SPEEDOMETERS.

FITTING
INSTRUCTIONS
and
SPARE PART LIST

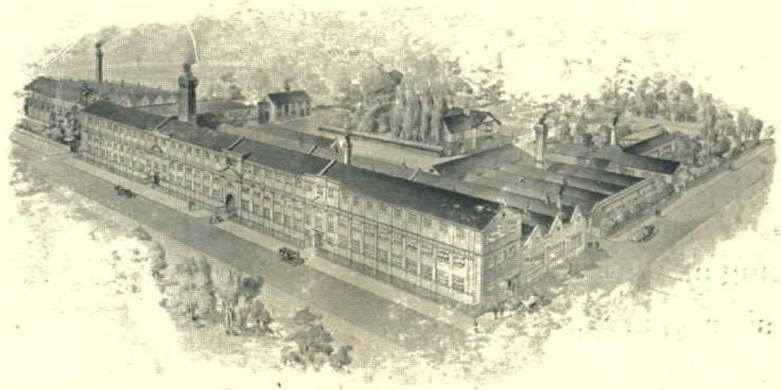
NORTH & SONS, LTD.

The British-Made

WATFORD SPEEDOMETERS

Instructions & Spare Part List

For Models used on Standard Cars.



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INTRODUCTION

This booklet is issued for the convenience of our customers, and gives a number of details which we trust they will find useful with regard to the fitting of Watford Speedometers, and to the supply of spare parts.

A list of spare parts is given at the end of the booklet, the part numbers quoted for identification are indicated on the various illustrations

These parts can be supplied from stock.

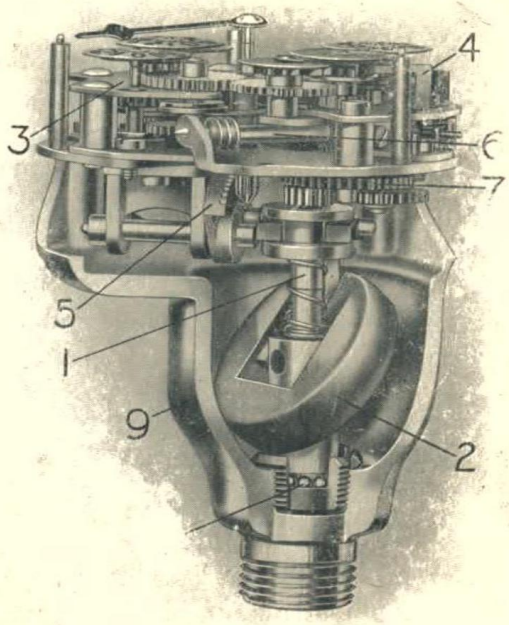
We have a well-equipped department dealing with the repair of Watford Speedometers, which is arranged for dealing with the receipt, repair and despatch of instruments in the shortest time possible.

Watford Speedometers.

The instrument, which is of the centrifugal type, is illustrated in section below.

The various parts are indicated by numbers as follows:-

1. Governor spindle
2. Governor weight
3. Mileage counter
4. Trip mileage counter
5. Toothed segment operating indicating hand
6. Worm driving mileage counter
7. Reducing gear driving worm 6
8. Ballrace
9. Case



It will be seen that the governor spindle is carried in ball bearings, and the instrument will consequently run for long periods without requiring re-lubricating.

The speed indicating hand is operated from the movement of the governor as follows: as the speed increases the weight (2) tends to assume a position at right angles to its spindle.

An arm attached to the weight at one end to a moveable sleeve on the spindle at the other, draws this sleeve along the spindle to a position depending on the speed of the governor.

This sleeve operates on a stud projecting from the face of the segmental rack (5), and the toothed portion of the rack turns the pinion carrying the indicating hand.

A point which cannot be very clearly seen from the illustration is that a steel shoe is interposed between the stud on the rack and the face of the collar.

This shoe retains lubricant on the face of the collar, and at the same time reduces friction.

The total mileage counter is positively driven by worm and spur gearing, and the trip mileage counter is driven from the total mileage counter, from which it is momentarily disconnected by the action of the pushpiece when being returned to zero.

We give this illustration and description in order that our customers may have a clear idea of the working of the instrument, but in the event of the instrument head needing repair, it is necessary to return it to the works, as the calibration will require checking, and re-calibration will probably be necessary.

The only parts of speedometer heads which can be supplied for fitting away from the works are the external details specified on page 13.

The Flexible Shaft and Tube.

