COMMISSIONER'S DECISION

SECTION 2 - ACYCLIC DIRECT CURRENT MOTOR

A proposed electric motor was held to be an inoperable theory. No working model was supplied.

Final Action: Affirmed

****

Patent application 312,909 (Cl.310-88), was filed on October 6, 1978 for an invention entitled "D.C. Machine". The inventor is William R. Cruikshank. The Examiner in charge of the application took a Final Action on September 21, 1979 refusing to allow it to proceed to patent.

The application is directed to an acyclic direct current motor or generator, as distinct from a commutating motor or generator. Claim 1 reads as follows:

> A true DC machine consisting of stator frame, stator winding, main rotor, rotor field poles and rotor shaft; in which the field poles on the main rotor are of the same magnetic magnitude and polarity and are directed perpendicular to the inside periphery of the stator; with the stator winding conductors perpendicular to the rotor field in axial planes, the stator core fastened between two stator side frames with one or more narrow inserts of non-magnetic material placed between the stator core and each side frame: the rotor is fastened to but separated from the rotor shaft by means of a flange at each end rigidly fastened to the shaft with one or more inserts of non-magnetic material placed between each flange and the rotor ends, the rotor having a hole through the center of somewhat larger diameter than the shaft: with a means of applying and removing DC voltages and currents from the machine winding, with a means of cooling and lubricating machine parts and fastening machine to rigid supports.

In the Final Action the Examiner refused the application because:

a) The disclosure is insufficient and does not satisfy Section 36(1) of the Patent Act.

b) The alleged invention is inoperable and does not satisfy Section 2 of the Patent Act because it is not useful.

In regard to the insufficiency of the disclosure the Examiner argued (in part):

> In his last letter, applicant has explained a few things, at least he has explained that by "true D.C. machine" he wanted to say "homopolar or acyclic" machine. The examiner was not able to guess that because the machine described and illustrated in Figs. 1 to 4 is not at all acyclic. However, it is still held that the present disclosure is just as insufficient, incomplete and confusing as before, even if all the amendments suggested in the last letter had been entered.
>
> It is still not clear, how the proposed machine could produce D.C., without a comutator, if both windings, on the stator as well as on the rotor, are wound (See present disclosure, page 3, lines 15 to 20).
>
> It is still not clear, how a "squirrel cage rotor", a typical A.C. machine component, can be of any use in a D.C. machine. Applicant refers the examiner for an explanation to pages 5A, lines 24 and 25. These two lines, however, give no explanation whatsoever. It is still not clear, how a squirrel-cage winding could be built into the present machine. Will it be in the rotor or stator? And how could it produce voltage and current if it is stationary (See disclosure page 1, lines 21 to 23) and does not move with respect to the magnetic field. It appears that applicant knows squirrel cage windings by name only and does not understand their purpose and function.
>
> The present disclosure is incomplete and indefinite because it does not say how the slip-rings or current collectors are arranged on the machine. In particular, it is not clear how current could be collected from or supplied to a squirrel cage rotor. This question is even more important for a homopolar machine because in such a machine current collection is a bottleneck and a headache (See copy from Engineering Handbook supplied by applicant). Because of all these questions, a person skilled in the art could not construct a useful machine by following only applicant's present insufficient disclosure.
>
> In his last letter applicant has proposed to modify throughout the disclosure the expression "shielded winding" to read "partially shielded winding". It remains unclear, however, why windings must be shielded, what is gained, and what material is used for shielding. (See disclosure page 1, line 22, etc).
>
> It is still not clear, what the non-magnetic inserts are supposed to do. Applicant, in his letter, paragraph 5(b) says, the non-magnetic insert 3f is "for the purpose of confining the flux to a particular assembly (as much as possible)". But it does not. According to lines 2 to 5 of the disclosure, page 4, the normal flux path in Fig. 2 is from inner core 4A to flux rings 3E. The interposed insert 3f only interrupts this flux path and renders the machine inefficient, if not useless.
>
> ...

It is held that the present disclosure does not "correctly and fully describe the invention and its operation or use as contemplated by the inventor .... in such full, clear, concise and exact terms as to enable any persor skilled in the art .... to make, construct, compound or use it," as required by Section 36(1) of the Patent Act.

On the question of inoperability of the invention the Examiner stated (in part):

At the first page of his last letter, in paragraph 3, the applicant says: "This machine could be more properly called acyclic or homopolar...". Now this statement is a radically new revelation because the machine disclosed and illustrated does not at all resemble an acyclic machine, nor can it be operated in an acyclic fashion.

