

CATALOGUE C (1914 Edition).

CONTROL *of* SINGLE LINE RAILWAYS

BY THE WEBB-THOMPSON
MINIATURE TRAIN STAFF APPARATUS
"S" TYPE
(PATENTED).



AGENTS FOR THE DOMINION OF CANADA:

MESSRS. SAXBY & FARMER, LTD.

MANAGER: **W. M. PUNTER,**

511 & 512, CANADIAN EXPRESS BUILDINGS

MONTREAL, CANADA.

J. Connor

Signal maintaine

An Index, and List of Catalogue
Numbers for ordering purposes,
is given on pages 35, 36 and 37.

SAXBY & FARMER, LIMITED
RAILWAY SIGNALLING ENGINEERS
511-12 CANADIAN EXPRESS BLDG.
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HAVE BEEN SUPPLIED.**

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Furness Railway.
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Etc., etc.

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Union of South Africa Railways.
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Queensland Railways.
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Railways
Federal Railways.
Tasmanian Railway.
New Zealand Railways.

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Antofagasta (Chili) and Bolivia
Railway, Etc.

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Kirin Chanchun Railway.
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Cyprus.

Cyprus Government Railway.

Demerara.

Demerara Railway.

India.

H. H. Nizam's Railway.
Etc.

Italy.

Adriatic Railway.

Japan.

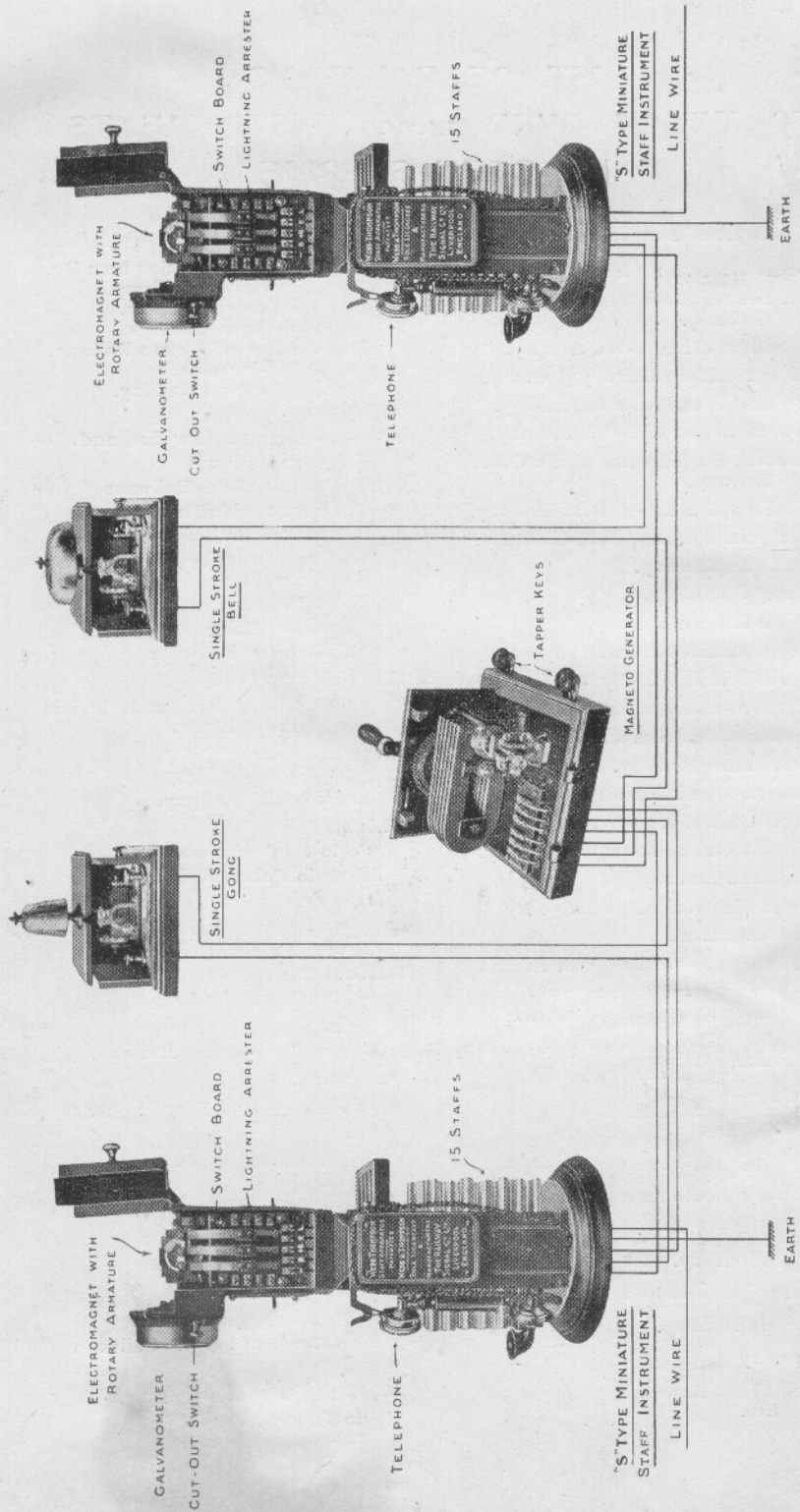
Nippon Railway.

Russia.

The State and Private Railways

Spain.

Madrid Saragossa Railway.
Rio Tinto Railway.



Standard Staff Instruments (with full equipment) as required at an Intermediate Station.

CATALOGUE C (1914 Edition).

CONTROL OF Single Line Railways

By the Webb-Thompson
Miniature Train Staff Apparatus.
"S" Type.
(Patented).



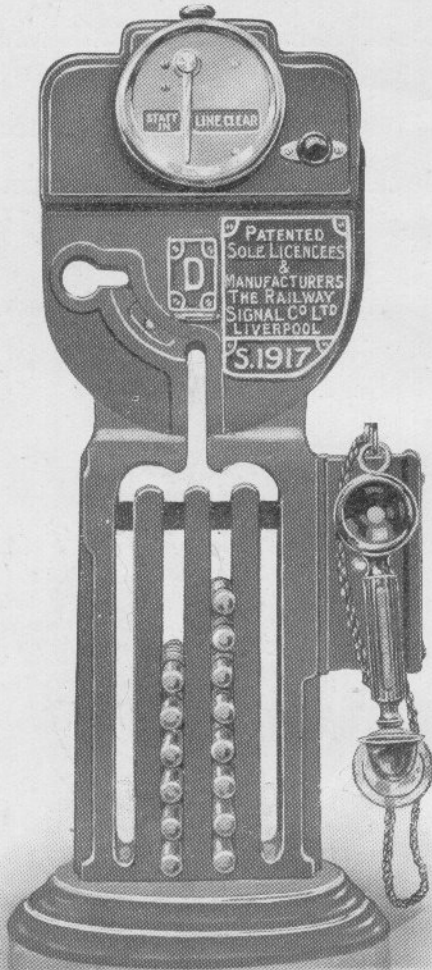
AGENTS FOR THE DOMINION OF CANADA:
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P R E F A C E .

In the early days when trains were few, movements were regulated over single lines by fixed times and crossing-places, but, as may be imagined, such arrangements soon became impossible on account of the enormous delays. To remedy this the Train Staff System was introduced, by which a wooden train staff was conveyed up

Particulars of
Indicator
on page 12.



**Standard "S" Type Miniature Staff Instrument, with Staffs,
Indicator and Telephone. (Cat. No. C22).**

and down a given section, and no train movement was allowed without it. This arrangement also caused delays, as it often happened that the staff was at one end of the section when it was required at the other end, and a man had to be sent specially to get it, there being only the one staff for each section.

METHOD OF WORKING A SINGLE LINE RAILWAY ON THE WEBB-THOMPSON TRAIN STAFF SYSTEM.

"S" Type Miniature Instrument, Ordinary pattern, fitted with galvanometer (Patented).

The "S" type instrument is primarily designed for operation by magneto generators, batteries being entirely dispensed with.

This type of instrument is fitted with a rotary armature working in conjunction with permanent and electro-magnets; the motion of the rotary armature allowing the operation of the lock controlling the issue of the staffs.

Referring to the folded diagram No. 1, W, X, Y and Z are four stations, or block posts, on a single line railway. Two Miniature Staff Instruments AA¹ are required for the section W-X (one fixed at W and the other at X), two instruments BB¹ for the section X-Y (one fixed at X and the other at Y), and two instruments CC¹ for the section Y-Z (one fixed at Y and the other at Z). Also four magneto generators are required, one at W, one at X, one at Y and one at Z.

Each Instrument in addition to its complement of staffs (which may be any number up to 25) is provided with a current indicator or galvanometer.

Bells are provided with the instruments in order to receive code signals.

The following table will illustrate the mode of working when sending a train from Z to Y:—

STATION "Z."	STATION "Y."
Attention ●	Acknowledge ●
Ask for staff ●●●	Acknowledge ●
And on receipt of acknowledgment withdraw staff and press on black button interrupting the circuit until galvanometer needle returns to vertical position (indicating to the other station that you have finished with the current).	..and continue to turn handle of generator, holding the key hard down, until the needle of the galvanometer returns to vertical position (indicating that the other station has finished with the current).
Train on ●●	Acknowledge ●
	On the arrival of the train place staff into instrument and give:
Acknowledge ●	Train arrived ●●●●

The above code is given as an illustration, and can be varied to suit local requirements.

The Miniature Staff Instruments are constructed so that the staffs for one section will not enter the instruments for an adjoining section.

When a Staff has been withdrawn, say from the Instrument at Z, for use on section Z-Y, a second staff cannot be withdrawn from that Instrument, nor from the corresponding Instrument at Y, so that even if the operators at Z and Y respectively forget that a Staff has been withdrawn for the section Z-Y and attempt to obtain another they would be unable to do so, and this condition continues until the first Staff has either been replaced in the Instrument at Z or placed in the corresponding Instrument at Y.

STAFFS (Patented).

Ordinary Staffs.

Cat. Nos. C43 to C48.

Unless otherwise specified Staff Instruments are supplied with 15 ordinary staffs for absolute block working.

The Ordinary Staff allows only one train to travel in a section at one time.

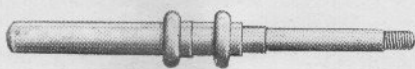


Where permissive working is adopted (that is to say, two or three following trains are allowed to travel in one section at the same time, with a certain interval between the despatch of each train) Composite Staffs divided into either two or three parts are supplied in addition to or in place of the Ordinary Staffs. A complete Composite Staff is equivalent to an Ordinary Staff, and may be used for absolute working.

Composite Staffs divided into two parts.

Cat. Nos. C49 to C54.

The two parts are known as the Permissive Staff and Ticket respectively, and permit two following trains to travel in one section at the same time, at intervals. The driver of the first train receives the ticket as his authority to travel in the section, and the driver of the second train receives the staff as his authority.



TICKET



STAFF

STAFFS (Patented)—continued.

After the arrival of both trains at the other end of the section, the two parts are screwed together and the complete Staff inserted in the Staff Instrument.

(When handing the ticket of the two-part Composite Staff to the driver of a train, the Stationmaster or Signaller must show him the Staff, and the driver must not accept the Ticket unless this regulation is complied with.)

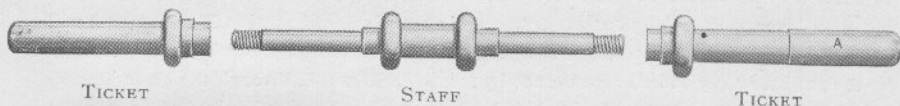
Composite Staff divided into three parts.

Cat. Nos. C55 to C60.

This consists of two Tickets and one Permissive Staff and permits three following trains to travel in one section at the same time, at intervals. The drivers of the first and second trains each receive a Ticket, and the driver of the third train receives the Staff.

After the arrival of the three trains at the other end of the section the three parts are screwed together, and the complete Staff inserted in the Staff Instrument.

(The driver of the first train must not under any circumstances accept a Ticket without being shown the Staff and the other Ticket; and the driver of the second train must not under any circumstances accept a Ticket without being shown the Staff.)



It is impossible to insert in or withdraw from any Staff Instrument any portion of a Composite Staff. All parts must be completely screwed together, and only the complete Staff can be placed in or taken from the Staff Instrument. It is also impossible for any part of a Composite Staff for one section to be combined with any part of a Staff for an adjoining section, with the object of forming a complete Staff to work an Instrument irregularly.

All Staffs are provided with name-plates, on which the names of the sections to which they apply should be engraved. (This refers to the Ordinary Staffs and each part of the Composite staffs.)

The Staffs can be supplied with ends differently shaped for different sections, if desired.

THE ELECTRICAL CONNECTIONS OF THE PATENT MINIATURE TRAIN STAFF INSTRUMENTS.

