

☐ Description : paged ..... to paged .....  
☒ Claim(s) : paged .....<sup>8</sup> to paged .....<sup>9</sup>.....  
☐ Drawing(s) : paged ..... to paged .....  
☒ Abstract : paged .....<sup>10</sup> to paged .....

## Control System and Process for the Contactless Control of a Unit, Specifically a Sanitary Facility

The invention relates to an electronic control system for the contactless control of a unit, e.g., a sanitary facility, specifically a urinal, comprising at least one emitter for emitting directed light signals, and a receiver which picks up signals reflected from a sensed object and applies them to a circuit controlling the unit. The invention relates also to a process for the contactless control of a unit.

Electronic control systems of this type have been known especially in the case of sanitary facilities. Obviously, they are being increasingly used in this respect, for hygienic reasons in public facilities, on the one hand, and generally for reducing water consumption, on the other.

Such control systems have been known also for the contactless control of washing units. These are based on an infrared sensor system. These comprise an infrared emitter which generates steady pulsed radiative power and is adjusted so that the wash basin is not sensed by an infrared receiver operating with an adjustable sensitivity but that an object, e.g., a hand, located in the intermediate zone, is sensed. Thus, a contactless control system which comprises an infrared light sensor inserted in a water circuit is known from CH-A-646 766. When a hand is introduced into the detection zone of the light sensor, the same responds. The detection zone is the region in which an emitting lobe and a receiving lobe intersect. The emitted power of the infrared emitter is constant. In order to blank out an existing background, the range of the system is appropriately limited.

Furthermore, CH-A-65 1 143 discloses a contactless electronic control system in which there are provided two spaced signal emitters which are alternately activated. In addition, two receivers are arranged near the signal emitter and are connected in such a way that a valve arranged in the water pipe is opened only when reflections of signals from both signal emitters are being received. Since two emitters as well as two

receivers are required, this control system is relatively expensive, and the power consumption is relatively high.

Finally, for controlling the flushing of a urinal, there has been known a control system provided with a radar sensor. This sensor is a direction-recognizing sensor and responds to an approach motion as well as to a subsequent withdrawal motion. Also this system is relatively expensive.

The problem underlying the invention is to create a control system of the above-described type, which has a simpler electrical and mechanical design but which is nevertheless reliable in operation and, in addition, can be manufactured at lower cost. In particular, the control system is to be suitable for controlling sanitary facilities and especially a urinal.

In a generic control system, the problem is solved in that the emitter and the receiver form an optical triangulation arrangement, wherein, for the purpose of suppressing the background, reflections from the background and from a predetermined detection zone are received. Thus, in the control system according to the invention, reflections originating from beyond the predetermined detection zone are taken into account, too. As a result, it is possible to exactly define the detection zone. The electrical and mechanical design of the control system according to the invention is very simple because only one emitter and one receiver are required. The control system can be mounted, for example, behind a cover plate in a wall recess.

The process according to the present invention is characterized in that the receiver picks up simultaneously signals reflected from a predetermined detection zone and signals from a zone forming the background and that the difference of the two signals is formed to blank the background. Thus, the signals of at least two receivers are subtracted so that a well-defined point of triggering is ensured even in the case of a relatively dark sensed object. An especially inexpensive and simple embodiment of the control system according to the invention is obtained if the receiver comprises

a differential diode and a diffusely reflected component of a light spot on the sensed object is projected onto this differential diode by means of a lens.

Disturbances due to reflections from a mirror are effectively avoided if, according to a modification of the invention, a reference receiver is mounted at a distance from the receiver and, to prevent switching because of a reflection, switching is effected only if the receiver and the reference receiver each pick up a signal. The receiver and the reference receiver always receive a signal in the case of a diffuse reflection to be detected, but only the receiver or the reference receiver receives a signal in the case of a mirror reflection which is to be excluded.

According to an advantageous modification of the invention, for the purpose of suppressing the foreground there is provided a diode which picks up reflections in the vicinity of the emitter.

The control system according to the invention is suitable especially for controlling a urinal. However, applications in other fields can be contemplated as well.

