The Pneumatic Grain Elevator, "Thomas Wiles."

THE pneumatic grain elevator "Thomas Wiles," a drawing of which forms the subject of our Supplement of to-day, was designed and constructed by Henry Simon, Ltd., of Manchester, to the requirements of Mr. A. Binns, M. Inst. C.E., M.I. Mech. E., the Engineer to the Port of London Authority. The elevator has been specially built to meet the demand of the grain trade in the Authority's docks, and an outstanding feature of the design is the wide range of steamers which it will serve, embracing the smaller tramp steamer to the large liners of the Atlantic Transport Company's "Minnewaska" and "Minnetonka" type, which have a beam of 70ft., and are the largest ships using the Port of London. Grain can be discharged by the new elevator at an average delivery rate of 110 tons per hour, with 150 tons as the maximum delivery for discharge with or without weighing.

As will be seen from Figs. 5 and 6 given on page 106 and the Supplement, the elevator is so constructed that it can be worked end-on or with either side to the ship, the pipe booms and delivery shoots being specially designed for such working positions. When required, these booms can also be mechanically slewed into working position, or when not required they can equally well be brought inboard for stowage or for examination and repairs. Any alteration in trim which may be caused by the movement of the booms is compensated by special ballasting arrangements. As our drawings show, the elevating, discharging, and weighing plants are neatly housed on a steel pontoon, which was built to Lloyd's Survey. In order to give a wide range of stability to the structure, the grain receiver is placed low down on the deck of the pontoon. The principal parts of the elevator include the boiler plant, and steam engine driven exhausting pumps which are arranged in the hull of the pontoon. The air is exhausted from the grain receiver through cyclones, and any dust which is mixed with the air is thus removed. Provision is made for mixing the dust back into grain to avoid loss of weight. The grain drawn from the ship's hold is taken from the receiver by means of one of the firm's patented tipper valve devices, and it is then elevated and may be discharged unweighed through the usual shoots, or passed through two 1-ton Simon "Reform" automatic weighing machines, which are arranged in adjustable swinging frames. It is then shot to either or both sides of the elevator to barges in weighed bulk.

THE PONTOON.

The pontoon was built to Lloyd's Special Survey, and its principal dimensions are as follows:—Overall length, 82ft.; overall breadth, 35ft. 6in.; breadth at bottom, 32ft. 6in.; moulded depth, 12ft. 6in. The vessel has raked sides and square ends, the bow and stern being raked similarly to the loaded water line.

The pontoon is divided into five compartments. Forward there is a store-room, which is separated by a water-tight bulkhead from the compartments in which are placed the engines and exhausting pumps, the elevating machinery, and the boiler respectively. At the after part of the pontoon, there are quarters for the crew, and amidships there are an engineer's cabin and a dynamo-room. The corners of the pontoon at either end are arranged with water-tight compartments for water ballast.

The shell plating is $\frac{3}{8}$in. thickness and the deck plating $\frac{5}{16}$in. All the side frames are made from standard 6in. by 3in. angles, and they are spaced 21in. apart. For supporting the floor there are 12in. channels which are riveted to the frames. The two side keelsons and the centre keelson are carried the entire length of the vessel, and are specially strengthened for the engine seatings so as to minimise vibration. The deck plating is carried on $5\frac{1}{4}$in. by 3in. beams riveted to the frames with brackets. In order to protect the pontoon from possible damage by other craft, a rail of heavy section is carried round the deck, and the chine angle is arranged outside the shell and is taken all round the hull. Special budgets are provided for towing purposes, and the ends of the pontoon are swim-shaped to permit better towing. Both the boiler and engine castings are provided with removable covers, giving facilities for examination and inspection.

Auxiliary appliances include the usual provision for mooring and towing ropes, and heaving lines, as well as cleaning-down gear. The arrangements of bollards, fairleads, and ring plates may be noted from our drawing. The service tanks include fresh water tanks for boiler feed, arranged fore and aft amidships, in which about 14 tons of water are carried. Aft of the engineer's room and the dynamo-room are the two main coal bunkers, which have a total capacity of 100 tons.

