



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.01.2020 Bulletin 2020/01

(51) Int Cl.:
G08G 1/01 (2006.01) G08G 1/08 (2006.01)
G08G 1/085 (2006.01)

(21) Application number: **19173689.1**

(22) Date of filing: **10.05.2019**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Eberle, Giorgio**
31053 Pieve di Soligo (TV) (IT)

(72) Inventor: **Eberle, Giorgio**
31053 Pieve di Soligo (TV) (IT)

(74) Representative: **Citron, Massimiliano**
Via Primo Maggio, 6
31020 San Fior (TV) (IT)

(30) Priority: **25.06.2018 IT 201800006619**

(54) **CONTROL METHOD FOR A TRAFFIC REGULATOR**

(57) To improve the traffic flow, a control method is proposed for a traffic regulator (70a, 70b), such as for example a traffic light, located at an intersection between two transit routes (10, 20, 30, 40) as for example a road crossing, the traffic regulator being able to emit a signal of transit consent or prohibition.

The method has the steps of

(i) modifying the count of a time-counter according to a signal indicating the presence of a vehicle in an area of the intersection,

(ii) switching the signals of transit consent or prohibition for the first and/or second route when the time T measured by the time-counter is greater than a threshold value T_s .

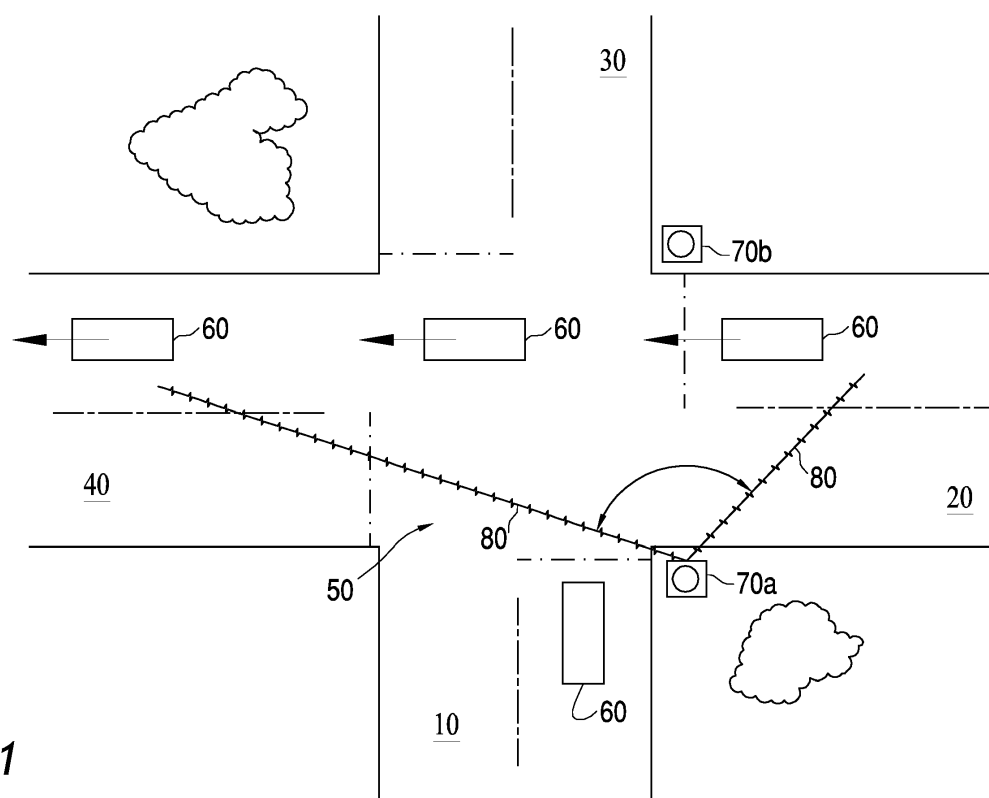


Fig. 1

Description

[0001] The invention relates to a management device and method for a traffic regulating device, such as e.g. a traffic light, located at an intersection between transit routes. The invention also relates to the regulating device provided with the management device and to a regulating device which implements the method.

