

Jan. 12, 1937.

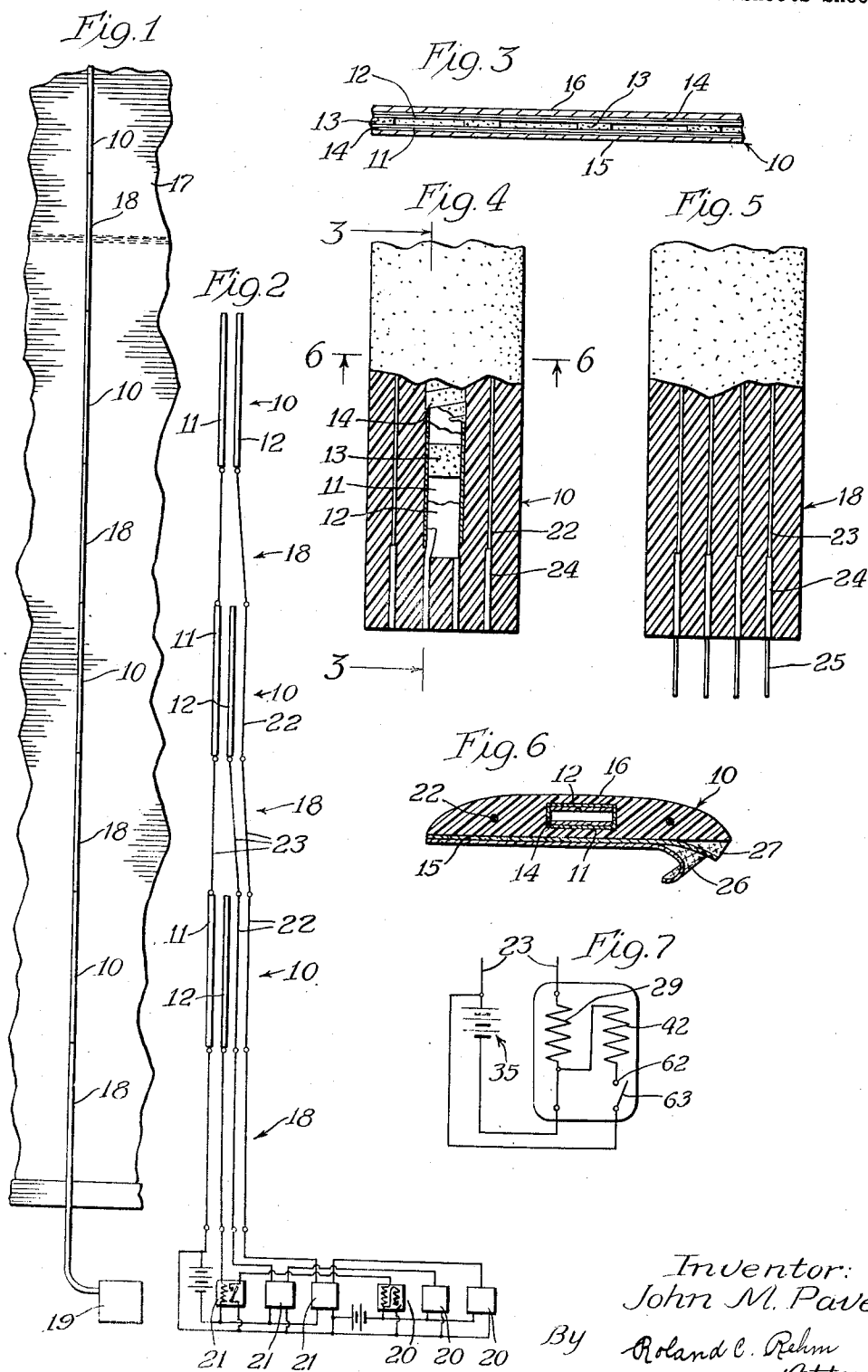
J. M. PAVER

2,067,336

APPARATUS FOR STUDY OF TRAFFIC

Filed Dec. 1, 1933

2 Sheets-Sheet 1



Inventor:
John M. Paver
By Roland C. Rehm
Atty.

Jan. 12, 1937.

