

Operation of Trains by Signal Indication on Single Track



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Union Switch & Signal Co.
SWISSVALE, PA.

Operation of Trains
by Signal Indication on a
Section of Single Track on the
Central of Georgia Railway

By

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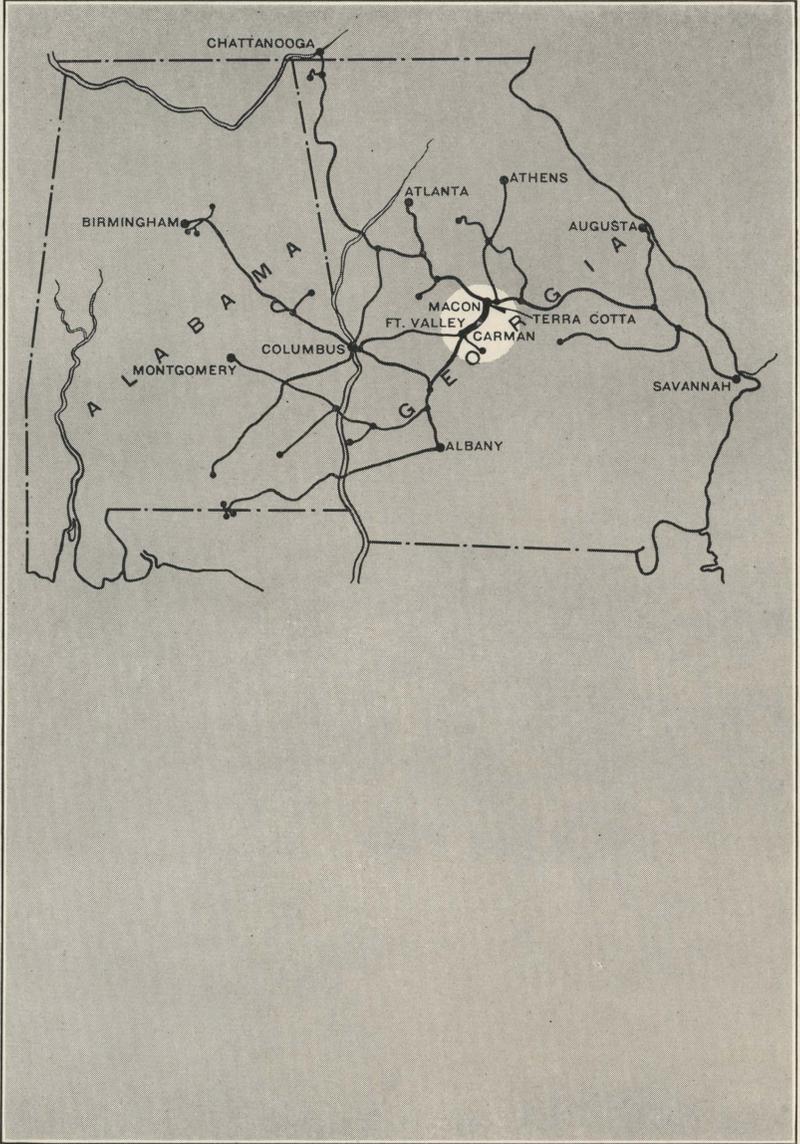
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BULLETIN 127

December, 1928

Union Switch & Signal Company

Swissvale, Pennsylvania



*The Central of Georgia Operates Trains by Signal Indication
between Terra Cotta and Carman*

Operation of Trains by Signal Indication on the Central of Georgia Railway

THE object of this paper is to show the results obtained by a special signal arrangement to handle trains by signal indication without train orders on that part of the Central of Georgia, between Macon, Ga., and Fort Valley, which is single track. This signal system and the method of operating trains there by signal indication is the result of a gradual development over a period of several years. A brief outline of some of the steps in this development may be of interest before we take up the economic side of the present arrangement; also a word as to the geographic location and traffic conditions.