There is a very complete ballast pipe system with seven suction points, while the ballast piping is run fore and aft to each quarter, so that the water delivered by the ballast pump may be used to give an even trim to the hull, this being shown by two indicators. The stability of the plant and the correct trim is further ensured by permanent ballast.

ENGINE AND BOILER PLANT.

The single two-furnace marine return-tube boiler is placed aft, and is secured to special stools attached to the keelsons. It was supplied by A. and F. Craig, Ltd., of Paisley, and is designed for a working pressure of 160 lb. per square inch. The furnace tubes are of the withdrawable corrugated type, and they are fitted into combustion chambers which have special sloping tops. The boiler works on natural draught, and balanced type fire-doors are fitted. The total heating surface is 1350 square feet, with a grate area of about 42ft., and provision is made for feeding the boiler either from the donkey pump, by an injector, or by a feed pump worked from the main engine. Two funnels, one for smoke and the other for exhaust air, are provided.

The main engine for driving the exhauster pumps was supplied by W. Sisson and Co., Ltd., of Gloucester, and has a designed output of 220 B.H.P. It is of the double-compound vertical condensing type and the H.P. and L.P. cylinders are 12in. and 27in. diameter respectively with a 20in. stroke, and the working speeds may be varied from 120 to 135 r.p.m., corresponding to a wide range of grain handling. A special speed adjustment gear is provided. The condenser is of the surface type with the air and feed pumps as well as the bilge pumps driven directly from the L.P. crosshead. The circulating pump is of the centrifugal type and forms a separate engine-driven unit.

