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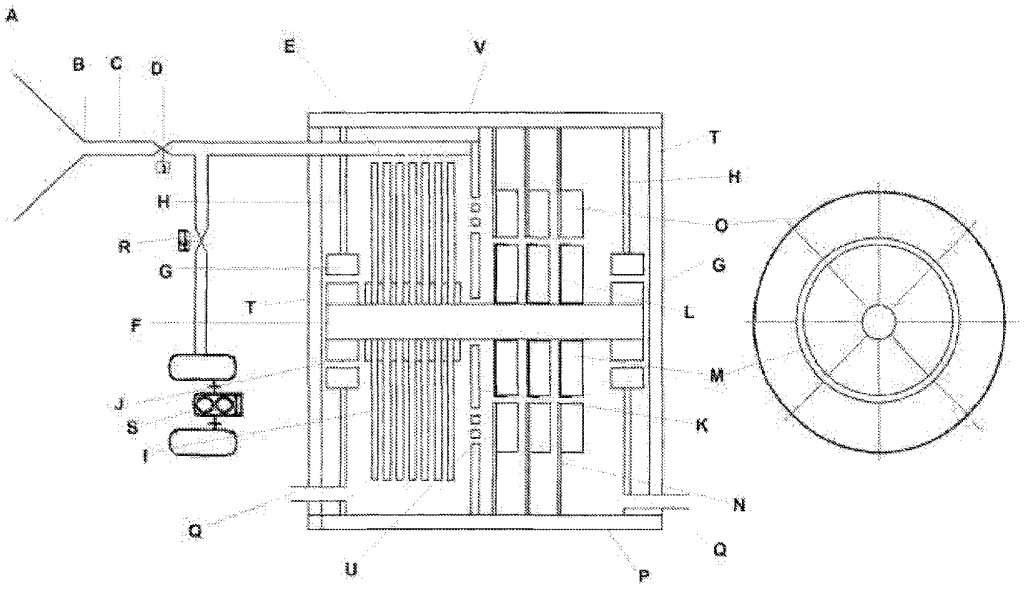
(56) Documents Cited:
GB 2463176 A **EP 1816348 A1**
WO 2011/002979 A2 **WO 2009/033925 A2**
CA 002498635 A1 **DE 004416560 A1**
US 20100111689 A1 **US 20080131273 A1**

(58) Field of Search:
INT CL **F03D**
Other: **EPODOC, TXTE, WPI**

(54) Title of the Invention: **Airflow driven electrical generator**
Abstract Title: **Air driven Tesla turbine with Halbach array generator**

(57) An airflow driven electrical generator incorporating a funnelled or coned particle collector (A) to augment turbulent airflow, convert it to laminar airflow (b) and direct it through a series of nozzles (E) to between a series of rotational shaft mounted disks of a Tesla turbine (I). The turbine is used to drive a high speed generator formed from a radial Halbach array of magnets (M). There may also be an air compressor (S) to provide a source of airflow when there is no wind and the inner surface of the particle collector may be volute shaped like a Fibonacci spiral. The rotor may also be mounted on magnetic bearings (G).

