

CPC**COOPERATIVE PATENT CLASSIFICATION****F16F****SPRINGS; SHOCK-ABSORBERS; MEANS FOR DAMPING
VIBRATION****NOTES**

1. This subclass covers:
 - springs, shock-absorbers or vibration-dampers;
 - their arrangement in, or adaptation for, particular apparatus if not provided for in the subclasses covering said apparatus.
2. This subclass does not cover inventions concerning the arrangement or adaptation of springs, shock-absorbers or vibration-dampers in, or for, particular apparatus, if provided for in the subclasses concerning the said apparatus, e.g.

[A47C 23/00](#)to [A47C 27/00](#) Spring mattresses{[A61F 2/00](#) Prostheses }[A63C 5/075](#) Vibration dampers in skis[B60G](#) Vehicle suspensions[B60R 19/24](#) Mounting of bumpers on vehicles[B61F](#) Rail vehicle suspensions[B61G 11/00](#) Buffers for railway or tramway vehicles[B62D 21/15](#) Vehicle chassis frames having impact absorbing means[B62J 1/02](#) Resiliently mounted saddles on cycles[B62K 21/08](#) Steering dampers[B63H 21/30](#) Anti-vibration mounting of marine propulsion plant in ships[B64C 25/58](#) Arrangement of shock-absorbers or springs in aeroplane alighting gear[B65D 81/02](#) Containers, packing elements or packages with shock-absorbing means[D06F 37/20](#) Resilient mountings in washing machines[D06F 49/06](#) Resilient mountings in domestic spin-dryers{[E04B 1/98](#) Protection of buildings against vibrations or shocks }[E05D 7/086](#) Braking devices structurally combined with hinges[F03G 1/00](#) Spring motors{[F16L 3/20](#) Pipe or cable supports }[F21V 15/04](#) Resilient mounting of lighting devices[F41A 25/00](#) Gun cradles to permit recoil[F41B 5/1426](#) Vibration dampers for archery bows[G01D 11/00](#) Indicating or recording in connection with measuring

F16F

(continued)

- [G01G 21/10](#) Weighing apparatus, e.g. arrangement of shock-absorbers in weighing apparatus
- [G04B](#) Clocks, watches
- [G12B 3/08](#) Damping of movements in instruments
- [G21C 7/20](#) Disposition of shock-absorbing devices for displaceable control elements in nuclear reactors.
- {[H02G 7/14](#) Arrangements or devices for damping mechanical oscillations of power lines }

3. Mention of "steel" or "metal" in groups [F16F](#), unless specific mention is made otherwise, should be seen in the light of the title of group [F16F 1/00](#), i.e. material having low internal friction. This normally includes composite materials such as fibre-reinforced plastics.
4. Mention of "rubber" or "plastics" in group [F16F](#), unless specific mention is made otherwise, should be seen in the light of the title of group [F16F 1/36](#), i.e. material having high internal friction. This normally does NOT include composite materials such as fibre-reinforced plastics except in the case of groups [F16F 1/366](#) to [F16F 1/3686](#) and [F16F 15/305](#).

WARNING

The following IPC groups are not used in the CPC scheme. Subject matter covered by these groups is classified in the following CPC groups:

- | | | | |
|----------------------------|------------|-----------------------------|-----------------------------|
| F16F 3/07 | covered by | F16F 13/00 | |
| F16F 9/24 | covered by | F16F 9/22 | |
| F16F 9/40 | covered by | F16F 9/00 | to |
| F16F 9/50 | | | |
| F16F 9/508 | covered by | F16F 9/512 | |
| F16F 11/00 | covered by | F16F 7/00 , | F16F 9/00 , |
| F16F 15/00 | | | |
| F16F 13/12 | covered by | F16F 13/08 | |

F16F 1/00**Springs (working with fluid [F16F 5/00](#), [F16F 9/00](#))**

F16F 1/02

- made of steel or other material having low internal friction {(characterised by their special construction from fibre-reinforced plastics [F16F 1/366](#); spring units consisting of several springs [F16F 3/02](#); making springs from wire [B21F 35/00](#)); Wound, torsion, leaf, cup, ring or the like springs, the material of the spring not being relevant

F16F 1/021

- {characterised by their composition, e.g. comprising materials providing for particular spring properties (composition and manufacture of clock or watch springs [G04B 1/145](#))}

F16F 1/022

- {made of ceramic materials}

F16F 1/024

- {Covers or coatings therefor ([F16F 1/24](#) takes precedence)}

F16F 1/025

- {characterised by having a particular shape ([F16F 1/04](#), [F16F 1/14](#), [F16F 1/18](#), [F16F 1/32](#), [F16F 1/34](#) take precedence)}

