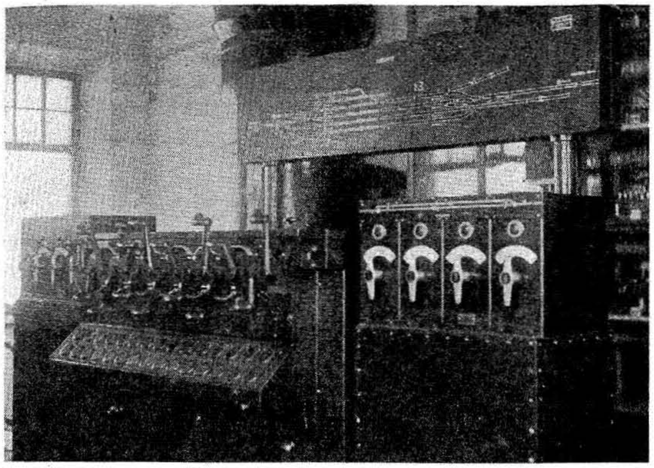
Railway Signaling

Modern Signaling in Soviet Russia

By J. M. Pelikan

Engineer, Union Switch & Signal Company, Swissvale, Pa.



Electro-pneumatic interlocking machine and remote-control levers at Pavshino

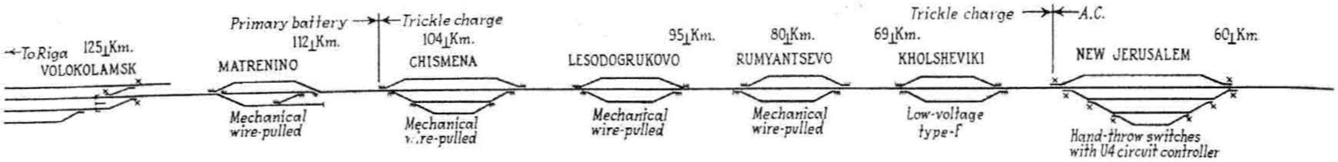
Post-revolution reconstruction of Russian railroads involves signaling patterned after American methods . . . Alternative of double-tracking existing single-track lines is avoided in solution of traffic problem

The old and the new . . . The cross on the mechanical signal signifies that this signal is out of service

SOVIET RUSSIA'S five-year plan included the huge task of reconstructing their transportation system, which had almost been wrecked during the years of civil war following the revolution. Modern signals and interlocking played, and are playing, an important role in solving the many operating problems presented by the increasing traffic.

Since the present Bolshevik government did not, until 1921, get complete control of what is now known as Soviet Russia, it was too busy with its political and military troubles prior to that date to do more than keep the main lines in operation for the purpose of supplying the various armies. During those days there was a shortage of everything, and thousands of box cars and passenger cars were used as housings for soldiers and officers, and for the "commissars" and their staffs. In central Russia and the Siberian steppes there are very few trees. In these regions, due to lack of fuel in the winter, hundreds of box cars and miles of ties were burned up for fuel in those turbulent times. Miles of cars stood on sidings for three to five years without being used. People would camp at stations for weeks hoping for a train to pull out. Since there were no regular railroad employes, excepting those in the service of the armies and the "commissars," a group of people, all of whom had the same general destination, would commandeer for their journey an engine and a few box cars in the station yard. The trip from Moscow to Rostoff, which is about 1,000 miles, would take anywhere from one to three weeks. If the engine ran out of fuel, the passengers would get off and cut some wood and in some cases even break up a box car for fuel. If the locomotive broke down, the train stayed on the main track until another train came along and pushed it to a siding.

One of the first and greatest tasks which faced the present Soviet government after it had obtained full control of the country, was to repair the damage which had been done to the railway system. This task, according to Soviet statistics, was practically accomplished by the fall of 1928. Although the amount of rolling stock and motive power was not as great in 1928 as in 1913, the year on which Soviet Russia bases all



of its pre-war statistics, the railroads of Soviet Russia hauled as many ton-miles of freight in 1928 as they did in 1913, and even more passengers. This was made possible by increasing car and train loads and by employing extremely large repair forces to keep the equipment in shape for the intensive use to which it was subjected.