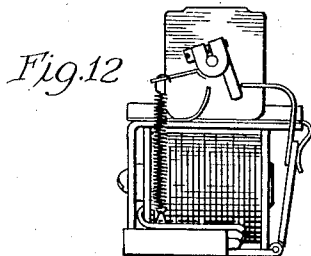
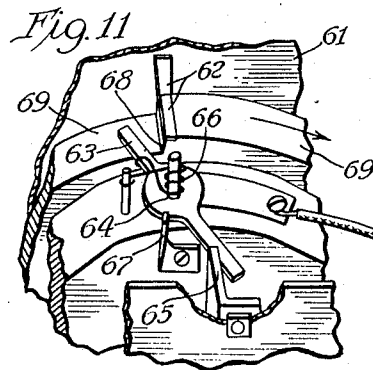
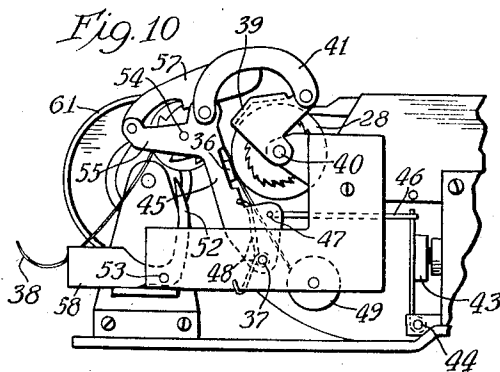
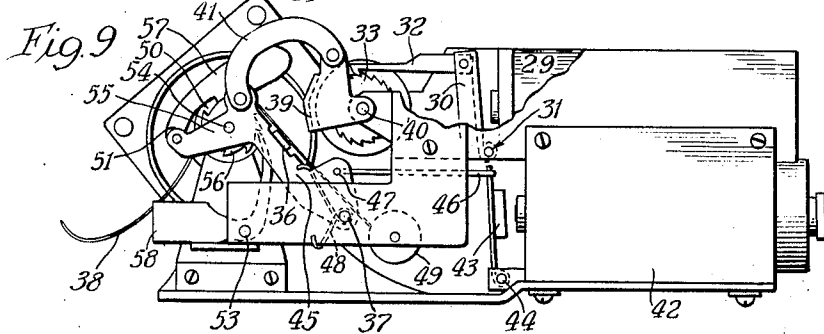
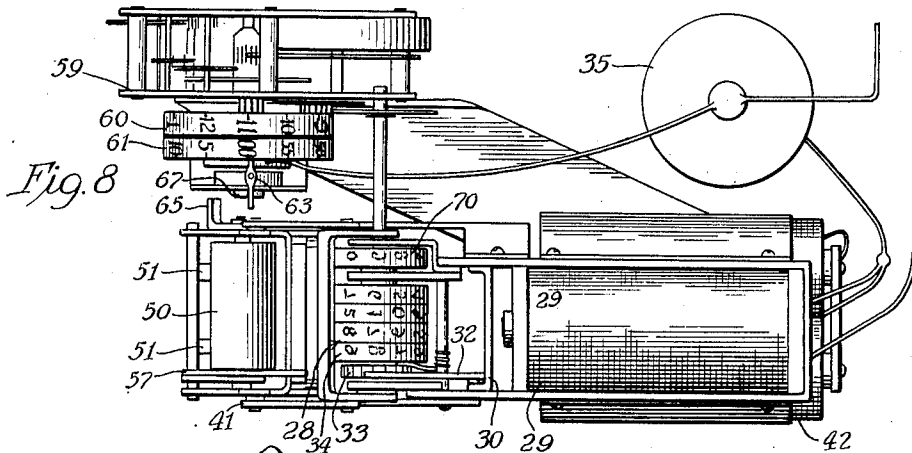
J. M. PAVER

2,067,336

APPARATUS FOR STUDY OF TRAFFIC

Filed Dec. 1, 1933

2 Sheets-Sheet 2



Inventor:
John M. Paver
By Roland C. Rehm
Atty.

UNITED STATES PATENT OFFICE

2,067,336

APPARATUS FOR STUDY OF TRAFFIC

John M. Paver, Wilmette, Ill.

Application December 1, 1933, Serial No. 700,449

7 Claims. (Cl. 235—92)

This invention relates to the study of traffic flow, and among other objects aims to provide reliable, compact and inexpensive apparatus by which traffic flow, such as vehicular or pedestrian traffic, may be effectively studied.

