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Maronde et al.

[11] **3,866,165**

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[54] **DEVICE FOR MONITORING TRAFFIC**

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[52] **U.S. Cl.** ..... **340/31 C**, 346/107 VP

[51] **Int. Cl.** **G08g 1/10**

[58] **Field of Search** ..... 340/22, 31 R, 31 C; 346/33 D, 107 VP

[56] **References Cited**

UNITED STATES PATENTS

2,347,194	4/1944	Holliday	340/31 C
2,871,088	1/1959	Abell	340/31 C
3,060,434	10/1962	Biedermann et al.	346/107 VP

FOREIGN PATENTS OR APPLICATIONS

945,693	1/1964	Great Britain	340/31 C

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Assistant Examiner—Randall P. Myers
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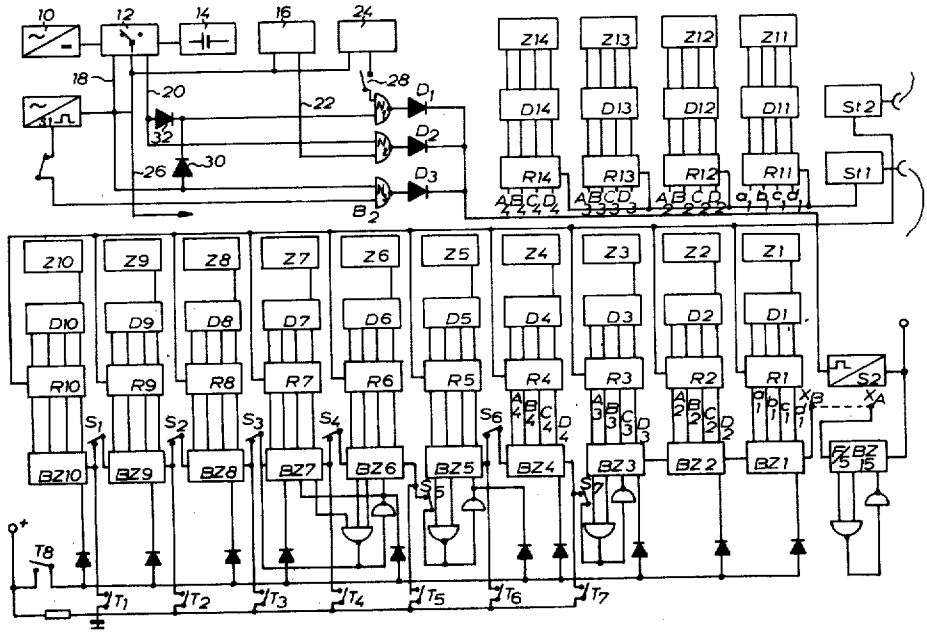
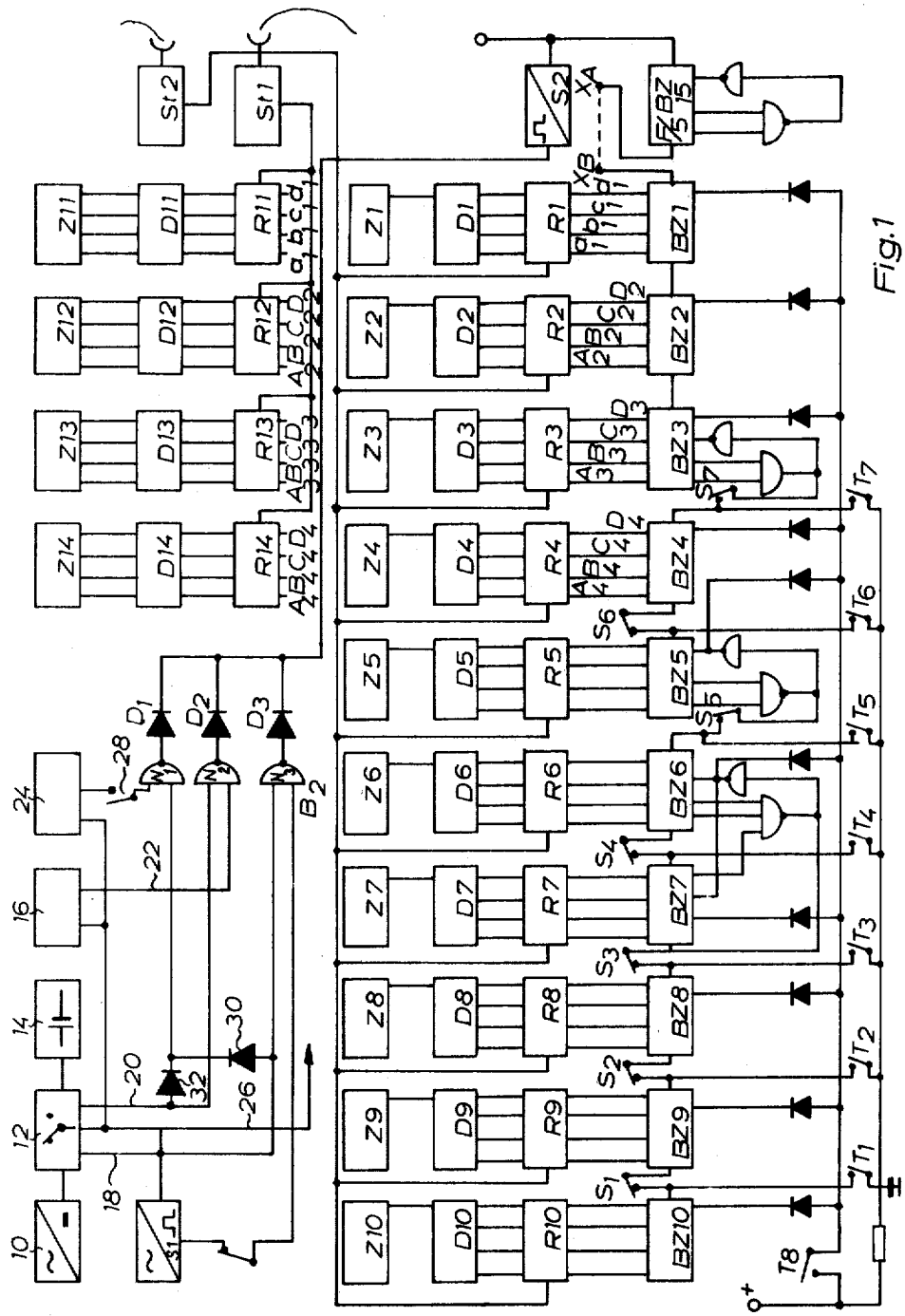
[57] **ABSTRACT**

