Trolleyman's Handbook on Efficient Car Operation

By
William Arthur
Electric Railway Engineer
New Haven, Conn.

Written for motormen and conductors
with special reference to methods of saving power
as dictated by the national coal shortage.

1918

TO MOTORMEN AND CONDUCTORS

The Coal Shortage

Every motorman and conductor knows there is a coal shortage, but not all appreciate the seriousness of the situation.

The National Need for Saving Coal

The country is at war; coal is needed in large quantities for our Allies, our Navy, our Munitions Factories, and for many other purposes. Consider only two facts:-

> Coal in France to-day costs $150.00 per ton and is hard to get even at that price.
>
> It was a coal shortage which chiefly caused the recent Italian disaster. Munition factories and railways had to shut down for the lack of coal, guns could not be produced, nor men and supplies transported. The enemy struck a blow at the critical moment and the Italian line collapsed.

We see, then, what serious results can follow a coal shortage.

The Company Need for Saving Coal

Every trolley road in the country is faced with rising expenses. Coal costs double per ton what it did before the war and so does copper trolley wire and practically everything else used by the company.

Increase in revenue does not keep pace with rising costs and the trolley roads are being crippled financially. Some have gone into receivership, others have gone out of business altogether, the remainder are struggling along under a growing burden. No adequate relief is in sight.

The chief thing a trolley company uses is coal to make electricity that runs and heats the cars. The trolley roads of the country use more than 14,000,000 tons of coal yearly. Of this amount the Government has said that at least 1,000,000 tons must be saved. It is therefore necessary to economize in the use of coal in every way possible.

The Individual Need for Saving Coal

Every motorman and conductor has a vital personal interest in this matter. In the long run a company's financial difficulties are bound to react unfavorably on its employees. Employees can be prosperous only so long as the company that employs them is prosperous. Under these conditions only a shortsighted motorman would refuse to help in efforts to save coal.

Do Motormen Waste Coal and Electricity Willfully?

No, most decidedly they do not. Waste comes usually from not thinking about it. There is a right way to run a car and a wrong way. Some men have operated the wrong way for years until their wrong methods have become a habit resulting in continuous waste. Nearly all motormen are reasonable and will avoid waste when the matter is fully explained to them. They soon find that it is easier to run a car properly than it is to run it carelessly when once the new habit is formed. The new alertness also makes for increased safety.

How Does a Careless Motorman Run His Car?

Let us watch him for one block. First he notches up very slowly, thus causing the car to gather speed slowly. As a result, and in order to avoid running behind his schedule, he is forced to keep the power on until her is near the end of the block. He then shuts off the power and applies the brakes, In the case of a poor motorman he will apply the brakes slowly and possibly release then once or twice in making the stop--will "fan the air" as it is called.

The above kind of operation wastes power in several different ways, each of which will be later explained.

How Does a Careful Motorman Run His Car?

The careful motorman notches up smoothly and safely, yet without dawdling on the resistance notches. The car is soon up to speed and as a result he is able to shut off power sooner and coast till near the end of the block. He then makes a smooth, quick stop, using only one application of the air, and releases the brakes just as the car stops to avoid a jerk.

This kind of operation saves power in several ways which will be later explained.

How to Tell an Efficient Motorman

Watch a car going along the street stopping at each block. If the car reaches its proper speed *early* in the block and then slows down by coasting till near the end of the block this is usually a sign of efficiency on the part of the motorman.

If however, the car gathers speed slowly and reaches its highest speed at the end of the block just before the motorman applies the brakes, probably a poor motorman is at the controller handle.

