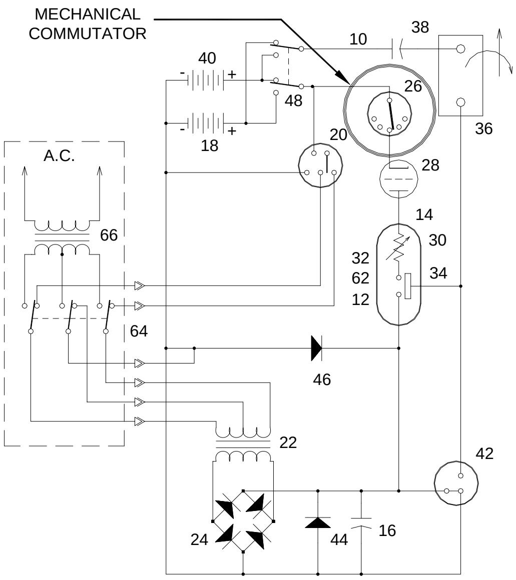
Secrets of the EMA4 and EMA5 Control Commutators (Still Unresolved)

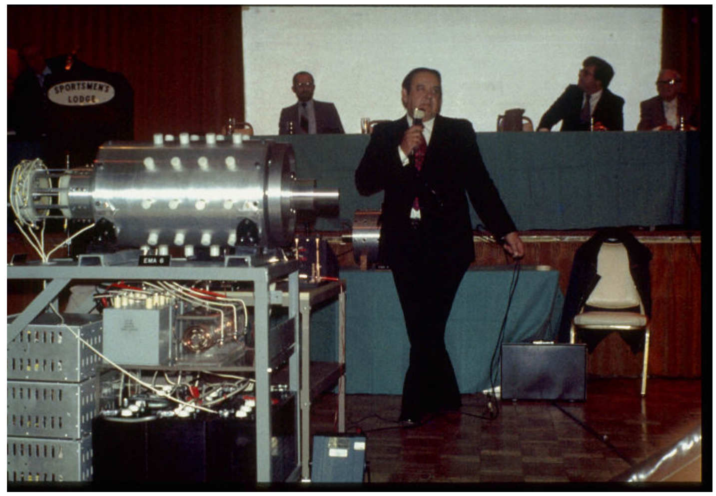
Mark McKay, PE

While the technical revelations provided by the disassembly of Mr. Gray's custom electromagnets is important, the observations collected from the EMA4 and EMA5 control commutators are even more interesting (and perplexing).

Prior to the recovery of the EMA4 & EMA5 it was thought that the attached white cylindrical device on the back end of the EMA6 was a simple rotary positional timing commutator device. According to patent 4,595,975 a commutator like device was included in the schematic diagram. It appeared to be some kind of mechanical rotary switch that controls timed pulses of power to flow through the anodes of the CSET. So when the patent and the photos are examined together the arrangement seems plausible.

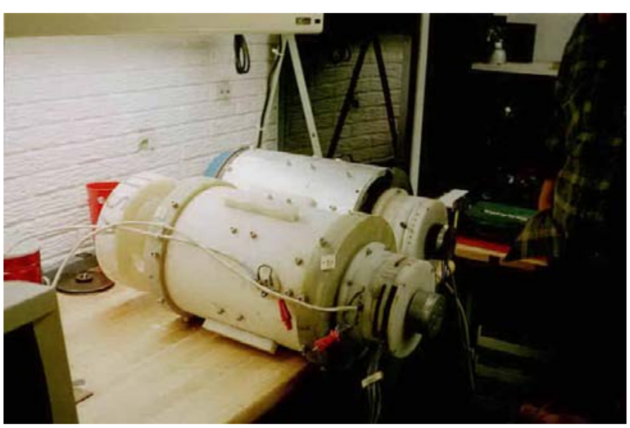


THE GRAY CIRCUIT PER PATENT 4,595,975
JUNE 17, 1986



The EMA6 – with Control Commutator on extreme Left
Stripped down EMA4 motor on back table