Referring to the folded diagram No. 1 or 10, illustrating three sections terminated by the four stations—W, X, Y and Z. A train is supposed to be passing in the direction from Z to X, it has passed through the section Z-Y and is now in the position indicated by the arrow, passing from Y to X. The sections W-X and Y-Z are free, the staff instruments A, A¹ are "in phase," the switch levers 1 and 2 being in the position they assume when there is an even number of staffs in the apparatus, namely on contacts 9 and 11; the instruments C, C¹ are also "in phase," the switch levers 1 and 2 being in the position they assume when there is an odd number of staffs in the apparatus, namely on contacts 10 and 12. *The indicators of these instruments show "line clear."* The instruments B, B¹ are "out of phase," the levers 1 and 2 in the instrument B at X, are on contacts 9 and 11, namely in the position when there is an even number of staffs in the apparatus, but the levers 1 and 2 in the instrument B¹ at Y are on contacts 10 and 12, namely in the position when there is an odd number of staffs in the apparatus; *the indicators of these instruments show "line blocked."*

In tracing the connections it will be seen that levers 1 and 2 form a reversing switch; in the one position as in instruments A, A¹ and B, the common terminal 8 is connected through contact 11 by lever 2 to earth, and lever 3 through contact 9, and lever 1 to line, and in instruments B¹, C and C¹, 8 is connected through contact 10, by lever 1 to line, and lever 3 through contact 12, and lever 2 to earth.

When the train approaches X, the Stationmaster there will ask W for a staff, by means of the code signal, and if W is ready to receive the train, he, W, will hold down the key of his generator and turn the handle. This will cause a positive current to pass from the generator by the terminal +, and by terminal +B, contact 13 to lever 3, thence by contact 9 and lever 1 to line. At Station X the current will pass from line by lever 1, by contact 9 to lever 3, thence by terminal +B through the generator key to bell, and thence by terminals B and 6, through the (*indicator and*) galvanometer back to terminal 8, and by earth back to Station W, by lever 2, contact 11, terminals 8, through the galvanometer to terminals 7 and back to the generator by terminals.—On X raising the staff in the act of withdrawing the same, the lever 3 is reversed, causing the current, instead of passing through the bell, to pass by contact 14 to terminal 5, through the electro-magnet to terminal 6, releasing the lock. The withdrawal of the staff will reverse the levers 1 and 2 at X, and the instrument A will then be "out of phase" with A¹, when it will be impossible for a staff to be withdrawn, as should this be attempted, the current would pass through the electro-magnet in the wrong direction to operate the lock.

During the withdrawal of the Staff from the instrument A¹ at X, the indicator there is reversed and will stand at "line blocked" and upon his signalling to W, the indicator at W will also automatically turn to "line blocked."

NOTE.—The words in italics refer to instruments fitted with the "L" type two-position indicator, description of which will be found on page 12.

TELEPHONE (Patented).

Cat. No. C69.

Telephones are provided when required, attached to the Staff Instruments. This does not necessitate an additional line wire, as the telephones are worked on the same line wire as the Staff Instruments and without any switching whatever.

Although both the Staff Instruments and the telephones are on the same wire they in no way interfere with each other, and both are always available for use.

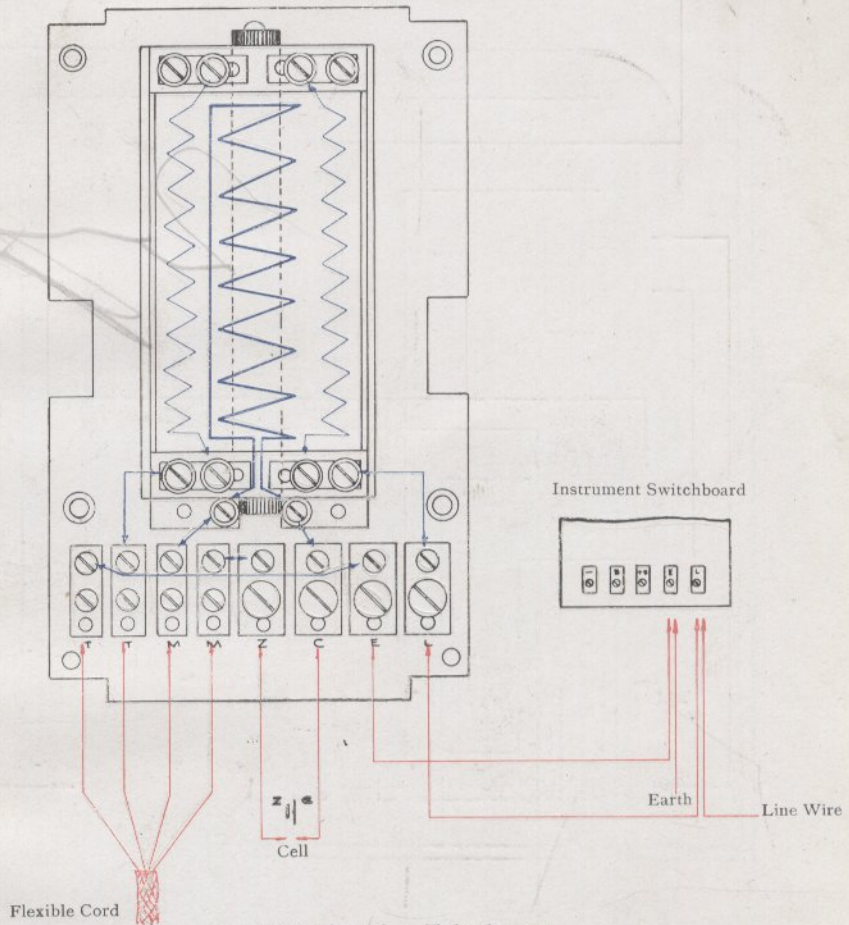


Diagram of Wiring for Telephones.

The telephone induction coil is of special construction and has two secondary windings, one terminal of each of which is left insulated. The other terminal of one secondary winding is connected directly to "line" by the terminal L, and one terminal of the second secondary winding is connected through the telephone receiver and terminal E to earth. The primary circuit is connected up in the usual manner, the dry cells, primary winding, transmitter and switch in handle of same, forming a simple electric circuit.

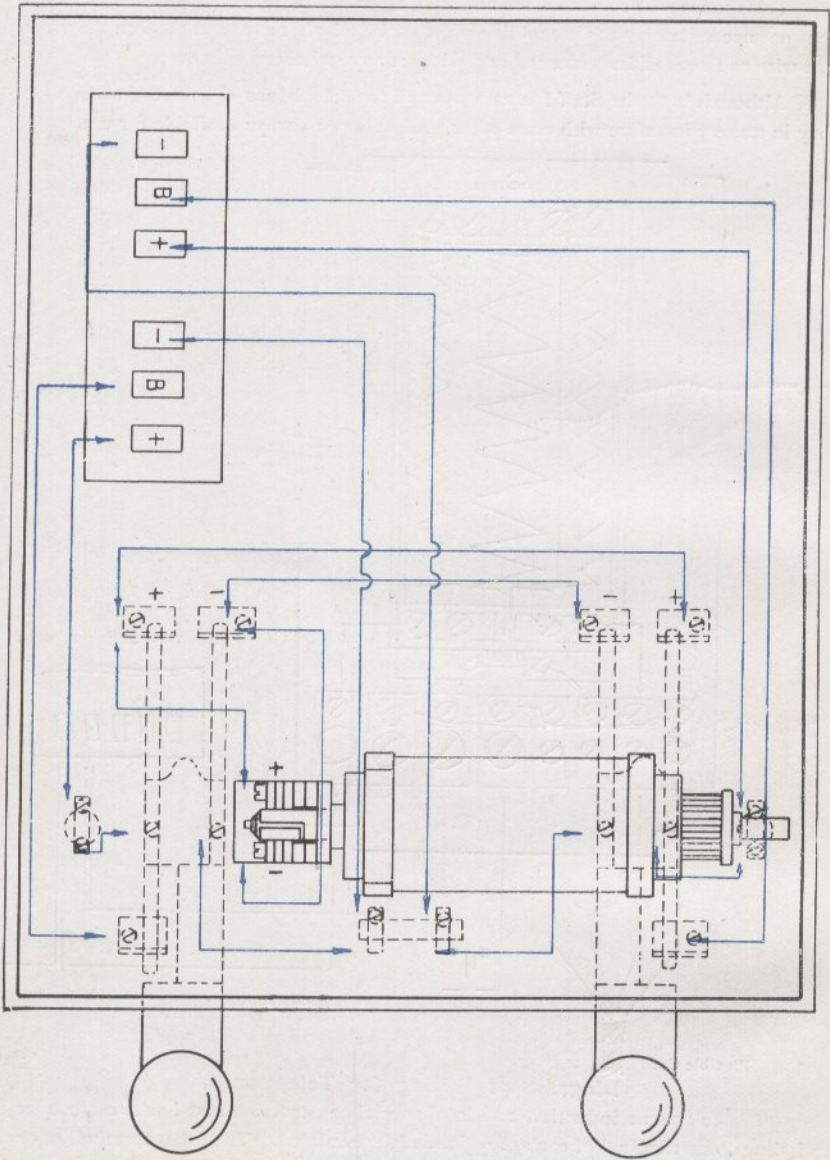


Diagram of Connections (internal) for Standard Magneto Generator.

MAGNETO GENERATOR FOR WORKING STAFF INSTRUMENTS (Patented).

Under ordinary conditions only one magneto generator is required for each ordinary Staff Station, as will be seen by reference to the folded diagram No. 1.

The Generator is of similar substantial construction to the Staff Instruments and has two tapper keys, which are mechanically interlocked one with the other, so that it is not possible to depress both at the same time.

The left-hand key on the Generator at Station Y controls the Staff Instrument and bell at Station X; and the right-hand key on the Generator at Station Y controls the Staff Instrument and bell at Station Z.

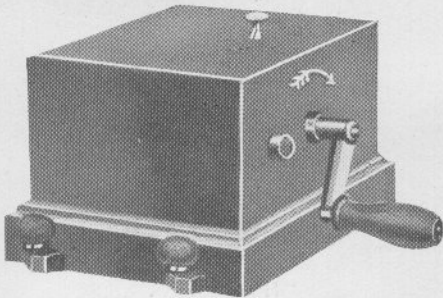
When ringing from one station to another the handle of the generator is turned continuously and the key depressed intermittently for the transmission of the necessary code of signals on the bell.

The Standard Magneto Generator, as illustrated, is suitable for working sections up to 15 miles. For longer sections a special long-distance generator is supplied which will work up to 50 miles. For all orders for Magneto Generators the Standard pattern is supplied unless otherwise specified.

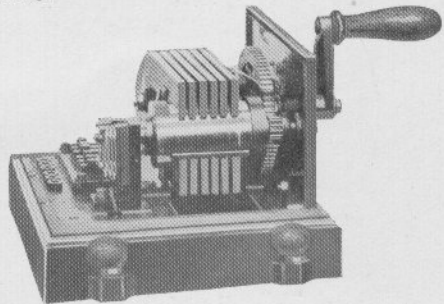
NOTE.—The above remarks with regard to the Standard Generator being suitable for sections up to 15 miles (and the special for sections up to 50 miles), is based on the assumption that a No. 8 iron line wire (or its equivalent in copper) is provided for the Staff Instruments.

Ordinary Magneto Generator.

Cat. No. C67.



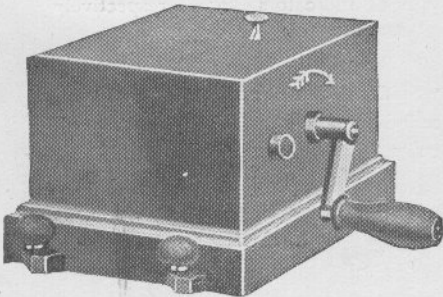
EXTERIOR VIEW.



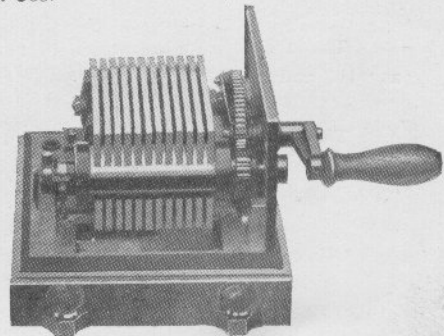
COVER REMOVED.

Long-Distance Magneto Generator.

Cat. No. C68.



EXTERIOR VIEW.

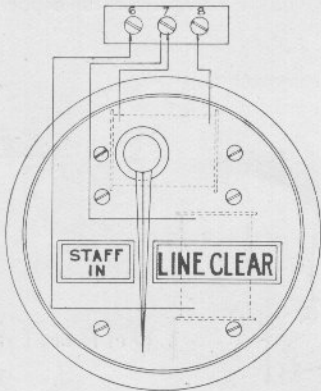


COVER REMOVED.

TRAIN INDICATORS (Patented).

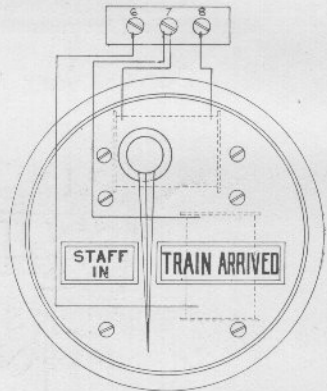
Staff Instruments can be supplied with Indicators, to indicate to the signalman at either end of the section whether it is occupied or not.

To corresponding terminals
on switchboard.



"L" Pattern.
Cat. No. C76.

To corresponding terminals
on switchboard.



"H" Pattern.
Cat. No. C77.

The above are illustrations of two types of Indicators, known respectively as "H" and "L."