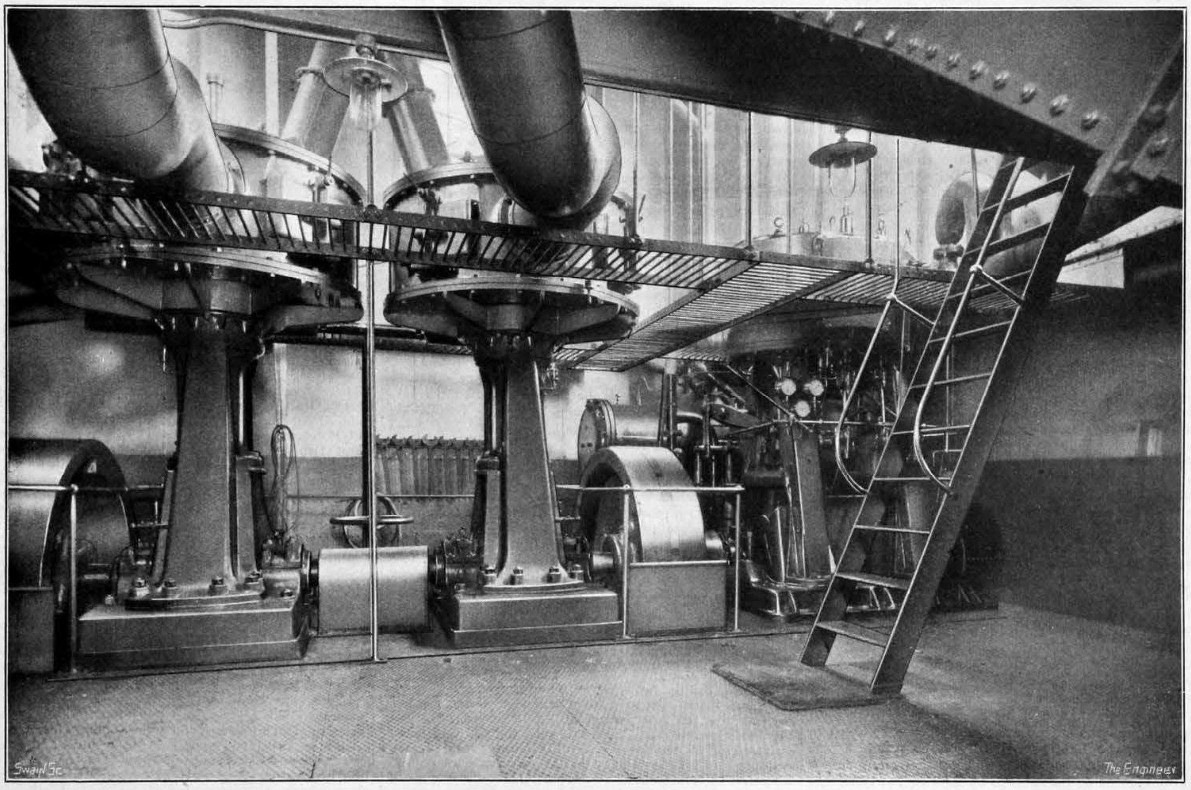

FIG. 1—VIEW IN ENGINE-ROOM SHOWING EXHAUSTER PUMPS

Messrs. Sissons also supplied the electric lighting set which comprises one of that firm's high-speed double-acting steam engines, coupled to a 220-volt generator. This set supplies lighting current and power for the elevator, tipper, and dust seal motors, and for the pipe boom winches and slewing gear. These machines are all driven by totally enclosed motors with starters.

EXHAUSTER PUMPS AND CYCLONES.

The twin engine-driven pumps which produce the vacuum for lifting the grain and depositing it into the grain receiver are of the "Simon" special type, with a cylinder diameter of $45\frac{1}{2}$in. and a stroke of 16in., and are direct coupled to the engine. They are shown in Fig. 1. The cylinders, it will be noticed, are supported on cast iron "A"-shaped frames secured to a heavy bed-plate, and when we had an opportunity of inspecting the elevator we noted the very quiet running of the pumps, which are provided with heavy balanced fly-wheels. A feature of the valve design is the arrangement of the valves at the outsides of the cylinders, which gives easy access for examination and cleaning, a special platform to the cylinders being provided. The pistons are furnished with special rings and are dry lubricated. Between the pumps and the receiver there are two cyclones for removing the dust, and there is a release valve which can be operated from the engine-room, the function of which is to break the vacuum in case of emergency. The inter-connecting piping between the pumps, cyclones and grain receiver is of welded steel. At each cyclone there is a motor-driven dust seal, which removes the dust without breaking the vacuum.

GRAIN RECEIVER AND TIPPER MECHANISM.

The grain receiver consists of a large circular steel tank, which is built in sections and is attached to the superstructure of the pontoon by a steel ring with cast iron supporting feet. It has a manhole door which gives access to all interior parts, so that the dust removing cyclones and the interior pipes and fittings may be inspected. The inlet to the receiver

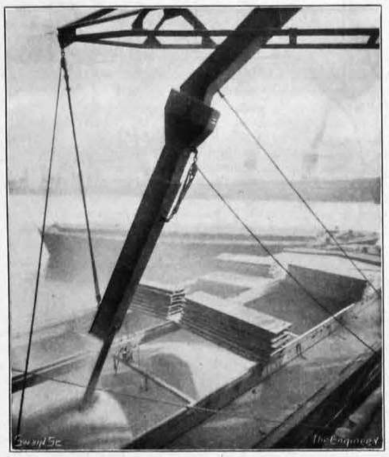

FIG. 2—DISCHARGING GRAIN INTO BARGE

takes the form of a cast iron entry piece with connections to each of the two pipe booms. Below the receiver is the tipper sealing valve, which is of the firm's patented type, the object of which is to render it impossible for a piece of wood, rope, or iron, which may be lifted along with the grain, to damage the sealing mechanism or obstruct the working of the plant. As the drawing reproduced at the right-hand bottom corner of our Supplement shows, the top part of the tipper valve consists of a machined cast iron saddle with air pockets and pre-vacuum pipes attached to which there are two cast iron side brackets fitted with sliding bearing blocks having adjusting screws. The oscillating part of the tipper valve, which is shown clearly in our drawing, is carried on a shaft passing through the bearings in the side brackets. It consists of a central casting with a machined radial top, to which is attached the light steel pockets with their steel doors. Each door has rubber faces, and is suspended at its centre on a steel dog, provision being made for the adjustment of the stroke and swing, so that the opening of the door can be regulated for different speeds of discharge. As the two pockets are filled and emptied alternately, no loss in vacuum takes place. The oscillating motion for the tipper valve is obtained by two side rods with adjustable double springs, which are joined to a single connecting-rod taking its motion from a crank disc, having an adjustable crank pin. The disc is driven through a totally enclosed worm gear by a 5 H.P. motor, and the gear shaft is extended to work the two dust seals by means of bevel gears and silent chain drives. Underneath the tipper valve there is a steel plate hopper in which both the grain and dust is collected and delivered to the boot of the bucket elevator.

