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BREAKAWAY CONNECTOR

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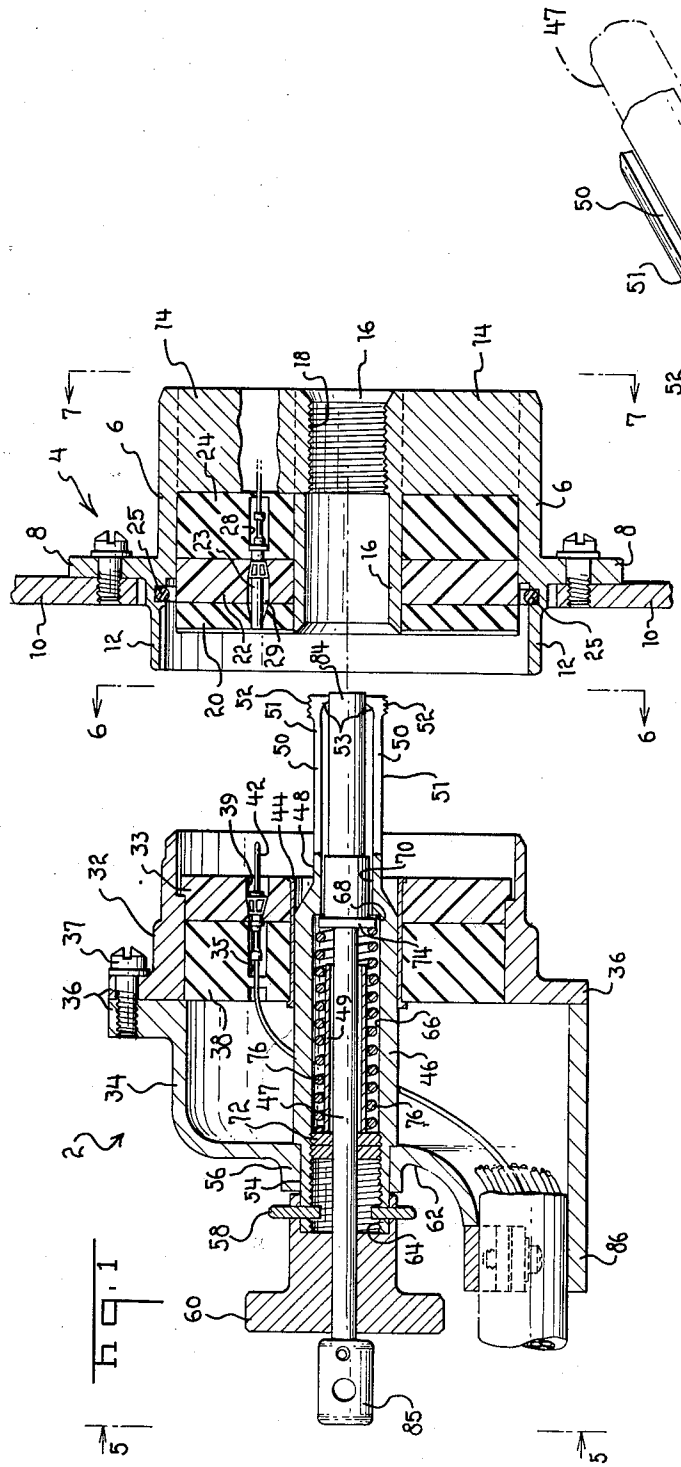


