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DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH
ROAD RESEARCH

AUTOMATIC TRAFFIC COUNTER.

by

G. Bird, B.Sc., A.C.G.I., D.I.C., A.M.I.Mech.E., A.M.I.A.E.

and

F. Garwood, M.A., Ph.D., F.S.S.

Date: March, 1938.
Ref: R.N. 138.

ROAD RESEARCH LABORATORY,
HARMONDSWORTH,
MIDDLESEX.

SUMMARY.

Consideration was given in 1935 to the design and requirements of automatic traffic census systems. As a result of the study of traffic being made in connexion with road wear, it was decided in 1937 to instal an automatic axle counter on the Colnbrook Bypass, and this is now in operation.

This note describes the apparatus and its method of operation. The results of a comparison between it and census enumerators are also given, showing that the agreement was reasonably close.

The cost of the complete equipment and installation was about £250, but this might be reduced under circumstances where a less comprehensive system of recording would be permitted.

AUTOMATIC TRAFFIC COUNTER

Introduction.

Some time ago the Laboratory gave a considerable amount of attention to the possibilities of devising apparatus which would automatically take a census of road traffic. Both the counting and the weighing of vehicles were considered, and the main conclusions then reached were:-

- (1) Automatic counting of vehicle axles could be provided at at comparatively low cost.
- (2) Automatic weighing of vehicles would require a considerable amount of development work, would not attain a high degree of accuracy, and would be costly.

As at that time there was no particular application in view for such apparatus, the problem being a general one, no further action was taken. Recently, however, it became necessary to take a continuous census, over an extended period, of traffic passing over an experimental section of road near the Road Research Laboratory, and as the cost of employing enumerators for this purpose would have been excessive the opportunity was taken to develop the automatic apparatus described in this paper.

While it would have been desirable to weigh as well as to count the traffic, in view of the conclusions previously reached it was decided to proceed with automatic counting equipment only, relying upon statistical information, obtained in the normal way, to convert the number of axles counted into an equivalent tonnage figure. As it was necessary in this case to complete the apparatus in a short time it was decided to employ as far as possible standard equipment similar to that used extensively in automatic telephone exchanges and street signalling systems.

With the co-operation of Messrs. Siemens and General Electric Railway Signal Co., a satisfactory circuit was evolved and equipment supplied by them was installed on the Colnbrook Bypass outside the Laboratory in October, 1937.

It is thought that the following description may be of interest to local authorities and others who may be contemplating the installation of equipment for the same uses. It will be apparent from what follows, however, that for some purposes simpler and cheaper systems would be sufficient. This point is dealt with more fully later.

/Description

Description of equipment.

The installation is arranged to record automatically the number of axles which pass in both easterly and westerly directions along the Colnbrook Bypass. The axle count is divided into two hour periods thus giving a detailed distribution of traffic density throughout the 24 hours. As a "wet road clock" (1) is used to record the total time during which the road is wet throughout the same intervals the two sets of records can be used together to give the "total axles road wet" and "total axles road dry" for every 2-hour period.

The instrument is read daily and a comparison with the hourly traffic census taken by the Ministry of Transport enumerators has been made. The results of this comparison are referred to later.

A detector pad of the "Autoflex" type as used in traffic signalling systems of Messrs. Siemens and General Electric Railway Signal Co.'s manufacture is employed to register the passage of a vehicle. There are two detectors, one for eastbound and one for westbound traffic, installed in the road outside the Laboratory in the positions shown in Figs. 1 and 2. The pads are unidirectional so that if a vehicle crosses them in the reverse direction to the normal flow of traffic the counter will not operate. The passage of an axle over the pads compresses the air in the rubber cells thus momentarily closing a contact in the contact box at the roadside which can be clearly seen in Fig. 1.

The contact boxes are connected to the recording instrument, which is mounted on the wall just inside the main entrance to the Laboratory, by two twin core 3/.029 armoured cables, one from each pad.