...

There is another reason, why applicant's machine cannot operate acyclically. In a uniform homopolar magnetic field the rotor must be a single straight conductor. It cannot be wound i.e. looped back and forth. If it were, the voltages induced in one half of the winding sides would oppose those induced in the other half, resulting in a zero output. For this reason, a homopolar machine with a wound rotor will not work. However, that is exactly what applicant has, a machine with a wound stator (See page 3 of the disclosure, lines 10 and 11) and a wound rotor (page 3, lines 19 and 20)....

If, then, applicant's machine is not homopolar, it is still the same machine that was analysed by the examiner on page 4 of the last Action. The three unusual features A, B and C have been condensed from the present disclosure and drawings, and it is therefore again held that the alleged invention is inoperable for the following reasons:

A. Applicant's machine, having a wound rotor, cannot run on D.C. or produce D.C. because it has no commutator, either to energize only certain windings which happen to be in the gap of the motor, or to rectify the output of a generator, as the case may be.

B. If all the stator poles facing the rotor have the same polarity and all rotor poles facing the stator have the same opposed polarity then each North pole would just lock with one South pole, and no torque would be produced by a motor. No voltage would be produced in a generator because no flux would be cut.

C. If rotor windings were somehow shielded, be it fully or partially, from the stator flux so as to eliminate or reduce Back EmF, then no or little flux would cut the conductors, thus producing no or little voltage in a generator and no or little torque in a motor.

If it therefore held again that the device described by applicant is inoperable and not useful.

In response to the Final Action the Applicant says (in part):

a) The objections raised under Sufficiency of Disclosure are not valid because the machine parts complained about are well known to one knowledgeable in the art for example slip rings.

b) Objections raised under Operability are not valid because the machine described do not function and are not arranged the way the examiner thinks they are and because he has not correctly applied machine principles.

We have reviewed the disclosure and have taken into consideration the Applicant's arguments as presented in his letter of December 18, 1979 in reply to the Final Action. On page 2 of the letter the applicant states (emphasis added):

> An acyclic machine by definition is one in which the field poles do not alternate in polarity so the machines I have described are definitely acyclic. The machines shown in the Standard Handbook for Elec. Eng. are essentially acyclic and UNIPOLAR (they have only one pole which consists of coils wrapped concentrically about the shaft but on the stator). The machines I have described are <u>acyclic but NOT unipolar</u>.

The following definition of a homopolar generator or a homopolar machine appears in the "McGraw-Hill Dictionary of Scientific and Technical Terms" 2nd ed., 1978, D.N. Lapedes, editor in chief:

> A direct-current generator in which the poles presented to the armature are all of the same polarity, so that the voltage generated in active conductors has the same polarity at all times; a pure direct current is thus produced, without commutation, also known as acyclic machine; homopolar machine; unipolar machine.

An acyclic machine is, therefore, by definition, the same as a unipolar machine.

The question which the Board must decide is whether the Applicant has made a new invention which makes the above definition of acyclic machines outdated, as suggested by the Applicant, or whether there is some error in the proposed machines which makes them inoperable.

In order to answer this question we repeat here the following paragraph from the Final Action:

> There is another reason, why applicant's machine cannot operate acyclically. In a uniform homopolar magnetic field the rotor must be a single straight conductor. It cannot be wound i.e. looped back and forth. If it were, the voltages induced in one half of the winding sides would oppose those induced in the other half, resulting in a zero output. For this reason, a homopolar machine with a wound rotor will not work. However, that is exactly what applicant has, a machine with a wound stator (See page 3 of the disclosure, lines 10 and 11) and a wound rotor (page 3 lines 19 and 20).

In reply to this paragraph the Applicant argued on page 3 of his letter as follows:

> Single Straight Conductor.
> Since the field poles are on only one side of the winding or armature what would induce a voltage in the opposite side in the opposite direction? The flux changes direction from perpendicular to parallel.

We place on record as of interest the following prior publication entitled "Homopolar Induction Machines", Canadian Electrical News by A.M. Gray, March 1, 1913. The article discusses impossible homopolar machines, and explains the Examiner's objection and the Applicant's question as follows:

> Much time has been spent in the endeavour to design a homopolar machine which will not require sliding contacts, and the usual result of such wasted energy is a machine such as that shown diagrammatically in Fig. 2; the operation of this machine is based on one if not on two fallacies.

