

**From:** "кирилльославъ бериновъ /Abram Burnett"

**To:**

**Sent:** Sunday, February 9, 2014

**Subject:** Re: Obscure Question about Semaphore Signal

This ain't going to be simple, Professor, so buckle your seat belt. I really cannot "tell you how it was done in 1910" without giving you the developmental background. And even after the explanation, there probably won't be any "one size fits all" answer to your question...

1. In the earliest days (1870s and later,) there was only ONE semaphore for each direction at a station. The Rule Books often referred to this simply as the "station signal." It could have several functions. On railroads which ran only by the Time Table/Train Order method of operation (i.e. no "Manual Block" superimposed on the TT/TO method of operation,) the "station signal" served as the Train Order signal. The semaphore was always painted red, had a square end, worked in the lower quadrant and had two indications: (1) straight out, horizontal (red roundel lit at night) = receive orders, or (2) "hanging down" (clear roundel lit at night) = no orders for your train. The Rule Book specified that its "normal position" was Stop, unless cleared for the immediate movement of a train.

1.1 The "station signal" was also used when the Train Dispatcher just wanted to hold a train at some point for some reason, or when the station agent or operator wanted to stop a train to do work.

1.2 Where Time Table/Train Operation was used WITHOUT the superimposition of Manual Blocking as a second layer of protection, many roads used the "station signal" to space following trains on a "time interval basis." Some roads required that the station signal be held at Red for 10 minutes after a train had passed; others allowed a 5 minute interval between following freight trains, but a 10 minute interval if either the preceding or the following trains was a passenger train.

2. Next, in 1864-1865, Ashbel Welch of the Belvidere-Delaware Railroad, came up with the idea of "spacing trains" not on the "time interval," but on a "space interval," by establishing fixed blocks, with a telegraph station at each end of each block. He published his ideas in a speech given before the Railroad Convention at the St Nicholas Hotel in NY City on October 17, 1866, the title of his speech being "A Report on Safety Signals." (I can send you that document in PDF, if I haven't done so before.) This was the first "Manual Blocking of Trains" in the US, and in his speech Welch says that the scheme had been in use "for about a year" on his road. Welch later also became President of the Camden & Amboy RR, and the Manual Block System was put into use there, too.

3. The next big step was in 1876, when the PRR was getting ready for the huge crush of traffic anticipated in connection with the nation's Centennial Exhibition, to be held in Philadelphia in 1876. To prepare for that, the PRR implemented Ashbel Welch's system of Manual Blocking from New York at least as far west at Pittsburgh, and installed those marvelous old "banner box" (a.k.a. "owl eye") signals, which were used to give the indication of the Block (Clear, Permissive, or Occupied.)

3.1 When this was done, the "station semaphores" may have been kept as Train Order Signals only, but there seems to be no documentary evidence on this (other than a few photographs.) The important thing for you to realize is that, with this step, a distinction had been made between Block Signals and Train order Signals.

3.2 It seems that the preparations for the 1876 Centennial was also the origin of the two-story "tower" structure on the railroad, the earliest of which were octagonal.

4. Now, let's pause for a minute in the commentary. I need to make two points:

4.1 Many railroads never adopted Manual Block as a form of protection on their railroads. West of the Mississippi, there was very little Manual Block. Manual Block was a very effective means of protection against rear-end collisions on double track roads where train density was high and there was a real problem with following fast trains overtaking slower trains ahead under circumstances where "Rule 99 flagging" was not fast enough to establish good protection. These were exactly the conditions which eastern railroads faced. The PRR was "Manual Block crazy"... but the Reading never implemented Manual Block rules on all of its territory. On single track railroads, the Time Table/Train Order method of operation was excellent protection against head-on collisions, and the imposition of Manual Blocking was really only of benefit with the "overtaking" situation between trains moving in the same direction. (There was plenty of non-ABS DOUBLE track operated under Manual Block Rules, too... the Trenton Cut Off and the A&S Low Grade did not get automatic signals until the Electrification Project, circa 1937, and parts of the Columbia Branch got ABS a decade later.)

4.2 Where Manual Blocking was superimposed on top of the Time Table/Train order method of operation, some roads installed TWO semaphore arms on their "station signals." One arm was to give the condition of the Manual Block, and the other was to indicate whether or not Train Orders were to be delivered. The best place for which I am aware of photographic evidence of this exists is stations of the Shenandoah Valley RR, which was built in the 1880s between Hagerstown and Roanoke, under the backing of the PRR and with management taken from the PRR. (The Superintendent of the S.V. RR, Joseph H. Sands, had at one time been the Trainmaster at Altoona. Sands may have brought the idea of one-arm-for-Block-and-one-for-Train Orders from the PRR, or he may have conceived it especially for his S.V. RR... I just don't know.)

