The SEG
Introduction and analysis

by

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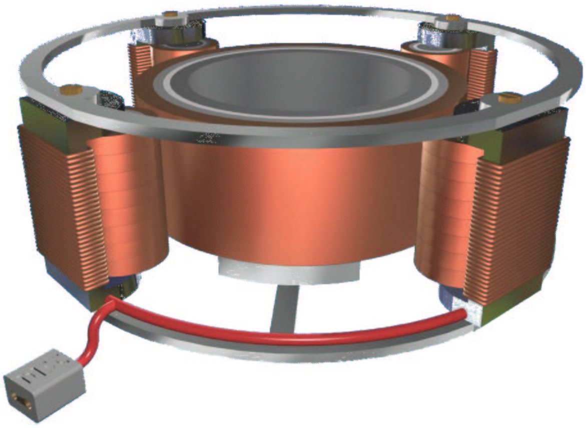

[above picture borrowed from `http://www.sisrc.com`]

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Abstract

This document is an introduction to, and superficial analysis of, the *Searl Effect Generator*, or *SEG*.
In here, I will try to:

1. identify the different SEG types made in the past,
2. do an analysis of the basic SEG and its parts,
3. point out some differences between the SEG types.

1 Introduction

The SEG is a unique free-energy device that can also be used as an antigravity device—known as the *IGV*, or *Inverse Gravity Vehicle*, where an *overloaded* SEG provides its energy and propulsion.

These related devices were created and perfected by *John Roy Robert Searl* and a group of skilled workers and engineers[1] over a period of more than thirty years. This group of people is said to have worked at—or had some relation to—the now-defunct public electric utility *Midlands Electricity Board* in the U.K.

1.1 The Basic SEG

For the sake of discussion, the Basic SEG will mean the *Layered SEG*. It is believed to be the last (and best) type produced by the old team.

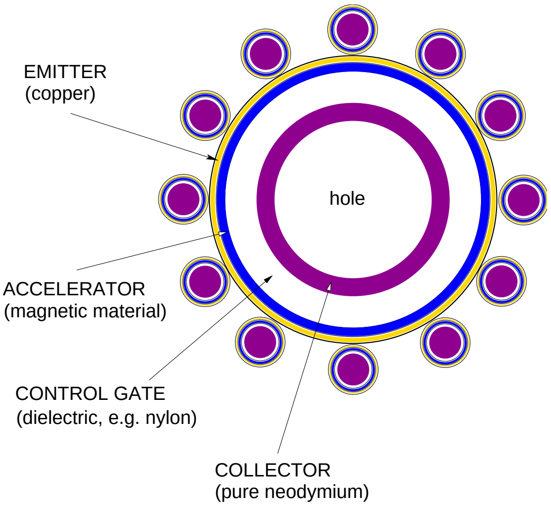

Figure 1: Four-layer plate with 12 similarly layered rollers (*GC*)

The basic SEG consists of one to three so-called *gyro cells* (GC), where each gyro cell consists of a circular *plate*, and a set of *rollers*.[2]

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[1] This group is hereinafter referred to as the *old team*.

[2] Plate and roller are sometimes called *ring* and *runners*. I propose that the term ”plate” be used instead of ”ring”, to avoid confusion with e.g. a ”ring of copper” or ”a ring of dielectric.”

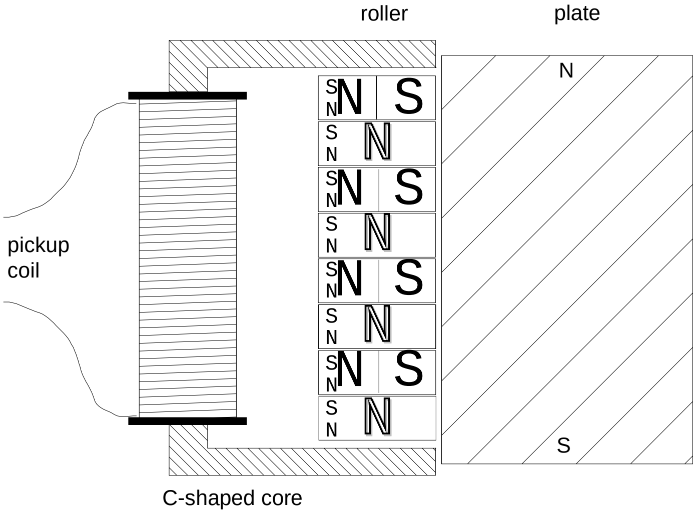

Figure 2: Peripheral pickup coils embracing outer roller set

The plate is an annular ring. It is surrounded by a set of rollers (never fewer than 12) orbiting the plate like planets around a star. A one-gyro-cell SEG (as shown in Fig. 1) is used to keep costs down when testing new SEG designs.

A roller is a stack of 8 *roller segments*, and these are not annular like the plate.

The plate and roller segments are given a special magnetisation that imprints sine wave-like poles in their magnetic layer. This so-called *AC magnetisation* is very hard to attain, and later attempts to build SEG's have failed to reproduce this magnetisation (see section 1.3)

The plate has a main field, whose orientation is up-down (*axial*, indicated by the 'N' (top) and 'S' (bottom) as seen in Fig. 2.) Each roller segment also has a main field oriented the same way (axial), but with a polarity opposite to that of the plate (i.e. they're swapped—see the tiny S (top) and N (bottom) on the left side on the roller segments.) When combined into a complete roller, an aggregate field of the same orientation will be formed; however, the individual roller segments are still able to minutely rotate to and fro (wiggle) around their individual axes. To facilitate this intra-roller-segment wiggle, the two flat end surfaces of each roller segment should be minutely convex to lower friction.

The plate and roller segments both have a special sine wave-shaped magnetic field pattern (poles) printed onto a permanent magnetic layer them. The plate's pattern ties in with the roller segments' pattern, like gears. In Fig. 2, one side of the roller segments' pole pattern are shown as the large 'N | S' and 'N' on each roller segment. The pole pattern of the plate is not shown here, but in Fig. 3 of section 2.3.

When a set of rollers is manually placed on the plate's outer surface, they will space themselves evenly from one another. If you move one with your hand, all the others will move in unison.

During operation, the rollers will travel in an orbit around the plate. The rollers will also rotate on their own axis—just like a planet in a solar system.

A number of pickup coils are mounted around the outermost set of rollers orbiting the outermost plate. When the rollers pass through the C-shaped core of the pickup coil, a current is induced in the coil. The pickup coils can also be used inversely: to push the rollers in their orbit. This is needed to start some SEG types.

Ideally, an SEG should be designed according to the *Law of the Squares*, that is based on John Searl's manipulations of so-called *magical squares*. It is mainly used to calculate optimal sizes of different SEG parts.

When an SEG is designed to use four layers (using Square 4), I have learned that the 1st layer is called the **collector**, the 2nd the **control gate**, the 3rd the **accelerator**, and the 4th the **emitter**. I have no idea what the two extra layers in the 6-layer type would have been called.

See section 2 for a discussion on layer numbering.

1.1.1 Collector

This is the innermost layer, and the main confusion generator of an SEG :-) In all "real" *layered* SEG's (i.e. SEG's produced by John Searl's old team members during the heydays,) this layer has always (to my knowledge) been made from a powder of pure *neodymium metal* with powdered nylon mixed in as a thermoplastic binder. People confuse neodymium metal with NdFeB (neodymium-iron-boron,) a powerful modern magnet material, which is also commonly bonded with nylon for injection moulded magnets.

In the SEG, the neodymium metal is claimed by John Searl to act as an *electron donor*. It is said that neodymium is the main source of electrons that flow from the innermost plate to the outermost roller set.

This could stem from a simple misunderstanding on behalf of John Searl: neodymium is indeed "an electron donor" in that, when it oxidises (as it readily does in air), it will give away electrons, but in the process, neodymium oxides will form. This is obviously something that you don't want to happen in your SEG.

This is also one of the main reasons why a binder was needed for the neodymium powder, since a binder will protect the neodymium from oxidisation.

Neodymium is a so-called *rare-earth metal* (REM) found in the Lanthanoid series in the Periodic Table of the Elements. Since many rare-earth metals have similar properties, one could presume that you could substitute mischmetal (a mixture of unseparated rare-earth metals) for neodymium. Mischmetal is significantly cheaper than other rare-earth metals, and is commonly used for the flint in cigarette lighters.

1.1.2 Control gate

This layer is always a dielectric (i.e. a non-conductive material.) It is said to moderate the flow of electrons from the collector. It should ideally be made of nylon 66, but other dielectrics can probably do the job too.

1.1.3 Accelerator

This layer is—to my knowledge—always made of a magnetic material in the basic SEG. In here, the magnetisation (both DC and AC) will leave its imprint: the main axial field, and the sine wave pole pattern.

It is unclear whether the layer needs to be conductive or not. In John Searl's parlance, it's "iron," and if John Searl (unknowingly) actually is referring to ferrite powder, which is good a dielectric. Plain (soft) iron is a conductor, is easily magnetised, but equally easy to demagnetise (i.e. it can't hold the magnetisation when subjected to an opposing [same polarity] field.)

Almost every other magnet material are conductors to some degree, even when bonded with plastic.

1.1.4 Emitter

The outermost layer can be made of copper, aluminium, or titanium. The thinner the layer is, the more of the accelerator's magnetic field can reach out to the rollers. The oppsite also applies, i.e. the roller's emitter layer shouldn't be too thick. A weak magnetic material in the accelerator implies a thin emitter, otherwise the rollers won't stick to the plate's surface.

Since the emitter must be a good conductor, maybe one of its functions is to be a place for the rollers to produce eddy currents in (see section 2.9.)

Another function is a mechanical one: to hold the roller segment/plate together in once piece. If the underlaying layers were pressed powder, I assume that they needed a non-powder emitter (e.g. annealed copper) layer that could ensure the mechanical integrity of the part, since pressed powder is inherently weaker than cast or extruded metal. Sintering at a high temperature will presumably make the parts hold together better, but it also makes them more brittle.

If the emitter layer is made exceedingly thick (i.e. a low-density metal was chosen), it will negatively affect the outreach of the accelerator's magnetic fields (yes, fields: axial main field and pole pattern fields.)

