PUL-SYN-ETIC

GENT'S LEICESTER

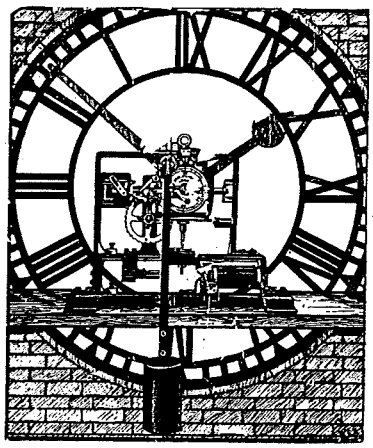
Book 5.
Section 2c.

THE

"PUL-SYN-ETIC" SYSTEM

OF

ELECTRIC TURRET CLOCKS



"WAITING-TRAIN"

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TANGENT

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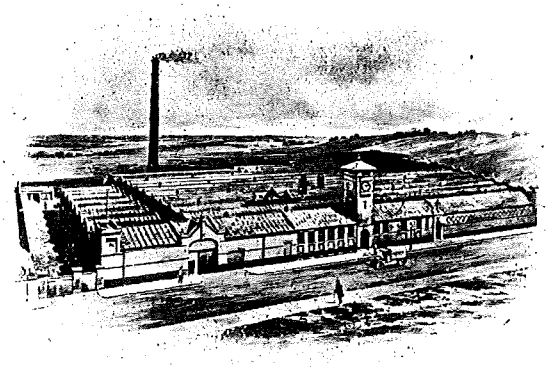
PUL-SYN-ETIC ELECTRIC.



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THE ILLUSTRATIONS show generally the appearance of the respective articles; but instruments may vary from the illustrations as improvements and alterations occur.

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PUL-SYN-ETIC ELECTRIC

Book 5.
Section 2c.

THE "PUL-SYN-ETIC" SYSTEM
OF
ELECTRIC
TURRET CLOCKS
"WAITING-TRAIN"

INDEX.

SECTIONS OF BOOK 5.

TELEGRAPHIC CODES.

CODES : WE USE THE FOLLOWING :—

OWN PRIVATE. A.B.C. (5th and 6th Editions). BENTLEY'S. MARCONI (Vol. 1).

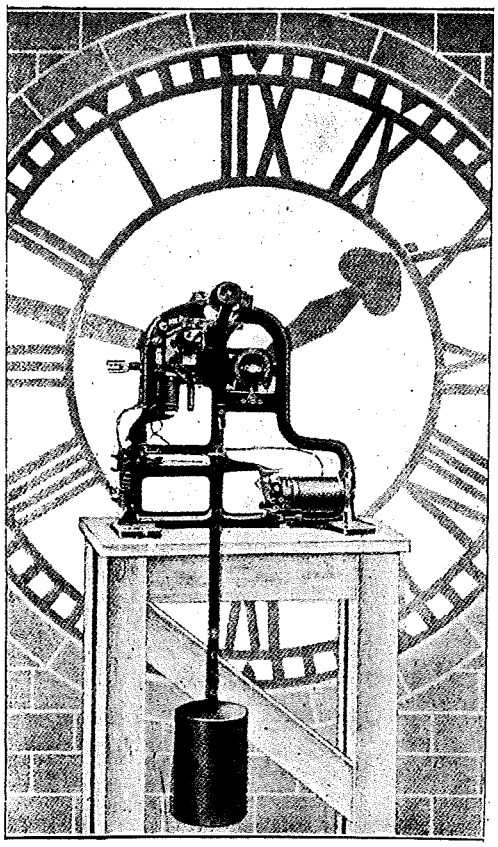
TANGENT

PUL-SYN-ETIC ELECTRIC

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

PUL-SYN-ETIC

Electric Turret Clocks



"WAITING-TRAIN" MOVEMENT. Until the arrival of the "Waiting-Train" Movement, Electric Turret Clocks (large and small) had their Dials covered with Glass to protect them from wind, storm and snow, the Glass often reflecting the sunlight, and glare preventing the Dials being read.

This has all been changed, as hands driven by the "Waiting-Train" Movement are unaffected by wind and snow, and unlike the weight-driven Mechanical Clocks, their time-keeping qualities remain absolutely unaffected by any atmospheric interference, the "moving fingers" are unaffected even by snow and sleet that would stop any Mechanically-driven Turret Clock.

It is this factor, combined with the absence of ponderous weights and the shafts for housing same, the risk of falling weights, broken cords, and the like, combined with the accuracy of the "Waiting-Train" Movement that has secured success for this form of electric drive.

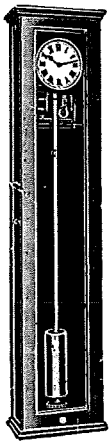


FIG. C7.
The substantial and accurate Seconds beat "Transmitter" that controls the "Waiting-Train" Movement and other dials if required.

In the following pages will be found details of "Waiting-Train" Movements with Striking Gear and Chiming Gear, and it must be remembered that not only the biggest Clocks in the British Empire, such as the Singer Clock on Clydebank, and the Liver Clock at Liverpool, but small Dials from 2 feet upwards are also operated. Some such clocks are illustrated in this Catalogue, and will perhaps be of interest to Architects, Civil Engineers, and prospective buyers generally.

EXISTING MECHANICAL TURRET CLOCKS. These can, by having their Pendulums fitted with "Duflex" Control, be compelled to keep true time with other Clocks of an Electric System (see page 11), and can be converted to Striking or Chiming Clock by the addition of the Electric Striking Gears shown herein.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

MAIN FEATURES.

GOING-TRAIN. The "Waiting-Train" Movement illustrated on page 4 shows the Going-Train connected to one Dial. Three other Dials may be driven radially from the Movement. Crown Work shown on the "Waiting-Train" Movement at pages 6 and 13 is provided for this purpose.

STRIKING GEAR. Mechanically separate, but electrically connected to the "Waiting-Train," this Striking Gear will count out the hours from 1 to 12 on a Bell of any size. Hour Bells weighing from a few lbs. to many tons are being operated by the Mechanism shown.

CHIMING GEAR in the same manner will ring out the Quarters and Half Hours on any number of Bells—two Bells for the well-known Ting Tang or four Bells if such Chimes as the Cambridge or Westminster, and Whittington or other number of Bells.

AUTOMATIC ILLUMINATION. Switching Gear can be electrically connected to the Going-Train so that the Dials are automatically illuminated, in accordance with the requirements of varying Seasons.

CURRENT SUPPLY. The Going-Train is easily operated by Leclanche Cells, but for Striking and Chiming, current from Service Mains, A.C. or D.C., is desirable, or Accumulators will, of course, give the necessary Current Supply.

THE ATTRIBUTES of Striking, Chiming and Illumination can be provided with the "Waiting-Train" Movement, or added to an existing Installation as and when required.

THE "WAITING-TRAIN" Turret Clock Movement provides practically unlimited power for driving the exposed hands of large clocks, and is under the constant control of a Time Transmitter, and hence, although the Turret Clock is exposed to varying weather conditions, it always shows accurate time as kept by a Time Transmitter which may be fixed in a position in the base of a building, or other position ideal for time keeping, and may also govern the other Clocks in the building, and so universal accurate time is provided throughout. Details of the Transmitter are shewn in "Book 5, Section 1."

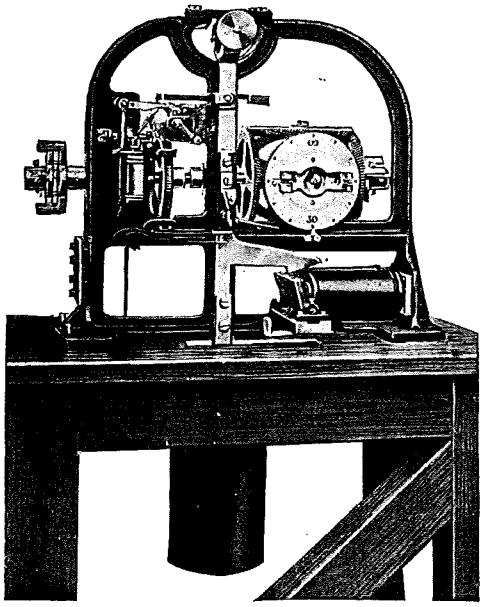
The Motor Pendulum of the "Waiting-Train" Movement can be energised by ordinary Leclanche Cells of good quality, by Accumulators, see "Book 5, Section 1," or from Service Mains, A.C. or D.C.

Where a single dial is employed, the "Waiting-Train" Movement can be fixed right behind the dial; and when two, three or four dials are used the movement is fixed on its stool in the centre of the clock chamber and all dials are driven from the one movement by connecting rods, one radiating to each dial. Where it is impossible to fix the "Waiting-Train" Movement in the **centre** of the chamber, because of some impediment, as a stair-case or tank, the Movement can be situated on one side of the Tower, or connecting rods may be led away vertically and the crown work fixed apart from the Movement.

The hands and hand gears used in our "Waiting-Train" Clocks are of a robust and durable type, and do not require glass in front, which would be impossible in the larger sizes (say, 25 feet) and, in the smaller sizes (say, 2 feet) would be undesirable, because of sun-glare and reflection, which frequently would make it impossible to read the time.