BUCKET ELEVATOR AND DISCHARGE GEAR.

The bucket elevator is enclosed in a weather-tight casing, supported on the floor of the pontoon, and is carried high enough to deliver the grain either to the weighing room or directly over-side. A feature of the gear is the provision of large inspection doors and the use of dust-tight roller bearings, which are fitted to all the shafts. The main sprockets of the elevator are carried on the head shaft, and steel link chain, to which the buckets are attached by means of special links, is used. There is an automatic tensioning gear with hand adjustment, and the guide rollers at the bottom are of such a type that should any foreign matter be picked up under the chain, the tension is automatically altered to take the obstruction without interfering with the working of the elevator. The head of the elevator is large enough to give a clean delivery, while a further useful feature is the large access platform with a davit tackle and a winch for carrying out repairs. The drive for the elevator is obtained from a back-geared weather-proof electric motor, which is mounted on the top platform.

The elevator shoots are specially designed to give an even feed to the two automatic weighing machines, while valves are also fitted to divert the grain when it is delivered over-side without weighing. The grain shoots from the head of the elevator are of the self-supporting type, with swivelling sections which enable barges to be loaded without having to swing them once they are under the side of the grain elevator. Grain can be delivered equally well on either side of the elevator. Special care has been taken to ensure that the delivery hoppers should be of ample capacity for feeding the weighing machines, and control mechanism is also provided. The discharge from the weighing machines passes into a large hopper, which delivers to the side shoots. All the grain shoots referred to have renewable liners. A view of one of these shoots discharging into a barge is reproduced in Fig. 2.

GRAIN PIPES AND NOZZLES.

The general lay-out of the grain pipes and nozzles is shown in our Supplement drawing, on which we also reproduce some details of a 6in. cleaning-up nozzle. The grain pipes are connected to the receiver at a common point, and are diverted to two side positions at the front of the elevator superstructure, at which points they connect to two large cast iron swivelling joints. These joints can be slewed mechanically by means of a cast steel spur wheel ring fitted at the base, which meshes with a steel pinion, an inspection door giving access to the joints, being fitted. The movement given to the joints enables the pipe booms to be slewed to either side or end-on to the ship, or moved aft for stowage. All operating tackles for the pipe booms are brought together at the swivel joints for ease of control. The booms themselves are made from weldless steel tube, and have rectangular bends with renewable wearing plates. Each boom is 45ft. in length, which is sufficient to enable the very large steamers referred to earlier to be dealt with.

