

# ENTERTECH PATENT REPORT

2023

# PATENT REPORT SERIES ON EARTHQUAKE PRECAUTIONS AND SEARCH AND RESCUE TECHNOLOGIES

Technology can be defined as a set of knowledge, tools, methods, and techniques that enable people to produce solutions for their needs and problems. Based on this definition, technological developments are expected to be coordinated on the time axis with the problems that society focuses on. It is clear in the simple example given below that patent publications follow the same trend.

Distribution of TR patent applications with titles including the word "earthquake" according to years



According to the research carried out on the patent portal named TURKPATENT, the annual distribution of patent applications with titles including the word "earthquake" between 2008 and 2022 is presented in the chart above. The number of TR patent applications with titles including the word "earthquake" peaked in the years 2012 and 2020-2021. When considered in conjunction with the major earthquakes that took place in Turkey, **patent applications for the year 2012 peaked after the Van earthquake that took place on 23.10.2011. A remarkable increase is also observed in the related patent applications in the years 2020-2021 after the Elazığ earthquake that took place on 24.01.2020 and the İzmir earthquake that took place on 30.10.2020.**

A patent report series was prepared by Entertech İstanbul Teknokent A.Ş. in order to follow the current developments in earthquake precautions and search and rescue technologies. The first report was prepared on "seismic isolators," which are used for the damping and reduction of earthquake loads on structures during an earthquake by providing isolation.

# SEISMIC ISOLATORS

Seismic isolators are defined as flexible and force-absorbing bearings placed between the foundation and the superstructure of the building. During an earthquake, seismic waves cause the ground to move, and seismic isolators reduce the amount of force and energy transferred to the building.

The patent search related to seismic isolators was done by combining the following keywords and patent classes in the Espacenet patent search portal in order to see the general trend globally. Searches can be diversified by increasing keyword and patent class alternatives.

## KEYWORDS:

seismic isolation", "vibration damping", "base isolation", "earthquake-resistant", "shock absorbers", "seismic dampers", "seismic isolator", "earthquake isolator", "seismic absorber", "earthquake absorber", "earthquake damper", "earthquake isolation", "base isolation", "seismic resilience", "seismic protection", "seismic mitigation", "earthquake proof" and so on

## PATENT CLASSES:

E04H9/02 - Buildings, groups of buildings or shelters adapted to withstand or provide protection against abnormal external influences, e.g. war-like action, earthquake or extreme climate

- withstanding earthquake or sinking of ground

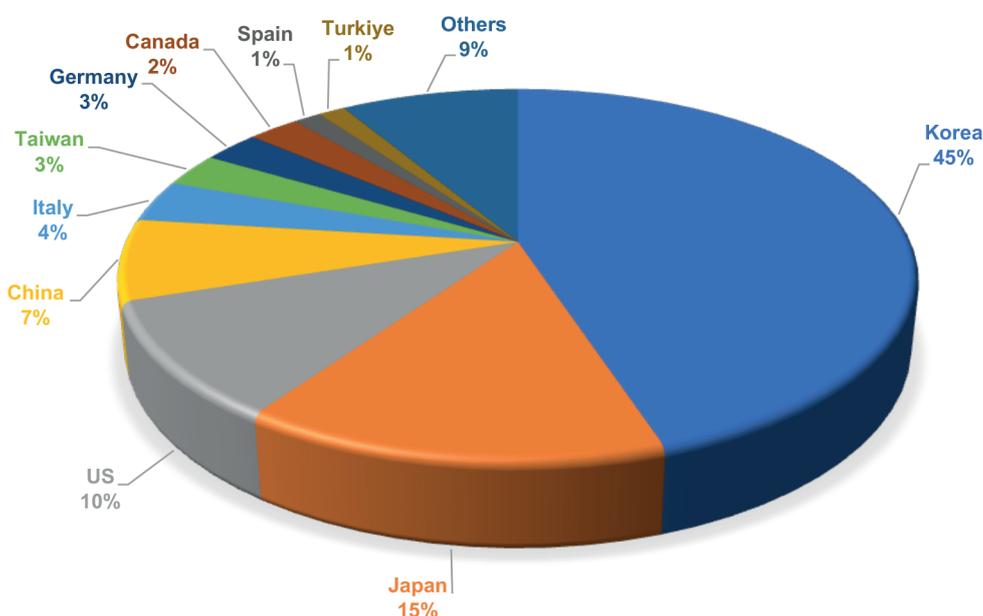
F16F 15/00 - Suppression of vibrations in systems

