Signals on the Berlin Subway and Elevated

Semaphores Used on Elevated and Light Signals Underground with Mechanical Trip Train Stops; Unique Locking on Switches

By T. S. Lascelles

London, England

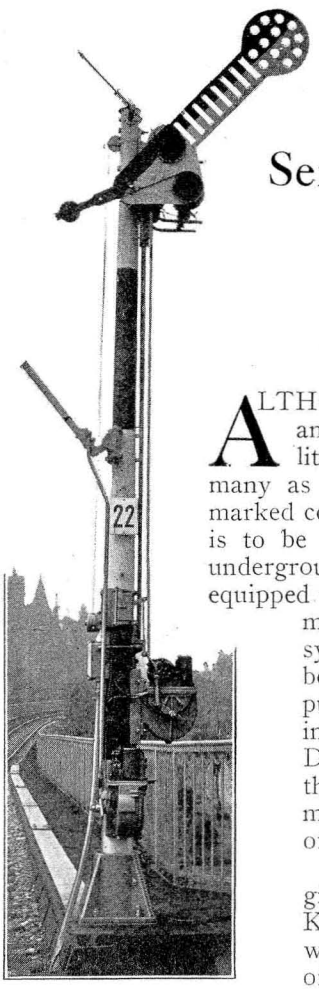

Fig. 1—Semaphore Signal Westinghouse Mechanism.

ALTHOUGH automatic signaling and track circuits have made little or no headway in Germany as yet on the steam roads, a marked contrast to this state of affairs is to be found on the elevated and underground line in Berlin, which is equipped with a very up-to-date automatic block and interlocking system. This installation has been described in a book,* published in 1921, by the eminent German signal engineer, Dr. G. Kemmann, adviser to the railroad company and for many years a strong advocate of track circuiting.

In this article I propose to give a brief review of Dr. Kemmann's remarkable book, which is without doubt one of the most complete and painstaking expositions of rapid transit signaling that has ever appeared. When it is stated that there are no less than 185 figures in the text and 15 folding plates, often printed in 3 or 4 colors, some idea of the character of the work may be formed by the reader. Valuable to anybody for the illustrations alone, to a reader of German the book is a mine of useful information. In spite of all this, it is so clearly written that anyone not having a special knowledge of signaling could readily understand every part of it. Dr. Kemmann had previously published, in 1914, a smaller but very valuable preliminary study† on the subject and he has in mind the publication of a third volume in which the results of some years' working of the system will be exhaustively treated from all points of view.

Dr. Kemmann's recommendation to the elevated railroad company to adopt automatic signaling in place of the controlled manual block, with which the line had originally been equipped, was the result of a thorough examination into everything that had been done in Europe and America but especially into the New York subway system and the signaling of the London underground roads. Through this investigation he had convinced himself that the manual system was out of date, as it could not handle properly the traffic requirements met with in elevated and subway work, and he published numerous articles in technical papers in Germany setting forth his views. His company accepted his advice and the results achieved have more than realized expectations. It remains only a question of time and all the Berlin electric roads now open or constructing will be equipped with automatic signaling with continuous track circuit control.

The book under review is divided into three principal sections, the two first describing the London and New York installations and the third, and, of course, by far the largest, is devoted to the Berlin installations. Though necessarily condensed to some extent the two first sections leave no important detail untreated, and the latest developments are mentioned.

The Propulsion Current Is A. C. and the Signaling Is Current D. C.

The Berlin Elevated and Underground is operated by direct current on the third rail system at 750 volts, the contact rail being outside the track. Alternating current track-circuits had therefore to be used and to enable both track rails to be utilized for the return circuit, double rail track circuits with impedance bonds are employed; these bonds having a capacity of 900 amperes per rail. The alternating current supply is obtained from converter sets which are located in the several traction sub-stations, taking d. c. from the traction circuit and delivering a. c. at 500 volts, 60 cycles, to a main cable running throughout the automatic signaling area. Transformers with suitable tappings provide the necessary voltages to the track and signal circuits. The automatic signal system is entirely operated by alternating current but the interlockings are operated by direct current; storage battery sets are provided which are charged from the traction circuit. This course was adopted because a. c. interlockings were not fully developed at the time the work was begun and it was desired to follow methods of switch operation already well tried in Germany and for which direct current was required.