A camera photographs an intersection when a vehicle enters the intersection against a "stop" light indication. The camera simultaneously photographs two clocks, a first of which exhibits the time when the photograph was taken and the other of which exhibits the time as it existed at the initiation of that "stop" light indication. The clocks are digitally operated by periodic impulses from one of several impulse generators. Alternative embodiments are described for delaying a periodic impulse from changing the reading on the first clock while a photograph is being taken.

10 Claims, 3 Drawing Figures

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St1
S2
XA
XB
BZ 15
Z11
D11
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Fig.1

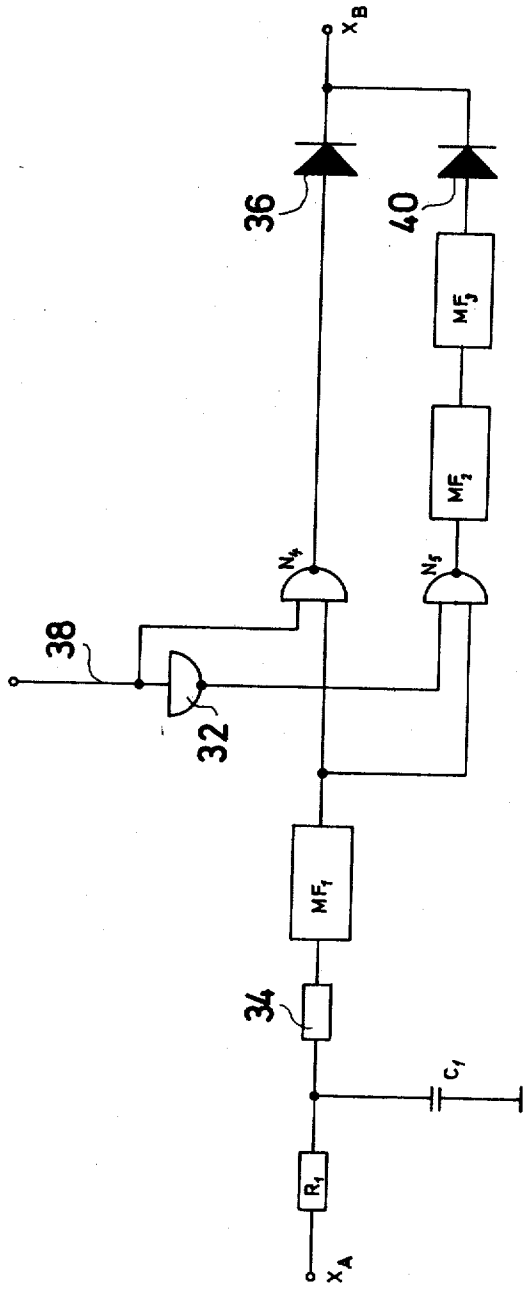

Fig. 2

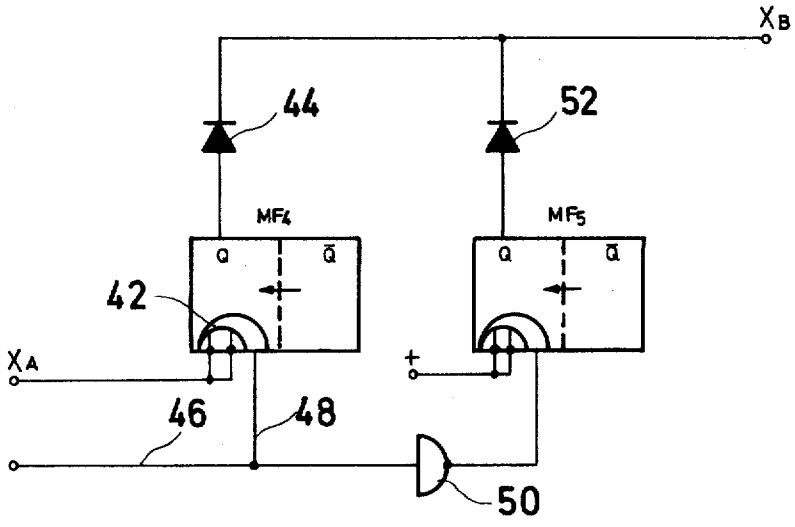

Fig. 3

DEVICE FOR MONITORING TRAFFIC

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a device for monitoring the traffic at signal-controlled road intersections comprising a photographic camera which, during the "stop" period, is actuated by a vehicle driving into the intersection to photograph simultaneously both the intersection and a time meter.

Devices of this type serve to provide evidence of traffic violations, particularly that of driving into a road intersection against a stop light. This evidence is provided by photographing the road intersection and the violating vehicle therein. Preferably it also shows the traffic signal. From such a photograph, the license plate of the violating vehicle can be seen. Such a photograph evidences that this vehicle was driven into the intersection during the stop period. Such devices for monitoring traffic are well known (German patent 683,658, U.S. Pat. No. 2,347,194).

It is often difficult, even for the defendant, to determine which of the individuals normally driving the particular vehicle was the one who was driving when the violation was committed. Therefore, in prior art photographic traffic monitoring devices, date and local time are photographed together with the violating vehicle (German Patent No. 946,594). Thereby the time of the traffic violation is fixed. In this prior art device, the time meter is a conventional watch.

