

CHAPTER XIII.
BLOCK SIGNALLING.

Definition of Terms.

147. By the term "**Block System**," is meant:—

First. The division of the line into certain portions.

Each portion is termed a block, or section.

Secondly. The method by which the traffic is regulated ;
so that only one train or engine shall be within any one "section" or "block," and upon the same line of rails, at one and the same time.

148. The method of working electric block-signals has been divided under three heads, viz., the **positive**, the **affirmative**, and the **permissive**.

149. The **positive** system is that under which the section is blocked only during the time it is being traversed, or is occupied by a train.

150. The **affirmative** system is that which, maintaining the electric signals normally at "blocked," requires that the station in advance shall be asked, under a preconcerted bell-signal, "may train proceed" ; and in a similar manner to have this *affirmed* by a certain bell, or other signal before the train is allowed to proceed into the section.

151. The **permissive** system is really no *block* system at all. Under it two, or more trains travelling in the same direction are allowed within the same section at the same time ; the second and following trains being cautioned as they pass the signal box that there is a train within the section, in advance of them.

Any such system is pernicious in the extreme, and cannot be too strongly condemned. Under it each driver is thrown upon his own responsibility, and whereas one may slacken speed and proceed at a moderate pace, another may be indifferent to the warning and continue his progress at the ordinary speed. Moreover, such a system cannot but be inducive of greater delay than if the sections were subdivided so as to accord more strictly with the requirements of the traffic, for the reason that it must lead to reduced speed.

152. The *positive* system is that most generally in use. It has this advantage over the *affirmative* system, that the instruments themselves show when a train is in the section, whereas under the latter system the "clear" signal is merely given to *admit* a train. Again, the out-door signals should, as a rule, be worked strictly in accordance with the indications of the electric signals. If these stand at clear, then the out-door signals should also stand at *clear*. If at blocked, then the out-door signals should also be at blocked, or *danger*. If the line signals are maintained at block when the section is not occupied by a train, it is impossible the danger indication can have that weight with the drivers that it would, were it employed to indicate danger only at such times as danger really exists. It is true that under each system a "train signal book," showing when each train is signalled in and out of the section, may be kept at hand for reference, still the "positive" system has not

only the book but the indication on the instrument for reference, and, as such, affords one more check upon forgetfulness or negligence.

It is not unusual to hear mention made of Tyers's system, Preece's system, Walker's system, &c., but when applied to the railway systems upon which such instruments are employed, the term is incorrect. Each maker or each inventor has a form of instrument, possessing certain characteristics, and applicable, in some cases, to a certain mode of working; but the form of instrument has very little, if anything, to do with the system, under which it is worked. For the manner in which the instruments are worked, the railway company alone is responsible; it is therefore the railway company's system, and should be recognized as such, and not under the name of the maker, or the inventor of the instruments employed.

153. Upon the **length and proper regulation of the sections**, depends the amount of traffic which may be worked over a line governed by a block-system.

Let fig. 75 represent a section of a railway system, of which A is the terminus, and B, C, junctions. The number of trains running out from A are at the rate of (say) twenty an hour. At B eight of these diverge for the branch E, and at C five diverge for the branch F. Now it is evident that to work this traffic without delay the sections between A and B must be such as to admit of each train passing through them within three minutes, and in order to provide against unpunctuality some margin should be allowed, so that it would only be safe to estimate the time of running at two minutes for each section. This at a speed of thirty miles an hour would give the length of each section as one mile. From B to C trains could be passed through at every five minutes,

but taking time tables and irregularities into consideration it would be advisable to reduce this to three minutes, which, at the speed previously mentioned, would call for sections of not more than one and a half miles in extent.