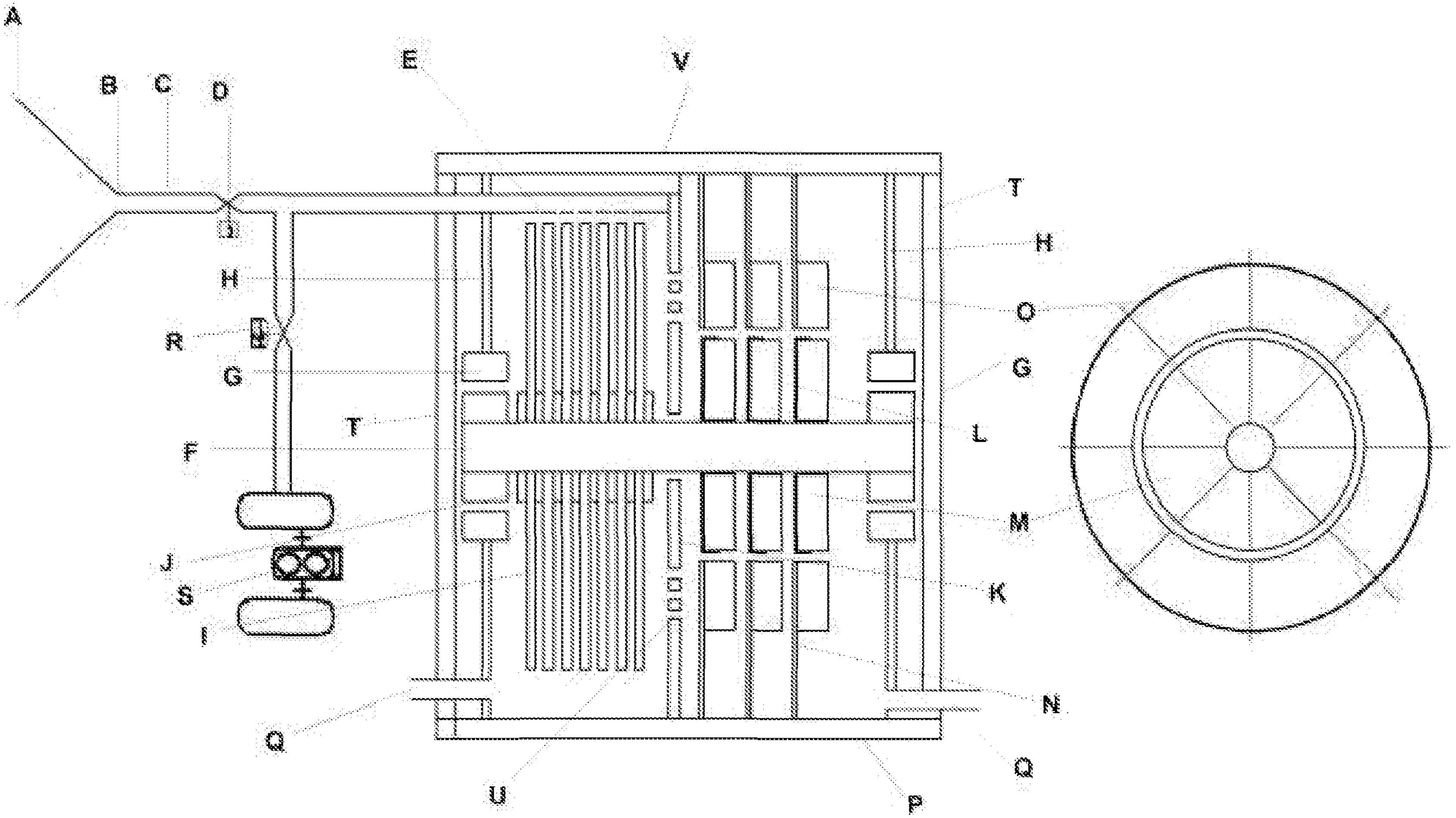
ADEG DRAWING 1/1



GB 2488394 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

ADEG DRAWING 1/1



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TITLE

Air Driven Electrical Generator (ADEG)

BACKGROUND

This invention relates to a device for the collection of turbulent airflow, converting it to laminar airflow, augmenting the pressure of the said airflow and using the said augmented airflow as the motive power to drive an electrical generator.

Once airflow ceases, air driven electrical generators such as wind turbines rapidly cease to rotate thus stopping the generation of electrical charge.

At present, conventional wind driven turbine devices rely upon aerodynamically shaped blades caused to be rotated by relatively high wind speeds. To achieve the optimum wind speed necessitates the devices utilizing large surface area blades being situated on the top of tall static pylons.

These wind driven turbines are notoriously inefficient in that they are only able to utilize a fraction of the volume of air required for them to rotate.