PRINCIPLE OF WORKING. The "power factor" of the "Waiting-Train" Movement is an electrically driven pendulum (termed a motor pendulum), the function of which is not to keep time, but to drive (by means of a pawl) a ratchet wheel, tooth by tooth, at each vibration, the ratchet wheel, in turn, by means of worm gearing, driving the hands of the clock. The motor pendulum is, by a simple device, re-energised by an electro-magnet when its oscillations fall below a pre-determined arc. Under normal working conditions re-energisation takes place about once per minute, but on heavy work being thrown on to the movement, due to resistance and wind pressure on the hands, the motor pendulum becomes energised more often; each complete vibration if necessary. On being energised at each complete vibration, the motor pendulum then develops 30 times its normal power, and it is impossible to stop the movement by hand, even when exerting one's full power on the worm wheel.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

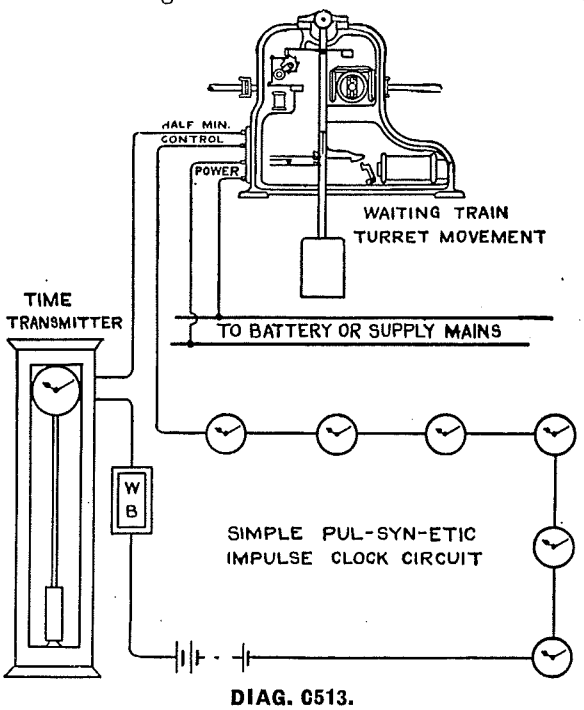


PRINCIPLE OF HALF MINUTE TIME CONTROL.—The gear ratio is such that the minute hand is driven through a half-minute space on the dial in approximately 27 seconds. The pawl of the motor pendulum is then automatically lifted out of engagement so that, although the motor pendulum maintains its action, the hands remain stationary for two or three seconds, locked by the worm gear. A current impulse from the transmitter, dead on the half minute, releases the pawl, and the hands are driven forward for another half minute on the dial. As a rest of two to three seconds is inappreciable, the hands appear to move with absolute regular progression, and do not move in half-minute jumps as is the case in impulse movements.

This control from the transmitter is effected in an exceedingly simple manner, and no separate battery or contacts are employed. For this control the half-minute impulse from the Time Circuit does all that is required.

The connections are clearly shewn in Diagram C513 below. The control is connected anywhere in the simple impulse time circuit, and it is also clearly shown how the motor pendulum is kept oscillating by a separate battery, or by any supply mains that can be depended on to give an absolutely uninterrupted current supply.

The dissociation of the driving mechanism from the time-keeping renders an accuracy on even the largest Turret Clocks of a second or so per week easily obtainable. The most striking feature of the " Waiting-Train " Movement is the entire absence of the heavy weights so necessary for the propulsion of mechanical Turret Clocks. These weights often cause considerable damage by falling, and their suspension occupies valuable space required for bells.



DIAG. C513.

The introduction of the " Waiting-Train " has rendered possible Electric Turret Clocks of the largest dimensions with academic time-keeping qualities, and all prejudice against this method of time-keeping has been effectively silenced by its adoption for the large Electric Clock constructed and erected by us at Liverpool, in 1911, for the Royal Liver Building.

Concerning the " Waiting-Train " Movement, we give below an extract from a letter received of J. J. Hall, Esq., F.R.A.S., undoubtedly the greatest living authority on Clocks and Clockmaking since the days of the late Lord Grimthorpe.

Mr. Hall says, " I like your ' Waiting-Train ' Movement, and shall recommend it wherever possible. Your system abolishes all anxiety with regard to falling weights, and I think very highly of it."

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS
GENERAL SPECIFICATION

WAITING TRAIN. The general construction is, as far as is applicable, in accordance with the latest mechanical turret clock practice, and is of equally durable construction in every respect.

The movement itself is built up on a substantial cast-iron base, with arbors or spindles of toughened steel running in gun-metal bushes, which are detachable to enable parts to be removed for cleaning, etc., without disturbing the remainder. The crown work is mounted directly on to the equivalent of the centre wheel of the movement, with the advantage that all back lash and consequent uncertainty in the pointing of the hands is avoided. The powerful worm-gear by which the movement is driven prevents all interference from wind pressure. The few wheels present in the movement are of hammered gun-metal, accurately machine cut. The contacts of the motor pendulum are of heavy gold-silver contact alloy, and are shunted by a correctly proportioned shunt to prevent sparking.

The motion-work and hands are made in accordance with the latest mechanical turret clock practice, and the hand spindles, where exposed to the weather, are constructed with gun-metal bearings in lieu of steel, which entirely prevents the rusting up of the spindles, as is often found to happen with mechanical turret clocks.

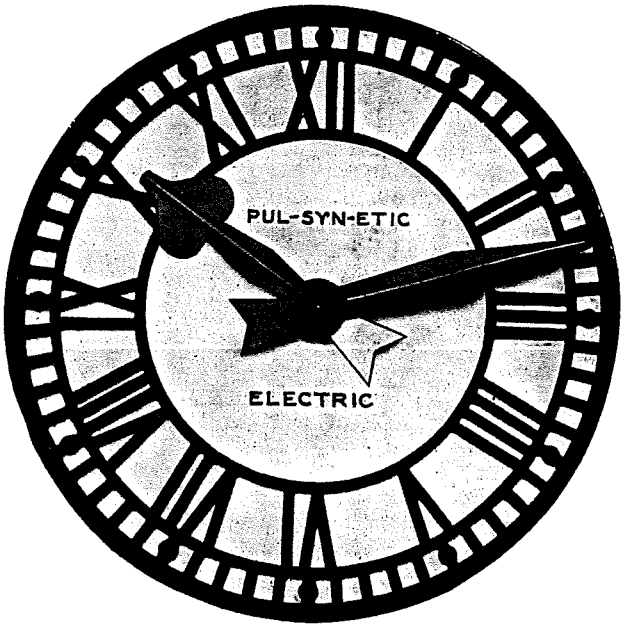
To give some idea of the solidity of the movement, we may say that the weight of the B size turret movement is 150 lbs., and the weight of the smallest wheel of the movement, together with its arbor to which it is screwed, is $1\frac{1}{2}$ lbs.

" WAITING-TRAIN " MOVEMENTS are made in 5 Standard sizes as below :—

		Code word
C40 A.	For driving four dials up to 5 feet in diameter, or two dials up to 5 feet 6 inches in diameter	**zizix**
C40 B.	For driving four dials up to 8 feet in diameter, or two dials up to 9 feet in diameter ..	**zizoz**
C40 C.	For driving four dials up to 15 feet in diameter, or two dials up to 16 feet in diameter	**zizub**
C40 D.	For four dials up to 20 feet in diameter, or two dials up to 25 feet in diameter	**zizva**
C40 E.	For four dials up to 28 feet in diameter, or two dials up to 30 feet in diameter	**zizwe**

Owing to the extreme flexibility of the driving power of these movements, these sizes are not strictly binding, as the different sizes of movements would be capable of driving larger dials than stipulated.

There is practically no limit to the size to which these movements can be made. " Waiting-Train " movements are also in use driving batches of recording instruments, advertising devices and the like, and are applicable to any slowly revolving power apparatus.



DIALS. Standard Dials are of Cast Iron Skeleton Type, fitted with Opal Panes for internal illumination, if desired. The Iron work of the Dial is protected with a suitable lead paint, the finishing coat being black, with the exception of the centre filigree work provided in large Dials, which is finished white to match the Opal.

Dials 6 feet in diameter and larger are made in four or more sections, arranged for bolting together on site.

Chapters consist of standard Roman numerals, or of 12 symbols as desired.

Smaller Dials, where the centre pane is not too large, no filigree work is necessary or provided.

Cast Iron Dials with Opal Panes are often chosen where no illumination is needed, because of their distinct appearance.

Dials of Copper, Iron or Wood can be quoted, where specially required.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

HANDS. Built up of sheet aluminium suitably ribbed and balanced, and provided with gun-metal bosses for attachment to the carrying spindles, reinforced with gun-metal shanks. Such hands are protected with suitable paint, the finishing coat being black except the counter weight of hour hand, which is painted white to match the Opal Centre.

MOTION WORK. Consists of the necessary minute spindle of steel, and hour tube of strong gun-metal or brass. The steel minute spindle, where exposed to the weather, protected with gun-metal sleeve.

The 12-1 Gear to be of gun-metal, and Bearings to be in accordance with the latest practice, so arranged that the minute spindle is relieved of the weight of the hour tube. The front bearing of gun-metal fixed in the Dial centre, and the back bearing of gun-metal mounted in suitable iron casting arranged for bolting to the internal structure.