The five-year plan contemplated that the railroads would haul, in 1933, twice as much freight and twice as many passengers as in 1928. This would, of course, necessitate a great increase in rolling stock and power equipment, as well as many improvements of the road beds. Since the Soviet government could not afford to buy modern heavy locomotives and rolling stock from foreign countries, it had to plan on using equipment of its own manufacture, most of which was very light. The average Soviet locomotive can haul from 1,000 to 3,000 tons and the average freight car holds around 16 tons, being a two-axle car.

Solution of Problem Found in Signaling

Since most of the main lines were already loaded to within 80 or 90 per cent of their capacity in 1928, the five-year plan required one of two things to be done: Either a considerable mileage of tracks would have to be added to the present system, or the traffic problem would have to be solved by means of signaling. The latter course was chosen as the most practicable and efficient.

The Russians looked to America for a solution of their problem. In the course of their studies, they found that American railroads had been able, over a period of years, to increase their ton and passenger mileage without adding trackage, and in some cases even with a reduction in trackage. In the United States, it was the introduction of signaling, plus the use of heavier equipment, that accomplished this. Since there was no immediate hope of greatly increasing the weight of the equipment in Russia, they decided that signaling would have to be stressed more heavily.

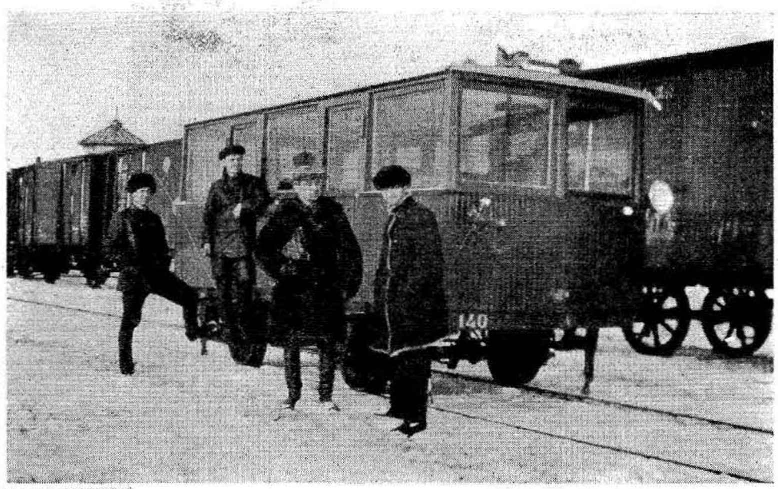
The so-called progressives in Soviet Russian railroad circles believed that automatic block signaling would solve Russia's railroad traffic problems, and automatic block signaling was soon hailed as being more important than equipping their freight cars with air-brakes, despite the lamentable fact that most of their freight cars even to this day are equipped only with hand brakes. The track-circuiting of their interlockings has also been overlooked; in fact, interlockings seem to be one of the weakest points on Russian railroads today.

About the time these studies were being made, a contract was given to the German concern of Siemens & Halske for the installation of reverse-running signaling on a three-track stretch of railroad, then being electrified, between Moscow and Mitistchi, a distance of 30 kilometers. This included an all-electric interlocking at the Moscow Northern Railroad terminal, and two small electric interlockings—one at Losinostrovskaya and one at an intermediate station, Moscow III.

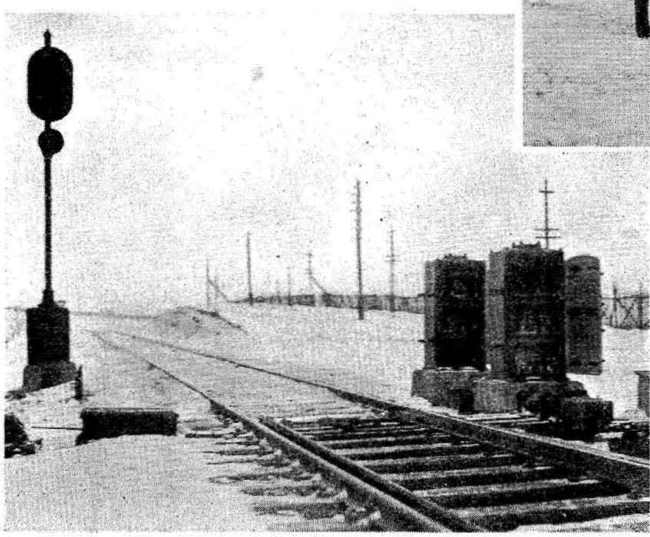
However, these installations were not considered as typical of the signal installations which would be necessary on most of the Soviet railroads, which were mostly single track. For this reason, several commissions were sent to America, the home of A. P. B. signaling, to study signaling methods. One of these commissions came to America in the early part of 1929 with authority to buy signal material for a trial installation on 110 kilometers of single track, between Pokrovsko, a suburb of Moscow, and Volokolamsk, on the Vindavsky Line of the Moscow, White Russia & Baltic. The material was bought from the Union Switch & Signal Company and arrived in Russia in the fall of 1929. The installation was placed in service in February, 1931.