Location of Territory and Traffic Conditions

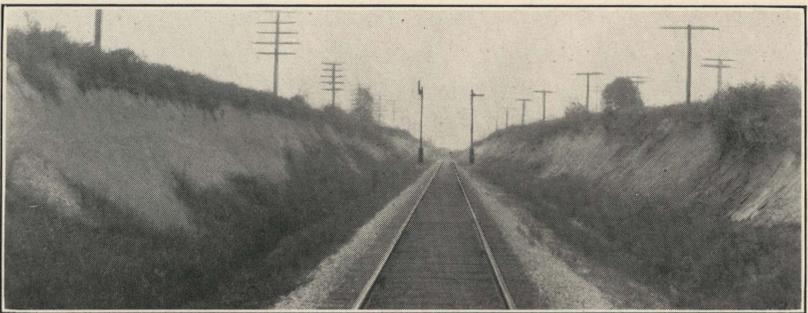
Macon is the point where several lines of the Central of Georgia converge; one line from the port of Savannah with a branch from it reaching Augusta, another branch reaching Dublin and another Porterdale; one line from Atlanta with a branch reaching Chattanooga, Tenn.; then the line in which we are particularly interested in this paper, to Fort Valley where the main line splits, one fork leading to Columbus and Birmingham and the other fork leading to Albany with branches to Montgomery, Andalusia, Ozark, Fort Gaines and Lockhart. The 29 miles between Macon and Fort Valley is, then, the neck of the bottle, for over it must pass the east and west movements and the north and south movements. Of this 29 miles, approximately 3 miles on the Macon end and 2 miles on the Fort Valley end are double track with the intervening 24 miles, Terra Cotta to Carman, single track.

Fort Valley is the center of the Georgia peach belt and it is from that point that refrigerators with the initial icing are distributed to a wide territory and where, after loading, the cars are re-iced. As the Central of Georgia moves about 75 per cent. of the Georgia peach crop, it is natural that the time of heaviest traffic in this particular territory is when the peaches are being shipped, or the "Peach Season" as it is commonly called with us, which usually starts in the latter part of May or the first of June and lasts for six weeks or two months, with the peak usually sometime in July.

The single track between Carman and Terra Cotta, in addition to handling the through movement of peach trains which are assembled in Fort Valley, also has to carry switching movements in placing cars and picking up loads at the various spurs just at the time of the heaviest traffic.

Train Operation

Manual block was used between Macon and Fort Valley for several years before the installation of automatic signals in 1917, when the manual block was discon-



An Intermediate Automatic Signal Location

tinued. The automatic A.P.B. signals were put in not only for the safety of operation, but to expedite train movements. A few years later the use of the "19" order was extended to supplant the use of the "31" order in all automatic signal territory.

One phase of the method of operation on the Central of Georgia must be clearly understood to see clearly the development that has taken place in the signaling and operation in this particular location, and that is that in manual block territory we do away with the superiority of trains. Rule 305 reads:

"Block signals govern the use of blocks, but, unless otherwise provided, do not supersede the superiority of trains, nor dispense with the use or the observance of other signals whenever and wherever they may be required."

It is the practice on the Central of Georgia to have the manual block signal dispense with the superiority of trains and so eliminate practically all train orders. The capacity of single track under this method, with operators at each passing track, is greater than it is where train orders are used without automatic signals but with a 10-min. spacing rule. How much the capacity of track over this method is increased by the use of train orders *with* automatic signals depends largely on the number of operators and the ability of the dispatchers.

For a number of years we have not used manual block on the Central of Georgia on lines where passenger trains are operated, unless it is in automatic signal territory.

The combination of manual block, doing away with the superiority of trains, with automatic signals, doing away with the 10-min. spacing rule and allowing following

moves on the 45-deg. indication of the automatic signal with a card from the operator, is a safe and effective way of handling heavy traffic on single track.

Advancing Trains Over the Territory

This combination of manual and automatic block without superiority of trains, and so with practically no train orders, was used frequently between Macon and Fort Valley during the few weeks of heaviest traffic in the years 1920 to 1925. Under this method of operation it is a simple matter to advance a freight train against a late passenger or scheduled freight, as no written orders are necessary. However, through movements are slowed up, as the engineman of an approaching train must see the manual block signal change from "Stop" to "Proceed" and therefore every train must approach each manual block signal prepared to stop or head in at the entering switch of the proper passing track.

In 1924 a special signal arrangement was installed between Macon and Paynes on the line to Atlanta to enable trains to operate on signal indication. A paper describing this signal arrangement and method of operation was presented at the March, 1925, meeting of the Signal Section and may be found in the Proceedings for the year 1925.