4.3 Note well what I have said above: We now have two-arm semaphores, one arm giving the Block, the other indicating Train Orders to be delivered.

5. We can now move on from our little pause, to the next topic... the introduction of interlocking.

5.1 In the late 1880s, and in the 1890s, there was a huge push to install on American railroads the invention of the two Englishmen, Saxby and Farmer, namely "interlocking." The record seems to indicate that the first interlocking was installed in late 1870 on the Camden & Amboy RR, at a place called Top-of-the-Hill in Trenton, NJ, under Ashbel Welch's guidance, from modified parts received from England. The first interlocking machine made in the US was installed in 1875 at Spuytin Duyvil, NY, on the NYC&HR, and its creators, proper was installed at East Newark Jct, using a machine imported from England, at a location which later became the site of Manhattan Transfer.

5.2 Note here, that with the introduction of interlocking, the semaphore arms suddenly take on an almost new meaning, viz. they are used to indicate the routes and permissible speeds through an interlocking. The matter of indicating Train Orders for delivery was no longer the primary purpose of the semaphore arms. And at a preponderance of the interlockings build in the 1890s, the giving of a Manual Block indication was not the primary concern either, because the electric "Track Circuit," invented by Dr. William Robinson in 1874, had come into use, and trains were now governed by Automatic Block Signals in most main line territory where interlockings were installed, instead of by hand-controlled Manual Block Signals. (The tying together of interlockings and the track circuit for the next block beyond the interlocking has a fascinating history, but it would be confusing if added in here.)

6. Once interlockings were installed, and track circuits and Automatic Block came into use, how was the delivery of Train Orders indicated to trains?

6.1.1 Some roads retained a semaphore at the tower, indicating that Train Orders were, or were not, to be delivered. (The C&O is a good example.)

6.1.2 Some roads (e.g. the PRR and the B&O) used a tin banner hung outside the window of the tower (or on a post on the station platform) to indicate that Train Orders were to be received. At night, an appropriately colored lantern was hung over the tin banner.

6.1.3 Some roads (in some places) used a flashing "O" light to indicate Train Orders. (Examples close to you are Lancaster and Columbia.)

6.1.4 On territory where Automatic Block was installed, the "normal position" of Train Order Semaphores was usually changed from normally Stop to normally Clear (i.e. no Train Orders for delivery.)

7. Another question you asked was about how many indications a Train Order Semaphore might give. Again, the answer is not a simple one.

7.1 In the earliest days, T.O. Signals indicated only Red (receive Orders) or White (no Orders.) There was no third position.

7.2 At that time, all Train Orders were what became referred to as the "Form 31 Train Order," which required that the Conductor (or Engineman, depending on the road and the time period) endorse the order at the time of delivery.

7.3 Eventually, however, it was realized that some Train Orders really did not require stopping the train and obtaining a signature, and thus the "Form 19" Train Order was invented (probably around 1887, as indicated in the commentaries printed at the back of the various editions of the Standard Code of Train Rules of the American Railroad Association.) Once this happened, a third indication was added to some Train Order Semaphores: Red = Stop and receive Form 31 Train Orders, or stop for some other purpose; Yellow = receive Form 19 Train Orders without stopping; Green = no Orders.

7.4 Once Automatic Block signaling was installed on a railroad or district, the use of the Form 31 ("stop and endorse") Train Order was generally eliminated.

7.5 Once Automatic Block signaling and interlockings had come into use, and the old "station semaphore" had been relegated to only a Train Order signal, some roads changed the color of the arm from red to yellow. There was great variation on the matter of color, however. Also, over time, the ends of semaphores used for purely Train Order indication were generally changed from a square end to a scalloped end.

7.6 I cannot put a date on the change over to three-position Train Order semaphores, but I can say that, prior to 1913, the glass manufacturers had great difficulty in perfecting a Yellow glass that was uniform from batch to batch, which had sufficient "transmissibility" to work with a small oil flame behind it, and which met railroad criteria. Thus, it was only around 1913 that the wholesale adoption of Yellow as a signal color happened on American railroads (although some pikes had been using Yellow as early as the 1890s.) Also, the three-position upper quadrant semaphore was not invented until

7.8 On roads where a third aspect was not added to Train Order signals to accommodate the Form 19 "on the fly" Train Order, there was a procedure to keep a train from stopping when the Order to be delivered was a Form 19. That procedure was for the signalman to hold the station signal at Stop, then go the platform and highball the train with a yellow flag (by day) or yellow lamp (by night) and hand up the Train Orders on the fly, along with a Clearance Card which listed the numbers of the Train Orders being delivered, and which constituted permission to pass the semaphore at Red/Stop.

