DESIGN OF NEW SWITCHES INTEGRATED IN CERAMIC TILINGS

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1. PRESENTATION

The form of energy that makes the technological equipment of a building work is electricity. Nowadays, most equipment, devices and power supply systems in housing and industrial constructions run almost entirely on electricity, even when solely for system control.

The premises for good energy use lie in the installation techniques for the power supply and electrical devices, which among other aspects, will need to satisfy the increasingly demanding requirements of safety, profitability and convenience of use.

This paper proposes to present the results of a research project relating to the design of new integrated optical fibre switches in ceramic tilings, which fundamentally seek to improve the three foregoing aspects in respect of traditional switches. The new integrated switches enhance safety, as they lie behind the ceramic tile, and enhance profitability and convenience owing to the improvement in switch use and maintenance.

This project requires development of a multidisciplinary character, as it combines highly differing features: technical and functional requirements corresponding to electrical-electronic devices, the complexities of the design, fabrication and machining of the ceramic pieces and the installation of the functional assembly. For this reason, the project has been undertaken by a team of three technological Institutes and three companies from different fields:

- Instituto de Tecnología Eléctrica, ITE
- Instituto de Tecnología Cerámica, ITC
- Association for the Promotion of Ceramic Design, ALICER.
- HIDROTALL: Company dedicated to the machining of ceramic pieces
- EXAGRES: Company that manufactures extruded ceramics
- MECEL: Company dedicated to the installation and assembly of electric panels

2. OBJECTIVES

In the frame of the foregoing outline, the present project has been undertaken with a view to designing the functional, aesthetic and safety characteristics of switches integrated in ceramic tilings. The development of this type of switches is intended to address two needs: to create switches in which the electric current is not in contact with the user, thus enhancing safety, and to improve the aesthetic qualities of the ceramic facings, avoiding breaks and devices in the tiled surface.

The design of a functionally innovative and aesthetic product needs to be sought in its make-up, respecting the technical requirements regarding electrical safety, without neglecting the technological requirements of the ceramic material.

In order to address the issue adequately, full compatibility between the constructive elements used and the design of the new switch, as well as between the materials and the production process, is fundamental. The switch shall have the simplest possible form of installation, which most resembles the current type of tile installation, thus assuring compatibility.

The applicability of the end product is fundamentally focused on domotic installations, although not exclusively, since the range of applications can be very wide. Aesthetic and functional criteria as well as special environments prevail in the intended application, such as wet areas, sanitary areas, high fire risk areas and contaminated environments, in which the prime criteria are safety, protection and maintenance.

In the process of developing the project, the new designs proposed need to address the different problems raised concerning:

- Design, relating to the regulation (substitution) of pieces and their installation, owing to possible clashes between the electric requirements and the system for mounting the ceramic piece.
- Electrical features, relating to the technical and electrical safety requirements of use.
- Ceramic features, relating to the fabrication and machining process of the material.

3. INITIAL PREMISES FOR THE DEVELOPMENT OF INTEGRATED SWITCHES

First it has been essential to establish the initial conditions in which the installation of the electric items and power supply was to be performed, together with the guarantees that the new product needed to provide.

3.1. BACKGROUND INFORMATION. INSTALLATION.

In a traditional electric installation and subsequent tiling, we can identify three stages; constructive organisation of the electric installation, ceramic tile fixing, and grouting, which we shall briefly describe.

3.1.1. Constructive organisation of the electric installation.

In general terms, the electric installation in a block of flats is organised in the following way. The work for the electric installation in a dwelling starts when the structural work has ended and the compartmenting of the dwelling starts. When the internal partition walls have been placed, the electrician sets out the electric installation according to the needs and applications of each dwelling.

This is when the position of switches, power points, audio-visual and telephone connections, light fittings and outlet boxes, as well as the track to be followed by the wire tubing, avoiding tight angles that prevent the passage of the wiring, are marked.

When the electric installation has been marked, the wall chases are made to lodge the corrugated tubing, outlet boxes and mechanisms, general protection panels (CGP), audio-visual installation box, etc. The foregoing items are then mounted and fixed with gypsum paste.

In this phase the boxes need to be levelled and set in their definitive positions. Then, in order to enable plastering all the internal wall facings and tiling the wet areas, the electric wiring is drawn, with a minimum of four circuits, depending on the applicable regulations.

At this point the tile fixing process will already be affected by the variations that the new system imposes. If we intend to couple the switch to the ceramic tile, the regulator box linked to the switch will need to be fixed. This means taking into account the layout of the ceramic tiling, an operation that requires great precision and depends on many factors, or leaving the definitive mounting of the box until the tiles have been fixed.