[0002] Several systems are known which manage a traffic light, here chosen as a preferred example, such as e.g. US20050046597. The object is to efficiently control car and pedestrian traffic through roads, sidewalks and intersections.

[0003] New traffic control algorithms are continuously developed not only to avoid accidents, but also to speed up runoff. If queues do not form and drivers can travel smoothly, the number of accidents is also reduced. See e.g. US20090146841.

[0004] Known systems use presence sensors, such as e.g. image or infrared sensors, to detect the position and number of vehicles at the intersection. On the basis of these data the lights of the traffic-light are then driven, and/or fines are issued for various violations.

[0005] In practice these systems do not always give repeatable or satisfactory results. There are always particular traffic conditions that cause crisis to the decision-making algorithm, so that traffic suffers. Queues, slowdowns, often accidents and over-polluted areas from exhausts are formed.

[0006] The main object of the invention is to improve this state of the art.

[0007] In particular, it is the object of the invention to improve the operation of a traffic regulating device, such as e.g. a traffic light, at an intersection between transit routes such as a road crossing.

[0008] In particular, the object of the invention is to improve the operation of the traffic regulator in order to speed up the traffic flow and avoid the formation of queues.

[0009] Another object of the invention is to provide an improved traffic control device.

[0010] A first aspect of the invention concerns a control method for a traffic regulator, such as e.g. a traffic light, placed at an intersection between two transit routes such as a road crossing, the traffic regulator being able to emit a consent or prohibition signal comprising the steps of

(i) changing the count of a time-counter as a function of a signal indicating the presence of a vehicle in an area of the intersection,

(ii) switching the signals of transit consent or prohibition for the first and/or second route when the time T measured by the time-counter is greater than a threshold value T_s .

[0011] In this way the method allows the traffic regulator to be switched to give the go-signal (consent) to a

route based on a favorable condition, i.e. when there is very little traffic or no traffic on the other route.

[0012] According to a first preferred variant, in step (i) the time-counter is started when an indicative signal is detected. E.g. then the time T after the passing of a vehicle may be measured and step (ii) may be performed if T is sufficiently great, e.g. $T > T_s$.

[0013] According to a second preferred variant, in step (i) the time-counter is stopped when an indicative signal is detected. Thus e.g. the time-counter may be periodically started and stopped if a vehicle is detected. If the time T of the stopped time-counter is greater than T_s then step (ii) is carried out.

[0014] According to a third preferred variant, in step (i) the time-counter is reset when an indicative signal is detected (the count is reset). Thus one can e.g. detect if a vehicle is present in an area of the intersection, wait for a time interval T_s , within the time interval T_s the time-counter is reset or restarted when a vehicle is detected, while when the time-counter has reached the T_s value, step (ii) is performed.

[0015] According to the third variant, the time T is preferably measured in which an area of the intersection remains clear of vehicles, and if the time T is greater than T_s step (ii) is performed.

[0016] With the combination of the first and second variants, the time T may be measured as time between two successive vehicle passes on one of the two routes.

[0017] According to a preferred variant, the signals of transit consent or prohibition are luminous signals, in particular corresponding to different light sources.

[0018] According to a preferred variant, the time T is detected on vehicles that run on one of the routes and the switching of the consent or prohibition signals takes place for the other route. So one can adjust the traffic on one route with respect to the detections made on the other, so as to optimize the slowdown or stops on the route.

[0019] According to a preferred variant, the time T is detected on vehicles that run on one of the routes and the switching of the transit consent or prohibition signals occurs for the same route. So one can regulate the traffic on a route compared to the detections made on the route itself. Still the advantage is to optimize slowdowns or stops on the monitored route.