1.1.5 Layered SEG from nylon-bonded powders

A special production method (apart from the two described in section 1.2.1) could've been developed for the layered parts. Here they'd add nylon as a binder to the powder(s) that would make up *each* layer, e.g.

1. the collector layer would be a mixture of neodymium powder and nylon powder,
2. the control gate would be only nylon powder, possibly with glass powder added to increase density, which leads to a thinner control gate layer—A Good Thing$^{\mathrm{TM}}$,
3. the accelerator would be barium-ferrite powder and nylon powder, but,
4. the emitter might've been made from a solid metal like copper or titanium.

1.2 SEG's known (or assumed) to have worked

Table 1: Approximate SEG timeline

when	*type*	*layered*	*layer production technique*	*layer joining technique*
40's (?)/50's	Sintered ferrite SEG	no	pressing & sintering	n/a
50's (?)/60's	Pudding mix SEG	no	pressing & cooking	n/a
60's/70's	Basic SEG	yes	pressing & cooking	unknown
80's	Paul Brown SEG	no	unspecified "molding"	n/a
90's	Roschin & Godin SEG	yes	machined standard materials	sleeving

1.2.1 Early years—sintered ferrite & pudding mix SEG's

I believe that John Searl's first SEG were made from a sintered ceramic ferrite material. At what time this happened is unclear. John Searl says it was in 1946, but I have my doubts about this date, since ceramic barium ferrite magnetes were invented by J.J. Went, G.W. Rathenan, E.W. Gorter, and G.W. Van Oosterhout at Philips in 1952.

To my knowledge, the Law of the Squares was not formulated at this time (40's/50's,) so the plates and roller segments were *unlayered*.

A simplification of the ferrite SEG later emerged: the pudding mix SEG. "Pudding mix" refers to how it was made: you took the desired powders (e.g. ferrite ("iron"), aluminium, titanium, neodymium, sulphur(!), silicon, etc, and nylon for binder) and mixed them well, then you pressed the mixture in a heated mould.

Judging from some replication attempts (see section 1.3,) there seems to be some confusion as to what materials and processes the old team were using.

When the old team wanted to make unlayered parts, they could choose from two different processes:

1. I believe the old team used pressed & sintered parts during the earliest years, mainly because sintered ferrite was an emerging technology at the time, and the Midlands Electricity Board probably had at their disposal the necessary equipment to produce sintered ferrite magnets.
2. later, probably in an attempt to eliminate the difficult sintering stage, they came up with the idea of mixing the magnetic powder and other interesting ingredients with a binder, like nylon.

   This is what I believe is called the *pudding mix* by John Searl. By pressing & "cooking" in one step also obviates the need to extract the pressed, unsintered, part from the mould for transfer to the sintering furnace. Of course a pudding mix part would have a lower density than a sintered one, and presumably of a lesser magnetic strength, but the simplicity of the process was probably appealing to them.

To start either of these unlayered SEG types, you had to apply an external force to the rollers, so that they commenced their orbit around the plates. The intuitive way of doing this is to use the pickup coils—just pulse them in a sequence to move the outermost set of rollers, and the rollers orbiting the inner plates will travel along. Another way to start it could be the use of compressed air.

Like all SEG's made by the old team, the plates and rollers were AC magnetised.

Since these SEG's were not *self-starting*, we can rule out (in this case, at least) that the complex attraction and repelling of roller segments in relation to the adjacent rollers and the plate (see Fig. 3) does not induce a self-start.[3] It appears that it is not the AC magnetisation per se that creates self-starting, but something more subtle.

1.2.2 Heydays—the layered SEG's and the Law of the Squares

This period (late sixties to late seventies) represents the peak of historic SEG/IGV development.

At least two radio-controlled IGV's (P-11 and DEMO-1) and many domestic SEG's were built and operated.

SEG's that supposedly were designed according to the Law of the Squares (LotS) began to appear sometime in the sixties. It is also during this time that the layering of plates and roller segments shows up (I could be wrong on both accounts.) It is unclear whether the layering was inspired by the LotS, or vice versa.

For domestic SEG's, Square 4 was used, and Square 6 was used for IGV's. A quick introduction to the LotS can be found in John A. Thomas Jr.'s book [10].

Square 4 gives four layers, and Square 6 six layers. John Searl claims that, in order to build IGV's, you need more power, and a 6-layer SEG delivers just that. Since this paper doesn't cover the IGV, I will not expound on the subject of 6-layer SEG's.

The LotS was used to calculate material proportions (in grams) of each SEG plate and matching roller segment. It was also used to calculate the AC magnetisation frequencies for the pole pattern of plates and roller segments.

I don't know what materials they used in the layers during the heydays. For example, John Searl writes that they used ”iron” for the magnetic layer in all his texts. This could indicate that:

- John Searl has no clue as to what kind of magnetic material they were using at the time, i.e. someone else (like an old team member) knew/knows,
- he forgot, or,
- he knows, but doesn't want us to know, to make it harder for others to do SEG replication attempts outside of his control, or knowledge.

1.2.3 Roschin & Godin, Russia

In June of 2000, two russians, Vladimir Roschin and Sergei Godin published a paper [17] that dealt with an SEG replication they did some seven or eight years prior to the paper's publication. They

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[3] Vaguely similar to Howard Johnson's permanent magnet motor (U.S. Patent number 4,151,431).

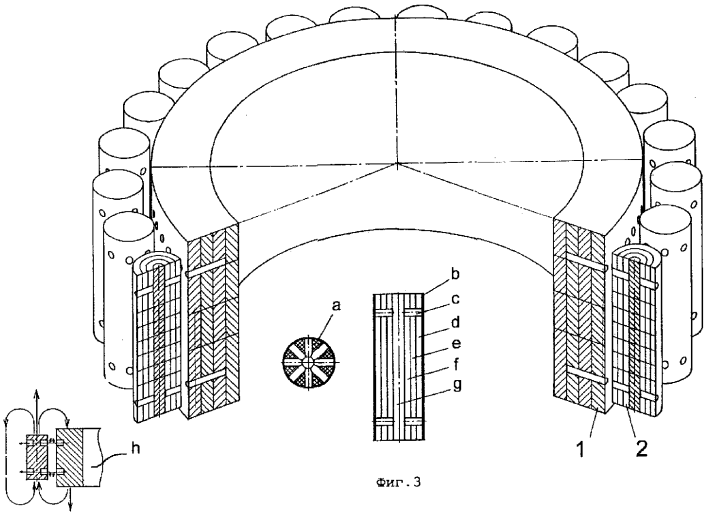
allegedly did this work under the auspices of (or at least in the labs of) the Institute for High Temperatures at the Russian Academy of Science. Officials there deny any association with Roschin and Godin.

The paper describes how they built and tested their own variation of an SEG. It featured solid unsegmented rollers with center bearings (unlike John Searl's rollers,) held in place by ah armature hooked up to an electric motor. The paper also has test data that would seem to confirm at least *some* of John Searl's claims. It also reveals other interesting aspects of the device that John Searl never mentioned, e.g. the magnetic walls phenomena.

What the paper did not mention was the fact that they built several (at least three) non-working prototypes before they finally had one that worked.

Recently, Roschin & Godin were awarded patents in Russia [18] and the U.S.A. [19]. I am using figures from the former to describe their SEG variant.

The Roschin & Godin SEG was very different from the SEG's built by John Searl and his old team:



Фиг. 3

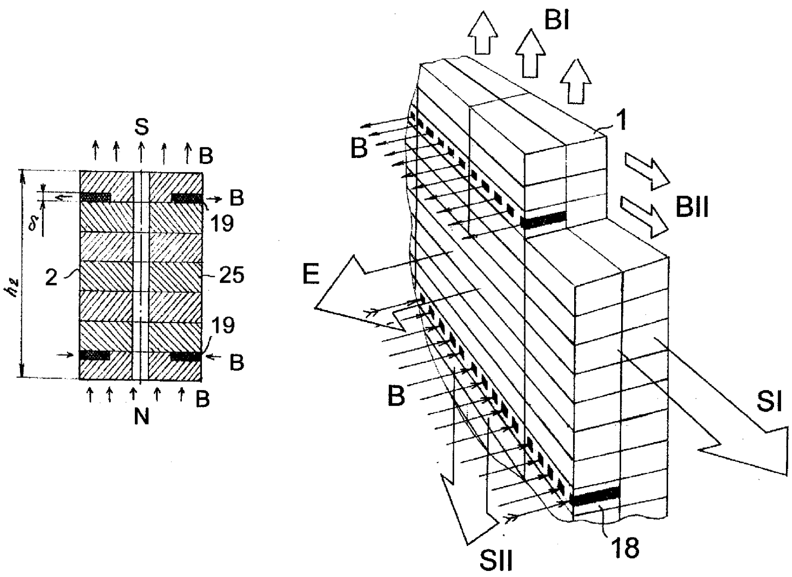
Now, let's figure out the polarities of the radially inserted sprocket magnets in the plate and rollers.

The rollers had two tracks of radial sprocket magnets inserted into small radial holes in the suface. The plate had two matching tracks of radial sprocket magnets inserted into holes. Plate and rollers ware made of the magnetic material samarium-cobalt wrapped in 0.8 millimeter thick copper foil, so you could say that it had two layers.

The rollers were mounted on an armature that kept the rollers evenly spaced around the plate, free to rotate around their own axes. The armature also held the rollers about 1mm away from the plate surface. If moved by hand, the armature would probably experience a jerky motion caused by this sprocket magnet arrangement.

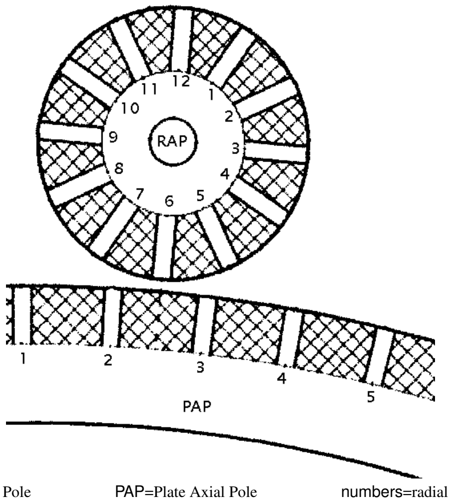
Figure 14 in the russian patent clearly shows the polarity of the roller (left-hand graphic) and plate (right-hand graphic.) This seems to indicate that the rollers and plate were mounted in a repelling orientation. However, the depicted roller and plate in the small graphic h (lower right of the patent's figure 3 shown above), seems to indicate an attractive orientation. Very confusing.