F16F15/02 - Suppression of vibrations of non-rotating, e.g. reciprocating, systems; Suppression of vibrations of rotating systems by use of members not moving with the rotating system

F16F15/133 - using springs as elastic members, e.g. metallic springs

Since this report focuses on seismic isolators for buildings, F16F (Springs; Shock-Absorbers; Means for Damping Vibration) and E04 (Building) classes were added to the keywords.

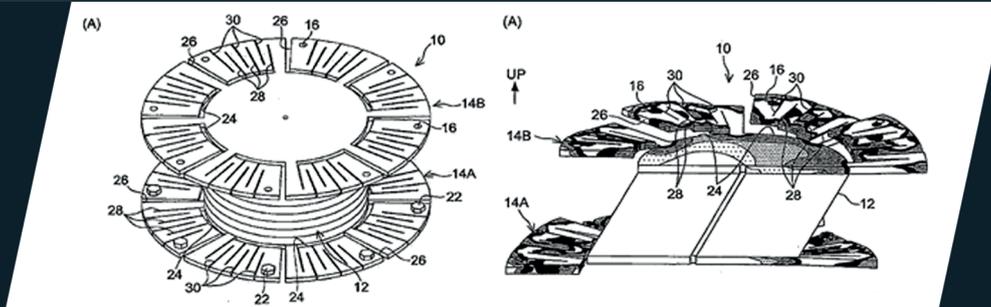
According to the search, the origin countries of the patent applications made in the last 10 years related to seismic isolators are presented in the chart below.



The countries that produced the most patent applications on seismic isolators for buildings in the last 10 years were Korea with 45% and Japan with 15%. Accordingly, 60% of the related applications originated from South Korea and Japan.

Some of the seismic isolator types that come to the forefront in patent applications in general terms are as follows:

**Rubber isolators:** They are made of natural or synthetic rubber and are designed to absorb seismic energy by deforming (usually semi-elastic) underweight.

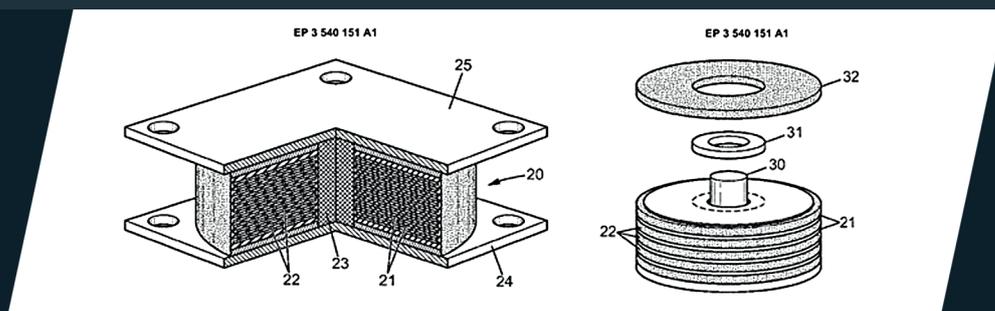


Example patent image: JP6294132B2 – Seismic Isolation Device (Bridgestone Corporation – Japan)

## Some patent applications that come to the forefront regarding rubber isolators

Patent Publication Number	Title	Applicant	Image (Thumbnail)
JP6294132B2	Seismic Isolation Device	Bridgestone Corp.	
JP2022085349A	Seismic Isolation	Toyo Tire Corp.	
JP2017072239A	Base Isolation Device and Laminated Rubber Isolator	Ohbayashi Corp.	
JP3713645B2	Seismic Isolator Making Use of Laminated Rubber	Shimizu Construction Corp.	

**Lead-rubber isolators:** They consist of rubber layers sandwiched between lead layers that provide both damping and energy dissipation during an earthquake.