3.1.2. Tile fixing.

Ceramic tiles can be fixed using the so-called thick-bed or thin-bed system. Owing to the general dissemination of the thin-bed system in the building sector, we have currently applied the new system of integrated switches to the thin-bed system. This system employs a cementitious adhesive for cladding walls with ceramic tiles, in a lasting and very resistant way.

The buttering and floating process is recommended for tile fixing. This consists of spreading the adhesive on the fixing surface by combing the adhesive with a notched trowel, and spreading adhesive on the tile back with a buttering or pointing trowel, or the straight edge of the notched trowel. The final thickness of the adhesive should not exceed the recommended maximum thickness.

The tiles are to be installed with a tile-to-tile joint, usually measuring 1.5 to 15 mm. These grout joints have technical functions, as their presence keeps the various stresses that arise in the multilayer system from being transmitted to the ceramic tiles.

The new integrated switches need not involve any interruption in the normal tile fixing process, because the installation of the functional piece will follow the fixing rate of the normal pieces.

3.2. ESTABLISHING TECHNICAL REQUIREMENTS

Trying to create electrical fittings built into the back of ceramic tiles poses certain constructive and electric problems that need to be solved. Some have already been mentioned, which occur both in their construction and in the maintenance of the electric installation.

One of the most important design requirements, from an electrical point of view, when approaching the design of the integrated switches developed in this project, has been that of assuring **user safety**. The basic standard that regulates electric installations, assuring installation safety, is the low voltage electrotechnical Regulation.

The Low Voltage Regulation, currently in force, was approved by Cabinet and laid down in Decree 2413/1973 of 20 September, published in the Spanish Official Gazette (BOE) nº. 242, of 9 October 1973, with the subsequent amendment of a further paragraph to article 2, on 9 October 1985 by Royal Decree 2295/1985. This regulation governs electrical installations in housing in Spain and establishes the general conditions that an installation must meet to provide an acceptable level of safety.

The integrated switches conform to the regulations on electrical circuits, while the optical fibre circuit can improve on its limits.

We shall briefly review the part of the standard that defines the prohibitions on the location of electrical fittings in wet areas, as we intend to overcome these barriers with our product, due to its features.

3.2.1. Prohibitions in installations in bathroom or toilets

For installations in bathroom or toilets, the following volumes and specifications shall be taken into account:

Prohibition volume.

This is the volume limited by vertical planes tangential to the outer edges of the bathtub, bath-toilet or shower, and the horizontal planes made up of the floor and a plane located 2.25 metres above the bottom of these or the floor, in cases where these appliances are built in the floor.

Protection volume.

This is the volume between the horizontal planes indicated for the prohibition volume and other vertical planes located 1.00 metre from this volume.

No switches, power points of light fittings shall be installed in the prohibition volume. Outside this volume, sound control mechanisms driven by a cordon or chain of insulation non-hygroscopic material are allowed.

No switches shall be installed in the protection volume, but safety power points may be installed. Fixed lighting fixtures may be installed, preferentially with Class II insulation, or lacking this, they shall not display any accessible metallic parts, while in the bulbholders no accidental contacts with active parts shall be possible when placing or removing the bulbs. In these lighting fixtures, no switches or power points shall be installed, unless the power points are safety power points.

With the new optical fibre switch it will be possible to readily access all these areas, as the switch solely runs on light.

3.3. CERAMIC MATERIAL

3.3.1. Characteristics of the ceramic material

The size foreseen for the device is that of a wall tile. In order to identify the most appropriate ceramic material to hold an installation of this type, we needed to know the technical characteristics of the possible materials.

The standards that define these products classify them in terms of the process used for forming these materials and their water absorption (indirect measurement of the porosity of the material). Moreover, the surface finish (unglazed or glazed) provides further classification criteria and appreciably modifies the behaviour of the product.

With regard to the forming process, the three types of forming mainly used in industry have been considered: dry pressing, extrusion and casting. Each of these contributes specific characteristics to the product, but also limits the possible composition of the material due to manufacturing process requirements. However, the characteristics relating to the electrical, functional and safety requirements are not particularly affected by the forming process, but rather by porosity and surface finish of the material, which depend on the manufacturing conditions used and firing temperature.

A very important characteristic of the ceramic tile, for the incorporation of a built-in switch, is mechanical strength, since the machining process will be more or less complicated and expensive depending on this characteristic. The mechanical strength of the product is directly related to porosity, and decreases as the porosity of the body (measured as water absorption) rises.

The selection of the type of ceramic tile is not limited by the above characteristics. In principle, all types of ceramic products are suitable for the application of the integrated switch, but study of these characteristics in the pieces chosen is advisable to ensure profitability, maximum efficiency and safety in the application of the system.

