the test machine had to be operating above 100% efficiency by drawing on thermal heat input."

"The most important observation, however, apart from finding that a pulse amplitude of about 0.8 amps in the single test winding was needed in the test, was that very nearly all of the inductive power input to the machine was being returned by the a.c. circuit. The volt-amp product reversed polarity as the half-wave current decreased. It could do this because the rectifier diode used could sustain current flow by the winding generating a forward EMF."

"Now here was a feature that was important. With the machine driven by the permanent magnet system the inductive power fed in to secure flux switching was not all used in adding power to the machine drive and even in these 50Hz tests, where current was reducing as flux collapsed, most was, it seems recoverable. This had been anticipated, or at least hoped for, in developing the machine design because the relative configuration of the source magnets and the stator pole pieces, but it was gratifying to see this confirmation."

"This then became a reason for examining the prospect of building or procuring an a.c. power source that could operate efficiently at 250-400 Hz to power an inductive load regeneratively through a diode. The attendant problem was also that of assuring sufficient frequency stability to be compliant with the synchronous operation of a motor not receiving its power drive as such from that supply."

"This pursuit tended to run away with the time available for the project, with partially successful results using the same test machine. Eventually, to move the project forward, the author decided to use a simple electronic power drive where one machine winding signalled the control timing needed to put power on the other winding. A pnp power transistor was connected so as to deliver its collector-base current to one winding in its ON-state, and inhibited so as to be in the OFF-state when the other winding delivered a positive polarity signal to the base."

"With such a control system the test results of this Report" (i.e. Report No. 7) "were obtained, but any inductive power returned from the machine winding is necessarily dissipated and detracts from the possible efficiency of the machine. This is because the forward EMF set up by that return of energy causes an unwanted current spike at the end of the cycle. There was the problem with the system under such test that it could very easily be set with its magnetic pole gap flux wasting power in oscillations. Had a capacitor been incorporated without informed design based on test performance then that too could have aided oscillation, rather than helping to suppress such effects whilst storing energy for use in the next machine cycle."

The above excerpts from Energy Science Report No. 7 will show the reader that one cannot just build a motor such as that illustrated in Fig. 9 and expect it to deliver 'over-unity' power on demand. It is essential that one understands how the design features are supposed to function. What was soon evident was the fact that the magnetic flux density across the pole gap was far below the level where 'over-unity' operation can really

reveal itself in a dominant way. However, the machine was a prototype that could be scaled up to achieve that result and the tests that could be performed could verify design feasibility.

The fact that the machine could be operated by the control of that external winding was the proof this author needed to see purpose in advancing the project.

As can be seen from Fig. 9, a d.c. motor is coupled to the main test machine, the latter having the all-enveloping helical winding by which it is powered. The 50Hz tests reported above as well as the electronically pulsed tests reported below were done at an early stage. It is only recently that the author has reverted to this early machine version and fitted the vane switch that can be seen behind the pulley. That vane switch comprised a single 8-pole electrical steel rotor lamination as used in the internal construction of the rotor. Its teeth swept through a gap in a sensor device including a small magnet and a Hall effect switch. The latter was used in onward testing to control the commutation. However, it was not fitted at the time the following test data were obtained.

These data were produced with only half of the test machine winding carrying drive current, the other half being used to provide the induced EMF controlling the electronic switching. One can, therefore, see that the  $I^2R$  losses in the winding can be halved by using both windings for drive power and using either the vane switch, a commutator, or fitting a winding of a fine gauge wire to produce the induced signal for electronic control. Further, one can have more turns or use much thicker gauge wire for the main winding. Essentially, the  $I^2R$  loss can be reduced to a very small value, the more so if the motor is scaled up in physical size. This is because the loss increases as the square of the linear dimension of the machine, whereas the drive power increases as the cube.

The objective is to see if the machine derives any drive at all from the current pulsing of the single helical winding and to get some measure of power gain.

Keeping speeds low, but well in excess of the 375 rpm used in the 50Hz tests, the whole machine combination was run, first at 800 rpm and then at 1350 rpm, just powered by the d.c. drive motor. This means that the test machine was simply a load, as the magnetism fluctuating across the pole gaps would involve some parasitic losses. There would be hysteresis loss and eddy-current loss and the retentive property of the stator bridging yokes would apply a stronger drag acting as a brake during pole separation than was gained as a forward drive during pole closure.

For these speeds the electrical power input was 3.331 watts and 5.255 watts, respectively. Note that the d.c. motor developed a high torque and was rated at 68 watts at a speed of 5100 rpm and a 12 volt input at that speed. It was of a kind used to power model boats. It included permanent magnets and tests indicated that its efficiency was about 50% over its main working range. It could be run in reverse to generate electrical power with much the same efficiency. Indeed, two such machines, coupled back-to-back, were tested to see how much d.c. power input to the drive machine could be recovered from the generating machine and overall the efficiency was between 25% and 30%.