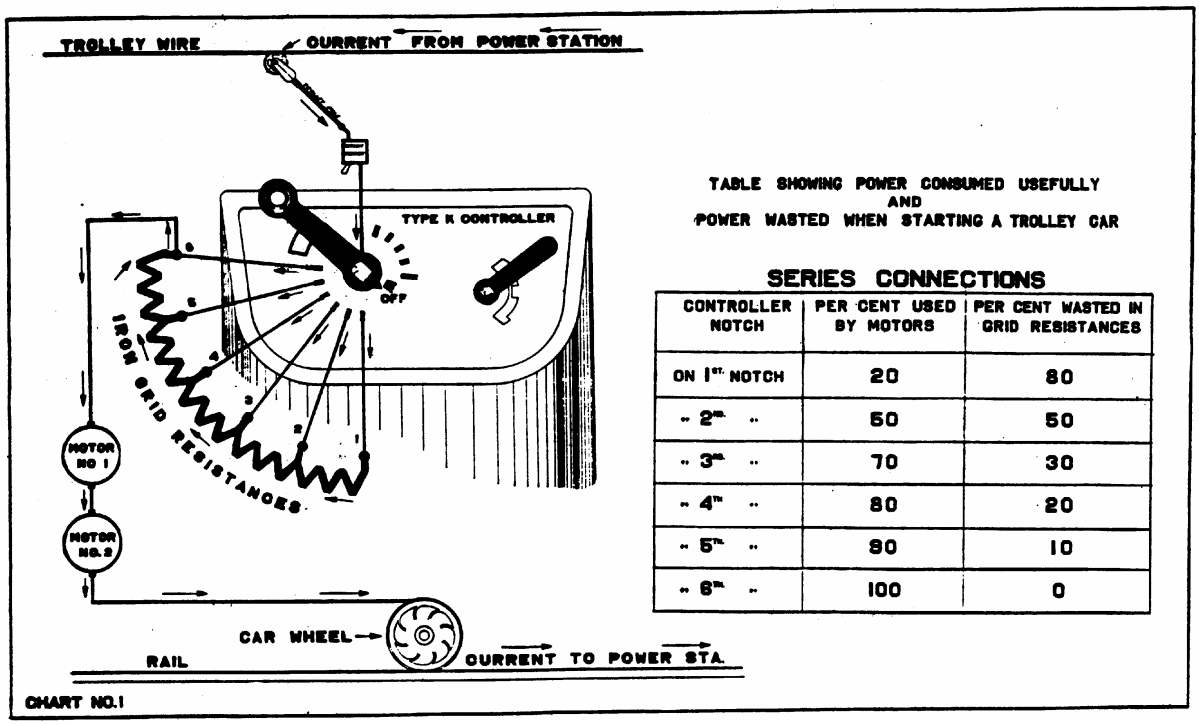
Now consider the above points in greater detail.

Notching Up the Controller Properly

Many motormen have the wrong idea as to how the controller "turns on power." They believe the controller draws from the trolley wire only a little power on the first notch, a little more on the second, still more on the third, and so on. They think of it as letting the electricity come gradually in the same way that a water faucet lets the water come gradually. This is a very natural thought, but it is all wrong,

and causes the waste of a surprising amount of coal. *The fact is that the controller draws substantially the same amount of power on the first notch as on the second, or on the third, but most of it is used up in the iron resistances underneath the car; only a little of it reaches the motors.* These resistances are just like big electric heaters. Their purpose is to choke back the excessive starting current until the car motors get up to speed enough to choke this excess back of themselves.

The resistances are in circuit and are wasting power on every notch excepting the running points. This is shown by Charts 1 and 2 and the tables on those charts. These tables also show how much power is wasted and how much is used by the motors on each notch. Every motorman should study these figures until he fully understands them.



This chart and table shows how much waste occurs when the controller is on each notch in series, Note that all the time a motorman has the controller on the first notch he is wasting four times as much power as the motors are getting. The arrows show the passage of the current from trolley wire to rail.

The rules for saving power in notching up are:-

(a) Run with the resistances in circuit as little time as is possible. This means notching up as fast a rate as a proper regard for safety, for comfort of the passengers and for the care of the equipment will permit.

(b) In starting a car move quickly over the resistance notches to the first running point; wait there a short time, then move quickly until the full multiple or last notch is reached. This waiting before moving into multiple has three good effects.