Fig. 1

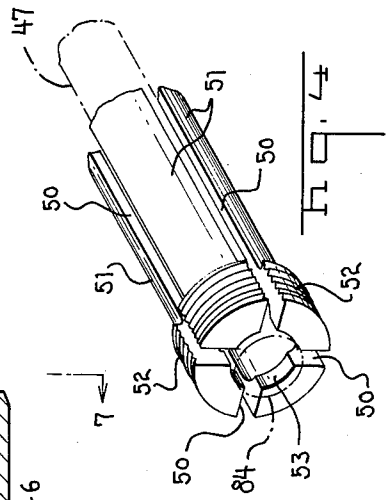


Fig. 4

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Fig. 2

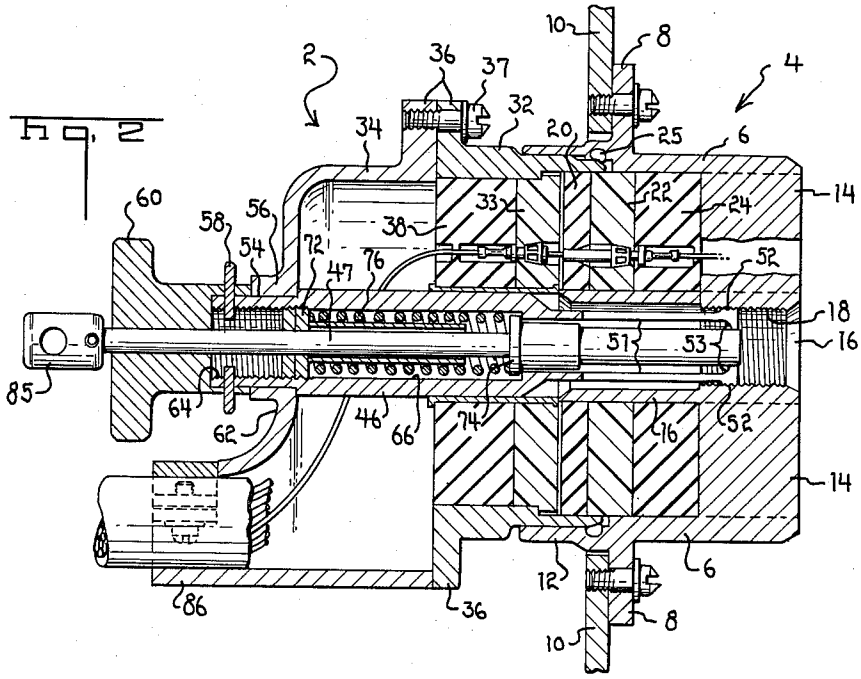
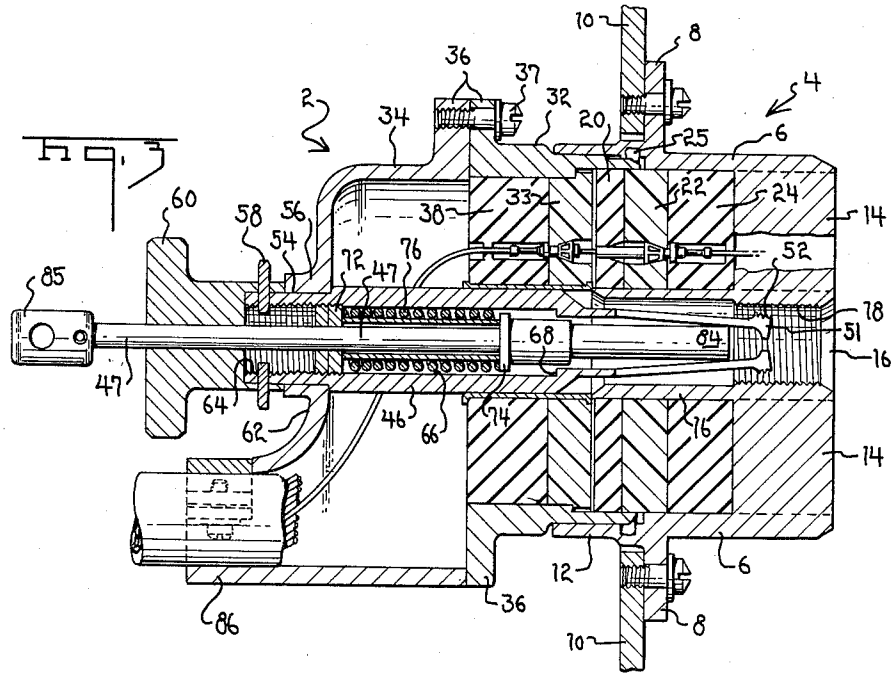