The flexible shaft consists of sixteen strands of a special quality of steel wire wound as shown in the illustration on page 9.

It is essential that the correct tension between the various layers should be maintained, otherwise the instrument end of the shaft will not turn uniformly in accordance with the driven end, but will turn with a series of jerks, which will be communicated to the indicating hand.

For this reason, it is necessary to specify the length of shaft required, although all shafts are most carefully made and tested before delivery, a shaft can be completely spoilt by cutting it to length, and it is therefore impossible to supply flexible shafting in continuous lengths to be cut by our customers to the lengths they require.

The connection of the Flexible Shaft to the Instrument and Pulley Spindle or Gear Box.

The connection to the instrument is shown on a label which is attached to each flexible shaft before it is despatched, and a reproduction of which, with the printed instructions on it, is given on next page.

The actual connection, as will be seen is made by a square on the end of the shaft, which passes into a square hole in the governor spindle.

The weight of the shaft is carried by a collar below the square, which is supported by a ball-race formed in the sleeve on the end of the flexible tube, the sleeve being made of a special quality of case hardening steel.

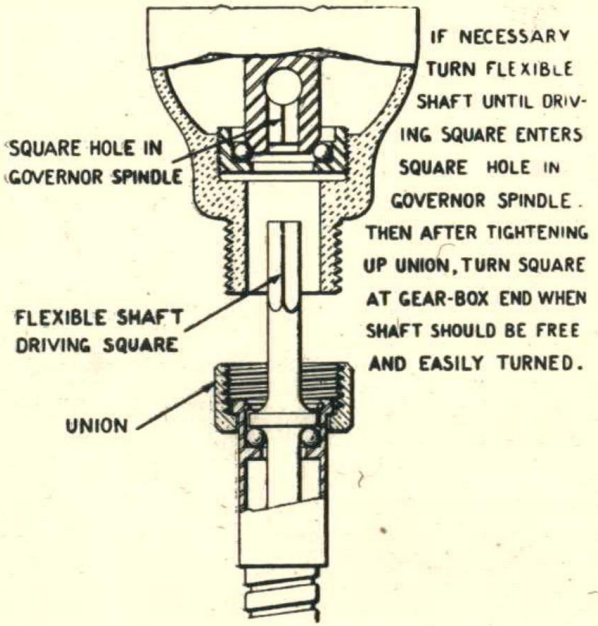
The lower end of the shaft is also furnished with a square which is of a larger size, to prevent any possibility

of the wrong end being connected to the instrument.

The square at the lower end is free to move for some distance with relation to the end of the tube in order to accomodate itself to the variation in the relative lengths of the shaft and tube with different amounts of bending.

WATFORD SPEEDOMETER

SECTIONAL VIEW SHOWING CONNECTION OF FLEXIBLE SHAFT



THE INDICATOR END OF FLEXIBLE SHAFT TO BE CONNECTED BEFORE THE GEAR-BOX END.

A washer with a U-shaped slot, which is placed over a turned portion of the end piece on the flexible shaft behind the square (after this has been attached and the shaft placed in the tube) prevents the square being drawn too far into the tube, and the square hole in the spindle of the driving pulley or gear box is of such a length as to permit of the necessary longitudinal movement.

The Flexible Tube

This is a steel tube covered with rubber which is vulcanised on the tube.

The sleeve at the top or instrument end of the shaft has already been referred to, but in addition to the ball race described, it is provided with an oil hole below this race, which permits of oil being poured into the tube from a small oil can.

The lubricating hole is normally covered by a short pipe, forming an extension of the union nut, and it is only necessary to unscrew the union and move it a little way down the tube to uncover the oil hole.

The shafts and tubes, when assembled, are well lubricated with a solidified oil (Price's Belmoline B), but this cannot be renewed without removing the flexible shaft, and we have therefore made the provision described for lubricating with engine oil.

The sleeve at the lower or gear box end of the tube is recessed to contain the washer described above, for limiting the movement of the square end. Details of the construction of the flexible shaft and tube are shown on page 9.

Removal of Flexible Shaft for Cleaning or fitting New Shaft.

It may appear, on examining the shaft and tube, that this U- washer cannot readily be removed, but if the tube is coiled into a circle of about one foot in diameter it will

be found that the comparative lengths of the shaft and tube are altered sufficiently for the washer to be quite easily removed.

The flexible shaft is retained in the tube at the other end by a small wire spring snapped into a groove in the sleeve, as can be seen on referring to the illustration on page 6.