Keeping the d.c. motor drive power on, the circuit feeding pulses to the winding of the test machine was then activated and the power supplied to the d.c. motor adjusted so that the whole machine combination ran at 1350 rpm, as before. The d.c. motor was then taking a power input of 2.618 watts, less than half the power needed to reach that speed without the test machine excited. Of course, there was electrical power input directly to the test machine, but that power was going into the helical winding you see in Fig. 9.

Clearly, the machine could be driven by such a winding, even though it was not linked by magnetic coupling to a flux path through the pole gaps!

Now, these tests were run at low voltage and the transistor circuit was very poorly designed for the purpose, but the oscilloscope waveforms could be analyzed and it was possible to segregate the power fed to the test machine to get a measure of the true power input, ignoring transistor losses. The latter can be reduced to very small proportions by using MOSFET technology. From this analysis the power supplied to the test machine for the 1350 rpm speed was 1.718 watts, of which 1.100 watts was VR loss in that helical winding.

If the latter  $I^2R$  loss is discounted, because it can be reduced to negligible proportions with appropriate design, and we look solely at the magnetic activity of the drive, we find that the added 0.618 watts plus the d.c. motor input of 2.618 watts is doing the work which needed 5.255 watts using the d.c. motor on its own. It took 3.331 watts to run the system at 800 rpm before the test machine was excited, but, once excited by magnetic power input of 0.618 watts to the test machine, the 3.331 watts input reduced to 2.618 watts and the whole system increased in speed to 1350 rpm. Ostensibly, to the extent that we can virtually eliminate much of that VR loss in the helical winding, we have a reduced power input of 0.095 watts and the machine runs 69% faster.

Now, even if the test machine were 100% efficient and the d.c. motor were 50% efficient, this could not account for this reduction in power, and so one simply must conclude that there is evidence of 'over-unity' performance.

Although I could, at this point, begin to describe my onward research efforts and other machines that I have assembled, I intend to confine this Report to the basic issue of establishing a scientific basis for the design of an 'over-unity' machine. There are really only two questions to answer when it comes to assessing the prospect of such technology impacting our future. These are: (a) can one build a machine of such large power that we can use it for generating electricity supplied by a utility distribution network and (b) can one explain the design principles in sufficient detail for scientists to understand the true source of power?

I see little point in just building a bench-top machine which runs to illuminate a few light bulbs as if with no input power source, because others who have done that are deemed to be performing tricks and are not heeded by the scientific establishment. As I see it, it should suffice to present the outline of a motor design such as is introduced in this Report No. 9 and as described in Energy Science Report No. 7 and let those interested ponder on my explanation of the scientific principles that I explain. If they can then see the light then, and only then, will they see purpose in building their own machines, guided by what is here disclosed. As with any technological development there is much to learn in the know how of the design and I do not see myself as a one-man R&D operation competing with major industrial power engineering interests. Nor is it my role to educate those expert in that field of endeavour. I will, however, disclose the secrets of that energy world which I have deciphered from my studies, founded as they are on early academic and industrial training in heavy electrical engineering and research in ferromagnetism, and I look only for recognition for my scientific endeavour. This is why I have interrupted my motor research and given priority during 1996 to producing my book 'Aether Science Papers' [1996a].

Accordingly, for those having the necessary skill and background experience in understanding magnetism and electrical theory, especially those versed in power engineering, I will now move on to Part III of this Report.

### PART III: The Energy of a Magnetic Circuit

The academic understanding of the way in which energy is deployed within a magnetic core in which there is a small air gap was a mystery some 50 years ago and has remained a unsolved mystery, now ignored by professors of electrical engineering. Professors of physics teach the science of magnetism but are seemingly unaware of the problem. Indeed, by adopting a particular interpretation of a physical phenomenon of no practical importance they have, in effect, blocked the way forward to solving that mystery and in so doing they have not seen the scope for generating power thermodynamically from the aether itself. The mystery is rooted in the phenomenon discovered by Michael Faraday, namely electromagnetic induction.

It is an experimental fact that a closed magnetic circuit formed by a ferromagnetic ring core wrapped within a magnetizing winding will develop a very powerful state of magnetic polarization around the core even when a quite small current is supplied to the winding. However, if you so much as slice a gap in the core no greater than two thousandth of its overall length, then that polarization will immediately lose of the order of 5% of its strength. Make the gap four thousandths of the core length and you lose 10%. Professors will tell you that this is caused by 'magnetic leakage'. The core section may have a width of one hundred times that of the gap but those professors will still say that 5% of the overall magnetism in the ring core is 'leaking' from the gap and presumably finding a route through air that is far longer than that through the air in the gap.

