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(54) **Seismic shock absorber system and damping device for buildings with framed structure made of reinforced concrete**

(57) This invention relates to a shock absorber System and Damping device designed to improve the strength against seismic action upon existing buildings with a framed structure made of reinforced concrete beams, columns and slabs, by means of anti-seismic dampers connecting one beam support from a particular floor to the base of the column on the next lower floor, where it rests on another end of the same beam inside each portal gap. (Fig.4).

Said system can also be adopted for new buildings.

Its area of utilization is that of anti-seismic building and rehabilitation of buildings.

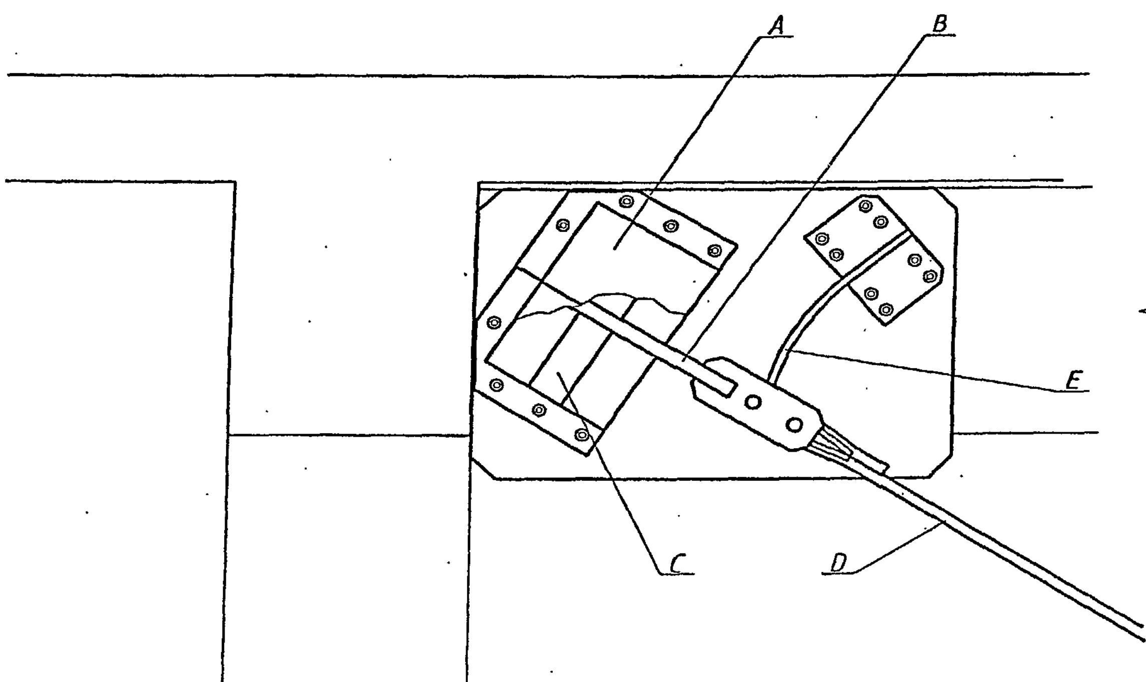

FIG. 4

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Description

[0001] The present description relates to a system designed to improve the behaviour and to enhance security in face of seismic action, of existing buildings with a framed structure formed of reinforced concrete beams, columns and slabs.

[0002] A great number of the buildings that compose the country's housing complex possess a three-dimensional structure made of reinforced concrete columns and beams, that form a portal like system on each one of the in plan directions.

[0003] In case of occurrence of an earthquake a building having one such structure will resist chiefly through the flexion forces installed in the columns, and in the beams as a result of horizontal displacements imposed by the seismic acceleration that is transmitted to them from the ground.

[0004] For small displacements, the structure behaves elastically, wasting some of the seismic energy through the successive traction and compression of steel rods present inside columns and beams without suffering great damages; for great displacements however the deformations upon the rods turn themselves irreversible, and plastic hinges start forming upon the more stressed sections of beams and columns with appreciable damages to the structure, and increasing danger of collapse.

[0005] The preferred embodiment of this invention is afterwards described in detail, based on the drawings from the annexed figures, which show schematically:

Fig.1 - Assembly scheme of the anti-seismic damping devices for the seismic shock damping system of the invention, at two perpendicular vertical plans.
Fig.2 - An assembly scheme for the anti-seismic damping devices.
Fig.3 - The Assembly of a damper from said shock damping system.
Fig.4 - The main body of an anti-seismic damping device, and its fittings.
Fig.5 - A lower anchoring element for an anti-seismic damping device.
Fig.6 - The masking of an anti-seismic damping device.