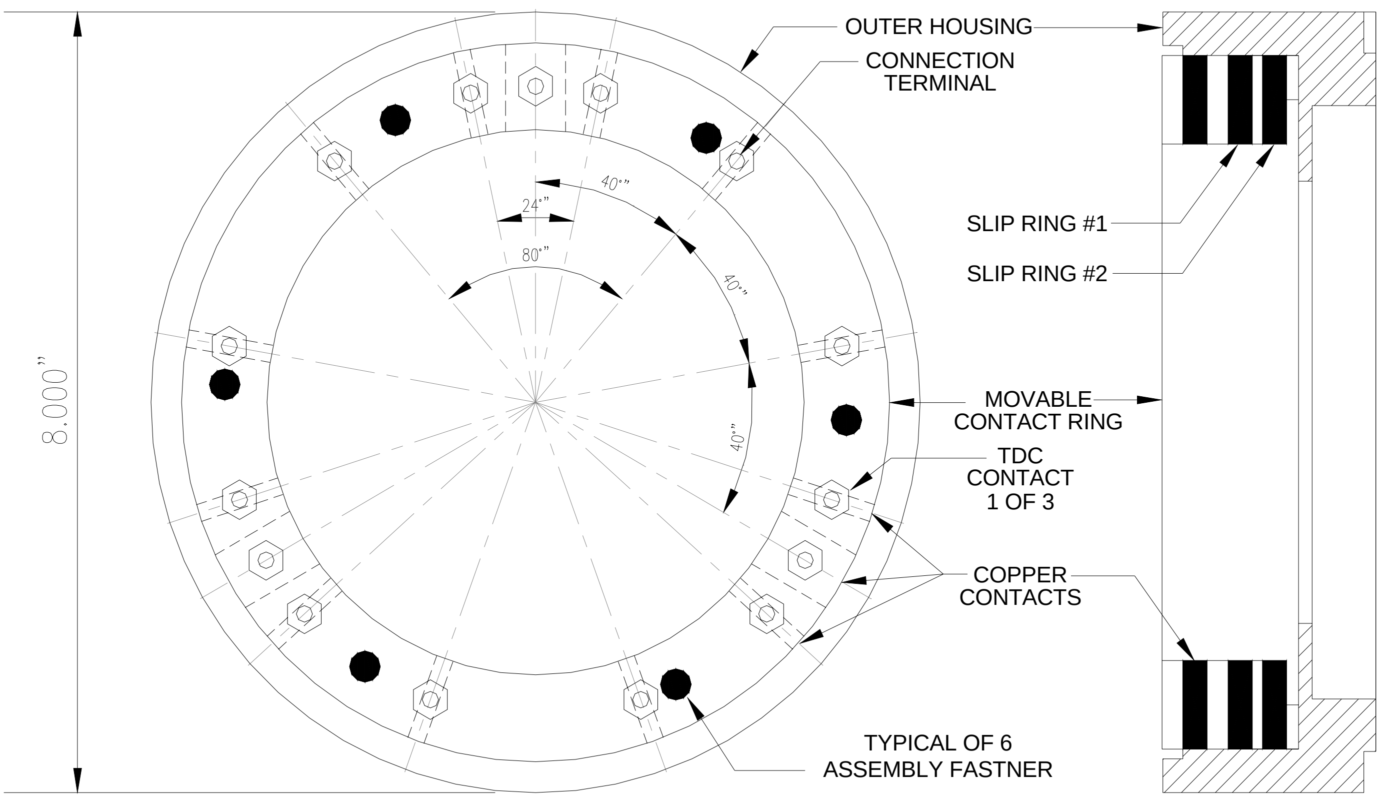
As it turns out the EMA4 and EMA5 motors reveled a much more complex component for researchers to consider. These commutators were constructed in such a way that they contained way more contacts than what would be needed for simple positional feedback. The units that came with each motor were designed to be pretty much the same, however they were wired differently. More control wires were utilized with the EMA5 than with the EMA4. This would be consistent with the fact the EMA4 only had one electromagnet pair to pulse while the EMA5 had three. The EMA5 commutator used 9 of its 15 contacts and was connected with 7 control wires. The EMA4 commutator also used 9 of its contacts but was only connected with 3 control wires.



EMA4 and EMA5 Motors at the time of recovery in 2000
With external Control Commutators mounted on the right

An examination for wear on the commutator contact surfaces, from possible arcing and heating, showed almost no signs of degradation. The conclusion reached from this observation was that whatever energy passed through these devices must have been at a very low level. This being at least two or three orders of magnitude less than what would be needed to pulse all the stator and rotor coils at once. Estimated classical current levels of less than 1 mA at 200 Volts have been proposed as being an upper limit. Mr. Wooten examined these motors from a mechanical point of view, using his professional expertise, and reported that each motor appeared to have logged at least several hundred hours of operation. Yet, you would never conclude that much use by looking at the contact surfaces alone. It is possible that the commutators may have been replaced, prior to being taken out of service, but that is a long shot.