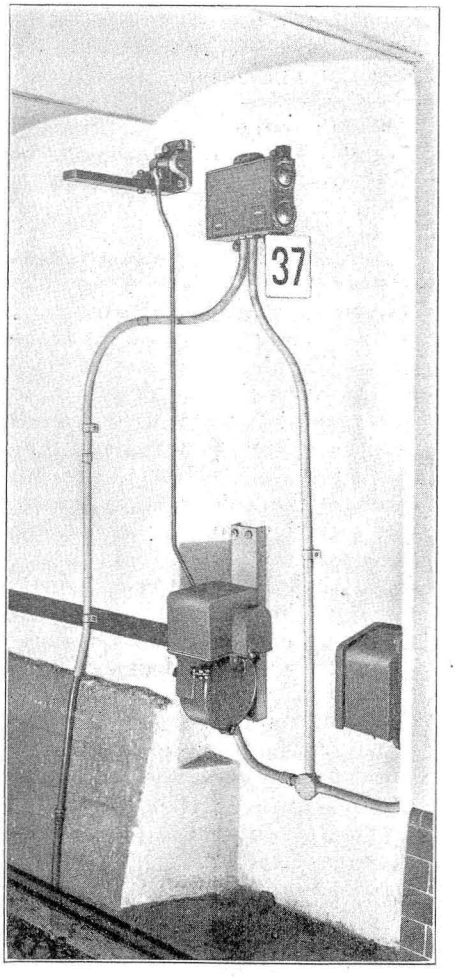

Fig. 2—Light Signal Underground

The first section of automatic signaling was placed in service in 1913, being installed by the Westinghouse Brake and Saxby Signal Company, Limited, of London, and it superseded the Simens and Halske controlled manual. Work was being prosecuted on additional sections when the war intervened, with the result that the railroad company had to continue the task as best they could by themselves, manufacturing a quantity of apparatus in their own workshops. In spite of all kinds of diffi-

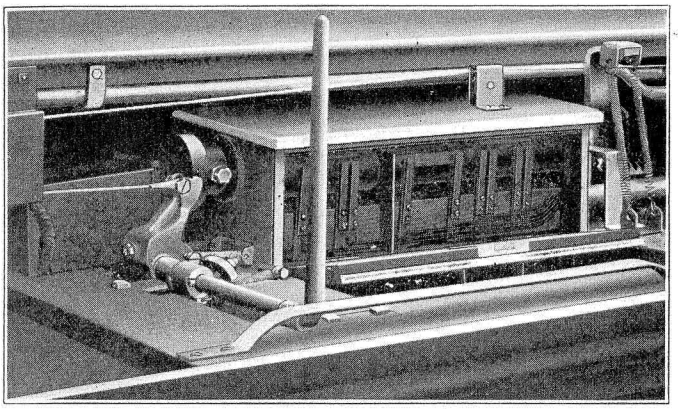

Fig. 3—Train Stop Arm on the Roof of a Car

culties much progress was made and the work is being continued, so that in due course the whole line will be equipped. Some sections as yet are not open to traffic. Dr. Kemmann has many words of praise for the Westinghouse Company's engineers and the way in which they tackled every difficulty with success, convincing the many opponents of automatic signaling in Germany of its reliability and great practical value.

Train Stops Are Placed at Signal Locations

On the elevated sections the block signals are semaphores operating from 0 deg. to 45 deg. in the upper right-hand quadrant (see Fig. 1), the usual German prac-