[0006] In an elastic phase, the displacements endured by the structure are limited by its inherent damping capacity that allows it to dissipate some of the received energy. However, this capacity is reduced, and that's why in present structures the displacements may easily exceed the values corresponding to resilient behaviour.

[0007] The anti-seismic dampers of the current invention aim at providing an already existing structure with extra damping capacity, therefore allowing a bigger energy dissipation for relatively small displacements.

[0008] The applied principle is that of the energy dissipation through the repeated deformation of blocks equipped with cores comprising high ductility metal rods. When the system is repeatedly actioned by an earthquake the rods get heated, and they dissipate the energy received as heat, which is transmitted to the metallic parts and is then dissipated to the concrete and to the surrounding atmosphere.

[0009] The shock damping system is installed inside each structure portal (Figs. 1 and 2) between opposed joints on the same diagonal, i.e. connecting a beam support from a certain floor to the base of the column that supports the other end of same beam. The system is mobilized through the successive extensions and shortenings of the diagonals when the earthquake acts upon it.

The damping devices comprise the following elements:

[0010] One or more pairs of blocks of a bind confined elastomer (A) put end to end, and that are actioned through a steel plate (B) located in between; inside the elastomer block there is a rod made of plumb or other ductile metal (C);
a steel cable (D) that connects the damping to the support of the close pillar;
a spring (E) that keeps the system under strain; and
a lower anchoring element (F, Fig.5), which fixes the steel spring under strain.

[0011] When the earthquake takes place, and during the time of its action, each one of the building floors displaces itself in relation to the floor immediately under it, alternately extending and shortening the diagonals (Fig. 2). The fact that the system is let under strain allows for that in each of the damping devices there is energy dissipation, both when a diagonal extends itself and when it shortens.

[0012] Each one of the damping devices is installed near the support of a structure beam, being linked to the lower anchoring element by said cable. After the anchoring of the two parts, the cable is stressed up to a predetermined value, taking the wedges its lined up position.

[0013] The system is periodically inspected in order to ensure its good functioning condition. After an earthquake the system is inspected, the connections to the concrete are verified, as well as the condition of the different parts, especially of the elastomer blocks that can have been damaged, in which case they shall be replaced.

[0014] For aesthetical reasons a metallic lid can mask each one of the damping devices, and the connecting cables can be hide by means of a coating plate set upon the wedges, or upon an eventual thin filling (Fig. 6).

[0015] The claimed system is innovative:

Because of the use of a system of restitution that allows for the damping in both displacement directions during the earthquake;

Because of the permanent strain of the cables;

Because of the use inside a building structure of confined elastomer blocks that have a ductile core.

[0016] The main advantage of the invention system is the one that results from its object, i.e., the reduction of the displacements imposed to the structure by the earthquake, maintaining it under an elastic regime, and reducing damages and the risk of collapse.

[0017] Furthermore the system still presents the following advantages:

- The use of known technology and materials
- Easy assembling and possibility of dismantling (reversibility)
- Reduced intrusiveness and thus reduced disturbance to the building users during and after de assembly
- Easy inspection and replacement of damaged elements after the action of an earthquake
- Low cost

Claims

1. Seismic vibrations damping device, **characterized by** the fact that it comprises the following elements:

    One or more pairs of confined elastomer blocks (A) installed end to end, and that are actioned by a metallic plate (B), preferably made of steel, located in between and in whose interior there is a single rod made of a ductile metal, preferably plumb (C);

    A steel spring (D) that makes the connection from de damping device to the base of next column;

    A spring (E) that keeps the system under strain; and

    A lower anchor element (F), where said steel spring (D) is connected.

2. Seismic shock damping system for buildings with a reinforced concrete framed structure, **characterized by** the fact that inside each portal gap of the structure, between opposed joints of the same diagonal, at least one anti-seismic damping device as per claim 1 is inserted.