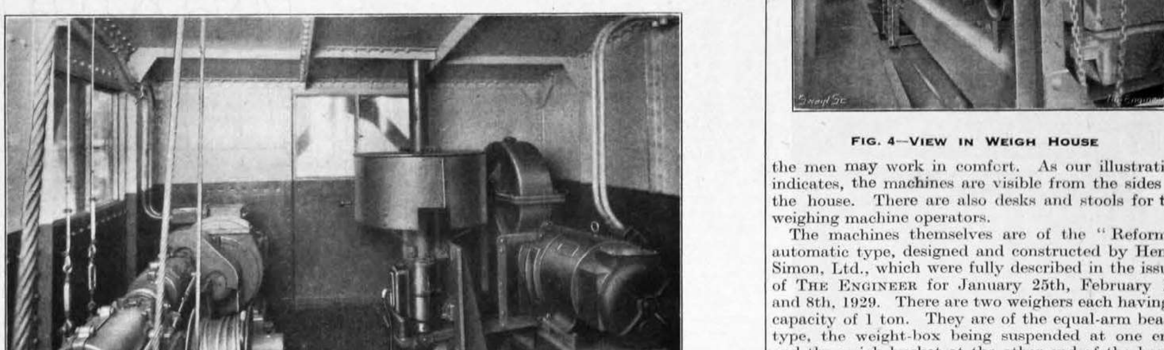

FIG. 3—PIPE BOOM LIFTING WINCHES AND SLEWING GEAR

In order to avoid kinking in the flexible pipes, there are special joints below the rectangular bends, from which are suspended two lengths of the firm's patented telescopic piping, which can be mechanically lengthened or shortened by the tackle ropes. Below this point there are, as shown, two flexible pipe lines on each boom. The telescopic pipes give an 18ft. working range, in addition to the 20ft. topping lift on the booms, so that, for ordinary sized ships, it is seldom necessary to add any extra portable lengths of piping. The steel-lined flexible pipes terminate in bulk-handling or cleaning-up nozzles. The booms and telescopic pipes are lifted by wire rope tackles supported on outriggers and are finally led through guide pulleys to a multiple drum winch, which is operated by a 10 H.P. motor. Each winch has a self-sustaining friction clutch, so that when the clutch is out, the brake is always on. Each pipe slewing gear comprises a 5 H.P. motor with a worm reduction gear, and a vertical bevel drive mounted on a combination bed-plate. In Fig. 3 we reproduce a view of the cabin in which are arranged the lifting and slewing winches for the pipe booms. In addition to the gear we have described, there are also two derricks with operating tackle for lifting on board any spare piping or for dismantling the pipe booms for overhauling purposes.

WEIGH HOUSE AND WEIGHING EQUIPMENT.

The automatic weighing plant is accommodated in a steel-braced weigh house, having steel-framed windows and wooden doors, with the necessary access platforms and ladders. An interior view of this house is given in Fig. 4. The same structure is extended in a forward direction, and carries the cyclone, the operator's cabin, the winch machinery cabin, and the pipe booms, the latter being supported from a crane post superimposed on the main structure. The weigh room itself is lined with wood, and the machines are partitioned off with wood and glass screens, so that

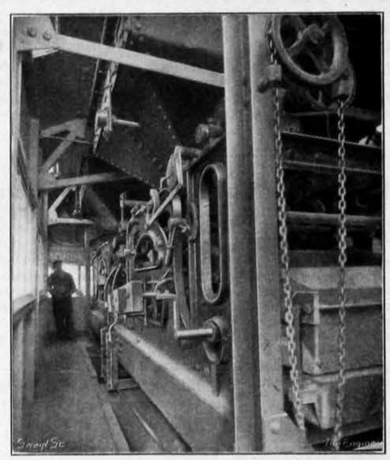

FIG. 4—VIEW IN WEIGH HOUSE

the men may work in comfort. As our illustration indicates, the machines are visible from the sides of the house. There are also desks and stools for the weighing machine operators.

The machines themselves are of the "Reform" automatic type, designed and constructed by Henry Simon, Ltd., which were fully described in the issues of THE ENGINEER for January 25th, February 1st and 8th, 1929. There are two weighers each having a capacity of 1 ton. They are of the equal-arm beam-type, the weight-box being suspended at one end, and the weigh bucket at the other end of the beam. The weighing, delivering, and recording mechanisms are entirely automatic, and the speed of the machine conforms to the rate at which grain is discharged. Both machines are mounted together in a swinging frame, so that they may maintain a horizontal position, irrespective of the transverse trim of the vessel. Some new features have been embodied to meet the special requirements of the plant and to facilitate the task of the weighman. An important departure is the provision of means for testing the unloaded balance of the beam. It is customary to check the unloaded balance of the machine before discharging cargo, which normally entails the removal by hand of a large number of weights. In the installation we are describing, the whole of the deadweight is lifted and supported upon a carrier, so as to allow the beam to float freely with the empty bucket at one end and the tare box at the other. When carrying out the test, it is only necessary to operate a chain-wheel which, by means of worm gearing, raises the weight-box and, through cam controls, performs the proper sequence of movements involved in the operation. Similar means are employed when at the end of a cargo it is desired to weigh a quantity of grain less than a full charge for the machine. There is a change-over handle with two positions, one for testing and the other for residue weighing. The steelyard has a ticket-printing device with a ticket-printing counter actuated from the weigher mechanism.

