WHERE DOES THE OPPOSITE MOMENTUM GO?

A Maxwell-Lorentz Study of Causal Electromagnetic Momentum Transfer and Patent Claims 16-17

Theoretical study - September 2026

This document is a theoretical study. It deliberately begins with ordinary Maxwell-Lorentz electrodynamics and an exaggerated one-light-year thought experiment before introducing the patent timing. The objective is to make the momentum accounting transparent before any claim about a practical device is discussed.

Zoran Ozimec - Inventor

with adversarial technical analysis and drafting assistance from OpenAI ChatGPT, GPT-5.6 Sol, used specifically and rigorously to represent mainstream scientific reasoning

MAXWELL ANSWERS THE TITLE QUESTION

The title is not intended to remain an open question. Under the causal control-volume conditions developed in Part I, classical Maxwell-Lorentz electrodynamics places the complementary momentum in the electromagnetic field/stress system. Matter alone need not form an instantaneous Newton-third-law pair. The remaining question is narrower: what mechanical impulse does the timed Claim 16/17 apparatus retain after every relevant Maxwell-Lorentz momentum term is counted?

1. The Question and the Method

The question is simple: when an ordinary electromagnetic force gives mechanical momentum to matter before a causally separated part of the system can respond, where is the complementary momentum?

This study developed through an extended adversarial dialogue. Zoran Ozimec supplied the patent architecture, timing requirements, engineering constraints and physical interpretation, and repeatedly defended them against objections. ChatGPT was used as an adversarial analytical tool: applying mainstream electromagnetic reasoning, building control cases, looking for cancellation mechanisms, checking causality and momentum bookkeeping, performing calculations, and editing the resulting argument.

The aim was not to insert a desired answer into an equation. A substantial part of the work consisted of trying to recover the conventional zero-net-impulse result without removing the timing that distinguishes Claims 16-17.

> A mildly ironic consequence was that, while trying to test the patent, the analysis eventually became so basic that we found ourselves testing the momentum accounting of the Laplace force itself.

PART I - Thought Experiment No. 1: One Light-Year

2. Begin with an undisputed electromagnetic force

Inventor: Before discussing the patent, can we agree on something completely conventional? A current-carrying conductor placed in a magnetic field experiences electromagnetic force.

Analysis: Yes. For a conductor element the magnetic force is the familiar Laplace form, and the more general local force density is the Lorentz force density.

$$d\boldsymbol{F} = I\, d\boldsymbol{\ell} \times \boldsymbol{B}$$

$$\boldsymbol{f}_{\mathrm{L}} = \rho \boldsymbol{E} + \boldsymbol{J} \times \boldsymbol{B}$$

No new force law is introduced. To avoid the trivial special case of a closed loop in a perfectly uniform magnetic field having zero net translational force, the local apparatus is understood to have a geometry and nonuniform pre-existing external field for which a net conventional electromagnetic force exists.

3. Put the field source one light-year away

Inventor: Make the source of that already-established field one light-year away. The distance is intentionally absurd. I want causality to be impossible to hide.

Assume the remote source has existed long enough that its field is already present at the local apparatus. At time $t = 0$, the local current state is changed and the ordinary electromagnetic force acts according to the field that already exists there.

$$T_d = \frac{D}{c} = 1 \text{ year}$$

For one full year, the remote source cannot contain new causal information about the event initiated at the local apparatus. The local force does not wait for the distant source to be informed; it depends on the local current and local electromagnetic field.

$$\boldsymbol{J}_{\mathrm{mech}} = \int_0^{t'} \boldsymbol{F}_{\mathrm{L}}(t')\,dt'$$

The uncomfortable question is now unavoidable: during that first year, where is the equal complementary momentum?

4. Maxwell answers the question

Electromagnetic fields carry momentum. The field momentum density and total field momentum are

$$\boldsymbol{g}_{\mathrm{EM}} = \varepsilon_0 \boldsymbol{E} \times \boldsymbol{B}$$

$$\boldsymbol{P}_{\mathrm{EM}} = \int_V \varepsilon_0 \boldsymbol{E} \times \boldsymbol{B}\,dV$$

Local momentum conservation is expressed through the field momentum and the Maxwell stress tensor:

$$\frac{\partial \boldsymbol{g}_{\mathrm{EM}}}{\partial t} + \nabla \cdot \boldsymbol{T} = -\boldsymbol{f}_{\mathrm{L}}$$

Now choose the control volume carefully. It contains all local matter, and we subtract the pre-existing static-field baseline. During a short enough interval the newly generated disturbance has not yet reached the outer control boundary, and the remote source is still causally unable to respond to the new event.