It has also been suggested to photograph a secondindicating hand on said watch. This latter prior art device serves for speed monitoring by following the vehicle to be monitored in a monitoring vehicle at the same speed and taking photographic pictures in selected time intervals.

The defendant could argue that he had entered the intersection just at the moment when the traffic signal was switched from "go" to "stop," so that he was not able to stop in front of the intersection. In order to overcome this objection, a watch has been photographed together with the traffic signal, in a prior art device for monitoring traffic signals (U.S. Pat. No. 2,871,088). In this prior art a plurality of photographs are taken manually. From these photographs and the states of the traffic signal, which can be recognized thereon, it is possible to determine, by means of a diagram, the mutual time relation of the moment of entering the intersection and the stop period of the traffic signal.

Furthermore, in order to make this process automatic, another prior art traffic monitoring device at signal-controlled road intersections comprises a photographic camera, actuated by a contact sensor on the road, and a time meter, which adopts a predetermined initial position before the traffic signal changes from "go" to "stop", and is started by that change. The meter is reset to the initial position at the end of the "stop" period. This time meter appears in the picture together with the image of the traffic situation. See German Pat. No. 1,154,963.

It is an object of the invention to utilize devices of the type initially discussed to provide evidence both of the accurate time of the traffic violation and of the relation of this time to the moment when the traffic signal changed from "go" to "stop." For the purposes of the discussion, the yellow caution light can be regarded as a stop indication.

According to this invention, this object is achieved in that the time meter indicates time with an accuracy of at least one-tenth of a second, and that a memory and display device is employed, to which the indication of the time meter is transferred automatically at the beginning of the stop period, and which is photographed together with the time meter and the intersection.

Thus, similar to U.S. Pat. No. 2,871,088 a time meter is photographed together with the intersection monitored, said time meter giving the exact local time at which the photograph was taken. It is, however, not necessary to take additional photographs in order to relate this occurrence to the moment at which the light changed from "go" to "stop". Instead, the time of the change of the light is established by a memory and display device. In contrast to the device of German Patent No. 1,154,963, there is no resettable time meter, but the time meter for reading local time (which is not provided in the device of the German patent) is, at the same time, used to determine the instant in the "stop" period at which the vehicle entered the intersection.

Preferably the time meter is a digital counter. The reading of the digits of that digital counter (the digits corresponding to the small time units) is transferred to a register by a control impulse produced at the beginning of the "stop" period.

In one embodiment the time meter comprises flip-flops, by which an input frequency of clock impulses is divided in accordance with the time units (days, hours, minutes, seconds and tenths of a second). The counts of the flip-flops are applied through decoders to electronic display elements. The memory and display device comprises shift registers which are also connected to digital electronic display elements through decoders and which have the control inputs to which a control impulse from the traffic signal is applied at the beginning of the stop period.

In order to make sure that the time reading is not changed during the exposure time of the photograph, it is advantageous, that the time meter comprises shift registers having parallel inputs, which shift registers are connected to the flip-flops and which actuate the digital electronic display elements through decoders, said shift registers receiving a control impulse, when the camera is released, such that the reading of the time meter remains unchanged for the duration of the photographic exposure.

Another solution of the latter problem would be, that, at the input of the time meter, a delay circuit controlled by the release impulse from the camera is provided, by which, when a release impulse is received, the next clock impulse is delayed and is counted in the space between the next-following clock pulses.

Finally the desired constancy of the time reading during the exposure can also be achieved in that a first monostable flip-flop is connected to the input of the time meter. This monostable flip-flop is triggered by the clock pulses and is rendered insensitive to the clock pulses by a camera impulse. A second monostable flip-flop is connected in parallel to said first monostable flip-flop. This second monostable flip-flop is triggered by the camera impulse and transmits a counting impulse to the time meter.

Thus an additional impulse is fed to the time meter shortly before the exposure, and then the counting of

impulses by the counter is interrupted for the duration of the exposure.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of an embodiment of the invention;

FIG. 2 is a schematic illustration of a modification, in which constancy of the reading during exposure is achieved in a manner different than the embodiment of FIG. 1; and

FIG. 3 is a schematic illustration of a modification to ensure constancy of the reading during the photographic exposure.