F16F 1/027

- {Planar, e.g. in sheet form; leaf springs}

F16F 1/028

- {cylindrical, with radial openings}

F16F 1/04

- Wound springs {(making springs by coiling wire [B21F 3/00](#))}

- F16F 1/041 . . . {with means for modifying the spring characteristics ([F16F 1/12](#), [F16F 3/06](#) take precedence; fluid regulation of coil spring characteristics in vehicle suspensions [B60G 17/0272](#))}
- F16F 1/042 . . . {characterised by the cross-section of the wire}
- F16F 1/043 {the cross-section varying with the wire length}
- F16F 1/045 . . . {Canted-coil springs}
- F16F 1/046 . . . {with partial nesting of inner and outer coils ([F16F 3/04](#) takes precedence)}
- F16F 1/047 . . . {characterised by varying pitch}
- F16F 1/048 . . . {with undulations, e.g. wavy springs}
- F16F 1/06 . . . with turns lying in cylindrical surfaces
- F16F 1/065 {characterised by loading of the coils in a radial direction (canted-coil springs [F16F 1/045](#))}
- F16F 1/08 . . . with turns lying in mainly conical surfaces, {i.e. characterised by varying diameter ([F16F 1/10](#) takes precedence)}
- F16F 1/10 . . . Spiral springs with turns lying substantially in plane surfaces {([F16F 1/326](#) takes precedence)}
- F16F 1/12 . . . Attachments or mountings {([F16F 1/041](#), [F16F 13/02](#) take precedence; of combinations of vibration damper and mechanical spring for vehicle suspension units [B60G 15/02](#))}
- F16F 1/121 {adjustable, e.g. to modify spring characteristics}
- F16F 1/122 {where coils, e.g. end coils, of the spring are rigidly clamped or similarly fixed}
- F16F 1/123 {characterised by the ends of the spring being specially adapted, e.g. to form an eye for engagement with a radial insert ([F16F 1/122](#), [F16F 1/125](#) take precedence)}
- F16F 1/125 {where the end coils of the spring engage an axial insert ([F16F 1/126](#), [F16F 1/128](#) take precedence)}
- F16F 1/126 {comprising an element between the end coil of the spring and the support proper, e.g. an elastomeric annulus ([F16F 1/13](#) takes precedence)}
- F16F 1/127 {allowing rotation about axis of spring}
- F16F 1/128 {with motion-limiting means, e.g. with a full-length guide element or ball joint connections; with protective outer cover ([F16F 1/121](#) takes precedence)}
- F16F 1/13 comprising inserts and spacers between the windings for changing the mechanical or physical characteristics of the spring {([F16F 1/122](#) takes precedence)}
- F16F 1/14 . . Torsion springs consisting of bars or tubes
- F16F 1/145 . . . {with means for modifying the spring characteristics (fluid regulation of torsion spring characteristics in vehicle suspensions [B60G 17/0277](#))}
- F16F 1/16 . . . Attachments or mountings {([F16F 1/145](#) takes precedence; mounting means for vehicle stabiliser bars [B60G 21/0551](#))}
- F16F 1/18 . . Leaf springs {(planar springs in general [F16F 1/027](#); "Belleville"-type springs with generally radial arms [F16F 1/324](#))}

- F16F 1/182 . . . {with inter-engaging portions between leaves or between leaves and mountings, e.g. ridges, notches, ripples}
- F16F 1/185 . . . {characterised by shape or design of individual leaves ([F16F 1/22](#) takes precedence)}
- F16F 1/187 {shaped into an open profile, i.e. C- or U-shaped}
- F16F 1/20 . . . with layers, e.g. anti-friction layers, or with rollers between the leaves
- F16F 1/22 . . . with means for modifying the spring characteristic {(fluid regulation of leaf spring characteristics in vehicle suspensions [B60G 17/0275](#))}
- F16F 1/24 . . . Lubrication; Covers, e.g. for retaining lubricant
- F16F 1/26 . . . Attachments or mountings ({[F16F 1/182](#), [F16F 1/22](#)} [B60G 11/10](#) take precedence)
- F16F 1/28 comprising cylindrical metal pins pivoted in close-fitting sleeves
- F16F 1/30 comprising intermediate pieces made of rubber or similar elastic material
- F16F 1/32 . . Belleville-type springs (friction-clutch diaphragm springs [F16D 13/583](#))
- F16F 1/322 . . . {Snap-action springs}
- F16F 1/324 . . . {characterised by having tongues or arms directed in a generally radial direction, i.e. diaphragm-type springs}
- F16F 1/326 {with a spiral-like appearance}
- F16F 1/328 {with undulations, e.g. wavy springs}
- F16F 1/34 . . Ring springs, i.e. annular bodies deformed radially due to axial load
- F16F 1/36 . . made of rubber or other material having high internal friction, {e.g. thermoplastic elastomers (spring units consisting of several springs [F16F 3/08](#))}
- F16F 1/3605 . . {characterised by their material ([F16F 1/362](#), [F16F 1/364](#), [F16F 1/366](#), [F16F 1/37](#) take precedence; composition of macromolecular compounds in general [C08L](#))}
- F16F 1/361 . . . {comprising magneto-rheological elastomers [MR], (magneto-rheological fluid dampers [F16F 9/535](#))}
- F16F 1/3615 . . {with means for modifying the spring characteristic ([F16F 1/371](#) takes precedence)}
- F16F 1/362 . . made of steel wool, compressed hair, {woven or non-woven textile, or like materials}
- F16F 1/364 . . made of cork, wood or like material
- F16F 1/366 . . made of fibre-reinforced plastics, {i.e. characterised by their special construction from such materials}

NOTE

Attention is drawn to notes following the subclass title regarding interpretation of the term "plastics" in groups [F16F](#), in particular as regards the subject matter of groups [F16F 1/366](#) to [F16F 1/3686](#).

- F16F 1/3665 . . . {Wound springs}
- F16F 1/368 . . . Leaf springs
- F16F 1/3683 {Attachments or mountings therefor}
- F16F 1/3686 {End mountings}