Norman Wooten displaying the Non-Disclosed Complexities of the Timing Commutator from the EMA5 Gray motor at the 2001 KeelyNet Conference[5] – Courtesy Dr. Peter Lindemann



EMA4 CONTROL COMMUTATOR

Observing the lack of wear, the new belief is that the commutators were providing both control timing and positional signals to Mr. Gray's energy converter. They were defiantly not directly switching the prime power that went to the stator and rotor coils. Further more, these timing signals were more complex than ever thought. In the recovered motors the commutator section and the motor electromagnets were wired independently.

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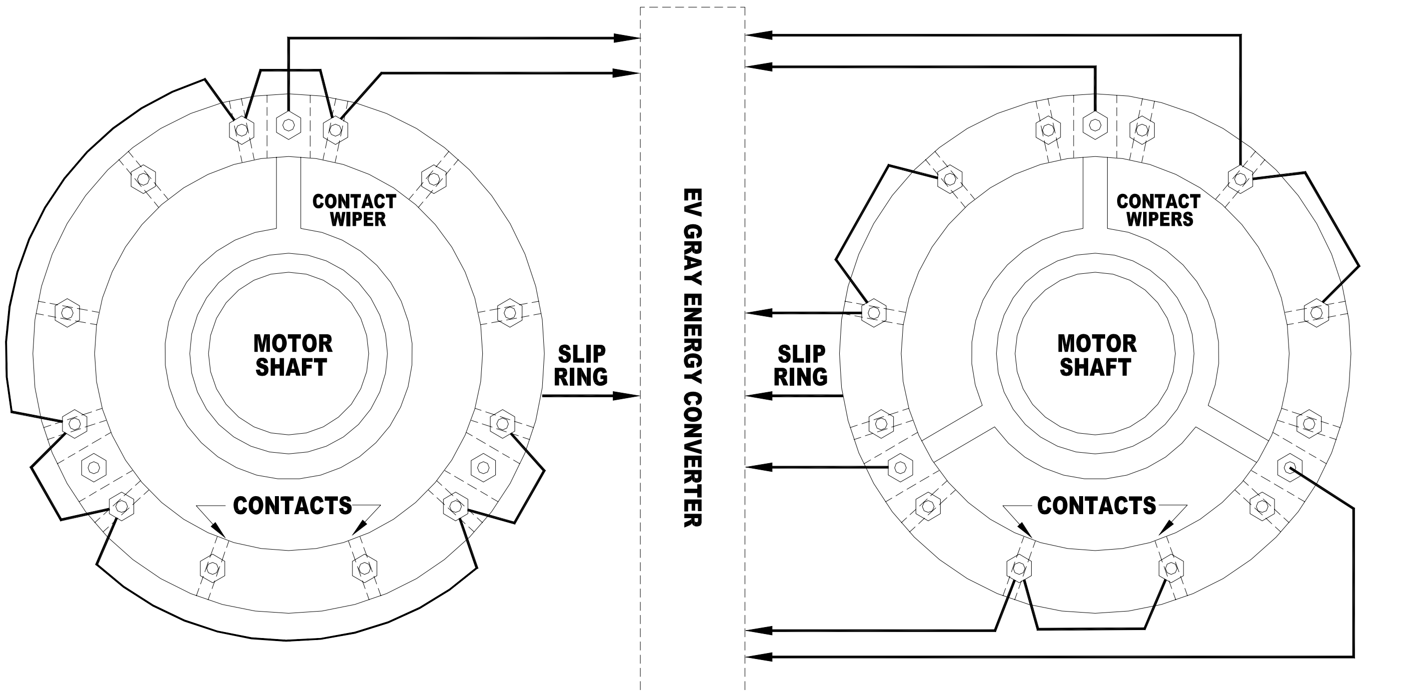
There are 15 contacts and two independent aluminum slip rings in each commutator subassembly. Three of these contacts are rectangular (1/4” x ¾”) copper bars that are three times wider than the remaining ¼” diameter copper rod contacts. For both motors there appears to be two general timing patterns that emerge when looking at the angular spacing relationships of these contacts.