DESCRIPTION OF SPECIFIC EMBODIMENTS

The following disclosure is offered for public dissemination in return for the grant of a patent. Although it is detailed to ensure adequacy and aid understanding, this is not intended to prejudice that purpose of a patent which is to cover each new inventive concept therein no matter how others may later disguise it by variations in form or additions or further improvements.

In the circuit of FIG. 1, clock impulses for the time meter, which is a digital counter, are normally derived from the frequency of the a.c. power supply. To this end the a.c. supply is applied to a Schmitt trigger S_1 which produces corresponding square-wave impulses. The square-wave impulses are applied through a NAND-gate N_3 and a diode D_3 to a Schmitt trigger S_2. The output impulses from Schmitt trigger S_2 are fed to a frequency divider BZ_{15}, by which a frequency division by 5 is effected. Thus with a supply frequency of 50 cycles per second for example, the frequency divider provides an output frequency of 10 cycles per second, or one impulse each one-tenth of a second. These 10 cycles per second impulses, which will be termed "clock impulses" hereinafter, are fed to a time meter formed by a digital counter.

The d.c. supply voltage for the apparatus is provided by a rectifier and smoothing device 10. In case of failure of the a.c. supply voltage, there is an automatic change-over by means of change-over switch 12 to supply power from a battery 14. At the same time an RC-generator 16 is connected to generate the clock impulses. With a.c. supply operation, the d.c. supply voltage is applied to a conductor 18 (from which Schmitt trigger S_1 gets its d.c. power) and NAND-gate N_3 is opened. With battery operation, the d.c. supply voltage is applied to conductor 20. The power through conductor 20 opens NAND-gate N_2 and it is closed by the lack of power thereat. The impulses from RC generator 16 are fed through conductor 22 then to NAND-gate N_2. When the gate is open these impulses continue through diode D_2 to Schmitt trigger S_2.

Alternatively, the clock can be a quartz generator 24 which can be used both with a.c. power supply and with battery operation. Quartz generator 24 gets its supply voltage through an output conductor 26 from change-over switch 12, to which conductor voltage is applied both when operating with a.c. supply and with battery supply. The output pulses from the quartz generator are applied through a switch 28 to a NAND-gate N_1 which is held open by power from conductor 18 through diode 30 and by power from conductor 20 through diode 32. The impulses from quartz generator 24 are fed from gate N_1 through a diode D_1 to Schmitt trigger S_2.

The digital counter comprises flip-flops $BZ_1 \ldots BZ_{10}$ for indicating day, hour, minute, second and one-tenth of a second. These receive impulses from frequency divider BZ_{15} through the connection $X_A - X_B$. The counter readings are normally permanently taken over by shift registers R_1 to R_{10} each having four parallel inputs, for example a_1, a_2, a_3, a_4 for counter R_1. Each counter has a respective decoder identified as $D_1 \ldots D_{10}$. The amounts in the decoders are displayed by electronic display tubes Z_1 to Z_{10}.

If a photograph is taken, an impulse from the camera is applied through a control unit St2 to all of the shift registers R_1 to R_{10}. For the duration of this impulse this blocks the shift registers from the readings of the counters. Thus the last previous counter reading for each shift register is stored in the respective shift register.

The shift registers $R_1 \ldots R_{10}$ are used to take over the readings of the flip-flops (i.e. digital counters) $BZ_1 \ldots BZ_{10}$ and to store the readings if necessary. Each shift register is a well known electronic module, which normally is connected to take over the reading of the respective binary counter in parallel manner through the four inputs upon receiving a control impulse. It then stores this reading until to the end of the control impulse. By the use of the shift registers R_1 to R_{10} the display at the display tubes Z_1 to Z_{10} is kept constant for the duration of the photographic exposure thus ensuring a clear reading on the photograph.