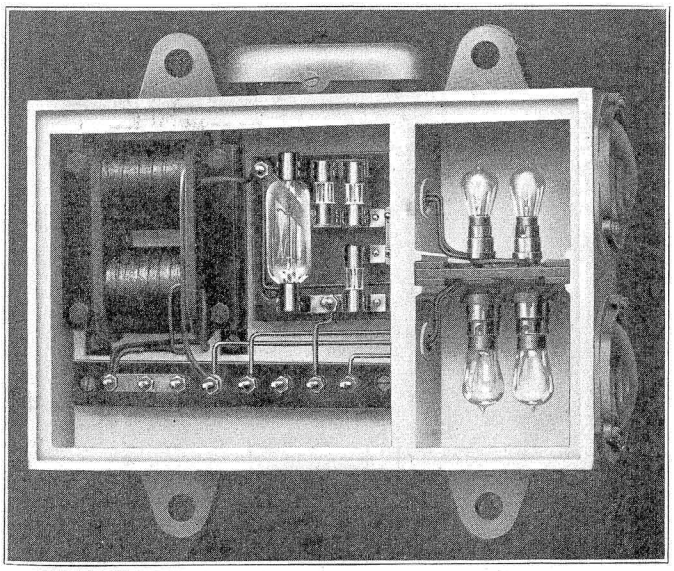

Fig. 4—A. C. Type Light Signal, Showing the Flux Neutralizer

tice; while the distant or "repeater" signals are round yellow disc signals which are turned on edge for the "proceed" indication. Red, yellow and green lights are used for the three indications. The signal in Fig. 1 is operated by a Westinghouse Company's machine (110 volts a. c.) as is also the train stop trip arm, but large numbers of the Siemens and Halske machine (Fig. 7) are now in use as well. All signals, with the exception of the starting signals at simple through stations where all trains call, are fitted with train stops. This exception is being made at present because it is felt that the likelihood of an over-run in this case is very remote and economy must be considered. The train stop arm engages with a trigger on the roof of the leading car (Fig. 3) which acts upon the Carpenter brake by electrical means and also cuts off the traction control current at the same time. It cannot be reset without the co-operation of the conductor and it can be brought into use in emergency by pulling down a special handle inside the car. In order to pass an automatic signal at danger the train stop may be held out of action by using a special key, normally kept under seal. The car trip arm is trailable, that

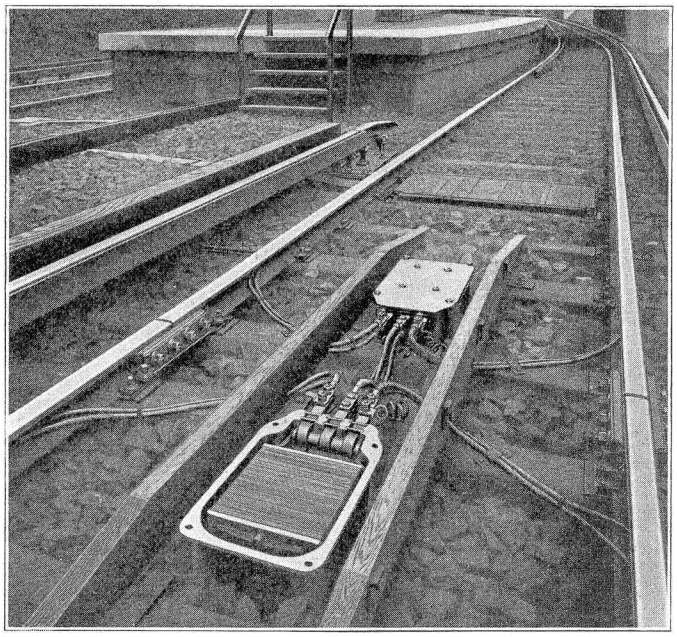

Fig. 5—Impedance Bonds Are Located Between the Rails

is, a car can *back* past a danger signal without anything happening at all, this result being automatically attained. When several cars in a train have trip arms, all those except the leading one are fixed down clear, but before the driver can operate the master controller on or release the brakes from a car he must set the trip arm in position on that car, so that safety is fully assured.

An interesting feature of the installation upon which Dr. Kemmann lays much stress, is the automatic detection of false clear failures of both signals and train stops. A signal cannot clear again for a second train unless the following signal and train stop have actually returned to danger behind the first train, the signal control relay being worked as a stick relay and picked up when this condition is fulfilled. The writer does not believe that this has been much, if at all, followed out in America. It is, however, practiced with a different circuit, on the London Metropolitan and on the Eastern and Grande Ceinture railways in France, and it is unquestionably a very great safeguard. In the Berlin case it is merely following out a principle generally adhered to in all Prussian signal installations.

The track circuits are mostly end-fed, but there are some longer ones center-fed. Galvanometer relays are employed, while the insulated joints consist of the ordi-

* "Die selbstätige Signal Anlage der Berliner Hoch—und Untergrundbahn nebst einigen Vorläufern," by G. Kemmann, Geheimer Baurat. (Berlin, Julius Springer, 1921.)

† "Vorstudien zur Einführung des selbstätigen Signalsystems auf der Berliner Hoch—und Untergrundbahn," by G. Kemmann, Geheimer Baurat. (Berlin; Julius Springer, 1914.)

nary fishplates held away from the rail by fiber plates.