Wind turbines also are susceptible to natural phenomena such as turbulence, gusting, and sudden changes in wind direction. When air flows at higher velocities, especially over the earth's irregular surface, flow is generally disorganized, even chaotic, and tends to form eddies. This is called turbulent flow. A relatively large driving pressure is required to sustain turbulent flow. Driving pressure during turbulent flow is in fact proportional to the square of the flow rate such that to double the flow rate it is necessary to quadruple the driving pressure.

When air flows through a smooth bore, it tends to be more orderly and streamlined and to flow in a straight line. This type of flow is called laminar flow. Unlike turbulent flow, laminar flow is directly proportional to the driving pressure, such that to double the flow rate, it is only necessary to double the driving pressure.

The objections to the present wind turbine devices are;

1. They are noisy.
2. They are unsightly.
3. They are static.
4. They only produce charge when a suitable a suitable airflow is present.
5. They are only suitable in supplying the grid when accumulated in large 'farms', often offshore.
6. They require large blades and pylons which are expensive to construct install and maintain.
7. They need blades to be high up to take advantage of high wind speeds and reduced turbulence.
8. They are susceptible to natural phenomena such as turbulence, gusting, sudden changes in wind direction, lightning strikes.
9. They only utilize a small amount of the air required to cause rotation.

Moving vehicles create a drag pressure which can be utilized to produce electrical charge. At present there are no successful turbines or induction devices that rely upon drag created by vehicles moving through air particles to create charge.

STATEMENT OF INVENTION.

To overcome these problems I have developed, from proven technology, an Air Driven Electrical Generator (ADEG) that can continue to produce electrical charge after any wind/drag force has been removed.

The invention proposes a device that is relatively small and can be mounted either on a static structure or moving vehicle and comprises:-

- A form of air collector that allows moving air particles (in the form of wind, or drag from a moving vehicle) to be collected and converted from turbulent flow into laminar flow and at the same time augmenting airflow pressure.

- An electrical generator driven by the motive power of the said airflow

- A safety device incorporating sensors and solenoid valves that detect when the generator has reached a predetermined output and causes a solenoid valve to be closed to prevent any overrun, and also causes that solenoid valve to be reopened when the sensor detects the output from the generator has fallen to a predetermined level.

The Air Collector is an inventive step and comprises a form/s of cone/s (funnel/s) that permits turbulent air to enter. As air particles are forced through the funnel the said air particles are gradually converted from turbulent flow to laminar flow. The particles then exit the cone/funnel and nozzle at an augmented pressure and pass through the solenoid valve into the generator.

The generator comprises a shaft rotating between magnetic bearings. The magnetic bearings are mounted on bulkheads in such a way that the fixed, or non-rotating, part of the bearing is prevented from moving.

The shaft is located into the rotating part of the magnetic bearing forming the rotor.

The magnetic bearings cause the rotor to 'float' within the stator. In other words there is an air gap between the rotor and stator parts of the bearing and thus minimal friction force is generated as the shaft rotates. This allows the rotor to rotate at very high speeds.

Mounted and fixed at one end of the shaft, is a series of disks located in close proximity to each other. Laminar air flow passes at pressure between the faces of the disks. The laminar fluid airflow passing between the faces of the disks causes lateral resistance (drag friction) on the disks resulting in rotation of the shaft.

Mounted and fixed at one end of the shaft is a permanent magnet assembly, which rotates as the shaft rotates.

Mounted on a bulkhead, in close proximity to the permanent magnets, are a series of wire wound coils, one for each magnet. As the magnets pass across the face of the coils then the magnetic fields of the magnets cause a charge to be generated in the coils.

Depending on the arrangement of magnets and coils, the charge produced maybe alternating current, direct current, and single or 3 phase.

The amount of charged produced by the generator will depend upon a number of factors, including

- Strength of magnetic field
- Speed of rotation of the magnets
- Number of turns of coil wire
- Gauge of wire.