Embodiments of the invention are explained below in detail with reference to the drawings. There show:

Figure 1, a schematic view of a control system according to the present invention on a urinal;

Figure 2, an illustration of the intensity of the signals at a first receiver and of the signals at a second receiver as a function of the distance of the reflection from the emitter;

Figure 3, a schematic representation of a variant of the control system according to the invention;

Figure 4, an illustration as per Figure 2, but adapted to the embodiment according to Figure 3;

Figure 5, a schematic representation of another variant of the control system according to the invention; and

Figure 6, a schematic representation of the background blanking as well as of the foreground blanking in a control system according to the invention.

Figure 1 shows a urinal 14 which is attached to a building wall 15. To flush the urinal, it is connected to a water pipe 13. Flushing is started and stopped via a valve 12 inserted in pipe 13 and actuated by a control signal of a control system 34. The control system 34 is accommodated, e.g., behind a cover 7 in a recess 35 of the building wall 15. An electrical line 36 connects a control unit 11 of the control system 34 with the flushing valve 12.

The control system 34 has an emitting lens 10 which is mounted in an opening 38 of the cover 7. An emitter 6, which is connected to the control unit 11 via a line 39, is arranged behind this emitting lens 10. Emitter 6 is preferably a photodiode which generates infrared light pulses. The emitter's minimum power required for detection of emitter 6 is preferably adapted to the reflection properties of the background, as explained in greater detail in Swiss Patent No. 01955/93-6. The power consumption is very low so that the system can work for approximately 2 years with a battery, not shown. The control system comprises also a receiving lens 8 which is mounted in an opening 40 of the cover 7 at a distance from the emitting lens 10. A receiving system 37 comprising a first receiver 1 and a second receiver 2 is arranged behind the lens 8 in a somewhat downwardly offset position. The receivers 1 and 2 are preferably conventional receiving diodes which, as is shown in Figure 1, are arranged in side-by-side relationship on a plane parallel to the cover 7 and at different distances from the emitter 6.

The emitter 6 emits directed signals 20 exiting from the wall 15. If a user is within the detection zone 31, the signals 20 generate on the same a light spot, which is not shown here and which is diffusely reflected. The receiving lens 8 picks up a fraction 23 of this diffusely reflected radiation and projects it onto the second receiver 2.

If the user or some other sensed object is located at a trigger point 17 farther away from the emitter 6, a light spot on the user is likewise diffusely reflected. The reflected radiation fraction picked up by the receiving lens 8 is, however, passed in essentially equal parts to the first receiver 1 and to the second receiver 2.

If the operator is at a point in the background and consequently at a point even farther from the emitter 6, the radiation projected by the receiving lens 8 is passed mainly to the first receiver 1.

For the arrangement according to Figure 1, Figure 2 shows by curve S1 the intensity  $y$  of the signals at the receiver 1 as a function of the distance  $x$  of a sensed object from the emitter 6 and, accordingly, by curve 2, the intensity of the signals at the receiver 2. As can be seen, the signals at the receiver 1 for a distance exceeding the distance of trigger point 17 from the emitter 6 are stronger than the intensity of the signals at the receiver 2. Conversely, if the distance between the sensed object and the emitter 6 is shorter than the distance from the trigger point 17, the signals at the receiver 2 are stronger than at the receiver 1. Thus, by comparing the intensities of the two receivers 1 and 2, a sensed object located between the trigger point 17 and the emitting lens 10 can be distinguished from a sensed object located in the background. These two zones are denoted by the reference numbers 31 and 32 in Figure 1. The trigger point 17 can be recognized even in the case of relatively dark sensed objects if the signals of the receivers 1 and 2 are subtracted. The receiving system 37 may comprise more than two receivers or diodes if a subdivision into more zones is desired.

In the embodiment according to Figures 3 and 4, there is provided a third receiver 3 which is also mounted behind the cover 7 at a distance from the receiving system. This receiver 3, which likewise may be a diode, picks up mainly signals developing in a foreground 19. By means of this third receiver 3, sensed objects can be recognised in the blanked zone. In

order to obtain a well-defined blanked zone in the case of very bright objects, the signals of the receivers 1 and 3 are added.