The instrument itself is enclosed in a glass fronted cabinet 3 ft. 10 in. x 1 ft. 9½ in. wide and 8 in. deep as shown in Fig. 3. Figs. 4 and 5 show the apparatus removed from the case, a light angle-iron frame being used to carry the units.

The instrument consists of four banks each comprising six counting units. The two left hand banks record eastbound axles and the right hand banks westbound axles. Between the eastbound and westbound banks at the top of the case is a time switch similar to those used in
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(1) See Annual Report 31st March, 1937. p. 111-114, and Figs. 73 and 74.

the "wet road clock", consisting of a conductor ring and two sets of 12 contact pieces. The hand of the 24-hour mains-driven clock carries 3 leaf springs, one bearing on the common conductor ring and the other two on the two sets of contact pieces, so that the clock contacts select the appropriate counting units, east and west for each 2-hour period, and are carefully arranged to switch both units together.

Below the time switch on the left is a single pole tumbler switch in the 240 v. 50 cycle mains supply and next to this is a Bray Pigmy Contactor modified to act as a no-volt cut out. At the bottom of the case is a "Transrecter" set comprising a transformer, rectifier, and condenser providing a smoothed 50 volt D.C. supply for operating the various relays and counters comprising the equipment.

Operation of equipment.

The passage of a wheel or axle over the detector pad causes a puff of air to flow from the pad to the contact box at the roadside. The connecting pipe contains a length of baffle wire to damp out pressure waves in the pipe which would otherwise cause the contact to close more than once per axle. The air pressure operates a flap in the contact box carrying a contact which is thereby closed momentarily once per axle. For unidirectional working, a second flap is provided, interlocking with the contact flap and preventing it from closing when a vehicle traverses the pad in the wrong direction.

The wiring of the equipment is shown in Fig. 6. One side of the detector contacts is connected directly with the positive supply. The other side is connected to all the counting units in parallel, the selection of the appropriate unit being performed by the time switch, the common arm of which forms the negative return.

Each counting unit consists of a High Speed Relay, a uniselector, and an electrically operated counter. The counter is connected directly with the positive supply and to the bank contact of the uniselector. On the uniselector are two banks of 25 contacts, and on the centre spindle two arms or wipers one for each bank. By parallelling two of these contacts one from each bank, and connecting these to the counter it will operate once, i.e. count one unit for every 25 axles. While each unit on the counter is therefore equivalent to 25 axles, single axles from 0 to 25 can be read from a dial attached to the uniselector arm. The uniselector coil is in parallel with the high speed relay.

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The actual operation of one counting unit can be taken to describe the working of the instrument as a whole. The contact being made in the junction box, the high speed relay is energised, closing the high speed relay switch. The detector contacts are then shunted until the uniselector has been energised, breaking the uniselector switch. This stick circuit is necessary because of the much greater sensitivity of the high speed relay compared with the uniselector. The former will operate on a 3 to 5 millisecond duration of contact, whereas the latter requires 20 to 50 milliseconds to operate. The counter requires about $\frac{1}{2}$ second to operate and is energised when the arm of the uniselector is making contact on the bank contact which is connected to the counter. There is then a circuit direct from the negative supply through the selector arm to the counter and through the counter to the positive supply.

It is important that the case housing the instrument should be dust-tight, as dust has been found to cause failures. As can be seen in Fig. 2, white lettering on the glass front of the cabinet shows the Eastbound and Westbound counters, and the units for the 2-hourly periods, also on the time switch the figures denoting the "watch" are in white with NOON at the top and MIDNIGHT at the bottom. The clock incorporated with the time switch is always run on Greenwich Time.

The whole of the instrument is mounted on a steel angle frame and was finally wired and assembled before fixing into the case. For simplicity two terminal strips are attached to the frame one on each side of the time switch. On each of these are 3 terminals, two for leads to the detector pads on the road and one for the lead-in of the 250 volt mains supply.