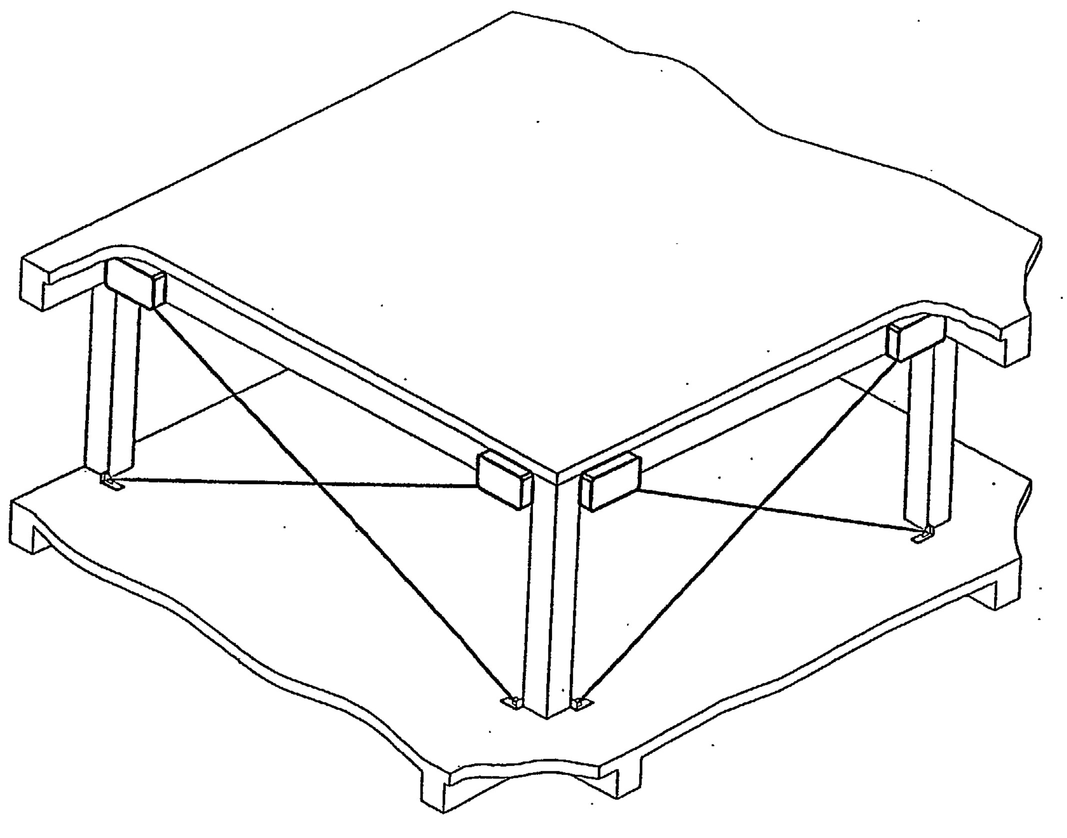

FIG. 1

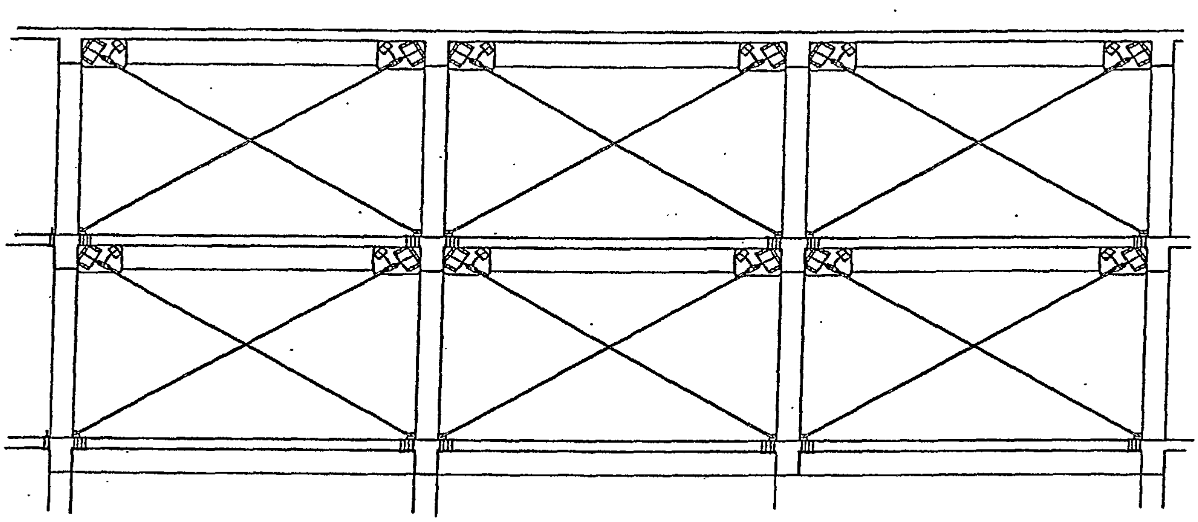

FIG. 2