Now, I say that is simply 'rubbish' and I can also say that I have yet to see any textbook present a verified theory of magnetic leakage that explains the phenomenon in a formal scientific way. The nearest one can get to that, so far as I know, is the Oxford Clarendon Press textbook published in their Oxford Engineering Series in 1955 under the title 'The Principles of Electromagnetism'. Its author was Professor E. B. Moullin, who was President of the Institution of Electrical Engineers in U.K. when I began my first year of research in the Department of Electrical Engineering which he headed at Cambridge (1950). That is nearly half a century ago. You will find that 5% factor, just mentioned, on page 174 of that work and you may take note of his final sentence on that page:

"The writer is not able to forecast any relation between the leakage inductance and the size of the magnet".

However he did find it possible to match up theory and experiment in the case where the gap was made extremely large by completely removing the bridging yoke in his experiment. the calculated leakage inductance did agree with the measured inductance in that case, but there was something amiss in the concept of leakage when the gap width was small and of the order of a few millimetres.

Professor Moullin presented experimental data of tests he had performed on a core which was about one metre in overall circuit length and which had a square cross-sectional area of 8 cm by 8 cm. Although he saw the experimental data as representing 'leakage' this author sees something far more important in that data. There was more energy in the gap than had been supplied by the magnetizing current!

This was only noticed many years after Moullin's book was published, but it then caused the author to repeat the experiment and confirm that the flux was not leaking to the extent suggested. This was reported Energy Science Report No. 1 in this series, where it

was suggested that we might be able to build 'over-unity' motors, guided by that new knowledge.

I wish here, however, to enlarge on the academic theme involved in this question of the core with a small air gap. There are other mystery questions involved in this subject. Firstly, how can it be that a coil uniformly wound over a one metre length of core can somehow shed energy confined to a one millimetre length where the air gap is located? You may say that the magnetic core accepts that energy and transfers it to the air gap but, again, apart from doing an accounting fiddle and making the energy books balance, how does energy travel through that magnetic core? We are not dealing with water in a porous conduit having an empty cavity at one position along its length, though some professors may be satisfied with that type of analogy.

No, the answer to this question is something rather startling that will surprise any professor! In fact, what happens when we put electric current through that winding is that it produces a magnetic field around the whole core and in the onset of that field there is electromagnetic induction by which energy is fed uniformly into the whole reacting system, whether the latter is the substance of the core, mere air or even just the vacuum. I am saying also that all that energy input is lost as heat with no time delay since it is fed directly into charge in motion over which we have no control. That moving charge can be in the form of free conduction electrons in a metal or electrons belonging to atomic structure in, for example, a ferrite or be the charges that sustain Maxwell's displacement currents in the vacuum field. The energy is lost as surely as if it were shed in a microwave oven by eddy-current heating. It adds to the entropy of the environment.

The secondary effect of that magnetic field acting all the way around the ring core is to assert forces on the electric charges that are moving freely as part of that world of entropy, whether in the air gap or elsewhere around the core inside that winding. No energy transfer is involved in this steady-state condition because the forces act at right angles to charge motion. However, by Lenz's law which requires an opposing reaction or by reference to the derivation of what is known as the Larmor formula, there is deflection of charge motion into helical paths orientated to set up a reaction field.

The existence of this field even in metals is never mentioned in physics textbooks. On the contrary, the nearest one gets to this is the occasional reference to what is known as 'the absence of free electron diamagnetism'. Physicists who studied this problem early in the 20th century were at pains to eliminate it from their thoughts by inventing statistical reasons, such as spins being paired in opposite directions and so cancelling, their objective being to avoid the embarrassing question of why a steady magnetic field could penetrate copper when, in theory, it should be completely suppressed by diamagnetic reaction.

I found those arguments unconvincing and decided that we had to face up to this question and accept that Nature did react to set up a strong opposing field. I went a little further in my interpretation of the reaction and added the rider that Nature would limit its response to the extent that allowed potential energy to transfer into the magnetic energy of the reacting field. You see, my argument is that forces acting on charge in motion are not set up by a magnetic field just because some scientist or other enunciated a form of law. Forces exist only as part of the energy transfer process and are governed by what happens to energy, the latter being subject to that natural 'law of conservation of energy'.

Simple analysis told me that the maximum transfer of energy into the reacting field occurred when the reaction halved the strength of the applied field. It further told me that the kinetic energy density deployed from the random motion of that world of entropy and used in the orientation of the reacting orbital motion of charge will exactly correspond to

that we associate with the magnetic field. In other words, I had discovered how magnetic energy is stored in the vacuum field and how it is recovered when the field subsides. I had discovered the mechanism underlying the process of electromagnetic induction and I knew that it involved reversible thermodynamic processes.