The "L" type gives two indications, "Staff in, line clear," and "Staff out, line blocked," and the "H" type gives three indications, "Staff in, train arrived," "Staff out, train coming," "Staff out, train going."

Other types of indicators can be supplied to suit special conditions of working.

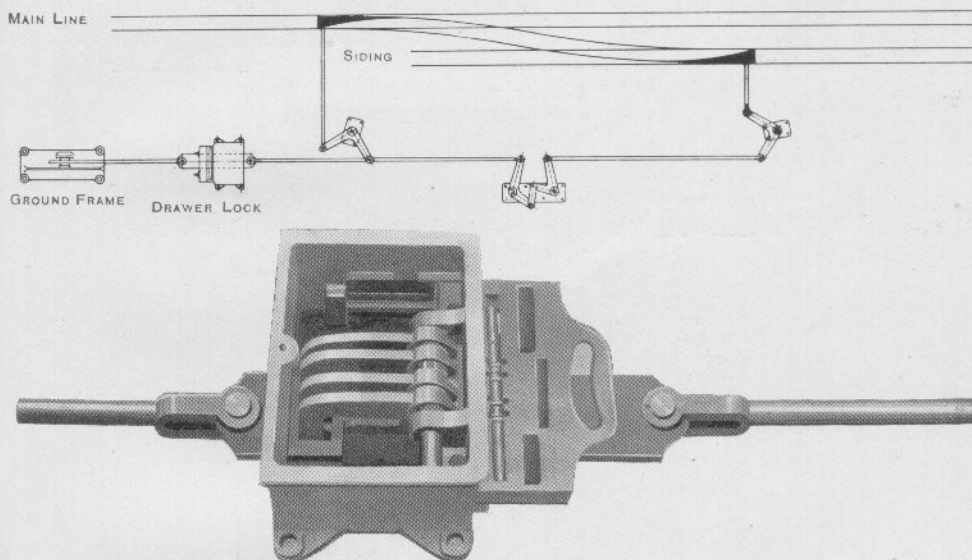
DRAWER LOCK FOR INTERMEDIATE AND OUTLYING SIDINGS (Patented).

Cat. Nos. C61 to C66.

This lock has been designed to control sidings which may exist in a single line section, ensuring that the points are normally locked for main line working. The staffs operate the lock and no special key or other attachment is required.

Only the staffs controlling the particular section in which the siding occurs will operate the lock.

The sketch below shows the position of the Drawer Lock in the connections between the Ground Lever and the siding points.



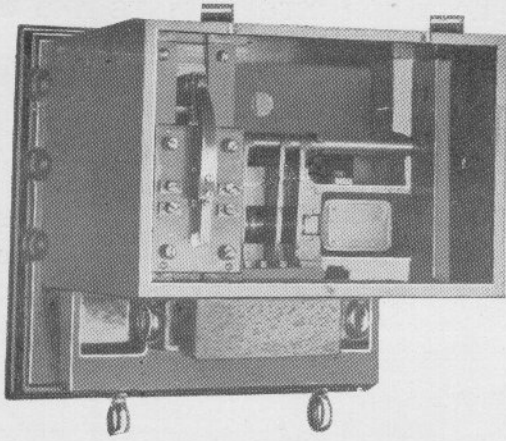
Drawer Lock with Cover removed and Staff in position.

The operation of unlocking the siding points is as follows :—

On the arrival of the train at the Siding the Staff is placed in the drawer, which is then pushed in as far as it will go, this action raises four pawls from their respective slots in the slide and enables the slide to move with the lever connections when the points are worked.

The movement of the points has the effect of back-locking the drawer so that the staff cannot be taken out until the points are restored for the main line, when the drawer will be released and the staff can be withdrawn,

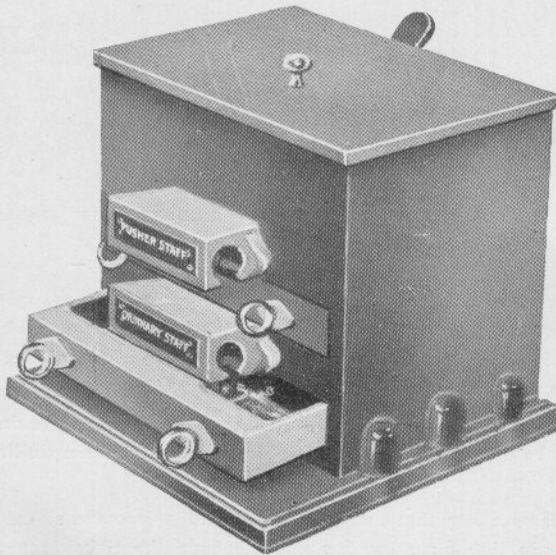
Where it is necessary that a whole train should go into the siding and remain clear of the main line for some considerable time the Subsidiary Siding Staff Instrument described on page 23 should be adopted in addition to the Drawer Lock described above.



Rear Bank or Pusher Engine Apparatus, showing Staff in Drawer
(Cover removed).



Rear Bank or Pusher Engine Staff.



Rear Bank or Pusher Engine Apparatus (Exterior View).
Cat. No. C73.

REAR BANK OR PUSHER ENGINE APPARATUS (Patented).

Cat. No. C73.

Description of Working.

Referring to the folded diagram No. 2:—

When a train travelling from say Station X to Station Y requires the assistance of a Rear Bank or Pusher Engine for part of the journey, the train Staff at X is obtained in the usual way, and, after the exchange of bell signals with Y, the signalman at X inserts the Ordinary Staff in the bottom drawer of the Bank or Pusher Engine apparatus. The closing of the bottom drawer unlocks the top drawer and allows X to take out the Special Staff and also the Ordinary Staff which has been used to unlock the top drawer.

The operation of taking out the Special Staff breaks down the line wire, and no other Staff can be taken out at either end of the section until:—

- (a) The Rear Bank or Pusher engine (after assisting the train as required) has returned to X and the Special Staff has been replaced in the top drawer, restoring the line wire, and
- (b) The Ordinary Staff carried by the through engine has been placed in the Staff Instrument at Y.

The above working can be used for a following ballast train which starts from Station X and goes into section X-Y and then returns to X.

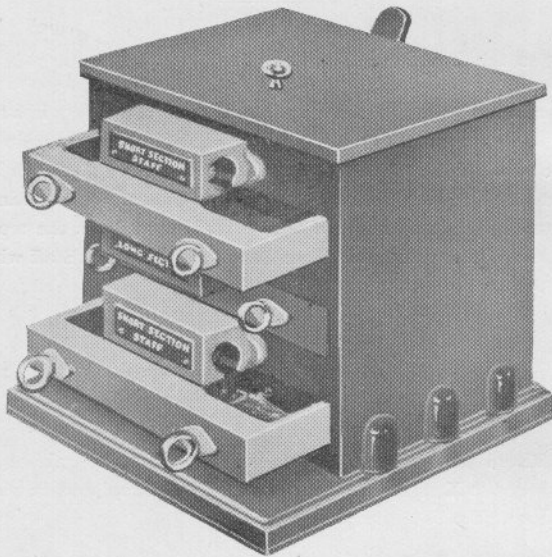
(When handing the Special Staff to the driver of the Rear Bank or Pusher Engine, or the driver of a following ballast train, the Stationmaster or Signalman must show him the Ordinary Staff, and the driver must not accept the Special Staff unless this regulation is complied with.)

SWITCHING-OUT APPARATUS (Patented).

Switching-out apparatus is provided to enable Stations or block posts to be switched-out and closed at night-time or when not required. The folded diagram No. 3 illustrates this scheme.

X, Y and Z are three Stations on a single line railway, Y being the intermediate Station which it is desired to close at certain times.

The two pairs of Staff Instruments A-A¹ and B-B¹ are for normal working, *viz.*, when Station Y is open, and the pair of Instruments C-C¹ are for through working when Station Y is closed.



**Mechanical Switching-Out Apparatus
(Exterior View).**

Cat. No. C72.

The Instrument A at Station X, and the Instrument B at Station Z, cannot be used for through working, as the Staffs which would enter one would not enter the other.

A mechanical switching-out box which is fitted with three drawers is required at Station Y in addition to the Staff Instruments.

The object of the mechanical switching-out box is to prevent the issuing of Staffs from the Instruments A-A¹ and B-B¹, when the intermediate Station Y is closed and *vice versa* to prevent the issue of Staffs from the "through" Instruments C-C¹

SWITCHING-OUT—continued.

when the intermediate Station Y is open. This is accomplished in the one case by locking one Staff from the Instruments A-A¹ and one Staff from the Instruments B-B¹ in the bottom and top drawers respectively of the mechanical switching-out box, and in the other case by locking one Staff from the Instruments C-C¹ in the middle drawer of the mechanical switching-out box.

The locking of the switching-out box is so arranged that it is necessary to insert an A Staff in the bottom drawer and a B Staff in the top drawer before the C Staff in the middle drawer can be released, and *vice versa*—the A and B Staffs in the bottom and top drawers can only be released by the insertion of a C Staff in the middle drawer.

METHOD OF WORKING.

Referring to the folded diagram No. 3:—

When the intermediate station Y is open, a C Staff is normally locked in the middle drawer of the switching-out box.

When it is desired to close Station Y, with a given train going from X in the direction of Z, the operator will obtain a Staff for the section X-Y in the ordinary way and hand it to the driver of the train. On the arrival of the train at Y, the operator there will insert the Staff A in the bottom drawer of the switching-out box, and if he has not already done so, will then ask Z for permission to withdraw a Staff from the Instrument B. When he has obtained the Staff B, he will place it in the top drawer of the switching-out box and will then be able to pull out the middle drawer and take the C Staff contained therein, which he will hand to the driver of the train as his authority to proceed to Z.

The operator at Y will then signal to X and Z that his Station is closed. When the train arrives at Z with the C Staff, this is placed in the through Instrument C, and through working will then be conducted between Stations X and Z direct.

When it is desired to re-open Station Y the operator will receive a C Staff carried by the first train stopping there; this he will place in the middle drawer of the switching out box, thereby releasing the top and bottom drawers.

Should the train be proceeding towards X, the driver will be given the A Staff appropriate to the re-opened short section Y-X and the other B Staff will be returned into the B Instrument at Y, after which the operator at Y will signal Stations X and Z that his Station is open.

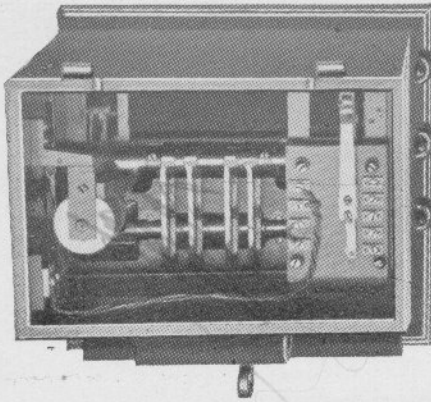
The operation of the apparatus is purely mechanical and in no way depends on currents received or sent for its reliability in working.

Neither of the line wires are touched, so that whether the intermediate Station is open or closed, X or Z can exchange signals by bells, and the line is also available for telephonic communications.

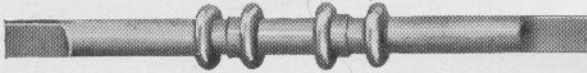
The operator need not reside at Station Y, but may arrive with the train opening the Station and depart with the train closing the Station.

Two or more intermediate Stations or Block Posts (in one Staff section) can be switched out by this system.

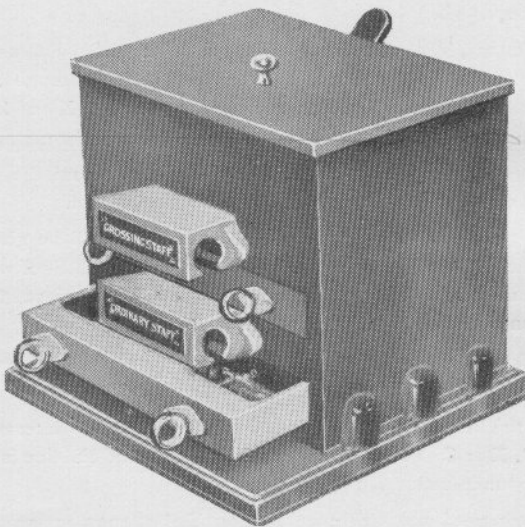
INTERMEDIATE PASSING PLACE INSTRUMENTS.



Intermediate Passing Place Instrument
(Cover removed).



Intermediate Passing Place Staff.



Intermediate Passing Place Instrument
(Exterior View).

Cat. No. C71.

INTERMEDIATE PASSING PLACE INSTRUMENTS

(Patented).

Cat. No. C71.

Where there are one or two intermediate passing-places in a section, and no permanent officials or operators at such intermediate passing-places, special apparatus is provided in addition to the ordinary Staff Instruments for normal working.

The passing-place Instrument, which consists of a box with two drawers, is provided with a special staff, and when normal working is in progress (*i.e.*, there is no necessity for passing trains at the intermediate loop), the special staff is locked up in the passing-place instrument.

Referring to the folded diagram No. 4, X, Y and Z are three stations on a single line railway, Y being an intermediate passing-place where there are no permanent officials or operators. When ordinary staff working is in progress the lower drawer of the passing-place instrument at X stands open, but the top drawer containing the special staff is locked in, and at Z the top drawer (which is a dummy) of the passing-place instrument stands open, whilst the lower drawer, containing the special staff, is locked in.