Fig. 3



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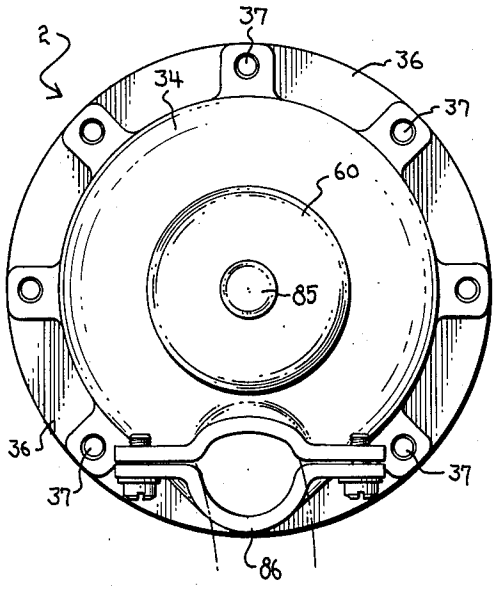


Fig. 5

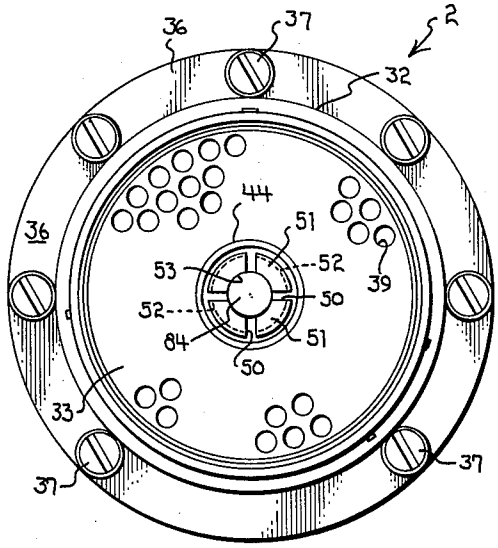


Fig. 6

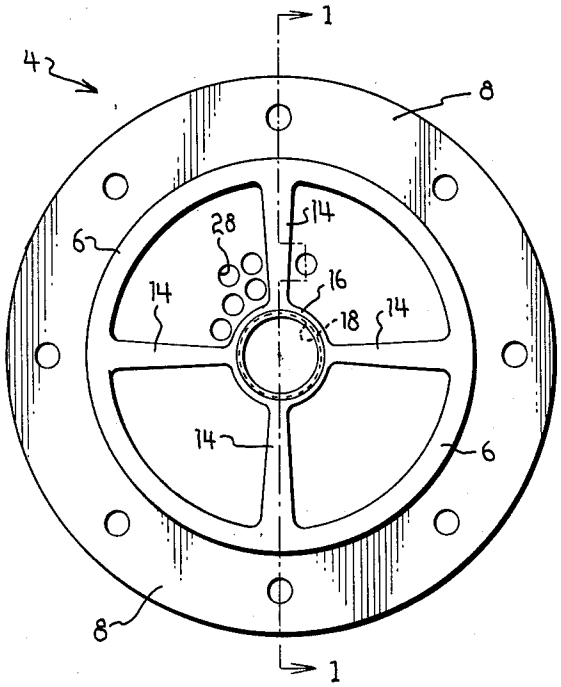


Fig. 7

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BREAKAWAY CONNECTOR

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5 Claims. (Cl. 339—45)

This invention relates to multi-contact electrical connectors of the breakaway type.

Breakaway type electrical connectors are devices for disengageably connecting a plurality of electrical conductors in a manner such that disengagement can be achieved by remote control under predictable circumstances and conditions. Breakaway connectors are used, for example, for the electrical connections between the stages of a multi-stage rocket in which one or more stages are dropped during flight. When a given stage is dropped, the electrical connections between the circuitry of that stage and the adjacent stage must be broken, preferably under circumstances such that the wiring in the adjacent stage will not be damaged. Prior to dropping of the lower stage of the rocket, the breakaway connector must be highly reliable under adverse operating conditions as regards vibration, acceleration forces, and sometimes elevated operating temperatures. The requirements for a breakaway connector are therefore somewhat antagonistic towards each other since the two parts of the connector must be readily and positively disengageable from each other by means of remote control when disengagement is desired and the connector must possess an extremely high degree of reliability under severe operating conditions prior to disengagement.