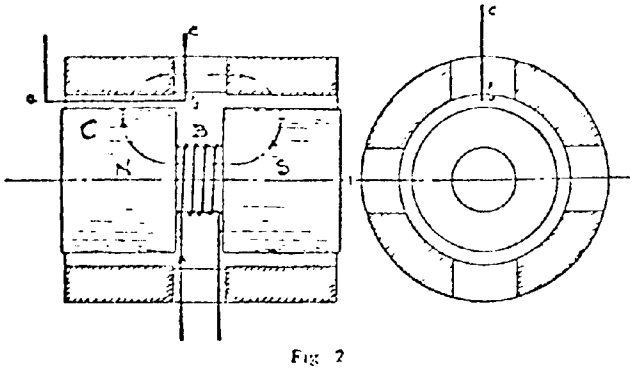

Fig. 2

> If a direct current be passed round the exciting coil B, a magnetic field is produced as shown and the assumption is made, which may or may not be correct but which has not been proven experimentally, that as the rotor C revolves, the magnetic field revolves with it, and the lines of force cut the stationary conductor ab generating a voltage therein; it is also assumed that, since the conductor bc is brought out through a large opening and is therefore in a weak magnetic field, the lines of force will slide around the conductor in some way or other without cutting it, or, if they do cut the conductor, that the voltage induced therein will be very small because of the low flux density in the surrounding space.

The article goes on to state that the latter assumption is wrong. Although the flux density in the air space is low, the velocity of the lines of force is large, and the same number of lines are cut by a conductor in the air space as by a conductor embedded in iron. The Applicant has stated in his letter that the expression for the induced voltage is E=BLV.

> In Figure 2 (of the publication), the same total flux is cut by conductor bc as by conductor ab, and the voltages induced in these conductors are equal and opposite, so that the resultant voltage measured at the terminals ac is zero.

Looking at Figure 2, we note that the flux also changes direction from perpendicular direction to the parallel direction as argued by the Applicant. Using the well known right-hand rule it is seen that the voltage induced in line ab cancels the voltage induced in line bc. We, therefore, must conclude that the dictionary definition of an acyclic machine should be maintained unchanged and that in fact Applicant's machines cannot work. It is also noted that the Applicant apparently does not have a working model of his machines, though one was requested by the Examiner (paragraph 8 action of July 23, 1979). This is a further indication that the applicant's invention is a question of theory which has not been reduced to a practical form (Sections 28(3) and 40).

To further support our conclusion we refer to page 1 of Applicant's disclosure which states (in part):

> The stator winding may be wound, squirrel cage or shielded winding with a DC voltage applied to or removed from the stator windings.

Similarly, claim 1 (12-14) contains the expression:

> ... with a means of applying and removing DC voltages and currents from the machine winding ....

Figure 1 of Applicant's drawings shows a stationary stator. Since the stator does not move,brushes or collectors are not needed on it.

We now quote from the following reference which is cited as of interest and which is entitled "the Unipolar Generator", Westinghouse Engineer, March 1956, vol. 16, pages 56-61:

> Most unusual is the young dc machine designer who has not schemed to turn the unipolar "inside out" so the voltage-generating, current-carrying parts could be on the stator. This would avoid all the brush and collector problems. However, to date, all attempts have failed. As Mr. B.G. Lamme once said, "You can't fool the flux."

We do not think it necessary to discuss this matter any further. Solutions to the problem which the applicant has set out to solve have been tried before by many people. All designs of acyclic machines having voltage generating or current carrying parts on the stator are unsuccessful because they are based on fallacies as discussed above.

We have considered all the arguments presented and have carefully reviewed the application. The Applicant's design of acyclic machines is based on fallacious theory. We, therefore, support the Examiner's rejection of the application under Section 2 of the Patent Act for inoperability.

C.A. Asher
Chairman
Patent Appeal Board, Canada

S. Kot
Member

I have reviewed the prosecution of this application and considered the recommendation of the Patent Appeal Board. I concur with the reasoning and finding of the Board. Accordingly, I refuse to grant a patent on this application.

J.H.A. Gariepy
Commissioner of Patents

Agent for Applicant

William R. Cruikshank
5300 Tobin St., Apt. 9
Halifax, N.S.
B3H 1S2

Dated at Hull, Quebec
this 20th. day of March, 1980