- F16F 1/37
 - • of foam-like material, {i.e. micro-cellular material}, e.g. sponge rubber {(padded linings for vehicle interiors B60R 21/04)}
- F16F 1/371
 - • characterised by inserts or auxiliary extension {or exterior} elements, e.g. for rigidification (F16F 1/387 takes precedence; {non-embedded reinforcing elements for flexibly-walled air springs F16F 9/0436})
- F16F 1/3713
 - • • {with external elements passively influencing spring stiffness, e.g. rings or hoops}
- F16F 1/3716
 - • • • {External elements such as covers or envelopes, that are flexible}
- F16F 1/373
 - • characterised by having a particular shape {(F16F 9/58 takes precedence)}
- F16F 1/3732
 - • • {having an annular or the like shape, e.g. grommet-type resilient mountings}
- F16F 1/3735
 - • • • {Multi-part grommet-type resilient mountings}
- F16F 1/3737
 - • • {Planar, e.g. in sheet form (vibration dampers comprising one or more constrained viscoelastic layers F16F 9/306)}
- F16F 1/374
 - • • having a spherical or the like shape
- F16F 1/376
 - • • having projections, studs, serrations or the like on at least one surface {(F16F 1/3835) , F16F 1/387 take precedence}
- F16F 1/377
 - • • having holes or openings {(F16F 1/37) , F16F 1/387 take precedence}
- F16F 1/379
 - • characterised by arrangements for regulating the spring temperature, e.g. by cooling
- F16F 1/38
 - • with a sleeve of elastic material between a rigid outer sleeve and a rigid inner sleeve or pin, {i.e. bushing-type (hydraulically-damped bushes F16F 13/14; suppression of vibrations in rotating systems by making use of elastomeric spring members between rotating elements, driveline torque being transmitted therebetween F16F 15/126, by making use of a dynamic damping mass attached to a rotating element by means of elastomeric springs F16F 15/14; pivots per se F16C 11/00; elastic or yielding bearings or bearing supports F16C 27/00; parts of sliding-contact bearings, e.g. bushes F16C 33/04)}
- F16F 1/3807
 - • • {characterised by adaptations for particular modes of stressing}
- F16F 1/3814
 - • • • {characterised by adaptations to counter axial forces (F16F 1/393 takes precedence)}
- F16F 1/3821
 - • • • {characterised by adaptations to counter torsional forces}
- F16F 1/3828
 - • • {End stop features or buffering (F16F 1/3807 takes precedence)}
- F16F 1/3835
 - • • {characterised by the sleeve of elastic material, e.g. having indentations or made of materials of different hardness (F16F 1/3807, F16F 1/387 take precedence)}
- F16F 1/3842
 - • • {Method of assembly, production or treatment; Mounting thereof (supports for pipes, cables or protective tubing F16L 3/00)}
- F16F 1/3849
 - • • • {Mounting brackets therefor, e.g. stamped steel brackets; Restraining links}
- F16F 1/3856
 - • • • {Vulcanisation or gluing of interface between rigid and elastic sleeves}
- F16F 1/3863
 - • • {characterised by the rigid sleeves or pin, e.g. of non-circular cross-section (F16F 1/3807, F16F 1/387 take precedence)}
- F16F 1/387
 - • • comprising means for modifying the rigidity in particular directions {(spherical or conical sleeves F16F 1/393)}
- F16F 1/3873
 - • • • {having holes or openings}

- F16F 1/3876 {by means of inserts of more rigid material}
- F16F 1/393 . . . with spherical or conical sleeves
- F16F 1/3935 {Conical sleeves}
- F16F 1/40 . . consisting of a stack of similar elements separated by non-elastic intermediate layers {(F16F 9/306 takes precedence; laminated constructions to protect buildings against abnormal external influences, e.g. earthquakes, E04H 9/022)}
- F16F 1/403 . . . {characterised by the shape of the non-elastic interengaging parts between the elements}
- F16F 1/406 . . . {characterised by the shape of the elastic elements}
- F16F 1/41 . . . the spring consisting of generally conically arranged elements {(if sleeve-like, i.e. a surface of revolution F16F 1/3935)}
- F16F 1/42 . . characterised by the mode of stressing

NOTE

Classification of documents in groups F16F 1/42 to F16F 1/54, concerning the mode of stressing of elastomeric springs, is to be considered only when classification in other subgroups of F16F 1/36 would be unsuitable. Attention is drawn to the parallel scheme of indexing codes under F16F 2236/00.

- F16F 1/422 . . . {the stressing resulting in flexion of the spring}
- F16F 1/424 {of membrane-type springs}
- F16F 1/426 {Radial flexion of ring-type springs}
- F16F 1/428 {of strip- or leg-type springs}
- F16F 1/44 . . . loaded mainly in compression
- F16F 1/445 {the spring material being contained in a generally closed space (F16F 1/393 takes precedence)}
- F16F 1/46 . . . loaded mainly in tension
- F16F 1/48 . . . loaded mainly in torsion
- F16F 1/50 . . . loaded mainly in shear
- F16F 1/505 {Rotational shear}
- F16F 1/52 . . . loaded in combined stresses
- F16F 1/54 loaded in compression and shear
- F16F 1/545 {Neidhart-type rubber springs (vehicle suspensions having Neidhart-type rubber springs B60G 11/225)}

F16F 3/00 **Spring units consisting of several springs, e.g. for obtaining a desired spring characteristic** {(F16F 1/32, F16F 1/34, F16F 7/14 take precedence } ; if including fluid springs F16F 5/00, F16F 13/00)

NOTE

In this group, vehicle leaf spring units, i.e. "packets" of individual leaves, are considered as a single spring

- F16F 3/02 . . with springs made of steel or of other material having low internal friction
- F16F 3/023 . . {composed only of leaf springs}

- F16F 3/026 . . {to give a zero-spring rate characteristic}
- F16F 3/04 . . composed only of wound springs
- F16F 3/06 . . . of which some are placed around other in such a way that they damp each other by mutual friction
- F16F 3/08 . with springs made of a material having high internal friction, e.g. rubber {(multi-part grommet-type resilient mountings [F16F 1/3735](#))}
- F16F 3/087 . . Units comprising several springs made of plastics or the like material ([F16F 1/40](#), {[F16F 1/545](#) take precedence})
- F16F 3/0873 . . . {of the same material or the material not being specified}
- F16F 3/0876 {and of the same shape}
- F16F 3/093 . . . the springs being of different materials, e.g. having different types of rubber {([F16F 1/3835](#) takes precedence)}
- F16F 3/0935 {and being of the same shape}
- F16F 3/10 . . combined with springs made of steel or other material having low internal friction
- F16F 3/12 . . . the steel spring being in contact with the rubber spring {([F16F 1/12](#) takes precedence)}

- F16F 5/00** **Liquid springs in which the liquid works as a spring by compression, e.g. combined with throttling action; Combinations of devices including liquid springs** {(dampers with solid or semi-solid material [F16F 9/30](#))}

- F16F 6/00** **Magnetic springs; {(magnetic spring arrangements for the suppression of vibration in systems [F16F 15/03](#))}; Fluid magnetic springs, {i.e. magnetic spring combined with a fluid}**
- F16F 6/005 . {using permanent magnets only}