Cost.

The total cost of the equipment was about £250, including installation, but in cases where the total number of axles passing in a given period only is required, enabling the clock and all the counter units except one for each side of the road to be dispensed with, a substantial reduction in cost would be possible. The power supply required is 50 volts D.C. for the counter, and, should some form of portable contact strip be possible, the apparatus would be readily removable. Such contact strips, however, are not very suitable on roads carrying heavy traffic, and in such cases it would probably be essential to install proper detectors at selected census points.

/Comparison

Comparison of Axle Counter with Enumerators' Records.

The results of a comparison, extending over eight 24-hour days, between a direct enumeration of traffic on the Colnbrook Bypass and the records from the axle counter are shown in Fig. 7. Each point represents the difference between the number of axles of vehicles using the road during a two-hour period, as derived from the enumerators' records, and the number counted by the instrument. This difference is plotted against the former number, and it is seen that on the majority of occasions the ratio of the two is less than 10 per cent.

A prominent feature of the results is the fact that the westbound counter appears to miss more traffic than the eastbound counter, particularly when the road is busy. While the sensitivities of the two pads are, in fact, not quite the same, in most cases the difference probably originates in the fact that a road junction with a roundabout is situated a short distance to the east, whose lay-out has the effect of checking the speed of westbound traffic. Thus when traffic is dense, fast vehicles start overtaking as soon as they have cleared the junction and there will therefore be more overtaking among westbound vehicles immediately to the west of this junction than there would be if they had not been checked, as is the case with eastbound traffic. Consequently the proportion of vehicles which are travelling on the right hand side of the road, and therefore fail to be counted, is greater westbound than it is eastbound.

The data are plotted in the form of a direct comparison in Figs. 8 and 9, and the daily totals obtained by the two methods of counting are compared in Table I. (The totals extend over 22 hours of each day as on some of the days the instrument was not working between 2 and 4 p.m.) In view of the fact that the direct enumeration of traffic was subject to a human error which at present it is not possible to estimate, the results of the comparison appear to be quite satisfactory. It will be noted that the maximum daily errors were -5.3 per cent. Eastbound and 7.1 per cent. Westbound, while over the total period of 8 days the errors were -1.9 per cent. and 3.5 per cent. respectively.

The tendency for the eastbound differences to be negative, i.e. for the eastbound axle counter to count more than the enumerator, is probably due to the fact that motorcycles are excluded from the enumerators' records given above. In preliminary tests it was found that eastbound motorcycles crossing the pad counted, on the average,

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as one axle each, while westbound motorcycles usually failed to count. It was therefore thought desirable, for the sake of consistency, to omit motorcycles altogether. Pedal cycles very rarely registered, and were also omitted.

The instrument will be calibrated later for the estimated average weight corresponding to each axle it counts, and allowance for systematic errors will then be made automatically.

TABLE I.

Comparison of Axle Counter with Census Enumeration from Thursday 16/12/37 to Thursday 23/12/37 inclusive.

Date	EASTBOUND				WESTBOUND			
	Axles recorded by		Difference (Enumerators- Axle Counter).	Difference %	Axles recorded by		Difference (Enumerators- Axle Counter).	Difference %
	Enumerators	Axle Counter			Enumerators	Axle Counter		
Dec. 16	6209	6254	-45	-0.7	6330	6065	265	4.2
17	6100	6253	-153	-2.5	6273	5827	446	7.1
18	5515	5495	20	0.0	5204	4910	294	5.6
19	2916	3014	-98	-3.4	2862	2874	-12	-0.4
20	4197	4420	-223	-5.3	3966	3993	-27	-0.7
21	5610	5667	-57	-1.0	5311	5248	63	1.2
22	5772	5868	-96	-1.7	5790	5656	134	2.3
23	5922	6066	-144	-2.4	6084	5780	304	5.0
Total	42241	43037	-796	-1.9	41820	40353	1467	3.5