An object of the present invention is to provide an improved breakaway electrical connector. A further object is to provide a breakawy connector in which disengagement of the parts of the connector is achieved by a relatively light pulling force on one part of the connector. A still further object is to provide a breakaway connector having a positive clamping or holding means for securing the parts of the connector together which holding means is effective so long as the parts must remain coupled and is completely ineffective when disengagement of the parts is desired. A still further object is to provide a breakaway connector having jack screw means for engaging the two parts of the connector with each other.

These and other objects of the invention are achieved in a preferred embodiment comprising a plug and a receptacle, the receptacle having a threaded socket therein for engagement with a threaded shaft which is rotatably mounted in the plug. The two parts of the connector can thus be engaged or coupled with each other by turning the shaft to engage its threads with the socket in the manner of a conventional jack screw. The threaded shaft is axially bored and has slots extending inwardly and axially from its threaded end. These slots form fingers on the threaded end which normally are radially collapsed but which are maintained in a radially expanded condition by means of a control rod extending axially through the shaft. The control rod is resiliently biased to a position in which it maintains the fingers on the end of the shaft in their expanded condition so that they are engageable with the threads of the socket member but upon movement of the rod out of engagement with the ends of the fingers, the fingers collapse and the threads on the shaft are disengaged from the threads of the socket. The control rod in turn is axially moved relative to the threaded member when disengagement is required so that the holding effect of the threaded member of the plug and the threaded socket of the socket member can be instantaneously broken.

In the drawing.

FIGURE 1 is a cross sectional view taken along the lines 1—1 of FIGURE 7 showing a plug member and a receptacle member in accordance with the preferred embodiment of the invention with the parts disengaged from each other.

FIGURE 2 is a view similar to FIGURE 1 showing the parts in engagement with each other.

FIGURE 3 is a view showing the movement of the control rod at the instant of breakaway of the parts.

FIGURE 4 is a fragmentary view showing the end of a threaded shaft which forms part of the invention.

FIGURES 5, 6, and 7 are views taken along the lines 5—5, 6—6 and 7—7 of FIGURE 1.

The disclosed embodiment of the invention comprises a plug 2 having a plurality of pin contacts mounted therein and a receptacle 4 having an equal number of socket contacts so that as the plug is brought into engagement with the receptacle, the individual pin contacts in the plug are engaged with the socket contacts of the receptacle. If desired, the pin contacts can be mounted in the receptacle and the socket contacts in the plug. Receptacle 4 comprises a generally cylindrical metallic shell 6, 12 having a radially extending flange 8 intermediate its ends by means of which it is adapted to be secured to a panel 10. The rearward portion 6 of the shell has a plurality of evenly spaced spokes or webs 14 extending radially towards the center or axis of the shell which support a generally cylindrical hub 16. The rearward portion of this hub which appears at the right in FIGURE 1 is internally threaded at 18 and is adapted to receive the threaded end of a shaft in the socket member as described below. Insulating discs 20, 22, 24 are mounted in the shell in front of the spokes 14 and in surrounding relationship to the hub. These discs have aligned openings 28, 29 to define cavities for reception of socket contacts 23 the disclosed embodiment having retaining springs in the cavities which springs permit insertion of the contacts from the right-hand side of the receptacle and are effective to prevent withdrawal of the contacts. The disc 22 is advantageously of a relatively hard epoxy resin while the disc 24 may be of silicone rubber or other softer insulating material. The disc 20 is also of a yieldable material such as silicone rubber in order to achieve an interfacial seal when the plug and receptacle are in engagement with each other. In the disclosed embodiment, a sealing ring 25 is provided in a recess on the inner wall of the forward shell portion 12 in order to seal the periphery of the mating faces of the plug and receptacle when they are against each other.

