First, a brief, candid summary of the latest developments in the subject. Details will be filled in later.

Whereas usually the electric current is said to come from the fields within a two wire transmission line, Oliver Hermida says, "We reverse this\(^1\). The flux field (\(B\)) travels down the wires and causes an electric current in the wires.

We shall call the normal theory the conventional theory that current flows down the wires and causes the E-M field. The Normal Theory or Theory N. Hermida's theory, that the field flows down between the wires and causes current in the wires we shall call Theory H.

The third, most recent theory, is a step beyond Theory H, and is called the Catt Theory, Theory C. In this theory, the field (\(B\)) flows down between the wires and there is no electric current. Hermida probably never got this far, although it will be necessary to research his latest writings to confirm this. It is noticeable that Gornik (and I think also Fred Towne) says that Hermida went wrong, and further

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\(^{1}\) Hermida went wrong, and Gornik says his later writings should be dismissed. Gornik has
Inductor

27 May 74/3

Single turn inductor, iron cored.

\[ Z_0 \approx 100 \Omega \]
\[ \mu \text{ very high} \]
\[ Z_n = \frac{1}{\mu} \]
\[ Z_0 \text{ very high.} \]
\[ \theta = \frac{1}{\mu} \] very slow since \( \mu \) very high.

Multi-Turn Inductor

\[ Z_0 \approx 100 \Omega \]
\[ \mu \text{ very high} \]
\[ Z_n = \frac{1}{\mu} \]
\[ Z_0 \text{ very high.} \]
\[ \theta = \frac{1}{\mu} \] very slow.

Transformer

27 May 76/4

\[ Z_0 \approx 100 \Omega \]
\[ Z_0 \approx 100 \Omega \]
\[ C = \frac{1}{\sqrt{\mu C_0}} \]
\[ Z_0 \text{ very high} \]
\[ \theta = \frac{1}{\mu C_0} \]
\[ Z_0 \text{ very high} \]
\[ \theta \text{ very slow.} \]

At P (and also at Q) reflections and contollable occurs between primary & secondary & due between windings of the primary. Again follow the method for X talk between pairs of long lines. (Descirbed in my IEEE Dec 1967 paper. If Xformer core is iron, sensitive places paper analogy will work. For sensitive paper, take a cross section 1 to the paper and 1 to direction of transmission lines (i.e. in Y plane).}
Real iron is not bi-speed iron, so the full μ does not arise on the step or wave front; uses the material. So with real iron the story is more complex, with new wave fronts being generated from behind the original wave front as the effective μ changes (as the magnetic material domains accelerate, your velocity τc μC).

Probably the best model to start with is an air wound Xformer or choke, get familiar with it and proceed from there to the more complex practical case of a slot (1 piece) μ, that is a μ with frequency bandwidth.

Discussion of Xformer on last page

An initial wave front 5, perhaps P, where it sees a change of impedance from 20 to 0, is then a reflection of but some of the energy current continues towards A. If μ is > μc, the velocity between P and A is slower. At 0, reflections occur and also some of the wave front proceeds further to the right on the secondary (3p) of the transformer.

Transmission lines can be cancelled.

Assume no fringing (i.e., imagine a core within a core). K

Keep μ, C the same for line AB + line BC.

Project a step (wave front) down AB 9p at the same time project one down BC. It can be arranged that the first front took currents 6p = -iB equal to those for the second wave front 6p = -iC. Total current down B is then zero.

Note B can be removed if wave fronts are unaffected. This is if stress levels in each energy current is the same.

Integration

Wave fronts can be cancelled laterally.

The Xformer line wave front rules apply to one very segment (side) of energy current just as much as the apply to the full...
energy current. So we can apply ideas of energy current to a small volume.

In a space with \( \mu \) and \( E \), velocity of energy current is \( c = \frac{1}{\sqrt{\mu E}} \) (see note 1).

dec 1967 paper).

Dimension of \( E \). High \( E \) means less voltage drop across for a given displacement current, in the language of Theory N (page).

A conductor allows displacement current or even electric current then itself with no voltage drop. That is what is meant by "a conductor". A conductor is a material with \( E = \infty \).

Velocity of an energy current in a conductor is \( \frac{c}{\sqrt{\mu E}} = \frac{1}{\sqrt{\mu E}} = 0 \).

So an energy current flows through a conductor at zero velocity.

An energy current cannot enter a perfect conductor.

In a flow wire transmission line, the energy current is steered by the wire because the energy current cannot enter it in the same way as water is steered by a pipe because it cannot enter the metal of the pipe.

An energy current does enter an imperfect conductor to the extent that the conductor will allow or sustain voltage drops through itself (voltage drop in the Theory N sense) and so affect the equivalent of a non-infinite \( E \).