The nature of the invention may be readily understood by reference to one illustrative apparatus embodying the invention and shown in the accompanying drawings.

In said drawings:

Fig. 1 is a fragmentary plan view, somewhat diagrammatic in character, of a roadway showing one arrangement of traffic contact strips by which the flow of traffic is measured;

Fig. 2 is a diagrammatic view of electric circuits which may be employed in the arrangement shown in Fig. 1;

Fig. 3 is a fragmentary longitudinal section of a contact strip taken on the plane 3—3 of Fig. 4;

Fig. 4 is a fragmentary broken plan section of a contact strip;

Fig. 5 is a similar view of a connector strip carrying electrical conductors for connecting sections of contact strips;

Fig. 6 is a transverse section of a contact strip; Fig. 7 shows a wiring diagram for one form of recorder illustrated in the following figures;

Fig. 8 is a plan view of such recorder;

Fig. 9 is a side elevation, certain portions having been broken away to facilitate illustration;

Fig. 10 is a view similar to that of Fig. 9 but showing the recorder in the act of printing;

Fig. 11 is a perspective view of the time control recorder actuating switch; and

Fig. 12 shows in somewhat diagrammatic form a simple electrically actuated counter.

The invention is here shown embodied in apparatus which may be readily installed at or removed from any strategic point without impairing or altering the pavement of the roadway or without special structure in the pavement to receive it. It may therefore be installed at what are considered to be the most advantageous points for traffic study without special preparation as regards the roadway and independently of an outside source of power. Moreover, it may be installed or removed with no substantial interruption of traffic and it may be operated without interference to or special regulation of the traffic. Since the apparatus is quite inconspicuous, it may safely be applied in highly public locations without attracting attention or inviting tampering. For these and other reasons which will presently appear, the apparatus is highly efficient

for counting dense traffic flowing simultaneously in a plurality of traffic lanes, this traffic being of a character which it is most often desired to count effectively and efficiently.

In general, the illustrative apparatus comprises an electrically operated counting or recording apparatus and an improved contact strip 10 actuated by the passage of traffic, i. e., vehicles, to operate the counter or recorder.

As here shown, the so-called contact strip comprises a pair of spaced electrical conductors at least one of which is movable relatively to the other and is resilient so that it will not be permanently distorted by passing traffic. In the present instance these conductors are in the form of spaced strips 11 and 12 of resilient metal, such as phosphor-bronze of such character as will not be permanently distorted or deformed by the forces exerted upon it by passing traffic. Such strips may advantageously be one-fourth of an inch wide and .010 of an inch or thirty gage in thickness. The strips are held in separated relation by resilient or compressible spaced members here shown in the form of short blocks 13 of sponge rubber which in the present case are about three-eighths of an inch in length and separated to allow about five-eighths of an inch gap between adjacent blocks. The blocks may advantageously be approximately one-sixteenth of an inch thick. Surrounding the strips and the interposed blocks is a protecting sheath or envelope 14 which not only keeps the contact faces of the conductor strips 11 and 12 clean, but prevents the entry between the strips of foreign substances which might prevent the strips from being brought into electrical contact by passing traffic. The strip 10 is preferably shaped in section so as to have a flat bottom 15 and a gradually inclined approach to the top 16. The height or thickness of the strip is made as small as practicable so as to offer a minimum amount of obstruction to traffic and thereby reduce the forces exerted upon it by passing traffic. It may advantageously be about five thirty-seconds of an inch at its thickest point, i. e., the middle, and about one and one-quarter inches in width.

When laid on a roadway, the pressure exerted by passing traffic, such as the wheels of vehicles, temporarily deforms the strip by pressing the rubber and spacer blocks at one or more points so as to bring the strips 11 and 12 into electrical contact at one or more places. The resilient character of the strips 11 and 12, the slight obstruction which the strip presents to traffic, and the protection afforded by the resilient envelope,

insures that the metal strips will not be permanently deformed or distorted into continuous electrical contact after release of pressure. While rapidly moving traffic is capable of exerting tremendous force against obstructions, the present strip rising as it does less than three-eighths of an inch above the pavement, offers so little obstruction that the force delivered by the wheels of passing vehicles is relatively slight and well within the capacity of the materials of the strip to resist wear and deformation.