Under those conditions the changed momentum ledger reduces to

$$\Delta \boldsymbol{P}_{\mathrm{mech}} + \Delta \boldsymbol{P}_{\mathrm{EM}} = 0$$

$$\Delta \boldsymbol{P}_{\mathrm{EM}} = -\Delta \boldsymbol{P}_{\mathrm{mech}}$$

Under the stated boundary and causal conditions, electromagnetic field momentum is not merely one candidate explanation. It is the remaining Maxwell term required by local momentum conservation. The opposite momentum has somewhere physical to be: in the electromagnetic field/stress system.

This is not a photon-thrust substitution. General electromagnetic field momentum is not synonymous with freely propagating radiation. Maxwell stress applies to static, quasi-static, near-field, induction-field, transient and radiative configurations. The mechanical force remains the ordinary Lorentz/Laplace force.

The long distance does not create new physics. It merely stretches the causal delay until the bookkeeping becomes impossible to blur.

PART II - Thought Experiment No. 2: The Man With a Switch

5. Reality sanity check with an industrial lifter

Inventor: Now I want to test something even simpler. Take an industrial electromagnetic lifter. Remove its own ferromagnetic core so we are not relying on a local iron core at all. Keep the coil and a separate iron target. Then play stupid: switch the coil ON and OFF and see whether electromagnetism behaves as advertised.

Removing the lifter core weakens the actuator but does not remove the underlying electromagnetic interaction. With a suitable air-core coil and nearby ferromagnetic target, current in the coil produces a magnetic field, the target responds, and an attractive force exists. When the commanded current is allowed to decay to zero, the current-dependent magnetic Lorentz term in the winding vanishes and the ordinary magnetic attraction collapses accordingly.

$$I \neq 0 \Rightarrow \boldsymbol{J} \times \boldsymbol{B} \text{ may act}, \qquad I = 0 \Rightarrow \boldsymbol{J} \times \boldsymbol{B} = 0$$

Sanity check: ON means the required current exists. OFF means, after the actual coil current has decayed to zero, that current-dependent magnetic force channel no longer exists. This is ordinary electromagnet engineering.

6. Try the Claim 16 timing - and discover the real problem

At an ordinary industrial gap, we now try to turn the active current OFF before the delayed electromagnetic interaction associated with the passive Fe target returns to the active winding. The first obstacle is not Maxwell and not Laplace force. The obstacle is the hardware clock.

- A conventional switch is too slow for nanosecond or microsecond timing.
- The winding is inductive; opening the external switch does not make current everywhere disappear instantly.
- Current and voltage changes propagate through finite conductors, feeds and returns.
- Stored magnetic energy and parasitic paths affect how fast the actual local current state can change.

The patent requirement is therefore not merely "command the switch OFF." It is the physically stronger condition

$$I_{\text{active}}(t_{\text{return}}) = 0 \Rightarrow \boldsymbol{F}_{\text{return},B} = 0$$

If that condition is satisfied, the magnetic return-force term requiring active commanded current is zero. Maxwell is still free to account for electric forces, induced currents, magnetization, field momentum and stress wherever they actually exist. What it may not do is reinsert a current that the physical apparatus has successfully driven to zero.

7. Stretch the clock again - now with the lifter idea

Inventor: If the ordinary switch is too slow, then in a thought experiment we can make the separation absurdly large again. Move the passive Fe target one light-year away. Scale the electromagnetic source as necessary so that the target interaction remains finite. The distance is being used to stretch the clock, not proposed as a practical machine.

At $t = 0$ the source current is turned ON. The field disturbance takes one year to reach the passive Fe target. When it arrives, the target responds and begins accelerating toward the source. The target may be imagined as enormously massive but mechanically free, so its displacement is negligible during the interval of interest; no attachment to Earth is needed.

The target response then requires another year to propagate back to the active source region. Before that return arrives, the active current is switched OFF and allowed to decay completely. When the delayed target-related field reaches the now-current-free active winding, the commanded current-dependent magnetic reaction channel is absent.

$$I_{\text{active}}(t_{\text{return}}) = 0 \Rightarrow \boldsymbol{F}_{\text{return},B} = 0$$

The returning field disturbance has not vanished. Its electromagnetic momentum and stress must still be accounted for. But the ordinary magnetic $\boldsymbol{J} \times \boldsymbol{B}$ term on the now-current-free active winding is not available.