- F16F 7/00** **Vibration-dampers; Shock-absorbers** (using fluid [F16F 5/00](#), [F16F 9/00](#); specific for rotary systems [F16F 15/10](#); {belt tensioners [F16H 7/12](#)})
- F16F 7/003 . {One-shot shock absorbers (using plastic deformation of members, e.g. using sacrificial, fibre-reinforced composite members [F16F 7/12](#))}
- F16F 7/006 . . {using textile means (safety belts or body harnesses incorporating energy absorbing means [A62B 35/04](#))}
- F16F 7/01 . using friction between loose particles, e.g. sand
- F16F 7/015 . . {the particles being spherical, cylindrical or the like}
- F16F 7/02 . with relatively-rotatable friction surfaces that are pressed together ([F16F 7/01](#) takes precedence; one of the members being a spring [F16F 13/02](#); {friction devices between relatively-movable parts of a hinge [E05D 11/08](#); braking devices for wings [E05F 5/00](#))
- F16F 7/023 . . {and characterised by damping force adjustment means}
- F16F 7/026 . . . {resulting in the damping effects being different according to direction of rotation}
- F16F 7/04 . . in the direction of the axis of rotation {([F16F 7/023](#) takes precedence)}
- F16F 7/06 . . in a direction perpendicular or inclined to the axis of rotation {([F16F 7/023](#) takes precedence)}
- F16F 7/065 . . . {where elements interengaging frictionally are in the shape of spiral bands}

- F16F 7/08
 - with friction surfaces rectilinearly movable along each other ([F16F 7/01](#) takes precedence; {one of the members being a spring [F16F 13/02](#)})
- F16F 7/082
 - • {and characterised by damping force adjustment means}
- F16F 7/085
 - • • {resulting in the damping effects being different according to direction of movement}
- F16F 7/087
 - • {Elastomeric surface effect dampers}
- F16F 7/09
 - • in dampers of the cylinder-and-piston type
- F16F 7/095
 - • • {frictional elements brought into engagement by movement along a surface oblique to the axis of the cylinder, e.g. interaction of wedge-shaped elements}
- F16F 7/10
 - using inertia effect ([F16F 13/108](#), [F16F 13/22](#), [F16F 15/10](#), [F16F 15/22](#) take precedence; stabilising vehicle bodies by means of movable masses [B62D 37/04](#); protection of buildings against vibrations or shocks by mass dampers [E04B 1/985](#); arrangements or devices for damping mechanical oscillations of power lines [H02G 7/14](#))
- F16F 7/1005
 - • {characterised by active control of the mass}
- F16F 7/1011
 - • • {by electromagnetic means}
- F16F 7/1017
 - • • {by fluid means}
- F16F 7/1022
 - • {the linear oscillation movement being converted into a rotational movement of the inertia member, e.g. using a pivoted mass}
- F16F 7/1028
 - • {the inertia-producing means being a constituent part of the system which is to be damped}
- F16F 7/1034
 - • {of movement of a liquid}
- F16F 7/104
 - • the inertia member being resiliently mounted ({[F16F 7/1022](#) takes precedence})
- F16F 7/108
 - • • on plastics springs
- F16F 7/112
 - • • on fluid springs
- F16F 7/116
 - • • on metal springs
- F16F 7/12
 - using plastic deformation of members ({[F16F 9/30](#) takes precedence; yieldable means for mounting bumpers on vehicles [B60R 19/26](#); yieldable or collapsible steering columns [B62D 1/192](#)})
- F16F 7/121
 - • {the members having a cellular, e.g. honeycomb, structure}
- F16F 7/122
 - • • {characterised by corrugations, e.g. of rolled corrugated material}
- F16F 7/123
 - • {Deformation involving a bending action, e.g. strap moving through multiple rollers, folding of members ([F16F 7/125](#), [F16F 7/128](#) take precedence)}
- F16F 7/124
 - • {characterised by their special construction from fibre-reinforced plastics}
- F16F 7/125
 - • {Units with a telescopic-like action as one member moves into, or out of a second member ([F16F 7/124](#), [F16F 7/127](#), [F16F 7/128](#) take precedence)}
- F16F 7/126
 - • • {against the action of shear pins; one member having protuberances, e.g. dimples, ball bearings which cause the other member to deform}
- F16F 7/127
 - • {by a blade element cutting or tearing into a quantity of material; Pultrusion of a filling material}
- F16F 7/128
 - • {characterised by the members, e.g. a flat strap, yielding through stretching, pulling apart}
- F16F 7/14
 - of cable support type, i.e. frictionally-engaged loop-forming cables