The contact strip 10 may, of course, be made in any appropriate lengths; but it can be advantageously made into lengths which slightly exceed the space between the tire contact areas, namely, an effective length of about fifty-five inches, to enable its use advantageously in counting the traffic in each of the plurality of lanes on a given thoroughfare. The tire-on-pavement contact being of substantial width and not a narrow line, this length is of course less than the nominal tread gage of the vehicle. Since about one and one-half inches of the length of the illustrative strip at each end comprises the terminal connectors which do not function as contactors, the actual length of the contact strip should be about fifty-eight inches. In Fig. 1 is shown one arrangement of this character. The roadway 17 is wide enough to allow six lanes of traffic, i. e., three in each direction. The contact strips 10 are spaced transversely of the roadway by inactive connector strips 18 whose length is barely less than the maximum pavement contact gage for the average standard automobile, being the distance from the outside of one contact area to the outside of the opposite contact area. Taking into account the three inch inactive length of the contact strips 10, the connector strips 18 (see Fig. 2 and 5) serve to connect each of the contact strips 10 with a counting or recording apparatus located as at 19 in a convenient point along the roadway. One form of wiring diagram by which the elements of the apparatus are connected is shown in Fig. 2. As there shown, each of the contact strips 10 is connected to a separate counter or recorder 20, three in the present case for one side or half of the roadway.

Since the counters or recorders are to be actuated by a low voltage battery, it is preferable where a long series of contact and connector strips are employed, to interpose a relay 21 between each contact strip and its counter or recorder. This avoids possibly faulty operation which might occur by direct connection between the contact strips, counter and its battery, owing to the relatively high resistance (compared to that of the battery and the counter magnet) of a circuit comprising a long series of contact and connector strips. The resistance of such circuit would vary of course with each contact strip because the length of each of the circuits would vary. The relay magnet, on the other hand, being low powered (since it need only close the circuit through a recorder and the battery) can have a winding of relatively high resistance so that variation of the resistance of the circuit comprising the contact and connector strips is negligible. Such relay may of course be operated by a higher voltage battery whose life would of course be long since the energy demand is slight compared to that on the battery for operating the counters.

For narrower roadways and also for a single circuit having a fixed resistance, the relays need not be interposed. Relays of this character are

common on the market and their details form no part of this invention.

When a relay is employed a battery of one or two dry cells is sufficient to actuate the counting or recording apparatus. Only a single battery need be employed for all of the counters or recorders since their circuits (except for the battery) are independent.

The foregoing arrangement (Fig. 2) may advantageously be employed for counting or recording heavy traffic such as that occurring on a wide roadway having a plurality of lanes of traffic flow in the same direction. The simultaneous crossing of the line of contact strips by a plurality of vehicles does not result in a loss of count since each of the vehicles engages a different contact strip which is in circuit with a different recorder. The connector strips traversing what may be called "clear" pavement lanes (i. e., the width of pavement straddled by the vehicle as it crosses the line of strips or counting line), are not wide enough to permit a vehicle to pass over them without contacting with an adjoining contact strip. On the other hand, each connector strip is long enough so as to minimize the double counts made by a vehicle exactly straddling it and operatively contacting with each of the adjoining contact strips. Furthermore, the contact strips are made as short as possible (but long enough so as not to be straddled completely by a vehicle) so as to minimize the loss of count which would result in adjacent vehicles running hub to hub and striking the same contact strip simultaneously.

In arranging contact strips for a thoroughfare of a given width, the contact strips and connector strips of the lengths above given are assembled alternately. The total length of assembled strips should be great enough so that the connector strips spanning the "clear" lanes adjacent each of the curbs should not greatly exceed the aforesaid maximum pavement contact gage for the average vehicle. Their length may exceed it a small amount, say about eight inches, since it is found that the tires of running vehicles rarely come closer than eight inches from a curb. In adjusting this arrangement for thoroughfares of varying widths, these "clear" lanes adjacent to the curbs may vary from the maximum of sixty-six inches to zero.

It will be apparent that the foregoing arrangement seeks to avoid engagement with a contact strip of all the wheels of the vehicle. Duplication and loss of count is minimized if only a single set of wheels (front and back) strike a contact strip. With the above described arrangement of contact strips, it is possible to count dense and heavy traffic at the most effective points and to avoid the practice of counting traffic in intersections. With far less attention than would ordinarily be necessary for counting traffic in intersections, the above described apparatus may be installed on opposite sides of a given intersection on each of the intersecting roadways and thus obtain simply and without attendants a complete picture of traffic flow involving the intersection.

