Electricity in Jewish Law Part 1
New Technology, Old Halakha

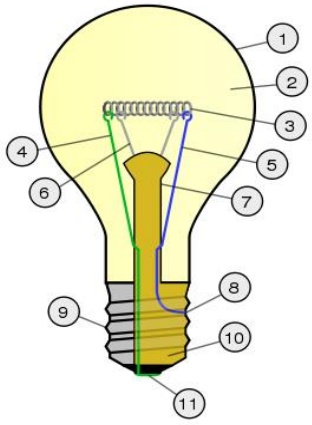
Electrical conduction is the movement of electrically charged particles through a transmission medium (electrical conductor). The movement of charge constitutes an electric current. The charge transport may result as a response to an electric field, or as a result of a concentration gradient in carrier density, that is, by diffusion. The physical parameters governing this transport depend upon the material.[1]

Incandescent Light Bulb[2]

The incandescent light bulb, incandescent lamp or incandescent light globe is a source of electric light that works by incandescence, (a general term for heat-driven light emissions which includes the simple case of black body radiation). **An electric current passes through a thin filament, heating it until it produces light.** The enclosing glass bulb prevents the oxygen in air from reaching the hot filament, which otherwise would be destroyed rapidly by oxidation. Incandescent bulbs are also sometimes called electric lamps, a term also applied to the original arc lamps. [Emphasis Added]

Incandescent light bulbs consist of a glass enclosure (the envelope, or bulb) with a filament of tungsten wire inside the bulb, through which an electric current is passed. Contact wires and a base with two (or more) conductors provide electrical connections to the filament. Incandescent light bulbs usually contain a stem or glass mount anchored to the bulb's base which allows the electrical contacts to run through the envelope without gas/air leaks. Small wires embedded in the stem in turn support the filament and/or its lead wires. The bulb is filled with an inert gas such as argon to reduce evaporation of the filament.

An electrical current heats the filament to typically 2000 K to 3300 K (about 3100-5400°F), well below tungsten's melting point of 3695 K (6192°F). Filament temperatures depend on the filament type, shape, size, and amount of current drawn. The heated filament emits light that approximates a continuous spectrum. The useful part of the emitted energy is visible light, but most energy is given off as heat in the near-infrared wavelengths.



1. Outline of Glass bulb
2. Low pressure inert gas (argon, neon, nitrogen)
3. Tungsten filament
4. Contact wire (goes out of stem)
5. Contact wire (goes into stem)
6. Support wires
7. Stem (glass mount)
8. Contact wire (goes out of stem)
9. Cap (sleeve)
10. Insulation
11. Electrical contact

[1] http://en.wikipedia.org/wiki/Electrical_conduction
[2] http://en.wikipedia.org/wiki/Incandescent_light_bulb