When you study the roller and plate detail in the graphic below (an edited detail of Fig. 11 in the russian patent; 1-12 on roller, 1-5 on plate,) you can see that the roller's sprocket magnets want to



Фиг.14

stay between the plate's sprocket magnets, i.e. the former is apparently repelled by the latter, and the former ends up at a point of equilibrium. Hence their orientation, with roller sprocket magnets never "facing" a plate sprocket magnet.



RAP=Roller Axial Pole PAP=Plate Axial Pole numbers=radial sprocket magnets

Suppose that RAP=N and PAP=S, the roller sprocket magnets 1-12 must be attractive to the plate's main axial pole (PAP) and repel plate's sprocket magnets 1-5, i.e. both roller and plate sprocket magnets would have their N pole near the surface. Other combinations might work too.

For a single-plate SEG, the whole setup was incredibly heavy—350 kg, and 110 kg of that was the plate and rollers. According to my calculations, the 3 plates and 84 rollers of an 30 inch SEG would weigh in at around 60 to 80 kg. A set of pickup coils and an insulating mounting base will probably double that figure—but that is still significantly lighter than the complete Roschin & Godin SEG! Draw you own conclusions.

In its original shape, the Roschin & Godin SEG is—in my opinion—not worthy of replication!

1.3 Modern SEG replication attempts

Almost every modern (after around 1980) SEG replications have failed. I've partially read some of John Searl's books [11, 12, 13, 14, 15] and in them I can count 3 (three) replication attempts (or would-be attempts) in the 1980's: one in the U.K., one in the U.S. and one in Spain.

I also know that DISC, Inc. in the U.S. (John A. Thomas Jr.'s company) are trying their best at this very moment, although on a very tight budget. I know that they have successfully magnetised roller segments, but so have SISRC, Ltd. in the U.K! It seems like roller segments are the easy part of an SEG.

All these four attempts had, or has, John Searl involved. He couldn't help them with the magnetiser, since he seems incognizant of the engineering difficulties involved with the design of high-frequency, high-power magnetic systems, like an powerful AC magnetiser. This is also a strong indication that someone else but John Searl did the electrical engineering during the old days. Maybe he was never informed of the problems involved.

Why have so many failed? I believe the answer to this is simple: the AC magnetisation hurdle. First, people are very enthusiastic and charge ahead with the plate and roller production. Then they realise that they must build a magnetiser. ”OK, no sweat,” is what they initially think. But after a while, it occurs to them that this particular task was beyond both their engineering capability, and not least, their budget.

These circumstances makes me doubt that John Searl really has any know-how of SEG production techniques, and judging from his books, he seems to lack any real engineering capability.

So, behind all this wonderfully designed technology, there must've been skilled people hidden somewhere—people that actually did the engineering, maybe based on John Searl's whims or ideas. Most old team members were old during the heydays, and they must be very old now, possibly even deceased.

1.3.1 Paul Brown, U.S.A.

The young american engineer Paul Brown built a little SEG in 1986. According to copies of his correspondence [9] with *Gunnar Sandberg* (see section 1.3.2,) *Brian Williams*, *Brian Collins* and John Searl, he completed and tested a small SEG, and allegedly it worked! After it had started, he shorted the coils on the C-shaped cores. The conductors began to glow and were soon red hot. This ignited the SEG which continued to burn for another fifteen minues, thus destroying the prototype.

When you look at the correspondence, it is clear that he knew how to build an SEG. Gunnar Sandberg had sent him some of his famous reports ([1, 2] are mentioned therein,) and somehow this information proved to be just what he needed to build one.

His SEG was unlayered, and the plate and rollers were unsegmented. He built his own magnetiser based on the Sandberg reports.

He also designed (but never built) what he tought was an IGV, but the design was flawed.

Paul Brown died in an accident a few years ago.

1.3.2 Brian Williams and The University of Sussex

In 1982, Gunnar Sandberg from the University of Sussex, was given a demonstration by John Searl featuring two bar magnets and two differently-shaped rollers ([1] and [14, pp. 52–70]). Sandberg was impressed by this and the story told by John Searl. He interviewed John Searl a couple of times. From these interviews, he wrote 7 (seven) reports, the famous SEG-001 through SEG-007 that many base their replication attempts on.

Gunnar Sandberg later brought in an investor, Brian Williams, who — according to John Searl — tried to steal the SEG from him. John Searl never signed any papers, though.

John Searl took great offense from Brian Collins' actions.

1.3.3 Paul Hudz, U.S.A.

To my knowledge, this endeavor in 1988 was only committed to paper. They were going to build a pudding mix SEG, consisting of carbon, magnesium, titanium, cobalt, selenium, neodymium, and, of course, nylon.

Nothing seems to have been built, and in one of his books (written a few years later,) John Searl does not approve of Hudz's SEG calculations ([12, pp. 20–22] & [13, pp. 57–60].)

1.3.4 David Stirling, Spain (Lanzarote, The Canaries)

David Stirling tried to hire John Searl in 1989 to help him build an SEG. John Searl belived he was being had, and refused to sign the agreement.

They were apparently going to build a pudding mix SEG. The materials listed ([13, p. 54] were different from those Paul Hudz listed: aluminium, silicon, sulphur, neodymium, titanium, and iron — i.e. the same stuff that can be seen in Sandberg's spectrogram [2, p. 4]. Very interesting. Additionally, the metals hafnium, lanthanum, zirconium, and cobalt are listed, marked with an asterisk—maybe these are alternative materials. Nylon 6 is listed last as the bonding agent.

I assume that nothing was ever built, and I haven't found any corresponding SEG calculations in the Searl books I've read so far. At least they seem to have realised that a **huge** hydraulic presses was requirement, since they list a 600 tonne(!) press.

1.3.5 DISC, Inc., U.S.A.

This is the only current replication effort that is sanctioned by John Searl. They successfully magnetised roller segments in the late 1990's, but I doubt that they have done the same with a plate.

I don't know what materials they are using in their parts, but on photos from around 1996, a thick emitter (outermost layer) of aluminium is apparent. However, later

1.3.6 SISRC, Ltd.

SISRC, Ltd. (formerly known as DISC U.K.) have built a plate and a couple of rollers. They have magnetised the roller segments, but not the plate. For that, they would've needed a much larger magnetiser (several hundred kilowatts,) for which they lacked funding.

In the autumn of 2003, John Searl and SISRC, Ltd. have terminated their cooperation. John Searl is accusing folks at SISRC, Ltd. of burglary, and as far as I know, the case hasn't ended in a court of low.

2 Superficial SEG analysis

This is an attempt to analyse the SEG. The topic of the IGV will be covered in a forthcoming document.

During its operation, the active parts of an SEG interact with one another in many—and poorly understood—ways.

2.1 The two operating states

The SEG operates in one of two *states*: low-energy and high-energy. It is unclear whether any intermediary state(s) exists outside of these two, *or* whether there actually are no states, just energy density. However, at least two other devices known to me (the *MAGVID* solid-state device, and the *Repulsin* air vortex device of Viktor Schauberger) seem to have these two states as well.

Some properties (of the whole SEG or of SEG parts) are believed to exist only in one of the two operating states, and some in both.

2.2 SEG building material factors

Over the years, both working and non-working SEG's have been built from a wide range of materials. Factors like the electrical and physical properties of some materials, price, availability, etc, would need to be taken into account.

Since they were treading uncharted territories, the material choice probably reflected the state-of-the-art at the time as well as the old team's ideas, knowledge, hopes, beliefs, skills, and expectations.

Some of the parameters the old team members had to consider might have been:

3001#1) physical properties:

  3001#2) dielectric constant (for the control gate in layered SEG's),

  3001#3) density of the constituent materials,

  3001#4) powerful magnetic materials (for the accelerator in layered SEG's),

  3001#5) other unknown properties that only the old team knew the importance of.

3001#6) processability: they had to find materials that could be used with what they had at their disposal, like:

  3001#7) the capability to mix self-igniting powders in an inert gas atmosphere,

  3001#8) big hydraulic press,

  3001#9) a mould with built-in heater too "cook" the parts during pressing,

  3001#10) Van De Graaff generator (see section 2.5),

  3001#11) gigantic room-size magnetiser (a modified turbine shaft degausser)

  3001#12) other unknown equipment, skills and capabilities.

3001#13) availability, i.e. I am told that there was a big glass factory in John Searl's neighbourhood, and neodymium (in one form or another) is an important ingredient in e.g. ordinary window glass (it takes away the green tinge caused by iron,) so maybe neodymium was available to the old team for a reasonable price. Today, the price of neodymium have sky-rocketed because of the popularity of NdFeB magnets.

3001#14) price was most likely a limiting factor.

2.3 The pole pattern—magnetic gears

In Fig. 3 , I have tried to depict how one roller moves in an orbit over a plate's surface (i.e. we don't see five rollers here, and please don't complain about that the rollers shown couldn't possibly cover that distance over the plate with the drawn roller diameter—I didn't try to be exact, just conveying the general idea.)

When assembled, a roller will automatically assume the indicated inter-segment orientation, i.e. if you number the roller segments ascending from the top of the roller, the second segment will orient itself 90° from the first, the third back to 0° the fourth 90°, and so on. They do this because of their radial pole pattern fields (and not the individual roller segments' axial main field): imagine one small bar magnet embedded radially across the diameter of the roller segment.

Please note: this is just an analogy[4] —keep in mind that the basic "real" SEG does not have any inserted radial bar magnets,[5] only printed pole patterns from the AC magnetisation! The field structure of the printed pole pattern of a plate or roller segment is probably very dissimilar to the field an inserted radial bar magnet would create.