To avoid numerous circuits for a wide thoroughfare, it may be desirable to place a recording apparatus on each side of the thoroughfare, so that each recording apparatus need be connected with contact strips for only one-half the width of the thoroughfare.

For less congested thoroughfares where the

number of vehicles simultaneously crossing the line of contact strips is negligible compared with the total traffic passing, a single or continuous series of contact strips and single counter may be employed.

To simplify the connecting and placing of the contact and conductor strips, the contact strips are advantageously provided with conductors 22 embedded in the protecting envelope and running along the contact strips 11 and 12. The number of conductors generally need not exceed two for arrangements such as that shown wherein three (a series of not more than three) contact strips are employed. The connector strip 18 is advantageously of approximately the same contour as the contact strips and carries a plurality of flexible wires 23. For an arrangement such as that here shown, not more than four wires are needed. In both the contact strips and connector strips the metal strips 11 and 12 and the wires terminate in jack tubes 24 having a fixed spacing. By the use of dowel pins 25 a plurality of contact strips and connector strips may be electrically connected easily and simply.

The contact and connector strips are preferably attached to the pavement by the use of a plastic cement which at no time becomes brittle. A tacky rubber cement is advantageous for this purpose and is sufficiently strong to hold the strips in place against the horizontal forces exerted by traffic. In this connection it should be remembered that the traffic exerts not only downward compression on the strip but a horizontal force, the latter resulting from the horizontal driving effort or kick given by a vehicle tire as it leaves the strip. By comparison, the horizontal force delivered as the tire strikes the strip is much smaller. The transverse or horizontal resilience of the strip, attributable largely to the resilient bronze contact strips, is sufficient to restore to normal position any portion of the strip which may be momentarily slightly displaced by passing traffic. This prevents creeping of the strip in a direction opposite to the direction of traffic. To facilitate the application of the contact and connector strips to the pavement, they may be furnished coated with the cement which is protected by a covering 26 of Holland or equivalent tape which may be removed just before application to the roadway, thereby presenting an efficient adhesive surface. The cement may be applied to the bottom of the strip by means of a cheese cloth or other cloth tape 27 impregnated with the cement and serving as a medium for applying a uniform layer of cement. The protecting cover 26 is of course laid upon the cement layer.

The contact strips and also the connector strips may advantageously be made by vulcanizing together strips of gum rubber, which are laid so as to surround the conductors and metal strips. After assembly, the composite strip may be placed in a vulcanizer which molds the strip into proper shape, i. e., with a flat bottom and convex top and causes the rubber to flow around the metal strips and conductor wires, thus forming a solid or integral covering or sheath. If the contact strips be thus formed, it is preferable to wrap the metal strips 11 and 12 with their intervening spacer blocks with a cloth or other wrapping to prevent the rubber from flowing between the metal strips during the vulcanizing process.

The counting or recording apparatus may be

arranged simply to count passing traffic or to count and record the count at given intervals. For merely counting, any appropriate magnetically operated counter may be employed, such as that shown in Fig. 12, wherein an armature actuated by the closing of the circuit through the magnet operates a conventional counter. These are purchaseable on the market and their details form no part of this invention. It is advantageous however to select a design which is compact and whose moving parts have a minimum inertia. Preferably the counter should be designed to require two electrical impulses before registering a count. Thus only a single count is registered by the impulses received by the successive closing of the circuit upon the passage of the front and rear wheels, respectively, of a vehicle. This is effected simply by employing a ratchet having twenty notches instead of ten for actuating the units wheel of the counter.

In Figs. 8 to 10, I have illustrated one form of recorder which serves both to count traffic and to record the same at given intervals. Such apparatus comprises a magnetically actuated counter of the type above described, coupled with a magnetically actuated recording apparatus for printing the count on a tape or the like at given intervals. The recorder is actuated by a clock which is associated with the apparatus and controls the circuit which actuates the recorder.

As here shown, a simple counter 28 is provided with printing characters adapted to print upon a tape or the like. The counter is actuated by a magnet 29 and armature 30, the latter being pivoted at 31. A pawl 32 engages a twenty tooth ratchet 33, thus requiring two impulses for each registered count of the units wheel 34. The counter in the present instance is also of standard construction, the details of which form no part of this invention. The magnet or solenoid 29 is actuated by a battery 35 which is placed in circuit with the magnet and the contact strips 11 and 12, as illustrated diagrammatically in Fig. 7.