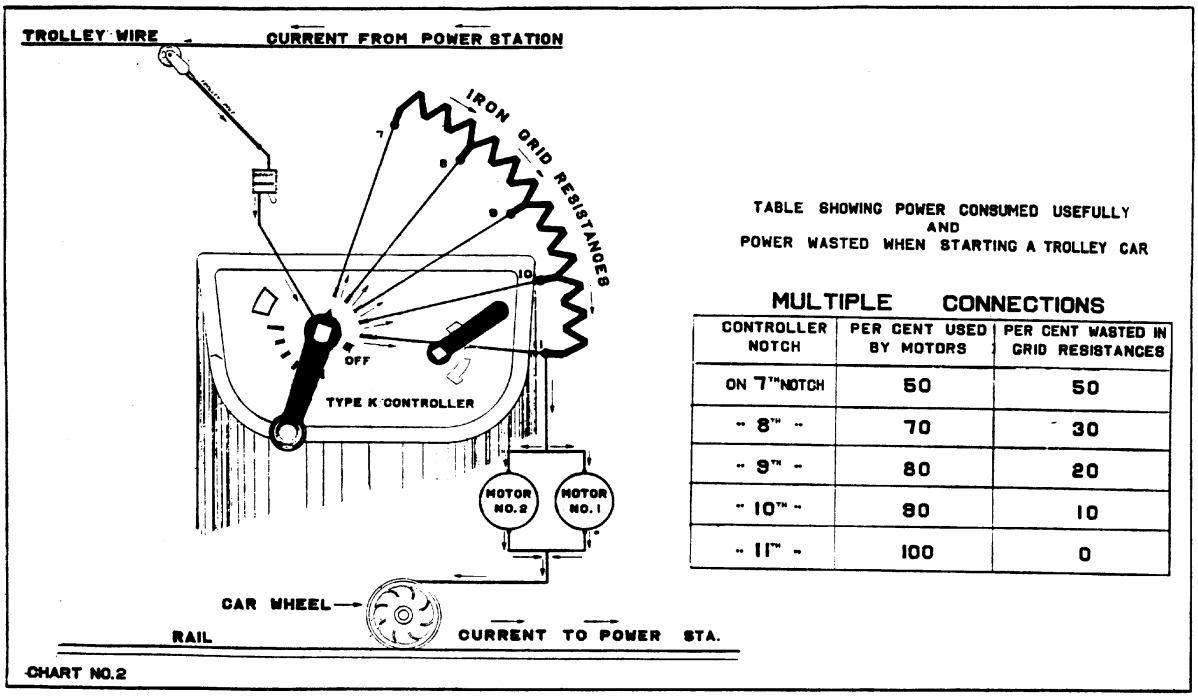


TABLE SHOWING POWER CONSUMED USEFULLY AND POWER WASTED WHEN STARTING A TROLLEY CAR

MULTIPLE CONNECTIONS

CONTROLLER NOTCH	PER CENT USED BY MOTORS	PER CENT WASTED IN GRID RESISTANCES
ON 7TH NOTCH	50	50
" 8TH "	70	30
" 9TH "	80	20
" 10TH "	90	10
" 11TH "	100	0

This chart and table shows the same thing as Chart No. 1, except that the controller has been moved across the gap to the multiple position. Note that the waste on the first notch in multiple is less than it was on the first notch in series.

First-It enables you to move more quickly over the multiple resistance notches and so saves power.

Second-It reduces strain on the controller. And

Finally-It reduces the draft of power and strain on the power station.

Don't, however, notch up so fast as to spin the wheels and pull out the circuit breaker, as this will waste power just as much as the old way. Use good judgment in this as in everything else. When the rails are slippery adjust your operation accordingly.

Shut off the Power Sooner and Still Maintain the Schedule

You can't follow this rule unless you first followed the previous one. You can't shut off sooner and still maintain schedules unless you have notched up sufficiently faster to begin with. It is an important fact that wasting power by slow notching up forces a further waste by making it necessary to keep power on longer. It is equally true that saving power by a quick start and so lessening waste in resistances produces a second saving by permitting the shutting off of the controller sooner. See charts 3 and 4 in further explanation of this.