F16F 9/00	Springs, vibration-dampers, shock-absorbers, or similarly-constructed movement-dampers using a fluid or the equivalent as damping medium (F16F 5/00 takes precedence; connection of valves to inflatable elastic bodies B60C 29/00 ; {braking devices, stops or buffers for wing-operating appliances E05F 3/00 , E05F 5/00 })
F16F 9/003	. {Dampers characterised by having pressure absorbing means other than gas, e.g. sponge rubber}
F16F 9/006	. {characterised by the nature of the damping medium, e.g. biodegradable (variable viscosity damping adjustment F16F 9/53)}
F16F 9/02	. using gas only {or vacuum (F16F 9/006 takes precedence)}
F16F 9/0209	. . {Telescopic (F16F 9/04 takes precedence)}
F16F 9/0218	. . . {Mono-tubular units (F16F 9/0227 , F16F 9/0236 , F16F 9/0245 take precedence)}
F16F 9/0227	. . . {characterised by the piston construction}
F16F 9/0236	. . . {characterised by having a hollow piston rod}
F16F 9/0245	. . . {Means for adjusting the length of, or for locking, the spring or dampers}
F16F 9/0254	. . . . {mechanically lockable, e.g. by use of friction collar (mechanical locking of extensible devices for holding wings E05C 17/30)}
F16F 9/0263	. . . . {characterised by actuation means, e.g. manually-operated lever arrangement (F16F 9/0254 takes precedence)}
F16F 9/0272	. . . . {with control rod extending through the piston rod into the piston}
F16F 9/0281	. . . {Details}
F16F 9/029	. . . . {electrical, e.g. connections or contacts}
F16F 9/04	. . in a chamber with a flexible wall {(producing hollow articles of plastics, e.g. air bellows, B29D 22/00)}
F16F 9/0409	. . . {characterised by the wall structure}
F16F 9/0418	. . . {having a particular shape, e.g. annular, spherical, tube-like (F16F 9/05 takes precedence)}
F16F 9/0427	. . . . {toroidal}
F16F 9/0436	. . . {characterised by being contained in a generally closed space}
F16F 9/0445	. . . {characterised by intermediate rings or other not embedded reinforcing elements (wall structure F16F 9/0409)}
F16F 9/0454	. . . {characterised by the assembling method or by the mounting arrangement, e.g. mounting of the membrane (F16F 9/0409 , F16F 9/0445 take precedence)}
F16F 9/0463	. . . . {with separate crimping rings}
F16F 9/0472	. . . {characterised by comprising a damping device (with plastic deformation of members F16F 7/12 ; delay devices or arrangements F15B 21/10)}
F16F 9/0481	. . . . {provided in an opening to the exterior atmosphere}
F16F 9/049	. . . {multi-chamber units (F16F 9/0472 , F16F 9/05 take precedence)}
F16F 9/05	. . . the flexible wall being of the rolling diaphragm type
F16F 9/052	. . . . {characterised by the bumper}
F16F 9/055	. . . . {having a double diaphragm construction}
F16F 9/057	. . . . {characterised by the piston}

- F16F 9/06
 - using both gas and liquid {(F16F 9/486 take precedence; self-pumping fluid springs B60G 17/044)}
- F16F 9/061
 - • {Mono-tubular units}
- F16F 9/062
 - • {Bi-tubular units}
- F16F 9/063
 - • {comprising a hollow piston rod}
- F16F 9/064
 - • {Units characterised by the location or shape of the expansion chamber (F16F 9/068, F16F 9/08 take precedence)}
- F16F 9/065
 - • • {Expansion chamber provided on the upper or lower end of a damper, separately there from or laterally on the damper}
- F16F 9/066
 - • {Units characterised by the partition, baffle or like element (F16F 9/068, F16F 9/08 take precedence)}
- F16F 9/067
 - • • {Partitions of the piston type, e.g. sliding pistons}
- F16F 9/068
 - • {where the throttling of a gas flow provides damping action}
- F16F 9/08
 - • {where gas is} in a chamber with a flexible wall {(pressurised fluid system accumulators per se F15B 1/04)}
- F16F 9/081
 - • • {being of the fluid displacement type, i.e. the piston not comprising damping arrangements (F16F 9/096 takes precedence)}
- F16F 9/082
 - • • {characterised by the hydropneumatic accumulator}
- F16F 9/084
 - • • comprising a gas spring contained within a flexible wall, the wall not being in contact with the damping fluid, i.e. mounted externally on the damper cylinder
- F16F 9/088
 - • • comprising a gas spring with a flexible wall provided within the cylinder on the piston rod of a monotubular damper or within the inner tube of a bitubular damper
- F16F 9/092
 - • • comprising a gas spring with a flexible wall provided between the tubes of a bitubular damper
- F16F 9/096
 - • • comprising a hydropneumatic accumulator of the membrane type provided on the upper or the lower end of a damper or separately from or laterally on the damper {(F16F 9/088 takes precedence)}
- F16F 9/10
 - using liquid only; using a fluid of which the nature is immaterial
- F16F 9/103
 - • {Devices with one or more members moving linearly to and fro in chambers, any throttling effect being immaterial, i.e. damping by viscous shear effect only (F16F 9/53 takes precedence)}
- F16F 9/106
 - • {Squeeze-tube devices}
- F16F 9/12
 - • Devices with one or more rotary vanes turning in the fluid any throttling effect being immaterial, {i.e. damping by viscous shear effect only (F16F 9/53 takes precedence ; pivoting supports for apparatus or articles placed on stands or trestles F16M 11/06)}
- F16F 9/125
 - • • {characterised by adjustment means}
- F16F 9/14
 - • Devices with one or more members, e.g. pistons, vanes, moving to and fro in chambers and using throttling effect
- F16F 9/145
 - • • {involving only rotary movement of the effective parts (wing closers or openers with fluid brakes of the rotary type E05F 3/14)}
- F16F 9/16
 - • • involving only straight-line movement of the effective parts {(wing closers or openers with liquid piston brakes E05F 3/04)}