On the underground section light signals are of necessity used instead of semaphores. The automatic signals are of the a. c. flux-neutralizer type installed by the Westinghouse Company on the Central and East London lines in England. In this signal (Figs. 2 and 4) the red lamp circuit is never broken, but when the green lamp circuit is closed the red lamp is shunted out owing to the impedance of the shunt being neutralized by the current in the green circuit, this circuit and the shunt on the red lamp forming two sides of the small transformer seen in the signal case. At interlockings, the

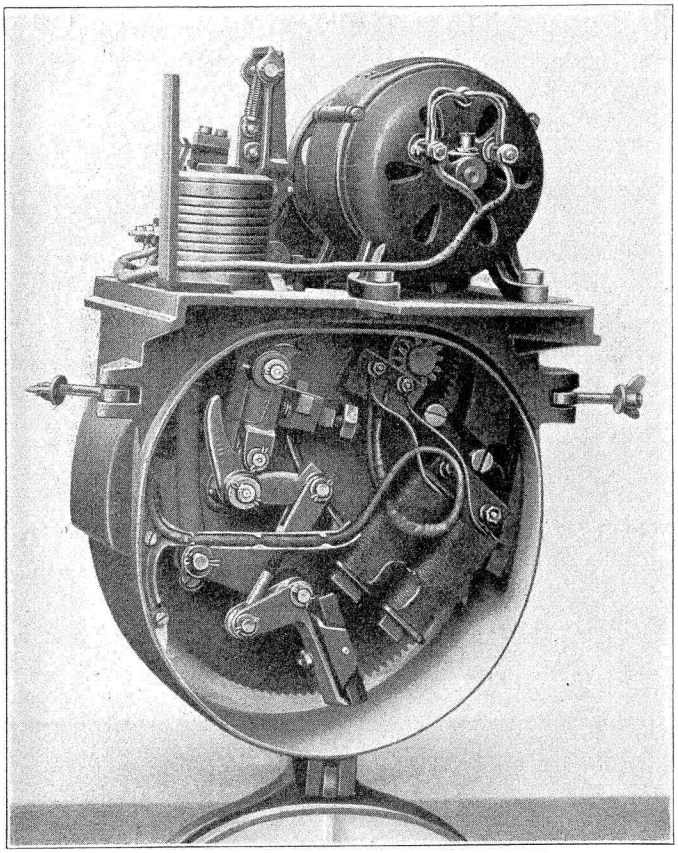

Fig. 6—Westinghouse Signal Mechanism With Electric Slot

light signals are simple d. c. relay controlled signals. Repeater signals are similar but are equipped with yellow in place of red lenses. Platform repeaters, however, have only a green lens and remain dark while the starting signal is at danger. A special signal, called an emergency stop signal, normally dark, is provided just at the entrance to stations. This signal is controlled by several covered switches along the platform so that the station agent can at the very last minute signal "Stop" to an oncoming train in the event of some mishap, such as a person falling from the platform. These have proved useful on more than one occasion.

Wherever required by the traffic, first and second "closing in" home signals are fixed at the approach to stations. The theory of these, accompanied with numerous explanatory graphs, is fully discussed by the author, and Waldron's speed-control signals on the New York subway are described. These have not been copied so far in Berlin, the extra home signals being deemed sufficient.

The semaphore and disc signals on the elevated sections are all operated by base-of-mast mechanisms. Both the Westinghouse and Siemens machines (Figs. 6 and 7) are of the slot type in which the signal is returned to stop or caution independently of the motor gearing and is cushioned on an air buffer.

The interlockings present many interesting features, especially in connection with switch operations. It will be noted from the picture of the Alexanderplatz tower that illuminated track diagrams are provided, on which the position of controlled signals is shown as well as the condition of the track circuits. Semi-automatic stick control of signals is provided, whereby the leverman must clear each signal again after it has been automatically restored to danger by the train. At some towers, however, only used at intervals, the working can be made entirely automatic by reversing a special master-lever in the machine. The machines are of the English Westinghouse type, employing miniature levers and improved S. & F. locking. Indication locking is employed and constant detection of all switches, the correspondence between lever and switch being shown by illuminated plus and minus signs over the levers concerned. This machine is a very neat one and convenient to operate.