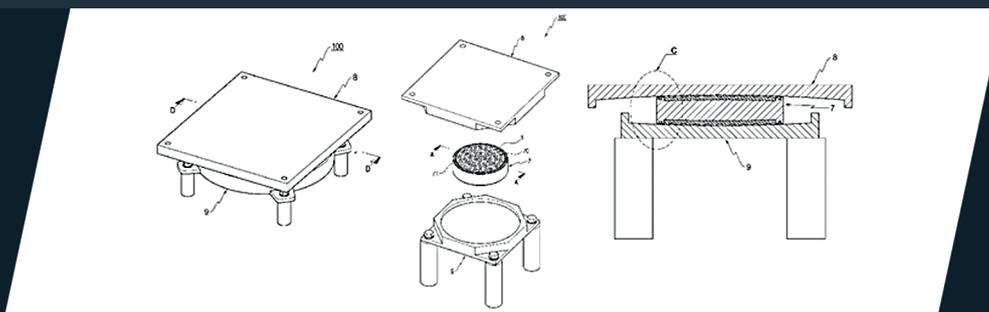


**Example patent image: EP3540151A1 – Enhanced Seismic Isolation Lead Rubber Bearings (Soletanche Freyssinet – France)**

## Some patent applications that are at the forefront regarding lead-rubber isolators

Patent Publication Number	Title	Applicant	Image (Thumbnail)
EP3540151A1	Enhanced Seismic Isolation Lead Rubber Bearings	Soletanche Freyssinet	
KR101426248B1	Lead Exchange Device of Inside Lead-Rubber Bearing Isolating Device	Korea Hydro & Nuclear Power Co	
KR100994370B1	Lead Rubber Bearing and Manufacture Method Thereof	Bu Heung System Co Ltd.	

**Friction pendulum bearings:** They are bearings that provide damping of earthquake effects by the movement of at least one pendulum between curved surfaces with optimum friction during earthquake movements.

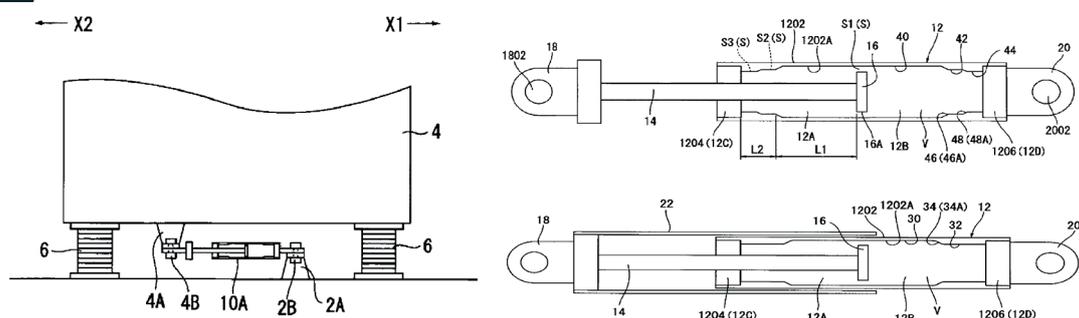


Example patent image: KR101696600B1 – Friction Pendulum Bearing (Bu Heung System Co Ltd – S. Korea)

## Some patent applications that come to the forefront regarding friction pendulum bearings

Patent Publication Number	Title	Applicant	Image (Thumbnail)
US2009188179A1	Friction Pendulum Bearing	Steelpat Gmbh & Co	
KR102353909B1	Pendulum Bearing and Construction Method Thereof	Daechang Corp.	
US10947679B2	Sliding Pendulum Bearing and Method of Dimensioning Such a Bearing	Maurer Eng Gmbh	

**Viscous dampers:** These dampers use the viscous properties of fluids to absorb seismic energy by creating resistance to movement with hydraulic or pneumatic systems (pistons). They can be used in combination with other isolators.