3.3.2. *Machining processes*

The ceramic product can be machined in several ways, which basically depends on the type of machinery used. In this section we set out the most common machining processes, which are able to perforate a ceramic piece with precision. The reason is the need to perforate the ceramic piece in order to install the switch in the tile.

Hydraulic cutting

This involves subjecting the piece to water at high pressure (3000 to 4000 atm) by means of a hydraulic circuit and pressure intensifier. Water is subsequently directed through a diamond orifice of approximately 0.2 mm diameter, into a mixing chamber to add to the abrasive that will promote cutting.

The abrasive, generally garnet between 80 and 120 nm, is incorporated into the cutting beam by the Venturi effect produced by the water, and is then directed towards the boron carbide or tungsten nozzle of 0.8 to 1.2 mm diameter and about 7 cm length, where the abrasive acquires sufficient speed and kinetic energy to produce cutting by abrasion in the region it strikes.

The cutting rate depends on the material to be treated and is about 1 to 2 m/min in single-fire and stoneware tile, etc., and below 1 m/min in porcelain tiles.

Sand blasting

These are machines that blast sand at high pressure onto the piece. The areas not to be machined are protected by an adhesive film. It is possible to control the machining depth by varying the application time. The results are difficult to control dimensionally and application is manual.

Milling machines

These allow drilling the material to the desired depth by means of high-speed boring machines and special milling cutters. They have a great precision, as the process is performed by numerical controls. Production cost is high.

4. SYSTEM GENERATED FOR THE INTEGRATED SWITCH

The purpose of the new switch is the substitution of traditional electric switches, which as already mentioned require breaking the tile to install them, in addition to hampering cleaning and not being an element that generally fits into the ceramic decoration.

The integrated switch is an optical fibre terminal with two terminations, which make any device connected to it run when the circuit is closed simply by touching it with the hand, making the light travel from one optical fibre termination to the other. The response is collected in a regulator box that will allow or prevent the passage of electric current to the connected apparatus.

The integrated switch project consists of two parts. The first part relates to the electrical features, which include the design of the switch and optical fibre circuit that accompanies it with the corresponding systems that make it work. The second part relates to the mechanical tile fixing envisaged for the new switch, which enables replacing or repairing the mechanism if necessary.

4.1. MECHANICAL TILE FIXING FOR THE FUNCTIONAL PIECE WITH STANDARD GROUTING.

It was been attempted to find the simplest possible solution which best fitted in with the thin-bed tiling system, so that the implementation of the system would be fast by all users of the new switch. Mechanical tile fixing was solved by means of a magnetic system, which assured tile installation on the wall.

The system sets the functional piece on the vertical facing using four magnets fixed by adhesive to the tile corners and four metal plates anchored in the wall. In a pre-fabrication process prior to the installation, a circular neodymium magnet is adhered in each ceramic tile corner with suitable resins for ceramic and metal, whose dimensions depend directly on the weight of the piece to be held. In the installation process, the four circular metal plates of the same dimensions as the magnet are embedded in the wall, coinciding exactly with the position of the magnets, and hence of the ceramic tile. The tile is thus fixed to the wall by the interaction between the magnet and the metal plate, but in an adjustable way.

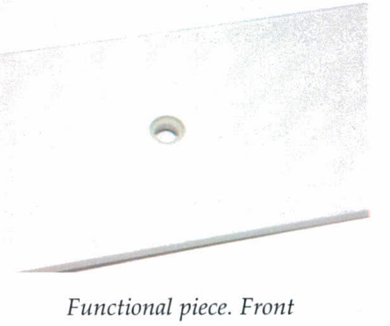
4.1.1. Pre-fabrication of the ceramic tile

As mentioned above, the tile is subjected to preliminary assembly and machining processes, which may be defined as: drilling of the piece, application of a demoulding agent in the rear part and assembly of the fittings.

The machining of the ceramic piece consists of boring a hole in the centre and cutting away a concentric area in the fair face, of a diameter defined by the dimensions of the switch. If necessary, when the total thickness of the tile plus the magnetic system exceeds the minimum thickness of the tiling, areas are to be cut away in the corners to lodge the magnets and thus reduce the build-up in thickness caused by the metal connections.

Functional piece. Back

Functional piece. Detail



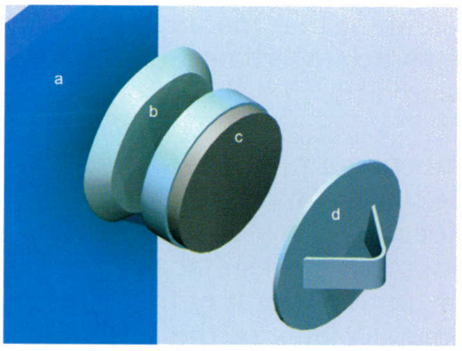
Functional piece. Front

As the execution of the tiling is intended to be fully uniform, to keep the back of functional piece from sticking to the wall, it is impregnated with a demoulding agent or covered with a plastic sheet, depending on the case and type of tile. This will avoid from it adhering to the wall because of the cementitious mortar spread on the wall.