F16F 9/165	. . . . {with two or more cylinders in line, i.e. in series connection (F16F 9/26 takes precedence)}
F16F 9/18	. . . . with a closed cylinder and a piston separating two or more working spaces therein
F16F 9/182	. . . . . {comprising a hollow piston rod}
F16F 9/185	. . . . . {Bitubular units (where compression of gas leads to a clear spring action F16F 9/062)}
F16F 9/187	. . . . . . {with uni-directional flow of damping fluid through the valves}
F16F 9/19	. . . . . with a single cylinder {and of single-tube type}
F16F 9/20	. . . . . with the piston-rod extending through both ends of the cylinder, {e.g. constant-volume dampers}
F16F 9/22	. . . . with one or more cylinders each having a single working space closed by a piston or plunger
F16F 9/26	. . . . . with two cylinders in line and with the two pistons or plungers connected together
F16F 9/28	. . . . . with two parallel cylinders and with the two pistons or plungers connected together
F16F 9/285	. . . . . . {by a rocker arm}
F16F 9/30	. with solid or semi-solid material, e.g. pasty masses, as damping medium {(in devices where rotary elements are damped by viscous shear effect only, any throttling effect being immaterial F16F 9/12 ; where members moving with a rotating system are being damped F16F 15/16)}
F16F 9/303	. . {the damper being of the telescopic type}
F16F 9/306	. . {of the constrained layer type, i.e. comprising one or more constrained viscoelastic layers}
F16F 9/32	. Details
F16F 9/3207	. . {Constructional features (F16F 9/34 to F16F 9/50 take precedence; assembly or repair F16F 9/3271)}
F16F 9/3214	. . . {of pistons (F16F 9/0227 and F16F 9/36 take precedence; throttling passages in or on piston body F16F 9/3405)}
F16F 9/3221	. . . {of piston rods}
F16F 9/3228	. . . {of connections between pistons and piston rods}
F16F 9/3235	. . . {of cylinders (F16F 9/483 takes precedence)}
F16F 9/3242	. . . . {of cylinder ends, e.g. caps}
F16F 9/325	. . . . {for attachment of valve units}
F16F 9/3257	. . . . {in twin-tube type devices}
F16F 9/3264	. . {Arrangements for indicating, e.g. fluid level; Arrangements for checking dampers (F16F 9/3292 takes precedence; testing of vehicle damping G01M 17/04)}
F16F 9/3271	. . {Assembly or repair}
F16F 9/3278	. . {for lubrication (lubricating per se F16N)}
F16F 9/3285	. . {for filtering (filters per se B01D)}
F16F 9/3292	. . {Sensor arrangements}

- F16F 9/34
 - • Special valve constructions ([F16F 9/44](#), [F16F 9/50](#) take precedence; filtering details [F16F 9/3285](#) ; valves in general [F16K](#)); Shape or construction of throttling passages
- F16F 9/3405
 - • • {Throttling passages in or on piston body, e.g. slots ([F16F 9/344](#), [F16F 9/3481](#) take precedence)}
- F16F 9/341
 - • • {comprising noise-reducing or like features, e.g. screens ([F16F 9/3415](#) takes precedence)}
- F16F 9/3415
 - • • {characterised by comprising plastics, elastomeric or porous elements}
- F16F 9/342
 - • • Throttling passages operating with metering pins ([F16F 9/486](#) takes precedence)}
- F16F 9/344
 - • • Vortex flow passages
- F16F 9/346
 - • • Throttling passages in the form of slots arranged in cylinder walls
- F16F 9/3465
 - • • • {Slots having a variable section along their length}
- F16F 9/348
 - • • Throttling passages in the form of annular discs {or other plate-like elements which may or may not have a spring action}, operating in opposite directions {or singly, e.g. annular discs positioned on top of the valve or piston body ([F16F 9/341](#), [F16F 9/3415](#) take precedence)}
- F16F 9/3481
 - • • • {characterised by shape or construction of throttling passages in piston ([F16F 9/344](#) takes precedence)}
- F16F 9/3482
 - • • • {the annular discs being incorporated within the valve or piston body ([F16F 9/3484](#), [F16F 9/3485](#) take precedence)}
- F16F 9/3484
 - • • • {characterised by features of the annular discs per se, singularly or in combination}
- F16F 9/3485
 - • • • {characterised by features of supporting elements intended to guide or limit the movement of the annular discs ([F16F 9/3488](#) takes precedence)}
- F16F 9/3487
 - • • • • {with spacers or spacing rings}
- F16F 9/3488
 - • • • {characterised by features intended to affect valve bias or pre-stress}
- F16F 9/36
 - • Special sealings, including sealings or guides for piston-rods ([F16F 9/325](#), [F16F 9/3485](#) take precedence; arrangements for filling via piston rod sealing or guiding means [F16F 9/432](#) ; sealing of moving parts in general [F16J 15/16](#) to [F16J 15/56](#))
- F16F 9/361
 - • • {Sealings of the bellows-type}
- F16F 9/362
 - • • {Combination of sealing and guide arrangements for piston rods ([F16F 9/361](#), [F16F 9/365](#) take precedence)}
- F16F 9/363
 - • • • {the guide being mounted between the piston and the sealing, enabling lubrication of the guide}
- F16F 9/364
 - • • • {of multi-tube dampers}
- F16F 9/365
 - • • {the sealing arrangement having a pressurised chamber separated from the damping medium}
- F16F 9/366
 - • • {functioning as guide only, e.g. bushings}
- F16F 9/367
 - • • • {allowing misalignment of the piston rod}
- F16F 9/368
 - • • {Sealings in pistons}
- F16F 9/369
 - • • {Sealings for elements other than pistons or piston rods, e.g. valves}
- F16F 9/38
 - • Covers for protection or appearance