The recording apparatus comprises a movable platen 36 hinged at 37 and adapted to be actuated to press a printing tape 38 or the like against the face of the printing characters (see Fig. 10). Ink may be supplied by a printing ribbon or in any other convenient manner such as by an inking device 39 in the form of a small pad which is rubbed over the printing characters in the region where the impression is to be placed, just prior to the operative movement of the platen 36. The inking pad is hinged at 40 which is coaxial with the axis of the counter and is actuated by a link 41 by which it is raised out of the path of the platen (see Fig. 10).

The platen and inking mechanism are actuated by a magnet 42 and armature 43 hinged at 44. The armature is connected with the platen carrying arm 45 by a link 46 pivoted to the arm at 47. A helical torsion spring 48 coaxial with the pivot point 37 engages the platen arm 45 to return it to inactive position (see Fig. 9) when the magnet 42 is deenergized.

The record tape 38 is carried in a cylindrical shell 49 from which it issues and passes across the face of the platen over the feeding roll 50 and under the small spring fingers 51 which serve to hold the paper against the feeding roll during the interval of feeding. The roll 50 is preferably faced with friction material such as crepe rubber or the like which exerts sufficient friction

against the paper tape (the latter being in contact with the roll for about one-half of its circumference during the intervals of feeding) to draw it from the supply cylinder 49 after each impression by a sufficient distance to present a clean surface to the counter type. The tape feeding roll is periodically advanced on the return stroke of the platen by engagement with a pawl 52 pivoted at 53. The engagement is effected by the downward movement of the feeding roll which is mounted at 54 on an extension 55 of the platen carrying arm 45. The shaft which carries the fingers 51 is likewise carried on such an extension. The downward movement of the roll under the action of gravity and with the assistance of spring 48, brings the ratchet 56 on the roll in engagement with pawl 52, thus rotating the roll a part of one turn and advancing the tape 38. Movement of the feeding roll in the opposite direction during the printing operation is prevented by the pawl 57 which engages the ratchet 56 at a point opposite pawl 52. The latter is counterbalanced either by a spring or in the present case, by a weight 58.

It is apparent from the foregoing that when the magnet 42 is energized, its armature through the link 46 draws the platen arm 45 toward the counter type. Before the platen reaches the type the ink 39 is raised out of position (see Fig. 10) by link 41 which is pivoted at its other end to the platen arm 45. During this movement the pawl 57 prevents any reverse rotation of the feeding roll 20 under tension of the paper. Upon opening of the circuit the platen arm falls away, lowering the ink 39 and causing the pawl 52 to rotate the feeding roll by engagement with ratchet 56.

The recorder may of course be actuated by any appropriate means either manually or automatically. Preferably its actuation is automatic so as to avoid the necessity of any manual attention. For that purpose a time clock arranged to close the recorder circuit momentarily at stated periods may advantageously be associated with the apparatus. A clock of this character is indicated at 59. The mechanism of the clock itself is standard and forms no part of this invention. Instead of hands, hour and minute wheels 60 and 61 may be employed so that the hour of the clock may be read from above through an opening in the housing in which the apparatus is enclosed. In the arrangement shown, it would be difficult to note the time of the clock for the purpose of setting it if the ordinary hands were employed. In the present instance the clock is arranged to take hourly readings and for that purpose the minute wheel is provided with a contact 62 which on each revolution engages contact 63 (see Fig. 11) to close the recorder circuit. To secure merely a momentary closing of the circuit and opening of the same independently of the movement of the clock, the contact 63 is pivoted at 64 and is engaged by finger 65 carried on one of the extensions 55 on the platen arms when the latter are raised by the closing of the circuit. The finger 65 turns the contact about its pivot in a counter-clockwise direction thus moving it out of engagement with contact 62 and opening the circuit. A helical spring 66 tends to return the finger 65 to its normal position determined by the stop 67 but it is prevented again from engaging contact 62 by the offset or step 68 which occurs adjacent the contact 62. As here shown, the surface 69 upon which contact

62 is carried is offset as at 68 to provide the step which prevents the contact 63 from again engaging contact 62. Upon completion of the rotation of the minute wheel, the contact 63 rides along the surface 69 and eventually engages with contact 62. If records are desired at a greater frequency than one hour, a plurality of contacts 62 will be required at proper intervals on the minute wheel.