[0020] According to a preferred variant, step (ii) occurs if another condition is verified, regardless of the detected time T which is then compared with the threshold T_s . This other condition is that step (ii) occurs when a certain predetermined time $T_e > T_s$ has elapsed since the last switching. The advantage is to avoid stalls on one route in the absence of traffic on the other.

[0021] According to a preferred variant, step (ii) occurs if another condition is verified, regardless of the detected time T which is then compared with the threshold T_s . This other condition is that step (ii) occurs when a number N of indicative signals, corresponding to the passage of N

vehicles, have been received. The advantage is to avoid stalls on one route in the absence of traffic on the other.

[0022] According to a preferred variant, step (ii) takes place if or only if there are vehicles waiting or parked on the route where the consent signal, near the intersection, would be given.

[0023] According to a preferred variant, step (ii) comprises the step of switching the transit consent or prohibition signals by emitting an intermediate signal of warning of switching (for example the yellow light before the red light and after the green light).

[0024] Another aspect of the invention is a manager device comprising means for carrying out one or each of the steps of the method.

[0025] In particular, the manager device is adapted to control a traffic regulator, such as e.g. a traffic light, placed at an intersection between two transit routes such as a road crossing, the traffic regulator being able to emit a signal of transit consent or prohibition, and comprises:

- a time-counter,
- a sensor adapted to emit a signal indicative of the presence of a vehicle in an area of the intersection,

wherein the counting of the time-counter can be modified as a function of the indicative signal,

- an electronic circuit configured to switch the transit consent or prohibition signals for the first and/or second route when the time T measured by the time-counter is greater than a threshold value Ts.

[0026] Preferably the electronic circuit is configured to perform one or each of the method's variants.

[0027] Another aspect of the invention is a traffic regulator device, such as e.g. a traffic light, placed at an intersection between two transit routes such as a road crossing. The traffic regulator device comprises the manager device as defined above.

[0028] In particular, said electronic circuit is a processor programmed to perform the activities defined above.

[0029] In particular, said sensor comprises an infrared sensor, or an image sensor (such as for example a video camera), or a proximity sensor, or a contact sensor (for example comprised in the road surface).

[0030] Another aspect of the invention is a software program which, loaded into a microprocessor, performs the actions described above and/or one or each of the aforementioned steps of the method.

[0031] Preferably Ts is 3 to 5 seconds, in particular 3 or 5 seconds.

[0032] Preferably Te is 3 to 5 times Ts.

[0033] Preferably N is 5 to 10, in particular 8.

[0034] In this text the word *vehicle* mainly and preferably indicates a generic mechanical means driven by man (or even remote-controlled or with autonomous driving), used for transporting people, animals or things. The

vehicle is preferably circulating on a road, but there may be a variant of a *vehicle* on rail (a train or a tram, for example) or travelling by sea or river navigation. The *vehicle* may e.g. have two wheels (like a bicycle or motorcycle), four wheels (like a car) or more than four wheels (e.g. a truck).

[0035] Consequently said *transit routes* are preferably roads, but variants are possible for transit routes comprising e.g. rails or waterways (e.g. in river deltas).

[0036] The advantages of the device and method will however be clearer from the following description of a preferred embodiment, referring to the appended drawing in which

- Fig. 1 shows a schematic view of a regulated intersection for cars.

[0037] An intersection 50 taken as an example is determined by the intersection at 90 degrees of four roads 10, 20, 30, 40, as shown in fig. 1. The roads 10, 20, 30, 40 can be run by vehicles 60, or cycles (not shown) or pedestrians (not shown).

[0038] The transit on the road 10 is regulated by a traffic light realized according to a preferred embodiment of the invention.

[0039] For the sake of exposition only a few traffic lights are shown, but it is understood that the number and arrangement of traffic lights is dictated for example by the number of roads to be regulated and/or by the type of intersection. E.g. on the opposite roads 30, 10 or 20, 40 of the intersection 50 there are synchronized traffic lights.

[0040] The traffic light has e.g. the three known colored lights as luminous regulating signals, but could be equipped with an LCD or LED display to generate an image to be used as a signal of transit consent or prohibition. The type of traffic regulation signals in themselves and the means to generate them are not essential.