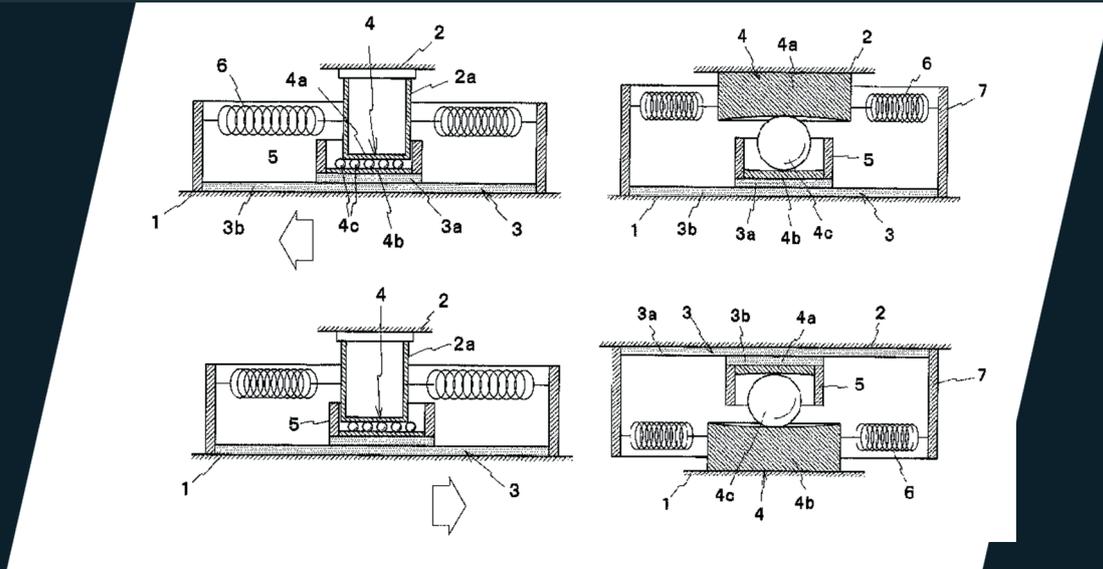


Example patent image: JP2022131575A – Viscous Damper (Fujita Corporation – Japan)

## Some patent applications that come to the forefront regarding viscous dampers

Patent Publication Number	Title	Applicant	Image (Thumbnail)
KR101209959B1	Composite Damper of Viscous Damper and Slit Damper	Daelim Ind Co Ltd	
JP6913645B2	Viscous Damper	Aseismic Devices Co Ltd Nippon Steel Corp	
EP2261443A2	Damper and vibration damping structure using the same	Oiles Industry Co Ltd	

**Sliding bearings:** These bearings consist of balls, cylinders, spheres, or surfaces that allow the structure to slide during an earthquake and reduce the forces acting on the structure.



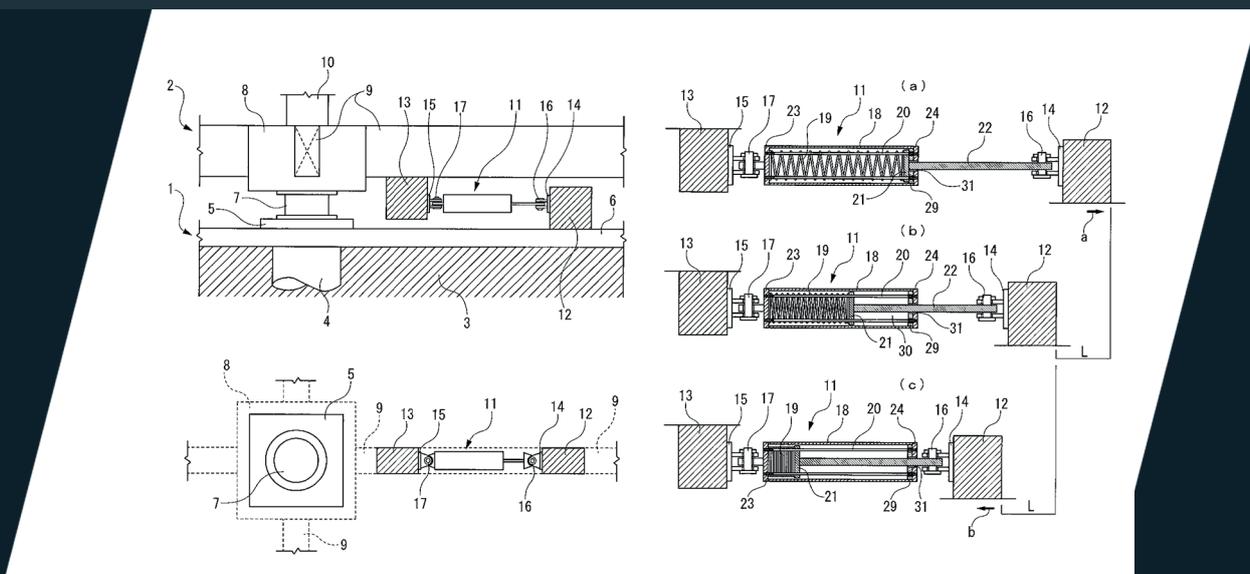
**Example patent image: JP4159959B2 – Quake-Absorbing Structure (Daiwa House Industry Co. – Japan)**