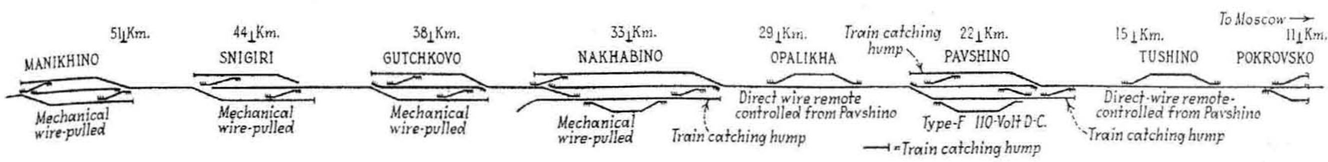
As this was a trial installation, the Soviets wanted to try several types of apparatus in order to determine

Group of Russian engineers, with a test motor-car . . . Note the two-axle freight cars in the rear



End of remote-controlled passing siding at Opalikha





which suited their conditions the best. One section was equipped with a-c. signaling, another with d-c. floating battery, and a third with primary battery. Color-light signals were used throughout, excepting at one interlocking in which searchlight signals were used.

On the first 60 kilometers, extending from Pokrovsko to New Jerusalem, the signaling equipment is a-c., operating at 50 cycles, 110 volts, with a 6,600-volt 3-phase high-tension line. In this territory there is one Type-F high-voltage d-c. interlocking, at Pavshino, a four-track station of the type commonly seen in Russia and Europe. A Model-14 15-lever control machine is used in this interlocking. The track circuits are a-c. and the control circuits within the interlocking are 10-volt d-c. Union rectifiers charge the switch operating and control-circuit battery. The signals are of the searchlight type and are lighted from the a-c. source without any standby. Switch movements are 110-volt d-c. Style-M2 type.

Two sidings, each five miles from Pavshino, are remotely controlled from Pavshino by direct-wire circuits. Each of these sidings has two switches and four signals, and each is controlled by a four-lever non-interlocked circuit controller, with a miniature track model above the levers. These four-lever control units are mounted on either side of the Model-14 machine at the Pavshino tower. The operator thus has control of three passing sidings and approximately 10 miles of single-track territory. The switch movements at the remote-control sidings are of the M-20 dual-control type, operated from 24 volts d-c. The signals at these sidings, as well as in all of the rest of the territory, with the exception of Pavshino, are of the R-2 color-light type, using 8-volt lamps. The track circuits at these sidings are also a-c. The local control circuits at each end of the siding operate on 10 volts d-c.

Besides the above three interlockings, there are in this territory four other stations which have three tracks each. These sidings were formerly equipped with wire-pulled mechanical interlockings of the Siemens & Halske type, which were modified by the addition of track circuits, by the equipment of the route levers with Union Model-12 a-c. locks, and by the addition of table-lever interlockers for the control of the signals. The electrical circuits at these mechanical interlockings are arranged so that detector and approach locking of the route levers, is effected. The table interlocker signal levers are locked in their normal or center position, and are so interlocked electrically with the electric locks on the route levers, that the signal levers cannot be moved to their extreme right or left position unless the swich levers are in their proper position and are locked by a route lever.

The d-c. floating-battery section extends from New Jerusalem to Chismena, 40 kilometers. Here the 8-volt line circuits are energized by RT-11 rectifiers. Style-R2 light signals, and storage-battery track circuits using RT-11 rectifiers, are used. At Kholsheviki a low-voltage Type-F interlocking, operated from a six-lever table-interlocking machine, handles the three-track station. In this section there are three other three-track stations, which are equipped with mechanical wire-pulled interlocking machines of the Max Udele type. These were modified with the same electrical features as the mechanical interlockings in the a-c. territory, using in this case Union Model-12 d-c. electric locks on the route levers, d-c. trickle-charged detector track circuits, and d-c. table-lever interlockers for the control of the signals.