[0041] The traffic light is equipped with means for detecting the presence and/or position of the passing vehicles 60 or cycles or pedestrians. E.g. the traffic light may be equipped with infrared sensors, a VHF radar, or an image detector or contact or proximity sensors placed on the road surface. E.g. the traffic light has a capture field 80 which covers the intersection 50 and the convergent and intersecting end part of the roads 10, 20, 30, 40.

[0042] In particular, the traffic control system may be reduced to practice in a traffic light 70a placed to control traffic on the roads 10, 30 and able to monitor the transit on roads 40, 20, and in another traffic light 70b placed to control traffic on the roads 40, 20 able to monitor the transit on the roads 10, 30.

[0043] The traffic lights 70a and 70b comprise the features described above for the traffic light according to a preferred embodiment of the invention.

[0044] The traffic light 70a (70b) detects, by said means for detecting, the objects or vehicles transiting on the roads 20, 40 (10, 30) and the signal of the sensors is then processed. Such processing may take place on

board the traffic light, e.g. through a processor programmed to such aim, or via a remote control unit that responsively drives the traffic light 70a, 70b.

[0045] According to a preferred embodiment, the signal of the sensors is processed to extract the time T passing between two successive vehicle passages 60 along the roads 10, 30 or 20, 40 both measured with respect to a predetermined point of the roads 10, 30 or 20, 40.

[0046] The control logic of the traffic light 70a, 70b then performs this processing:

if the time T is less than a threshold time T_s , there is no change of state in the traffic light and traffic continues to be monitored;

if the time T is greater than a threshold or greater than T_s , the traffic light 70a, 70b switches its own regulation signals, passing for example from green to red or vice versa, to reverse the signal of consent or prohibition.

[0047] Then, when e.g. along the roads 20, 40 the traffic is very sparse (T very large and/or greater than T_s), the traffic light 70a will allow with its signals the passage of traffic along the roads 10, 30. Conversely, when along the roads 20, 40 the traffic is very intense (T small and/or less than T_s), the traffic light 70a with its signals will inhibit the passage of traffic along the roads 10, 30. The traffic light 70b behaves in the same way for the roads 20, 40.

[0048] It should be noted that this control method ensures that there are no queues on the roads 10, 30 or 20, 40, which e.g. occurs when a traffic light blocks traffic or switches even if the intersection is clear.

[0049] An operating variant for one or each of the traffic lights 70a, 70b provides for the evaluation of the time T by monitoring the presence of vehicles in an area of the intersection 50, e.g. in the center. Until a vehicle passes in the monitored area of the intersection, a counter is incremented, or a timer is allowed to run, which represents or gives the time T. When instead a vehicle passes in the monitored area of the intersection, the value of the counter, or of the timer, represents or gives the time T, which is compared with the threshold T_s . The decision taken after this comparison follows the same logic already described.

[0050] To prevent a traffic light from ever switching, for example because nothing passes on the monitored road, there may be a timer or watchdog that after a time T_w much greater than T_s forces the switching of the traffic light state.

[0051] To avoid dangerous or unwanted conditions such as the simultaneous switching of the traffic lights 70a, 70b in the signals of transit consent or prohibition, it is advantageous to realize, for the control of the traffic lights of the crossing a higher level logic, which takes into account in real time the state of the traffic lights. E.g. it is sufficient to provide that a traffic light can switch to the consent signal only if the other one (or each of the other ones) is already set with the prohibition signal. Or simply,

the state of one or several traffic lights is regulated as the opposite state to that of a main traffic light.

[0052] To implement simultaneous control of N traffic lights ($N > 2$), they can exchange data (and there will be a traffic light that drives the others) or there is a remote control unit that acquires data from all the traffic lights and then drives them in a safe way.

[0053] The aforementioned operating steps may be carried out by a purposely programmed microprocessor. The microprocessor may be installed in the traffic light or in a remote location.