Back to our magnetic core problem, I knew that the energy fed into the magnetizing winding is all shed as heat and lost to the world of entropy but, equally, I knew that, of the entropy action inside that core, as distributed all along the length of the core and through that air gap, there is an orientation of magnetic moments producing a uniform reaction field. Furthermore, this reaction is not just attributable to the field  $H$  set up by the winding. The reaction cannot discriminate between fields set up by windings or those set up by electrons in motion within atoms in a ferromagnet. So the reaction field really is of strength  $B$ , the full intensity of the flux traversing the air gap. However, its direction is in opposition to that of the primary magnetization. Now, far from this being a problem, it was truly wonderful to see what all this implied. The theoretical analysis underlying the reaction effect had told me that the reaction field would halve the strength of the applied field. So, if the learned professor tells me that the magnetizing field set up by current in a winding has a value  $H$  but there is no diamagnetic reaction in the vacuum, I say "Oh, no!" and declare instead that the field set up is  $2H$  but it is always opposed by the reaction  $H$  in the vacuum state and so the measured field is  $H$ , but because of that reaction there is reason to understand how the vacuum stores energy as a function of  $H$  and how when the  $2H$  influence is switched that energy is returned to the winding by induction.

The professor may say that this adds up to the same result as his interpretation so why complicate things; it is better to keep the argument simple. My answer to that is that it is essential to know the truth where energy is concerned and, furthermore, that it is the physicist who has complicated things beyond all reason. I refer here to the obvious fact that if what I say above is correct the intrinsic magnetic moment of a charge in orbit when measured in relation to angular momentum will be double the value calculated by that professor on his own reasoning. I then appeal to experiment and ask what happens when a ferromagnetic rod finds its magnetism reversed. Will it acquire a change of angular momentum corresponding to its electrons having the gyromagnetic ratio  $e/mc$  or  $e/2mc$ , where  $e/mc$  is the charge mass ratio of the electron in electromagnetic units?

Lo and behold, the textbooks say that the theoretical value for electron orbital motion is  $e/2mc$  but the value  $e/mc$  is observed! So how does that learned professor explain the anomaly of that gyromagnetic ratio of 2. He invents, or rather Nobel Laureate Paul Dirac invents, the notion of 'electron spin' and says that a spinning electron will set up twice the ratio of magnetic moment to angular momentum as applies to orbital charge. The Larmor formula demands the reaction of charge in orbital motion, but Dirac invented spin. What Dirac did not invent was a way of explaining how magnetic induction energy can return to electrons in spin. You see, there is no area described by the motion of a centre of charge and so no scope for flux linkages by which to capture an EMF that can act on the electron to give it energy!

Dirac was wrong to offer 'spin' as an explanation for the gyromagnetic properties of an iron rod and because of that error professors of electrical engineering live in the dark when it comes to understanding how energy is transferred to and fro the vacuum by magnetic induction. They live in the dark by not realising that we can take more energy from the entropy of our environment than we release, thanks now to this knowledge presented here.

The question I want now to address is the further understanding of how that, magnetic field set up around the ring core can cause an excess of energy to be fed to the air gap.

From about 1988 onwards I realised that one could see a way to extract energy from the aether by magnetic techniques, but I thought it would involve magnetizing a magnetic core beyond the knee of the B-H magnetization curve. That really means expending energy in setting up strong currents or contriving to incorporate powerful magnets. The Moullin experiments on the core with a small air gap did, however, suggest that something offering energy gain was occurring below the knee of that B-H curve. I now know why.

Essentially it is because we can cause magnetism to turn around corners in a magnetic core. The magnetic flux wants to follow preferred directions in the crystals inside the body-centred structure of iron. If it confronts a corner that is not much of a problem unless there is an air gap ahead around the bend. In that case the magnetism has to get leverage as it were to contend with the demagnetizing effects of the air gap. It has to back-up in some way to build an underlying magnetic field action. Once there is a field H set up inside that iron core then the core is no longer one having high permeability and it develops characteristics that are non-linear which are accentuated below the normal flux density level of the knee of the B-H curve.

To glimpse the reason why that 'knee' is so important, imagine you are sitting inside the iron of that core, well away from the air gap. You sense the field H. Now if you are inside a magnetic domain within an iron crystal you are where the iron is magnetized to saturation along one of the three main axes of its body-centred cubic structure. That field H is not going to have much effect unless you are close to a domain wall separating you and an adjacent magnetic domain. In the latter case the wall could sweep right through you as the domain polarization reverses. Very little external energy is involved in this exercise. The field H needed when that air gap is present is far too strong to be wholly absorbed by the lateral shifting of domain walls. Given, however, that the field H exists, those magnetic domains that have the most vulnerable orientation, allow some rotational deflection of their polarization vectors and they will respond as if they have a magnetic permeability of the order of, say, 50 in gauss/oersted units. With no air gap the normal B-H curve can show a permeability of several thousand up to the knee and then, as domain rotation takes over from domain wall movement, the incremental permeability drops to that lower value. With an air gap the need for H to exist at a significant level, even within the core in its below-the-knee state, means that some rotation occurs. Note that rotation in the normal sense begins when all domains have taken up states of polarization along the preferred crystal axes most nearly aligned with the core axis. The sudden instabilities that flip the transitions over lower ranges of magnetization account for hysteresis loss, but once all the triggered transitions are complete and the rotation is smoothly controlled by the strength of the field H, the hysteresis loss reduces. Indeed, rotation regulated by a field strong enough to assure saturation involves no hysteresis loss. This can be a considerable advantage in machines operating with superconducting windings and with limited magnetic flux ranges confined to the above-the-knee region.