7.9 In the late 19th Century and early 20th Century, Red, Green (for Caution,) and White (for Clear) had been the standard signal colors. The PRR did not convert to Red/Yellow/Green for its Automatic Block Signals until 1917.

8. So, now to the question of what you should install at your station. You are working with what appears to be a small branch line depot, and the context has to be "somewhere in the state of ——" but not specific to any one railroad in the state, and the time period has to be 1910. Given the facts stated above, and realizing that all of the permutations listed above were in flux and varied from railroad to railroad and from time to time, I would suggest the following:

8.1 Assume your depot is on a single track branch which hasn't received a lot of modern amenities (e.g. Automatic Block signaling)

8.2 Use lower quadrant, two position semaphores, with arms painted red on front and black on back, and having square ends

8.3 Use roundels (flat or curved glasses, not lenses, in front of an oil lamp) of red and white

8.4 Operate the semaphores by pipe connection, or rope-pulled with a counterweight to restore the semaphore arm to Red when the rope is released

8.5 The normal position of the semaphore is to be at Stop, unless cleared for a train for which there are no Orders

9. From the above you may reasonably conclude that there was no "one exact way it was done in 1910." It depended the railroad, the scheme of operation (TT/TO, TT/TO + MBS, or ABS,) and how much the railroad had caught up to the latest industry procedures. But if you use the guidelines suggested in 8.1 - 8.5, you will have a simulation which is highly typical of what was in use in 1910, and which will be bullet-proof against sniping criticisms.

I'll attach a few photos of the old "Banner Box" signals, since they fascinate me. The dimensions and construction techniques are known... recreating one for your Museum would be a worthwhile undertaking !

I'm also attaching two articles (one PDF) by J.A. Anderson in the Journal of the Railway Signal Association in 1909 (vol. VI.) Anderson was Superintendent of the Belvidere-Delaware RR 1870-1886 and thus his information is first hand on his two topics, viz. the first block signal system in the country, and the first interlocking in the country.

May I have your permission to share the above thoughts with a few others who think about old issues like this ? Also, I think that — might like to read the above explanations.

-- adb

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Sent to you from my Telegraph Key...

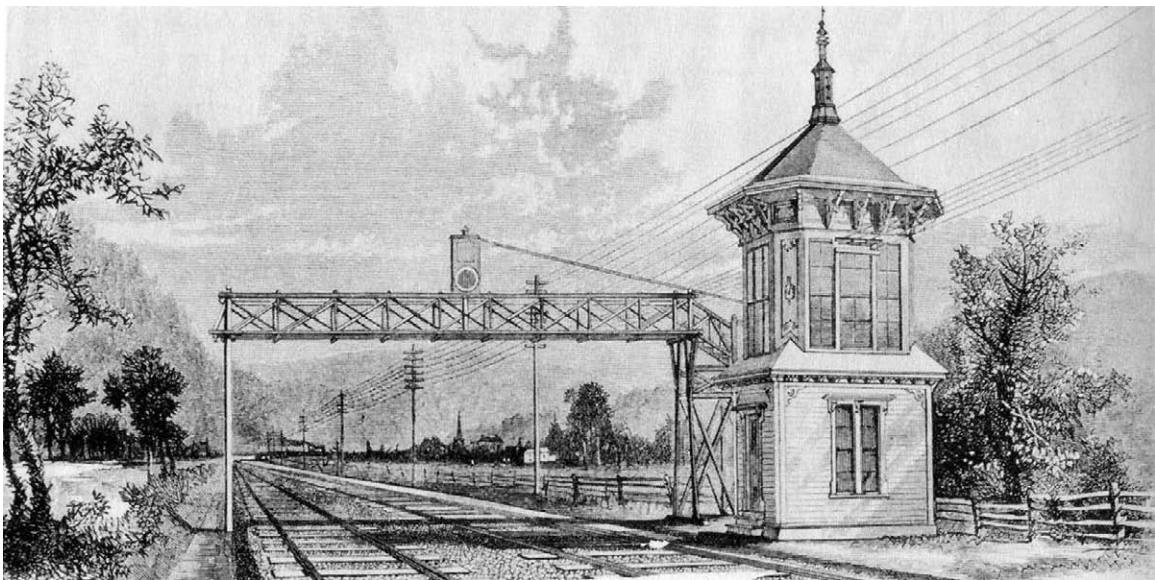
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**"C" Telegraph Office  
Princeton Jct  
1870s**



PRR Philadelphia Division, Dillerville Jct, Lancaster, Pa.



Identified only as "PRR, On the Main Line." The tower depicted was likely on the Philadelphia Division, between Philadelphia and Harrisburg.