The signaling between Macon and Paynes gave such satisfactory results that it was decided to have a similar arrangement worked out for the single track between Carman and Terra Cotta. While the details of this signaling scheme were being studied, an estimate was also made of the cost of double tracking and it was finally decided that the next logical step was the signal rearrangement, as this

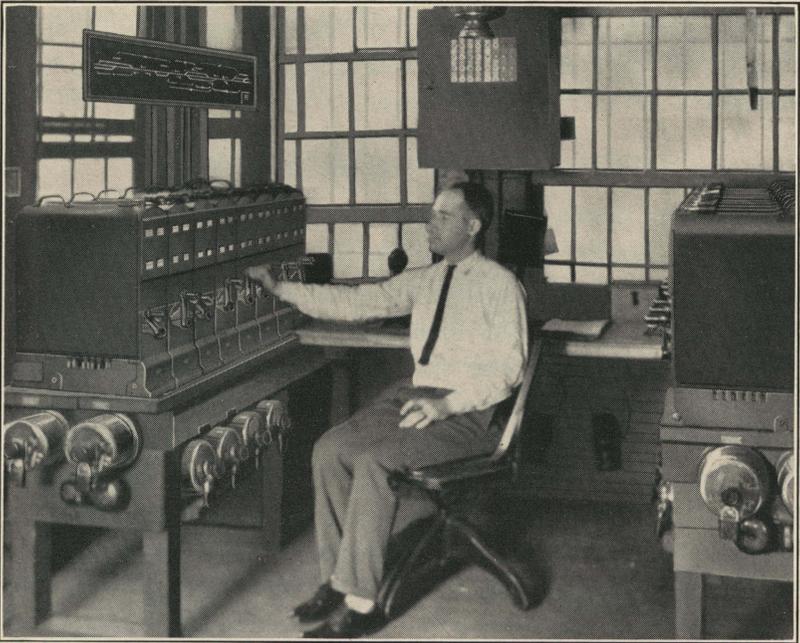
would increase the capacity of the present track sufficiently to warrant the postponement of building the second track for a number of years.

Operating and Signal Requisites

From an operating point of view this scheme must add to the advantage of manual block and overcome the disadvantage. For through moves, an engineman should be given clear signals at all locations so that maximum speed could be made from one end to the other. When a train is to enter a passing track, information must be given the engineman to approach the entering switch prepared to stop and specific instructions must be given at the switch to head in. With a train in the passing track, a means must be provided for indicating when the train should head out and proceed.

It must speed up traffic on a division where overtime of freight train crews was already low, as freight trains averaged better than 13 mi. per hr. There were only three continuously open telegraph offices and two of these were necessary for other purposes than train orders for this territory, therefore there was no large reduction of operators' pay roll to be made. Further, the installation must be such that it would show a return on the investment at times of the year when traffic would not exceed 30 trains a day and yet be flexible enough to handle efficiently traffic of twice that number of trains a day.

From a signaling point of view the signal, having the entire responsibility of authorizing train movements, must, of course, be semi-automatic and must have safeguards equivalent at least to those commonly applied to high speed moves over interlocking plants. It was felt, too,



*Operator Handling Interlocked Desk Circuit Controllers
at Byron Passenger Station*

that apparatus used should be only that which might be called standard signal material, and that information should be given as to the location of trains at all times. It was decided, too, to have each signal, when clearing, check the position of each opposing signal in the same block in the "stop" position and also check the opposing distant signal to that block as being at either 0 deg. or 45 deg. Special measures were also taken to guard against crosses and grounds.

On account of freight trains entering and leaving the main line at Terra Cotta it was decided to retain operators at that point and they were given control over the signals and therefore over the train movements for approximately