In order to finalise the process of forming the functional piece, the magnets are adhered in the corners and the switch is mounted in the tile.

The system has been designed with axial **neodymium** magnets, since these magnets are 7 to 10 times stronger than traditional ferrite magnets. For example, for a tile of 24x12 cm four magnets of 12 mm diameter and 3 mm thick are used, which hold a total load of four kilograms.

As neodymium is a material subject to fast oxidation, the magnets are protected after they are made by a nickel coating.

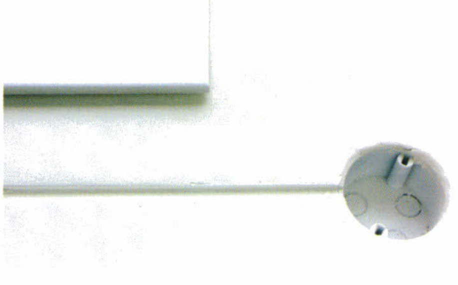


a. Ceramic tile b. Cementitious mortar. c. Circular neodymium magnet.
d. Metal plate embedded in the wall.

4.1.2. Installation

The new integrated switches entail no interruption in the normal tile fixing process, because the installation of the functional piece follows the setting rhythm of the wall tiles.

Before beginning with the tile fixing, the pre-installation is performed, which involves lodging the necessary circuits for the proper operation of the switch. In the definitive mounting of the regulator box destined for the switch, the position of the switch and the preliminary layout of the tiles making up the panel will have to be considered. The precaution needs to be taken of installing a slightly larger box than necessary in order to have a little room to allow for a small positioning error of the box during tile installation.



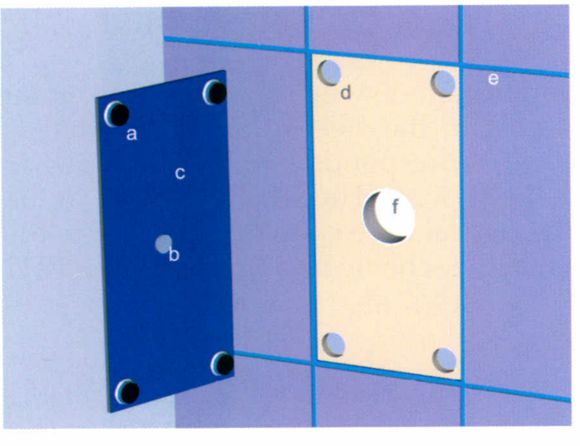
Placement of box and cable guide in the wall

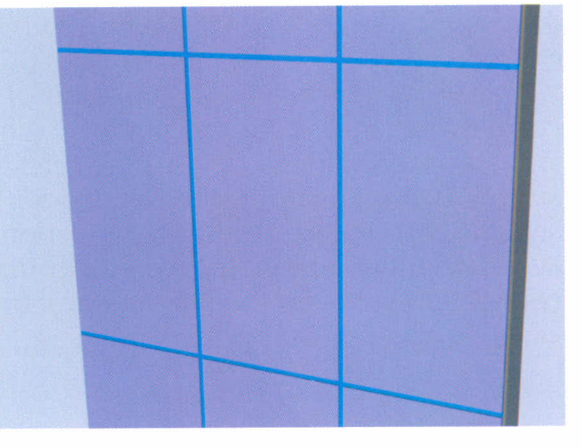
A "cable guide" is installed together with the switch regulator box that will carry the optical fibre cable circuit needed to make the installation under the ceramic tiling.

In the normal tiling process with buttering and floating, the installation of the functional piece will not be very different from that of the other tiles. After the adhesive has been spread on the fixing surface by combing with a notched trowel, the functional piece with the metal plates held together by magnets is taken, and instead of buttering the piece, the adhesive is solely spread on the metal plates. The assembly is then set on the wall.

We must only be careful during the adhesive setting time, while holding the piece in its place with the corresponding props. In this way, the plates will be definitively anchored to the wall. However, after the setting time has elapsed the tile can be withdrawn to make the connections and perform switch maintenance.

The metal plate shall have cracks and projections that favour bonding to the wall, and since the plate is mounted in adhesive, this needs to be appropriate for metal. If the tile weight is very great, and the contact surface of the adhesive with the metal is considered insufficient, larger plates than the magnet could be chosen, or fastening with bolts after the adhesive has set.