**Note: Daiwa House is the parent company of Fujita Corp.**

## Some patent applications that come to the forefront regarding sliding bearings

Patent Publication Number	Title	Applicant	Image (Thumbnail)
JPH10292671A	Rolling, Sliding Bearing Structure for Base isolating Device	Fujikura Ltd	
JP2002115419A	A Seismic Isolator	Daido Metal Co Ltd	
KR100914032B1	Ball Bearing-Type Seismic Isolator with a Conical Groove	Entire Safe Co Ltd	

**Spring isolators:** These isolators are generally made of steel springs and are designed to absorb seismic energy by deforming under the weight of the structure. They can be used in combination with other isolators.



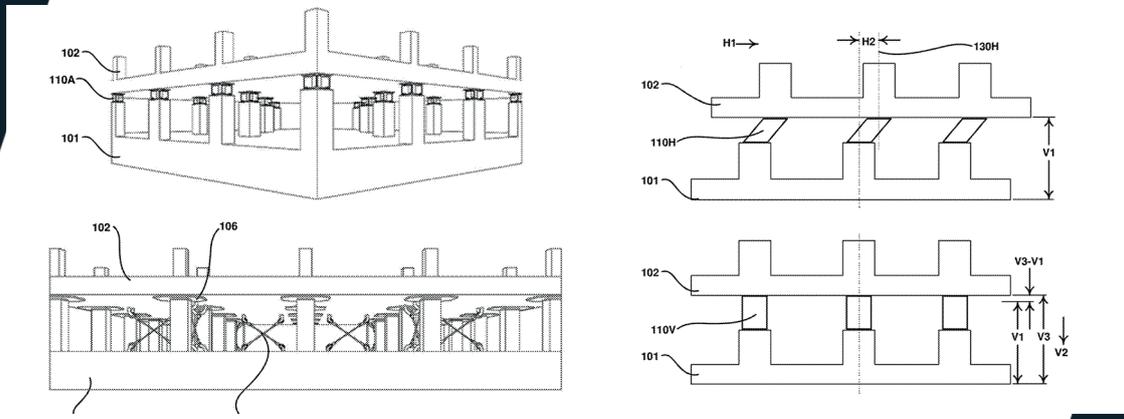
Example patent image: JP6613443B1 – Spring Type Seismic Damper (Kurosawa Kensetsu KK – Japan)

## Some patent applications that come to the forefront regarding spring isolators

Patent Publication Number	Title	Applicant	Image (Thumbnail)
KR102164349B1	Aseismic Reinforcement Structure using Spring Damper	Sunggeoneng	
JP2014137109A	Seismic Isolator	Aseismic Devices Co Ltd	

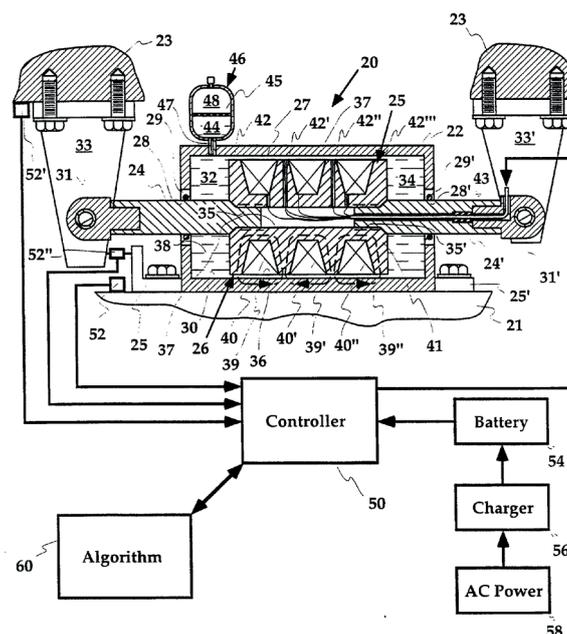
In addition to the examples above, two recent technologies used in the field of seismic isolators come to the forefront. These technologies are shape memory alloys (SMAs) and magnetorheological (MR) fluids.