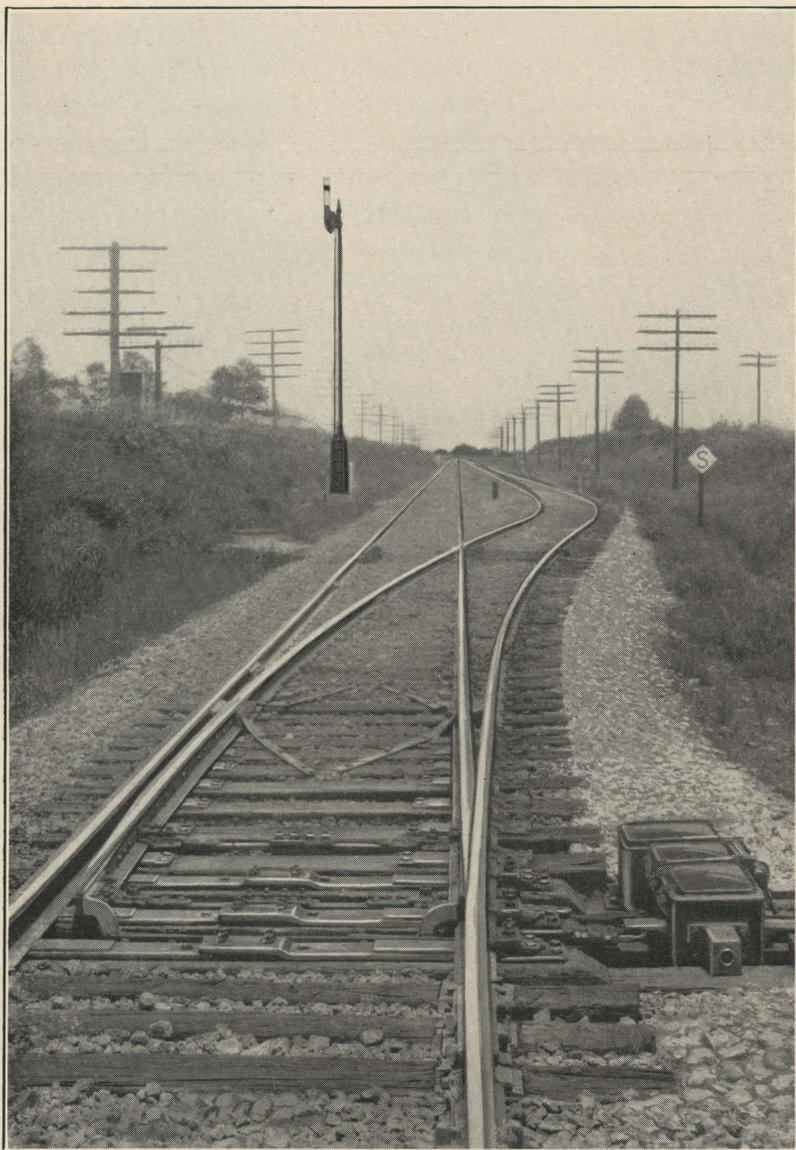
one-third the territory. Another set of operators were retained at Byron to control the balance of the territory. Control of the signals was given the operators by means of interlocked desk circuit controllers* and information as to the location of trains conveyed to them by means of the indicators on these controllers. The operator at Terra Cotta controls movements between that point and the east switch at Echeconnee. The operator at Byron controls movements between the east switch at Echeconnee and the end of double track at Carman.

Power Switch Machines Help Traffic

Power switch machines are used at only two points where there are heavy grades either entering or leaving the passing track. Where power switch machines are not used, the indication to take siding is given by a red light signal unit with black letter "S" on the cover glass, located at the entering end of the passing track. At most locations this is attached to the mast of the signal—the high signal of course indicating "stop" when the "take-siding" indication is displayed.

To indicate to the crew of a train on a passing track that they may line the switch and head out, a dwarf light signal is located near the fouling point. This dwarf signal has a frosted white unit with a white letter "S" and yellow and red units. The white letter "S" indicates that the main line switch may be thrown, after which, if the lever is still in the proper position and the track unoccupied, the red and "S" lights go out and the yellow light is displayed. This yellow light authorizes the train to move from the passing track to the main line and to the next signal.

*Bulletin No. 110, giving detailed information on desk circuit controllers, will be sent on request.



*Power Operated Switch at Byron Passing Siding
Keeps Trains Moving*

Passing tracks are used directionally except at Byron. At this point the signal arrangement is somewhat different from that at other points to take care of special local conditions and to allow flexibility of switching movements.

The power switch machine at the west switch at Byron enables eastbound trains to take siding at that point, which could not previously be done without considerable delay on account of the grade.

Walden and Ohio are not passing tracks, but since at certain times a train may get in the clear at these points, provision is made for the operators to authorize a move from the siding to the main line only when the entire block from passing track to passing track is unoccupied.

The Track and Signal Layout

The switch at the end of double track, Carman, is a spring switch installed prior to this signal re-arrangement.