The SAFETY DEVICE comprises sensors incorporated into solenoid valves to detect when the output charge of the generator reaches a predetermined value. At that point the valve, or other shut off mechanism, would be activated to prevent any more air entering the generator. When the output charge of the generator drops to another predetermined value, the sensor would activate the opening of the valve or other opening mechanism.

The uniqueness of this device is that apart from being more efficient than other wind driven devices, the magnetic bearings allow the rotor to rotate at very high speeds and continue to rotate for a considerable time even after wind or drag has been shut off from the device, due to the very low resistance of the magnetic bearings

Also incorporated into the device, in the event of an absence of wind or drag force for a considerable length of time, is an air compressor the product of which performs a similar function to generated laminar air flow.

ADVANTAGES

The advantages of the invention are;

1. the invention, being relatively small, can be sound insulated to ensure quietness of operation
2. the invention, being relatively small, can be situated in unobtrusive positions
3. the invention will be suitable for static and mobile platforms
4. the invention will be suitable for supplying the national grid when a number of units are grouped together and mounted on offshore/onshore platforms
5. the invention can be positioned wherever any type of airflow can be captured
6. the invention will not require large blades or pylons and is therefore less expensive to install and maintain
7. the invention will have no need to be mounted high up
8. the invention will not be susceptible to turbulence, gusting or changes in wind direction
9. the invention will utilize the majority of airflow required for rotation
10. the invention, fitted with magnetic bearings, will allow rotation at very high speeds and thus produce large amounts of charge, and also allow rotation to continue after airflow has ceased

The invention, when fitted with a multi directional array of air particle collector/s, can take advantage of the lower wind speeds found at the low altitude levels of most buildings to produce usable charge. This would enable users to offset costs of energy bills. The internal surfaces of the air particle collectors may be formed into Fibonacci spirals to improve efficiency of particles through the collector.

A group of devices, when fitted with a multi directional array of air particle collectors, could be mounted on offshore or onshore platforms to take advantage of winds at sea and land so contribute to the national grid.

The invention, when fitted with a fixed directional air particle collector, can be used on a moving vehicle to take advantage of the drag pressure caused by the said vehicle moving through air particles. This should have major repercussions within the automobile industry in its search for efficient electric motor driven vehicles since it will reduce the reliance on expensive battery arrays.

INTRODUCTION TO DRAWINGS

An example of the invention showing a possible configuration of generator, compressor and air collector is shown in the accompanying drawing.

DETAILED DESCRIPTION

Turbulent air flow particles enter the Air Collector at point (A) and move through the Collector to point (B) where they exit into delivery tube (C). As the air particles move from point (A) to point (B) they become less turbulent until at point (B) the air flow becomes virtually laminar.

If pressure x volume at point (A) is P_1V_1 and pressure x volume at point (B) is P_2V_2 then according to Boyle's Law $P_1V_1=P_2V_2$. Thus, as the volume of air particles decreases during passage from point (A) to point (B) then pressure increases. The increase in pressure is dependent upon the dimensions of the Air Collector at points (A) and (B).

Laminar flow air particles pass along delivery tube (C), through solenoid valve (D), and exit through nozzles (E) into the Generator Housing