Route Locking and Switch Locks Are Special Features of Interlockers

The switches are all worked by Siemens and Halske d. c. 120-volt mechanisms, these having been employed extensively in Germany for many years past. They ac-

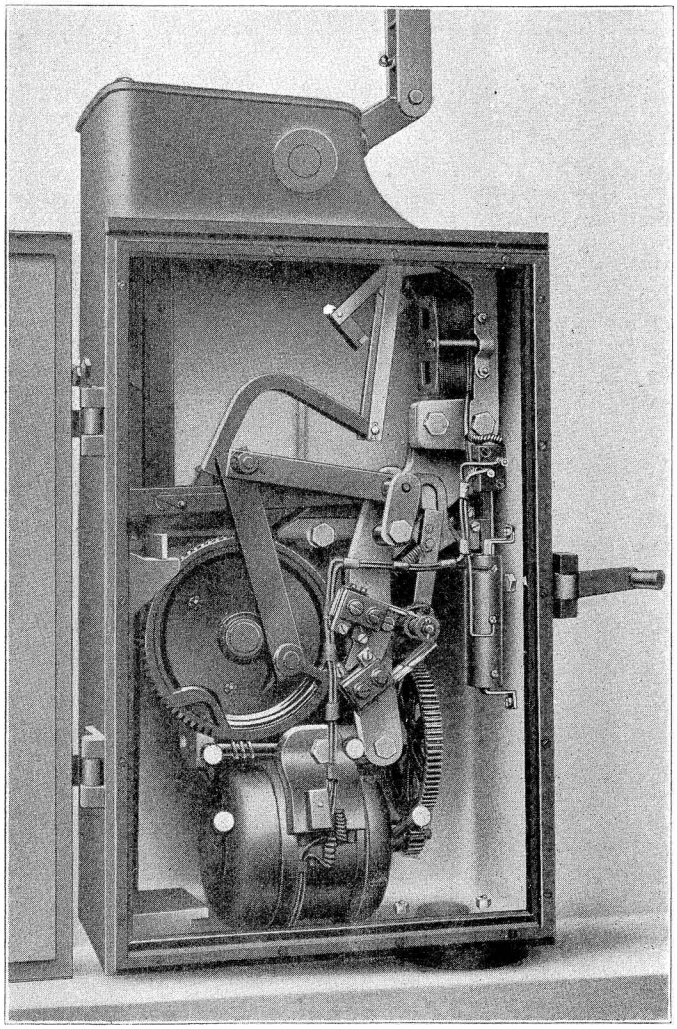

Fig. 7—Siemens and Halske Signal Mechanism

tuate the switches through the standard Prussian facing-point hook lock which admits of the switches being run through from the wrong direction without any damage whatever resulting, a standard requirement in all Ger-

man signal installations. This is a very valuable feature and saves a great deal of time, expense and annoyance should a run-through accidentally occur. It is accomplished by not connecting the switch-tongues rigidly together, as in American practice, but by carrying the open tongue over a little further after the closed tongue is home and, in so doing, locking that one by a hook which clamps it to the stock rail. A train coming from the wrong direction first forces the open tongue over and so unlocks the closed tongue in time and then throws that over, too, to the other position. When this occurs the control circuits are altered so that any signals involved are thrown to or held at stop while a fuse blows out at the machine and the pilot lamp is extinguished. To restore matters the switches and lever must be put into correspondence again, the switch being cranked over. Dr. Kemmann gives complete circuit diagrams illustrating all this and drawings of the switches in all possible positions.

Short switch-locking track circuits are installed and approach locking is also used which is effective when the train passes the last automatic signal in the rear of the interlocking. Route locking is always employed in Germany, even with mechanical signaling, but special route levers are usually used to effect it. In this case, however, no route levers are provided, the approach locking controlling a back-lock on the home signal lever direct, through approach circuit line relays, thus guaranteeing the integrity of the route.