**Seismic isolators using shape memory alloys:** One of the recent developments in the field of seismic isolation is the use of shape memory alloys (SMAs) as materials for seismic isolators. SMAs are metallic alloys that can undergo large deformations when exposed to certain stimuli, such as temperature changes or mechanical stress, and subsequently regain their original shape. Researchers are investigating the use of SMAs in seismic isolation systems in terms of their energy dissipation capacity and seismic response properties.



**Example patent image: US11313145B2 – Earthquake protection systems, methods, and apparatus using shape memory alloy (SMA)-based super elasticity-assisted slider (SSS) (Cal Poly Corp – USA)**

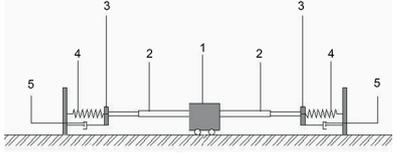
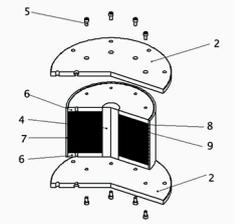
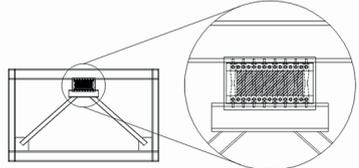
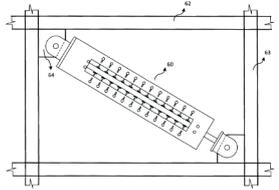
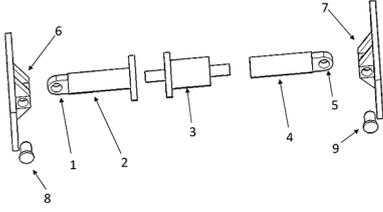
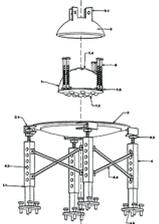
**Seismic isolators using magnetorheological (MR) fluids:** Another recent development is the use of magnetorheological (MR) fluids in seismic isolators. MR fluids are fluids that change their rheological properties such as viscosity and hardness in response to a magnetic field. Researchers are investigating the use of MR fluids in seismic isolators to provide seismic isolation and energy dissipation properties.



**Example patent image: US6296088B1 – Magnetorheological fluid seismic damper (Lord Corp – USA)**

**Conclusion:** Seismic isolators are devices that aim to minimize the effects of earthquake forces on buildings during an earthquake. Although there are various types of seismic isolators, R&D studies continue to improve the design, efficiency, and effectiveness of these devices. It is seen that different seismic isolators are used in combination, especially according to the characteristics of the structure and the ground. As can be seen from the patent applications made in recent years regarding seismic isolators, interest and investment in this technology are increasing. The development and application of innovative seismic isolator technologies seem important for the construction industry of Turkey, which is located in an area with high seismic activity.

## Some of the patent applications regarding seismic isolator technologies originating from Turkey:

Patent Publication Number	Title	Applicant	Image (Thumbnail)
TR2017/21775	A Dual Stage Damping System for Seismic Control of Structures	Istanbul University-Cerrahpaşa	
TR2022/004741	A Rubber Earthquake Isolator	Biensis Mühendislik ve Enerji Sistemleri İnş. Taahhüt San. ve Tic. Ltd Şti	
TR2018/20466	A three-component modular seismic energy damper	Karadeniz Technical University	
TR2017/22584	A Seismic Energy Damping Steel Cross Assembly	Karadeniz Technical University	
TR2016/17611	A Damping System for Improving the Earthquake Performance of Non-Moment Transferring Joints in Precast Reinforced Concrete Building Systems	Istanbul Technical University	
TR2014/02761	A movable mechanism that minimizes the destructive effect of the earthquake	Cemalettin Kaya	

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