A rotatable shaft (F) made of non-magnetic material, has mounted two or more magnetic bearings (G). The bearings (G) can be active magnetic (AMB), passive magnetic (PMB) active/passive magnetic (APMB), homopolar electrodynamic (HEDB), or a combination of any of the aforementioned. The inner part of the bearing allows the shaft (F) to rotate whilst the outer part of the bearing is mounted on bearing plate (H). A form of Tesla Turbine comprising non-magnetic disks (I) and non-magnetic spacers (J) is mounted on shaft (F). A second bearing plate, with or without a mounted bearing (K) isolates the turbine whilst continuing to allowing the shaft to rotate. Located in the bearing plate (K) are a series of ventilation holes (U) adjacent to the coils. These allow used airflow to leave to leave the disk turbine chamber and air-cool the coils (O).
In the configuration described in the Drawings, a magnet plate/s (L) is mounted on the shaft. Affixed to the said magnet plate/s is a plurality of magnets (M) in the form of a radial Halbach Array. The said magnet plate/s (L) is allowed to rotate within a coil plate/s (N) to which is affixed a plurality of coils (G), one coil for each segment of the radial Halbach Array. Since the shaft (F) would be capable of rotating at high speed the radial Halbach Array being mounted on the said shaft minimizes the effect on the magnets of centrifugal force. The rotation of the magnets in the vicinity of the coils causes a charge to be generated.
In other configurations magnets may be located in many ways. The magnets may be on an end plate of the rotor (on a pitch circle diameter, pcd). They may be on the inner diameter of a cylinder (stator design or external rotor). They can be built within the stator or rotor sections. The magnets may be designed to be stationary or form part of the moving sections. The placement, style, shape and design of the coils may also vary.
End plates (T), upper base plate (V), and lower base plate (P) give rigidity to the unit as well as offering protection. A vent (Q) in the end plate (T) allows airflow to exit the turbine section of the unit.

On a static platform, airflow (wind) enters via a multidirectional air capture cone. On a mobile platform airflow (drag) enters via the single directional air capture cone. When the free air solenoid valve (D) is open, airflow continues through the airlines (C) and enters the turbine chamber via nozzles (E). The augmented pressure airflow passes between the disks (I) in the turbine section of the unit. When airflow comes into contact with the disks (I) it is taken hold of by the latter and subjected to two forces, one acting tangentially in the direction of rotation, and the other radially outward. The combined effect of these tangential and centrifugal forces is to force the shaft (F) to rotate, and to propel the airflow in a spiral path until the airflow reaches a suitable peripheral outlet (Q)/(U) from which it is ejected.

Since the shaft (F) is mounted on magnetic bearings (G), which by their very nature are low friction, a minimum of airflow force is required to rotate the said shaft. Laws of Motion dictate that if, whilst the shaft is rotating, force continues to be applied then the rate of rotation of the shaft will increase until forces are balanced, at which point the shaft will rotate at a constant speed. If the airflow force is removed then the rate of rotation of the shaft will decrease, however since the bearings are of low friction, rotation decreases at a considerably slower rate than if conventional roller or ball bearings were used.

As shaft (F) rotates so magnet plate (L) rotates at the same rate causing the magnetic field generated by magnets (M) to pass across the windings of coils (O) thus generating a charge. As speed of rotation of the said shaft increases so charge generated increases. A sensor incorporated into free air solenoid valve (D) detects when the maximum permitted output charge has been reached and causes the said solenoid valve (D) to shut, thus permitting no further airflow to enter the unit. As the rate of rotation of the shaft decreases so generated charge decreases. The said sensor incorporated into the free air solenoid (D) detects the drop in charge and at a predetermined level opens the said solenoid valve (D) permitting airflow to enter the system and increase the rate of rotation of the shaft thus maintaining generated output charge.

If there has not been airflow entering the system, and rotation of the shaft has ceased, then solenoid valve (R) may be opened manually or remotely, permitting air from compressor (S) to enter the system and allow electrical charge to be generated as described above. Opening of solenoid valve (R) will cause solenoid valve (D) to close thus preventing compressed air from being exhausted through the Collector. Once the permitted output charge has been reached then a sensor incorporated into solenoid valve (R) causes the valve to shut and solenoid valve (D) to open. Any charge surplus to use is used to power the compressor and recharge the compressed air tanks.

APPLICATION

1. A small ADEG device could be located in an electric vehicle where the drag produced by the forward movement of the vehicle would be more than capable of charging the vehicle's batteries, or even powering the electric motor. This would reduce the reliance of electric vehicles on expensive batteries, and drastically increase the range of the vehicle.