> The one-light-year version makes Claim 16 timing easy for an ordinary switch. Shrinking the machine does not change the physics; it only makes the timing requirement harder to realize.

8. Shrink the apparatus - the engineering problem becomes the invention

As d becomes smaller, the available causal interval scales as d/c. Eventually the ordinary winding cannot establish the required current state quickly enough. That is an engineering limitation, not a prohibition in Maxwell-Lorentz electrodynamics.

The solution developed in this work is a high-speed segmented electromagnetic source: a macroscopic magnetic source whose phase-critical current state is established through multiple short, locally energized causal segments rather than by requiring one transition to propagate around one long winding.

> U.S. Provisional Patent Application No. 64/149,475
> HIGH-SPEED SEGMENTED ELECTROMAGNETIC SOURCE SYSTEM

The detailed architecture is intentionally not needed for the present momentum argument. Its relevance is simple: the thought experiment identifies the required current state; the segmented source was filed to make that state physically realizable at high speed and useful scale.

PART III - Compressing the Same Physics Into Claims 16-17

9. Claim 16: OFF gating

Let the source-target separation be d. The one-way propagation time is d/c and the round-trip causal delay is 2 d/c. Claim 16 deliberately changes the active current state before the delayed returning interaction arrives.

$$I_{\text{active}}(t_{\text{return}}) = 0 \Rightarrow \boldsymbol{F}_{\text{return},B} = 0$$

This is not a new force law. It is an operating condition imposed on an ordinary electromagnetic force law.

10. Claim 17: phase control instead of OFF gating

The continuous alternating-current operating form discussed here belongs to the inventor's later patent development rather than to the granted patent alone. The relevant development trail is:

U.S. Provisional Patent Application No. 64/128,198
Claim 17 timing concept

U.S. Provisional Patent Application No. 64/147,166
Alternating-current operation and timing clarification

The later high-speed source architecture developed to preserve these timing relationships in a physically extended electromagnetic source is separately addressed in **U.S. Provisional Patent Application No. 64/149,475**, HIGH-SPEED SEGMENTED ELECTROMAGNETIC SOURCE SYSTEM.

For continuous sinusoidal operation, Claim 17 uses the causal timing relation

$$f = \frac{c}{4d}, \qquad \frac{2d}{c} = \frac{T}{2}, \qquad I\left(t - \frac{2d}{c}\right) = -I(t)$$

The propagation contribution therefore returns after a pi phase shift. For a real passive target and real apparatus, the material and geometrical response can add further phase and amplitude effects. A rigorous frequency-domain representation is

$$\widetilde{\boldsymbol{B}}_{\text{ret}}(\omega) = H(\omega)\, \widetilde{I}(\omega) e^{-i\omega 2d/c}$$

The patented relation fixes the propagation factor; H(omega) describes what the actual target, geometry and materials add. Again, the novelty is the deliberately engineered causal phase, not a new fundamental force.

PART IV - The Control: Disable the Timing

11. The 10-second control test

Now remove the distinguishing timing condition. Maintain the excitation for approximately ten seconds - enormously longer than the microsecond or nanosecond propagation intervals relevant to the device. When the delayed interaction returns, the active current remains available in essentially the same operating state.

$$\text{timing disabled } \Rightarrow J_{\text{net}} \approx 0$$

In the reduced modeling framework used during this investigation, the long-pulse control returned the conventional near-zero net result. This matters because the same framework does not automatically manufacture a positive impulse. Conventional timing gives conventional cancellation; the patented timing changes the current state at the moment of delayed interaction.

PART V - The Scientific Bargain

12. What is the inventor scientifically entitled to do?

Inventor: Am I scientifically entitled to build ordinary electromagnetic elements, choose their geometry, deliberately switch or phase their currents according to the known finite propagation time of electromagnetic fields, and then calculate or measure what the actual apparatus does?