When orbiting the plate (as seen in Fig. 3), the roller's rotation will exactly follow the printed pole pattern (sine wave) on the plate. The first position is *a*, it then continues clockwise all the way to *e* where the roller assumes the same orientation it had at *a*, from whence it will continue to *b*, and so on, indefinitely.

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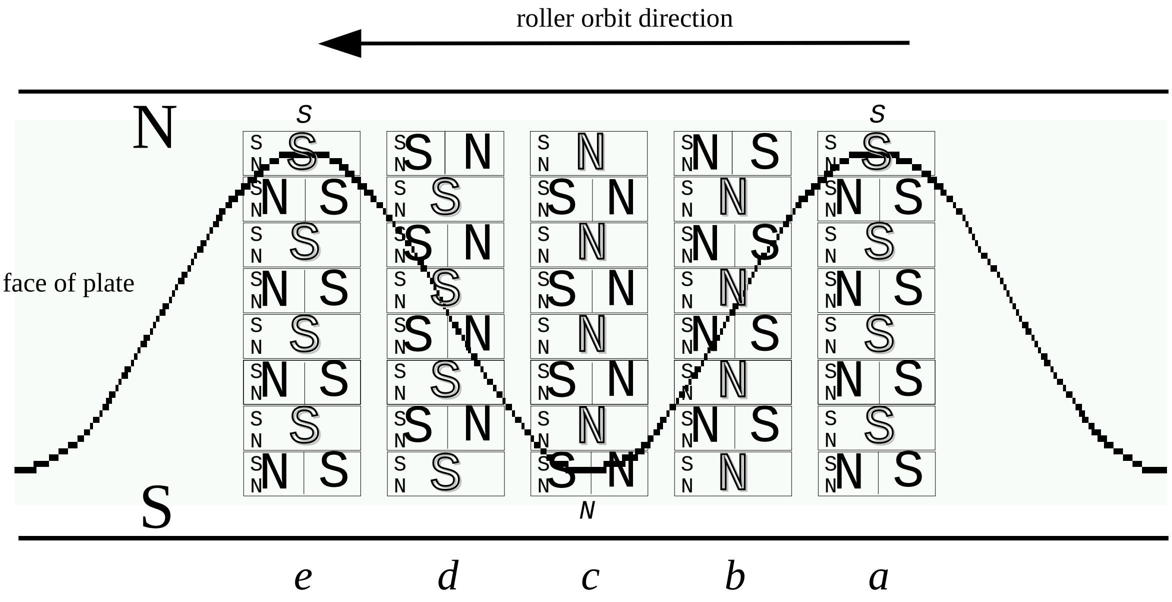
[4] An analogy I imagine R&G were inspired by when they came up with the idea to place bar magnets in drilled holes.

[5] The R&G-inspired SEG types have radial pole pattern magnets inserted (see below.)



Legend: N, S = plate's axially oriented main poles, i.e. from the DC magnetisation

ℕ = N pole on opposite side of roller segment, i.e. vertically oriented and nearer the plate surface

𝕊 = S pole on opposite side of roller segment, i.e. vertically oriented and nearer the plate surface

S | N = the two poles oriented horizontally (line indicates Bloch wall)

N, S = AC component sine wave peaks

S N = [in left corner of] roller segment's axially oriented main poles, i.e. from DC magnetisation

Figure 3: Roller's orbit over plate surface with *printed* sine pole pattern

If a permanent magnet motor effect was at play here, the rollers would eventually come to a halt. There are a couple of permanent magnet motors in existence (e.g. Howard Johnson's and Reidar Finsrud's,) and I believe they all slowly consume their magnets' energy (stored in them by magnetisation), all due to poor coercivity (the ability to withstand an external opposing (demagnetising) field.) At a finnish science museum, they have a permanent magnet motor on display, and whose magnets are replaced every now and then.

The cause for the self-starting is probably not the permanent magnet motor effect, but something else. Maybe a combination of several effects, even when in the low-energy state.

A self-starting SEG will continue indefinitely (in its low-energy state) until stopped or taken to its high-energy state. For any non-self-starting SEG, the rollers will come to a stop sooner or later (I don't know the time frame(s)), unless they're spun up to the RPM where the transition from low-energy to high-energy state takes place.

2.3.1 AC magnetisation

The original way to create the pole pattern in the magnetic layer of the SEG's parts is **AC magnetisation** (also called printing). This is *very* hard to attain—the machinery needed would be gigantic (see section 2.2) and prohibitively costly! A fellow named Mike Furness tries to show this in a Yahoo Groups posting.[6]

Of course we need to have some sort of pole pattern on the plate and roller segments, but doing it the ”real” way just seems too hard for most of us. And to AC-magnetise a plate with an NdFeB layer (even if each segment is magnetised seperately before assembling the whole plate) is undoubtedly waaaaaaay beyond most peoples funds. With buckets of money, one could probably hire people to do it. And the magnetiser would weigh several tonnes and involve **big** power amplifiers for the AC signal.

Another problem is that no one can tell us what frequencies to use for a roller segment or plate. One way to find the frequency would be trial-and-error, but this is a bigger obstacle than you might first expect. At best, it will consume a lot of time just to find the right frequencies for the roller segment and plate (implies many magnetisation/measurement/demagnetisation cycles before you get it right, but only if you can demagnetise the chosen material, that is!) At worst, you'll have to buy new unmagnetised magnets for each trial, and that would be a financial disaster! Trial-and-error could work if we could find some magnetic material that's easy to magnetise and demagnetise. As long as you can measure the printed pole pattern, it's good enough. Ferrite could maybe be used for this, but not NdFeB!

When you've found the suitable frequencies (one for the roller segment and one for the plate), you're able to switch to a more powerful magnet material. If you're lucky, you could even formulate your findings in equations, so you don't have to do it all again for the next SEG you build.

When we have a working R&G-inspired SEG, we can probably acquire enough funds for the design of a ”real” AC magnetiser (and a production line for the SEG.) So, eventually we'll get rid of the inserted bar magnets.

2.4 Possible requirement of rare-earth metal in collector

Barium-ferrite (BaFe) is the most common magnetic material in the world. It is used in loudspeakers, microwave ovens, flexible rubber magnets, and what have you. It contains no neodymium as far as I know.

The spectral analysis of the magnetic material discussed in Gunnar Sandberg's SEG-002 report [3, p. 4] (there said to be a combination of two ”ferromagnetic powders”) indicates that neodymium was indeed present in it.

This could indicate that the old team added neodymium powder into the ferrite powders.

However, Roschin & Godin's SEG (see section 1.2.3) was built with the magnetic material samarium-cobalt (SmCo)[7], and samarium is—just like neodymium—a rare-earth metal.

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[6] see `http://groups.yahoo.com/group/aggroup/message/1487`

[7] see `http://groups.yahoo.com/group/greenglow/message/2193`

2.5 Electrets and their possible significance

An electret[8] is a dielectric material that has been permanently electrically charged (polarised), just like a permanent magnet has been permanently magnetised. It is produced by treating a dielectric material (usually while solidifying from its molten state) with high-voltage DC.

John Searl has allegedly said, that they connected a high-voltage source (a Van de Graaff generator) to the parts after they had just been pressed and ”cooked” and were cooling.[9] The obvious points to connect the high-voltage leads would be the innermost and outermost layers.

Since we have assumed that at FIXME FIXME FIXME FIXME layer 1, 2 & 3 are (at least partially) dielectrics

Being an electret, the control gate would generate a low voltage (at a *very* low current) between layers 1 and 3 (and indirectly layer 4, since layers 3 and 4 are electrically connected.) The electret's minus pole should likely be directed towards the next outer layer.

2.6 The self-charging effect

This is what John Searl refers to as the ”kick” or ”static”. Regardless of the effect that lies behind the mysterious self-charging, it is my opinion that it is not important for an SEG's high-energy state. However, I find it more likely that the self-charging is instrumental to the self-starting and low-energy state of an SEG. Maybe it helps amplify the DC field, or create oscillations in conjunction with the roller segments. Nobody knows at this time.

The ferrite SEG does not self-start, even though it was magnetised the same way as the layered types. Also, when I had the opportunity to measure the ”kick” on a roller segment with an oscilloscope at the John Searl seminar in March, 1996. I tested it for magnetism, and noticed that it was unmagnetised.

This 6 to 9 volt ”kick” that I saw on the oscilloscope, fascinated me to such a degree, that I decided to find out as much as I could about the SEG!

A possible cause for this effect could be the fact that the parts of the basic SEG were electrets.

2.7 The self-starting effect

According to my opinion, the main cause of this effect is the self-charging effect. It obviously belongs to the low-energy state.

The magnetic gears (magnetisation) maybe has some part in this, but the magnetic gears themselves just won't make it! What really happens deep inside the active parts is unknown. Maybe an oscillation that is created by the gears and the electrons from the self-charging effect. We will find out eventually!

2.8 The Law of the Squares

This is weird. Really weird. Anyone who has read books 1, 1A and 1B know this. I have heard of people that design a diversity of things based on the LotS, claiming it will increase their efficiency.

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[8] see `http://en.wikipedia.org/wiki/Electret`

[9] ”cooking” implies a thermoplastic binder like nylon 66

That's what I think it *could* do to an SEG—increase its efficiency.

Some people say that it's the LotS that creates the self-charging effect, and hence the self-starting. I did my own home-made 4-layer roller segment (singular, Cu+NdFeB+PTFE+Nd, never magnetised) a few years ago. One thing I noticed was that my home-made segment had very different dimensions to the one I saw and measured in March 1996, so I wonder if that particular segment really was made according to the LotS. John Searl has stated that the smallest roller segment that can be made must weigh 34 grams, and that means Square 4 Level 2 in LotS terminology. The segment I saw in March 1996 had a much smaller diameter and was thicker than the 34 gram one I made (if I remember it correctly.) Maybe it was a Square 4 Level 2 segment, and they simply choose to have another thickness and diameter.

I think that the LotS could have its merits, so my opinion is that we *might* use the LotS to calculate the weights of the parts of our SEG's, although that shouldn't stop us from trying other (sometimes more practical) material proportions.

2.9 Currents induced in plate and rollers through roller motion

When the rollers orbit the plate (and they themselves spin around their own axis), their magnetic fields (both main axial and radial pattern field) will create eddy currents in the plate's emitter layer, and probably to some degree in a conducting accelerator (magnetic) layer. The opposite is also true, i.e. the plate's fields will create eddy currents in the rollers.