- F16F 9/42 . . Cooling arrangements
- F16F 9/43 . . Filling {or drainage} arrangements, e.g. for supply of gas {(filling vessels with, or discharging from vessels, compressed, liquefied, or solidified gases [F17C](#))}
- F16F 9/432 . . . {via piston rod sealing or guiding means}
- F16F 9/435 . . . {via opening in cylinder wall ([F16F 9/432](#) takes precedence)}
- F16F 9/437 . . . {Drainage arrangements}
- F16F 9/44 . . Means on or in the damper for manual or non-automatic adjustment; Such means combined with temperature correction ([F16F 9/53](#), [F16F 13/26](#)) take precedence; temperature correction only [F16F 9/52](#)
- F16F 9/443 . . . {manually adjusted while the damper is fully retracted or extended in a non-operational mode by rotating mechanical means that have engaged between the piston and one end of the cylinder}
- F16F 9/446 . . . {Adjustment of valve bias or pre-stress ([F16F 9/443](#) takes precedence)}
- F16F 9/46 . . . allowing control from a distance, {i.e. location of means for control input being remote from site of valves, e.g. on damper external wall (attachment of valve units to cylinders [F16F 9/325](#))}
- F16F 9/461 {characterised by actuation means}
- F16F 9/462 {Rotary actuation means}
- F16F 9/463 {characterised by electrical connections}
- F16F 9/464 {Control of valve bias or pre-stress, e.g. electromagnetically ([F16F 9/465](#) takes precedence)}
- F16F 9/465 {using servo control, the servo pressure being created by the flow of damping fluid, e.g. controlling pressure in a chamber downstream of a pilot passage (self-adjustment of damping [F16F 9/50](#))}
- F16F 9/466 {Throttling control, i.e. regulation of flow passage geometry ([F16F 9/464](#), [F16F 9/465](#) take precedence)}
- F16F 9/467 {using rotary valves}
- F16F 9/468 {controlling at least one bypass to main flow path}
- F16F 9/469 {Valves incorporated in the piston ([F16F 9/467](#) takes precedence)}
- F16F 9/48 . . Arrangements for providing different damping effects at different parts of the stroke ([F16F 9/346](#), [F16F 9/516](#) , [F16F 9/53](#) take precedence)
- F16F 9/483 . . . {characterised by giving a particular shape to the cylinder, e.g. conical}
- F16F 9/486 . . . {comprising a pin or stem co-operating with an aperture, e.g. a cylinder-mounted stem co-operating with a hollow piston rod}
- F16F 9/49 . . . Stops limiting fluid passage, e.g. hydraulic stops {or elastomeric elements inside the cylinder which contribute to changes in fluid damping (fluid-actuated displacement devices with means for accelerating or decelerating the stroke [F15B 15/22](#))}
- F16F 9/50 . . Special means providing automatic damping adjustment, {i.e. self-adjustment of damping by particular sliding movements of a valve element, other than flexions or displacement of valve discs} ([F16F 9/53](#) takes precedence); {Special means providing self-adjustment of spring characteristics}
- F16F 9/504 . . . Inertia, {i.e. acceleration,}-sensitive means

- F16F 9/512
 - • • Means responsive to load action, {i.e. static load} on the damper or {dynamic} fluid pressure {changes} in the damper, {e.g. due to changes in velocity (F16F 9/504, F16F 9/516 take precedence; non-automatic damper adjustment from a distance using servo control, the servo pressure being created by the flow of damping fluid F16F 9/465; self-pumping fluid springs in vehicle suspensions B60G 17/044)}
- F16F 9/5123
 - • • • {responsive to the static or steady-state load on the damper}
- F16F 9/5126
 - • • • {Piston, or piston-like valve elements (F16F 9/504 takes precedence)}
- F16F 9/516
 - • • resulting in the damping effects during contraction being different from the damping effects during extension, {i.e. responsive to the direction of movement (F16F 9/504 takes precedence)}
- F16F 9/5165
 - • • • {by use of spherical valve elements or like free-moving bodies}
- F16F 9/52
 - • • in case of change of temperature {(F16F 9/003 takes precedence; } combined with external adjustment F16F 9/44)
- F16F 9/523
 - • • • {with coil or spiral of bimetallic elements being used to change flow cross-section}
- F16F 9/526
 - • • • {Self-adjustment of fluid springs}
- F16F 9/53
 - • Means for adjusting damping characteristics by varying fluid viscosity, e.g. electromagnetically {(F16F 13/30 takes precedence; brakes comprising a medium with electrically or magnetically controlled friction F16D 57/002; electrorheological fluids per se C10M 171/001; magnetorheological fluids per se H01F 1/447)}
- F16F 9/532
 - • • {Electrorheological [ER] fluid dampers}
- F16F 9/535
 - • • {Magnetorheological [MR] fluid dampers (springs comprising magnetorheological [MR] elastomers F16F 1/361)}
- F16F 9/537
 - • • • {specially adapted valves therefor}
- F16F 9/54
 - • Arrangements for attachment {(grommet-type rubber mounting springs per se F16F 1/3732; construction of cylinder ends F16F 9/3242; attachments to vehicles B60G 13/001, B60G 15/00)}
- F16F 9/56
 - • Means for adjusting the length of, or for locking, the spring or damper, e.g. at the end of the stroke {(F16F 9/50 takes precedence; for telescopic gas springs or dampers F16F 9/0245; vehicle suspension locking arrangements B60G 17/005)}
- F16F 9/58
 - • Stroke limiting stops, e.g. arranged on the piston rod outside the cylinder (F16F 9/49 takes precedence)
- F16F 9/585
 - • • {within the cylinder, in contact with working fluid}
- F16F 13/00**

Units comprising springs of the non-fluid type as well as vibration-dampers, shock-absorbers, or fluid springs (F16F 5/00, {F16F 6/00, F16F 9/003} take precedence)
- F16F 13/002
 - {comprising at least one fluid spring (F16F 13/005, F16F 13/02, F16F 13/04 take precedence)}
- F16F 13/005
 - {comprising both a wound spring and a damper, e.g. a friction damper}
- F16F 13/007
 - • {the damper being a fluid damper}
- F16F 13/02
 - damping by frictional contact between the spring and braking means (frictionally coacting wound springs F16F 3/06)
- F16F 13/04
 - comprising both a plastics spring and a damper, e.g. a friction damper