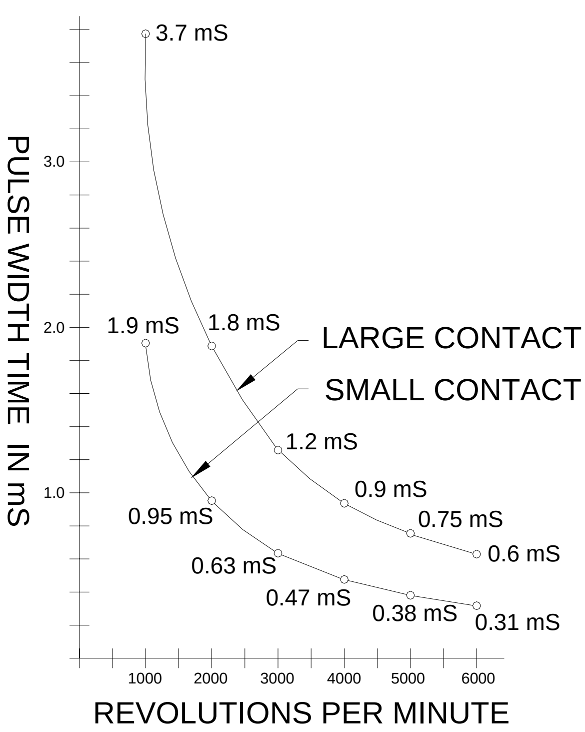
1.) The three large rectangular contacts and 6 of the smaller contacts are equally spaced 40° apart from each other around the circumference of the mounting ring. These would provide a continuous evenly spaced train set of short timing pulses, proportional to the speed of the motor, with every third pulse having three times the pulse width of the others. But, this is not what has been wired to go to the energy converter.

2.) There is also a repeated pattern with three clustered contacts. This group is composed of two small and the one large contact. These seem to be related to the “firing” of the electromagnets when the wiper is about 6° past TDC.