It is believed that these eddy currents help keep the rollers near the plate surface, instead of these just departing away from plate due to centrifugal forces. A small gap will be maintained that separates the rollers from the plate surface; thus totally eliminating friction if operated in a vacuum, e.g. in the IGV, or an evacuated SEG enclosure for domestic models.

It is not known at which roller orbit velocity this effect becomes noticeable.

The above applies for SEG's that have at least one conducting layer. So, how did the ferrite SEG keep its rollers from departing? I have no idea.

These eddy currents could also have another function. On page 2 of his paper *How the Searl Effect Works: An analysis of the Magnetic Energy Converter*,[10] Paul A. LaViolette points out:

> ”The clockwise displacement of the ring of magnetized rollers (clockwise as viewed from above) generates a radial current that induces electrons to flow outward from the central stator ring to the roller ring and on outward.”

This could help explain how electrons are drawn out from the plate and rollers, in conjunction with the self-charging effect that is at work even if no eddies are induced due to moving magnetic fields (i.e. even when the rollers are not orbiting the plate.) This probably requires the presence of neodymium metal to supply the electrons drawn out, so I guess the ferrite SEG here creates even more questions.

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[10] see `http://groups.yahoo.com/group/aggroup/files/SEG/Godin%20%26%20Roschin/MEC.pdf`

2.10 The SEG's transition from low-energy to high-energy operating state

When the roller orbiting velocity of an SEG is steadily increased, it will—at some RPM (presently unknown)—suddenly (or gradually?) enter its high-energy state.

I call this the low-energy to high-energy state transition. This transition can be initiated in a few ways:

3001#15) a SEG in the low-energy state is overloaded by increasing the electric load (see section 2.10.2) placed on it, or,

3001#16) a SEG in the low-energy state is revved up (via an external power source) to a certain RPM when the low-energy to high-energy state transition occurs (applies to SEG's that don't self-start.)

When in the high-energy state, its behaviour changes:

3001#17) RPM will increase even further (by itself).

3001#18) electrons will start to flow in a so-called *bipolar toroidal vortex*—a spheroid consisting of two spinning donuts (on both axes) having two counter-rotating centripetal (sucking) vortices with their funnel throats at either pole, and two (parallel) flat centrifugal (spewing) vortices at the equator region (separating the donuts.) This spheroid of electrons will completely envelop the SEG, accompanied by intense ionisation of surrounding air.

3001#19) the SEG's temperature will fall with increasing RPM, presumably all the way down to just a few degrees Kelvin, making the constituent metals in it is superconductive, regardless of what metals are used. When the SEG goes superconductive, a number of questions arise:

> **3001#20)** how will the Meissner effect (when a superconductor will exclude all magnetic fields from its interior) affect the SEG's operation? [11]
>
> **3001#21)** will a layered SEG form a number of *Josephson junctions*,[12]
>
> where each Josephson junction is formed by layer 3 (copper, will superconduct), layer 2 (dielectric, a non-superconductor), and layer 1 (has metal in it, so it too will superconduct). Four different types of Josephson junctions will form: one in each of the three plates, and one in *each* roller segment. All these Josephson junctions in the roller segments and three plates will create a chorus of frequencies. What these do to the system is unknown.
>
> **3001#22)** what will happen to the mechanical integrity of the SEG when:
>
> > **3001#23)** the parts contract due to the extreme cooling?
> >
> > **3001#24)** the SEG slows down (leaves the high-energy state), and the parts slowly expand back to their ”original” low-energy state dimensions?

3001#25) it will become lighter and lighter, and will eventually repel everything. Since it is smaller than the Earth, the SEG will have to yield, so it will fly away from the Earth. This effect is used in the IGV.

> **3001#26)** when the IGV leaves the earths vicinity, what astronomical bodies are there to be repelled away from? Will the IGV repel itself away from the solar system? And when the IGV leaves the solar system, ... and so on.

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[11] see `http://en.wikipedia.org/wiki/Meissner_effect`

[12] see `http://en.wikipedia.org/wiki/Josephson_junction`

2.10.1 An SEG operating in its low-energy state

Domestic SEG's must **never** make the transition to the high-energy state, otherwise you'd have to mend the hole in you roof.

If not persuaded to do this state transition (from low-energy to high-energy), any sufficiently large SEG will happily struggle along at low RPM's indefinitely, yet fully capable of delivering a decent amount of power, without going to the high-energy state and fly away.

The transition very likely occurs gradually. It would be nice if we could determine this transition curve in the future, when we have working SEG's.

So, how much power will the ”kick” contribute? My opinion is that the self-charging effect only contribute a small amount of the power. Even at low RPM's, I believe that a bipolar toroidal vortex will begin to form, albeit one less dense than in the high-energy state.

2.10.2 An SEG operating in its high-energy state

The energy that circulates in the SEG in this state is just immense, but it can/should be controlled by several means:

3001#27) load resistors (or rheostats) to increase the load (that leads to even higher energy output—totally opposite to ordinary generators,)

3001#28) control coils to counteract the oscillation in the SEG, i.e. to ”brake” it and bring it back to its low-energy state,

3001#29) heaters to heat the plates and thus slowly returning it to the low-energy state,

3001#30) other (yet unknown) means.

The IGV flight cells (i.e. the hydraulic switches and solenoids that directs high voltage from the brushes near the outermost layer of rollers to the rim spikes, and the upper and lower hull outside grid electrodes) probably don't contribute much to the control of the SEG itself. The flight cells only control the flight parameters like direction, attitude, what have you.

When an SEG has reached its high-energy state, the amount of power that can be drawn from it is extremely large. It is also notoriously hard to control in this state—it can break though your ceiling and disappear into space.

As a curious side note, ball lightnings (which I believe have pretty much in common with an SEG in its high-energy state) are capable of boiling off large volumes of water in *very* a short time, e.g. I quote:

> *”In the city of Habarovsk, Russia, a sphere of ball lightning fell into a reservoir containing approximately 7,000 liters of water. In ten second the water started to boil. It boiled for approximately ten seconds. Then the sphere of ball lightning exploded. The yield of this ball lightning was the equivalent of two tons of TNT.”*[13]

My estimate indicates that several giga joules would be required to bring those 7,000 liters of water up to 100°C in ten seconds, and that was just an ordinary ball lightning (usually football-sized.) Now imagine the energy in a 12 meter diameter IGV....

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[13] see `http://www.chukanovenergy.com/bl/`

2.11 MAGVID and SEG compared

I mention the MAGVID[14] (an electronic solid-state device) simply because the theory behind it very neatly explains how the bipolar toroidal vortex is formed—it's all based on the Lorentz force law. I believe the same law can explain how the bipolar toroidal vortex is created in an SEG.

The MAGVID is very simple: four ”motor stator” coils around a static axial magnet in the center. However, I have no idea how to control one when it enters its high-energy state. We at least have a few clues how to do that with an SEG, so I guess a MAGVID spaceship has to come later.

Apart from the MAGVID control problem, I think that the properties that the MAGVID is said to have agrees with what has been said about the SEG. A clip from Vencislav Bujic's (now unavailable) web site:

> Reported effects of Magnetic Vortex Hyper-Ionization Device:
>
> Conventional:
>
> 1) Production of extreme High Voltage.
> 2) The rotating magnetic field spins compass needle.
>
> Unconventional:
>
> 1) EM Doppler effects.
> 2) Time dilation (measured from inside) with all that follows it:
>   - Resultant time compression of EM radiation.
>   - Resultant decrease in perceived inertia and mass.
>   - Resultant greater perceived acceleration with less force (measured from inside.)
>   - Resultant speed compression (low speed inside, appears as high speed outside.)
> 3) Shielding effect on the inside by the oblate spheroids of ionized particles and electrons outside the device. Anything that comes in contact with the rotating ionization cloud would be heated and swirled.

The MAGVID and the SEG both have parts in them that creates:

3001#31) radially rotating magnetic field(s): from the coils in the MAGVID, from the (mostly) radial field lines that go between roller the segment pole pattern and the plate pole pattern in the SEG,

3001#32) static axial magnetic field: from central electromagnet in the MAGVID, from plate axial field in the SEG.

Anyone else see the similarities, or am I just hallucinating again?

3 Building new SEG's, inspired by the Roschin & Godin SEG

3001#33) instead of hard-to-do AC magnetisation, we drill or mill holes or recesses in the magnetic layer of roller segments and plate. In these, we insert small bar magnets (hereinafter called *pattern magnets.*) An implication of this fact: we should use a plate magnet material that is easy to machine (see (3001#35 below.) The pole pattern magnets can be mounted in more than one way:

- **3001#34)** radially, in holes—just like Roschin & Godin(see Fig. 4 on page 32.)
  - **3001#35)** for type 4a & 4b roller segments, you must drill all the way (like a flat bead), since the pole must be present on either side. Please note: I'm not talking about the main axial field!
- **3001#36)** axially, in milled slanted recesses at maybe 135° from the plate's axial plane (see Fig. 5 on page 33.) Paul Horwood suggested this pole pattern magnet layout. To quote him:[15]

  > ”In our version could we use a bar magnet at the correct angle behind a metal plate to do the same thing.”

  I assume that this slanted recess method is only feasible for the plate. Other ways to mount and orient the pole pattern magnets will most certainly come up. The pole pattern magnets could be glued into place, or—if someone is really determined—we could thread the holes and screw threaded pole pattern magnets in place. The next layer (i.e. the one outside the magnetic layer) will also help keep the magnets in place.