Using that arbitrary value of 50 for permeability attributable to flux rotation developing at a flux density of, say, 15,000 gauss, the increment  $H\delta B$  which equals  $B\delta H$  for the normal linear permeability condition can flip to one where a change of B of 1,000 gauss would make  $H\delta B$  20,000, whereas  $B\delta H$  is 300,000. As will become evident from what is reported below, this implies a 'free energy' power gain of about half of this 15:1 ratio. The reason, as we shall see, is that  $H\delta B$  represents energy supplied by a magnetizing

winding whereas  $B\delta H$  represents energy fed into the system by the aether which sustains the quantum condition of the polarized atoms in the ferromagnetic core.

The formal mathematical summary of this situation now follows. First, we perform the energy calculations for normal below-the-knee operation, ignoring domain flux rotation.

Let  $P$  denote the intrinsic field intensity set up by the ferromagnetic properties of the core, so that:

$$P = B! H \quad (1)$$

Let  $I$  denote the current in the magnetizing winding, which has  $N$  turns over a total ring length  $D$ . The core has a cross-sectional area of one sq. cm. and an air gap of width  $g$ , so that the length of iron core is  $D! g$ . The winding is tightly wrapped around the core and we can assume this winding also has a cross-sectional area also of one sq. cm.

At this point I explain that I prefer to use a system of units which takes the vacuum state as the base of reference, by which it is assigned unit dielectric constant and unit magnetic permeability, meaning the cgs system. It involves use of  $4\pi$  but avoids other complications that tend to dominate and confuse formulations where the fundamentals of magnetism are concerned.

The energy input  $W$  to the magnetizing winding is then found by integrating the current  $I$  in amps times the induced back EMF  $E$  in volts. We write:

$$H = (4\pi/10)(N/D)I \quad (2)$$

and: 
$$\delta E = (N\delta B)10^{18} \quad (3)$$

We will work in ergs, rather than joules, and this introduces a factor  $10^7$  in the expression:

$$\delta W = (I\delta E)10^7 \quad (4)$$

From (2), (3) and (4):

$$\delta W = (1/4\pi)H\delta BD \quad (5)$$

By analogy with the derivation of equation (5) one can see that the corresponding amount of work performed by the atoms generating the ferromagnetic state of the core is given by:

$$\delta W_i = (1/4\pi)P\delta BD \quad (6)$$

From standard physics we know that the energy in the air gap is given by:

$$W_g = (1/8\pi)B^2g \quad (7)$$

It then follows, from (5) and (8) that:

$$W_g = W \quad (8)$$

if: 
$$B = (D/g)H \quad (9)$$

because, given this linear proportionality, the integral form of equation (5) becomes:

$$W = (1/8\pi)HBD \quad (10)$$

It has been the logical assumption, therefore, to accept that energy conservation implies the transfer of the energy input  $W$  to the air gap and presume that the action effectively attributes the core-cum-air-gap with an overall magnetic permeability of  $D/g$ .

This is in no way a proper physical explanation of the energy transfer phenomenon because the flux density  $B$  traversing that air gap exists essentially owing to the

polarization by the ferromagnet and must therefore have been powered primarily by the energy represented by equation (6). This equation was not used in deriving equation (8).

To proceed, we may add (5) and (6) to obtain, from (1):

$$\delta W + \delta W_i = (1/4\pi)B\delta BD \quad (11)$$

which, upon integration, tells us that overall there is a uniform energy density of  $B^2/8\pi$ , as we expect. However, this can best be interpreted by saying that the energy supplied to the gap comes essentially from the

ferromagnet whereas the energy supplied by the magnetizing winding merely tops up the energy around the whole magnetic circuit to make up for the energy drained into that gap from the ferromagnet.

This leaves us now with a new perspective. The energy supplied to the magnetization winding should not be assumed to transfer to the gap. Instead we should study how the ferromagnet, which delivers energy from the aether by the quantum priming processes that keep it ferromagnetic, can deliver some excess energy which we can use in running our motor.