Claims

1. Control method for a traffic regulator (70a, 70b), such as for example a traffic light, located at an intersection between two transit routes (10, 20, 30, 40) as for example a road crossing, the traffic regulator being able to emit a signal of transit consent or prohibition, comprising the steps of

- (i) modifying the count of a time-counter according to a signal indicating the presence of a vehicle in an area of the intersection,
- (ii) switching the signals of transit consent or prohibition for the first and/or second route when the time T measured by the time-counter is greater than a threshold value T_s .

2. Method according to claim 1, wherein in step (i) the time-counter is started when an indicative signal is detected.

3. Method according to claim 1 or 2, wherein in step (i) the time-counter is stopped when an indicative signal is detected.

4. Method according to claim 1 or 2 or 3, wherein in step (i) the time-counter is reset when an indicative signal is detected.

5. Method according to claim 4, with the steps of detecting if a vehicle is present in an area of the intersection, waiting for a time interval T_s , within the time interval T_s , resetting or restarting the time-counter when a vehicle is detected, while when the time-counter has reached the value T_s , performing step (ii).

6. Method according to claim 4 or 5, wherein the time T is measured in which an area of the intersection remains free of vehicles, and if the time T is greater than T_s , step (ii) is performed.

7. Traffic regulating device (70a, 70b), such as for example a traffic light, located at an intersection be-

tween two transit routes (10, 20, 30, 40) as for example. a road crossing, comprising:

- an emitter device for emitting a transit consent signal or no transit signal, 5
- a time-counter,
- a sensor adapted to emit a signal indicating the presence of a vehicle in an area of the intersection, 10

wherein the counting of the time-counter can be modified according to the indicative signal,

- an electronic circuit, connected to the previous components, configured to switch the consent signals or prohibition signals for the first and/or second route when the time T measured by the time-counter is greater than a threshold value T_s . 15

- 20
8. Device according to claim 7, wherein the electronic circuit is configured to start the time-counter when it detects an indicative signal.
- 25
9. Device according to claim 7 or 8, wherein the electronic circuit is configured to stop the time-counter when it detects an indicative signal.
- 30
10. Device according to claim 7 or 8 or 9, wherein the electronic circuit is configured to reset the time-counter when it detects an indicative signal.