Each special staff should be engraved with the name of the short section to which it refers.

To enable trains to pass at Y, the method of working is as follows, commencing at X:—With the permission of the operator at Z a Staff is extracted from the ordinary staff instrument at X, and is placed in the lower drawer of the intermediate passing-place instrument; this drawer is then pushed in and releases the top drawer containing the special staff for the short section X—Y; meantime the operator at Z has pushed in his top (dummy) drawer. Permission can now be given to Z to release the lower drawer of the passing-place instrument at his station which contains the special staff for the short section Y—Z.

Both special staffs are now free, but the staff for the Ordinary Staff Instrument is locked up in the lower drawer of the passing-place instrument at X.

INTERMEDIATE PASSING PLACE INSTRUMENTS—continued.

The special staffs are given to the drivers of the two trains it is desired to "cross" at Y, but these only authorize the drivers to travel to Y, and when they arrive there they must exchange the special staffs, so that the driver from X will travel to Z with the special staff issued by Z, and the driver from Z will travel to X with the special staff issued by X.

On the arrival of the trains at X and Z respectively, after having crossed at Y, the operator at Z inserts the special staff Y-Z in the lower drawer of the passing-place instrument and pushes in the drawer. This allows him to pull out the top drawer, and he is then able to send current to X. Meantime the operator at X will have replaced the special staff X-Y in the top drawer of his passing-place instrument and pushed the drawer in; these operations free the staff for the ordinary staff instrument which was locked in the lower drawer, and this is then placed in its proper instrument, restoring normal working.

(Where there are facilities for passing more than two trains at the intermediate passing-place, the special instruments are fitted with divided staffs, which are issued subject to the usual instructions for permissive working. See pages 6 and 7).

If there is more than one intermediate passing-place in a section, a modification of the above is necessary.

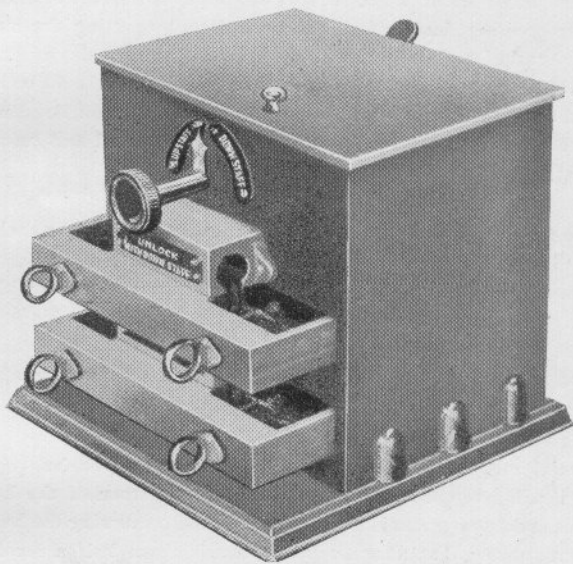
Where a special line wire cannot be provided for the passing-place instruments, they can be arranged for working on the same line wire as the normal staff instruments. In this case the passing-place instruments are operated by alternating currents, special generators being provided for this purpose.

INTERMEDIATE NON-CROSSING PLACE SWITCH (Patented).

Cat. No. C70.

For intermediate Stations or Block Posts where there is no provision for crossing trains, special "non-crossing place switches" are provided in addition to the usual Miniature Staff Instruments. These give the possibility of working the sections on either side to their full capacity, and prevent delay.

The non-crossing place switch is made up in an iron box, the upper part of which contains the electrical portion, which consists of two switches arranged to bring the normal generator into one or other of the staff instrument circuits. These switches are operated by turning the handle on the front of the box. In the lower part of the box are two drawers suitable for receiving the staffs referring to sections on either side. These drawers control the locking arrangement which is entirely mechanical.



Intermediate Non-Crossing Place Switch (Exterior View).

In the normal position of the switch, *i.e.*, with the pointer vertical, the ordinary magneto generator is not in either circuit, consequently the operator cannot give permission to the station on either side to withdraw a staff.

In connection with this switch a special magneto generator is required for giving the code signals on the bells.

Referring to the folded diagram No. 5, Y is the intermediate station or block post, and X and Z the stations on either side. AA¹ are the staff instruments for the section X-Y, and BB¹ the staff instruments for the section Y-Z. When the switch at Y is in the normal (vertical) position the magneto generator is out of

INTERMEDIATE NON-CROSSING PLACE SWITCH**—continued.**

circuit, consequently Y cannot give permission to X or Z to withdraw a staff. If Z has a train which has to pass to X he will ask Y for a staff by the usual code signal, Y will then turn his switch to "staff B"; this operation will bring the normal magneto generator in circuit with staff instrument B, the instrument belonging to the section Y-Z. Y can then give Z permission to withdraw a staff in the usual manner, *i.e.*, by pressing his right-hand key and turning handle of the generator. Y's switch is now locked over to "staff B," and remains so. The special magneto generator remains in connection with the instrument A, enabling Y to exchange signals with station X, but he is unable to give X current to withdraw a staff. Y will obtain from X permission to withdraw a staff from his instrument A, to pass a train on, and on the arrival of the train, will receive the "B" staff which the train has brought from station Z. If there is another train waiting at Z, Y can at once put the "B" Staff in the instrument B and give Z permission to withdraw a second staff. If Z has not another train, before putting the staff in the instrument, Y will release his non-crossing place switch. This is done by putting the staff into the drawer marked "staff B" and closing same. This action releases the lock, and the pointer will return to the vertical position; the drawer should be immediately re-opened, and the staff removed and put in the staff instrument B. The staff must not remain in the drawer, but should be immediately removed and returned to the staff instrument.

Similarly to pass a train from X to Z, Y would first turn his switch to staff A. After passing the train he would re-set his switch by inserting the "Staff A," which arrived from station X in the corresponding drawer of the non-crossing place switch, before placing same in the staff instrument A. Should Y turn his switch in the wrong direction by mistake, say to "staff B," he would have to ask station Z to give him permission to withdraw a "Staff B" in order to re-set his switch, after which he would immediately replace the staff in the staff instrument.

The special magneto generator provided for giving the bell signals is so arranged that it will give one stroke of the bell for each turn of the handle. The armature of the special magneto is so constructed that, on turning the handle, it does not rotate continuously, but after turning through about half a revolution, it is released and flies back under the influence of a spring. This produces a single impulse current which will ring the bell, but will not operate the staff instruments.

To give any required code signal, the key is depressed and the handle turned the number of times corresponding to strokes of the bell required.

The bells at the stations on either side should be adjusted very lightly by removing the counter balance weights and lessening the tension of the spring to ensure them ringing under the action of the impulse currents.

SUBSIDIARY JUNCTION OR SIDING APPARATUS (Patented).

Cat. Nos. C37 to C42.

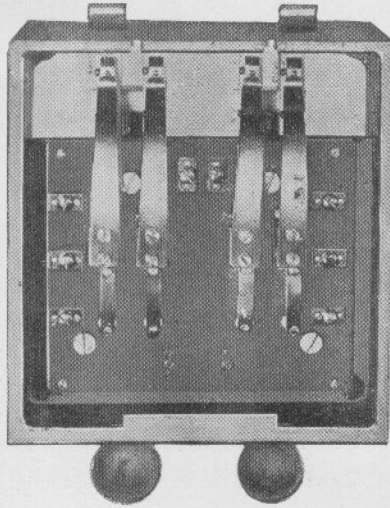
Referring to the folded Diagram No. 6, two Instruments are required at Station X, one at Station Z, and one at the Subsidiary Junction Y. The Instruments at X and Z will contain 15 Staffs each, and the one at Y will be without Staffs.

Working from X to Z is normal.

When a train is proceeding to the Subsidiary Siding, either from X or Z, a Staff is obtained and given to the driver in the usual manner. On the arrival of the train in the siding (the siding should, of course, be controlled by a Drawer Lock as described on page 13) the Staff is placed in the Instrument at Y and permission is given to X to withdraw a Staff from the corresponding Instrument, which is transferred to the Main Line Instrument, thus locking up the Subsidiary Siding Instrument and restoring the Main Line Working.

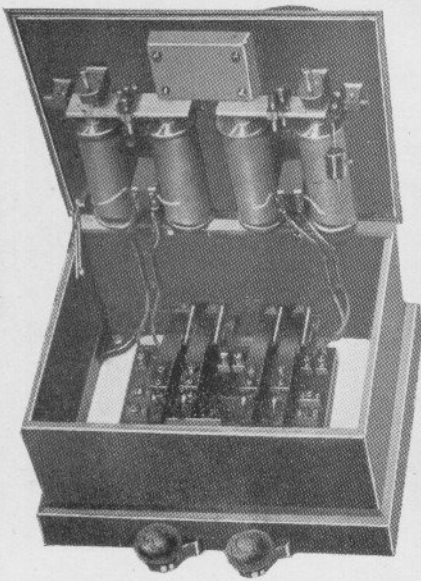
When a train requires to leave the Subsidiary Siding, permission is asked by code from X, who will first obtain a Staff by permission from Z from the Main Line Instrument, which he will transfer to the Subsidiary Siding Instrument, thus enabling him to give permission to Y to withdraw a Staff.

It will be seen by this description that several trains can pass from X to Z into the Subsidiary Junction or Siding and also that these trains can afterwards return to the point from which they started or proceed to the Station at the other end of the section, as may be required.

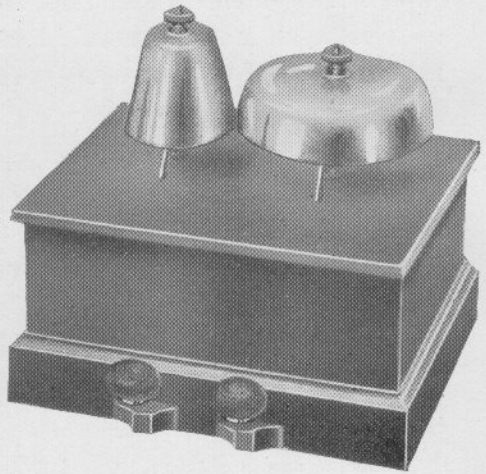


Battery Switch without Bells (Cover removed).

Cat. No. C80.



LID OPEN.



EXTERIOR VIEW.

Battery Switch with Bells.

Cat. No. C81.

WORKING "S" TYPE PATENT MINIATURE STAFF INSTRUMENTS BY PRIMARY BATTERIES.

As previously mentioned, the "S" Type Miniature Staff Instruments were primarily designed for working by Magneto generators, but they can also be arranged for battery working, batteries taking the place of the magneto generators. The number of cells required for varying distances is given in the following table:—

**Table of Battery Power required for "S" Type Patent
Miniature Staff Instruments.**

Distance in Miles.	* Line Wire No. 8, 400 lbs. per mile.	Resistance of Line.	Number of Leclanché Cells required.
2	No. 8	24 ohms.	14
4	No. 8	48 ..	16
6	No. 8	72 ..	18
8	No. 8	96 ..	20
10	No. 8	120 ..	22

* For smaller gauge wire, proportionately increased battery power must be provided.

Owing to the special construction of the magnet movement, the safe working of the Instruments is in no way affected by the amount of battery power provided, direction of current being the sole determining factor.

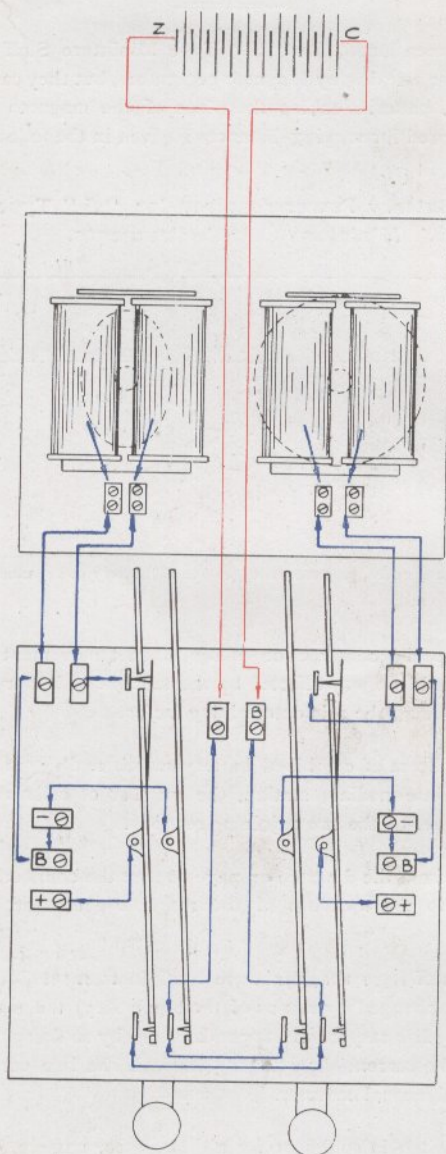
With the latest form of combined battery switch and ringing keys, one battery is sufficient for an intermediate station, the number of cells required being that necessary for the longer of the two adjoining sections.

It will be seen from the diagram on page 26 that the connections of the battery switch are similar to the switches of the magneto generator. (See also folded diagram No. 7).