It is intuitive to examine how the H-dependent energy component is supplied. There are four components of energy of the forms:  $H\delta P$ ,  $H\delta H$ ,  $P\delta H$  and  $P\delta P$ . The first two are power input from the magnetizing winding and the other components are power supplied from the aether. We see that the third term tells us that by applying current to set up the field H we have tapped some aether energy. Now, so long as P and H are linearly proportional, the deployment of energy into the air gap will be approximately equal to the total energy stored by the first component. Also the first and third energy will represent equal amounts of energy when integrated. Note that the four energy components are pooled and distributed over the whole core-cum-gap length D, but it just so happens that H-dependent energy seems to be mainly deployed into the gap. It is then of interest to consider what happens owing to the non-linearity of the B-H curve. At higher flux levels  $P\delta H$  will exceed  $H\delta P$  and the difference escalates the nearer one gets to magnetic saturation.

The consequence of this is that the H-dependent energy being pooled is drawn progressively more and more from the aether as H is increased. It follows from this that the reluctance motor power that can be drawn from the air gap will be contributed more and more by the aether as we take the level of magnetization to higher H levels.

The strict assumption that the energy supplied by the magnetizing coil all goes into the air gap is clearly incorrect. The energy is lost as heat, but we can recover it from the aether owing to the inductance effect and the half-field reaction explained above. More than this, however, we can recover energy well in excess of the amount supplied to the magnetizing coil because, owing to the curved higher range of the B-H relationship of the core, the aether sets up a stronger inductance field than applies for a linear B-H characteristic.

It will now be understood why a high level of magnetizing current and the use of a superconducting winding can make this technology commercially viable. It will also be understood why the energy in the air gap exceeds that supplied to the magnetizing winding, as was shown by the experiments reported in Energy Science Report No. 1. Remember in that connection that, whereas Professor Moullin had measured the magnetic flux in the core legs conveying magnetism to the air gap and found that the current needed to drive a given amount of flux across the gap reduced in relation to the gap thickness, I have argued that was not due to magnetic leakage. I say it is attributable to the aether

feeding, in effect, its own magnetizing current to keep that flux on track through the gap. I proved this in the experiment I reported by testing the level of flux reaching the bridging yoke.

In summary, therefore, there can be no doubt that what has been disclosed above explains how aether energy can be tapped by astute design of a magnetic reluctance motor and the use of superconducting windings to avoid  $I^2R$  heating.

There is good reason to expect a machine of such design to operate with at least a 5:1 power gain by polarization bias to a basic flux density of 1.5 tesla (15,000 gauss) and operating over a cyclic flux density range between 1.5 tesla and 2 tesla in the ferromagnetic core. Note that such flux densities are commonplace in superconductor magnet technology where there is no ferromagnetic core to assist in developing that level of magnetic flux.

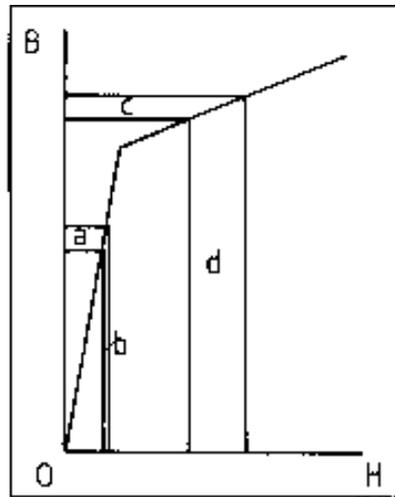


Figure 12

To underline the point just made it helps to consider what is shown in Fig. 9. Readers who are familiar with the general curved form of the B-H magnetization curve will realise that the curve has been 'idealized' in a straight-line form to facilitate analysis. The B-H relationship is shown to define four separate areas a, b, c, d which represent, respectively,  $H\delta B$  and  $B\delta H$  over a range of low flux density and then  $H\delta B$  and  $B\delta H$  over a range at higher flux density. It can be verified by geometrical analysis that the areas a and b are equal. This is because the straight line which separates them passes through the origin at O. However, the area c is between 4 and 5 times smaller than the area d, because the slope of the straight line separating those areas is much reduced and the line intercepts the B ordinate at a high B level. The difference is of vital significance in our 'over-unity' motor design. First of all do keep in mind that B and H are not different physical effects acting at right-angles to one another. They act in the same direction. Secondly, note that our forebears who coined the B and H expressions really deceived us. They disguised the formulation by writing it as B equals H plus  $4\pi I$ , where I was stated as being the 'intensity of magnetization'. Yet all that was meant by this was that H is the effect of the ampere-turns per cm that we apply to develop the state of magnetization and B! H or B!  $4\pi I$  is the

effect of the ampere-turns that the ferromagnet itself contributes to the state of magnetization. That source of  $I$  in this latter expression is current sustained by the quantum activity which keeps the ferromagnet alive as a source of magnetism.