The apparatus is here shown with an hour printing wheel 70 driven by the clock at the same speed as the hour wheel 60, and located coaxial with the counter printing wheels so as to print upon the tape adjacent the record of the count, the hour at which the record was made. Thus the tape itself will contain a complete record of the traffic flow as regards quantity and concentration of traffic.

In Fig. 7 is illustrated diagrammatically the relation between the counter and recorder circuits arranged for operation by the single battery 35.

Where a counter alone (see Fig. 12) is actuated, a much smaller battery may be used and the registering apparatus may be made much more compact. This is particularly advantageous where it is difficult to conceal the registering or counting apparatus to prevent unauthorized tampering. A compact apparatus also makes more simple the location of the contact strips between street car tracks in the event it is desired to count vehicular traffic on streets having street car traffic. A compact registering or recording apparatus may be simply suspended under a convenient manhole cover without requiring conductors to be led under a rail to the curb.

Obviously the invention is not limited to the details of the illustrative apparatus since these may be variously modified. Moreover it is not indispensable that all features of the invention be used conjointly since various features may be used to advantage in different combinations and sub-combinations.

Having described my invention, I claim:

1. Apparatus for counting traffic comprising in combination a plurality of thin contact strips each having an effective length of a little less than the tread gage of vehicles laid in a line transversely of the roadway where a count is desired and maintained against displacement relative to the pavement, said strips being separated a distance a little greater than the tread gage of vehicles, each of said strips containing a pair of resiliently spaced conductors adapted to be brought into contact at the point of passage of vehicle wheels, said pairs of conductors being respectively connected with electrically actuated counters and a source of energy whereby vehicles simultaneously crossing the counting line will be individually registered.

2. In an apparatus for counting vehicular traffic including, conductors, a source of electrical energy and an exhibiting means in series with said conductors, the improvement comprising a contact strip extending transversely of the road at the line of count, and having alternately arranged active and inactive sections, each active section containing a pair of normally separated conductors extending longitudinally of the strip, said pair of conductors having an effective length of slightly less than the standard tread of vehicles to be counted.

3. In an apparatus for counting vehicular traffic including, conductors, a source of electrical energy and an exhibiting means in series with said

conductors, the improvement comprising, a contact strip extending transversely of the road at the line of count, and having a series of longitudinally spaced conductors, said conductors extending longitudinally of the strip and being spaced a distance slightly greater than the standard tread of vehicles to be counted.

4. Traffic counting apparatus of the character described comprising in combination a series of spaced contact strips extending transversely across a roadway, the effective length of each strip being approximately that of the standard vehicle tread spacing, said strips being spaced apart by a distance slightly greater than such tread spacing, and an independent counter associated with each strip.

5. Traffic counting apparatus of the character described comprising in combination a series of spaced contact strips extending transversely across a roadway, the effective length of each strip being approximately that of the standard vehicle tread spacing, said strips being spaced apart by a distance slightly greater than such tread spacing, each strip having a pair of spaced electrical conductors extending longitudinally thereof and adapted to be brought into electrical contact by a passing vehicle, a counter for each of said strips, and electrical circuits between said strip and counters respectively whereby the

counters register traffic engaging the respective strips.

6. Traffic counting apparatus of the character described comprising in combination a series of spaced contact strips extending transversely across a roadway, the effective length of each strip being approximately that of the standard vehicle tread spacing, said strips being spaced apart by a distance slightly greater than such tread spacing, each strip having a pair of spaced electrical conductors extending longitudinally thereof and adapted to be brought into electrical contact by a passing vehicle, a counter for each of said strips, and relays in circuit with each of said strips, said relays respectively controlling said counters whereby a low voltage source of current may be employed to actuate said counters.

7. Traffic counting apparatus of the character described comprising a counter actuating device in the form of a deformable strip extending transversely across a roadway and maintained against displacement relative to the surface thereof, said strip having active sections each having an effective length approximately that of the standard vehicle tread spacing and longitudinally separated by an inactive section of a length slightly greater than such tread spacing, and a counting device associated with each active section of said strip.

JOHN M. PAVER. 30