The third part of the installation is a 20-kilometer primary-battery section, using approach-lighted Style-R-2 signals. This section also includes a four-track station which has a mechanical interlocking of the Max Udele type, electrically modified in the same manner as the interlockings in the trickle-charge territory. The circuits in the automatic territory are of the polarized-line three-wire A. P. B. type. Since every siding is interlocked and the entering and leaving signals are controlled by an operator who is at all times in communication with the dispatcher, the installation is in effect a dispatcher-control system and has the same traffic capacity.

Some Interesting Sidelights

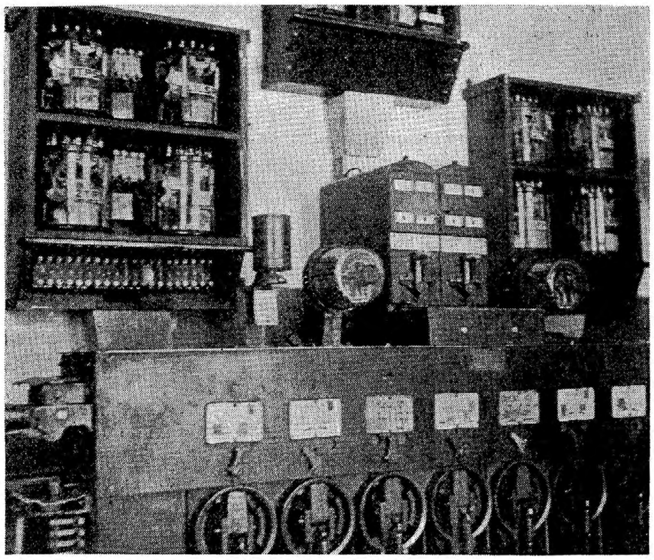
As much of the material used was of Soviet manufacture, the installation has many interesting and odd features. Because of the lack of fiber in Soviet Russia,

Typical double location in automatic territory

the insulated joints are made of wood, and therefore are mechanically very weak. In the summer months, when the rails expand, taking up most of the slack, the end pieces, which are made of leather, are smashed, and the result is that there are many broken-down insulated joints. The section gangs are kept busy driving the rails back from the wooden joints in the summer time.

A second feature is the use of iron line wire which corresponds in size to our No. 4 A. W. G. Iron wire had to be used because of the scarcity of copper. A third feature was the use of parkway cable, the individual wires of which were insulated only with one layer of jute and, in some cases, only with waxed paper. The insulated wire used in the wiring of the signals and instrument cases has only one thin layer of rubber and a layer of braid. Its insulating qualities are comparable with those of our ordinary green lamp cord. As a result, much trouble is being experienced due to crosses and grounds. Three cases of false-clear signals were reported during the first six months of operation of this installation, all due to this poor-quality wire and cable.

Because the equipment is so light, some of the two-



Wire-pulled mechanical interlocking machine of the Siemens-Halske type, equipped with modern table interlockers . . . Model 12 a-c. locks on the route levers

axle flat cars weighing only 7 or 8 tons, several cases of poor shunting were noticed. In some cases a single flat car standing on the main track in an interlocking hardly affected the vane of an a-c. track relay which was adjusted so that the vane just touched the roller. It is very questionable whether in some cases one of these light cars would shunt the track circuit at the fouling point if only one axle was in the track circuit. The track-relay equipment was the same as that which is ordinarily used in the United States, and the track circuits were adjusted carefully so that they would have maximum sensitivity and still hold up, and this adjustment is checked several times a year. In future Soviet signaling, a special track relay will have to be designed to be far more sensitive than the ordinary track relay used on American railroads.

Another interesting feature is the use of humps to catch run-away cars. The Russians have learned not to trust their brakes too much. Due to the fact that most of the freight cars are equipped only with hand brakes, and that the couplers are of the hook-and-link type, it frequently happens that part of a train breaks away from a train going up-grade, and rolls back down. For this reason, sidings are located at the bottom of grades wherever possible. A steep hump track is built at the end of the siding and the switchmen and interlocking operators at such sidings set the switches at the siding after a train going up-grade has passed, so that if part of the train breaks away and rolls back, it will run up this hump and stop. Also, if a train is to stop at the siding and is coming down-grade, the switches must be set for the hump, as a precaution in case the train cannot stop. These humps are called "train-catching dead ends."