For Dials 8 feet in diameter and above, the Motion Work is provided with roller bearings near the Dial, and ball bearings back and front are provided for Dials of unusual diameter.

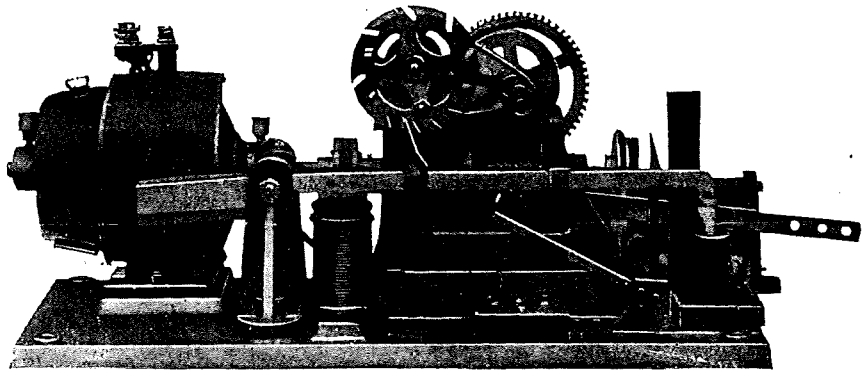


FIG. C54. MOTOR DRIVEN STRIKING GEAR.

MOTOR DRIVEN STRIKING GEAR. This is operated by an Electric Motor, and is energised by Accumulator or by A.C. or D.C. Current from the Supply Mains.

The principle is shewn in illustration of the Bell Toller on page 10.

The Mechanism is mounted on a strong cast iron base, and consists of a Cam rotated by the Motor arranged to operate a lever, which, in turn, by means of a wire connection, lifts a drop hammer, which falls by its own weight and strikes the Bell.

A buffer spring lifts the hammer slightly off the Bell, to allow the latter to give forth its full volume of sound.

A count wheel and gear is fitted to count out the hours from one to twelve, and the Striking Mechanism is released at each hour by a Contact Maker, provided with the Gear, and which is driven from the Impulse Circuit controlling the " Waiting-Train " Movement, or by the Going-Train where necessary.

The striking of Bells by drop hammer is the best method of sounding the hours on Bells, particularly of the larger sizes. Church Bells of over two tons in weight are struck by this Mechanism.

The size of Motor, Mechanism and Hammer varies with the weight of the Bell to be struck, but the following are standard sizes of Striking Gears for counting the hours on Bells of various weights, and Code Words for same :—

Standard	Weight of Striking Bell	Code Word	Standard	Weight of Striking Bell	Code Word
AS.	2 tons	**zoagh**	DS.	5 cwt.	**zoalm**
BS.	1 ton	**zoahj**	ES.	3 cwt.	**zoamn**
CS.	10 cwt.	**zoajk**			

Striking or Chiming Bells can be quoted for on receipt of particulars at current market prices.

The character of Current and Voltage available must be given, and if A.C., the Frequency and Phases must be stated.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

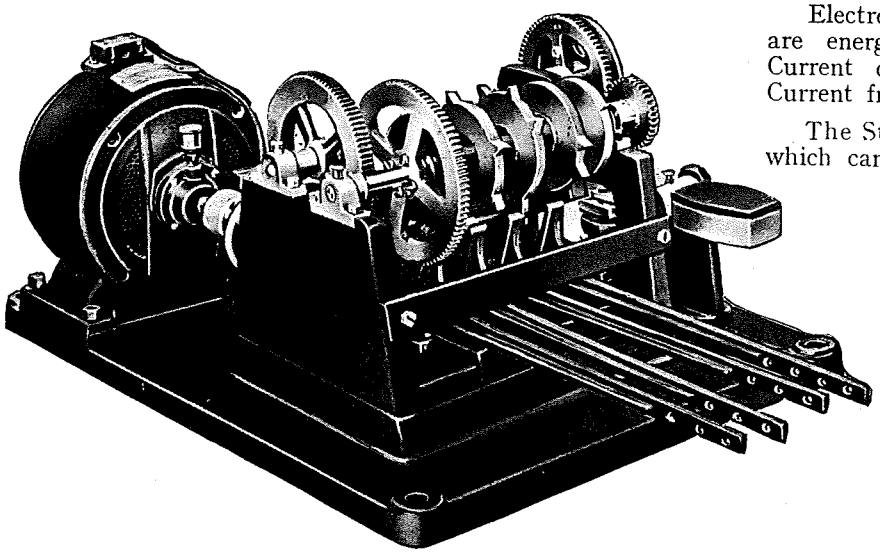


FIG. C58. MOTOR DRIVEN CHIMING GEAR, WITH 4 LEVERS.

Electro-Motor Chiming Gears are energised by Accumulator Current or by A.C. or D.C. Current from Supply Mains.

The Standard Mechanism, which can be arranged with 2 levers for Ting Tang, 4 levers for Westminster or Cambridge Chimes, or with 6 or 8 levers for other Chimes such as the Whittington, is mounted on a strong Cast Iron Base of suitable proportions, and consists of a series of cams arranged in proper sequence for the correct stanzas of the Chimes. These Cams, rotated by the Motor, operate Levers, which, in turn, by wire connections, lift the Drop Hammers, which fall by their own weight and strike the Bells with the requisite power and in correct sequence. An outline of the action is shown on page 10.

A Count Wheel and Gear is fitted to give the correct sequence at the quarter hour or half hour as may be desired, and the Chiming Gear is released at the appointed time by the Contact Maker, provided in the Striking Gear mentioned above, additional Contacts being fitted for this purpose.

The size of the Motor, the Mechanism and the Hammers varies with the weight and number of Bells of the Chime, but the following are our standards of Westminster Chiming Outfits.

Each Outfit consists of Chiming Hammers and Motor and Gear for 4 Bells.

Each Outfit is suitable for use with one of the Hour Striking Gears (scheduled on previous page), Chiming Gear, etc., exclusive of Bells.

Striking or Chiming Bells can be quoted for on receipt of particulars at current market prices.

Standard	Suitable for 4 bells of total weight of	Suitable for use with Hour Bell of	Code Word
AC.	1 ton 18 cwt.	2 tons	**zoars**
BC.	19 cwt.	1 ton	**zoast**
CC.	9 cwt. 2 qrs.	10 cwt.	**zoawy**
DC.	4 cwt. 3 qrs.	5 cwt.	**zoazb**
EC.	2 cwt. 3 qrs. 15 lbs.	3 cwt.	**zobac**

Larger and other chimes are detailed and quoted on enquiry.

The illustration shows 4 Levers suitable for Westminster or Cambridge Chimes. Ting Tang Chiming Gear requires 2 levers only, and is often supplied as such a Chime is low in price compared with 4 Bell and larger Chimes.

The character of Current and Voltage available must be given, and if A.C., the Frequency and Phases must be stated.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

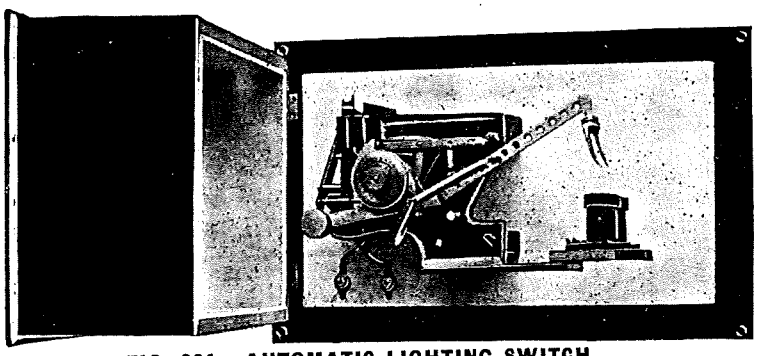


FIG. C64. AUTOMATIC LIGHTING SWITCH.

AUTOMATIC LIGHTING SWITCH. This is designed to automatically switch on Lamps behind Turret Dials at dusk, and switches off at dawn or before, if desired. The Time Cams are adjustable by hand so that changes may be made to suit the gradual changes of the Seasons, and as the Gear does not require winding, such changes may be made fortnightly, or at other periods desired. The Mechanism consists of the necessary 24-hour Cams with Time Dial for setting, Switching Gear with Mercury Contact Cups of special design, all mounted on Cast Iron Base and fitted in an asbestos lined hardwood case, with glazed front provided with lock and key. The Apparatus is driven from the Time Circuit of the Clock System. It is sometimes found desirable for the sake of economy to switch off lights for some hours during the "small hours of the morning" and switch on again before dawn. A special set of Cams can be provided for this economical purpose, if desired.