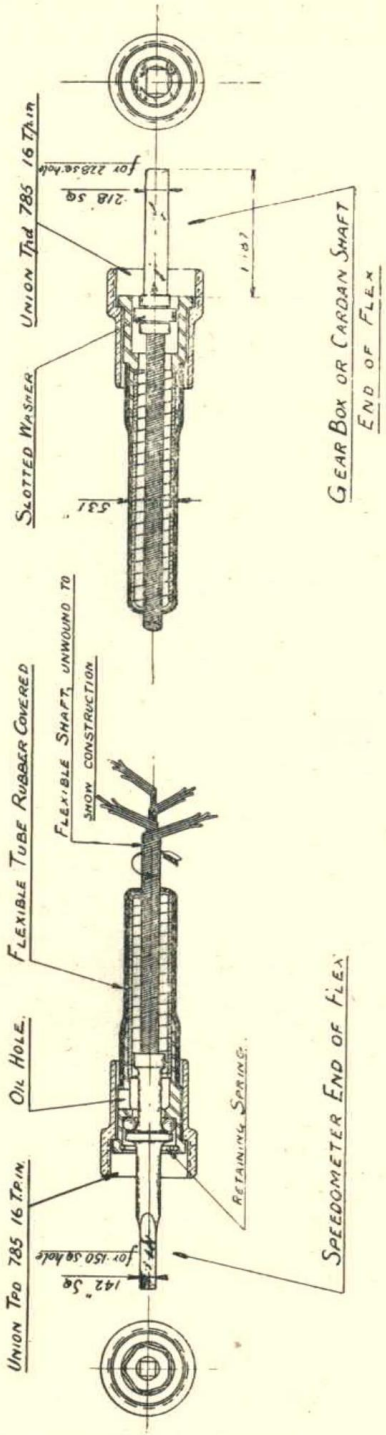
This spring can be readily removed by a pocket knife, and if the washer at the lower end has already been removed the shaft can be drawn out of the tube, but care must be used not to lose any of the nine $\frac{1}{8}$ in. steel balls, which will be drawn out by the flange on the end piece of the flexible shaft.

When replacing the shaft or fitting a new one, the steel balls referred to should not be placed directly in the bearing, as there is a danger of them falling down the tube, but should be placed with a sufficient amount of grease in position on the cone of the steel end piece of the shaft.

When the shaft is placed in position they will be held by the seating in the tube, and remain in position.

The spring retaining the end piece in position should be replaced, and finally the washer with U-slot at the other end of the shaft should be placed in position.

FLEXIBLE SHAFT ASSEMBLY FOR WATFORD SPEEDOMETER.



THE SHAFT MAKES 3720 TURNS PER MILE.

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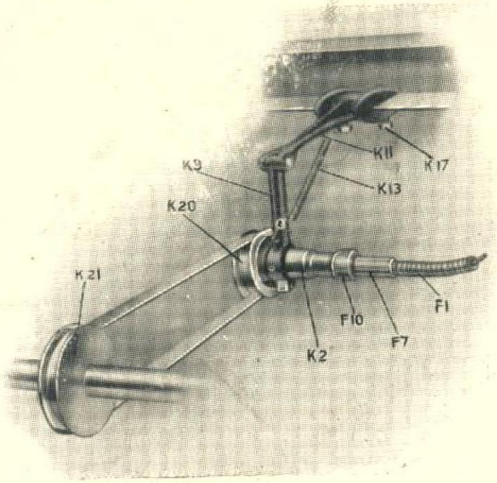
Drive from Cardan Shaft.

The standard cardan shaft drive is illustrated below, and consists of a split pulley K 21, clamped to the cardan shaft by screws, and a driven pulley K 20 carried on a swinging arm K 9, which is supported by a bracket K 11.



This bracket is clamped to the chassis by means of set screws with hardened points K 17, and it is not necessary to drill the frame as these points force a cone of metal into the corresponding hole on the other side of the slot, and thus hold the bracket quite firmly.

The swinging arm K 9 carries the ball bearings for the pulley spindle, and this spindle drives the flexible shaft, while the adapter K 2 is threaded for the union nut on the end of the flexible tube.

The bearing for the pulley spindle is prevented from turning by a knurled set screw in the swinging arm, and the removal of the set screw permits of the bearing being oiled, as the hole into which it screws serves both to locate the bearing when the screw is inserted and as an oil hole when the screw is removed.

Watford Speedometers

Sizes of Pulleys for Cardan Shaft Transmission.