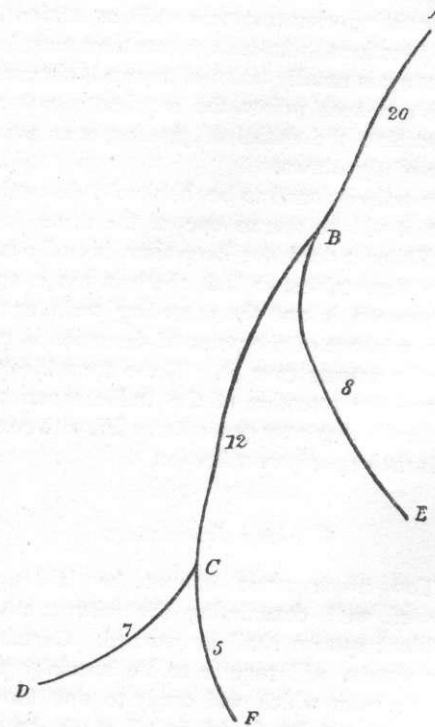


FIG. 75.

From C to D the number of trains is reduced to seven, which if equally dispersed throughout the hour would mean one train every 8.57 minutes. The farther we get

from the terminal station, however, the more irregular will become the intervals between train and train, and here the sections may fairly be regulated to four minutes in time, or two miles in length.

But, as a rule, the sections are to a great extent determined by existing circumstances such as stations, crossings, and junctions. At such points men must be kept, and advantage is usually taken of any such circumstances to establish at such points the required signal station, and so combine the duties of gatekeeper or pointsman with those of signalman.

Where a train is found to be habitually delayed at any one point it will be due to one of the three following causes. Either it does not keep time, is badly provided for in the time tables, so that there is not a sufficient interval between it and the preceding train, or that the section in advance of the point of detention is too long for the traffic passing over it. These are subjects which will demand the attention of the traffic superintendent, in whose hands they may generally be left with confidence as regards their speedy rectification.

Working Instructions.

154. Too much stress cannot be laid upon the necessity of well considering the instructions under which a block system shall be worked. Certain points of every system will require to be specially provided for, and the rules which will apply to one form of instrument will not be found, in all cases, to apply to others. So much depends upon the instructions under which a system is worked, that it is possible, under well-digested rules and regulations, to render an indifferent form of instrument as safe, or safer, for the regulation

of a service than would be the case with a superior form of instrument, worked under loose and ill-considered instructions.

In framing instructions, the working of the traffic should be considered under its most adverse circumstances, as for instance a snow-storm or a dense fog; and although it may be protected by other safeguards, the block-signalling instructions should, for the time, be regarded as forming in themselves the sole protection of the traffic. An important point to be borne in mind is the effect which the failure of a signal, or any portion of a signal, may produce. For instance, nothing could be more injudicious than to confirm the "all clear" signal by one beat of the bell, or to use one beat on the bell for that signal. Assuming, that with a system having an indicating signal—as a needle or semaphore—and a bell, the "all clear" signal was indicated by pointing the needle to the "all clear" side, or by lowering the semaphore arm to the all clear position, accompanied by one beat on the bell, and that the indicating portion of the apparatus failed and the signalling had to be carried on by the bell only, and that two beats on the bell indicated the "departure" signal; it is evident that if by careless signalling, or from any other cause, one beat of the departure signal is missed or lost, a very serious mistake may arise; for that which was intended to indicate the departure of a train from station A to station B, would reach B as the all clear signal, and if B had sent forward a train towards A, this imperfect departure signal would be to him the all clear signal for the train which he had sent on. A parallel case, unfortunately culminating in an accident, actually occurred in this way no great time since. The indicator was out of order,

the departure signal for one train was received at the adjoining cabin as the all clear signal: another train was sent in and came into collision with that which had preceded it, and which it was supposed had been signalled clear, but which was in reality being held by signal at the advanced station.

The errors which a disordered electrical apparatus may produce, or those which may result from negligent manipulation, are best known to the electrical engineer; and all instructions for working electrical block signals, placed under his charge, should have his careful consideration.

Although it is impossible to prescribe regulations applicable to every form of instrument, or such as would meet all the specialties of a railway service, the following observations may be found useful as generally applicable to the subject.