"Pul-syn-etic" Motor Driven Tolling Gear

AS SUPPLIED FOR LIGHTHOUSE, HARBOURS, CHURCHES AND SCHOOLS

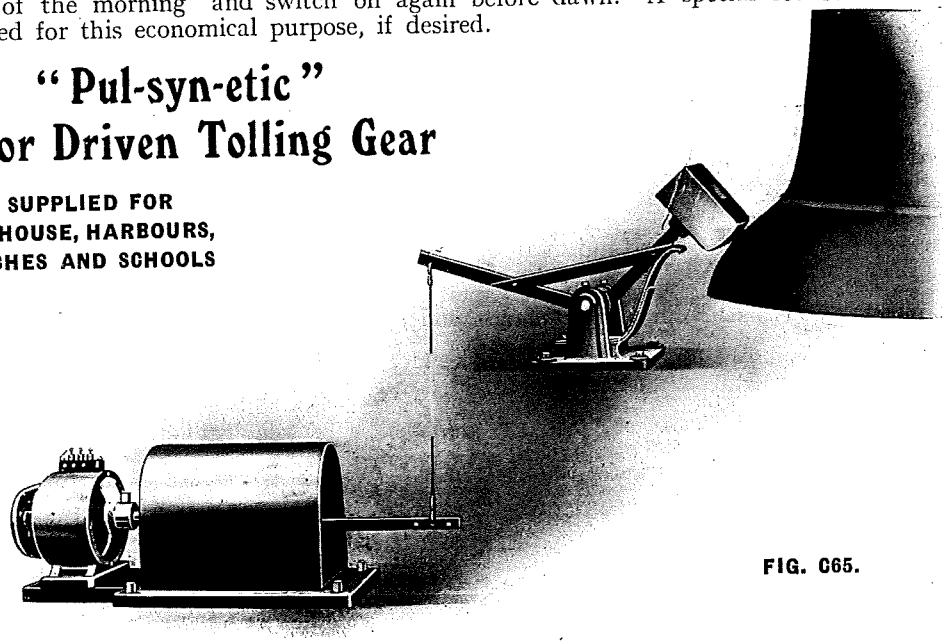


FIG. C65.

The above illustration serves to show how Bells, large or small, can be tolled by the **"PUL-SYN-ETIC"** Tolling Gear in any position where Electric Current is laid on. Automatic Contacts and Switching can be provided if desired. They have been supplied for various Marine purposes, in Harbours, Beacons and the like, when the whole mechanism except the actual hammer gear is in a cast iron water-tight case, also to Churches and Schools for tolling on occasion. The Angelus has been automatically sounded by it. The illustration is self explanatory, and incidentally shows how Striking and Chiming with Gears, as shown on pages 8 and 9, are effected.

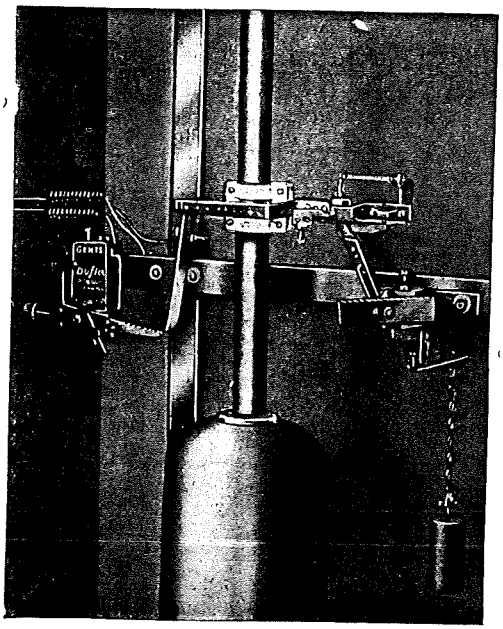
"DUFLEX" PENDULUM CONTROL

FOR PUBLIC CLOCKS IN CITIES LARGE AND SMALL.

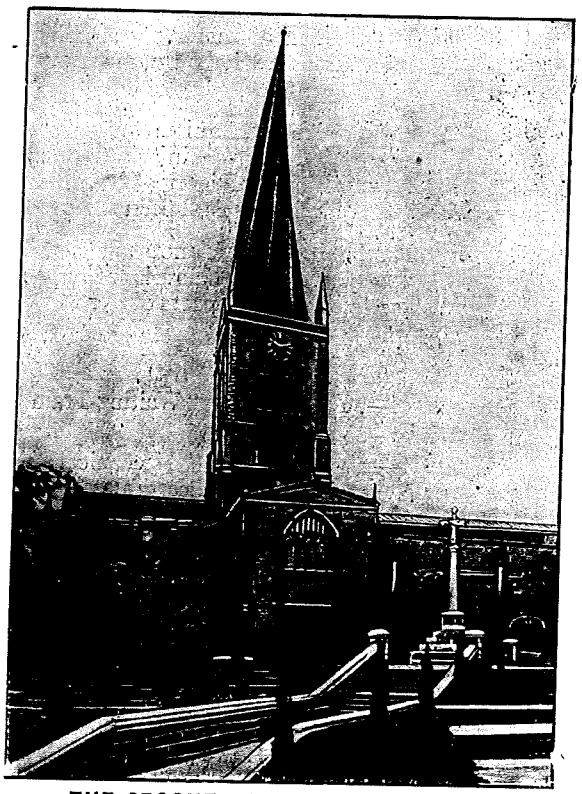
Just as our "Reflex" Pendulum Control controls the Pendulums of Workmen's and other Clocks, so the "Duflex" Control, illustrated herewith, is designed to deal with the heavy Pendulums of existing Mechanical Turret Clocks.

With the "Duflex" the Pendulum is set as it is now to keep its own accurate time, but should it depart from this either by gaining or losing, the "Duflex" comes into action, and corrects either of the faulty rates.

If the Circuit in which the "Duflex" is connected is destroyed, the Turret Clock keeps on under its own power and Pendulum as before. This particular feature enables Overhead Wires, ordinary Telephone style, to be used, and permits the system to be employed generally, whereas the inconvenience and expense of Underground Wires might make the Time Circuit prohibitive.



"Duflex" Control fitted to existing Turret Clock Pendulum.



THE CROOKED SPIRE, CHESTERFIELD.
The Clock is now fitted with "Duflex."

The Overhead Wires may be carried away by snow and frozen sleet or mechanical interference, but the Time System of a City will not radically be interfered with in such instances, and the lines can be repaired at any early convenience.

All the Public Clocks at Chesterfield, England, have been fitted with "Duflex" Control governed by a Transmitter fixed in the Corporation Offices, which sends half-minute correcting impulses. These clock towers have been connected up with ordinary Overhead Telephone Wires, so that the Inhabitants have the still rare advantage of knowing that all their Public Clocks are to universal time and that that time is correct.

Chesterfield was the first City to dispense universal accurate time, and the Illustration herewith shows the Famous Crooked Spire, which contains one of the Clocks under "Duflex" Control.

PUL-SYN-ETIC ELECTRIC

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

MAMMOTH CLOCKS OF BRITISH EMPIRE

One of, if not the most conservative industries extant, is the Clock Industry.

Large Mechanical Turret Clocks were made and fixed long before Industrial Machines were needed or even thought of, consequently, the Clock Industry has stood up against the innovations of Electricity longer than any other.

Conservatism and opposition to change is a very strong factor and it is, therefore, interesting to see how of late years the old-time industry of Clock-making has succumbed to the merits of electrically driven mechanism.

The merits of simplicity, accuracy, ease of adjustment, and the absence of ponderous weights and storing energy thereby, together with the avoidance of the labour of winding in Electric "Waiting-Train" Turret Clocks are now appreciated both by the Purchaser and the Clock-maker of to-day.

Big Ben with its 4—22½ feet Dials, built as it was in 1854, is now one of our National Monuments, and for sentimental reasons must ever remain a Mechanical Time-keeper. It is interesting to note, however, that it has recently been fitted with a Motor Winding Gear, so that sinew and muscle are not expended in lifting its huge weights for storing energy for driving this Clock and chiming the hours, and although driven still by ponderous weights, and timed by a massive Pendulum, it is to-day really indirectly energised electrically.

The Singer Clock, Clydebank, Glasgow, is the biggest electrically operated Clock in the British Empire. It is illustrated here with its 4 Faces, each 26 feet in diameter. This Clock is now operated by a "Waiting-Train" Movement and the hands are driven by the simple electrical Movement as described herein.

The Clock Chamber was originally built in 1884, and the massive Mechanism for driving these 8 enormous hands has now been replaced by one modern "Waiting-Train" Movement which ensures its absolute accuracy as a time-keeper, and avoids the storing of energy by winding heavy weights into a potential position with all its dangers, this Gear having now all been removed.

The Royal Liver Clock on Mersey Side, Liverpool, designed and built by us, is another example of a Mammoth Clock. Further details are given here of both these Clocks, and below is a schedule of some of the well-known Clocks of the British Empire and some fixed in other parts of the world.