After the installation was placed in service, there were many cases of enginemen disregarding red signals, and in three of these instances a derailment resulted. At the Pavshino interlocking, 11 switches were broken, due to trains trailing through them. This was due partly to the fact that the Russian enginemen had been accustomed to the German type of wire-pulled interlocked switches whose points are not rigidly connected and can be trailed through without danger to the train or harm to the switch. This lack of discipline on the part of the enginemen is slowly being remedied.

Prior to the installation of signals, this section was equipped with a staff system, and, in the summer of 1930, before the signals were placed in service, the number of scheduled passenger and freight trains on the first half of the stretch, that is, the one nearest to Moscow, was around 40 trains a day. The scheduled trains in the summer of 1931 amounted to 45 trains. It was felt at this time that as many as 60 trains could be handled when the operating people became accustomed to the signal system. The average passenger train in this section comprises 7 to 12 cars, the majority of which are two- or three-axle cars. The passenger schedule for the local trains is four hours for the 120 kilometers, and for the express trains it is three hours. The freight trains usually have from 50 to 70 cars, these being mostly of the two-axle type having an average capacity of 16 tons.

This road, however, is not one of the most important commercial roads in Russia. Most of the other lines have much faster and better passenger schedules and more powerful freight locomotives. In the coal regions of the Donetz Basin, a fairly large part of the coal cars are of the four-axle type and are equipped with air brakes. In the Transcaucasian region all the oil-tank cars are equipped with air-brakes. These constitute the major part of the traffic between the oil fields of Baku and the Black Sea port of Batum.

The Soviets as Manufacturers

In the summer of 1931, the Soviet government again bought from the Union Switch & Signal Company a considerable number of d-c. relays, a-c. relays and rectifiers, for future installation. They planned, however, on manufacturing their own signals, circuit controllers, instrument housings, interlocking machines, and all accessory equipment. In Leningrad there is a small factory which formerly belonged to the German firm of Siemens & Halske, at which they now manufacture some d-c. relays, circuit controllers, electric switch movements of the Siemens type, and also mechanical and electrical interlocking machines. Due to their lack of experience and proper technical help, they have not as yet made much progress.

At Moscow a manufacturing plant is being constructed for the manufacture of telephone, telegraph and signal equipment. Due to lack of foreign technical aid, and to lack of money with which to buy plant equipment, this plant is progressing slowly and it is questionable as to when it will be ready and what sort of signal equipment it will turn out.

A few signals similar to the Union R-2 type are being manufactured, the various parts being made at several factories and assembled in the signal factory at Leningrad or on the ground. Naturally this method of manufacture is not giving good results. The first few batches of d-c. relays turned out by the Leningrad factory had so much residual magnetism in the cores that it was dangerous to use them. The Soviets are

(Continued on page 68)

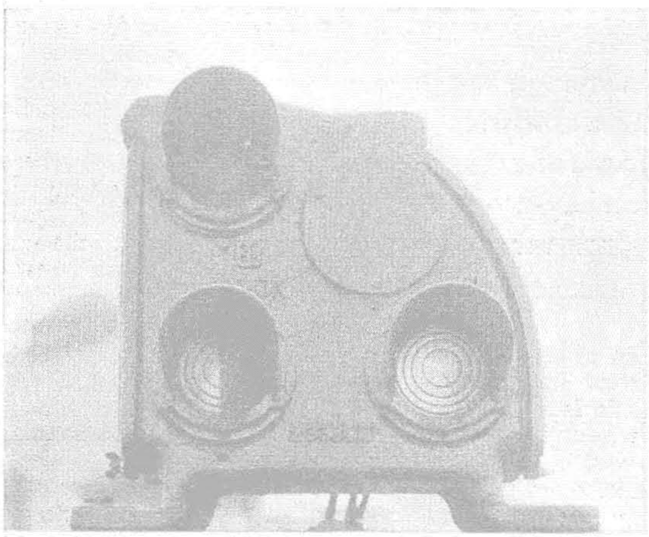
Double-Filament Lamp With Dividing Screen Gives Burn-Out Indication

By Charles Adler, Jr.
Signal Engineer, Maryland & Pennsylvania Railroad, Baltimore, Md.