Coast as Much as is Possible

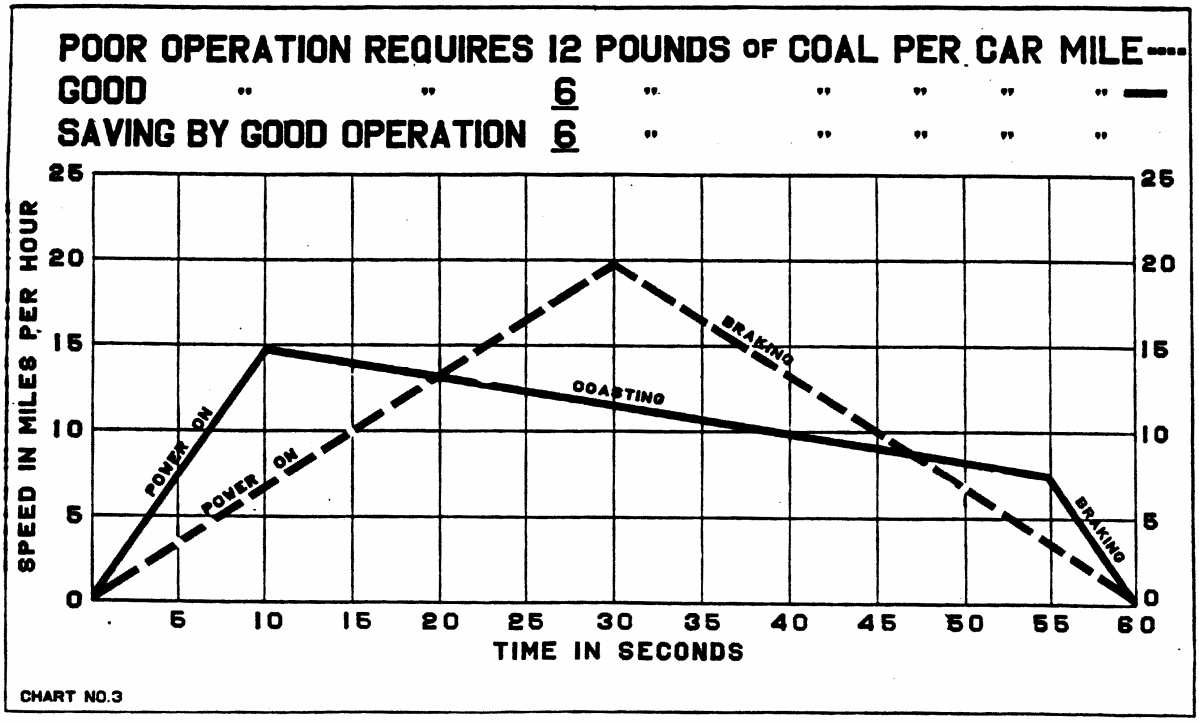
All the time you are coasting you are saving power. Don't overdo it, however, and take chances by coasting to excessive speeds down steep grades. Remember safety first and always.

Many motormen ask, "How can I coast more and yet not lose time?" There are several ways in which this can be done. Some of these ways require the conductor's help and others don't.

The whole secret consists in learning to save a few seconds here and there and then using these seconds for more costing. For instance:

(a) By being alert in responding to the bell.
(b) By notching up more quickly.
(c) By braking at a higher rate and not "fanning the air."
(d) By helping the passengers in and out and so saving a second or two at the stop.
(e) By not arriving at the end of the line ahead of time in order to get a longer layover.
(f) By starting on time.
(g) By stopping at the right place so that the passengers don't delay the car by having to walk some distance to the doors.
(h) By the conductor calling out the streets in a clear voice and opening the doors wide so as to permit quicker unloading.

All of these points are worth studying and their observance marks the difference between careful and careless operation.