155. Every signal box should be provided with a "**Train Signal-book**," in which should be entered all up and down trains under their respective columns; giving the description of train, the time it is signalled, the time the line is blocked, and the time it is again cleared. (See form in Appendix.)

For **single lines**, as the blocking will be in advance as well as in the rear of each train, double columns will be required. (See Appendix.)

For **junctions**, a special form, showing at a glance the signalling of each train, will also be found convenient.

All entries should be made direct into the book, and no erasures allowed. When an erroneous entry is made the pen should be drawn through it in such a manner as to show that it is crossed out, and yet not so as to obliterate it.

All **obstruction** signals should be duly recorded

after the following manner. The entry should be made under the line obstructed, whether the up or down. In the column for the description of train, the word "obstruction" should be entered, and under the column, "line blocked," the time at which the obstruction signal has been sent and acknowledged; and when the obstruction has again been removed, under the column "line cleared," the time at which the all clear signal has been sent.

When signalmen change duty, a line should be drawn across the book immediately beneath the last entry. The signalman going off duty should sign his name above this line, accompanied by the remark "off duty," with the time at which he hands things over to his successor, as "*C. Jones, off duty 2.0 p.m.*" The signalman who "takes on" should sign his name *under* the line with the remark, on duty at ———, as "*W. Williams, on duty, 2.0 p.m.*"

This **book should be inspected** by the station agent, the inspector, or other officer in charge of the signal-box, every day. It should be signed by him as a notification that he has inspected it, and taken note of any irregularities recorded by the signalmen for his information. When completed, the book should be stored away in the signal box, and never destroyed, except under directions from head-quarters.

156. **The block system should in no way cause those other and necessary precautions adopted for the protection of the traffic to be dispensed with or even relaxed.** Distant signals, hand signals, fog signals, and all other precautions should be as strenuously observed and enforced as though no block existed. The safety of railway traffic, or of any traffic where the responsibility is

necessarily of a divided character *is only to be secured by overlaying one precaution by another and duly enforcing the principle of each.* Thus when a train breaks down within a block section, the guard of the train might argue that he is perfectly secure, as the block at the box in his rear will be maintained till he arrives at that in advance; but his rules prescribe that he shall immediately go back, and by means of his flags, lamp, or fog signals protect the rear of his train. Again when a fog prevails, although the sections are sufficiently long to protect trains, it is yet necessary fog-men should be sent out, and that their instructions should be as carefully fulfilled as though the block were not in existence. It is by these checks upon checks, that any evil, which the remissness of the one individual is liable to produce, is to be averted. Their importance cannot be overestimated, and they should never be relaxed.

On single lines the block system must be subservient to the time tables; the crossing-places of trains should never be altered except under the direction of the officer whose special duty it is to attend to that important function. At the same time the all-important object of the system, viz.: *to permit but one train to be in a section, on the same line of rails, at the same time, must ever be the paramount consideration of those working the signals.*

157. All **working instructions** should give a short description of the instruments to be employed, the mode of working them, and their object, so that those who have to work them may be conversant with their several uses.

Every train or engine should be signalled in its progress between station and station, or signal-box and signal-box, in accordance with a bell code, and the mode of working

the instruments, so as to produce the *blocked* and *clear* signals.

The **all clear** signal should not be given until the station at which a train has arrived *is actually clear, and ready to receive another train on the same line.* Nor should it be given in any case until the *tail lamps* of passenger trains, and the *break van* of goods and ballast trains have been seen. This is to provide against danger in case of any portion of the train having broken away.

No second train or engine should be allowed to follow on the same line of rails until that previously in the section has been signalled clear of it.

On **single lines** no train or engine should be allowed to leave or pass a station or signal box, until the station or signal box **in advance has been blocked**, so as to prevent a train, coming from that direction, meeting that about to proceed towards it.

The **outdoor signals** should be worked in perfect consonance with the electric signals, except at junctions and other special points; and here any deviation from the general rule should be specified in writing.