3001#37) use wedge-shaped segments for the plate (at least for the magnetic layer.) This method is probably similar to what they did in the old days for large SEG's. However, I don't know if they had an outside Al/Cu/Ti band to hold the plate segments together, a thing that we must have. They also had longer plate segments. How large our's will be must be determined through LotS calculations. Also, depending on the number of rollers orbiting the plate:

- **3001#38)** for 12 rollers on a plate:
  - **3001#39)** for plastic-bonded NdFeB plate wedges with drilled radial holes, you need:
    - **3001#40)** 24 wedges with a drilled hole.
    - **3001#41)** 24 small plastic-bonded NdFeB bar magnets that will be glued into the above mentioned hole.
  - **3001#42)** for plastic-bonded NdFeB plate wedges with milled slanted recesses, you need:
    - **3001#43)** 12 plastic-bonded NdFeB plate wedges with a milled slanted recess across.
    - **3001#44)** 12 small plastic-bonded NdFeB bar magnets that will be glued into the above mentioned hole.
- **3001#45)** for the roller segments:
  - **3001#46)** for types 4a & 4b (disks), you need:
    - **3001#47)** 96 small plastic-bonded NdFeB disk magnets with a radial hole drilled though it.

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[14] Google ”MAGVID” or see `http://groups.yahoo.com/group/MAGVID/`

[15] see `http://groups.yahoo.com/group/aggroup/message/1728`

      - **3001#48)** 96 small plastic-bonded NdFeB bar magnets (round) that will be glued into the above mentioned holes.
    - **3001#49)** for small rings (type 4c), you need:
      - **3001#50)** 96 small plastic-bonded NdFeB ring magnets with two semicircular cutouts in them
      - **3001#51)** 192 tiny semicircular magnets that will fit in the above mentioned cutouts.

- **3001#52)** use a plastic-bonded magnet material for roller segment and plate.
  - **3001#53)** the pros:
    - **3001#54)** it is easier to machine plastic-bonded magnets, regardless of which magnetic material is used.
    - **3001#55)** if made by plastic-bonded NdFeB (e.g. Neomag C, or Neomag H), they don't suffer from excessive corrosion like sintered NdFeB (Neomag S) does when the plating is compromised.
    - **3001#56)** a well-equipped shop could probably machine the necessary moulds to press them in. (Forget injection moulding at this stage — that's for future mass-production.)
  - **3001#57)** the cons:
    - **3001#58)** plastic-bonded NdFeB is a little harder to magnetise than sintered NdFeB (Neomag S.)
  - **3001#59)** a plastic-bonded magnet could (depending on the material used) serve three somewhat different purposes:
    - **3001#60)** be a plain accelerator (layer 2) in a 4-layer SEG. This accelerator layer can be made from any plastic-bonded magnetic material. This is type 4c (R&G-inspired #3.)
    - **3001#61)** be a combination of collector, control gate, and accelerator in one layer! This must be plastic-bonded NdFeB. By doing it this way, we would end up having just two physical layers: Al/Cu/Ti band (emitter), and our plastic-bonded NdFeB layer (accelerator, control gate, and collector.) This is type 4b (R&G-inspired #2.)
    - **3001#62)** be a combination of collector and accelerator. This also has to be plastic-bonded NdFeB. And, yes, you read me right: I have changed the layer order of the original basic SEG layers somewhat (just a hunch—it could work!?) This is type 4a (R&G-inspired #1.) It has one major drawback, though:
      - **3001#63)** since the dielectric layer now separates the innermost NdFeB layer and the outermost emitter layer (Al/Cu/Ti), the dielectric layer must not be too thick (i.e. low-density dielectrics must be avoided), or the fields of the NdFeB layer won't reach out to the rollers; however, NdFeB is such a powerful magnetic material that I think (hope, rather) that the fields will reach out far enough. After all, as long as the rollers stick to the the plate, we're O.K.

- **3001#64)** be a little more Searl-ish, i.e. calculate weight & dimensions with the LotS.

- **3001#65)** avoid some strange Roschin & Godin solutions:
  - **3001#66)** don't use unsegmented rollers.
  - **3001#67)** don't use the pole placement that Roschin & Godin used.

3001#68) use fewer poles in roller segment and plate. They had 24 sprocket magnets per roller, we'll have 8 pattern magnets per roller (one per roller segment.)

3001#69) use the C-shaped pickup coils to start the SEG by moving the rollers on the outermost plate, instead of the engine and the armature used by R&G.

3.1 Type 4a: R&G-inspired #1

This is the simplest—and probably also the least expensive—one to build. It has two layers:

3001#70) combined (actually mixed in a compound) collector,, control gate and accelerator: plastic-bonded NdFeB with pole pattern magnets inserted.

3001#71) emitter: band (for the plate) or tube (for the roller) made of Cu, Al, or Ti.

The first layer (the combined one) in the plate is made from an even number of wedge-shaped segments of NdFeB (1 2 3 in Fig. 4, or 1 2 in Fig. 5.) Each wedge has a radial hole (Fig. 4) or slanted recess (Fig. 5) where the pole pattern magnet is inserted. Please note that the pole pattern magnets shown are probably not to scale.

The sine wave on the plate above is shown just for reference. In reality, the pole pattern magnets won't create an exact sine wave replica, but presumably a more triangular or sawtooth-like waveform. If the sine wave causes some necessary oscillation, maybe our interpolated "sine wave" from the pole pattern magnets will result in similar oscillations. After all, a triangular or sawtooth wave also oscillates, but has a different set of harmonics.

Actually, we may find that the pole pattern formed by this round pole pattern magnet is inappropriate at worst, of inefficient at best (we can at least say: it worked for R&G.) If this happens, a number of alternative pole pattern magnet shapes and placements/orientations must be tried. Maybe Paul Horwood's slanted pole pattern magnets is a better alternative.

3.1.1 The roles of the plastic-bonded NdFeB layer in types 4a & 4b

For these SEG types, we should use plastic-bonded NdFeB. Why? Because the NdFeB layer plays three separate roles: collector, control gate, and accelerator—all in one!

In its collector role, the neodymium metal in the NdFeB alloy will donate electrons. But there's a little catch here: if all the neodymium atoms in the NdFeB alloy have no electrons available to donate (due to valence binding), the whole idea of electron donation from NdFeB drops dead to the ground. But, we could be lucky here: R&G used samarium-cobalt magnets, and if our previous assuption (that the rare-earth metal used in these magnet alloys donates electrons), I believe types 4a and 4b could work anyway—Roschin & Godin's original type worked without a trace of neodymium in it, that means we can probably use any magnetic material for types 4a & 4b.

The control gate is the plastic binder of the NdFeB itself (yes, I know I'm stretching it at bit here), and the accelerator (magnet) is the magnetic property of the NdFeB alloy. Neat, ain't it? Worth trying.

3.2 Type 4b: R&G-inspired #2

Here I've changed the order of the layers. It has three layers:

3001#72) combined collector and accelerator: plastic-bonded NdFeB with pole pattern magnets inserted.

3001#73) control gate: dielectric.

3001#74) emitter: band (for the plate) or tube (for the roller) made of Cu, Al, or Ti—just like type 4a.

Just like for type 4a, the combined collector and accelerator layer must be NdFeB: the neodymium metal in the NdFeB alloy functions as an electron donor. Here we have a separate control gate layer, albeit in the ”wrong” place. If John Searl is right about a control gate being a moderator of sorts, maybe it could be a good thing to have here.

3.3 Type 4c: R&G-inspired #3

This is as near as you can get to a ”real” 4-layer SEG. It has four layers:

3001#75) collector: neodymium metal, cast, or perhaps plastic-bonded (beware: powdered neodymium is explosive, and self-ignites at room-temperature in air!)

3001#76) control gate: dielectric. PTFE has a higher density than nylon 66.

3001#77) accelerator: can probably be of any magnetic material, but for machining simplicity, a plastic-bonded material is recommended.

3001#78) emitter: band (for the plate) or tube (for the roller segment) made of Cu, Al, or Ti—just like type 4a and 4b.

As can be seen, everything but the pole pattern magnets is identical to our ”basic” 4-layer SEG.

The main complications of type 4c are:

3001#79) the neodymium metal in layer 1:

- **3001#80)** if you cast it (can be done in one piece), it must be done in a vacuum or under an inert gas atmosphere. Also, you must ensure that a margin for turning it to its final size is included—casting can be inexact. Turning neodymium is uncomplicated.
- **3001#81)** if you make it from powder, you'll have to order some expensive neodymium powder from e.g. China first. Then you can produce the parts in two different ways:
  - **3001#82)** pressing: under an inert gas atmosphere, mix your powder with epoxy resin and then press your parts. Just out of curiosity, I asked a magnet manufacturer about part sizes and needed pressures. He said that for e.g. a ring of 7 inches across, and a wall thickness of 2 inches, they needed a 320 tonne press that they didn't have anyway. So, for the plate's neodymium metal layer ring, you'd have to make it segmented.
  - **3001#83)** injection moulding: have a plastic raw-materials supplier produce neodymium/ nylon pellets from the powder (these pellets go into the feed funnel of an injection moulding machine.) At the same time, order two injection moulds: one for roller segment center cores (multiple pieces per mould), and one for a plate collector segment. Then find a company with injection moulding machines with hardened screws that can cope with the fairly abrasive (tool-wrecking) neodymium/nylon 66 compound. After this, you're ready to produce your roller segment center cores and plate rings. When you have your parts of neodymium metal bonded with a plastic, you can then either:
    - **3001#84)** use them as they are, or
    - **3001#85)** have them sintered in vacuum or in an inert gas atmosphere (not sure if you can sinter neodymium like this.)

3001#86) for the magnetic layer in type 4c roller segments, you can't do it the way you'd do it for types 4a & 4b: to drill a radial hole all the way through the magnet disk. It would be difficult to machine a small hole in the small plastic-bonded NdFeB ring, the same way you would in a plate wedge. The fields strength of a pole pattern magnet you would place in such a tiny hole will probably not be sufficient. Possible solutions:

- **3001#87)** instead of holes, mill out two semicircular cutouts maybe halfway into the magnet ring (i.e. with a diameter two to three times larger than the tiny hole mentioned in (3001#86.) One cutout on the upper side, and one at the lower side (180° from the other.) Glue semicircular plastic-bonded NdFeB magnets into these cutouts. This way the pole pattern field will be slightly slanted radially. By this arrangement, we don't get a vertically displaced pole pattern field in the roller segments.
- **3001#88)** we could try AC magnetisation for these small magnet rings. If I remember it right, John A. Thomas Jr. can magnetise roller segments, maybe made of NdFeB? We could ask him to do it for us (hopefully for free.)