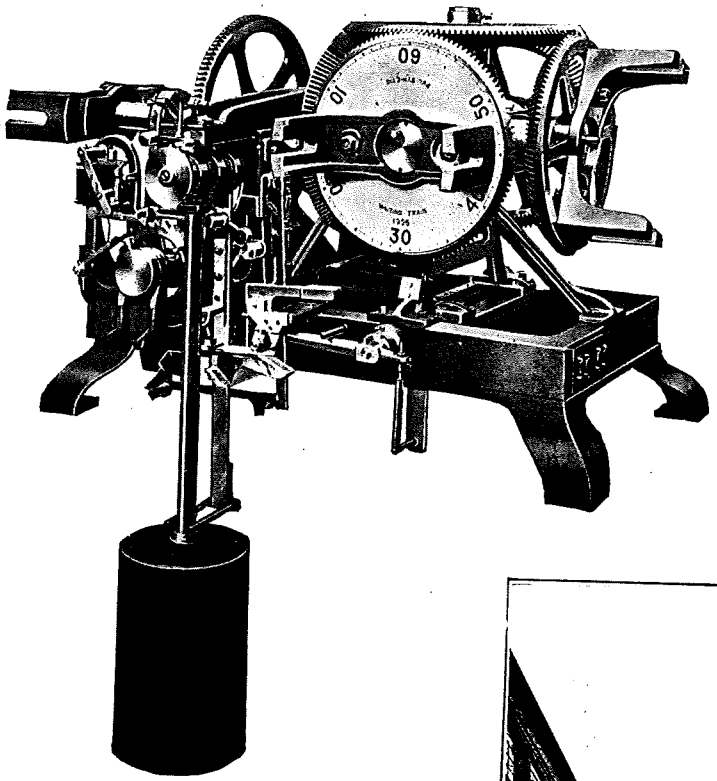
Name	Size	Movement
Singer Clock, Clydebank, Glasgow (See illustrations) ..	4—26 ft. Faces	"Waiting-Train"
Royal Liver Clock, Mersey Side, Liverpool (See illustrations) ..	4—25 ft „	„
Big Ben, Westminster	4—22½ ft. „	Mechanical Electrically Wound
St. Pancras Railway Station, London	1—18 ft. Face	"Waiting-Train"
Sydney Railway Station, N.S.W. (See illustration)	4—16 ft. Faces	„
Dunlop Cotton Mills, Rochdale	4—12 ft. „	„
Hull Docks	4—10 ft. „	„
Shanghai Post Office	1— 9 ft. Face	„
Toronto Station, Canada	4— 8½ ft. Faces	„
Terry's Chocolate Works, York	4— 8 ft. „	„

For further list of Turret Clocks see page 24.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

THE LARGEST ELECTRIC CLOCK IN THE WORLD

The Famous "Singer" Clock, Glasgow



Standard Pattern Large "Waiting-Train" Movement as used in the Singer Clock. FIG. C40E.

A Standard "Waiting-Train" Movement designed for, and now driving the four pairs of gigantic hands of the Singer Clock shown below.

The current for operating the Motor Pendulum is obtained from 21 small Accumulator Cells.

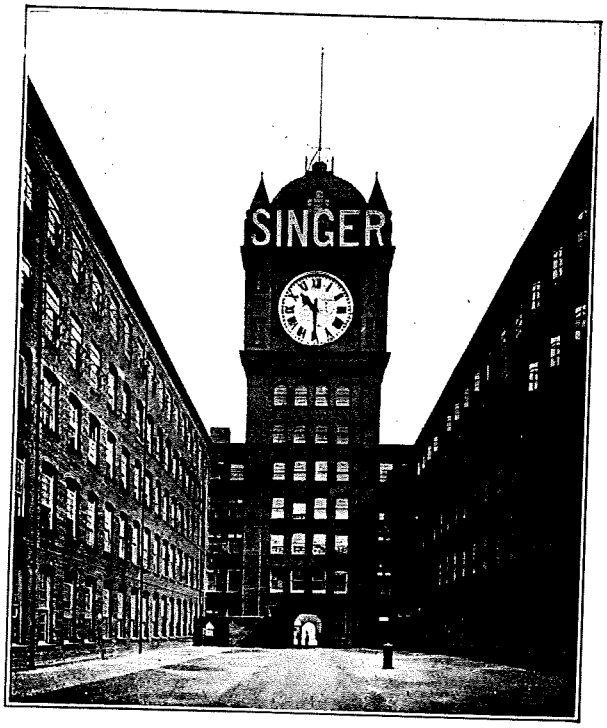
The time-keeping is dependent upon a Standard Fig. C6 Time Transmitter, which also governs or controls the small Clocks and Workmen's Recorders throughout the large and scattered Singer Works.

The Singer Clock, Clydebank, Glasgow, with its 4—26 ft. Faces showing above the surrounding Buildings.

The Singer is the largest illuminated 4-Faced Clock in the World.

Height of Tower	.. 240 ft.
Length of Hour Hands	9 ft. 6 ins.
Length of Minute Hands	15 ft. 7 ins.
Size of Chapters	.. 4 ft. 3 ins.

All operated by a Standard Type "Waiting-Train" Movement.



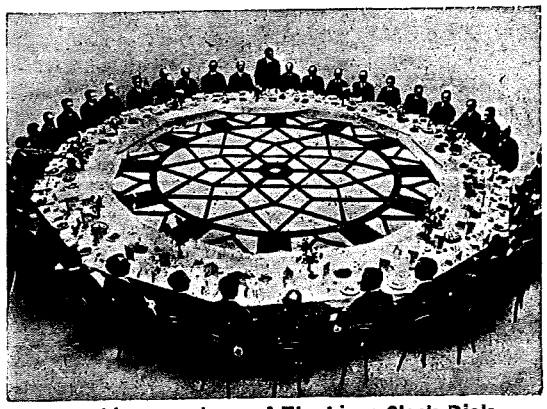
The Singer Clock Tower Operated by "Waiting-Train" Movement. For an interior view of the dials see page 20.

PUL-SYN-ETIC ELECTRIC

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

The Famous Royal Liver Clock, Liverpool.

Amongst the most notable achievements in Electric Clocks since their introduction, is the erection of the Large Electric Clock, designed, constructed and erected by us on the Tower of the Royal Liver Building, Liverpool. This Clock, which stands at an altitude of 220 feet from the ground, has four dials, each 25 feet in diameter, exceeding Big Ben, Westminster, by 18 inches. The hands of The Royal Liver Clock are 14 feet in length, and 3 feet wide in the centre, and are constructed of sheet copper with gun-metal ribs. No less than 16 tons of iron and opal glass were used in the construction of the dials, while the total weight of the clockwork is nearly three tons. The movement driving the hands is our Patent "Waiting-Train." Despite the immense proportions of this timepiece it is under perfect control, and an accuracy of approximately two seconds per week is maintained. It is controlled by the Greenwich Time Signal, received at 10 a.m. daily, and a number of small Office Clocks fixed in the many offices of the building are controlled on the same circuit. The small inset in the illustration gives a better idea of the proportions, the figures of the men indicating the scale. One hand is already fixed, while the minute hand is being hoisted into position.



Lunching round one of The Liver Clock Dials.

This historic picture shows a number of people (our guests for the occasion) lunching round one of the four 25 feet dials of the **Royal Liver Clock,** on November 18th, 1910, shortly before its being erected in the Royal Liver Building.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

The Famous Royal Liver Clock, Liverpool.

The Liver Clock, viewed from the Mersey or from the Street, owing to its being in proper proportion to the immense Liver Building, offers no very striking feature. The illustration of thirty-nine people lunching round the Dial (shown on opposite page) gives a better impression of its proportions, but the Clock Chamber has to be seen from the inside for its size to be fully appreciated. In the case of this Clock, owing chiefly to the East Dial being in a separate tower at the East Wing of the Building, four " Waiting-Train " Movements are employed, all coupled together electrically.

The illustration here shows the South and West Dials photographed while the " Waiting-Train" Movements were being erected.

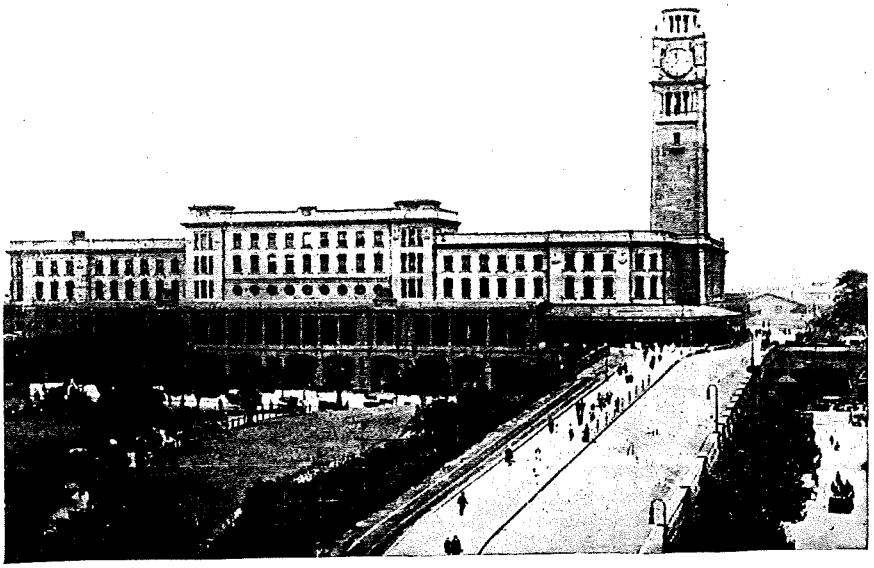
The 12-inch Office Clock shown over the left dial of the picture shows the proportions of the Clock faces.

INSIDE THE CLOCK CHAMBER, ROYAL LIVER BUILDING, LIVERPOOL.
Shewing the Two Bases for Two of the Waiting Train Movements.