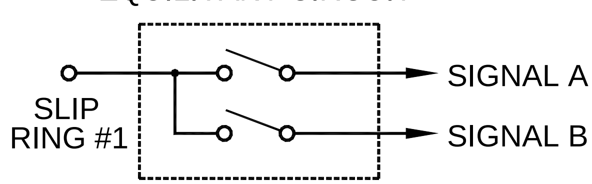


EMA4 COMMNETATOR CONNECTIONS

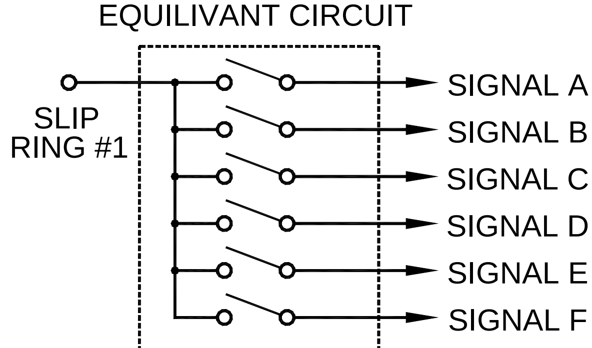
EMA5 COMMNETATOR CONNECTIONS



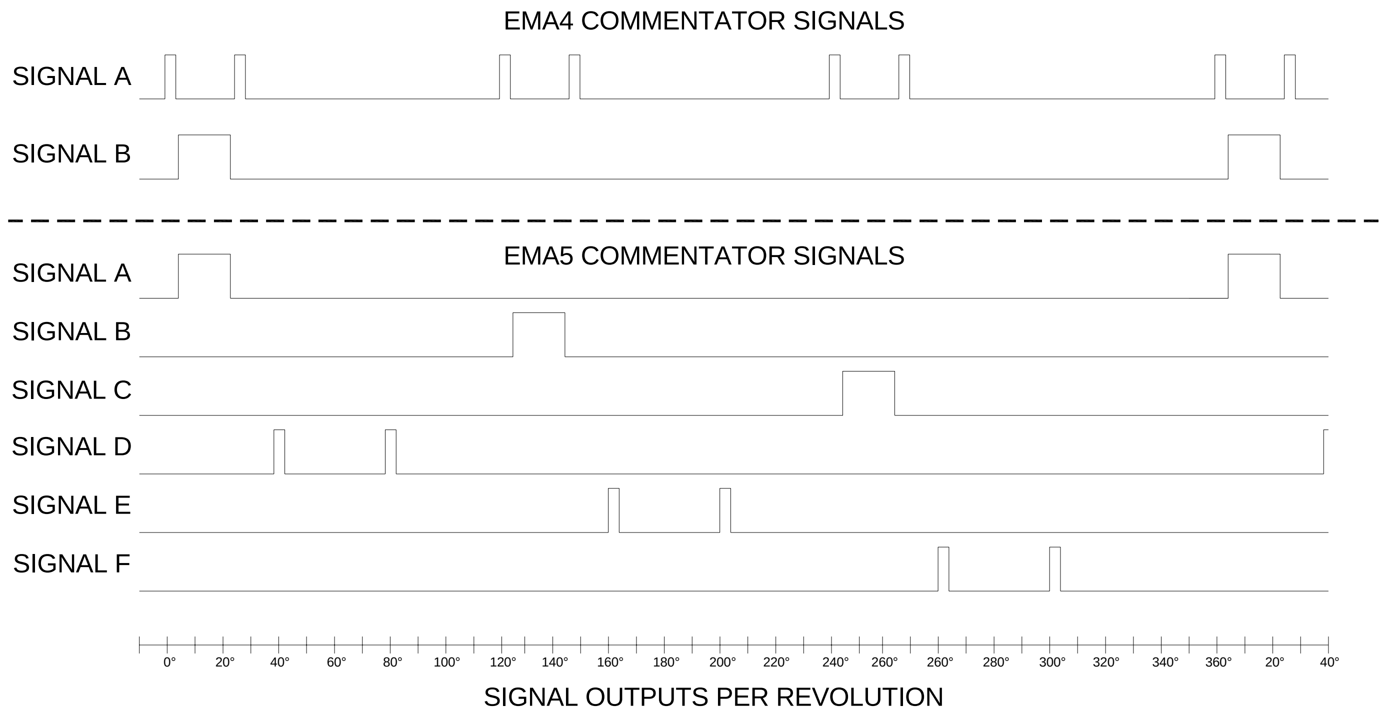
EMA4 COMMENTATOR EQUILIVANT CIRCUIT



EMA5 COMMENTATOR EQUILIVANT CIRCUIT



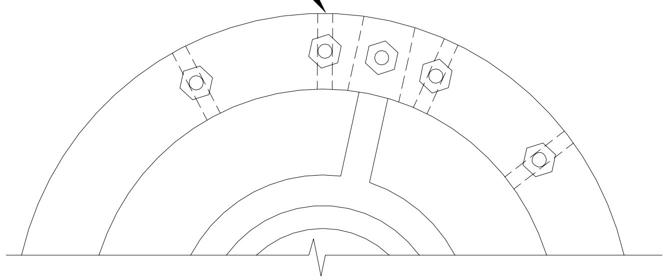
The rotary aluminum shaft wiper houses a spring loaded metallic “brush” that connects each contact to the slip ring in a sequential order. A second aluminum slip ring was installed, but was not utilized in the EMA4. If the slip ring were considered a circuit common then the timing pattern shown in Diagram 01 would be the result. Again not all of the contacts were used in either motor. This is indeed puzzling. Apparently different circuit configurations were being planned that might have used all these contacts.



Timing Diagram 01 for Control Commutators for the EMA4 and EMA5 EV Gray Motors

Mr. Gray used a construction technique that is not generally seen in rotary equipment. There are three slip ring assemblies used in each of these two motors. One assembly is used in the commutator subassembly and has two slip rings sharing a common wiper. The other two slip ring assemblies are used to conduct pulse power through the rotor electromagnets. One is in front and the other is in the back of the motor. All three of these slip ring assemblies have an uncommon internal design. This is because the wiper and “brush” are rotating around the inside of a stationary slip ring. This is just the opposite to 98% of all other industrial machines in the world that use slip rings. Almost always, the slip rings are attached to the rotating shaft and the contacts or “brushes” are stationary. The obvious advantage of this common approach is that it allows the brushes to be easily replaced when they wear down. Another important advantage is that the “brushes” can easily accommodate some imperfections in the roundness of the slip rings that rub against them. This is because the brushes are mounted in spring loaded holders that allow them to move back and fourth. However, in Mr. Gray’s design, a brush or wiper replacement would require way more disassembly. Also, it doesn’t appear that this design could allow for nearly as much deviation from tolerance as the standard brush and slip ring arrangement can. We just don’t know what the application specific reason was that promoted this kind of solution; it certainly is not obvious from looking at the motors alone. Mr. Wooten contends that he could have designed a much better system to get the power into the rotor as well as several other major mechanical system improvements. So far no one has disputed his claim.

It is interesting to note that the Top Dead Center (TDC), the position where the electromagnets are squarely aligned with each other, takes place when the wiper is on the first small round contact in the cluster of three contacts, rather that the larger rectangular contact. Mr. Gray designated this location as 0°. It has been proposed that a certain amount of angular displacement is needed between opposing electromagnets when operating in the repulsion mode to insure that the generated forces are focused in one direction. Perhaps Mr. Gray determined that the optimum angle, for this size motor, is around 6°. The actual working angular displacement could be adjusted. Perhaps this was just a convenient reference point and had nothing to do with the function of the motor.