1. Shmot 35:3 Do not light a fire in any of your dwellings on the Sabbath day.	**1. שמות פרק לה פסוק ג** לֹא תְבַעֲרוּ אֵשׁ בְּכֹל מֹשְׁבֹתֵיכֶם בְּיוֹם הַשַּׁבָּת
2. B. Shabbat 41b Rav said: They taught [that it is permitted] only to temper [the water]; but if it is to harden [the metal], it is forbidden [to heat the metal]. Whereas Samuel ruled: Even if to harden it, it is still permitted. If the primary purpose is to harden it, can it be permitted! Rather if stated, it was thus stated: Rav said: They taught this only where there is [merely] a sufficient quantity to temper it; but if there is enough to harden it, it is forbidden. Whereas Samuel maintained: Even if there is a sufficient quantity to harden it, it is permitted.	**2. תלמוד בבלי שבת מא:ב** אמר רב: לא שנו אלא להפשיר, אבל לצרף - אסור. ושמואל אמר: אפילו לצרף נמי מותר. לצרף לכתחילה מי שרי? אלא, אי איתמר הכי איתמר, אמר רב: לא שנו אלא שיעור להפשיר, אבל שיעור לצרף - אסור. ושמואל אמר: אפילו שיעור לצרף מותר.
3. B. Shabbat 74b R. Aha son of R. Avira said: He who throws a tent peg into a stove is liable on account of cooking. But that is obvious? — You might say, His intention is to strengthen [harden] the article, therefore we are informed that it [first] softens and then hardens. (The fire heats the moisture in the wood, which softens it, and it is only after it evaporates that the wood hardens. This prior softening partakes of the nature of cooking)	**3. תלמוד בבלי שבת עד:ב** אמר רב אחא בר רב עוירא: האי מאן דשדא סיכתא לאתונא - חייב משום מבשל. פשיטא! מהו דתימא - לשרורי מנא קא מיכוין, קא משמע לן: דמירפא רפי, והדר קמיט
4. B. Shabbat 75b Rabba and R. Zeira both say that any action which completes a forbidden action is prohibited on the grounds of "hitting with a hammer."	**4. תלמוד בבלי שבת עה:ב** הבונה והסותר המכבה והמבעיר והמכה בפטיש. רבה ורבי זירא דאמרי תרוייהו: כל מידי דאית ביה גמר מלאכה - חייב משום מכה בפטיש.
5. Rambam Shabbat 12:1 One who ignites even a small amount violates the Shabbat (biblically), provided he does so with the intent to collect the ashes. However, if he ignites for the purposes of a destructive act he is exempt (biblically, not rabinically) because he is destroying…someone who heats metal so that it should be tempered in water has violated the biblical prohibition of lighting a flame. Ra'avad: And why is it not because of the prohibition of cooking as in the case of throwing a tent peg into a stove which softens and hardens, or heating the ember to temper in water is not considered extinguishing, but it is "hitting with a hammer"	**5. רמב"ם שבת יב:א** המבעיר כל שהוא חייב, והוא שיהא צריך לאפר, אבל אם הבעיר דרך השחתה פטור מפני שהוא מקלקל…המחמם את הברזל כדי לצרפו במים הרי זה תולדת מבעיר וחייב. +/השגת הראב"ד/ הרי זה תולדת מבעיר וחייב. א"א ולמה לא משום מבשל כמו סיכתא לאתונא דמרפא רפי והדר קמיט (שבת עד), והמחמם את הגחלת והמצרפו במים אינו מכבה אבל הוא מכה בפטיש…
6. B. Pesachim 41a R. Hisda said: He who cooks [food] in the hot springs of Tiberias on the Sabbath is not culpable; if he boiled the Passover sacrifice in the hot springs of Tiberias, he is culpable. Wherein does the Sabbath differ, that [he is]	**6. תלמוד בבלי פסחים דף מא:א** אמר רב חסדא: המבשל בחמי טבריא בשבת - פטור. פסח שבשלו בחמי טבריא - חייב. מאי

not [culpable]? **Because we require the product of fire, which is absent**!	שנא בשבת דלא - דתולדות אש בעינן, וליכא.
7. Rambam Shabbat 9:3 Someone who puts an egg in a warm cloth, or in dirt or ash that is normally heated from the sun, even though the egg is cooked, the person is exempt because the derivative of the sun is not the same as a derivative of fire, but the sages restricted it due to its derivative of light. Similarly, someone who heats [food] in the hot springs of Tiberias or the like is exempt. Someone who cooks on light something which has already been cooked – or something which does not need cooking at all – is exempt.	**7. רמב"ם שבת ט:ג** המפקיע את הביצה בבגד חם או בחול ובאבק דרכים שהן חמים מפני השמש אע"פ שנצלית פטור, שתולדות חמה אינם כתולדות האש, אבל גזרו עליהן מפני תולדות האור, וכן המבשל בחמי טבריה וכיוצא בהם פטור, המבשל על האור דבר שהיה מבושל כל צרכו או דבר שאינו צריך בישול כלל פטור.