THE almost universal use of light signals by the railroads of this country has brought to the fore the problem of guarding against failure of the incandescent source of illumination. When a failure of this nature occurs in a signal dependent upon a single incandescent lamp for the display of its aspect, two undesirable conditions are created: First, the possibility of a delay to train movements; and second, the potential danger of an engineman's failure to see the signal, in its unlighted condition.

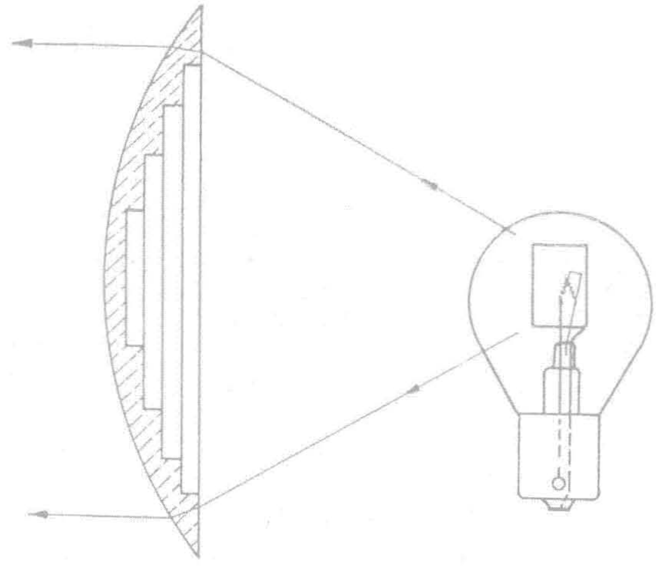
One of the important functions of light signals is the protection of highway traffic at railroad crossings; and it is of paramount importance that the standard aspect of two red lights flashing alternately, be kept uniform at all times. The burning out of a lamp in one of the flashing units will cause this wig-wag form of indication to be changed to that produced by a single flashing lamp. Such an indication may at night be readily confused with the constantly flashing highway beacon lights which have a meaning foreign to that of the highway-crossing signal.

Recognizing the importance of the lamp-outage problem, the Maryland & Pennsylvania has installed in its alternate-flashing-light signal at Cold Spring Lane crossing in Baltimore, double-filament screened lamps recently developed and made available by the Union Switch & Signal Company. This type of lamp is constructed with two filaments placed parallel with each other and slightly spaced by a centrally located metal screen. Normally, both filaments are incandescent and



Position-light dwarfs signal—Note clear-cut division of light in left unit in which one filament is burned out

the entire bulb is illuminated. However, upon the failure of either filament, the screen causes the lamp to be divided into contrasting bright and dark halves. This effect is reproduced on the signal lens and thus gives unmistakable notification that the lamp should be replaced. At the same time brilliant illumination is still provided on the bright half of the lens, enabling the signal to be read clearly. To guard against the possibility of the simultaneous failure of both filaments of the lamp, the filaments are constructed of slightly unequally rated life.



A small metal shield is mounted between the two filaments

While installing the screened lamps at Cold Spring Lane crossing, a sample lamp having one filament disconnected, was placed in one of the signal units, and the telltale failure indication produced on the lens was clear-cut and arrestive. The maintenance men were shown this indication and instructed to inspect the signal at regular intervals, replacing the lamp behind any lens showing the failure aspect. The sample lamp was then removed, and lamps having both filaments operative, were permanently installed. The illumination given by the new lamps was found to be equal in brilliancy to that afforded by those of similar wattage formerly used. Other light signals on the Maryland & Pennsylvania will be equipped with the screened lamps in the near future.

Russian Signaling

(Continued from page 60)

slowly learning that they cannot build up an industry over night, but must go through the same process of mistakes and experiences which was gone through in capitalistic countries.

The original five-year plan called for the construction of from 15,000 to 20,000 kilometers of automatic signaling on the Soviet railroads. What has actually been done is shown by the following excerpt from the report to the central committee of railroads by Comrade Andreyeff, minister of railroads, which was published in the Soviet Official newspaper, "Pravda," on December 14, 1932: "In the field of semi-automatic block signaling, the plan was fulfilled 201 per cent. Twelve-hundred five kilometers have been installed, and at last this year we have made a serious beginning in the field of automatic signaling. On the first of January, 1932, we had 195 kilometers of automatic block signaling. This year we evidently will have 700 additional kilometers of our own Soviet-made automatic block signaling."