Signalmen should be cautioned **when an electric signal stands at danger or blocked longer than is usual**, not to become nervous or over-anxious. The signal is before them. It says the line is blocked. Let them so regard it; and rather than suppose it is the result of negligence or error, *look upon it as a positive indication of danger to any following train.* It is at such moments that men are required to act with more than ordinary caution. Let them not therefore fear to stop any following train, or hesitate to hold any train which may be waiting to enter the section. It is better the train should be delayed than that risk and danger should be incurred. A signalman so placed should wait a reason-

able time, and if the signal still continues, then direct the attention of the signalman at the distant box to it by the *attention* signal, when, if the section is still blocked, the distant box will return the **obstruction** signal. Should no answer be received to a repeated inquiry, the signalman would be warranted in concluding the instrument out of order, and sending forward the waiting train under instruction to "proceed with caution to the next signal box, the block signals being out of order."

Should a **departure signal have been received, and the train not arrive within the usual time**, the signalman at the box at which it is due should immediately put on his outdoor signals for trains proceeding in an opposite direction, and only allow such to proceed under verbal caution, as possibly an accident, fouling both roads, may have occurred.

All shunting and crossing operations should be carried on under the block. Thus, for instance, station B has some waggons to cross over both roads. Before he does so he should see there is nothing coming towards him from either A or C, and this being so he should then give the "*obstruction*" signal to both stations, thereby blocking trains back at these points, and keeping them so until the roads are again clear when the "*obstruction*" should be removed, by giving to the stations obstructed the "*all clear*" signal. Anything which fouls a road is a source of danger to the traffic. The rules may forbid any shunting to be done during the approach of a train, but unless they go further than this and forbid it being done *only under the obstruction signal*, it *will* be done during the approach of trains. Moreover, without being thus protected the shunting is a positive source of danger, in that, although no train may have been signalled, a truck or a carriage may foul a point and

get off the road, and, before steps can be taken to stop a fast-speed train, it may not only pass the distant signal-box (which may be indicating the all clear signal), but be upon the cause of the obstruction before those engaged with it are aware. The very essence of block-signalling consists in keeping trains apart the space—whatever it may be—comprised within the section. If shunting is conducted simply under the protection of the station-signals, the danger which accompanies the presence of another train within the section exists, and the "*block*" becomes a farce.

Ballast trains should not be allowed to stop to load or unload materials between signal stations, without having first advised the signalman, and obtained his permission to do so.

Trains calling at **mineral sidings**, intermediate between signal boxes, should in like manner communicate with the signalman prior to entering the section. It may be that the train has to foul the opposite road, in which case it will be necessary to block trains in that direction till the crossing has been completed [the working of siding traffic will be found specially dealt with at p. 187.]

When a **speaking telegraph** exists between two signal stations, between which the regular block signals have failed, and it is desired to work the traffic under it; it should be worked only in accordance with *printed or written instructions*, and by *bona fide messages*—not by mere signals—as

SP.—Williams to Jones
 A **B**

Number —— (giving the number of the train in the service time-tables) up, left **A** at 7.30 : and on its

departure from **B**, after having been in like manner signalled to **C**, it should be signalled back, thus:—

SP.—Jones to Williams
 B to **A**

Number — up, clear at 7.35.

Until it has thus been signalled clear of the section, no other train should be permitted to follow.

All such signals should be recorded in the train signal-book, precisely as the signals are rendered, accompanied by a remark to the effect that the signal was rendered by speaking telegraph.

All signals should be rendered as distinctly as possible, free from undue haste, and perfectly free from temper. A passionate man makes a bad signalman. Signals are frequently made far too rapidly for the instruments to render them clear and unmistakable. For this there is no necessity: there is always ample time for all signalling purposes between the trains, and in the end it will be found that the man who does his work in a steady, methodical manner, will occupy less time in doing so than will an intemperate man, who, in a moment of irritation, works his instruments utterly regardless how the signals may reach his comrade, and totally unmindful of the importance of his work.

When signals are not acknowledged, they should be steadily repeated. No signal should be acknowledged unless it is *clearly rendered and properly understood*.

No signal should be regarded as complete until it is acknowledged.