An energy current limits the extent of its penetration of resistive transmission line wires in the same way as an overflowing river limits the extent to which it flows through the impeding brushes etc. far from its normal river bed.

The Resistor.

The energy stress or pressure, for probing throughout the rectangular space above and then expands itself through the gap switch.

The maximum stress (Theory N voltage drop) is across the switch contacts, and the energy stress then spreads out above the switch, the stress falling away with distance.
When the switch is closed the current no longer accelerates itself at its point, and makes its own the right as the potential difference drops away slowly. (theory C) At C suddenly moves from 0V to 5V and a wave front moves towards R at a velocity V. If R were pure Z the energy current would hit a solid wall of E = 5V and bounce back.

However, an R allows the penetration of the energy current and its dissipation in a laterit mode.

In fact, a perfect conductor will not allow an energy current. E = 00 and the current will spread with Z0 velocity.

An R, however, does accept the incursion in its skin of an energy current. Inside the R the energy current is converted into heat.

Electricity

"Electric current" is the edge of an energy current, sitting now and so does not appear in theory C. If the edge of an energy current is sharp, "electric current" would have to concentrate into see with little added.

If transmission line conductors are imperfect so that the energy current fluctuates, the "electric current" spread down into

The unit of energy current is the Watt.

Energy current flows through a surface, so it has a current density. The unit of energy current density is the Watt per square metre. This we shall provisionally call the "Hennstedt".

Never mention that we should have used the great man's name for one of our fundamental wave units.

This name for 1 Watt per square metre will need to be ratified by the international convention.

Now thoughts on the transformer

We have a complex multiple reflection situation at P and at 0 and at Load. Clearly, a low (say a shot) at Load will send back reflections calling for more 1/P, only after attention at Q and at P.
1

27 Nov 76/11

The story is the same if primary and/or secondary have more than one turn.

For years I have said that the change in impedance $Z_0$ of a transmission line is primarily a power transformer

$$\frac{1}{50} \quad \frac{1}{70} \quad \frac{1}{C}$$

A wave front 50v, 1a coming from the A

$$\frac{2-2}{2+2} = \frac{70-50}{70+50} = \frac{20}{120}$$

If voltage increase at B, a 50v wave front goes back to A.

Incident power is 50v x 1a = 50watts. Reflected power is $\frac{50}{36}$ = 1.4 watts.

... power which continues to the right is the remainder, i.e. $50 \times \frac{35}{36}$.

So only 3% of power is reflected.

If further downstream there is another

change from 70 \( \times \) 1 to 50 \( \times \) 2, a further 3\% only of the power is reflected.

Generally, if $Z_0$ changes by $\frac{1}{2}$, power suffers itself (reflected) is $\frac{1}{2}^2$.

[If the above simple calculation is wrong - it seems too good, so extreme to be true - no matter. I've proved the key point in the past anyway that very little power reflects at a reasonable discontinuity. The main effect is (my) v increases & i decreases, but power (V.I) hardly changes]

It follows that on entering the transformer at P (page 10) most of power continues. At Q, again most power continues, only the V & I will obviously change & it looks as if it is by the turn ratio. When we reach the load, the normal reflection - absorption rules apply, and if the load is "reasonable", most power will be absorbed. However, a short or
on the circuit will reflect 100% and
will break with its devastating news
(jokes) briefly denying as it passes Q and
P, so tell the source the depth to take.
That is, in practice, P points to P
and Q do nothing to the passing power
[energy current] but transform the
v and i (in theory N). Of course if
the transmission lines Source = P and
Q = load an identical the transformed
power will not lightly slide down from A
load, and lots of reflection along that
section will be needed. (That last sentence
is partially valid only).

Battery electrolysis resistor.

Energy current is bounced sideways, from
a battery and "walled in", or guided, by
inductors.

Electrolysis.

Energy current is absorbed and dissipated
by various things including electrolysis
or a reactor. A reactor is non-directional
electrolysis.

In electrolysis, we have no need of ions.

Electrode

1. A bridge of no particles can reach from one.
   Electrode to the other. By chemical reaction, the
   electrodes "steal" half of the nearest atom.

2. The other half grabs the nearest half of the
   next one, and so on down the line.

3.
1. The stress in the energy current (or field)

2. Turn them all round, and an extra one slips into the line.

3. Start again.

4. This is a possible model, quickly conceived. The + and - are electric charge (theory N).

Dimension of Energy Current.

Some time ago I typed out a document entitled "Electromagnetic Theory" which discussed many things, including Heaviside's ideas on the subject and including numerous quotations from his writings. It also included my 4 pp (approx) article "The Breakdown of Fleming in Electronics", which was refused publication for folded off in some other way a number of years ago by the IEE and the IEEE. The correspondence will give the details. This current writing follows that earlier material.

If current current is flowing from A to B, it can only flow; it cannot be pulled, because energy