To extract a Staff from the Miniature Staff Instrument (after the proper bell signals have been exchanged by means of the tapper key) the man at the adjoining station presses down his respective tapper key and by so doing brings the battery into operation and the current then flowing through the line wire enables the Staff to be withdrawn in the usual manner.

The battery switch is sufficient for all purposes, namely, operating the staff instruments, giving code signals on bell, and telephone ringing communications.

NOTE.—When desired the battery switch can be combined with two bells in one case.



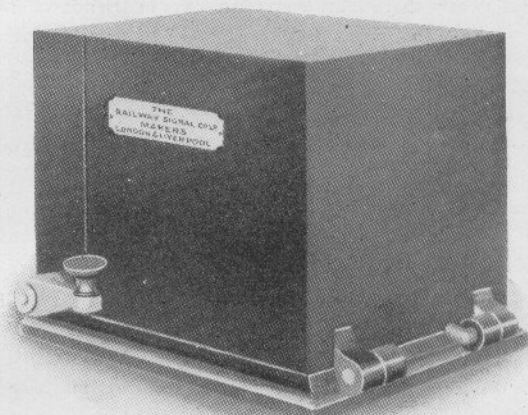
**Diagram of Connections (internal) for Combined Bells
and Battery Switch.**

AUTOMATIC OPERATOR (Patented).

Battery Working.

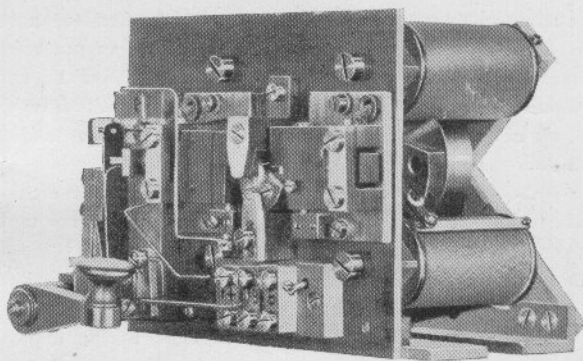
(See Folded Diagram No. 8).

To obviate the necessity of providing special local staff at intermediate stations to operate the Staff Instruments, where otherwise there would be no necessity, an "Automatic Operator" (which is a small apparatus in a cast-iron box) is provided, the action of which is as follows:—



Automatic Operator (in its box).

Cat. No. C86.



Automatic Operator (removed from its box).

Cat. No. C86.

When it is required to withdraw a staff, a signal is sent to the station at the other end of the section by depressing the tapper key on the Automatic Operator; on releasing the key, the Automatic Operator at the other end of the section brings the line battery into the circuit, enabling the staff to be withdrawn (if the section is not occupied) and the battery remains in the circuit until the cut-out switch on the staff instrument has been pressed and the galvanometer needle returns to zero. An indicator is provided on the staff instrument, consisting of a needle, which (after pressing the tapper key of the Automatic Operator) indicates the condition of the section, *i.e.*, either "Free" or "Occupied" ("Staff in" or "Staff out").

SEMI-AUTOMATIC STAFF APPARATUS (Patented).

When a section is terminated at one end by a station "X," where there is always an operator in attendance, and at the other end by a station "Y," where there is no permanent operator, it is necessary that the staff instruments should be automatic in working in one direction and advisable that they should be non-automatic in the other direction. The equipment required for such a section (as will be seen from the folded diagram No. 9), is as follows :—

For Station X (where there is an operator always in attendance) :—

"S" type Staff Instrument fitted with "G" pattern Indicator.

Magneto Generator.

Continuous Bell.

For Station Y (where there is no operator in attendance) :—

"S" type Staff Instrument fitted with "K" pattern Indicator.

Continuous Bell.

Automatic Operator and Bell Key.

At Station Y in place of the Magneto Generator a primary battery, or other source of current, must be provided.

The operation is as follows :—On the arrival of a train at Y the authorised train official will call X's attention and ask for staff by means of the tapper key attached to the automatic operator ; X will reply, if the section is clear, giving permission in the ordinary way by turning the handle of his magneto generator and depressing the key. After withdrawing the staff the train official will signify to X that he has finished with the current by pressing his cut-out switch, causing the galvanometer needle at X to resume the vertical position, he should press his tapper key giving the train on signal which causes the Indicator at X to show "Staff-Out."

When X requires to withdraw a Staff from his Instrument to pass a train to Y, he will send a current to Y by turning the handle of his generator and depressing the key for a short time. The releasing of the key will then put the automatic operator into action, which will close the battery circuit at Y, sending current to X, who, if the section is clear, can then withdraw a Staff. After withdrawing the Staff X will depress his cut-out switch, which interrupts the current and causes the automatic operator to resume its normal position.

On the arrival of the train at Y, the train official will put the Staff into the Instrument and signal to X that this has been done by means of the tapper key on the automatic operator.

If the bells continue ringing or the pointer of the Indicator remains deflected, the automatic operator is in action. The automatic operator should be put out of action by depressing the cut-out switch until the bells cease to ring, and the pointers remain vertical.

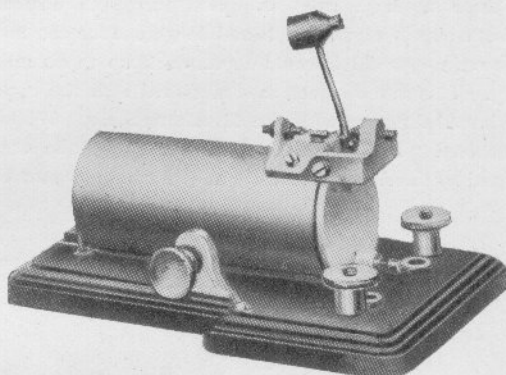
The bells provided are arranged to ring continuously whilst there is a current on the line. They differ in construction from "trembling bells" in that the vibratory contacts do not interrupt the current.

The "K" type indicators have a pointer which normally stands in the vertical position, and is deflected by incoming currents to either side, indicating "Staff in" or "Staff out" ("Section clear" or "Section occupied"), as the case may be.

The "G" type Indicator has a pointer which indicates "Staff-In" or "Staff-Out," in addition to a galvanometer needle to indicate the current.

STANDARD BELL FOR STAFF INSTRUMENTS
IN CAST-IRON CASE.

Cat. No. C82.



View with cover removed.

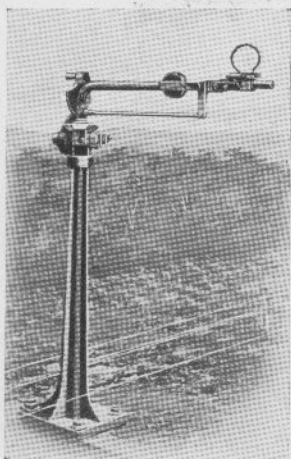


Exterior view.

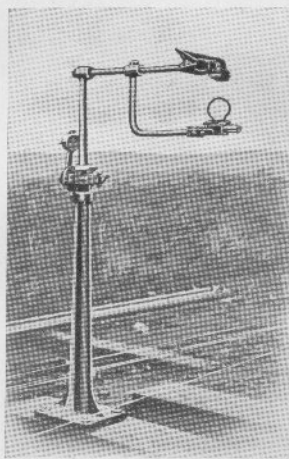
Previously the Staff Instrument Bells have been supplied in wooden cases, but recently (to meet demands from various directions), we have designed a bell in cast-iron case, of which two illustrations appear above.

WHITAKER'S AUTOMATIC STAFF EXCHANGER (Patented).

Since the introduction of Tokens for working single line railways, the necessity of exchanging these at high rates of speed has been demonstrated. Hand exchanging for fast trains is impracticable and dangerous for the men, and therefore a good automatic exchanger which would do its work up to 60 miles per hour has become necessary. This rate of speed is maintained with the apparatus described herein, which is intended for use with the Miniature Staffs. Whitaker's apparatus comprises a Combined "Receiver" and "Deliverer" on the engine or tender, a "Deliverer" placed by the side of the rails at the commencement of a single line



Cat. No. C87.



Cat. No. C88.

section, a "Receiver" similarly placed at the end of the section, and a combined "Receiver" and "Deliverer" placed at each side of the line at the intermediate crossing-places.

In the illustrations:—

- Cat. No. C87 is "Deliverer" for commencement of single line section.
- „ „ C88 is combined "Deliverer" and "Receiver" for intermediate station.
- „ „ C89 is "Receiver" for end of single line section.
- „ „ C90 is Engine Attachment with slide out ready for exchanging.

The arms on the columns stand normally parallel to the running track, but when it is required to exchange staffs, the arms are swung out at right-angles to the line, into such a position that they are ready to engage with the corresponding apparatus fixed on the locomotives; the moment the staffs are exchanged, the arms swing back automatically clear of the line to their normal position again.

WHITAKER'S AUTOMATIC STAFF EXCHANGER—continued.

The staffs are carried in a suitable leather pouch, having a steel hoop attached.

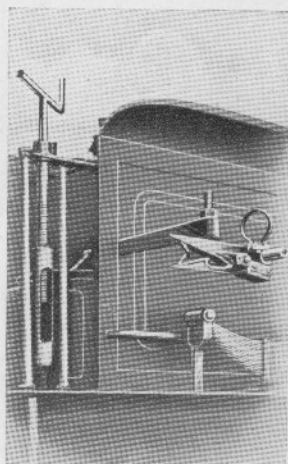
The attachment on the locomotive consists of a slide working in a cast-iron guide fitted to the tender; at the end of this slide is a jaw fitted with triggers, which prevent the steel loop on the pouch rebounding off the jaw after being caught.

The rear end of the jaw is constructed so as to carry the staff about to be given up, the pouch being held in a spring clip.

The picking-up apparatus on the ground consists of a column with two arms, the top arm carries the jaw to catch the staff to be set down by the engine, and the second arm carries a holder, similar to that carried on the locomotive, in which the staff to be picked up is placed.



Cat. No. C89.

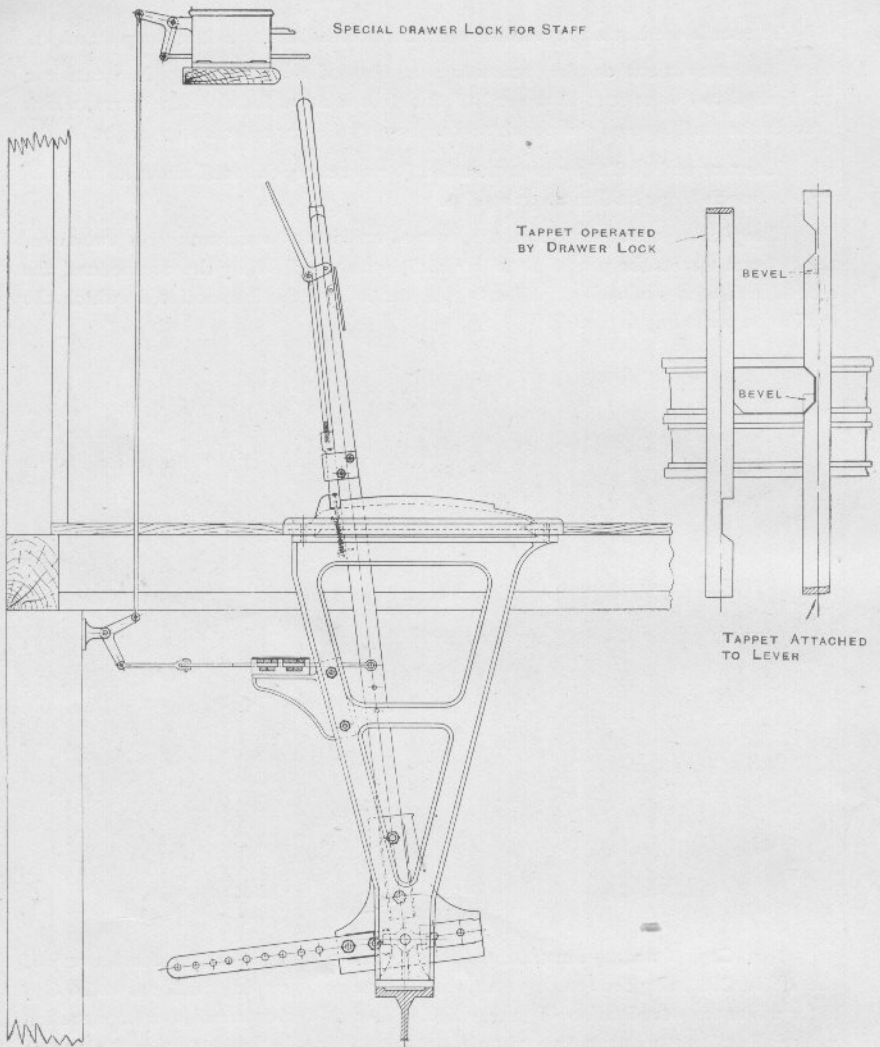


Cat. No. C90.