The plug member 2 comprises a two part shell consisting of a cylindrical forward section 32 and a rearward section 34, these sections having radially extending abutting flanges 36 through which fasteners 37 extend to secure the shell parts together. A pair of discs 33, 38 are contained in the forward shell section of the plug, the disc 33 advantageously being of a relatively firm epoxy resin while the disc 38 is again of a softer insulating material such as silicone rubber. Aligned openings 35, 39 in the discs 33, 38 are provided to form cavities for reception of the pin contacts 42 which are inserted from the rearward side of the disc 38 prior to assembly of the shell parts. It will be understood that the plug and socket insulating inserts 20, 22, 24 and 33, 38 may be of any desired insulating materials. The arrangement of having a silicone rubber disc 20 in the socket portion of the connector for engagement with a relatively hard epoxy disc 33 of the plug achieves a seal around each of the individual pairs of contacts as the two parts of the connector 2, 4 are drawn into engagement with each other with concomitant compression of the rubber disc 20.

The insert discs 33, 38 have a central opening in which there is mounted a cylindrical metallic bushing 44. A hollow shaft 46 is mounted coaxially in the plug member and rotatably supported in this bushing and a control

rod 47 is contained within the shaft and axially movable with respect thereto. The righthand end of shaft 46 which is received within the hub 16 of the receptacle is of reduced diameter as shown at 48 and a plurality of radially evenly spaced slots 50 extend inwardly from the end of the shaft to form resilient fingers 51. Fingers 51 are normally radially collapsed towards the axis of the shaft as shown in FIGURE 3 but are maintained in an expanded condition by the control rod 47 when the parts are in the positions of FIGURE 1. The extreme ends of the fingers have external threads 52 which are complementary to the internal threads 18 of hub 16 and on their inner sides have radially inwardly directed foot portions 53 for engagement with control rod 47. It will thus be undestood that the fingers 51 are maintained in the position of FIGURE 1 by the end of the control rod.

The lefthand end of shaft 46 is of reduced diameter as shown at 54 and extends through and is rotatably supported by a bearing boss 56 on the back wall 62 of shell section 34. A knob 60 is mounted on the end portion of the shaft which projects axially beyond the end of the bearing boss by means of a generally C-shaped retainer 58. This retainer extends partially around the knob and has its ends extending through aligned openings in the knob and in the shaft. Shaft 46 is thus restrained against axial movement by the shoulder at reduced diameter end portion 54 of the shaft and the end of knob 60 which is secured to the shaft and bears against bearing boss 56.

The left-hand end of the shaft has a threaded counterbore section 64 extending up to an intermediate uniform diameter bore portion 66. The intermediate uniform diameter portion 66 extends for a substantial distance along the center portion of shaft 46 and terminates in a rearwardly facing shoulder 68 so that the frontal portion 70 of the bore is of a further reduced diameter.

The control rod 47 extends through an axial bore in knob 60, through the intermediate bore portion 66 of the shaft 46, and has a radial collar 74 adjacent to the shoulder 68 in the control rod to prevent rightward movement of the rod 47 with respect to the shaft 46. A helical spring 76 is provided in surrounding relationship to the intermediate portion of the control rod and bears at its right-hand end against collar 74 and at its left-hand end against a threaded disc 72 in the threaded counterbore 64 of the rotatable shaft. Advantageously, an additional threaded disc may be provided to lock the retaining disc in its desired position. A sleeve 49 is provided on the intermediate portion of the control rod and between the spring 76 and the surface of the rod, this sleeve being of the length somewhat less than the distance between the collar 74 and the surface of the disc 72 when the parts are in the position of FIGURE 1. The sleeve 49 thus permits limited leftward movement of the control rod with respect to shaft 46 but prevents movement of the rod after the collar engages the end of the sleeve.

Advantageously, a portion of the control rod to the right of collar 74 is of a diameter slightly less than the internal diameter of the forward portion 70 of the bore in shaft 46 so that a bearing surface for the control rod is provided in this vicinity. The end 84 of the rod 47 normally extends to the end of the shaft so that the fingers 51 are normally held in their radially expanded position by the rod as shown in FIGURE 1.

A knob 85 is secured to the end of the rod 47 which projects beyond knob 60 and is adapted to receive a lanyard or other control member to move the rod 47 axially with respect to shaft 46. The conductors which extend from the contacts are led downwardly within the shell portion 34 and externally of the connector through a neck 86, a clamp member being provided to function as a strain relief for the conductors and prevent transmistion of tensile forces to the contacts themselves.