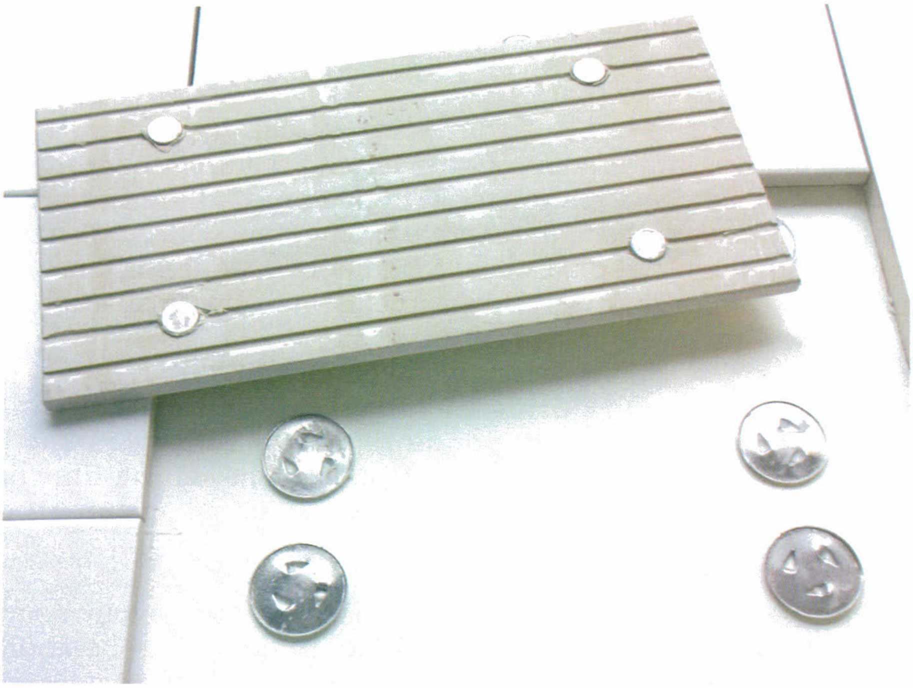


Installation.

a. Magnets. b. Switch. c. Non-stick surface.
d. Metal plate. e. Traditional grout joint. f. Regulator box.

The ceramic tiles must be installed with grout joints, as mentioned previously, including the functional piece, which is to fit perfectly into the grid formed by the ceramic tiles.

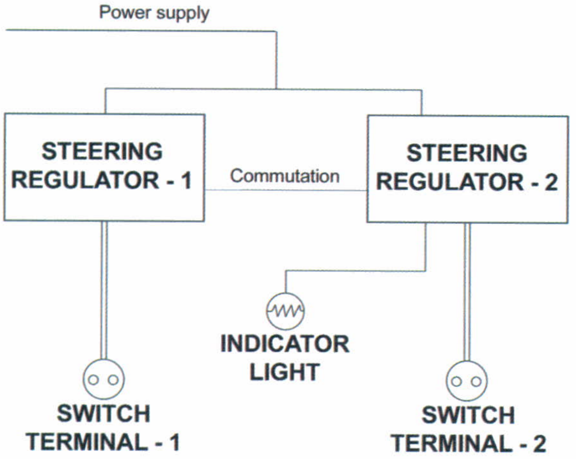
The grouting of narrow tile-to-tile joints can be done continuously, without particularly considering the presence of a special piece, which is thus completely integrated in the tiling. A minor disadvantage of this technique is that the grouting material needs to be removed whenever it is necessary to access the rear of the tile. For larger grout joints, their perimeter is first filled with a cord or rubber band, after which the joints are finished with the same material used in the entire tiled wall.



Photograph of the prototype, mechanical tiling.

4.2. INSTALLATION OF THE ELECTRICAL SYSTEM AND OPTICAL FIBRE

The system for the installation of two commutation switches and a light point consists of three different circuits, which interact in the steering box. The first is shown in the scheme by a single thick line, which corresponds to the electric power supply that feeds both steering groups and the light point. The second, shown in the scheme by two parallel lines, corresponds to the optical fibre circuit that connects the switch to the steering box. And the third, shown in the scheme by a fine line, is an RJ11 connection between the two steering boxes.



Power: To the domestic current of 230V AC/50Hz

Steering, output]-1,2: These are the electronic components that steer and verify the closing or opening of the optical circuit, with the resulting activation or deactivation of the secondary function.

Commutation: Both regulators are automatically commutated when connected. If we connect several of these regulators, they will all also be commutated.

Terminal Switch 1-2: These act as optical switches of the circuit. This is the interaction with the user.

Indicator or light point: This is the function that we are able to activate or desactivate.