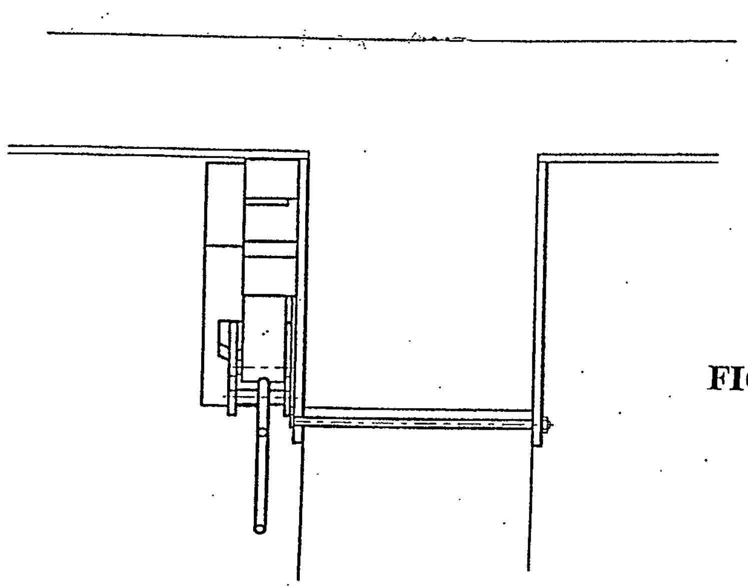

FIG. 3

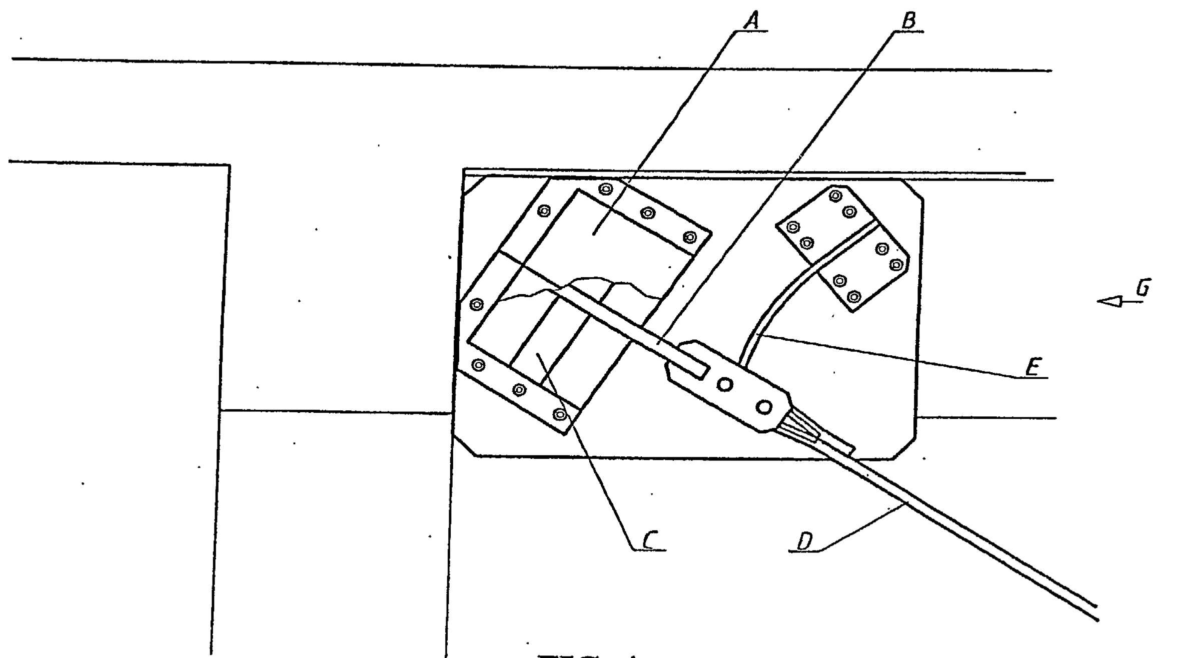

FIG. 4