PUL-SYN-ETIC ELECTRIC

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

Examples of "Waiting-Train" Turret Clocks at Home and Abroad.



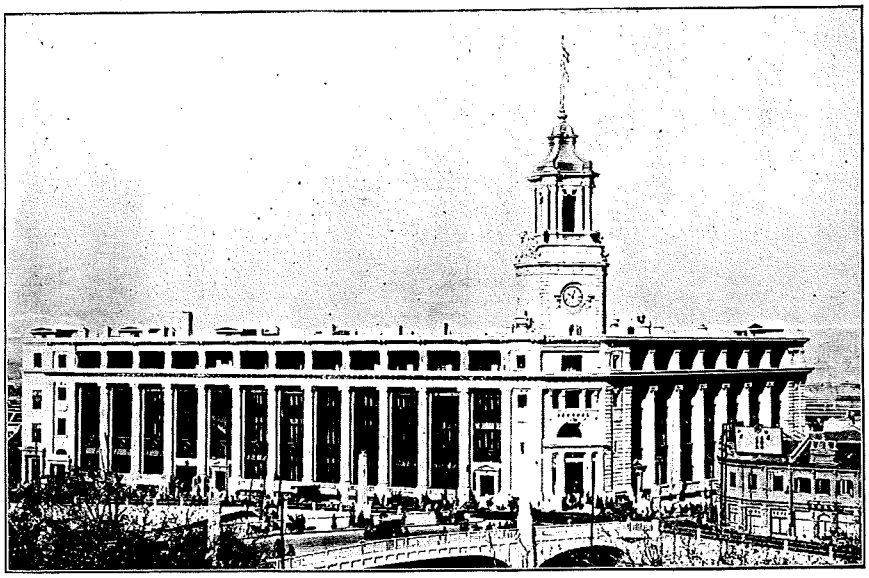
SYDNEY RAILWAY STATION, NEW SOUTH WALES.

"WAITING-TRAIN" TURRET CLOCK with 4 Illuminated Dials, each 16 ft. in diameter. This is a typical example of a large Turret Clock, manufactured and despatched from England by us, and fixed by the Railway Company's Engineers over there. The only critical measurements needed by us were :—The interior sizes of the Square Clock Chamber ; the thickness of the walls and the diameters of the openings.

SHANGHAI.
"Waiting-Train" Turret Clock.

With 1—9 ft. Dial over Main Entrance. This "Waiting-Train" Clock is driven by ordinary Leclanche Cells.

Many internal Clocks are connected on the same Circuit. The fixing, lighting and internal Wiring were all carried out by Local Engineers.



GENERAL POST OFFICE, SHANGHAI.

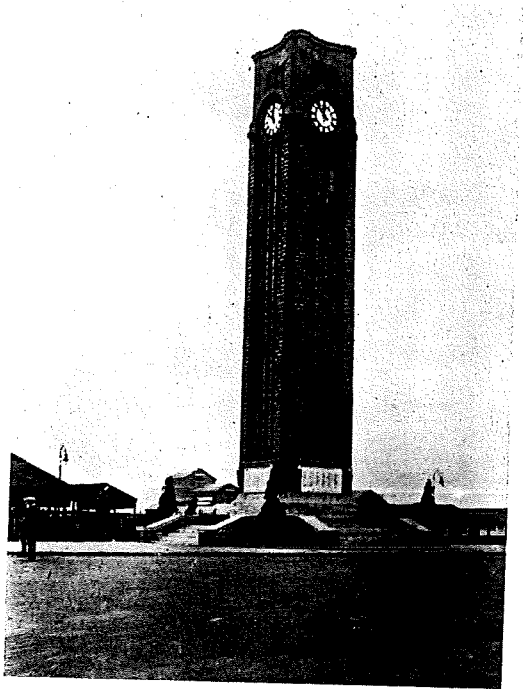
PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

Examples of "Waiting-Train" Turret Clocks at Home and Abroad.

SHANGHAI MEMORIAL.
"Waiting-Train" Turret Clock.

With Four 7 ft. Faces. This Clock strikes and Chimes on 5 Bells weighing a total of 1½ tons. The Power for the Going-Train and for striking and chiming is obtained from Alternating Current City Supply Mains. A Battery of ordinary Leclanche Cells with Sentinel Switch comes in automatically if the supply current is cut off.

Memorial Clock, Shanghai.



Memorial Clock, Warwickshire.

WARWICKSHIRE MEMORIAL.
"Waiting-Train" Turret Clock.

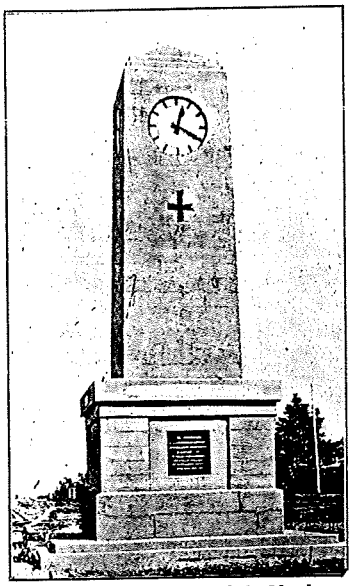
The Movement driving exposed Hands operates by means of Leclanche Cells over four 5 ft. Faces. Automatically illuminated. The Clock counts the hours on a 5 cwt. Bell hidden in the top of the Tower.

The Striking Mechanism is driven by A.C. Current 50 Periods from Supply Mains.

The Transmitter is in the base of the Tower.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

Examples of "Waiting-Train" Turret Clocks at Home and Abroad.



Illuminated Memorial Clock, New South Wales.

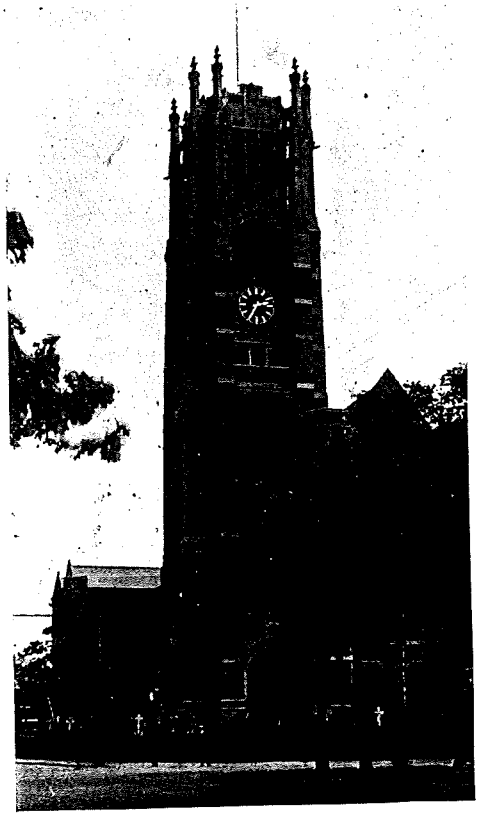
NEW SOUTH WALES MEMORIAL.

"Waiting-Train" Turret Clock on a Memorial, with four 4 ft. 6 in. Illuminated Faces operated by "Waiting-Train" Movement, shipped to New South Wales and fixed there by the Local Jeweller. Note the Dials have symbols instead of the usual Roman Chapters, which arrangement is preferred by many. The Transmitter is fixed in the base of the Tower, the whole forming the complete Installation in a simple and permanently useful Monument.

HOLY TRINITY CHURCH.
"Waiting-Train" Movement.

A typical example of a non-illuminated "Waiting-Train" Clock fixed in a modern City Church. There are four dials, each 8 ft. 6 ins. in diameter.

A motor driven Striking Gear operates by Accumulators and counts the hours on a bell weighing two tons. The striking is automatically silenced at night.



Holy Trinity Church.

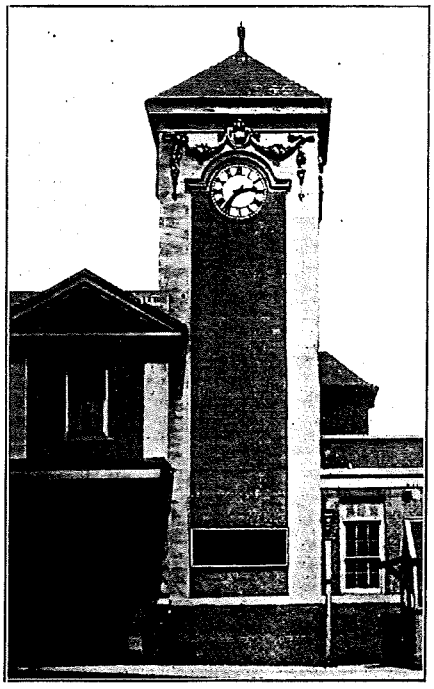
PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

Examples of "Waiting-Train" Turret Clocks at Home and Abroad.