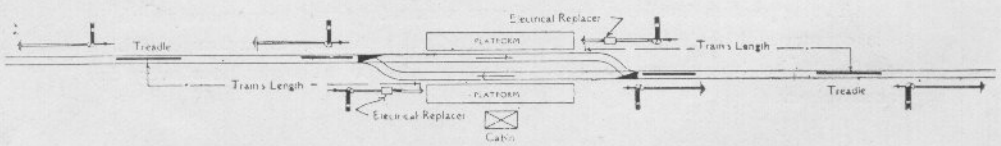
Nos. C87, 88 and 89 illustrate the three types of pillars used for the delivery of the staffs, C88 being the type used at intermediate non-stopping stations, whilst C89 is for use at the termination of single line, either at the entrance to a large station where all trains stop, or at the commencement of double line. C87 is for use at the commencement of single line in such situations where the speed of trains is comparatively slow, as when starting from a station or after being stopped by signal, and is therefore fitted with special slow speed mechanism.

The apparatus has been working most successfully and continuously both in this country and abroad, and in cases where it is necessary to exchange at high speeds, this has been done regularly at between 50 to 60 miles per hour every day for some years.

One of the features of the apparatus which will specially recommend it to railway men, is that in operation the arms on the exchanging standards automatically swing clear of the running gauges the moment the exchange has been effected.



CONTROL LOCK FITTED TO INTERLOCKING APPARATUS.



SIGNAL DIAGRAM FOR A PASSING STATION ON A SINGLE LINE RAILWAY.

**SPECIAL CONTROL LOCK FOR SEMAPHORE DEPARTURE
SIGNAL OPERATED BY TRAIN STAFF**

(Patented).

Cat. Nos. C74 and C75.

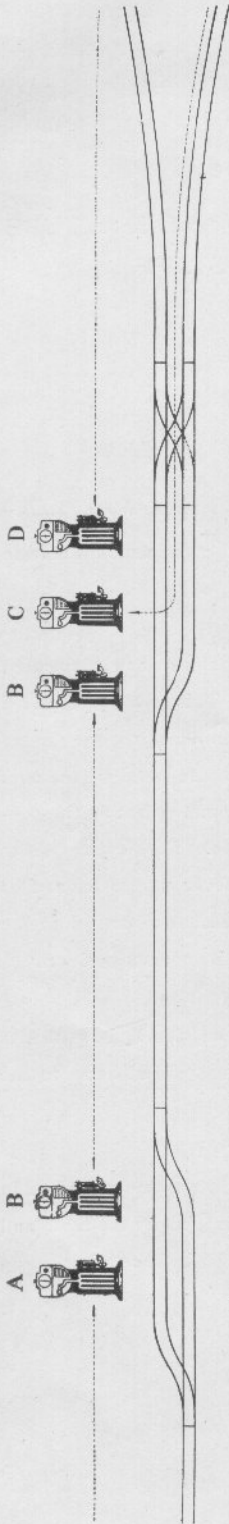
The object of this device is to prevent the signalman giving a "right-away" semaphore signal without having previously extracted a staff for the section the train is about to enter.

A special lock is fixed on the ordinary instrument shelf, in any convenient position, as close to the lever it releases as can be arranged. This lock is connected to a tappet in the locking-box by means of a rod, which is connected to one end of the lower slide. The slide is normally locked, and can only be released by the staff being placed in the drawer which is then pushed right home, operating the controlling arrangement in the box, and releasing the lower slide. The lower slide is now drawn out, and the tappet which releases the apparatus lever is operated so that the starting signal may be lowered; the staff may be released and handed to the driver in the usual manner by putting the lower slide back in its normal position.

The enlarged section of the locking arrangement shows clearly how this is accomplished; the lever operating the signal being free to be put back to the "normal" and lock itself.

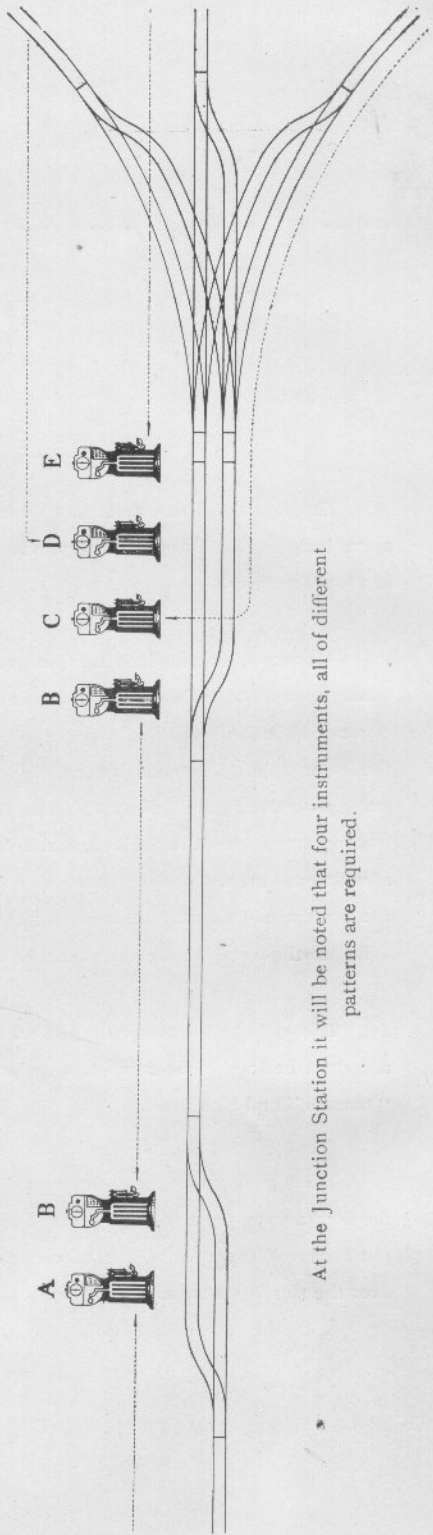
The general arrangement of signals for a Station on a single line is shown in the diagram on page 32, where the starting signals are controlled by the Staff and put back to danger by means of electrical replacers operated by the train passing over the treadles or insulated tracks.

JUNCTION IN SINGLE LINE SECTION.



The various patterns of instruments are shown distributed in such a manner that the staffs controlling one section will not enter the instruments controlling the adjoining sections.

TRIPLE JUNCTION IN SINGLE LINE SECTION.



At the Junction Station it will be noted that four instruments, all of different patterns are required.

NOTE.—When quoting the following Nos. please add "1914 Edition."

Page No.	Cat. No.	Description.
		Miniature Staff Instrument with Galvanometer, 15 ordinary staffs, and bell or gong.
5	C 1	"A" pattern.
5	C 2	"B" pattern.
5	C 3	"C" pattern.
5	C 4	"D" pattern.
5	C 5	"E" pattern.
5	C 6	"F" pattern.
		Miniature Staff Instrument with Galvanometer, 15 ordinary staffs, bell or gong, and telephone.
5	C 7	"A" pattern.
5	C 8	"B" pattern.
5	C 9	"C" pattern.
5	C10	"D" pattern.
5	C11	"E" pattern.
5	C12	"F" pattern.
		Miniature Staff Instrument with "L" type two-position indicator, 15 ordinary staffs and bell or gong.
	C13	"A" pattern.
	C14	"B" pattern.
	C15	"C" pattern.
	C16	"D" pattern.
	C17	"E" pattern.
	C18	"F" pattern.
		Miniature Staff Instrument with "L" type two-position indicator, 15 ordinary staffs, bell or gong and telephone.
2	C19	"A" pattern.
2	C20	"B" pattern.
2	C21	"C" pattern.
2	C22	"D" pattern.
2	C23	"E" pattern.
2	C24	"F" pattern.
		Miniature Staff Instrument with "H" type three-position indicator, 15 ordinary staffs, and bell or gong.
	C25	"A" pattern.
	C26	"B" pattern.
	C27	"C" pattern.
	C28	"D" pattern.
	C29	"E" pattern.
	C30	"F" pattern.

NOTE.—When quoting the following Nos. please add "1914" Edition.

Page No.	Cat. No.	Description.
		Miniature Staff Instrument with "H" type three-position indicator, 15 ordinary staves, bell or gong and telephone.
	C31	"A" pattern.
	C32	"B" pattern.
	C33	"C" pattern.
	C34	"D" pattern.
	C35	"E" pattern.
	C36	"F" pattern.
		Note. —Re items Nos. C1 to C36 inclusive.
		The above items will be supplied with bells and gongs in iron cases, Catalogue Nos. C82 and C83, unless bells and gongs in polished teak cases, Catalogue Nos. C84 and C85 are specified.
		When Instruments are required with Composite Stuffs, the catalogue number for the Composite Stuffs should be quoted in addition to the catalogue number for the Instruments; for instance, a Miniature Staff Instrument with Galvanometer, 15 two-part staves and bell or gong, should be quoted as Catalogue Nos. C1 and C49, or if required with three-part staves, Catalogue Nos. C1 and C55.
		Subsidiary Junction or Siding Instrument.
23	C37	"A" pattern.
23	C38	"B" pattern.
23	C39	"C" pattern.
23	C40	"D" pattern.
23	C41	"E" pattern.
23	C42	"F" pattern.
		Ordinary Stuffs.
6	C43	"A" pattern.
6	C44	"B" pattern.
6	C45	"C" pattern.
6	C46	"D" pattern.
6	C47	"E" pattern.
6	C48	"F" pattern.
		Two-part Composite Stuffs.
7	C49	"A" pattern.
7	C50	"B" pattern.
7	C51	"C" pattern.
7	C52	"D" pattern.
7	C53	"E" pattern.
7	C54	"F" pattern.
		Three-part Composite Stuffs.
7	C55	"A" pattern.
7	C56	"B" pattern.
7	C57	"C" pattern.
7	C58	"D" pattern.
7	C59	"E" pattern.
7	C60	"F" pattern.

NOTE.—When quoting the following Nos. please add "1914" Edition.

Page No.	Cat. No.	Description.
		Drawer Lock.
13	C61	"A" pattern.
13	C62	"B" pattern.
13	C63	"C" pattern.
13	C64	"D" pattern.
13	C65	"E" pattern.
13	C66	"F" pattern.
		Magneto Generator.
11	C67	For sections up to 15 miles.
11	C68	For sections over 15 and up to 50 miles.
9	C69	Telephone Attachment complete.
21	C70	Intermediate Non-crossing Place Switch.
19	C71	Intermediate Passing-place Instrument.
16	C72	Switching-out Apparatus.
15	C73	Rear Bank or Pusher Engine Apparatus.
33	C74	Special Control Lock.
		Note. —When ordering Catalogue Nos. C70, C71, C72, C73 and C74, please specify the patterns of the Staff Instruments, whether A, B, C, D, E, or F, in use on the section for which the apparatus is required, and also the patterns of the Staff Instruments in use on the sections adjoining on either side.
33	C75	Special Locking in connection with same.
12	C76	"L" type Two-position Indicator.
12	C77	"H" type Three-position Indicator.
28	C78	"K" type Indicator.
28	C79	"G" type Indicator.
24	C80	Battery Switch without bells.
24	C81	Battery Switch with bells.
29	C82	Standard Bell in iron case.
	C83	Standard Gong in iron case.
	C84	Standard Bell in wood case.
	C85	Standard Gong in wood case.
27	C86	Automatic Operator with tapper key.
34		Arrangement of Staff Instruments for Junctions.
		Whitaker's Automatic Staff Exchanger.
30	C87	Column—for starting of single line.
30	C88	Column—for intermediate station.
31	C89	Column—for end of section of single line.
31	C90	Attachment—for locomotive.
		Note. —When enquiring for or ordering Staff Instruments, please specify whether these are required for working by magneto generators or by batteries.

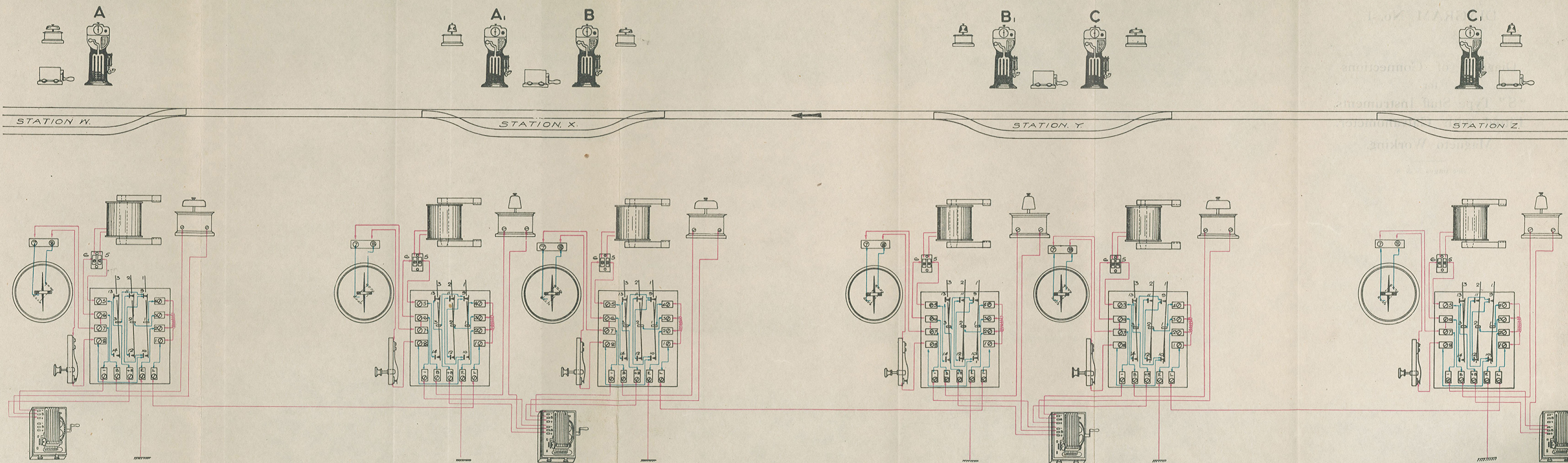


Diagram of Connections for "S" Type Staff Instruments. Fitted with Galvanometer. Magneto Working.