158. Many signals are rendered by the bell only; that is, so many beats on the bell, unaccompanied by any movement of the indicating (block) signal. All

signals which embrace the movement of the indicator—from *clear to blocked*, or *vice versa*—should be accompanied by a given number of beats on the bell, which should be regarded as forming part of the signal, and without which it should be held to be incomplete. Thus in giving the “all clear” signal, not only should the indicator—needle or semaphore arm—be placed at the “all clear” position, but the movement of it to this position should be accompanied by a certain number of beats on the bell appropriated to this signal.

The following is a bell signal code employed upon one of the principal English lines of railway. The letters placed against each signal have reference to the explanation of it which follows:—

- | | | |
|----------------------|--|----------|
| 1. One beat | Acknowledgment . . | A |
| 2. Two beats | Departure signal for
ordinary train . . | B |
| 3. Two „ given twice | Warning | C |
| 4. Three „ | All clear | D |
| 5. Four „ | } Departure signals for . | E |
| 6. Five „ | | |
| 7. Six „ | Obstruction | F |
| 8. Seven „ | Error | G |
| 9. Eight „ | Attention | H |
| 10. Nine „ | Testing | I |
| 11. Ten „ | Special attention . . | K |
| | (in advance.) | |
| 12. Eleven „ | Special attention . . | L |
| | (in rear.) | |

All bell signals are given by pressing the bell key steadily and firmly a number of times, corresponding with the number of beats required to be rendered.

A. Acknowledgment. — Given in reply or

acknowledgment of a signal received. When it is required to follow up an acknowledgment signal by one of another character—as, for instance, a “departure” signal—care should be taken to make a distinct pause between the two signals, so that they may not be blended together, and thus be misunderstood as representing some other signal.

B. Departure signal.—To indicate the departure of a train or engine in ordinary course.

C. Warning signal.—Given to the next station in advance when the departure of a train is signalled from the station in the rear. Thus the station in advance has timely warning of the approach of a train, and if the section is “obstructed” has the opportunity of clearing it in time to prevent the approaching train from being checked.

D. The “all clear” signal.—Given only when the train has passed out clear of the section, or when an “obstruction” signal has been given, and the line thereafter is clear. It is used in conjunction with the lowering of the electric semaphore arm.

E. Departure signals.—Reserved for special purposes. The *four beats* are usually employed for denoting the departure of branch trains, so as to enable the junction signalman to set his points, &c., and to send forward the “warning” signal to the proper signal-box.

The *five beats* may be employed to distinguish *ballast* trains.

F. Obstruction signal.—This signal is given by placing the electric arm at *danger*, accompanying it by the six beats on the bell. It should be employed on all occasions when a section is “obstructed” from any cause whatever, and ought to be regarded in the **fullest sense** as a **danger** signal. On its receipt every effort

should be made to stop any train from proceeding in the direction obstructed, whether such train has been “warned” or not. At the same time care should be taken *not to acknowledge its receipt until the outdoor signals have been set at danger and everything made sure against an approaching train.* The acknowledgment of it should be by six beats—a repetition of the bell signal itself—and should be held to indicate that the necessary steps *have* been taken to stop all traffic in that direction.

G. Error signal.—Given when an erroneous signal has been sent. It cancels the signal previously sent. Thus, supposing a train has been signalled to a junction as a main line instead of a branch train: the junction signalman will have, in the ordinary course, “warned” it forward to the next main line station. On the approach of the train, he discovers by its head lights, or the arrangement of its discs, that it is not a main line, but a branch train. He therefore sends the “error” signal to the main line signal-station, and thereby cancels the former signal. The signal is again useful for cancelling a “warning” sent forward for a goods train when such train may perhaps have work to do at a station which will occupy it some time.

H. Attention signal.—Used to call attention when a signal has not been acknowledged, or to any unusual continuance of the block.

I. Testing signal.—Indicating that the signals made are for the purpose of testing the instruments. A certain system should be pursued when making these tests, so that there may be no possibility of such being mistaken for *train signals* of any description. Moreover instruments should never be tested during the time trains are being signalled by them, or are traversing the section.