According to the jacket information the control conductors leading off from the commutators are rated at 25KV. Yet, their overall diameter is equivalent to common #14 AWG THHN household wire (.12” diameter). This is much smaller than typical electronic high voltage wire that has this kind of voltage rating. This wire was probably an expensive specialty cable in its time.

The small spacing between the wiper and the contacts in the clusters of three suggests that Mr. Gray didn’t utilize any classical control voltages that had a differential greater than 200V. If classical electron flow were involved then voltages higher than this would have caused arcing at both the leading and trailing edges of the contacts as the wiper approached and receded from them. Again arcing was not observed. Then what was the purpose of the expensive high voltage cable? One proposal is that all of the control voltages connected to the commentators were elevated to some high value and their differences was less than 200 volts. This means that the whole commutator was “floating” at some high potential above ground. The overall nylon construction of the commentator assembly suggests that it could have easily have supported this kind of high voltage operation (5KV to 20KV). The commutators on the EMA4, EMA5, and EMA6 are all mounted almost independently and external from the motor proper. This construction feature might imply a need for a high degree of isolation between the motor and the commutator. If so, then it is a distinct possibility that the commutator did operate at some high floating voltage.

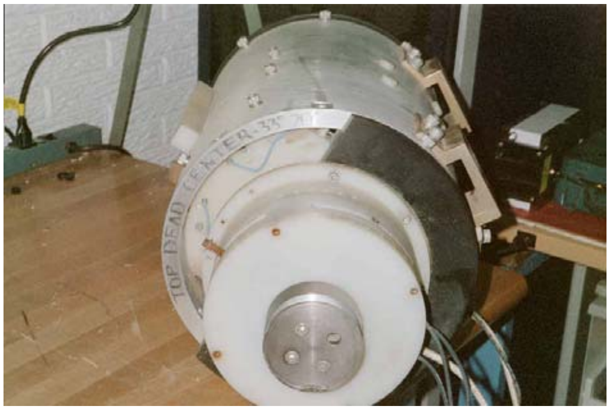
The purpose of the various timing signals has been discussed within the Free Energy community but so far no general conclusions have been tendered that would explain how they affected the energy converter’s circuit operation.

It appears that the energy converter needed at least two data streams, only a portion of which was the simple positional information. The rest of these short contact closures are assumed to be signals that could prepare the energy converter for its next pulse or to, perhaps, facilitate some kind of energy recovery cycle. There are four contacts between each TDC position; therefore there are provisions for as many as four changes of state per each power pulse. Not all of them were used at the time these motors were taken out of service, but they could have been.

Mr. Wooten, in his 2001 video, claims that the commutator compartments were filled with “Luberplate”. This is the trade name for premium quality white lithium machine grease. Given that Mr. Gray didn’t seem to spare any expense in the construction of this sub assembly, then what Norm could have observed might have been a special High Voltage Teflon/Silicon insulation compound that is used in the X-Ray business. This would have help to extend the voltage differential of Mr. Gray’s control signals to maybe 500 volts or so. However smearing insulation grease (or any kind of grease) on moving electrical contacts is a risky business. This is because it is difficult to build a system that will reliably wipe all the grease off the contacts just prior to contact and still provide a consistent low resistance connection.

Both commutators were built so that the contacts are housed in a movable nylon ring. This ring was installed in a larger hollowed out cylinder that acted as a housing so that the whole collection of 15 contacts could be adjusted together in relation to the shaft position. A machine set screw allowed for a wide range of timing angle adjustments (-40° to +40°). At a setting of -16°, according to notes written on the commutator, the pulse motor would run backwards. Probably not at full torque, but this shows that these motors were reversible.

After the recovery of the EMA4 and EMA5 motors the idea that Mr. Gray’s energy converters were dirt simple has come to be questioned. The revised thought is that the Mr. Gray’s low energy technology may have been simple, but the higher power technology now appears to be more complex.



EMA4 Rear View

EMA4 Front View

Photos of EMA4 and EMA5 motors are the courtesy of Mr. Norm Wooten via the KeelyNet

Note: This document is one in a series produced by Mr. McKay as part of his investigation of the work of Edwin Gray senior and he invites readers to contact him if they have any constructive comments or queries concerning the work of Mr. Gray. Mr McKay's e-mail address is mmckay@tycoint.com