The variant according to Figure 5 has an additional receiving lens 9 which is mounted in an opening 41 of the cover 7 at a distance from the emitting lens 10. A reference receiver 5 is arranged behind this additional receiving lens 9. If a mirror 25, which is aligned essentially at a right angle to the optical axis of the emitter 6, is situated in the background, signals of the emitter 6 are reflected from the mirror 25 to the receiving lens 9. These reflected signals are projected by the lens 9 on the reference receiver 5 which applies corresponding signals to the control unit 11. Since the reflections from the mirror 25 are not diffuse, the receiving system 37 does not receive any signals resulting from the reflections from the mirror 25. If a mirror 26 is inclined toward the receiving system 37, only the receiving system 37 rather than the reference receiver 5 will receive signals. If a diffusely reflecting sensed object, e.g., a person, is present instead of the mirrors 25 and 26, the receiving system 37 as well as the reference receiver 5 pick up signals at the same time. Thus, in this embodiment, the simultaneous detection of reflected light by both receivers 37 and 5 can be used as condition for recognizing a valid sensed object.

Figure 6 shows an embodiment in which the receiving system 37 has, next to each other, a first receiver 1, a second receiver 2, as well as a third receiver 3. The receivers 2 and 3 are connected in parallel in order to obtain a larger sensitive surface. The receivers 1 and 2, 3, by contrast, are connected in subtractive configuration in order to enable blanking of the background from the distance 29 cm, e.g., from 45 cm on. If a sensed object is at the distance 29, the image point appears on the receivers 1, 2 and 3 in such a way that the two receivers connected in subtractive configuration are equally illuminated, with the difference therefore being equal to zero. If a sensed object is at a greater distance, the cited difference is always negative or zero. If a sensed object is at a distance which is shorter than the distance 29, e.g., at the distance 28, which is, e.g., 15 cm, the cited difference is

positive, and the receiving system 37 is active. Thus, the valve 12 is opened by the control unit 11 in this case. If a sensed object is at a distance shorter than the distance 27, e.g., 5 cm, it is blanked by the fourth receiver 4. This receiver 4 is connected in parallel to the receiver 1. Thus, the difference is again negative in this near sensing area and, accordingly, the receiving system 37 is switched off. If a sensed object is in this near area, the flushing valve 12, for example, remains closed. The effect of the reference receiver 5 was explained above. As already outlined, the use of the control system according to the present is not limited to the control of a urinal or some other sanitary facility.



Claims:

1. An electronic control system for contactless control of a unit, e.g., a sanitary facility, comprising at least one emitter (6) outputting directed light signals and a receiving system (37) picking up signals (21, 22, 23 reflected from a sensed object (16, 17, 18) and applying the same to a circuit (11) controlling the unit (12 - 14), characterised in that the emitter (6) and the receiving system (37) form an optical triangulation arrangement, wherein, for the purpose of blanking the background, reflections (21) from that background and from a predetermined detection region are being picked up.
2. The system according to Claim 1, characterised in that the receiving system comprises at least one first receiver (1) and a second receiver (2), that the two receivers (1, 2) are mounted at different distances from the emitter (6) in such a way that a light spot on a sensed object (16) situated in the background (32) is projected substantially onto the first receiver (1) and a light spot on a scanned object (18) situated in a detection region is projected substantially onto the second receiver (2).
3. The system according to Claim 1 or 2, characterised in that the receiving system (37) comprises a differential diode and that a light spot on a sensed object is projected by means of a receiving lens (8) onto that differential diode.
4. The system according to any one of Claims 1 to 3, characterised in that at a distance from the receiving system (37) there is mounted a reference receiver (5) and that, for preventing triggering by a mirror reflection, triggering is effected only if the receiving system (37) and the reference receiver (5) pick up a signal at the same time.
5. The system according to any one of Claims 1 to 4, characterised in that an other receiver (4) is provided for recognizing a near sensed region.
6. The system according to any one of Claims 1 to 5, characterised in that the output of the emitter (6) is adapted to the reflection features of the sensed object.



7. The system according to any one of Claims 3 to 6, characterised in that the differential diode comprises a first diode (1), a second diode (2), and a third diode (3), that the second and the third diode are connected in parallel, and that the third diode is connected with the other two diodes in subtractive configuration.

8. A process for the contactless control of a unit, e.g., a sanitary facility, specifically a urinal, comprising at least one emitter (6) outputting directed light signals and a receiving system (37) picking up signals (21, 22, 23) reflected from a sensed object (16 - 19) and applying the same to a circuit (11) controlling the unit, characterised in that the receiving system (37) receives simultaneously signals reflected from a predetermined detection region (31) and signals from a background region (32) and that, for the purpose of blanking the background region (32), the difference of the two signals is formed.