It is a signal which should be used only by the telegraph inspector, line-man, or other authorised official.

K. Special attention or stop signal for the station in advance.—This is a most important signal, and indicates something noticed wrong in a passing train—as for instance a portion of the train missing, a tail-light out, a door open, or anything which might render it desirable to stop such train as speedily as possible. The station receiving such a signal should at once place his home and distant signal, for trains approaching from the direction in which the signal has been received, at *danger*, and on the arrival of the train advise the guard and driver of the signal received. Where a speaking telegraph exists between the points, the signal should be confirmed by a message giving particulars of what has been noticed to be wrong in the passing train.

L. Special attention signal for station in rear.—This is equally important, and is used to indicate to the station in the rear of a passing train that some portion of the train has been noticed to be wanting. It should be acknowledged by repeating the number of beats comprising the signal, and the signalman receiving such a signal should take immediate measures to secure the safety of the road, especially if the gradient be a falling one, and should stop any following train and warn it of the impending danger.

In framing a code of bell signals it is better first to draw out a list of the signals required to be used. To then arrange them in their order, appropriating the lesser number of beats to those likely to be most in requisition; being above all things careful that the “all clear” signal is not so formed that it can be produced by any foreign current—as contact or lightning.

No **private signals** should be permitted on any description of block-signal instrument.

It should be the duty of the station agent or inspector to see that a competent person is always in the signal-box half-an-hour before the arrival or departure of the first train, and no release from duty should be allowed till the “all clear” signal for the last train signalled has been received and entered in the train signal-book.

At certain stations where the duties are light and where the stopping traffic ceases at a comparatively early hour, switches (p. 241) are sometimes used for cutting the signal instruments of that station out of circuit, and placing the boxes on either side in direct communication with each other. Where this is so a special signal called the **switch signal** should be authorised in writing, the instruction being precise as to when the signals may be cut out of circuit—a clear time, *i.e.*, when no trains are being signalled, being usually selected for the purpose. The signal may be the same for “opening” as for “closing” the box; the one being in the morning and the other at night no confusion is likely to arise. Three times three strokes on the bell, given thus—

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the dots representing the bell strokes, and the space between the interval of time between them, would serve the purpose.

If a train is in transit at the time the switch is opened, the signalman should not give the line clear signal until the train has passed the switch station, or line clear has been signalled from that end of the section towards which the train is travelling.

Where **goods traffic intermingles** to a great extent **with passenger trains** it is advisable to

include in the bell code, a signal which shall indicate that the goods train then in the section is to be *shunted* for a following passenger train.

159. When the **block-signal instruments are out of order**, information to that effect should be sent, as speedily as possible, to the lineman or other authorised officer.

It is a good plan, **where no means exist of telegraphing to the proper quarter**, to make use of a **black-board**, which should be, on such occasions, exposed to the view of passing trains, the drivers of which should be required to report the fact to the next station from which the subject can be telegraphed.

When the block signals fail entirely and there exists no speaking telegraph between box and box, it becomes necessary to stop all trains and verbally caution the drivers to "proceed with caution as the block is out of order."

160. On some railway systems a **speaking telegraph** is provided **between the signal boxes**. Its object is to enable the signalmen and others to make inquiries respecting the running of the trains, and to form a reserve means of working the traffic in case of failure of the block-signal instruments.

The provision of a speaking telegraph for such purposes is no doubt convenient, but it is questionable if it is, in all cases, desirable. At stations where much shunting has to be performed it is an advantage, but in all such cases the communication should be with the traffic people—the station-agents, or superintendent's offices—and not with the signal-boxes. Unless there is an absolute necessity for it, for purposes independent of the block signalling, it is not desirable. It introduces laxity

on the part of those whose duty it is to keep the block signals in good order, and it is not inducive of that exactitude in dealing with the block signals so desirable on the part of the signalman; because, in both cases, the speaking telegraph stands in reserve. Where no speaking telegraph exists the men know they have but the block signals to rely on; hence the duties devolving upon the latter are likely to be the more faithfully performed.