Scheme of the circuit

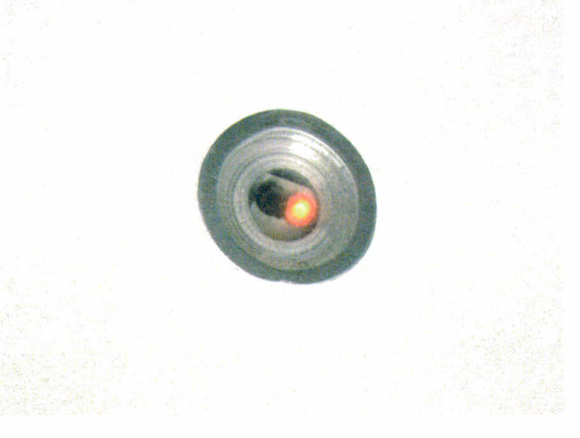
The electric wire circuit that carries 230 V shall conform to regulations and shall therefore not be located in the prohibition volumes established by these regulations. However, as the optical fibre circuit carries no voltage, it can be located inside these volumes without any problem.

Complete circuit, with two switches.

This photo shows the system mounted on the first prototype made, in order to verify the operation of the electrical devices and the installation system designed for the special piece.

4.2.1. Parts: Integrated switch

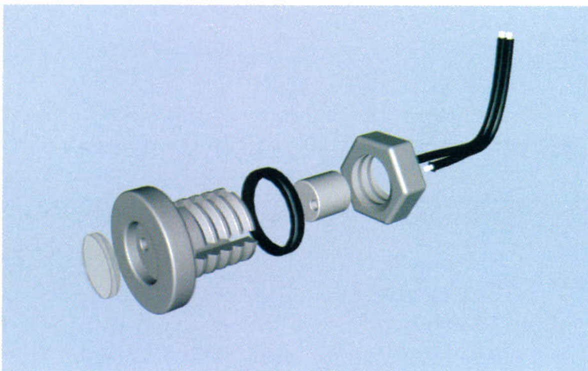
The switch allows turning the indicator light on and off as the user wishes. The design and operation of the switch are very simple. It basically consists of a flush terminal housing that holds two optical fibre cable terminations. One is active and continuously receives light from an element located in the steering box, while the other is a passive cable, which picks up the light that is reflected when the user passes his hand in front of the active terminal. Both terminations are protected by a lens to avoid damaging the piece and improve the contact surface with the user's hand.



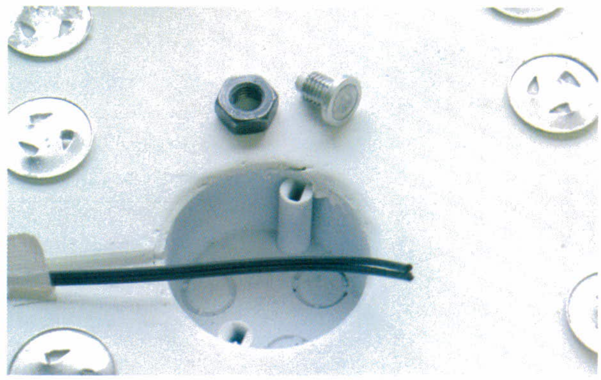
Beam of light that reaches the switch.

The circuit is thus closed with the on or off light indicator signal that reaches the steering box, which acts accordingly.

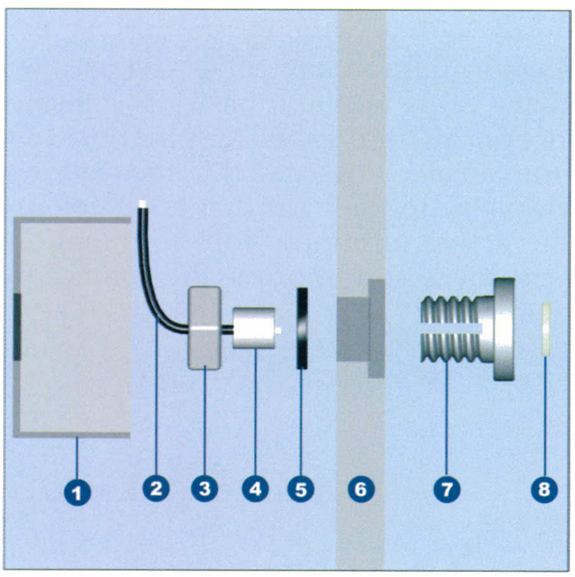
The "flush terminal housing" (made of aluminium, steel or brass) consists of a threaded cylinder with a wider head that fits in the concentric recess made in the fair face of the ceramic piece with the drill. The ends of the optical fibre cables are held inside the switch with a "guide holder" that keeps them in place. This assembly is set in the ceramic piece with a nut screwed to the "flush terminal housing" by the rear part of the ceramic piece.