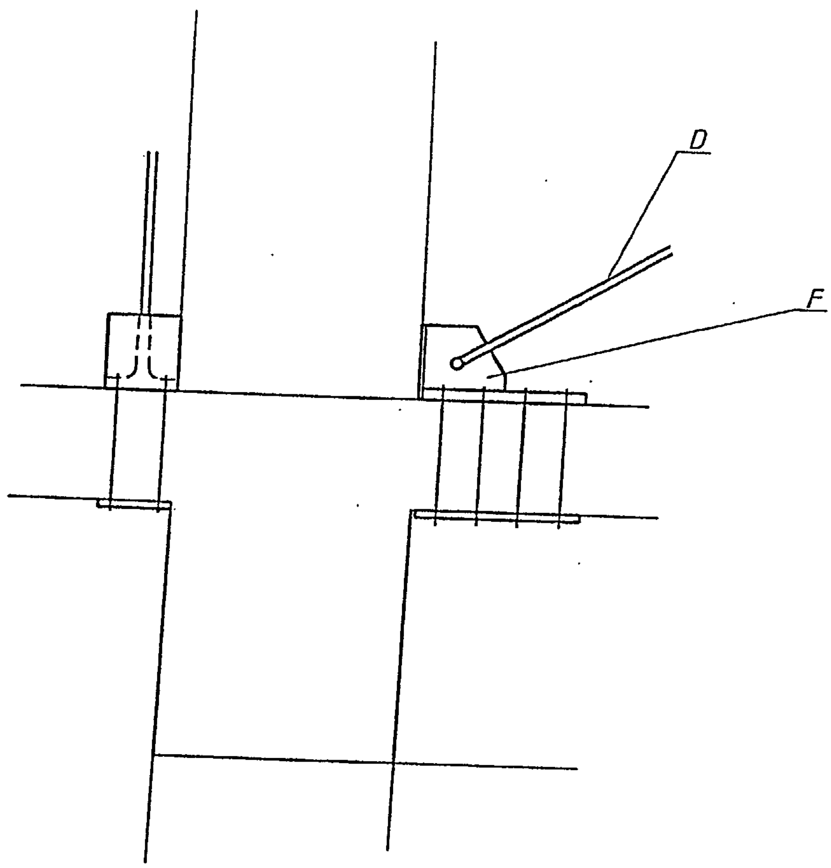

FIG. 5

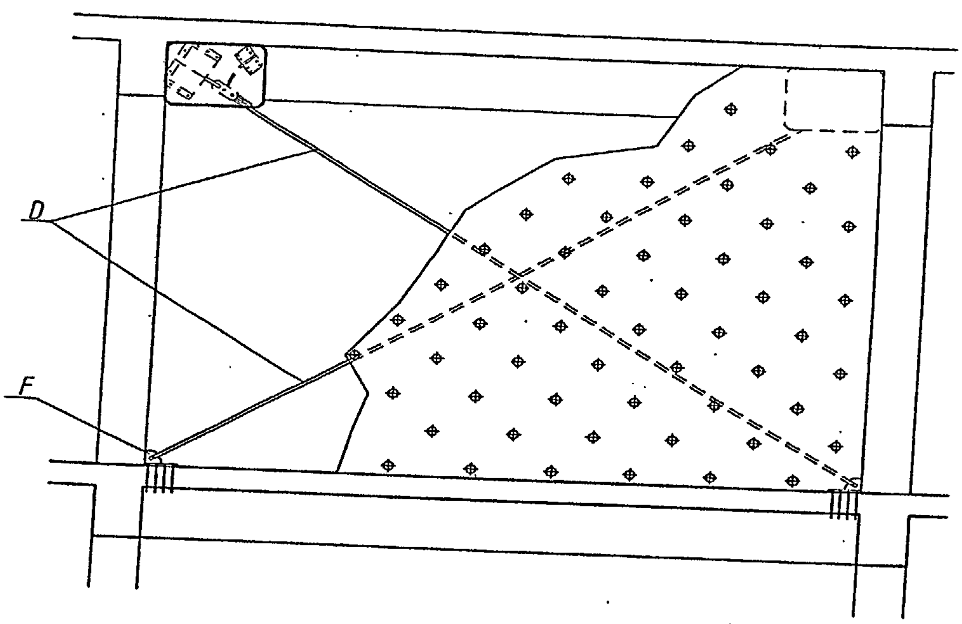

FIG. 6