8. Richard Feynman – Is Electricity Fire?

A footnote: While I was at the conference, I stayed at the Jewish Theological Seminary, where young rabbis - I think they were Orthodox - were studying. Since I have a Jewish background, I knew of some of the things they told me about the Talmud, but I had never seen the Talmud. It was very interesting. It's got big pages, and in a little square in the corner of the page is the original Talmud, and then in a sort of L-shaped margin, all around this square, are commentaries written by different people. The Talmud has evolved, and everything has been discussed again and again, all very carefully, in a medieval kind of reasoning. I think the commentaries were shut down around the thirteen- or fourteen- or fifteen-hundreds - there hasn't been any modern commentary. The Talmud is a wonderful book, a great, big potpourri of things: trivial questions, and difficult questions - for example, problems of teachers, and how to teach - and then some trivia again, and so on. The students told me that the Talmud was never translated, something I thought was curious, since the book is so valuable,

One day, two or three of the young rabbis came to me and said, "We realize that we can't study to be rabbis in the modern world without knowing something about science, so we'd like to ask you some questions."

Of course there are thousands of places to find out about science, and Columbia University was rss ight near there, but I wanted to know what kinds of questions they were interested in.

They said, "Well, for instance, is electricity fire?"

"No," I said, "but. . . what is the problem?"

They said, "In the Talmud it says you're not supposed to make fire on a Saturday, so our question is, can we use electrical things on Saturdays?"

I was shocked. They weren't interested in science at all! The only way science was influencing their lives was so they might be able to interpret better the Talmud! They weren't interested in the world outside, in natural phenomena; they were only interested in resolving some question brought up in the Talmud.

And then one day - I guess it was a Saturday - I want to go up in the elevator, and there's a guy standing near the elevator. The elevator comes, I go in, and he goes in with me. I say, "Which floor?" and my hand's ready to push one of the buttons.

"No, no!" he says, "I'm supposed to push the buttons for you."

"What?

"Yes! The boys here can't push the buttons on Saturday, so I have to do it for them. You see, I'm not Jewish, so it's all right for me to push the buttons. I stand near the elevator, and they tell me what floor, and I push the button for them."

Well, this really bothered me, so I decided to trap the students in a logical discussion. I had been brought up in a Jewish home, so I knew the kind of nitpicking logic to use, and I thought, "Here's fun!"

My plan went like this: I'd start off by asking, "Is the Jewish viewpoint a viewpoint that any man can have? Because if it is not, then it's certainly not something that is truly valuable for humanity . . . yak, yak, yak." And then they would have to say, "Yes, the Jewish viewpoint is good for any man."

Then I would steer them around a little more by asking, "Is it ethical for a man to hire another man to do something which is unethical for him to do? Would you hire a man to rob for you, for instance?" And I keep working them into the channel, very slowly, and very carefully until I've got them - trapped!

And do you know what happened? They're rabbinical students, right? They were ten times better than I was! As soon as they saw I could put them in a hole, they went twist, turn, twist - I can't remember how - and they were free! I thought I had come up with an original idea - phooey! It had been discussed in the Talmud for ages! So they cleaned me up just as easy as pie - they got right out.

Finally I tried to assure the rabbinical students that the electric spark that was bothering them when they pushed the elevator buttons was not fire. I said, "**Electricity is not fire. It's not a chemical process, as fire is**."

"Oh?" they said.

"Of course, there's electricity in amongst the atoms in a fire."

"Aha!" they said.

"**And in every other phenomenon that occurs in the world.**"

I even proposed a practical solution for eliminating the spark. "If that's what's bothering you, you can put a condenser across the switch, so the electricity will go on and off without any spark whatsoever - anywhere." But for some reason, they didn't like that idea either.

It really was a disappointment. Here they are, slowly coming to life, only to better interpret the Talmud. Imagine! In modern times like this, guys are studying to go into society and do something - to be a rabbi - and the only way they think that science might be interesting is because their ancient, provincial, medieval problems are being confounded slightly by some new phenomena.

Something else happened at that time which is worth mentioning here. One of the questions the rabbinical students and I discussed at some length was why it is that in academic things, such as theoretical physics, there is a higher proportion of Jewish kids than their proportion in the general population. The rabbinical students thought the reason was that the Jews have a history of respecting learning: They respect their rabbis, who are really teachers, and they respect education. The Jews pass on this tradition in their families all the time, so that if a boy is a good student, it's as good as, if not better than, being a good football player…

Feynman, Richard P., Ralph Leighton, and Edward Hutchings. "Surely You're Joking, Mr. Feynman!": Adventures of a Curious Character. New York: W.W. Norton, 1985. 279-287