Scheme of the switch



Disassembled switch



Switch part

1. Round regulator box.

2. Plastic optical fibre.

3. Mounting nut.

4. Wire guide holder.

5. Pressure washer. 6. Ceramic tile.

7. Flush terminal housing.

8. Protecting glass or lens.

Switch operation is based on the characteristics of the optical fibre, which transmits a beam of light generated by an emitter along the cable. This transmission does not occur continuously but is due to reflection phenomena along the length of the cable.

The optical fibre cable chosen in this project was a double optical cable. This cable has a core consisting of one or more acrylic resin fibres (Polymethyl Methacrylate) of 1 mm inner diameter encapsulated by a polyethylene coating of 2.20 mm diameter.

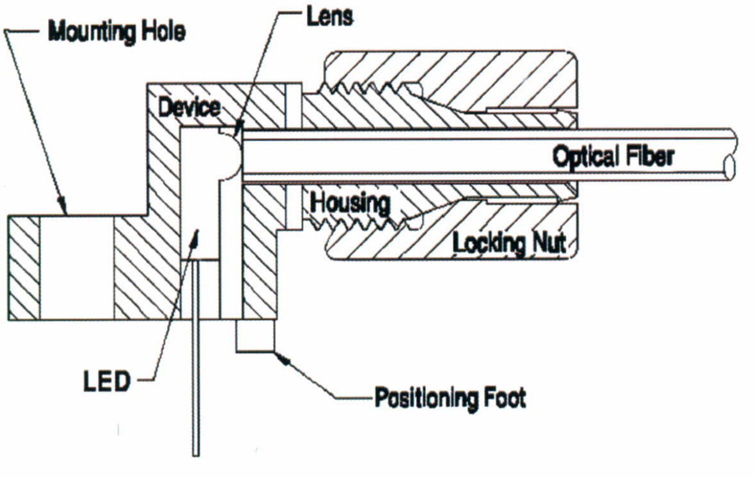
4.2.2. Parts: Steering-regulator box

The steering-regulator box holds the electronic components that run and verify the operation of the switch and the system in general. It contains the following elements.

For the optical fibre-based detection system to perform correctly, it is necessary to have a light source at one of the ends of the optical fibre cable and a photoreceptor at the other end. As far as the light source is concerned, this is provided by a red LED diode located at one of the ends of one of the optical fibre cables.

The light beam emitted by the LED diode has to be propagated by the optical fibre cable, such that the light beam can be seen at the end of the opposite end. For this, it is very important for the plastic optical fibre cable to "face" the LED diode perfectly, since loss of light could otherwise occur.

In order to solve this problem of perfect "facing" between the plastic optical fibre cable and the emitter LED diode, connectors have been used which, besides connecting the LED diode to a printed circuit board, enable facing and "strangling" the fibre cable.



Connection scheme of the LED diode and optical fibre cable.

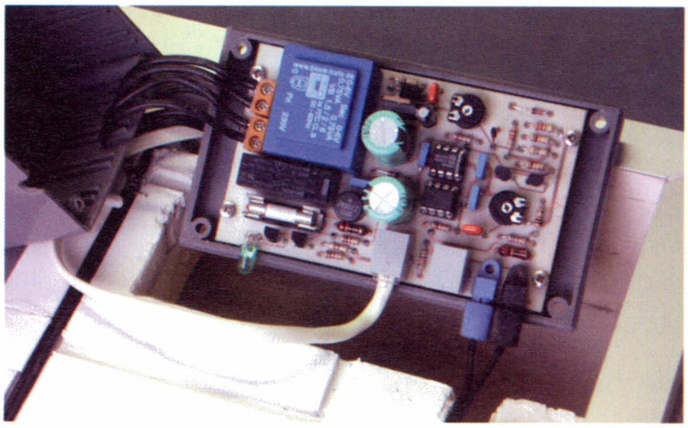
The accurate detection system also needs a photoreceptor that is able to capture the signal emitted by the LED diode. The selected photoreceptor is a phototransistor that allows logic level 1 between collector and emitter when there is no detection, and a logic level 0 when it detects the signal.

As occurred in the case of the emitter, the phototransistor must also "face" the plastic optical fibre cable perfectly. This problem of perfect "facing" has been solved with a connector very similar to the one shown previously.

Therefore, when the printed circuit board is connected to the 220 volt power supply, the LED emits a beam of red-coloured light that is viewed from the other end (located in the tile). This beam of light exits and when the light beam is refracted in the opaque object and captured by the receiver, this provides an electric signal.

The electronic circuit that uses optical fibre as a means of detection consists mainly of three clearly differentiated parts:

a. Emitter circuit and microcontroller.
b. Receptor circuit.
c. Power supply.



Interior of the steering box connected to the circuits, with the printed circuit board for the switch control.

a. Emitter circuit and microcontroller

The system used to emit the signal by optical fibre and signal treatment are based on an 8 bit microcontroller.