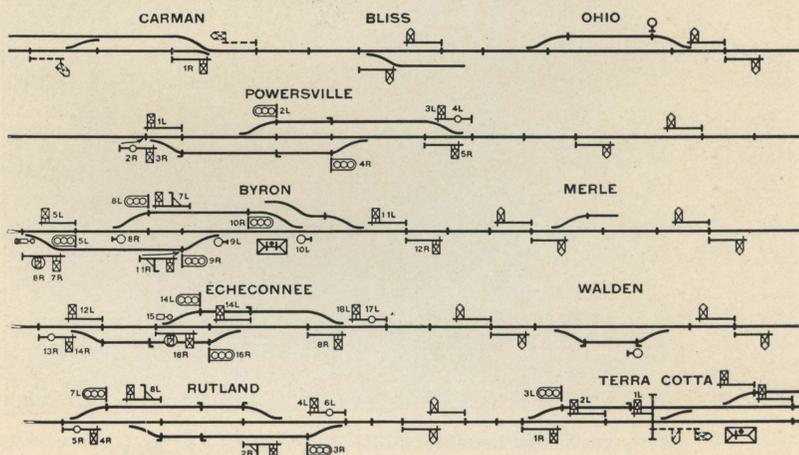


Fig. No. 1—Track and Signal Layout



Passenger Train Leaving Single Track at Terra Cotta

The part of this signal arrangement that is controlled from Terra Cotta—that is, Terra Cotta to the east switch at Echeconnee—was put in service, March 3, 1927. On April 14, Echeconnee to Byron was cut in, and on April 28, Byron to Carman, so that on that date trains were operated between Terra Cotta and Carman without train orders. See Fig. No. 1.

Flexibility of Train Operation

Just one illustration of how easily meeting points can be changed may be of interest. One night, No. 32, the Southland, northbound for Chicago, was unexpectedly delayed between Fort Valley and the end of double track at Carman. This train must meet No. 3, a passenger train for Columbus, and No. 11, a passenger train for Montgomery, which are scheduled 5 minutes apart. The dispatcher first told the operator at Byron to head-in No. 3 and No. 11 at Echeconnee for the Southland, based on Fort Valley's O. S. of that train. A little later he asked where No. 32 was, and the operator replied that it had not "dropped the approach indicator for Carman yet," but that No. 3 was on the approach to Echeconnee. The dispatcher immediately said: "Run 3 and 11 to Byron for 32." This was done by putting normal lever 17, which controls the Take Siding Light at Echeconnee, and putting levers 18, 14 and 12 to the left for the move from the east switch at Echeconnee to Byron.

A few minutes later a similar inquiry resulted in information to the dispatcher that 32 had not reached the approach track circuit to Carman and 3 and 11 were advanced to Powersville, the operator being further instructed not to clear the eastbound signal at Carman unless 32 was shown approaching it before No. 3 was shown

approaching Powersville. The result was that 3 and 11 went to Carman for 32. The intended meeting point was changed three times without issuing an order and without communication with the train against which the other trains were advanced and which under time table rights would have been superior by direction; in fact, without any communication with any of the three trains involved further than issuing instructions by means of the signals.

The engineman of No. 3 said afterward that he saw four yellow signals, but that three of them changed to green before he reached them. He may have been delayed a few seconds when approaching the east switch at Echeconnee before he came in sight of the signals. If so, that was the extent of his delay and No. 11 was not delayed at all. The dispatcher said that had this

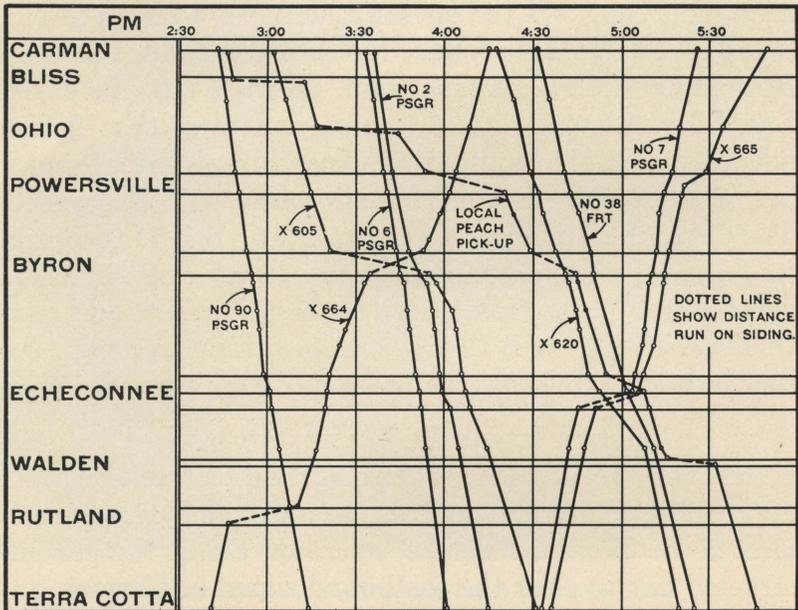


Fig. No. 2—Train Movements by Signal Indication for a 3-Hour Period

occurred a few days before when trains were operated on train orders, both No. 3 and No. 11 would have been delayed at least 30 min. each.