3.4 Other variations on the same theme

You can probably come up with a few more variations, e.g. a type 4d where you could add an innermost neodymium metal layer to type 4a; thus creating another 3-layer SEG.

4 Summary

Depending on our ambitions, I suggest we do one (or more) of the following:

- **3001#89)** design & build a type 4a SEG (2 layers.)
  - **3001#90)** pros:
    - **3001#91)** it's the cheapest one to produce,
      - **3001#92)** even more so if we come to the conclusion that the neodymium in the NdFeB alloy will not donate electrons, in which case we can use a cheaper magnetic material, e.g. plastic-bonded ferrite.
    - **3001#93)** it's pretty simple to assemble.
    - **3001#94)** very similar to Roschin & Godin original, so it should work.
    - **3001#95)** it has the added advantage that we could (perhaps) reuse the magnetic layer in a type 4b SEG.
  - **3001#96)** cons:
    - **3001#97)** it is probably the least powerful SEG of the R&G-inspired types.
- **3001#98)** design & build a type 4b SEG (3 layers.)
  - **3001#99)** pros:
    - **3001#100)** this one's also pretty simple to assemble.
    - **3001#101)** if you've built type 4a, you might be able to reuse 4a's magnetic layer, keeping costs down.
    - **3001#102)** since we don't need a neodymium metal layer, it's also fairly cheap to produce.
    - **3001#103)** still similar to Roschin & Godinś original, and it could work.
  - **3001#104)** cons:
    - **3001#105)** we don't know what happens when you change the order or the layers.
- **3001#106)** design & build a type 4c SEG (4 layers.)
  - **3001#107)** pros:
    - **3001#108)** still pretty simple to assemble.
    - **3001#109)** if you've built type 4a, you might be able to reuse 4a's magnetic layer, keeping costs down.
    - **3001#110)** this is pretty near the Basic SEG.
    - **3001#111)** still similar to Roschin & Godin original, and it could work.

  - **3001#112)** cons:
    - **3001#113)** we have to cast a neodymium metal ring.

Table 2 and 3 notes:

NdFeB[b] = plastic-bonded NdFeB, SmCo[s] = sintered SmCo

3001#114) the original Roschin & Godin rollers didn't have any segments.

3001#115) casting large neodymium metal rings is pretty hard.

3001#116) neodymium rods can be purchased, or you can turn neodymium ingots into rods.

A Glossary

BaFe Barium-ferrite is the most common magnet material. It is very inexpensive, but not as powerful as NdFeB and SmCo. It is either sintered or bonded with a plastic material.

electret An electret YADDA YADDA

NdFeB Neodymium-iron-boron is a rare-earth high-power magnet material.

NdFeB[b] NdFeB bonded with a plastic material, e.g. epoxy resin (compression moulded), or nylon (injection moulded).

SmCo Samarium-cobalt is another powerful rare-earth magnet material. It is very expensive.

SmCo[s] Sintered SmCo.

sleeving This is a process in which each SEG layer is manufactured separately. Thereafter—by e.g. heating and/or cooling selected layers—the parts can be joined together by fitting one inside the other. To reduce inter-layer slippage, some kind of circumferentially oriented mating grooves could be needed for some material combinations.

Example: how to manufacture the plate for SEG type 5 (three layers):

3001#117) glue all NdFeB[b] inserts into NdFeB[b] ring segments,

3001#118) glue all NdFeB[b] ring segments to make the layer 1 ring,

3001#119) place your ring 2 (dielectric) on surface with lowest possible heat conductivity,

3001#120) put your layer 1 ring (NdFeB[b]) in the freezer,

3001#121) put your layer 3 ring (copper) in the oven (maybe 200°C),

3001#122) take out your layer 1 ring (NdFeB[b]) from the freezer and fit it inside ring 2 (dielectric), then let layer 1 (NdFeB[b])) reach ambient temperature before proceeding,

3001#123) take out your layer 3 ring (copper) from oven and fit it outside the layer 2 ring (dielectric), then let layer 3 (copper) cool to ambient temperature,

3001#124) check for cracks, twists, warps, etc, if none is found **we're done.**

Note: if the dielectric layer needs to be an electret, this process must be modified somewhat.

press & sinter This is likely the first method used by John Searl and his old team. The method is very similar to that used for pressed ferrite materials. When you want to sinter a powder, it is convenient to mix the powders with a suitable liquid. Since water cannot be used, an alternative like acetone can be used instead.

For unlayered SEG's (e.g. the Ferrite SEG,) all powdered ingredients (probably BaFe powder and neodymium metal powder) are mixed well under an inert gas. Since neodymium metal is so corrosive, they probably didn't use the "wet method" of ferrite production (wet implies that water is added to the mix,) so I assume they had to fill the mould in the same inert atmosphere they mixed the ingredients in. The moulds were presumably tightly sealed to expel air.

The parts were then pressed in a large hydraulic press. After pressing, the parts were extracted from the mould, and then sintered the same way as ordinary barium-ferrite magnets.

Addition of a plastic binder to this ferrite mix (e.g. nylon 66) would be fruitless, since all binder would burn off during sintering. Ash and some carbonic residue would form and contaminate the finished product.

press & "cook" This is probably the second method used by the old team. It might've been used for the unlayered "pudding mix" SEG, and definitely for the layered SEG that was pressed & "cooked".

It is similar to injection moulding in that a thermoplastic polymer (e.g. powdered nylon 66) is used to bind the powders together.

3001#125) for the "pudding mix" SEG, all powders would've been mixed well under an inert gas (just like they did for the press & sinter method.) The parts were then pressed in their mould at an elevated temperature. nylon 66 melts at around 255°C, so this would be the YADDA YADDA! After the mould has cooled somewhat, the finished part is extracted and optionally hooked up to a Van-de-Graaff generator.

3001#126) for the layered SEG (including basic SEG's made by the old team,) a more complicated pressing process had to be used. Exactly *how* this was done is unclear, but a few guesses could be insightful:

  3001#127) yadda

However, this process raises a number of questions:

3001#128) the layers could "diffuse" into one another during pressing, leaving wavy boundaries between layers; thus creating rotational imbalance due to differing densities of the pressed materials? I actually saw pressed powder roller segments at the March 1996 seminar (made by a German fellow), and these had wavy layer boundaries. They also seemed to be exceedingly brittle.

  3001#129) this inter-layer boundary waviness might be reduced by the insertion of very thin tubular sleeves (of suitable materials) that will keep the layers separated. Hopefully, the sleeves will deform in a regular fashion, and the waviness will be reduced. The sleeves should preferably be of the same material as one of the layers it separetes, e.g. a very thin nylon 66 tube between the collector and control gate, and the same type of sleeve between the control gate and accelerator. (For more on the different layers, see section 1.1 above)

- **3001#130)** John Searl states [16] that they used paper in between the layers to separate the powdered materials. They also vibrated the parts before pressing them.

3001#131) how can a dielectric like nylon 66 survive the high temperatures of sintering/”cooking”? Maybe they were using another dielectric, e.g. barium-titanate ($BaTiO_3$, one of the best dielectrics around), and barium-titanate itself is always sintered.

3001#132) nylon 66 has a fairly low density (1.1 - 1.2). If you were to build a 4 kg plate with an outer diameter of 412 mm (16 inches) and a height of 100 mm (5 inches), you’d end up having a very thick nylon 66 layer: 91 mm, and the other three layers will (added up) only equal a mere 4.5 mm, i.e. a thickness ratio of 20:1 between nylon 66 and the other ones, all due to the comparatively low density of nylon 66. Of course, other dielectrics like PTFE (density 2.2) will just halve that amount. Barium-titanate (density 5.85) will leave you with a more manageable 17 mm dielectric layer. One solution could be to scale up e.g. Square 4 level 2 to fit a plate.

- **3001#133)** nylon 66’s density can be increased with a suitable dielectric powder, e.g. glass powder.[16] In this case, the nylon 66 will act as a binder to the glass powder.[17]

3001#134) if the above questions are solved, won’t these parts disintegrate over time (due to oxidation of most notably the neodymium metal layer), unless a protective binder material is added to the powders before pressing? (This binder would have to be taken into account when calculating the layer weights using the LotS.)

Maybe they also experimented with sleeving, i.e. machining (some of) the layers and shrink-fitting them to make the parts. The obvious layer to machine would be the outermost one, usually made of copper, aluminium, or titanium. Copper has the highest density; thus reducing the thickness of layer 1.

radial sprocket magnets I decided to refer to the original R&G bar magnets as *sprocket magnets*, i.e. those small magnets inserted into the surface of the plate and roller. In newer SEG’s, I call them *pattern magnets*.

rare-earth metal Rare-earth metals belong to the Lanthanoid group in the periodic table of the elements.

neodymium samarium cerium

YADDA YADDA YADDA FIXME!

B Document format conventions

Instead of standard enumerated lists like

1. this
    (a) is
        i. a

---

[16] PTFE with glass powder is a standard item at many plastics suppliers

[17] Altogether, glass might be a more suitable material for the control gate.

2. list

this document (and the succeeding documents by the undersigned) will use ordered lists with tags that contains the document number (01, i.e. part 1), a number sign, and list item number (1-999):

3001#1) this

  3001#2) is

    3001#3) a

3001#4) list

I will always use a right parenthesis in the list items, and a pair of surrounding parentheses when referring to a list tag, e.g. (01#12). The sole reason for this complication is: I want to refer to other lists by their tag instead of document name/page number/list number on page.

I could have used URI's instead, but they are bulkier and less human-readable, e.g.

`http://nonexistent.org/SEG/documentfile.html#list12point3`

References

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[3] Gunnar Sandberg's SEG-003 report. `http://www.stacken.kth.se/~mathias/searl/SEG-003.pdf`.

[4] Gunnar Sandberg's SEG-004 report. Handwritten. `http://www.stacken.kth.se/~mathias/searl/SEG-004.pdf`.

[5] Gunnar Sandberg's SEG-005 report. Handwritten. `http://www.stacken.kth.se/~mathias/searl/SEG-005.pdf`.

