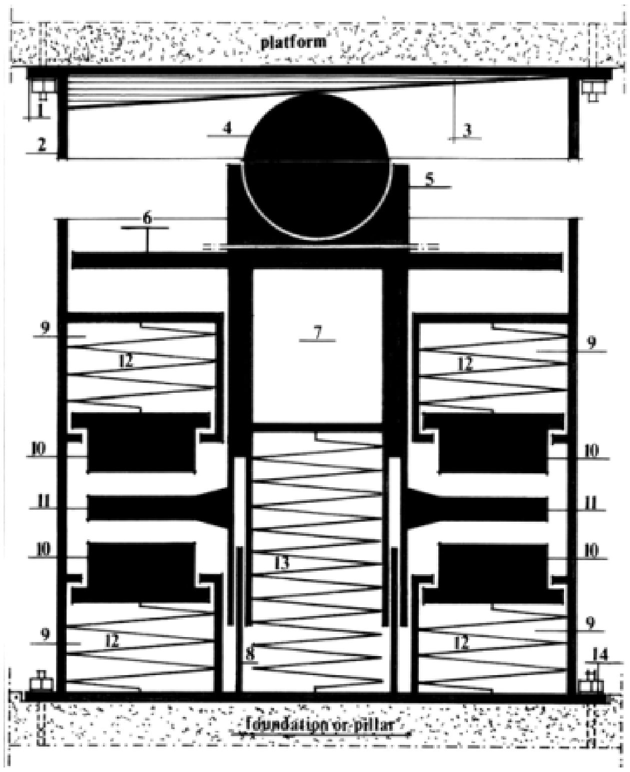
Bearing with Natural Frequency Automatic Variation

1 BEARING WITH CENTRED MAIN SPRINGS

Figure



Constitution

The bearing consists of:

- chamber for housing the sliding level inclined surface (3), consisting of a steel plate (1), connected to the platform by anchoring bolts, and of a steel perimetric spandrel (2);
- actual bearing (4), consisting of a movable ball (contact with rolling friction) or a fixed ball, the upper part of which is covered in Teflon (contact with sliding friction);
- chamber (5) for housing the ball (4), connected to the movable plate (6);
- coaxial chambers (7) and (8) for housing one or more main spring (13). The former chamber is movable with respect to the vertical translation and its upper part is soldered to the plate (6), the other chamber is fixed and it is connected to the base steel plate (14);
- No. 4 fixed chambers (9) for housing the auxiliary springs (12) and their respective pistons (10). The couples of chambers are arranged symmetrically with respect to the coaxial chamber (7) and (8). The central space, delimited by each couple of chambers (9), is partially taken up by the movable mass (11), an extremity of which is inserted rigidly into the external surface of the chamber (7).

Operating principle

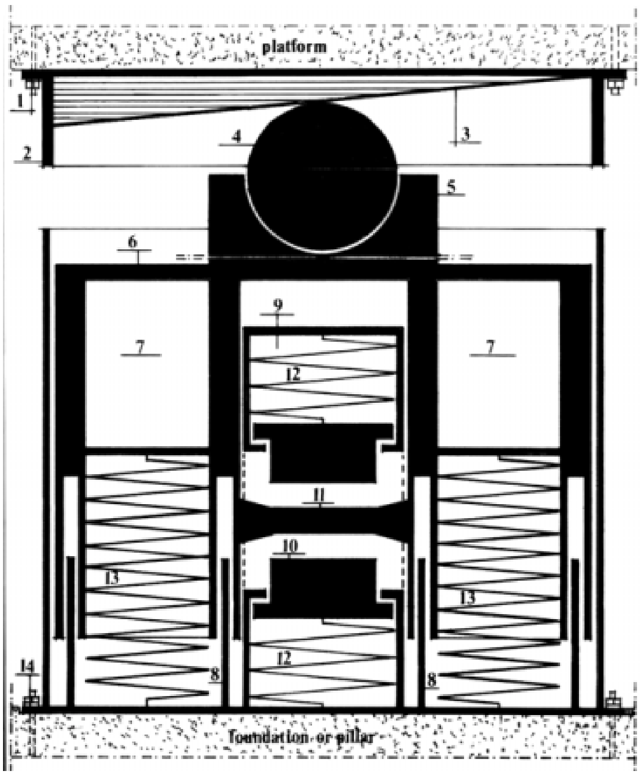
When the soil is in a state of rest, the bearing is subjected to the static load transmitted from the building and the main springs (13) become shorter because of compression. The building is perfectly centred because of the level inclined surface (3) and it is motionless. In the presence of an earthquake, due to the undulatory shock, the foundation-soil complex translates in a horizontal direction with respect to the building, and the variation of vertical rigid deflection due to the variation of thickness of the level inclined surface (3) is perfectly balanced by the corresponding elastic deformation of the main springs (13) in any instant and for any value of the displacement.

The building remains motionless with respect to the horizontal translation of the foundation-soil complex. The horizontal inertial force does not change the static equilibrium of the building, because it has a minor value when using bearings with sliding friction and it is negligible when using bearings with rolling friction. Due to the sub-undulatory shock, the vertical motion of the soil does not modify notably the behaviour of the building. In fact, it preserves the verticality, and its vertical displacements, both in phase and in phase opposition with the corresponding displacements of the soil, are always compatible with project fixed values.

When the earthquake frequency is outside to the emergency interval or coincides with the emergency limit frequencies, the mass (11) vertically translates without the participation of the auxiliary springs (12). Vice versa, due to the vertical motion of the mass (11), the participation of the auxiliary springs (12) takes place when the earthquake frequency is inside the emergency interval, including the resonance one. In this case, due to the combined action of the main and auxiliary springs, the increase of natural frequency of the building considerably decreases the vertical displacements of the building to values compatible with the safety conditions of the building.

2 BEARING WITH ECCENTRIC MAIN SPRINGS

Figure



Note

This bearing differs from the previous one because of the different position occupied by the main and auxiliary springs, which are respectively eccentric and centred. In addition to this, the mass (11) is fixed at both ends and, therefore, its static behaviour is certainly better than the bracket one of the same mass of the preceding bearing. The operating principle remains unchanged.

N.B. The bearings needs accurate experimental tests