The size of the pulley on the cardan shaft is proportioned to the tyre size, the diameter of the pulley being one-tenth of that of the tyre, that is to say, a tyre 700 m/m diameter requires a pulley 70 m/m in diameter, a tyre 760 m/m requires a pulley 76 m/m, a tyre 820 m/m requires a pulley 82 m/m, and so on.

It is important to note, however, that these details relate to actual and not nominal tyre sizes, and that there are considerable variations between actual and nominal diameters of tyres.

It is therefore advisable, to give the actual diameter of the tyre when ordering, where this is possible, for which purpose the tyre should be measured with the wheel raised clear of the ground.

A more accurate method is to measure the acting circumference by marking the tyre at a point where it is in contact with the ground, making a corresponding mark on the ground, wheeling the car in a straight line until the wheel has made exactly one turn ,and then making a second mark on the ground corresponding with that on the tyre.

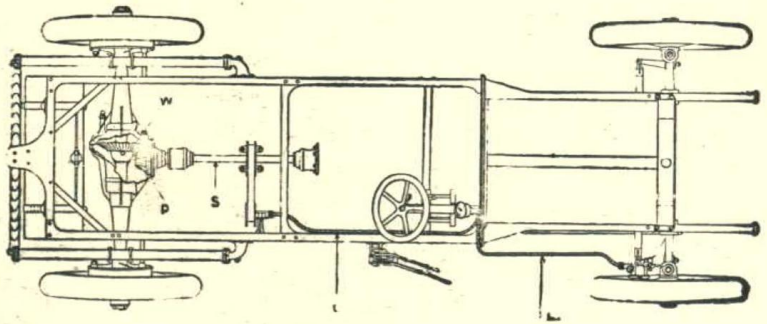
The distance between these marks will give the actual distance travelled per turn of the road wheel. If this distance is measured in millimetres it will be necessary to divide it by 31·416 to obtain the diameter of the pulley in m/m or if the distance is measured in inches, the diameter of the pulley in millimetres can be obtained by dividing this distance by 1·237.

The driven pulley varies in diameter according to the ratio between the crown wheel on the back axle and the pinion on the cardan shaft indicated respectively on the illustration below by the letters W and P, and the diameter in millimetres of the pulley can be obtained by the formula:

$$\frac{W}{P} \times \frac{55}{4} = \text{Diameter of pulley in millimetres.}$$

For example: with a crown wheel with 60 teeth and a pinion of 15, the diameter of pulley would be:

$$\frac{60}{15} \times \frac{55}{4} = 55 \text{ millimetres.}$$



Watford Speedometers

Spare Part List.

Parts for Speedometer Heads

Models fixed by screws through the flanges

Piece No.	*Description*	*Price* £	s.	d.
E 7	Glass only		1	6
E 30 & 31	Screws for fixing instrument in case: two screws $\frac{3}{8} \times 4$BA, cheese head; two screws $13/32 \times 2$ BA round head ... per set		1	0
E 20	Indicating hand		1	0
E 3	Screwed bezel holding glass, complete with glass and distance ring behind glass		7	0
E 4	Screwed distance ring for fitting behind glass only		2	0

Cardan Shaft Drive with flat belt illustrated on page 10.

K 1	Ball bearing for pulley spindle		4	6
K 2	Adaptor for bearing K 1		2	0
K 3	Pulley Spindle		4	6
K 4	Ball Race Nut		2	0
K 5	Nut for fixing pulley			6
K 6	Lock washer for nuts K 4 and K 5 ...			1
K 9	Swinging bracket carrying pulley bearing K 1		4	0
K 10	Screwed plug locating bearing and covering oil hole			3
K 11	Bracket to fix on chassis and carrying swinging bracket K 9		4	0
K 13	Spring			6
K 17	Clamping bolts for brackets K11 Per set of 2		1	6
K 20	Driven pulley for flat belt ... ... *(See page 12 for sizes)*		7	0
K 21	Split pulley for flat belt, to fit on cardan shaft *(See page 11 for sizes)*		8	0
	Special Cotton Belt with fastener ...		2	0
	Complete set of parts for cardan shaft drive, with flexible shaft and tube up to 6ft. in length	2	10	0
	Complete set of parts for cardan shaft drive, without flexible shaft and tube	1	14	0
	Flexible Shaft and tube up to 6 ft. long		18	0
	Flexible shaft only, up to 6ft. long without tube.		9	0
	Flexible tube only, up to 6 ft. long ...		9	0