Additional shift registers R_{11} to R_{14} are connected to the outputs a_1, b_1, c_1, d_1 etc. of the counter stages BZ_1 to BZ_4 reading minutes, seconds and one-tenth of a second. These shift registers are controlled by the traffic signal through a control unit St1 to pick up the respective counter reading at the beginning of the "stop" period and to store it. The respective counter reading is decoded by means of decoders D_{11} to D_{14} and is displayed by display tubes Z_{11} to Z_{14}.

The display tubes Z_1 to Z_{10} and Z_{11} to Z_{14} are photographed together with a photograph of the intersection being monitored. On one hand, they produce evidence of the time when the traffic signal changed from "go" to "stop" and, on the other hand, of when the photograph was taken. From this data, it is possible to determine whether the vehicle entered the road intersection immediately after the beginning of the "stop" period or sometime later.

Instead of the shift registers other means can be provided for making sure that no change of the counter reading takes place for the duration of the photographic exposure. One such circuit is shown in FIG. 2. This is a circuit which would be connected between the points X_A and X_B in FIG. 1. In this case, the shift registers R_1 to R_{10} and the associated control unit St2 could be eliminated. The circuit of FIG. 2 is based on the principle of delaying the clock impulse appearing during the photographic exposure in order that it be counted by counters $B2_1$ to $B2_{10}$ in a space between the subsequent clock impulses after the end of the exposure.

The circuit of FIG. 2 comprises an RC-network composed of a resistor R_1 and a capacitor C_1. Thereby the clock impulse arriving at X_A is delayed by about 50°, a complete cycle being 360°. This makes sure that the clock impulse cannot coincide with the control impulse

from the camera, which is also synchronized with the clock frequency. If no control impulse appears, NAND-gate N_4 is opened; and NAND-gate N_5 is closed through inverter **32**. The output from RC-network R_1, C_1 triggers a monostable flip-flop MF1 through a resistor **34**. Thereby a well defined impulse having a duration of about 1 millisecond is again obtained. This impulse passes to the counter through the open NAND-gate N_4 and a diode **36**.

When the photographic exposure is made, there is a control impulse at connector **38** which closes NAND-gate N_4. This impulse acts through inverter **32** to open NAND-gate N_5. Now the output impulse from monostable flip-flop MF1 does not get directly to the output X_B through gate N_4. Instead, it passes through gate N_5 to trigger another monostable flip-flop MF_2. The actuation of the flip-flop MF_2 triggers a monostable flipflop MF_3. The latter again produces an output impulse having a duration of 1 millisecond. This forms a delay circuit from which an output impulse is fed to the output X_B through a diode **40**. The flip time of the monostable flip-flops MF_2, MF_3 is selected to produce an additional phase shift of 410°. Thus the clock impulse flowing through gate N_5 will (1) be delayed until after gate N_4 opens and (2) appear at output X_B in the space between the next and the next but one clock pulse.

Another solution of the same problem is shown in FIG. 3. The circuit of this Figure also is to be connected between points X_A and X_B of FIG. 1 and also permits elimination of shift registers R_1 to R_{10}. Thus the counter stages are directly connected to the decoders.

In this embodiment an additional impulse is fed to the counter at the beginning of the photographic exposure, and then the passage of clock impulses to the counter is blocked for one clock impulse during the photographic exposure.

Normally the monostable flip-flop MF_4 is triggered by the clock impulses at input X_A, the clock impulses being fed to monostable flip-flop MF_4 through the normally open AND-gate **42**. The output impulses of flip-flop MF_4 pass through a diode **44** to the output X_B and thus to the counter. At the beginning of the exposure, the AND-gate **42** is closed through input **48** by a control impulse from the camera at the "clock shift" input **46**. Thus the flip-flop MF_4 will not be triggered by a clock impulse appearing during the photographic exposure.

A monostable flip-flop MF_5 is provided in parallel to the monostable flip-flop MF_4. Flip-flop MF_5 is triggered by the control impulse at the input **46** through an inverter **50** and supplies an impulse having a duration of 1 millisecond to the output X_B prior to the photographic exposure. The control impulse has a duration of one-tenth of a second, thus of the space between two consecutive clock impulses.