Analysis: Yes. Classical electrodynamics contains no rule requiring the experimenter to keep a current ON merely because a slower conventional machine normally would. The experimenter may choose any physically realizable current waveform consistent with the complete electrical apparatus. Maxwell determines the resulting fields; Lorentz force determines the resulting force on matter; Maxwell stress and field momentum complete the momentum ledger.

$$\Delta \boldsymbol{P}_{\text{matter}} + \Delta \boldsymbol{P}_{\text{EM}} + \boldsymbol{J}_{\text{boundary}} = 0$$

> The inventor does not get to discard an inconvenient Maxwell term. The physicist does not get to restore a current that the experiment has deliberately switched OFF. Physics must calculate the experiment actually performed.

The man with the switch is therefore scientifically legitimate. The switch itself is not a new law of nature. It is an experimental control variable. If the current exists, the corresponding current-dependent force term may act. If the actual current is zero, that term is zero. If the current reverses phase, the corresponding interaction changes according to the real returning field and the full Maxwell-Lorentz solution.

13. Where does the opposite momentum go?

The first thought experiment answered the momentum question before the patent entered the discussion. During the causal interval, Maxwell places the complementary momentum in the electromagnetic field/stress system.

$$\Delta \boldsymbol{P}_{\mathrm{EM}} = -\Delta \boldsymbol{P}_{\mathrm{mech}}$$

The second thought experiment then asks whether the experimenter may deliberately alter the current before the delayed interaction returns. An ordinary air-core electromagnet and Fe target show the basic ON/OFF logic. The one-light-year version makes the timing trivial. Shrinking the separation turns the problem into high-speed electrical engineering. Claim 16 uses OFF gating; Claim 17 uses phase control; U.S. Provisional Application 64/149,475 addresses the source architecture needed to establish the required current state quickly enough.

> The story is therefore not “reactionless propulsion.” The reaction momentum is not missing. The theoretical question is how electromagnetic momentum is partitioned and transported while the current state is deliberately changed during a finite causal delay.

**Build the electromagnets. Measure the current. Measure the fields. Operate the switches
at the prescribed times. Count every Maxwell-Lorentz momentum term. Then calculate -
and ultimately observe - what the apparatus actually does.**

> **INVENTOR'S POSITION - ZORAN OZIMEC**
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> For me, the net force predicted for the Claim 17 device is as real as the Laplace force itself. I regard it as the mechanical consequence of applying ordinary Lorentz/Laplace force to the actual retarded electromagnetic field and to the deliberately controlled current state prescribed by the timing. This is my scientific conclusion as the inventor. It is not offered as a substitute for independent calculation or experiment; it is the position I ask the calculation and the experiment to test.

PART VI - Mathematical Appendix: Reduced Laplace-Force Timing Derivation

14. General symbolic timing model

This appendix isolates the current-dependent Lorentz/Laplace timing term used in the preceding argument. It is deliberately symbolic: $K > 0$ collects fixed coupling and geometry, and no prototype dimensions, powers or force values are inserted. No separate radiation-force term is added here; electromagnetic field momentum and Maxwell stress remain governed by the conservation equations in the main text.

$$I(t) = I_0 \cos(\omega t)$$

$$T_d = \frac{d}{c}, \qquad \tau = 2T_d = \frac{2d}{c}$$

In the reduced reciprocal timing model, write the useful target force and the delayed return force as

$$F_T(t) = KI^2(t - T_d), \qquad F_R(t) = -KI(t)I(t - \tau)$$

The instantaneous reduced net force is

$$F_{\text{net}}(t) = K\left[I^2(t - T_d) - I(t)I(t - \tau)\right]$$

14a. One-period average and net impulse

Average over one electrical period:

$$\overline{F}_{\text{net}} = \frac{1}{T}\int_{t_0}^{t_0+T} F_{\text{net}}(t)\,dt$$

For sinusoidal current, the two required averages are

$$\left\langle I^2(t - T_d)\right\rangle = \frac{I_0^2}{2}$$

$$\langle I(t)I(t - \tau)\rangle = \frac{I_0^2}{2}\cos(\omega\tau)$$

Substitution gives the general timing result

$$\overline{F}_{\text{net}} = \frac{KI_0^2}{2}\left[1 - \cos(\omega\tau)\right]$$

and the net impulse accumulated over one period is

$$J_{\text{net}} = T\overline{F}_{\text{net}} = \frac{KI_0^2 T}{2}\left[1 - \cos(\omega\tau)\right]$$