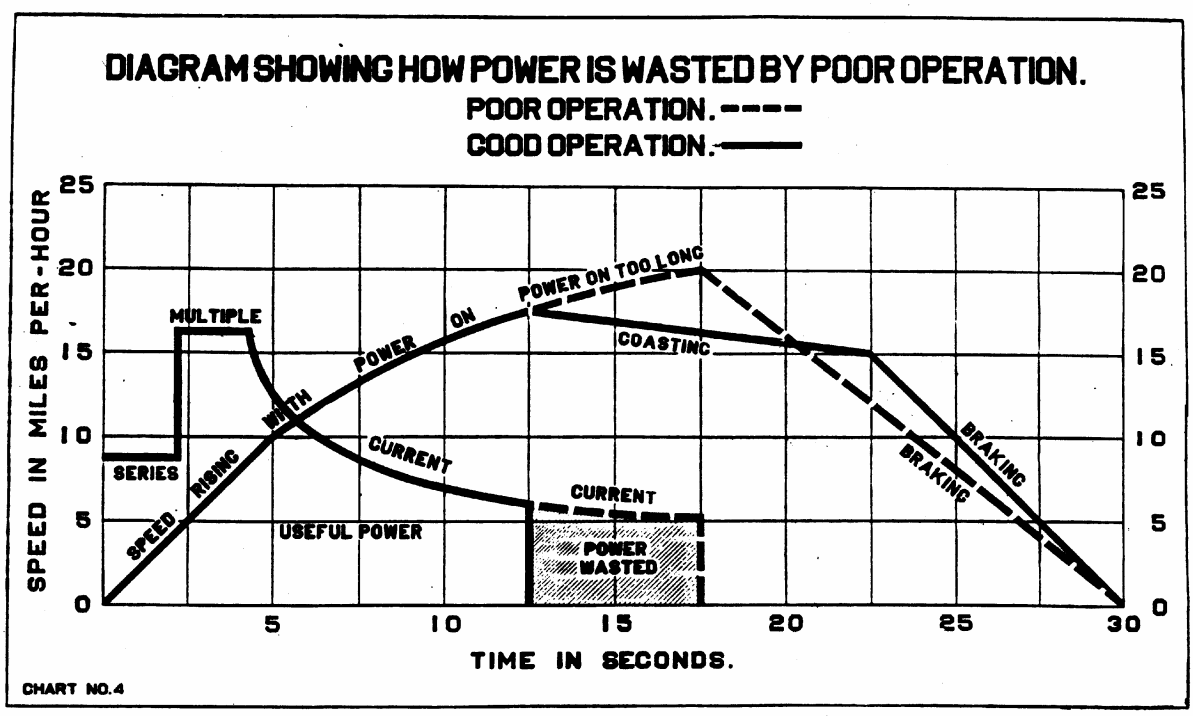
This chart shows that the man who starts his car too slowly is forced to keep power and brakes on longer to make up for the lost momentum . It wastes power and wears away brakeshoes and wheels to an unnecessary degree.

How to Apply the Brakes

Apply the brakes at as low a car speed and at as high a rate as is possible having regard to safety, to the comfort of the passengers and to the care of the equipment.

Heavier air applications can be used at high speeds than at low speeds. Slow down the car without jerks, avoid "fanning the air," and whenever possible make one application do the work. Release the brakes a little as the car slows down and before the final stop. This will avoid a jerk, and will reduce trouble from flat wheels.

Making a quick stop saves power just as making a quick start does, but in a different way. A slow stop loses time in one block and so leaves less time for coasting in the next or in a later block. "Fanning the air" aggravates this, and in addition wastes still more power by requiring the more frequent pumping up of the air reservoir. *Fast braking doesn't mean stopping the car so fast as to lock the wheels.* Good judgment will tell what is right in this as in everything else. Adjust the braking rate to suit the rail conditions from day to day.



This chart shows how power, brakeshoes and wheels may be saved by shutting off the power sooner. Note that the motorman who keeps power on too long obtains a higher speed than is necessary to maintain the schedule and is forced to apply his brakes sooner in order to stop at the right place.

Avoid Unnecessary Stops and Slowdowns

It takes a much power to start a car once as would keep it running for about a quarter of a mile on the level, so that unnecessary stops are very wasteful. Chart No. 5 shows the amount of coal wasted by an unnecessary stop and slowdown.

Note that the word "unnecessary" is used. All proper brake applications as dictated by safety and the needs of the public should of course be made. Only the "unnecessary" ones should be eliminated.