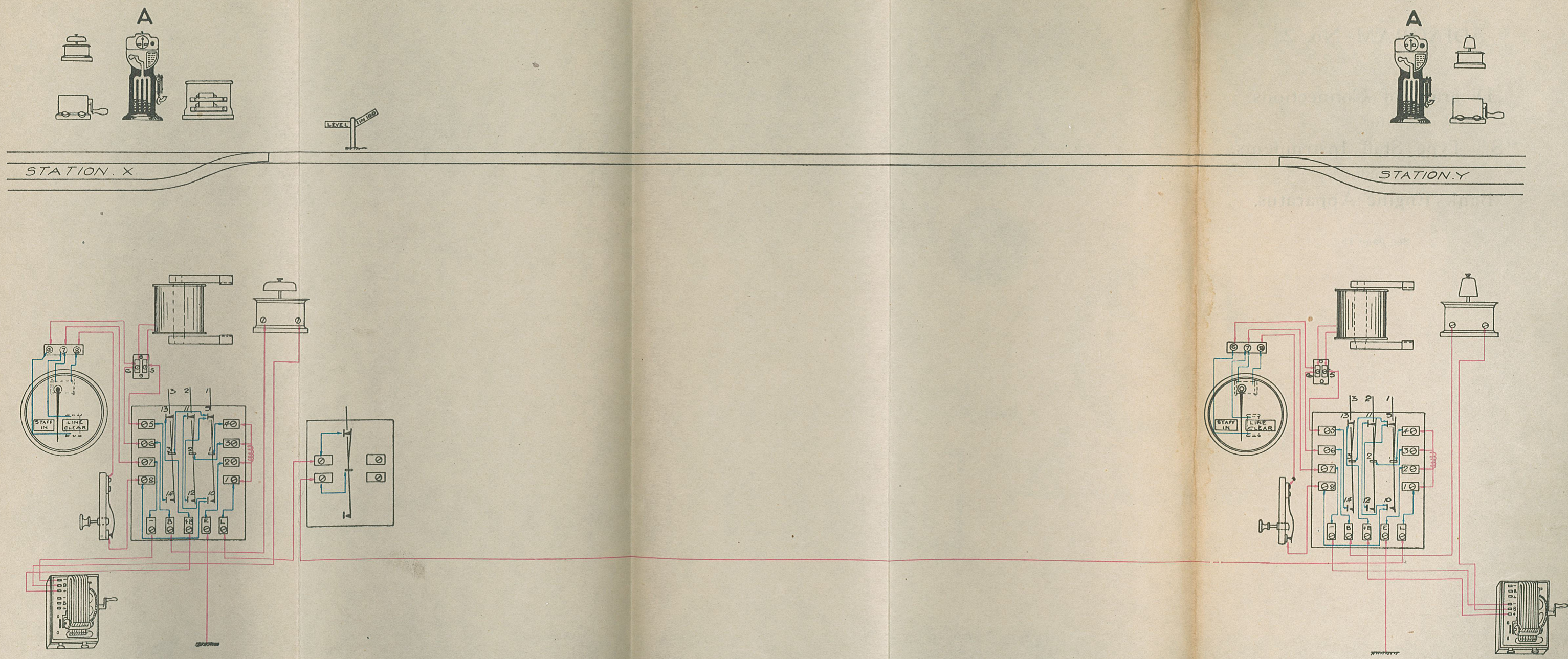
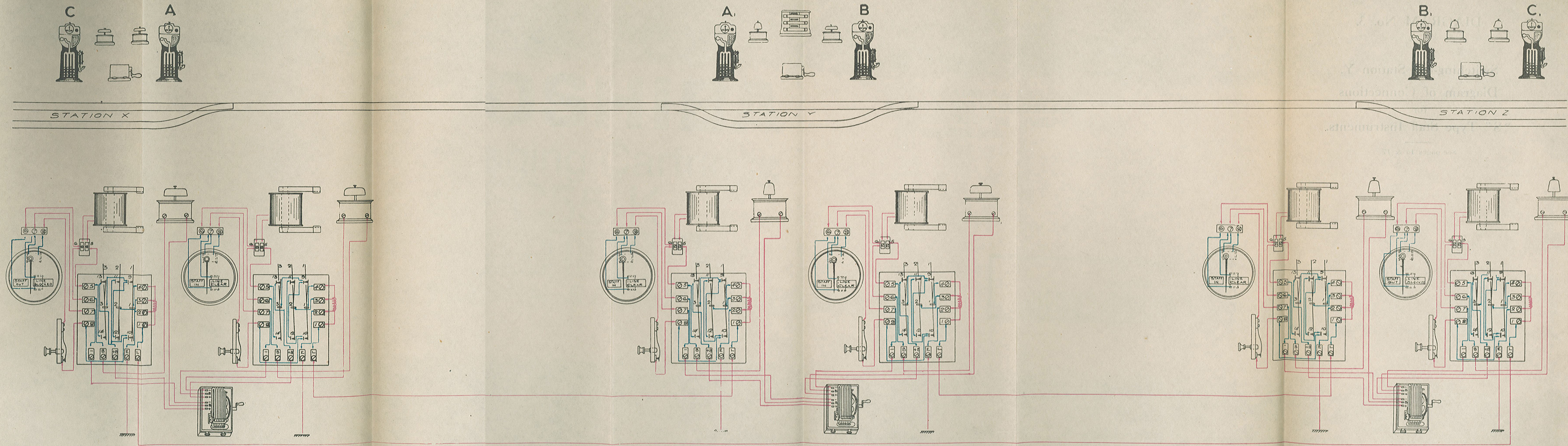
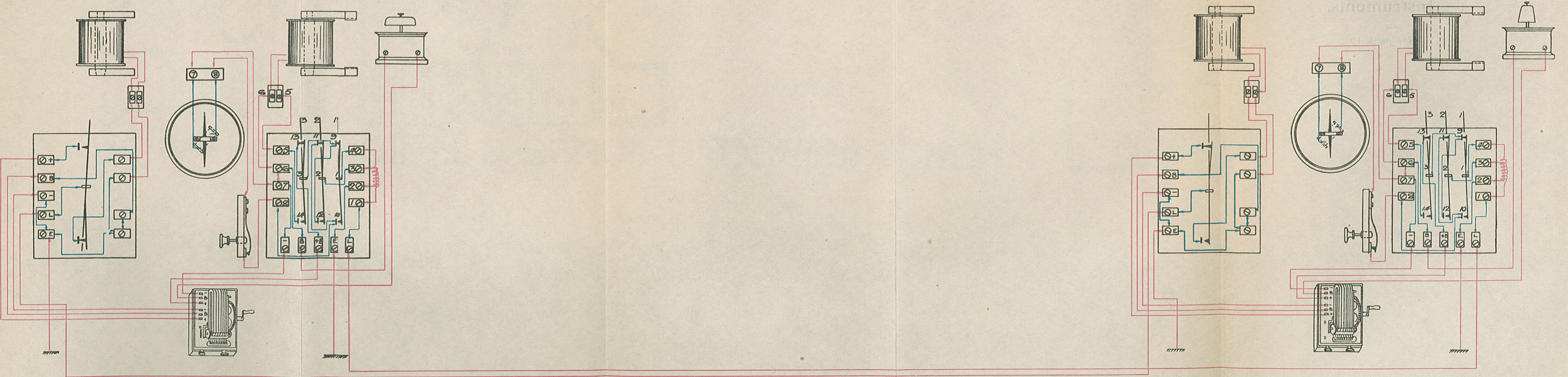
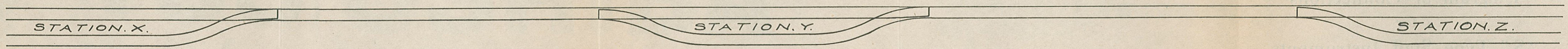
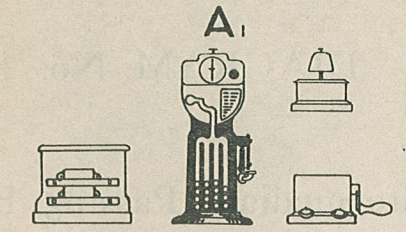
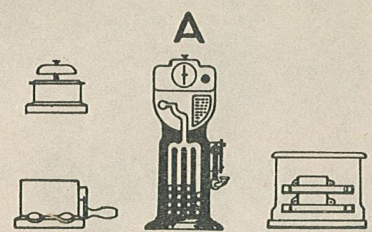


Diagram of Connections for "S" Type Staff Instruments and Bank Engine Apparatus.



Switching-Out Station Y. Diagram of Connections for "S" Type Staff Instruments.



Intermediate Passing Place. Diagram of Connections for "S" Type Staff Instruments and Intermediate Passing Place Instruments.

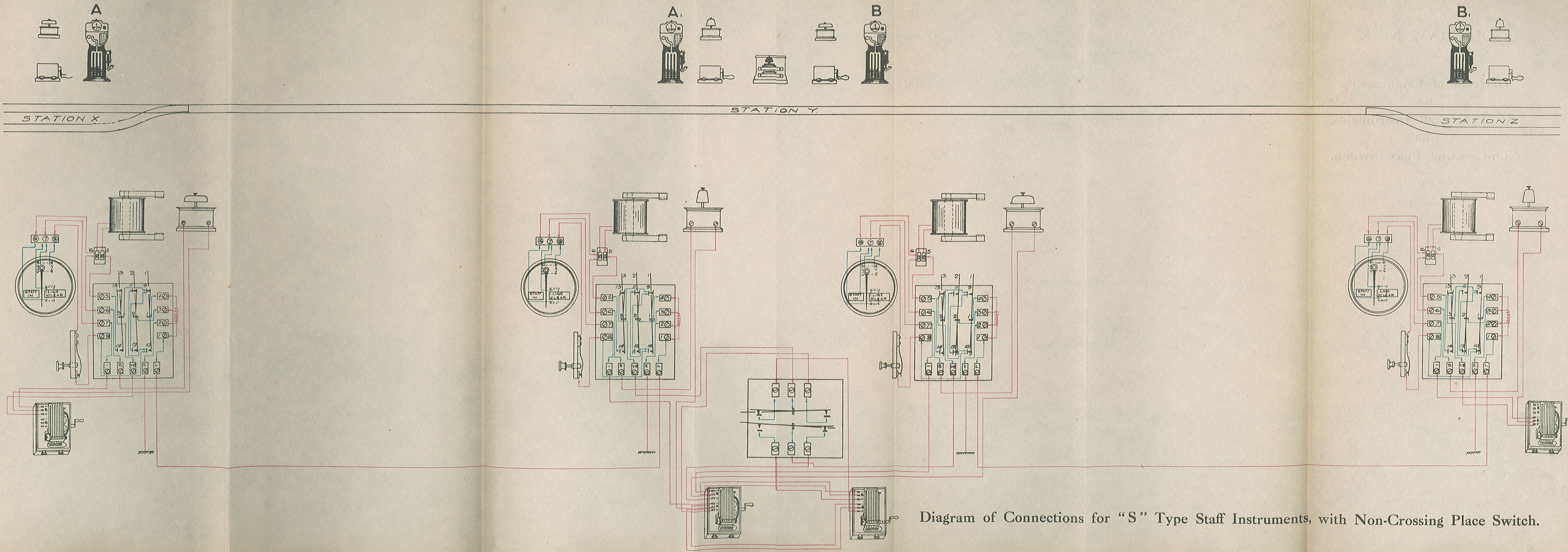
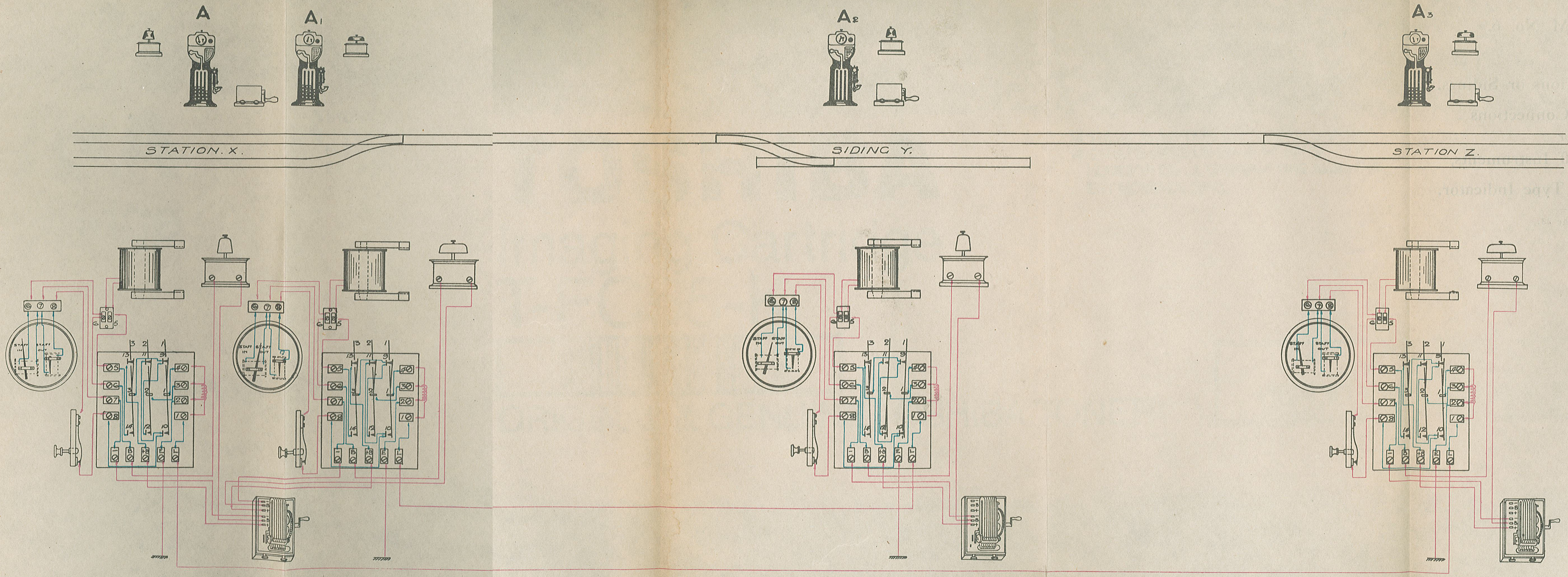


Diagram of Connections for "S" Type Staff Instruments, with Non-Crossing Place Switch.