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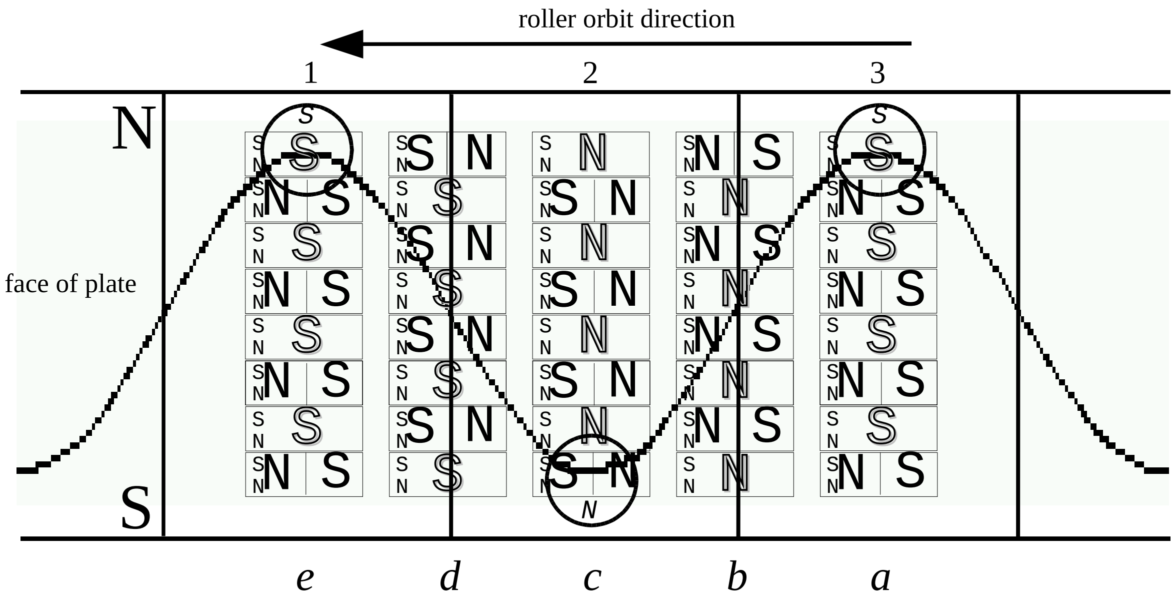
[15] John Searl, *The Law of the Squares, Book 5*, Direct International Science Consortium, London, 1994.

[16] *Searl and Newton Part 1*, video showing John Searl demonstrating SEG mock-up made by Fernando D. Morris, `http://www.youtube.com/watch?v=a-O7WNvKSvY&mode=user&search=`

[17] Vladimir Roschin & Sergei Godin, *Experimental Research of the Magnetic-Gravity Effects*, `http://searleffect.com/free/russianseg/images/russianseg.pdf`

[18] Vladimir Roschin & Sergei Godin, Russian Patent 2155435 *Mechanical energy generating device and process*, 1999, `http://www.stacken.kth.se/~mathias/searl/R-G-russian_patent-2155435.pdf`

[19] Vladimir Roschin & Sergei Godin, US Patent 6,822,361 *Orbiting multi-rotor homopolar system*, 2004, `http://www.stacken.kth.se/~mathias/searl/US6822361.pdf`



Legend: N, S = plate's axially oriented main poles, i.e. from the DC magnetisation

ℕ = N pole on opposite side of roller segment, i.e. vertically oriented and nearer the plate surface

𝕊 = S pole on opposite side of roller segment, i.e. vertically oriented and nearer the plate surface

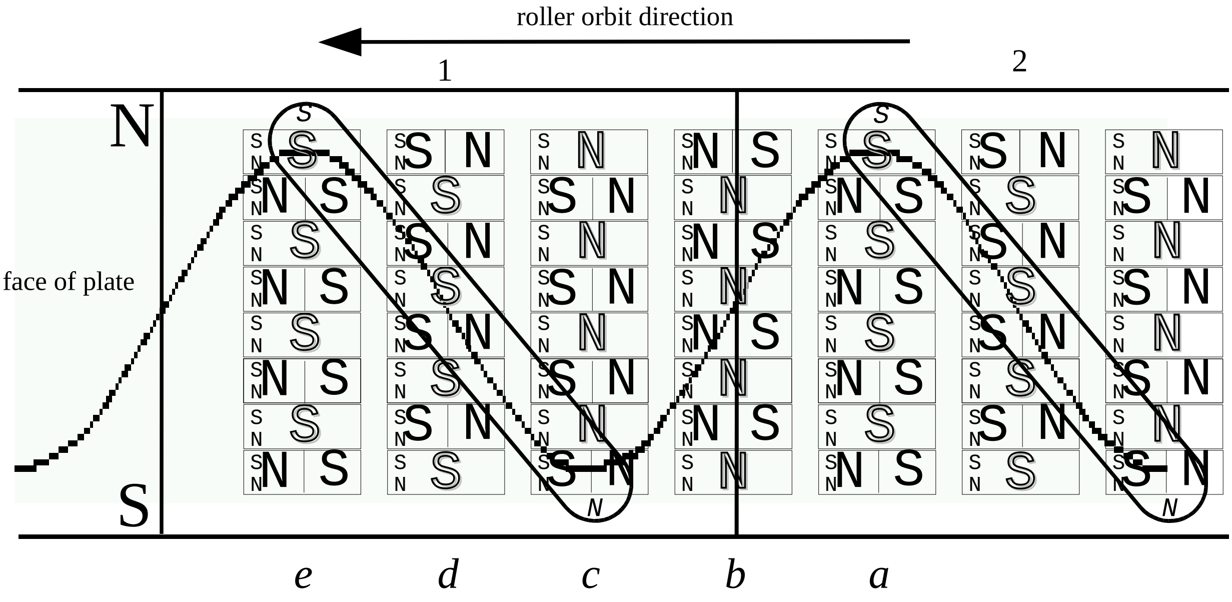
S | N = the two poles oriented horizontally (line indicates Bloch wall)

$\genfrac{}{}{0pt}{}{S}{N}$ = [in left corner of] roller segment's axially oriented main poles, i.e. from DC magnetisation

N, S = one pole of pole pattern magnet, radial field, i.e. other pole of magnet not seen

○ = small inserted bar magnet in hole with field perpendicular to plate

Figure 4: Radial pole pattern magnets in accelerator layer of R&G-inspired types



Legend:

N, S = plate's axially oriented main poles, i.e. from the DC magnetisation

ℕ = N pole on opposite side of roller segment, i.e. vertically oriented and nearer the plate surface

𝕊 = S pole on opposite side of roller segment, i.e. vertically oriented and nearer the plate surface

S | N = the two poles oriented horizontally (line indicates Bloch wall)

$\overset{S}{N}$ = [in left corner of] roller segment's axially oriented main poles, i.e. from DC magnetisation

N, S = both poles of pole pattern magnet, axial field

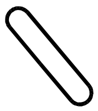

= pole pattern magnet in slanted (135°) recess (Paul Horwood's idea)

Figure 5: Slanted axial pole pattern magnets in accelerator layer of R&G-inspired SEG types

Table 2: Historical SEG types

type	*1: Ferrite SEG*	*2: Basic 4-layer SEG*	*3: Roschin & Godin SEG*
pole class	AC-Magnetised	AC-Magnetised	Pole-Inserts-UnSegmRoller
# layers	1	4	2
layer 1 composition	ferrite	Nd	SmCo[s] with small SmCo[s] inserts in radial holes
layer 2 composition	n/a	dielectric	Cu
layer 3 composition	n/a	magnetic material, probably ferrite	n/a
layer 4 composition	n/a	Cu/Al/Ti	n/a
production method	press & sinter	press & ”cook” **or** possibly sleeving	SmCo[s] wrapped with Cu foil
AC pole creation	magnetised with AC	magnetised with AC	small SmCo[s] inserts in radial holes
AC pole placement	pure sine	pure sine	sprocket
electric params	dielectric	conductor, dielectric, conductor	conductor
self-charging?	no	yes	no
self-starting?	no	yes	no
built according to the Law of the Squares*?*	not sure	yes	no
# bar magnets per plate	n/a		hundreds (hard to determine from R&G’s figures & Godin’s statements in GreenGlow Yahoo Group)
# bar magnets per roller	n/a	n/a	24
# bar magnets per roller segment	n/a	n/a	(3001#114)
plate mfg difficulty (1-5)	3	4	2
roller segment mfg difficulty (1-5)	1	2	n/a
plate m’tising difficulty (1-5)	2	5	n/a
roller segment m’tising difficulty (1-5)	2	2	n/a

Table 3: Suggested SEG types

type	*4: inserts (layer 1)*	*5: inserts (layer 1) with control gate*	*6: inserts in soft iron "accelerator" (layer 3)*	*7: Basic SEG with inserts (layer 3)*
pole class	Inserts-L1	Inserts-L1	Inserts-L3	Inserts-L3
# layers	2	3	4	4
layer 1 composition	NdFeB[b] with small NdFeB[b] inserts	NdFeB[b] with small NdFeB[b] inserts	NdFeB[b] with *no* inserts	Nd metal
layer 2 composition	Cu	dielectric	dielectric	NdFeB[b] with small NdFeB[b] inserts
layer 3 composition	n/a	Cu	unmagnetised soft iron with small NdFeB[b] inserts	NdFeB[b] with small NdFeB[b] inserts
layer 4 composition	n/a	n/a	Cu	Cu
production method	sleeving	sleeving	sleeving	sleeving
AC pole creation	small NdFeB[b] inserts	small NdFeB[b] inserts	small NdFeB[b] inserts in *unmagnetised* soft iron	
AC pole placement	sine peaks pattern	sine peaks pattern	sine peaks pattern	sine peaks pattern
electric params	conductor	conductor, dielectric, conductor	conductor, dielectric, conductor	conductor, dielectric, conductor
self-charging?	unlikely	unlikely	yes, hopefully	whatever
self-starting?	no	no	yes, hopefully	whatever
built according to the Law of the Squares*?*	yes	yes	yes	whatever
# bar magnets per plate	depends on plate circumference	depends on plate circumference	depends on plate circumference	whatever
plate mfg difficulty (1-5)	1	2	4 (3001#115)	whatever
roller segment mfg difficulty (1-5)	1	2	1 (3001#116)	whatever