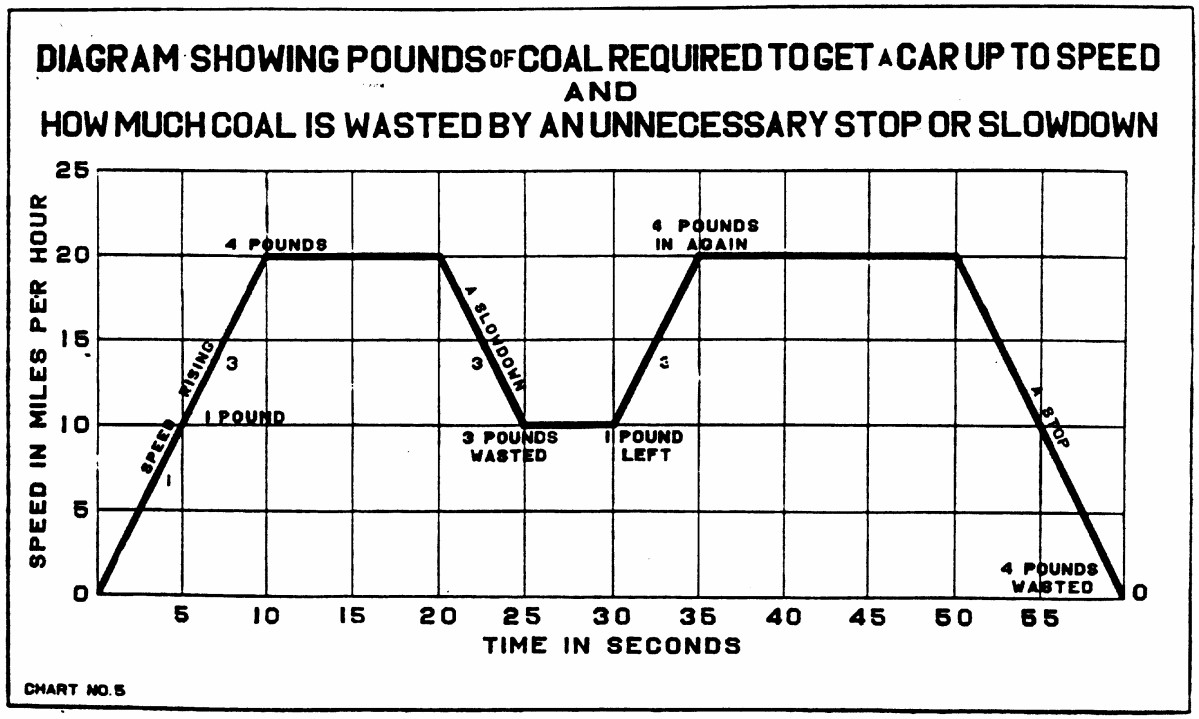
Unnecessary brake applications are as follows:

(a) Those caused by running too close to the car ahead, when you might just as well be a short distance behind.

(b) Those caused by approaching cross streets, curves, etc., at too high speeds.

(c) Those caused by not keeping a good lookout for teams and other obstructions ahead.

Note in each of the above three cases that saving power and increased safety go hand in hand. While developing carefulness in saving power you can't help also developing greater alertness in general, and so increasing the general safety of the operation.



Coal Required per Car Mile

With a careful motorman it requires about 6 pounds of coal to make enough electricity to run a car for one mile.

With a careless motorman it may take twice as much or 12 pounds per mile.

The saving to be made by care, then is about 6 pounds per mile. This does not seem very much, but let us see what it means in a year.

Suppose a motorman runs his car on the average of 100 miles a day. A careless motorman, then, will waste

6 X 100 = 600 pounds of coal per day.

This is equal to a ton every three and a half days or two tons a week—more than 100 tons per year! Think of it, a careless motorman can waste 100 tons of coal per year by little habits which are easily corrected when once he gives his mind to the matter.

Remember, too, that as stated before it is easier to operate carefully when once the habit is formed.

The average amount to be saved is much less than the above, for, of course, not all men are operating carelessly at present.

Rules for Conductors

As soon as the car starts call out in a clear voice the name of the next street or stopping point, so that as early as possible passengers may signify their desire to stop.

Give the stop signal early. The bell in time will often allow the motorman to shut off power sooner and coast, and so you will have helped to save power.

Make the stop as short as possible having regard to the safety and convenience of the public. All time saved at stops can be used by the motorman for extra coasting and so helps in saving power.

Avoid excessive use of heating current. It takes about one-third as much power to heat a car on a winter's day as to run it. An overheated car is more disagreeable to the public and more unhealthy for you than too cold car. Avoid waste in this as in everything else.

General

Motormen and conductors who carefully study the above rules and try to follow them out in their work from day to day will be proving themselves to be not only good trolleymen but good, patriotic Americans. They will be bettering themselves, bettering the company they work for and bettering the national coal situation.

In the future they will be able to say with pride that when the call came it found them ready to do what they could in helping to win the war. The help of every man is urgently asked for in this great cause.