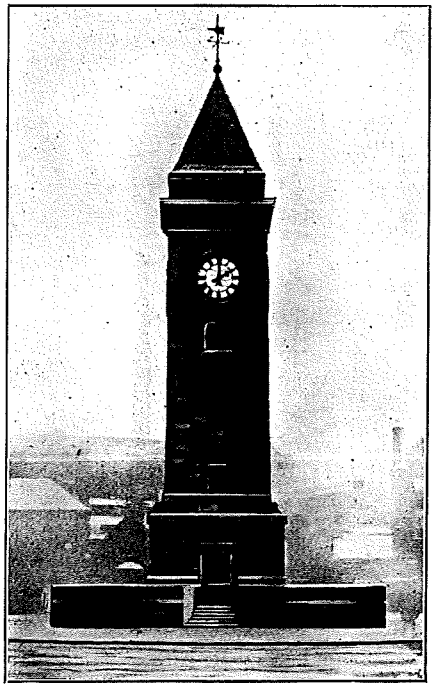
NUNEATON STATION.

"Waiting-Train" Turret Clock.

Four-Faced Turret Clock, Faces 6 ft. in diameter, fixed at Nuneaton Railway Station for the L.M.S. The Transmitter operates in the Telegraph Office in the Station proper, and controls besides the Turret Clock, several Platform Drum Clocks, Office Clocks in Booking Hall, Waiting Rooms, etc., also in Goods Offices some distance away. The Circuit extending along the line and into Goods Yard consists of nearly $2\frac{1}{2}$ miles of Wire. Thus the whole Junction, Goods and Passenger, is provided with the universal correct time.



Four-Faced Clock, Nuneaton Station.



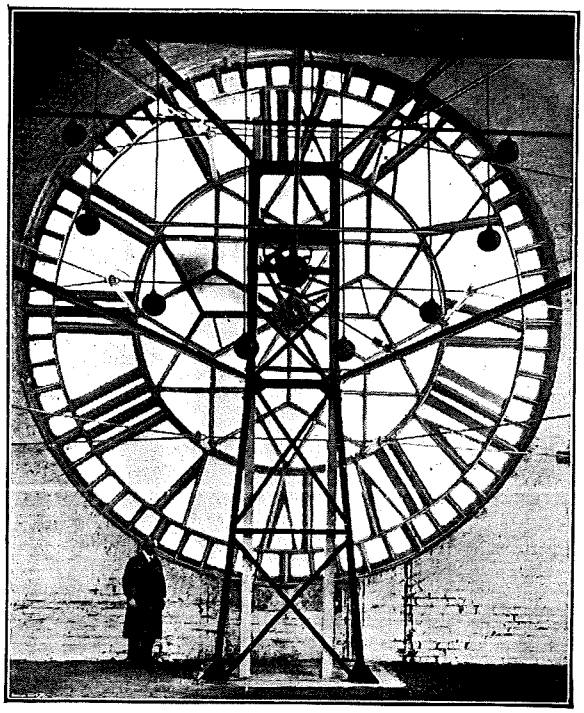
Chiming Memorial Clock.

Chiming Memorial Clock.

A Memorial Tower fitted with four 7 ft. Faces. The Tower contains "Waiting-Train" Movement, together with "PUL-SYN-ETIC" Striking and Chiming Gears, which operate on Bells having a total weight of $22\frac{1}{2}$ cwts. The hours are counted out by the Striking Gear on a Bell weighing 10 cwt., and the quarters on four properly proportioned Bells sounding the Westminster Chimes. The Dials are illuminated by 16 Lamps, switched on automatically. The current for Striking and Chiming Gear and Lighting is led into the Tower from the Town Service Mains, being 230 Volts D.C.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

Examples of "Waiting-Train" Turret Clocks at Home and Abroad.



Singer Clock, Clydebank.

SINGERS', CLYDEBANK.
"Waiting-Train" Turret Clock.

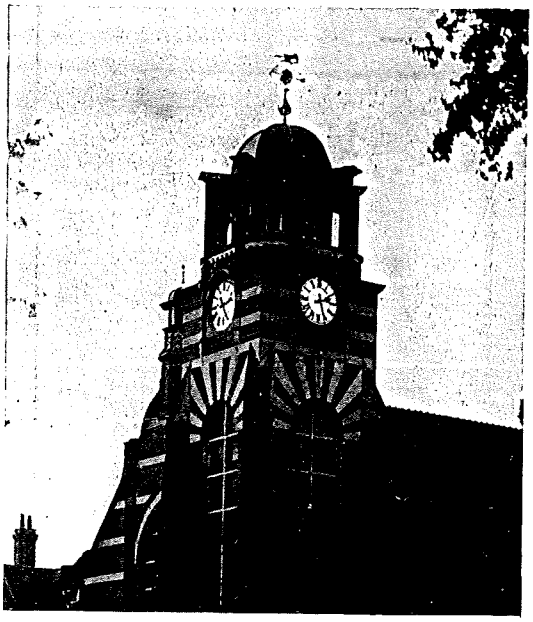
Interior view of one of four Faces. The 8 Reflectors are for illuminating the Dial.

The height of the Tower is 240 ft.

The length of the Hour Hand, 9 ft. 6 in.; of the Minute Hand, 15 ft. 6 in. The size of the Chapters is 4 ft. 3 in. long, and all is operated by a single Standard Type "Waiting-Train" Movement, see page 13.

BOURNVILLE VILLAGE.
"Waiting-Train" Turret Clock.

Public Four-Faced Clock at Cadbury's Bournville Village. Each Face 5 feet in diameter, all driven by one "Waiting-Train" Movement. Upwards of 200 smaller Clocks and Workmen's Registers are installed throughout the Model Village, and the large Chocolate Works connected therewith. Four Sub-Transmitters are employed, all connected together electrically so as to ensure one universal time. The System is energised by a Battery of small Accumulators.



Public Four-Faced Clock at Cadbury's Bournville Village.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

Examples of "Waiting-Train" Turret Clocks at Home and Abroad.

Small Turret Clock.
"Waiting-Train" on Railway Station.

Small Four-Faced Turret Clock. An example of small Clock Tower superimposed upon a Station Building. A "Waiting-Train" Movement operates the Dials. Note the Dials have no figures thereon, but symbols replace the usual chapters. The Building shown is Manor Station, Newcastle-on-Tyne.

Small Four-Faced Turret Clock.

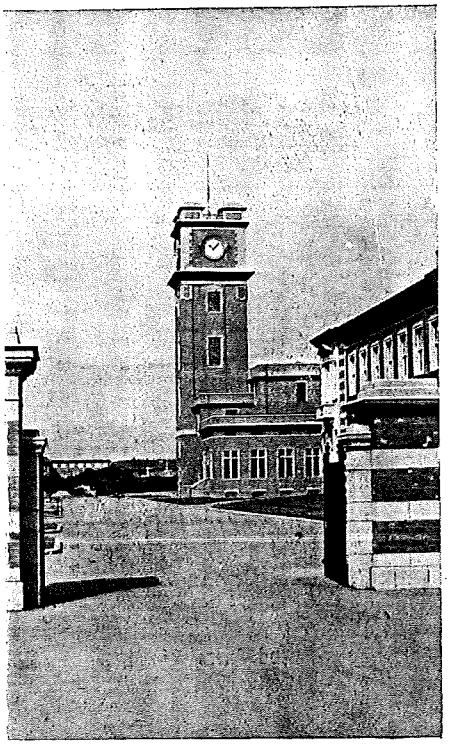
Clock with Carillon of Tubular Bells.

Clock with Carillon.

An Institution in the Midlands, England. Behind the Illuminated 3 ft. square Dial is a "Waiting-Train" Movement and a Striking and Chiming Gear, all operated from Service Mains at A.C. 200 Volts, Periodicity 50. Single-phase. There is fixed in the Tower a Carillon of 13 Tubular Bells. The Striking Gear counts the hours on a Tube, "E" Flat, while the Chimes are Westminster, operated on selected Tubes. Further, there is a Key Board in the basement of the Institution by which tunes on the Carillon are played on festive occasions. The time Circuit is operated by Leclanche Cells operating a Standard Time Transmitter. Incidentally, if the A.C. Current is cut off for testing or other purposes, the Leclanche Battery carries on the Clock Mechanism during such interference.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

Examples of "Waiting-Train" Turret Clocks at Home and Abroad.



Terry's Chocolate Works, York.

CHOCOLATE WORKS, YORK.

"Waiting-Train" Turret Clock.

Turret with four Illuminated Faces, each 8 ft. in diameter. The peculiarity about this Clock is that right behind the Faces is a large square Water Tank, which comes so close to the walls that the "Waiting-Train" Movement has had to be fixed below the Tank and the motion transmitted to the Hand Spindles by means of four Chains pendent from the Spindles, and the Illumination has to be projected on rods pendent from the top of Tank.

The appearance of the Clock outside, as seen from the picture, is normal.

LOURENCO MARQUES RAILWAY STATION.

The illustration shows a Clock with one 5 ft. Dial. Behind it is a "Waiting-Train" Movement. There is no glass in the front, and the Hands are exposed.

The Transmitter is in the Booking Office below and operates also Office Clocks and Platform Clocks throughout the Station premises.