Details of the Installation Explained

The last part of the book is taken up with a description of the mechanical locking employed with the Westinghouse interlocking machine and with details of sub-

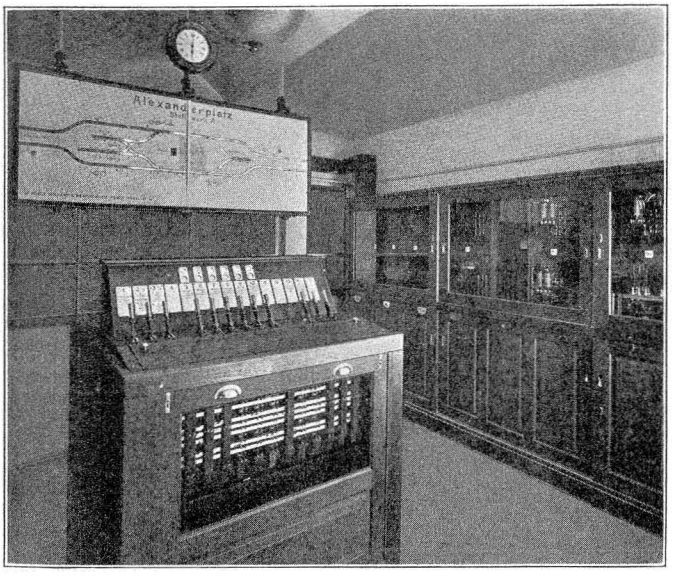

Fig. 8—Alexanderplatz Signal Tower

sidiary apparatus. There is also a complete description of the circuits of the Spittelmarkt tower with a detailed explanation of every movement that can take place, which, though relating to a small layout, enables the reader to get a very good idea of the whole system.

During the last few years the railroad company has been engaged in perfecting certain constructional details by the light of experience gained in actual service and if Dr. Kemmann is able to write his further promised volume these will be fully described therein. The Berlin elevated and underground road affords another example among many of the fine results following the adoption of automatic block for metropolitan services and is all the more remarkable in a country where, even more than in England, automatic working has not generally had a favorable reception.

The book is very well printed, the photographic illustrations (from which the present ones are taken with the author's permission) are excellent, while the diagram drawings and plates leave nothing to be desired. A very good feature of the diagrams is that whenever necessary the various stages in the movements are shown separately so that everything is made as plain as possible.

In works of this kind one is often given a complicated circuit diagram and left to imagine the moves concerned, so that a great deal of time is wasted in

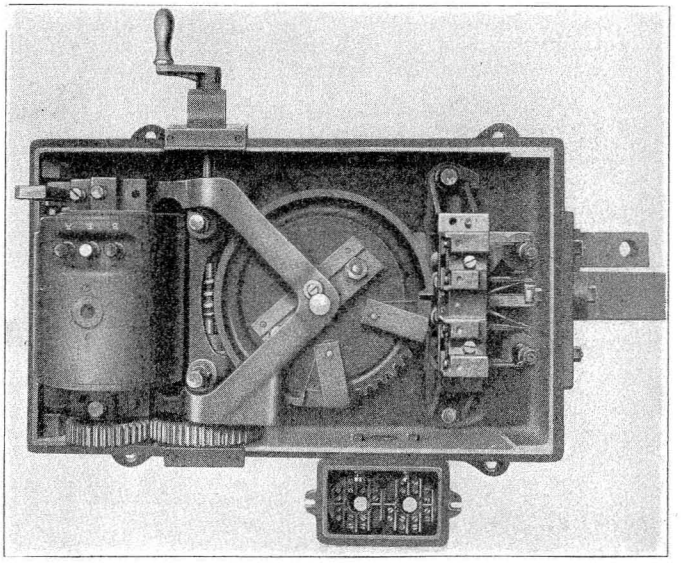

Fig. 10—Siemans and Halske Switch Mechanism, Showing Emergency Crank Handle in Place

unraveling them. In this case, however, no confusion is possible. All the circuits are also numbered, according to a key placed at the side, so that at any part of the diagram one can tell at a glance to what purpose or purposes any part of a circuit is devoted.

Dr. Kemmann is to be congratulated upon having, with much energy and perseverance, made so conspicuous a success of automatic signaling in the face of considerable difficulties and prejudices and upon the production of so valuable a descriptive work on the subject. In so doing he has rendered a very appreciable service to the cause of automatic block working and track circuiting generally.

Modern Yankee Doodle

By Jos. E. New

Yankee Doodle had a "noodle,"
But simply failed to use it.
Along he sped just as he said,
"I'm the guy that 'doosit.'"

Chorus

Yankee Doodle, in his car,
Crossed the railroad crossing.
The locomotive hit his car
And sent him on rejoicing.

He reached the track—now this is facts,
Just as the train came flying.
He couldn't stop but tried to hop—
They found him—later dying!

Yankee sighed just as he died,
"Just have my tombstone labeled:
"'Here lies a fool who broke the rule
And died somewhat disabled.'"