Now, if you were an electron sitting in the core of that ferromagnet or some aether charge form positioned to absorb energy as inductance in the pole gaps associated with that core, you would not know the difference between the ampere-turns producing  $H$  or the ampere-turns producing  $B$ !  $H$ . So, since those areas  $a$ ,  $b$ ,  $c$ ,  $d$  are really energy expressions, as we have seen from the above analysis, you confront the evidence that at low flux densities, where  $a$  equals  $b$ , the equal sharing of energy between core and air gap offers you no power gain helping to drive your motor. However, over the higher flux density range, where  $d$  exceeds  $c$  by a very substantial margin, that equal sharing of energy puts more power into the air gap between the motor poles than you supply to the magnetizing winding. That is why it is possible to design and run an electric motor which extracts power from the aether. It is simply a matter of understanding your  $a$ ,  $b$ ,  $c$  and  $d$  alphabet as applied to what is shown in Fig. 12!

The only problem you have in designing such a motor is one of devising a machine that does not run away with your input power in setting up the strong currents needed to reach the near-to-saturation level of magnetism. It is not the input power needed as inductance energy that is the problem. That is the energy  $a$  or  $c$  just mentioned. No, it is simply the ohmic heat loss that arises from the resistance of the magnetizing winding, but that is a loss we can eliminate as superconductive windings come to be used more and more in the design of electrodynamic machines. Machines have been devised in the past using superconductive windings, normally in the rotor of an alternator, but the object is to produce the d.c. magnetic field and that application has no bearing upon the 'over-unity' machine proposed in this Report. However, the feasibility of using superconductivity in a multi-megawatt machine is established and the way forward towards power generation using the 'over-unity' performance of the electrodynamic machine described in Part II of this Report seems now open and welcomes development.

#### PART IV: Commercial Development of the Invention

Readers will now see that I have introduced the expression 'invention'. This is because the technology is the subject of patents involving the author as inventor. The chances are that the corporate industrial world which has the capacity and the duty to replenish our power generating equipment will not heed the new technology represented by these patents. That world does not yet recognize that 'over-unity' is a realistic possibility. So, it seems likely that the patents will serve only the primary purpose for which they were originally filed, namely to show to future historians that we 20th century mortals are part of society which, in spite of its vast knowledge, has still much to learn, but is unwilling to 'unlearn' false doctrines to make way for truth.

We belong to a world which was created and which evolves as it is recreated and as energy is recycled. The machine described in this Report can capture energy as it is being recycled by the processes which underlie the aether. I have explained how the end-product of that recycling activity is the creation of electrons and protons throughout space using energy shed as radiant heat and lost to what we term 'entropy'. That was the reason I wrote 'Aether Science Papers' [1996a]. In this Report I have sought to prove that we can intercept energy as it meanders through that process and capture it through the quantum coupling that sustains ferromagnetism in steel cores.

The high energy physicist stands aloof from such proposals, even though the physics involved is clear and conclusive in showing how the precise value of proton mass is determined in relation to the fundamental constants of the space medium. Accordingly this Report is offered as a way forward to those in search of a non-polluting new source of power and the patent rights, so long as they stand in force, may have some commercial value in support of that prospect. Otherwise, as the rights lapse, their specifications stand of public record in testimony of missed opportunity in a technological era when we could ill-afford to turn our backs on such inventions.

That said, I will now revert to the onward design details pertaining to the multi-megawatt machine, making reference to a patent which relates to what has been disclosed.

As will be appreciated, the commercial viability of an 'over-unity' power generator does not just depend upon whether it can operate with a saving on the cost of fuel. It depends upon the investment, the scale of the machine and its reliability. Therefore, it seems appropriate to evolve the design by taking the existing technology of the turbo-alternator power unit as a basis for reference. The future technology proposed here will involve those same alternators as the electrical power generator. They run at 3600 rpm when developing 60Hz. The prime mover, the turbine, however, is replaced by a dynamoelectric machine such as that described by reference to Figs. 5 to 8 above. It needs no nuclear heat source to generate the pressurized vapour powering the turbine. All it needs is an electrical input to excite its pulsed operation and that can be produced regeneratively once the system is set rotating at its synchronous speed.

Thus, whereas in a conventional power plant the alternator is brought up to its synchronous speed by starting the turbine, we do need, in this new technology, to provide some kind of drive motor or small turbine unit which can initiate operation. Otherwise, one needs to look to the output alternator or exciter alternator of the system as serving a motor role during start-up. The exciter alternator generates the pulses for the main winding on our machine, as we shall see from Fig. 13, but the overall function, given

'over-unity' performance, is that the exciter alternator puts, say, one unit of electrical power into the winding of the main machine and the latter generates, say, four units of mechanical power, one of which feeds back to drive the exciter alternator and the other of which feeds the output alternator or applies mechanical drive as to a ship propeller.