Train Chart Shows Advantages of System

Figure No. 2 is a chart of the train movements as directed by signal indication for a 3-hr. period on July 6, 1927. This was plotted from data taken at the controlling stations as indicators showed the passage of a train at various points, and therefore it shows the actual operation more clearly than is possible where trains are O. S. 'ed by operators at their stations. It is of particular interest in showing the exact time each train cleared the main line when taking siding and also just when it started to move out of the siding. Extra 580 is known as the "peach local" and had work to do at Bliss, Ohio, Powersville, Byron, Echeconnee and Walden. This train has a schedule corresponding to the time peaches may be billed at each loading track and be on that day's schedule.

It will be noted that 10 trains were handled practically all the way through in this 3-hr. period—4 passenger trains, 5 through freights and Extra 580 that had more work to do than the usual local freight. This gives an idea of the way traffic was handled during the peak of 1927. Ten trains in 3 hours is at the rate of 80 trains a day and the chart shows that more could have been handled without serious delay. As 52 trains is the maximum we have had in any one day since this signal system has been in operation, it is clear that we have the facilities for handling a substantial increase in the volume of business. Further, the arrangement is such that other switches can be equipped with low voltage switch machines* with a minimum change in the signal apparatus.

*See Bulletin No. 93.

The Economic Side of Train Operation by Signal Indication

In making an economic study of the results obtained from the installation it was decided to compare the months of September, 1926, and 1927 as typical of 11 months of the year, and one week of heavy traffic in 1926 with one week of the same traffic in 1927 as typical of one month in the year. As previously stated, the peach season is the time of heaviest traffic and while that lasts from six weeks to two months, the traffic is not uniformly heavy throughout and therefore with a view of being conservative the week will be considered as typical of only one month.

It was thought at first that the basis of comparison should be the running time between Terra Cotta and Fort Valley. Going into the matter a little more carefully, it became evident that this would not be a fair comparison, as there were advantages gained that would not be covered by this method. A train might be held at Fort Valley or Terra Cotta under train orders for another train and then run through without a stop, making excellent time between those two points, while under the present method the train would be advanced but have to take siding somewhere in this territory, thus taking longer time between those points but reaching its terminal possibly 30 minutes to an hour earlier. Obviously the time that counts is the time on duty, to the time reaching terminal, and that was the basis used.

Comparing the actual operation in September, 1926, and September, 1927, it was found that traffic was somewhat heavier in 1926 than in 1927. However, a careful check showed that on the days of heaviest traffic in 1926

trains made faster time than the average for the month, so that the slight increase in traffic over 1927 had no noticeable bearing on the results.

Using Through Freights for Local Work

It was found, too, that in 1927 greater tonnage was handled per train and also that some of the through freights were used to do some local work, so that fewer local freights were run. The result was that the increase in speed of the through freights in 1927 was not so marked as it would have been had these trains been operated strictly as through trains on the same basis as in the previous year. It was therefore decided, that since part of the local work was done by through freights, it was fair to give this method of operation credit for the difference in local freight train hours.

In September, 1927, 37 through freights made a total of 49 hr. 43 min. overtime, while in September, 1926, 55 through freights made 58 hr. 13 min. overtime. However, as there were more trains operated in 1926, we will consider the saving in overtime as only the 15 min. difference in average running time applied to the 37 trains actually making overtime, or $9\frac{1}{4}$ hr. at \$5.76 per hr. equals \$53; the savings in wages of local freight crews amounted to \$1,225.11, and this combined with the \$53 saved on overtime for through freights, makes \$1,278 pay roll saving.

Fuel and Water Savings

In September, 1927, the 354 through freights averaged 15 minutes less time than in September, 1926. This is a reduction of $88\frac{1}{2}$ hours in fuel burning time. Fuel and water on this division for this month averaged \$3.07 per

freight train hour. There was, therefore, a saving in fuel and water of \$271.

There was a saving in local freight train time of 216 hr. While \$3.07 is the cost of fuel and water per freight train hour, it is probable that the consumption is not as great per hour for local freights, but there can be no question of its being at least 50 per cent. of that of through freights. We will therefore consider the cost of fuel and water for the local freights as only \$1.50 per hr. At this price the saving in fuel and water for the month for local freights amounts to \$324. This, combined with the \$271 saved on water and fuel of through freights, makes a total fuel and water saving for the month of \$595.