The components used for the emitter circuit and microcontroller are described below:

- Red light emitter LED: This emits light through the optical fibre at a frequency of 4.5 kHz imposed by pulses that the microcontroller supplies to two transistors in a Darlington configuration.
- Relay: This is made up of a coil and two contacts. One of the coil terminals is connected to the output of the voltage source rectifying bridge to be able to raise the voltage. This facilitates contact closure.
- RJ11 connectors: These are used for communication between different detection circuits. They are connected to two microcontroller pins and act according to the program that the microcontroller executes, which is detailed below.
- Potentiometer: This is used to adjust contact closure timing. It is connected to one of the microcontroller pins. Based on the resistance of the potentiometer, the microcontroller shortens or lengthens the time between relay contact opening and closure.
- Microcontroller: This steers all the foregoing inputs and outputs by means of its program.

b. Receptor circuit

This is made up of the following components:

- Receptor phototransistor: This receives the signal emitted by the emitter, which is amplified and compared by the rest of the circuit components, for subsequent introduction via one of the microcontroller pins.
- Amplification system: The pulses that come from the receiver are fed into a first amplifier by means of a condenser and a resistance. This pair of components forms a high pass filter with 1.6 kHz cut-off frequency. The signal is then amplified with a peak gain of 53.5 dB, limited in frequency by the low pass filter formed by another resistance-condenser pair.

c. Power supply

The following components were used in their fabrication:

- Fuse: The fuse cut-off value is mainly given by the consumption of all the components. Those that have the greatest consumption are essentially the relay (50 mA), emitter and receptor diodes (20 mA) and the microcontroller (100 mA max).
- Double coil transformer. The input is 230 V and the output has a power per coil of 0.75 VA.
- Double wave diode bridge. These rectify the transformer output voltage, transforming this to continuous current.
- Electrolytic stabilisation condensers. These reduce the voltage ripple. The greater their capacity, the lower the ripples, but the longer they will take to charge and achieve the desired output voltage.
- Ceramic condensers. These are placed parallel with two of greater capacity to provide a faster response to circuit current demands.
- LM7805 regulator. This serves to stabilise output voltage at 5 V and practically eliminate voltage ripple.

4.2.3. Microcontroller program for the optical fibre switch

The program run by the microcontroller is divided into two phases:

Verification of a detection, i.e., if 1 logic appears in the corresponding microcontroller pin. If this is the case, it is verified if it really is a detection or outside noise.

For this, there is a function that waits a time from the moment the first pulse is detected to then check if it is sufficiently long to be accepted as detection. The measurement of this time is performed by timer 0 by means of breaks.

If there is no noise, the corresponding microcontroller output acts in terms of the following table:

Exterior state	Interior state	Relay output
0	0	0
0	1	1
1	0	1
1	1	0

Relay output as a function of the internal state of two detection circuits.

This table refers on the one hand to the internal state of several devices. This means that we have various detection circuits that communicate with each other by RJ11 connectors. Depending on whether a detection has occurred or not, the internal state of each changes according to whether it is a connection or disconnection.

We consider the principal circuit to be the one we assign the internal state, and the other circuit to be the secondary one, to which we assign the external state.

As a function of the table, the relay contacts of both devices remain open or closed.

4.2.4. Operation

The operation of the system has been tested in a prototype made with two switches and an indicator light, to verify the three circuits that make up the system and their connection. The validity of the system and the possible industrial application of the mechanism were confirmed.

- *A 220 V microlamp was chosen as the element to be actuated.*
- *Ceramic tiles (functional and normal) installed by a system of magnetic fixing with a view to enable withdrawing any ceramic piece to observe the wiring.*
- *Optical switches anchored in the ceramic tiles.*

Prototype

5. CONCLUSIONS

A new optical fibre switch has been developed that improves the aesthetic and functional conditions of traditional switches. With regard to the installation, the minor inconvenience of fixing the functional piece in a special way, provides a series of advantages that facilitate use and maintenance of the installation:

- Regulation of all the pieces, which means enabling accessing the rear of the ceramic tile.
- Ease of maintenance of the switch and electric system.
- Firm fastening of the ceramic piece, preventing falling or detachment.
- Maintenance of the impermeability of the ceramic tiling.
- Absence or reduction of the volume of wall chases, given the small diameter of optical fibre.

The most significant technological advantages of the system of integrated switches compared with the conventional installation are set out below.

- Possibility of positioning switches in the prohibition and protection volumes specified in the low voltage electrotechnical regulations.
- Ease of use.
- Possibility of commutating devices with as many switches as desired, since the control box logic performs the commutation.
- Integration in the home domotic network.
- Multiple applications in dry areas (light switch, socket switch, tank switch) and in wet areas (alarms in showers and bathrooms).

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