In the embodiments of FIGS. 2 and 3 the assumption is made that the exposure time of the photographic exposure is shorter than the space between the clock impulses, i.e., shorter than one-tenth of a second.

We claim:

1. In an apparatus for monitoring the traffic at a road intersection at which there is a traffic control light having a "stop" period, said apparatus including a time meter which computes the local time and having a time display means which displays the local time as computed and a camera which is actuated, by a vehicle driving into the intersection, to photograph both the intersection and the time meter display means, the improvement comprising:

said time meter computes the time with an accuracy of at least one-tenth of a second;

a time display device positioned to be also photographed by said camera when a photograph is taken of said intersection and said meter; and

memory means connected to said time meter and said time display device to transfer to said display device the local time as computed by said time meter at the beginning of said "stop" period during which the photograph was taken.

2. In an apparatus as set forth in claim **1**, wherein said time meter includes a digital counter, said memory means comprises register means having a control input and connected to said digital counter so that the small time units on the digital counter are transferred to the register means when a control impulse is applied to said input at the beginning of the "stop" period.

3. In an apparatus as set forth in claim **2**, including means for generating clock impulses; wherein

said time meter display means comprises first electronic display elements;

said digital counter comprises flip-flops to divide said clock impulses into time units;

said time meter comprises means including first decoders connecting said flip-flops and said display elements to apply the counts of the flip-flops to the display elements;

said register means having parallel inputs connected to said flip-flops;

said time display device comprising second display elements; and

said memory means including second decoders between said register means and the second display elements to apply the count from said register means to said second display elements.

4. In an apparatus as set forth in claim **3**, wherein said means-including-first-decoders decoders comprises shift register means having parallel inputs connected to said flip-flops and a control input for receiving a control impulse when the camera is actuated so that the flip-flop count is retained by the shift register means for the duration of the photographic exposure.

5. In an apparatus as set forth in claim **3**, wherein said time meter includes an input to receive said clock impulses, delay means between the latter input and said flip-flops and including a control input so that when a camera actuating impulse is applied at the latter control input the next clock impulse is delayed and applied to the flip-flops following a subsequent clock impulse.

6. In an apparatus as set forth in claim **1**, including means for generating clock impulses; wherein

said time meter display means comprises first electronic display elements;

said time meter comprises flip-flops to divide said clock impulses into time units, and means including first decoders connecting said flip-flops and said display elements to apply the counts of the flip-flops to the display elements;

said time display device comprising second electronic display elements; and

said memory means including second decoders and means connecting the time meter and the second decoders, the second decoders being connected to the second display elements to apply the count from said flip-flops to said second display elements.

7. In an apparatus as set forth in claim 6, wherein said means-including-first-decoders comprises shift register means having inputs connected to said flip-flops and a control input for receiving a control impulse when the camera is actuated so that the flip-flop count is retained by the register means for the duration of the photographic exposure.

8. In an apparatus as set forth in claim 7, wherein said time meter includes an input to receive said clock impulses, delay means between the latter input and said flip-flops and including a control input so that when a camera actuating impulse is applied at the latter control input the next clock impulse is delayed and applied to the flip-flops following a subsequent clock impulse.

9. In an apparatus as set forth in claim 8, wherein said delay means has an output and includes two gates one of which is closed and the other of which is opened by an impulse at said control input of the delay means, means connecting said one gate to the delay means output to pass a clock impulse thereto when the one gate means is open, and means including monostable flip-flop means having a fixed time delay connecting the other gate means and the delay means output.

10. In an apparatus as set forth in claim 8, wherein said delay means has an output, monostable flip-flop means connected to the input of the time meter and to the delay means output and having a control input, said flip-flop means being triggered by the clock impulses at the time meter input to apply impulses to the delay means output except when a signal is being applied to the control input thereof, means including a flip-flop device connected to said delay means output and having a control input connected to the control input of the flip-flop means for applying an impulse to the delay means output when said signal is applied thereto.

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