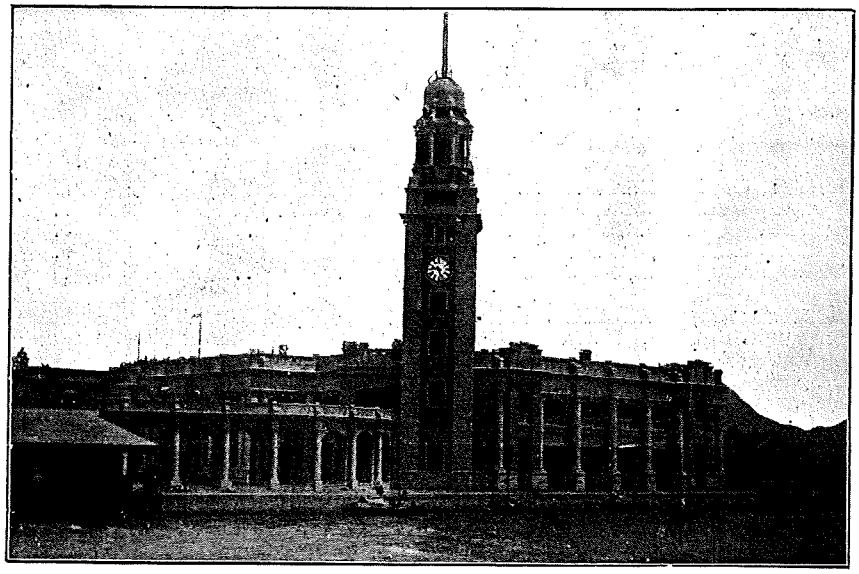
Lourenco Marques Railway Station.

PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

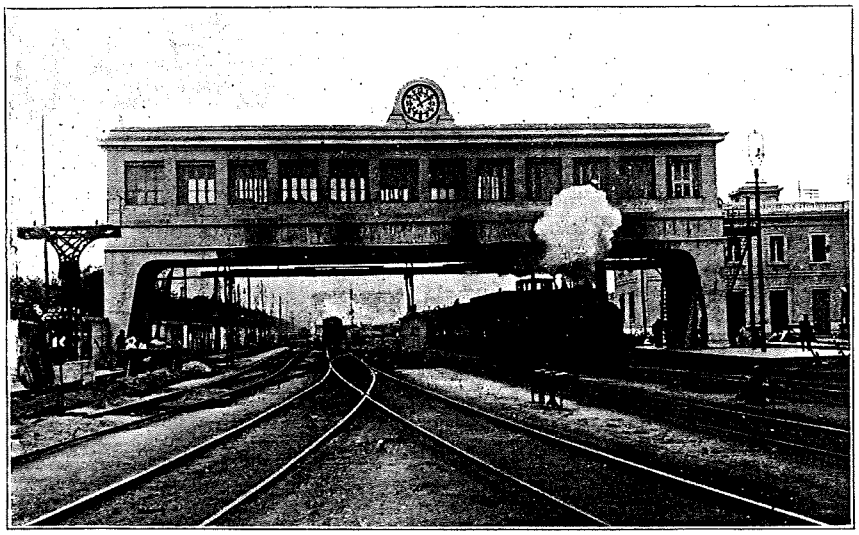
Examples of "Waiting-Train" Turret Clocks at Home and Abroad.

KOWLOON CANTON RAILWAY STATION.

Four 8 ft. Dials with exposed Hands with "Waiting-Train" Movement. The Clock counts the hours on a Bell weighing upwards of one ton. This Clock reports its time to the Observatory about two miles distant, in which place it also counts the hours on a small bell, thereby proving the Clock's accuracy.



Kowloon Canton Railway Station.

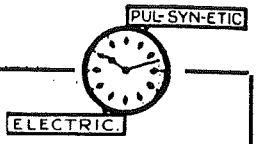


Barcelona Station, Spain.

BARCELONA STATION, SPAIN. "Waiting-Train" Clock.

The Gantry Clock illustrated here has two 72 inch Dials operated by a "Waiting-Train" Movement. The Hands of the Clocks are exposed, and the Dials themselves show in two sets of figures up to 24 hours.

The rest of the Station is fitted up with "PUL-SYN-ETIC" Impulse Clocks in all the Offices, Platforms, etc.



PUL-SYN-ETIC ELECTRIC TURRET CLOCKS

PUL-SYN-ETIC TURRET CLOCKS

With "Waiting-Train" Movements.

SOME NAMES YOU KNOW.

Send for more comprehensive list if required.

SINGER CLOCK, CLYDEBANK, GLASGOW (See Illustrations)	4—26 ft. Faces
ROYAL LIVER CLOCK, MERSEY SIDE, LIVERPOOL (See Illustrations)	4—25 ft. „
DUNLOP COTTON MILLS, ROCHDALE	4—12 ft. „
H.M. DOCKYARD, ROSYTH (See Illustration)	4—12 ft. „
THE DOCKS, HULL, L.N.E.R.	4—10 ft. „

POST OFFICE, SHANGHAI (See Illustration).
MEMORIAL TOWER, SHANGHAI (See Illustration).
CADBURY BROS., BOURNVILLE
TERRY'S CHOCOLATE WORKS, YORK „
SUNBEAM MOTORS, WOLVERHAMPTON.
WOLSEY, LTD., MILLS, KEIGHLEY.
ROUSE BROS., MILLS, OAKWORTH.
SOLDIERS' MEMORIAL, YOUNG, N.S.W.
ST. GEORGE'S CHURCH, LEICESTER.
ARMSTRONG, WHITWORTH, NEWCASTLE.
U.D.C. OFFICES, SPENNYMOOR.
THE TOWN HALL, TORQUAY.
ST. GEORGE'S MILLS, LEICESTER.
ST. MARY'S CHURCH, NORTHAMPTON.
GULVAL CHURCH, PENZANCE.
HOLY TRINITY CHURCH, SOUTHPORT (See Illus).
THE TOWN HALL, STIRLING.
GLASGOW CORPORATION TRAMWAYS OFFICES.
GLASGOW CORP. ELECTRICITY DEPT.
D. COLVILLE & SONS, MOTHERWELL.
HORLICKS MALTED MILK FACTORY, SLOUGH.
GIMSON & CO. LTD., ENGINEERS, LEICESTER.
KYNOCH LTD., BIRMINGHAM.
THE CITY FIRE STATION, LEICESTER.
DERRY'S CLOCK, PLYMOUTH.
MEMORIAL TOWER, COALVILLE.
POOR LAW INSTITUTION, ROCHDALE.
TOWN HALL, ST. HELENS.
BLACK'S BREAD CO., THE BAKERY, LEICESTER.
MEMORIAL TOWER, LEEK.
MITCHELLS & BUTLERS, BIRMINGHAM.
INSTITUTION FOR THE BLIND, LEICESTER.
HADDON HALL, near BAKEWELL, DERBYSHIRE.
MEMORIAL TOWER, REDDISH.
MEMORIAL TOWER, SYSTON, LEICESTERSHIRE.
WILLOWBROOK MOTORS, LOUGHBOROUGH.
ST. GILES' CHURCH, CAMBRIDGE.
CO-OPERATIVE SOCIETY, GLASGOW.
MEMORIAL CLOCK, COROWA, N.S.W.
UNIVERSITY COLLEGE PAVILION, LEICESTER.
PAVILION, SHEFFIELD.
G. ROSSITER, TEIGNMOUTH.
FORT DUNLOP, BIRMINGHAM.
SMITH, W. H. & SONS, GLOUCESTER.
PUBLIC CLOCK, LEAMINGTON.
TOWN HALL, BALLYMENA.
LLOYDS BANK, TEIGNMOUTH.
CASSENBURY PARK, WATFORD.
GREYS INSTITUTE HIGH SCHOOL, S.A.
ORATORY SCHOOL, READING.
SELWYN COLLEGE, CAMBRIDGE.
BIRKENHEAD CORPORATION FIRE STATION.
BIRKENHEAD CORPORATION FERRIES.
"BLUE BIRD" TOFFEE, HUNNINGTON.
CANTERBURY BARRACKS, CANTERBURY.
T. MORLEY & SONS, LEICESTER.
MILITARY ENGINEERING, CHATHAM.
WILDT & CO., LEICESTER.
ST. AUGUSTINE'S CHURCH, NORWICH.

RAILWAY STATIONS.

SYDNEY RAILWAY STATION, NEW SOUTH WALES (See Illustrations)	4—16 ft. Faces
ST. PANCRAS RAILWAY STATION, LONDON..	1—18 ft. Face; also 4— 6 ft. „

TORONTO STATION, CANADA.
MURZENBURG STATION, SOUTH AFRICA.
RAILWAY STATION, HONG KONG.
NUNEATON RAILWAY STATION, L.M.S. (See Illus).
YORK RAILWAY STATION, L.N.E.R.
BARCELONA RLY. STATION, SPAIN (See Illus).
AMIENS RAILWAY STATION, DUBLIN.
CREWE RAILWAY STATION, L.M.S.
WHITLEY BAY STATION, L.N.E.R.
RAILWAY STATION, NEWTON ABBOT, G.W.R.
BRIDLINGTON RAILWAY STATION, L.N.E.R.
MANORS RAILWAY STATION, NEWCASTLE, L.N.E.R. (See Illustration).
DELHI RAILWAY STATION.
ABERDEEN JOINT RAILWAY STATION.
PADDINGTON, G.W.R., LONDON.
PEKING MUKDEN RAILWAY, CHINA.
LOURENCO MARQUES STATION, SOUTH AFRICA (See Illustration).