2. A device with a form of air collector mounted on a (sic) domestic chimney, with the ADEG inside the building protected from the elements, could provide sufficient charge for the needs of an average house with the excess sold back to the National Grid.

3. Larger devices generating 3 phase would be capable of powering small workshops and factories.

4. Banks of larger devices offshore or onshore could supply the National Grid.

CLAIMS

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

Claim 1

A funnelled/coned particle collector, causing turbulent airflow to be captured, converted to laminar airflow, and directed through a series of nozzles before causing the said airflow to pass between a series of rotational shaft mounted disks thus providing the motive power for the high speed rotation of a series of radial Halbach Array magnets, mounted on the said shaft, in the vicinity of a plurality of radial mounted coils, one for each magnet, causing an electrical charge to be produced.

Claim 2

A particle collector and turbine as in Claim 1, in which an air compressor is included to provide a source of airflow when wind and/or drag are not present

Claim 3

A particle collector and turbine as in Claims1and 2, in which the inner surface of the particle collector is shaped in the form of a Fibonacci spiral to permit the more efficient movement of airflow particles through the collector.

AMENDMENTS TO THE CLAIMS HAVE BEEN FILED AS FOLLOWS

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE

PROPERTY OR PRIVILAGE IS CLAIMED ARE DEFINED AS FOLLOWS

CLAIM 1

A wind turbine system comprising;

a) a form of conical/converging airflow collector allowing prevailing wind or drag airflow to enter at a wide mouth of the collector and exit at a narrow neck of the collector wherein the inner surface of the collector is be formed into an open ended Fibonacci spiral, converting incoming turbulent airflow into exiting laminar airflow at augmented pressure and passing said laminar airflow through a delivery tube connected to

b) a chamber wherein the said laminar airflow is , through an extension of the delivery tube and a series of nozzles, directed between the discs of a form of Tesla turbine, causing said turbine to rotate,

and wherein the said turbine is mounted via a common non-magnetic shaft with a form of radial Halbach array generator, said radial Halbach array generator being located in an adjacent generator chamber,

and wherein the common non-magnetic shaft is supported on frictionless magnetic bearings, the said radial Halbach array generator produces charge over a range of rotational speeds

c) a secondary source of laminar airflow produced from a form of compressor and storage air vessel connected to the aforementioned delivery tube

d) a system of valves controlling the volume of airflow through the aforementioned mentioned chambers.

CLAIM 2

A wind turbine system as in Claim 1 wherein a plurality of air collectors wherein the inner surface of each collector is formed into an open ended Fibonacci spiral allowing airflow to enter the system from whatever prevailing wind direction without the need for the aforementioned wind turbine system to be rotated.

Application No:	GB1200292.9	**Examiner:**	Kingsley Robinson
Claims searched:	1-3	**Date of search:**	8 March 2012

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
Y	1-3	US2008/131273 A1 (FULLER) See especially figures noting Tesla turbine.
Y	1, 2	GB2463176 A (SHERRER) See whole document noting Tesla turbine.
Y	1, 2	CA2498635 A1 (NICA) See whole document noting Tesla turbine.
Y	1, 2	DE4416560 A1 (HAUSCHILDT) See especially EPODOC Abstract, WPI Abstract Accession No. 1995-284389 [38] and figures.
Y	1-3	US2010/111689 A1 (DAVIS) Note especially Halbach generator with magnetic bearings shown in figure 12.
Y	1-3	WO2011/002979 A2 (FLODESIGN) Note especially Halbach array.
Y	2	EP1816348 A1 (CONG) See especially air jet nozzles 5.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

F03D

The following online and other databases have been used in the preparation of this search report

EPODOC, TXTE, WPI

International Classification:

Subclass	Subgroup	Valid From
F03D	0001/04	01/01/2006
F01D	0001/36	01/01/2006
F03D	0003/04	01/01/2006
F03D	0009/02	01/01/2006