Records are obtainable of the number of full weighings made, and the amount of residue at completion of working, while there is a check counter which registers the number of times the bucket discharge door has been opened.

Compensation for the grain in transit at the cut-off of the feed gate is effected by the " Reform " patented compensating device, which permits of the amount in transit being ascertained and compensated for, positively upon the first weighment. A feed gate-closing handle, which is conveniently arranged on the side frame, enables the machine to be stopped instantly during any part of the weighing operation. This fitting, used in conjunction with the residue weighing steelyard, enables pre-determined parcels of grain to be weighed off with extreme accuracy. A supplementary locking catch is also fitted, so that the machine can be stopped at the end of any weighment. Both these stopping devices are designed to operate without having recourse to external slides or action upon the weighing mechanism. In order to obviate the spread of dust caused by the passage of air through the stream of grain, and to ensure consistency of feed to the machines, the machines are furnished with the " Reform " patented feed control, which is designed to meet the conditions by the use of a swinging frame below a mixed feeding hopper. The arrangement is such that at least a full weighment is guaranteed in the top hopper before the feed gate is released. In order to allow any quantity less than a full weighment to pass, as may occur at the end of a cargo, the feed gate can be released by hand. Before leaving the works, the weighing machines were subjected to prolonged tests for accuracy and reliability, and were approved by the Board of Trade, being tested and stamped by the Inspector of Weights and Measures.

The grain elevator we have described is fitted throughout with telephones and also with warning bells and red lamp signals. In the event of a hopper filling up a bell rings and red lights are shown in all working parts of the elevator, so that the machinery may be stopped if necessary. There is also a steam whistle for warning the men working in the ship's hold and in the barges. All the machinery we have referred to is guarded in a manner which conforms fully to the requirements of the London Dock Regulations and of the Port of London Authority.

Measurement of Speed Fluctuation.

By P. L. HENDERSON, B.E., A.S.T.C. (Sci.).

THE following is an account of some experimental work carried out by the author at the Engineering School, Sydney University. The object of the work was to devise some simple, accurate and direct means of measuring the fluctuation in speed of an engine such as the National gas engine, and to compare this record with that of the tachograph. The latter instrument will not be described, as it is doubtless well known to readers.

The apparatus designed by the author is shown in Fig. 1 and Fig. 2, and consists principally of a standard tuning

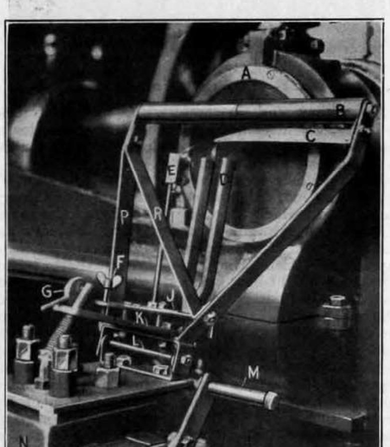

FIG. 1—SPEED FLUCTUATION RECORDER

fork, which makes 224 complete vibrations per second, together with a device which will always hold the tuning fork in the same relative position to the engine shaft, this being very necessary, as otherwise the end play in the shaft would soon damp the tuning fork vibration. An 8in. diameter steel plate is fitted to the end of the engine shaft, being held on by three ⅜in. screws. A glass plate, 7in. diameter, is held on to this steel plate by means of a ring A, Fig. 1, and set screws. The glass disc, before being placed in position, is uniformly smoked over a candle. A roller B, Fig. 1, made in two pieces, rests against the ring A. The roller is held in the frame P, which carries a plate K, and the whole is movable about the shaft L. The roller is held against the ring by a spring in compression, but can be released by the excentric G. On the top of the plate K rests another plate J, which has two legs at one end seated in semi-spherical recesses, and by means of a wing nut F the plate J can be moved in relation to the plate K against a spring in tension. The movable plate J carries the tuning fork D and an electric marker E. The whole of the apparatus is bolted to a lathe slide rest N, which in turn is clamped on to a timber support in a suitable position relative to the engine. The datum pointer C and electric