35

40

45

50

55

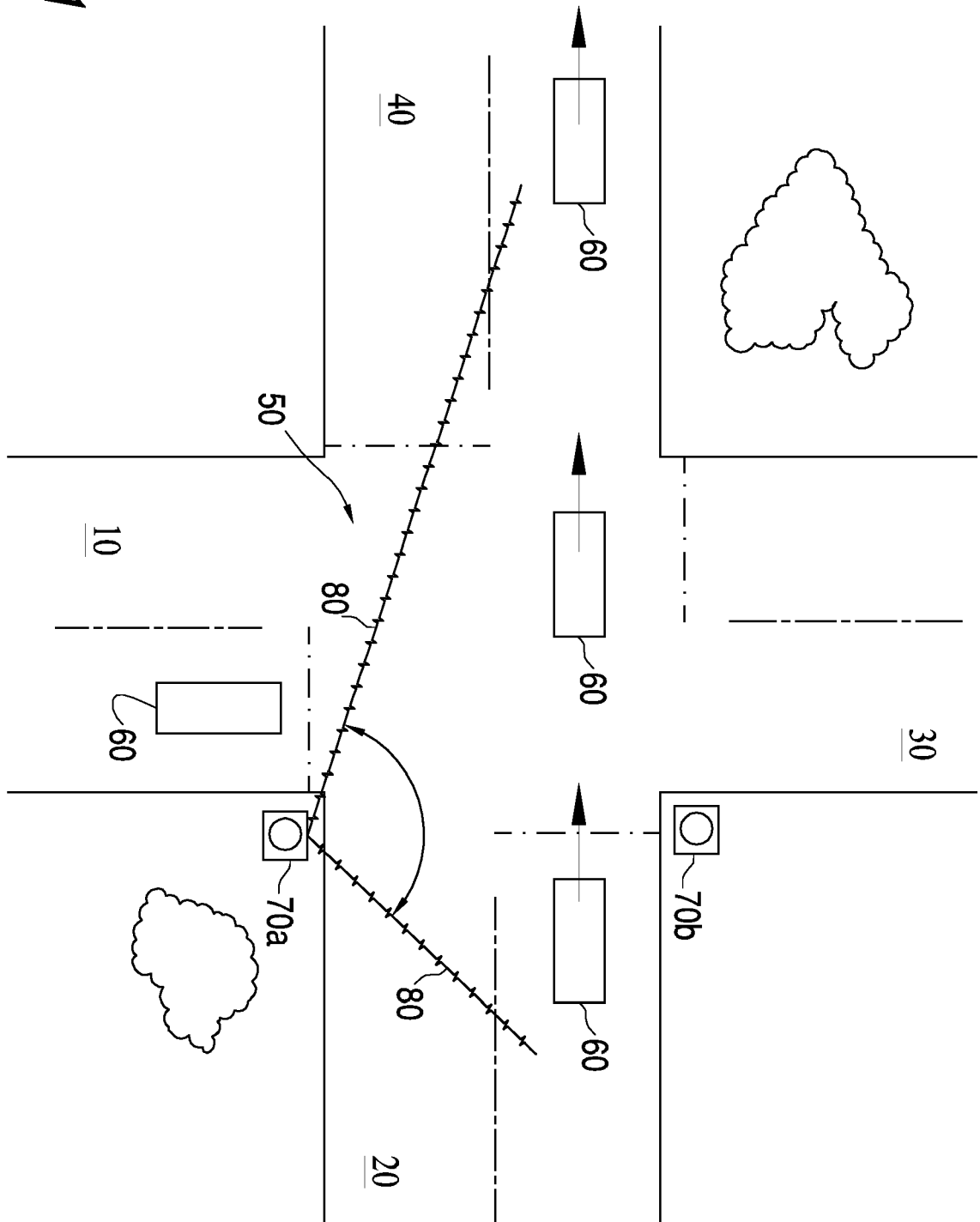


Fig. 1



EUROPEAN SEARCH REPORT

Application Number
EP 19 17 3689

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 599 144 A (DRESSAYRE JEAN) 10 August 1971 (1971-08-10) * column 1, line 15 - line 20 * -----	1-10	INV. G08G1/01 G08G1/08 G08G1/085
X	US 3 241 109 A (DU VIVIER CHARLES L) 15 March 1966 (1966-03-15) * column 7, line 11 * * column 8, line 7 - line 23; figures 1,2A * -----	1-10	
X	US 3 416 130 A (CLINTON BROCKETT PETER) 10 December 1968 (1968-12-10) * column 1, line 10 - line 50 * -----	1-10	
A	US 2009/231160 A1 (RAMASUBBU SRIDHARA SUBBIAH [US]) 17 September 2009 (2009-09-17) * paragraphs [0009], [0026] - paragraph [0029]; figures * -----	1-10	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			G08G
Place of search		Date of completion of the search	Examiner
The Hague		20 November 2019	Malagoli, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 1
EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 17 3689

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-11-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3599144 A	10-08-1971	BE 725752 A	19-06-1969
		CH 509638 A	30-06-1971
		DE 1816293 A1	24-07-1969
		DK 121595 B	01-11-1971
		FR 1567980 A	23-05-1969
		GB 1250026 A	20-10-1971
		NO 123119 B	27-09-1971
		US 3599144 A	10-08-1971

US 3241109 A	15-03-1966	GB 1019314 A	02-02-1966
		US 3241109 A	15-03-1966

US 3416130 A	10-12-1968	GB 1129498 A	09-10-1968
		US 3416130 A	10-12-1968

US 2009231160 A1	17-09-2009	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20050046597 A [0002]
- US 20090146841 A [0003]