15. Claim 17: half-cycle return

Claim 17 chooses the drive frequency from the separation d:

$$f = \frac{c}{4d}, \qquad \omega = 2\pi f, \qquad \tau = \frac{2d}{c}$$

The resulting round-trip propagation phase is

$$\omega\tau = 2\pi \left(\frac{c}{4d}\right)\left(\frac{2d}{c}\right) = \pi$$

$$\cos(\omega\tau) = \cos\pi = -1$$

Insert this into the general result:

$$\overline{F}_{17} = KI_0^2$$

Therefore, over one period,

$$J_{17} = KI_0^2 T > 0$$

Within this reduced Laplace-force timing model, the half-cycle return changes the delayed term from the conventional same-phase cancellation case to a positive cycle-integrated impulse. The force law is unchanged; the causal phase is the changed quantity. The real passive-target transfer function H(omega), introduced in the main text, can be inserted when the physical prototype is specified.

16. The 10-second control: timing disabled

The control interval is chosen enormously longer than the electromagnetic round-trip delay:

$$T_C = 10\ \text{s}, \qquad T_C \gg \tau$$

On the established constant-current plateau, after the propagation transient has passed,

$$I(t) = I(t - T_d) = I(t - \tau) = I_C$$

so the reduced useful and return terms cancel directly:

$$F_T = KI_C^2, \qquad F_R = -KI_C^2, \qquad F_{\text{net}} = 0$$

$$J_{\text{plateau}} = \int F_{\text{net}}\, dt = 0$$

The same result appears continuously for a deliberately slow control waveform. Define its characteristic angular rate by

$$\omega_C = \frac{2\pi}{T_C}, \qquad \omega_C \tau \ll 1$$

For a long control, the return phase is small. Using

$$1 - \cos x = \frac{x^2}{2} + O(x^4)$$

the general timing expression becomes

$$\overline{F}_C = \frac{KI_0^2}{4}(\omega_C \tau)^2 + O\big[(\omega_C \tau)^4\big]$$

Hence

$$\overline{F}_C \longrightarrow 0 \qquad \text{as} \qquad \tau/T_C \longrightarrow 0$$

Thus the reduced timing contribution approaches the conventional near-zero control result when the control timescale is very long compared with the propagation delay. Claim 17 deliberately selects the opposite timing condition: a one-half-cycle return phase.

PART VII - Independent Maxwell Cross-Checks

17. Patent-blind restatement of the same electrodynamics

After the argument in this document had been developed, the underlying one-light-year momentum problem was posed independently to xAI Grok and Microsoft Copilot without initially presenting it as a request to validate a propulsion patent. Despite different wording and different reasoning paths, both systems converged on the same basic Maxwell-Lorentz premises used in Parts I-V.

1. Local Lorentz/Laplace force remains valid and is determined by the actual local, retarded electromagnetic field.
2. At finite separation, equal-and-opposite mechanical forces on two bodies need not occur at the same instant.
3. Electromagnetic field momentum and Maxwell stress are part of the exact momentum-conservation ledger.
4. If the current in a conductor is actually zero when a delayed magnetic field arrives, its current-dependent J x B term is zero; the field momentum does not need to be mechanically deposited in that conductor.

GROK - summary and conclusion

"Keep Laplace. Keep the field."
"B can be kicked. A can be Laplace-free. The books still balance because the field is on the books. That is the whole claim."

MICROSOFT COPILOT - summary and conclusion

"Momentum is conserved when you include matter + electromagnetic field."
*"That's not a reactionless engine claim - it's a sharp exploration of how **field momentum** and **retarded interactions** let you decouple local forces from global conservation. And on that level, yes: your scenario is absolutely compatible with mainstream electrodynamics."*

18. What these cross-checks establish - and what they do not

These AI exchanges are not peer review, experimental validation, or proof that Claim 17 produces net thrust. Their value is narrower and useful: when asked the general electrodynamics question without first being told what conclusion the patent seeks, independent systems reproduced the same mainstream Maxwell premises on which this document relies. The Claim 16/17 result must still stand or fall on complete calculation and experiment.

THE BALANCED CONCLUSION

The title question is closed at the level of Maxwell momentum bookkeeping: the opposite momentum has a physical place in the electromagnetic field/stress system. The engineering question remains open to calculation and measurement: after the prescribed timing and the complete Maxwell-Lorentz ledger are applied, what net mechanical impulse does the real Claim 16/17 apparatus retain?