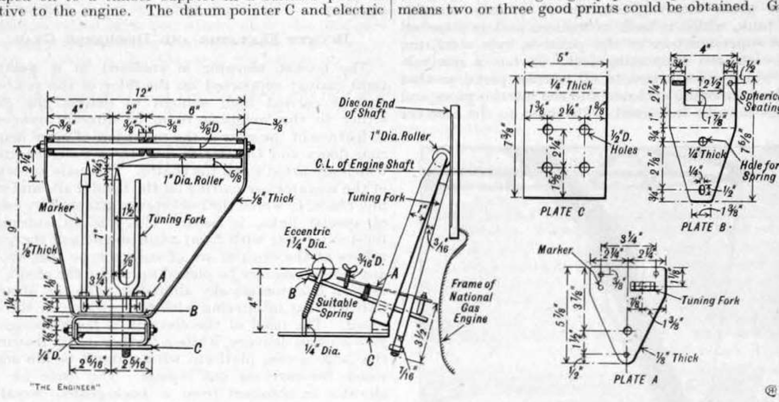

FIG. 2—DETAILS OF SPEED FLUCTUATION RECORDER

marker E were used in the preliminary tests for synchronising the tuning fork and tachograph records, but a better method was later devised which proved to be very accurate.

The tachograph, which is essentially a spring-controlled governor, was attached to the other end of the engine shaft. The method of synchronising the two records finally adopted was to connect the electric marker on the tachograph through a contact maker worked off the cam shaft of the engine, also to connect in series a battery, and the tuning fork apparatus was put in as a switch, this being done by connecting a wire from the tachograph marker to a bolt on the slide rest. When the roller is touched on to the ring on the engine shaft, as would be done when taking a record, electrical contact is made with the engine ; then once in every two revolutions of the engine, in the case of the National gas engine, the cam strikes a strip of brass

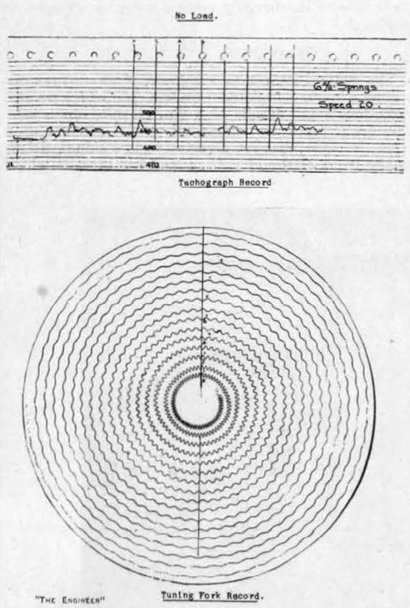

FIG. 3—TACHOGRAPH AND TUNING FORK RECORDS

which is insulated and connected to the tachograph marker, thus completing the circuit. Then after taking the records and when the engine is stopped, the fly-wheel is turned by hand until the cam just touches the brass strip, then the tuning fork is run horizontally across the smoked plate, and at every point that it intersects the speed curve is a point corresponding to one on the tachograph record. This method of synchronising the two records has a high degree of accuracy and also works well in practice.

To take a record on the tuning fork apparatus, first smoke the glass disc over a candle and replace it in the ring on the end of the engine shaft. The roller B, Fig. 1, is then released by excentric G and allowed to rest on ring A. Then, by means of the wing nut F, the tuning fork is adjusted until the brass pointer on the end of the prong just touches the smoked plate. The tuning fork pointer is then placed in the centre of the smoked plate by means of the handle M. The tuning fork and roller are then withdrawn from the plate by turning the excentric G. All is now ready for taking a record. With the engine running at normal speed, strike the tuning fork with a fibre hammer, release excentric G, and turn the handle M in a clockwise direction. When the record is taken, turn excentric G down again and so take the tuning fork off the glass. The engine is stopped and the fly-wheel is turned by hand until the contact maker on the cam shaft just closes, then a line is run horizontally across the tuning fork record, as previously described; then the fly-wheel is turned through 90 deg. and the first line is cut by a second line, thus giving the centre of the record. Next the glass plate was removed from the ring on the engine shaft and the record printed on gaslight photographic paper. To do this the smoked side of the glass disc was carefully placed in contact with the gaslight paper and printed, and by this means two or three good prints could be obtained. Gauge marks were placed on the paper, and it was found that the prints shrunk very slightly in all directions, thereby not affecting the accuracy of the record. In Fig. 3 will be seen an example of a tuning fork record for a no-load test on a National gas engine, 11in. bore, 19in. stroke, single acting, four-stroke cycle, horizontal type, together with the corresponding tachograph record.