Summarizing the Monthly Savings

During the month eastbound trains brought 8,270 cars into Macon and westbound trains handled 8,193 cars, making a total of 16,463 cars handled on through freights in this territory. A saving in time of 15 min. amounts to 4,116 car hours, or 171 car days. It is therefore fair to assume a saving in per diem of \$171 per month.

We have, then, so far, by a comparison of the two months, a monthly saving as follows:

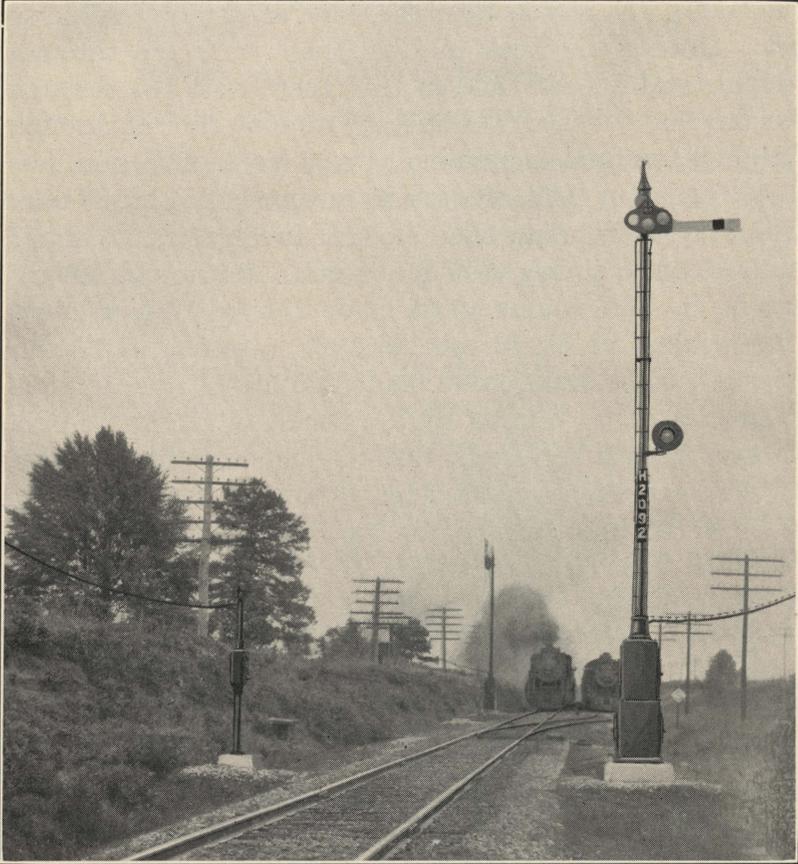
Wages of train and engine crews.....	\$1,278.00
Fuel and water.....	595.00
Per diem.....	171.00
Total	<u>\$2,044.00</u>

There is no doubt that there is a real cash saving in repairs to engines and freight cars by reducing the number of train stops. It is practically impossible to determine how many train stops are eliminated as a result of this signal re-arrangement and rather than approximate a

cash saving on an estimated basis that might be questioned, we will simply class this saving as intangible.

A few comparative statistics for the months of September 1926, and 1927 for this whole division may be of interest:

	1926	1927
Freight train miles per hour . .	13.1	13.9
Miles per car per day	39.88	48.04
Gross ton miles per train hour	14,747	16,475



Through Train Passing Local at Byron Passing Siding

It is not claimed that the operation by signal indication in this short territory is entirely responsible for these increases in operating efficiency, but it is obvious that this method of operation contributed toward this result.

Comparison of Results During Peach Season

For the purpose of comparison during the peach season, a week in 1926 and a week in 1927 were selected in which the traffic was just as near the same as it was possible to get. During the week in 1926 there were 183 through freights and 6 locals, and in 1927 there were 181 through freights and 6 locals. The average running time of through freights, terminal to terminal, was 1 hr. and 25 min. less in 1927 than in 1926, or a saving in time of 254 hr. 53 min. The average running time of local freights was 2 hr. 52 min. less, or a saving of 27 hr. 31 min. In through freight service in 1926 engine crews made 232 hr. 19 min. overtime against 61 hr. 51 min. in 1927, a saving of 170 hr. 28 min., while train crews made 235 hr. 47 min. in 1926 against 59 hr. 31 min. in 1927, a saving of 176 hr. 16 min. In local freight service in 1926 engine crews made 23 hr. 15 min. overtime against 6 hr. 40 min. in 1927, a saving of 16 hr. 35 min., while train crews made 21 hr. 55 min. overtime in 1926 against 5 hr. 40 min. in 1927, a saving of 16 hr. 15 min. Turning the savings in fuel, water and overtime hours for this week into money, we have the following:

Fuel and water for through freights,	
254.9 hr. x \$3.22	\$820.78
Fuel and water for local freights,	
27.5 hr. x 1.61	44.27
Total saving in fuel and water for the week	<u>\$865.05</u>
(Cost of fuel and water slightly higher in July than in September)	

Saving in crew overtime:

Local train crew, $16\frac{1}{4}$ hr. @		
\$5.57 $\frac{3}{4}$	\$91.63	
Local engine crew, 16.6 hr. @		
\$2.67 $\frac{3}{4}$	44.38	
Saving, overtime, local freights.....		\$136.01
Through train crews, $176\frac{1}{4}$ hr. @		
\$3.19 $\frac{1}{4}$	\$562.74	
Through engine crews, 170.5 hr. @		
\$2.565.....	437.25	
Saving, overtime, through freights.....		999.99
Saving in crew overtime for week.....		\$1,136.00

During this week 6,809 cars were handled in this territory with an average saving in time of 1 hr. 24 min., making a saving in car time of 9,532 hr., or 397 car days. On the basis of \$1.00 per day this saving amounted to \$397 for the week.

“Per diem” is strictly not the right expression, particularly at this time of the year when fresh fruit is in transit in large quantities. These cars must make their schedule or the road failing to make schedule is responsible for any claim that may be made for damages due to delay in transit. In this connection, a check made by the chief dispatcher of this division for a 60-day period in 1926 showed that some section of an eastbound perishable freight was late into Macon 19 times. In 1927 for a 60-day period, when the same number of cars of peaches were handled, only one section of one such train was late.

From this it would appear that the arrival of a car at a terminal one hour earlier is worth more than the 4.2 cents used above as the value of this car hour. Certainly any yardmaster would say that was a low figure. The

intangible savings increase, too, during the period of heavy traffic. It is a help in the roundhouse to get the engines in an hour earlier, and when the peak is reached fewer locomotives have to be used in a class of service for which they are not as economical.

The chief dispatcher of an adjacent division said recently that he was getting trains from this division at Macon nearer on reported time than formerly and therefore he called his crews closer, which is a big help when they double the line each day.

To return to our figures, which we intend to keep conservative and which, it must be admitted, do not show the entire saving, we have the savings for this one week as follows:

Fuel and water.....	\$ 865.00
Train crew overtime.....	1,136.00
Per diem.....	397.00
Total of three items.....	<u>\$2,398.00</u>

For a four week period this amounts to \$9,592. During this time of the year there were 5 operators less between Macon and Fort Valley in 1927 than in 1926.

Straight time for these 5 operators for 30 days each at 61c per hr. equals.....	\$ 732.00
Overtime saving of operators effected by signal system in July.....	356.00
Total saving, operator's payroll.....	<u>\$1,088.00</u>

This, with the saving of \$9,592 above, makes a saving for the month of \$10,680.

Summary of Savings

11 months @ \$2,044.....	\$22,484.00
1 month @ \$10,680.....	10,680.00
Gross saving for year.....	<u>\$33,164.00</u>

Signaling More Economical Than Second Track

The cost of the installation was in round figures \$94,000. The annual charges for interest, depreciation and the additional cost of maintenance and operation of the signal system are estimated at \$12,900. This makes a net annual saving of \$20,264, which is over 21 per cent. return on the investment.

As stated above, the intention has been to use conservative figures and it is certain that there are real savings that have not been included. Further, as traffic increases the savings will be larger, and it has been shown that the system can successfully handle a large increase above the peak of the heavy traffic period of the year 1927.

The estimated cost of double tracking was about \$2,500,000. It therefore seems clear that operation of trains by signal indication has proved an economical step and a good investment for a road to make in advance of the time it actually becomes necessary to double track.

Further, by postponing double tracking until a considerably greater traffic is reached, the large expenditure in the construction of an additional main line when finally made will be done at a time when greater use can be made of the new track, so that at its completion a larger return will be earned on the investment.



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