161. **No strangers, nor officials off duty should be admitted to the signal-boxes.**—Under no circumstances should any person be permitted to interfere with, or to engage the attention of, the signalman on duty.

162. The **batteries** should be kept in a closet specially provided for that purpose. No rubbish, books, or other matter should be placed upon them. It is by such means the wires become broken or disconnected. During very cold weather, hand, or other covered lamps should be kept burning within the closets in order to prevent the liquid in the batteries becoming frozen, and so rendering them inoperative.

Arrangement of Instruments.

163. **The manner in which block-signal instruments should be arranged** and fixed for use in a signal-box is a matter of more importance than would appear without due consideration. The duties of a signalman are onerous; his attention should always be on the alert. At busy points he knows not from one moment to another when he may be called on to obstruct the line—to place his signals at danger. An instant of time may be all-important. His duty is to watch for the

approach and departure of trains, and to protect them by the means placed at his disposal for that purpose. To enable him to do this his signal-box is usually so built and so arranged that, standing at his frame, ready to handle his levers, he may have a full view, up and down, of the lines he is required to work. It is evident that there is a purpose in this, and the purpose is that the man's attention shall not be diverted from his frame, or from the view which he obtains from the position in which it is placed.

His outdoor signals are worked by—that is, in accordance with—his electric signals. Now if the latter are arranged, as is frequently the case, on a counter at the back of the box, it is clear that when the signalman is attending to his frame his back is towards his block signal instruments; and when he is attending to his block signals, he is away from his frame, and probably away from the view which he ought to have of his roads. It is evident then that his **block signals should be arranged in such a manner that he may be able to work them, and to have a full view of them, without leaving his frame.**

It is to be regretted that the majority of the signal instruments in use are scarcely, in their present form, fitted for this. The needle forms are bulky and awkward to work from such a position. Spagnoletti's are not so bulky, but the tapper arrangement is not convenient for use over a man's levers. Tyer's is more convenient from the mode of working the plungers, but the instrument is large, and when arranged in front of the frame is destructive of the signalman's view. Only Walker's and Preece's are really applicable to this requirement.

In both these forms we have the indicating (block) instrument independent of the signalling portion. With

Walker's the signalling is managed solely by means of a double key—two plungers, one for blocked, the other for clear. These may, with convenience, be fixed immediately over the lever handles, so that they may be operated by the signalman at the moment he is operating

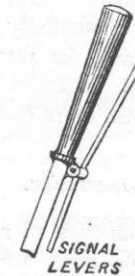
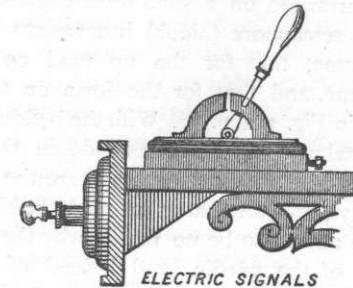


FIG. 76.

his levers, whilst the indicating portions may be placed at either end of the frame according to the roads they protect or represent.

The system advocated is that invariably pursued by the London and South-Western Railway, and no form of instrument is so thoroughly fitted for the purpose as that

employed, viz., that designed by Mr. Preece. Every portion of the apparatus is before the signalman; those portions he requires to use, the bell key (§ 114), and the switch (§ 112), are arranged on a shelf with a face to it, a side view of which is given in Fig. 76. The bell keys are placed on the facing board, the switches on the shelf. The bells are arranged on a shelf some eighteen inches above, and the semaphore (block) instruments at either end of the frame, that for the up road on the up side of the frame, and that for the down on the down side, as shown in Fig. 35a, p. 77. With the bells and semaphores the signalman has nothing to do in the way of manipulation; all he requires to touch are the switches and the bell keys, and these are thus ready at his hand.

There would appear to be no reason why the manipulating portion of the needle, and indeed of all other systems, should not be made separate from the indicating portions, and fixed in a similarly convenient manner before the operator; and for reasons which will be referred to hereafter (*vide* Junction Working, chap. xv.), this course is rendered still more desirable.