Under normal circumstances the parts will be in the positions shown in FIGURE 1 with the control rod 47 urged rightwardly in this view with respect to the shaft

46. The spring fingers 51 on the end of the shaft will therefore be resiliently expanded by the end 84 of the rod so that the threads 52 can be engaged with the threads 18 of the socket member. When it is desired to engage the parts of the connector with each other, the plug is aligned with the receptacle and the knob 60 is rotated to cause the engagement of the threads 52 with the threads 18 until the mating faces of the two parts are against each other. For purposes of assembling the plug 2 to the receptacle 4 then, the rods 46 functions as a jack screw and provides a mechanical advantage to overcome the force required to bring the parts into engagement with each other. Under many circumstances, and particularly where a large number of contacts are provided in the connector assembly, the force required for the coupling operation is quite large and the use of a jack screw arrangement to assist in bringing the parts together is highly advantageous.

After the parts have been coupled, the threaded engagement between the end of the shaft 46 and the hub 16 of the socket provides a positive and secure means of holding the two parts of the connector in engagement with each other. Breakaway connectors in accordance with the invention thus provide a positive clamping means for holding the parts together in the same manner as conventional connectors provided with conventional jack screws.

When rapid decoupling of the connector is to take place, a pulling force is exerted on the knob 85 on the end of the control rod 47 and the rod is pulled leftwardly in FIGURE 1 until collar 74 engages the end of the sleeve 49. During movement of the rod 47, the fingers 51 collapse radially inwardly and the threads 52 are disengaged from the threads 18 of the hub. Upon application of a further pulling force on the control rod 47, the plug contact 2 is pulled leftwardly out of engagement with the receptacle member.

The invention thus provides the overall advantages of a conventional multi-contact connector having jack screw means for drawing the parts together and for holding them in assembled relationship to each other and also provides a positive and relatively simple means for disengaging the parts when such disengagement is desired.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

I claim:

1. A breakaway type connector comprising a plug and a receptacle engageable with each other, an internally threaded socket in said receptacle and a hollow shaft rotatably mounted in said plug, one end of said shaft comprising a plurality of axially extending externally threaded fingers, the normal outside diameter of said one end of said shaft being less than the internal diameter of said socket, a control rod in said shaft, said rod being axially movable with respect to said shaft, and resilient means normally biasing said control rod towards said one end to resiliently expand said fingers to an outside diameter substantially equal to the inside diameter of said socket whereby, said plug and receptacle can be drawn into engagement with each other upon threading said end portion of said shaft into said socket, and said plug and receptacle can be disengaged from each other upon axial movement of said control rod against the force of said resilient means away from said one end with concomitant collapse of said fingers and disengagement of said shaft from said socket.

2. A device as set forth in claim 1 including means

applying a pulling force to said control rod to move said rod away from said one end.

3. A device as set forth in claim 2 including stop means for limiting movement of said control rod away from said one end and transmitting pulling forces from said control rod to said plug member.

4. A breakaway type connector comprising a plug and a receptacle engageable with each other, an internally threaded socket in said receptacle and a hollow shaft rotatably mounted in said plug, one end of said shaft comprising a plurality of axially extending externally threaded fingers, said fingers being normally radially collapsed and said one end of said shaft having a normal outside diameter which is less than the internal diameter of said socket, a control rod coaxially contained in said shaft and axially movable with respect thereto, a coil spring surrounding said rod and normally biasing one end of said rod towards said one end of said shaft whereby, said rod normally maintains said fingers in a resiliently expanded condition in which said threads on said fingers are engageable with said internally threaded socket thereby to permit pulling of said plug into engagement

with said socket upon threading said shaft into said plug, and means for moving said rod axially away from said one end of said shaft thereby to permit collapse of said fingers and disengagement of said plug from said receptacle.

5. A device as set forth in claim 4 wherein the opposite end of said rod extends axially beyond the end of said shaft opposite to said one end of said shaft and including shoulder means for transmitting a pulling force from said rod to said plug whereby, upon application of a pulling force to said opposite end of said rod, said rod first moves axially away from said one end of said shaft to permit collapse of said fingers, and thereafter said plug is pulled away from said receptacle.

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