Subsidiary Junctions or Sidings. Diagram of Connections for "S" Type Staff Instruments, fitted with "G" Type Indicator.

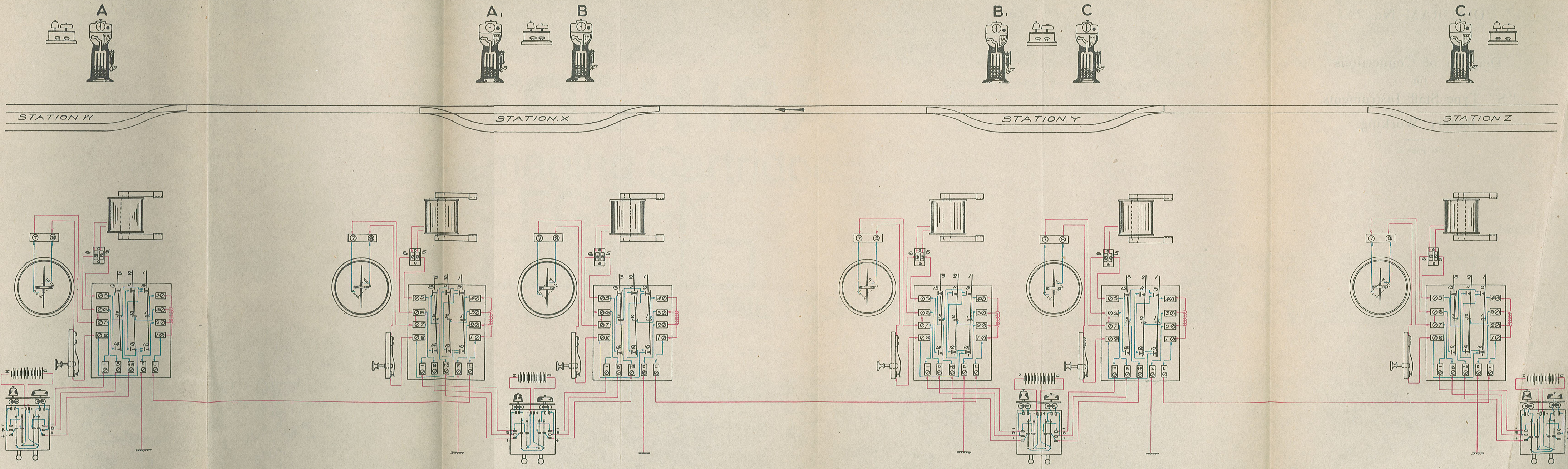
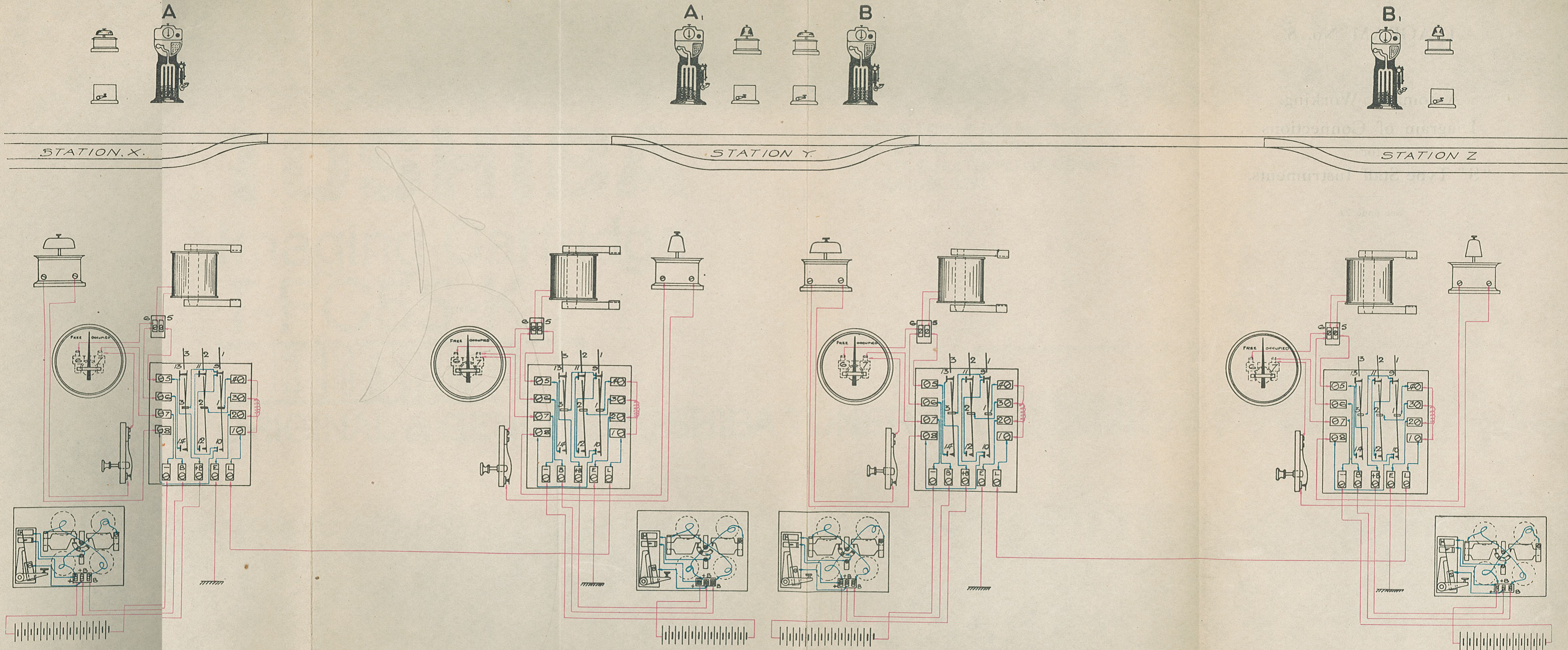
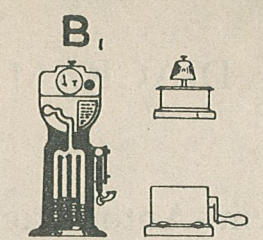
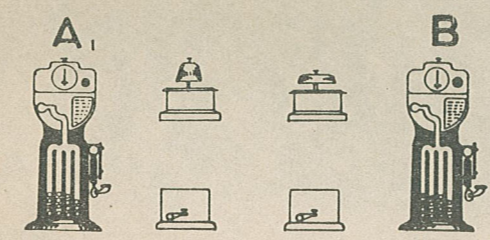
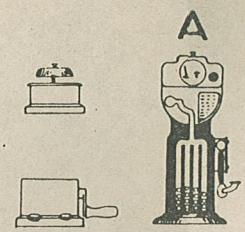


Diagram of Connections for "S" Type Staff Instruments. Battery Working.



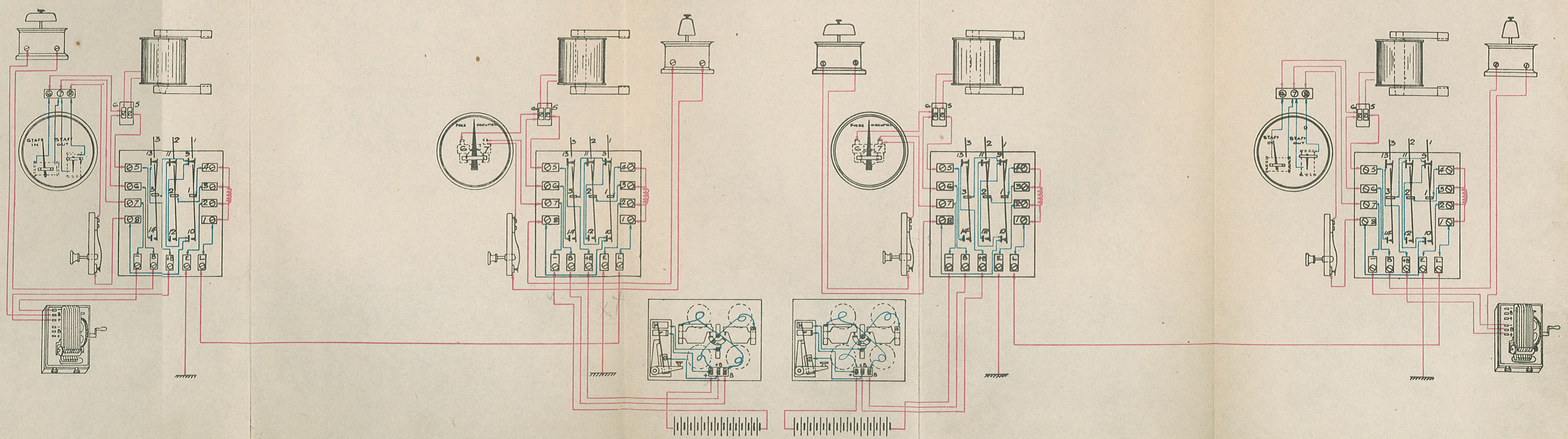
Automatic Working. Diagram of Connections for "S" Type Staff Instruments.



STATION X.

STATION Y.

STATION Z.



Semi-Automatic Working. Diagram of Connections for "S" Type Staff Instruments.

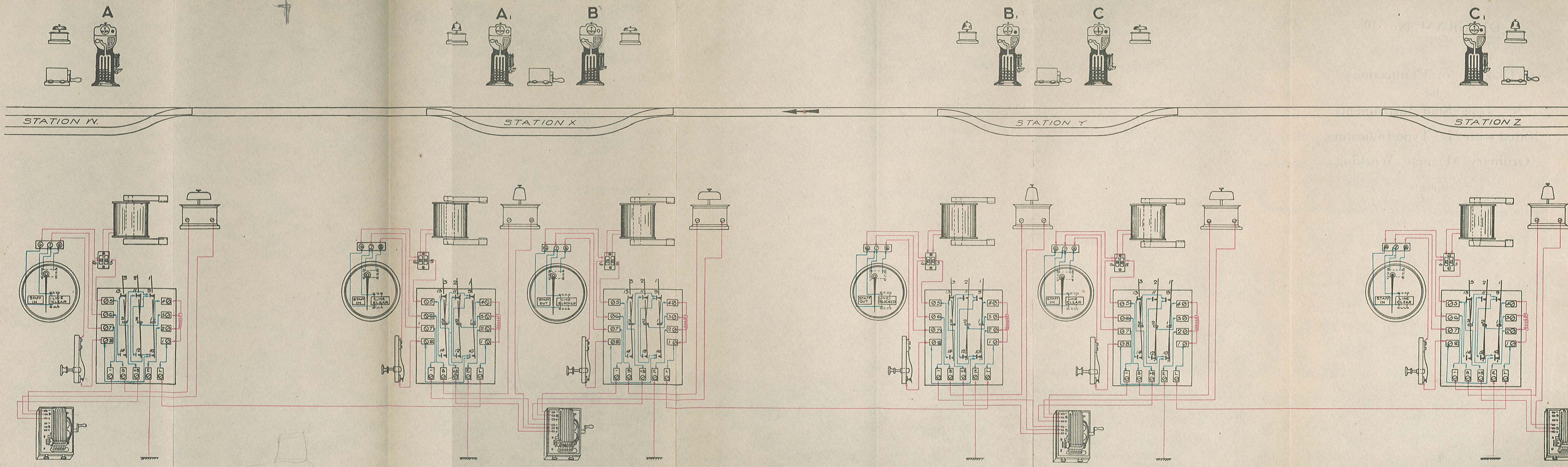


Diagram of Connections for "S" Type Staff Instruments. Fitted with "L" Type Indicators. Ordinary Magneto Working.

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