Supervision.

164. Although all branches of a railway service are important, it is probable none are more so than that appertaining to the signals. Under it the traffic of the line is conducted, and any looseness which may be allowed to creep in at once becomes a source of danger.

Every signal-box should be under the immediate charge of the station agent, whose duty it should be to see to its staff arrangements, its cleanliness and order, to examine the train signal-book, the method of conducting the signalling to check the time so that there may be as

little variation as possible in that of one box with that of another, to examine the locking and see that the points and signals are properly adjusted and working satisfactorily.

In addition, there should be a frequent periodical inspection of all signal stations by an officer competent to judge of all these matters, and to consider and deal with any suggestions having reference to the working of the traffic which the men may offer. Under his inspection the time at the one box would be compared with that at the next. The manner in which both the electric and outdoor signalling is carried on, the train signal-book, the locking, the appearance, order, and cleanliness of the signal-box, the comfort and cleanliness of the men, the detention of trains,—are all matters which would naturally obtain his consideration, and, where necessary, form subjects for report to his chief.

Considerations on the Requirements of Block Signal Instruments.

165. All forms of **speaking instruments are undesirable** as block-signal instruments, for the reason that the instrument being available for conversational purposes may be used for such a purpose when required for block signalling, and because the indications rendered by such systems are not so evident, and do not possess so distinctive a character, as do those of instruments made specially for the purpose.

Every block-signal instrument may be considered as a **distant stop signal**.

But two indications are required, viz., **blocked** and **clear**.

The **blocked** and **clear** signals should be **visible**, and **confirmed by a bell signal**.

The agency by which the **CLEAR** signal is produced should be active during the time such signal is required to be rendered.

This is only obtainable where a wire is devoted solely to each indicating signal. It is evident that one-wire systems do not admit of this, as upon that wire all signals, whether for moving the indicator or ringing the bell, have to pass. If the wire is occupied by a constant current of electricity it is clear no other current, of such a character as is required for other than the clear signal, can be sent through it.

Hence three-wire systems, where worked upon the constant current principle, are more reliable than single-wire systems.

The **danger** signal may be produced by **gravity**.

It is preferable that any **derangement of the wires or apparatus** should produce the **danger** than the **clear** signal.

In no case should the signalman at the station at which the *blocked* or *clear* signals are shown, be able to **alter** or **reverse** such signals. They should always be under the control of the signalman **in the direction in which the train is proceeding**.

A **record or repetition** of the condition—whether at *danger* or *clear*—of the block signal at the distant station is **highly necessary**. It inspires confidence in, and acts as a check upon, those who have to work the instruments, besides being to them a means of reference at any moment.

It is better that this repetition should be obtained **automatically from the distant block-signal instrument itself**. Failing this, it should be the **result of a signal from that station**; not merely the record of the outgoing current of the station

requiring the repetition. There is no reliability in the latter; the line wire may be to *earth*, and so long as the current leaves the sending station the assumed repetition will be produced on the instrument although the current will not have reached the distant station.

In single-wire systems it should be impossible, after the instrument has shown the **blocked**, for it to show the **clear** signal, **except by the joint action of the signalmen at either end of the section**.

No system in which the clear signal can be produced by lightning or contact is safe.

There is an advantage in **assimilating the form and method of working the electric to the outdoor system of signals**. The working of them is more readily understood by those to whom this duty is intrusted. It forms in fact but a repetition, the one of the other.

In no case should the means by which the *blocked* and *clear* signals are produced **be so similar as to admit of the wrong signal being sent** in moments of emergency, excitement, or haste.

At junctions and sidings that portion of the apparatus by which the *blocked* and *clear* signals are given **should interlock, so that any section which may be fouled by an approaching train shall be blocked before the clear signal for such approaching train can be given**.

The system should be such as to admit of all **draw-bridges, or other movable portions of the line, placing the signals for the section disturbed, at danger, automatically**.