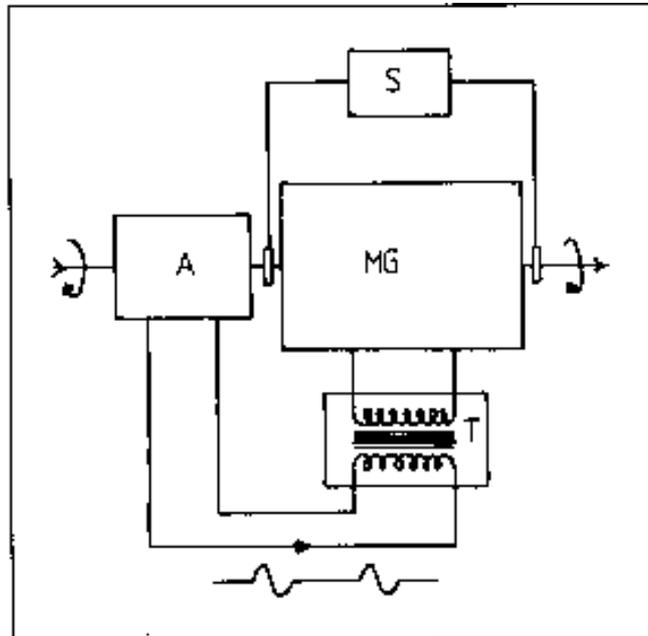


Figure 13

The patent covering what is here proposed does not require use of a superconductive winding and can avoid that requirement by sacrificing efficiency, but it is assumed that future technology will use the new warm superconductors.

In this respect, it should not be assumed that superconductivity is used as a substitute for a ferromagnetic core, that being the normal objective in existing machine technology. The problems of developing very high magnetic fields in warm superconductors not yet overcome. Fortunately, in the technology considered here, we need only moderate fields of a few hundred ampere-turns per cm. to penetrate the superconductor, because the primary magnetic flux that drives the machine is confined to a ferromagnetic core. Our objective here is really one of avoiding unwanted loss, both the VR loss in that main winding and any inductive power loss in exciting the machine. The objective of the patent is specifically directed to the recovery of induction energy and overcoming commutation problems.

By having the magnetizing winding on the stator at the outermost position around the rotor of the machine it is easier to keep it cool enough to assure the superconductive state. The primary design problem arises from the high induced voltage per turn of the winding, which could be 1,000 volts in a 100 megawatt installation. For this reason and to provide thermal isolation for the magnetizing winding, owing to its superconductive state, a transformer having a ferrite core is needed. This has one primary winding and several secondary windings, each serving just a few turns of the superconductive winding on the machine. Referring to Fig. 13, the main generator, denoted MG, is coupled to an exciter-alternator A, which feeds a commutated sinusoidal a.c. to the primary winding of

the transformer T. this has superconductive secondary windings feeding the turns of the superconductive helical winding on MG. Cooling is via the transformer tank housing T, where the primary winding is thermally insulated, as the metal of that winding can be cooled owing to its conductive connection with the exciter-alternator A, where normal features can be incorporated to cool that machine.

The d.c. power supply S connected to sliprings on MG provides the low power input needed to polarize the core, though this may prove unnecessary in practice because of the unidirectional current surges in the winding of MG.

The rather special feature of this design, as covered by the patent, is the way in which the a.c. input to the transformer is chopped into complete full-wave cycles, say one in three, in order that the EMF fed to the superconductive winding is pulsed in a timed phase with the stator-rotor pole positioning in MG. In an ideal case, where there is no magnetization loss in the machine (current in phase with EMF) as opposed to just inductive reaction (current in phase-quadrature with EMF), the superconductive winding will allow the magnetic flux change to conform with the a.c. time-integral of the voltage waveform.

It will be pulsed unidirectionally with a simple harmonic profile and if this is timed according to the position of the poles so as to assist pole closure, then the machine will operate in the manner already described. Note that the magnetization loss should be much smaller than it is in a normal alternator of similar size and so, having regard to the current strength supplied to pulse the superconductive winding, the phase should not differ too much from the zero-loss condition.

There is no electronic commutation or switching in the superconductive circuit. The only commutation is in the exciter-alternator A which supplies the chopped waveform shown in Fig.13 and interrupts the current flow to the primary of the transformer only at moments when the current is zero.

It is important to note again that, although there is extensive reference to the prospective use of superconductivity in the main windings of the generator described, it is not essential to 'over-unity' operation. It is, however, an inevitable development, once warm superconductivity comes to be used in standard design of main power generating equipment.

The above technique of using the chopped a.c. waveform with a magnetic reluctance machine biased to polarization close to saturation, all with the objective of running a machine with 'over-unity' performance is already the subject of the author's U.S. Patent No. 4,975,608 dated December 4 1990. The design features involving the single helical winding have evolved since and are the subject of independent patent applications.

The abstract title page and claim pages of that U.S. patent were reproduced in the Appendix attached to the first version of this Report published in 1996, but since such the full copy of that patent specification can be seen by accessing the U.S. patent office website, <http://www.uspto.gov/>, it is not included here in these pages.

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