The numbers on the tuning fork record correspond to those on the tachograph record ; for example, the speed curve between 2 and 4 on the tuning fork record corresponds to that between 2 and 4 on the tachograph record. The number of vibrations on the tuning fork record are counted, starting at zero every two revolutions for convenience, and are shown in small figures on the record. The tuning fork makes 224 complete vibrations per second. The results from the records in Fig. 3 are shown in graphical form in Fig. 4.

In most cases the mean speed recorded by the tachograph was about correct, but it usually recorded nearly 2 per cent. less fluctuation in speed than that which actually took place, and also in many cases was out of phase with

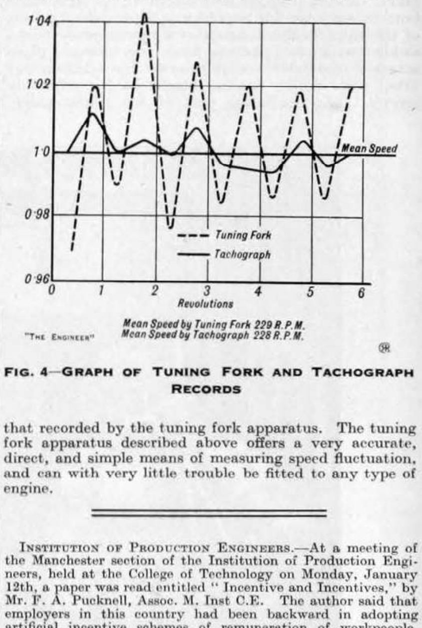

FIG. 4—GRAPH OF TUNING FORK AND TACHOGRAPH RECORDS

that recorded by the tuning fork apparatus. The tuning fork apparatus described above offers a very accurate, direct, and simple means of measuring speed fluctuation, and can with very little trouble be fitted to any type of engine.

INSTITUTION OF PRODUCTION ENGINEERS.—At a meeting of the Manchester section of the Institution of Production Engineers, held at the College of Technology on Monday, January 12th, a paper was read entitled " Incentive and Incentives," by Mr. F. A. Pucknell, Assoc. M. Inst C.E. The author said that employers in this country had been backward in adopting artificial incentive schemes of remuneration of workpeople. Very many of our plants were still using a straight-line method of payment, partly through the opposition of many employers to any system of payment by results, partly because old traditions died hard with us. In shops using incentive plans, straight piecework was the most popular, although premium or bonus plans, such as the Rowan and Halsey, had been largely used ; but chiefly owing to justifiable opposition on the part of the employees such schemes had lost favour.

INSTITUTE OF METALS.—The Institute of Metals has just issued the first number—dated January, 1931—of its new monthly *Journal*, containing original articles, Institute news and several hundreds of abstracts of the world's metallurgical literature, ninety-six pages in all. Hitherto the *Journal* has appeared in the form of half-yearly volumes divided into two sections, " Proceedings " and " Abstracts." Henceforward the volumes issued each June and December will contain only " Proceedings," and the " Abstracts " will appear monthly, to be re-issued in volume form at the end of each year. The effect of this arrangement is to speed up the receipt of the abstracts—which can be used for card indexing purposes—by several months ; furthermore, it will make the half-yearly volumes, which had grown rather bulky, easier to handle. It is anticipated by the Council that the new method of monthly publication will appeal particularly to research workers and to those engaged in industry, as it will enable them to keep in very close touch with the latest metallurgical developments throughout the world.