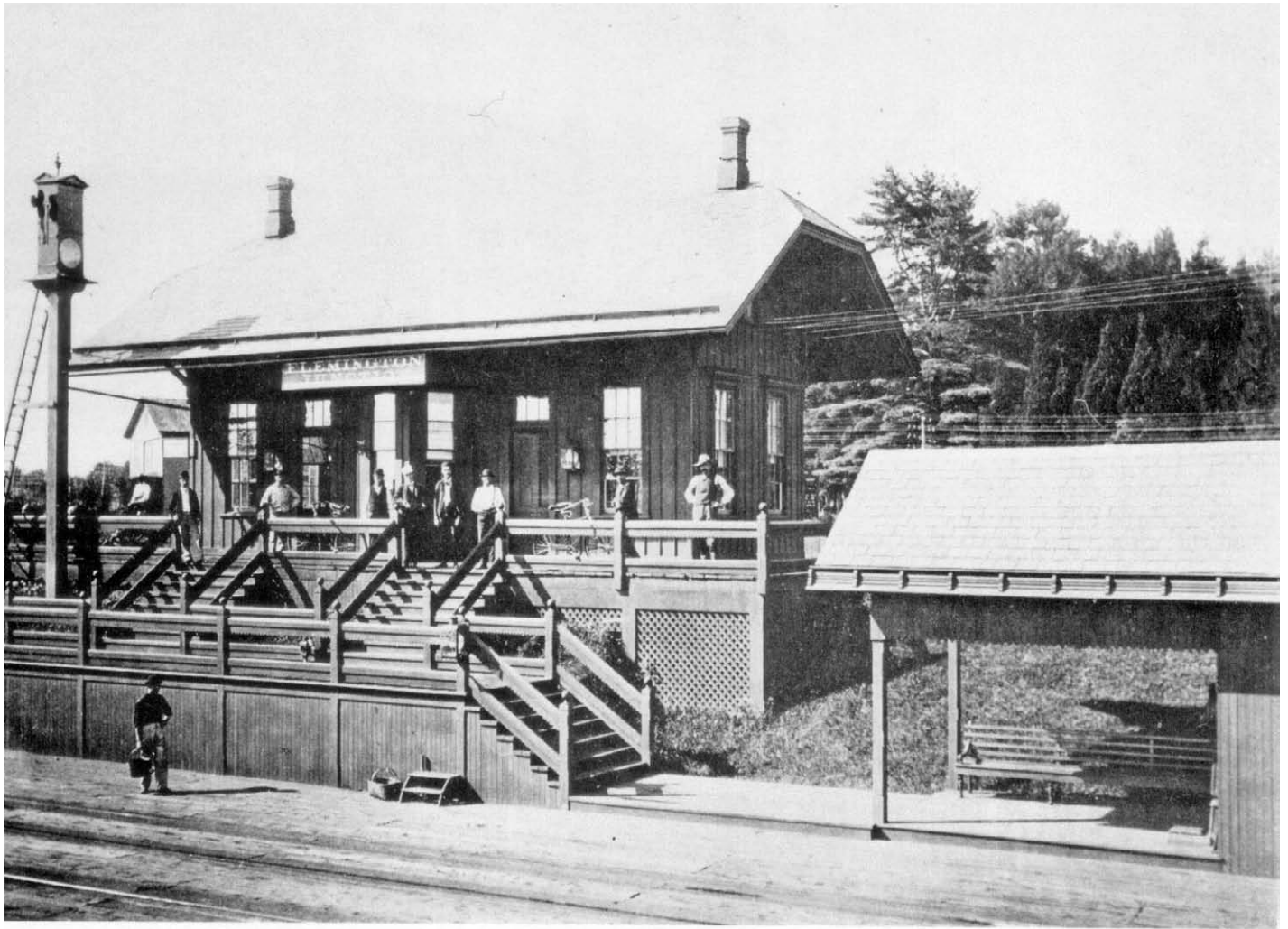


B&O RR Confluence, PA



Philadelphia & Reading RR, Williamsport & Catawissa Division, Ringtown, Pa.





**Opened in 1875, the New Jersey division was built to haul coal. As if to emphasize that point, the Lehigh Valley did not see fit to build passenger depots until 1880. Flemington Junction's station was erected and so-named about four years before the branch to Flemington was constructed. This view was taken about 1895. A platform canopy was added after the turn of the century and interior arrangements were revised in the 1930s.**

From *The Handsomest Trains in the World*, Greenberg/Kramet, 1978, page 37.





**Eng 751, Class I  
Blt Nov 1879**

PRR Pittsburgh Division, Kittanning Point at Horsehoe Curve. Note Banner Box signal on right side of tower.