- F16F 13/06
 - . the damper being a fluid damper, e.g. the plastics spring not forming a part of the wall of the fluid chamber of the damper ([F16F 13/26 takes precedence](#))
- F16F 13/08
 - . . the plastics spring forming at least a part of the wall of the fluid chamber of the damper ([F16F 13/20 to F16F 13/24 take precedence](#))
- F16F 13/085
 - {characterised by features of plastics springs; Attachment arrangements}
- F16F 13/10
 - the wall being at least in part formed by a flexible membrane or the like ([F16F 13/14 to F16F 13/18 take precedence](#))
- F16F 13/101
 - {characterised by buffering features or stoppers}
- F16F 13/102
 - {characterised by features of flexible walls of equilibration chambers; decoupling or self-tuning means}
- F16F 13/103
 - {characterised by method of assembly, production or treatment}
- F16F 13/105
 - {characterised by features of partitions between two working chambers}
- F16F 13/106
 - {Design of constituent elastomeric parts, e.g. decoupling valve elements, or of immediate abutments therefor, e.g. cages}
- F16F 13/107
 - {Passage design between working chambers}
- F16F 13/108
 - {characterised by features of plastics springs, e.g. attachment arrangements ([F16F 13/18 takes precedence](#))}
- F16F 13/14
 - Units of the bushing type, {i.e. loaded predominantly radially ([bushes F16F 1/38; mounting brackets therefor F16F 1/3849](#))}
- F16F 13/1409
 - {characterised by buffering features or stoppers}
- F16F 13/1418
 - {characterised by the location or shape of the equilibration chamber}
- F16F 13/1427
 - {characterised by features of flexible walls of equilibration chambers; decoupling or self-tuning means}
- F16F 13/1436
 - {with free- or virtually free-floating members}
- F16F 13/1445
 - {characterised by method of assembly, production or treatment}
- F16F 13/1454
 - {Sealing of units}
- F16F 13/1463
 - {characterised by features of passages between working chambers}
- F16F 13/1472
 - {Valve elements to cope with over-pressure, e.g. lips}
- F16F 13/1481
 - {characterised by features of plastic springs, e.g. presence of cavities or stiffeners; characterised by features of flexible walls of equilibration chambers, i.e. membranes}
- F16F 13/149
 - {Multiple bushings connected together; Restraining links}
- F16F 13/16
 - specially adapted for receiving axial loads {([F16F 13/1436 takes precedence](#))}
- F16F 13/18
 - characterised by the location or the shape of the equilibration chamber, e.g. the equilibration chamber, surrounding the plastics spring or being annular ([F16F 13/1418 takes precedence](#))
- F16F 13/20
 - . . . characterised by comprising also a pneumatic spring ([F16F 13/22, {F16F 13/26} take precedence](#))
- F16F 13/22
 - . . . characterised by comprising also a dynamic damper ([dampers using inertia effect per se F16F 7/10](#))

- F16F 13/24
 - • • the central part of the unit being supported by one element and both extremities of the unit being supported by a single other element, i.e. double acting mounting
- F16F 13/26
 - • characterised by adjusting or regulating devices responsive to exterior conditions [{\(F16F 13/101 takes precedence\)}](#)
- F16F 13/262
 - • • [{changing geometry of passages between working and equilibration chambers, e.g. cross-sectional area or length \(F16F 13/28 takes precedence\)}](#)
- F16F 13/264
 - • • [{comprising means for acting dynamically on the walls bounding a working chamber}](#)
- F16F 13/266
 - • • [{comprising means for acting dynamically on the walls bounding a passage between working and equilibration chambers}](#)
- F16F 13/268
 - • • [{comprising means for acting dynamically on the walls bounding an equilibration chamber \(F16F 13/264 take precedence\)}](#)
- F16F 13/28
 - • • specially adapted for units of the bushing type [\(F16F 13/30 takes precedence\)](#)
- F16F 13/30
 - • • comprising means for varying fluid viscosity, e.g. of magnetic or electrorheological fluids
- F16F 13/305
 - • • • [{magnetorheological}](#)
- F16F 15/00**

Suppression of vibrations in systems [\({damping of non-rotary systems using inertia effect F16F 7/10; prevention or isolation of vibrations in machine tools B23Q 11/0032; suppression of driveline vibrations in hybrid vehicle transmissions B60W 30/20} ; vehicle seat suspension devices B60N 2/50; {methods or devices for protecting against, or damping of, acoustic waves, e.g. sound G10K 11/16}\);](#)
Means or arrangements for avoiding or reducing out-of-balance forces, e.g. due to motion [\({vibration absorbing or balancing means for aircraft propellers B64C 11/008, for rotorcraft rotors B64C 27/001} ; testing static and dynamic balance of machines or structures G01M 1/00\)](#)
- F16F 15/002
 - [{characterised by the control method or circuitry \(control of mechanical oscillations per se G05D 19/00\)}](#)
- F16F 15/005
 - [{using electro- or magnetostrictive actuation means \(generating of mechanical vibrations operating with electrostriction B06B 1/06, with magnetostriction B06B 1/08; vehicle suspension arrangements characterised by use of piezo-electric elements B60G 17/01941; piezo-electric, electrostrictive and magnetostrictive devices per se H01L 41/00\)}](#)
- F16F 15/007
 - • [{Piezo-electric elements being placed under pre-constraint, e.g. placed under compression}](#)
- F16F 15/02
 - 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 systems [\({F16F 15/005 takes precedence} ; layered products B32B; suppression of vibration in ships B63; {relieving load on bearings, using magnetic means F16C 39/06}\)](#)
- F16F 15/021
 - • [{Decoupling of vibrations by means of point-of-contact supports, e.g. ball bearings}](#)
- F16F 15/022
 - • [{using dampers and springs in combination}](#)
- F16F 15/023
 - • using fluid means
- F16F 15/0232
 - • • [{with at least one gas spring \(F16F 15/027 takes precedence\)}](#)

- F16F 15/0235 . . . {where a rotating member is in contact with fluid (rotary viscous dampers per se F16F 9/12; suppression of vibrations in rotating systems containing a fluid F16F 15/16)}
- F16F 15/0237 . . . {involving squeeze-film damping}
- F16F 15/027 . . . comprising control arrangements {(F16F 15/0237 takes precedence)}
- F16F 15/0275 {Control of stiffness}
- F16F 15/03 . . using {magnetic or} electromagnetic means (F16F 9/53, {F16F 15/005} take precedence)
- F16F 15/035 . . . {by use of eddy or induced-current damping (dynamo-electric brakes of the eddy-current type H02K 49/04)}
- F16F 15/04 . . using elastic means (single elements or their attachment F16F 1/00 to F16F 13/00); {(F16F 15/023, F16F 15/03 take precedence)}
- F16F 15/043 . . . {acting on a cam follower}
- F16F 15/046 . . . {using combinations of springs of different kinds (F16F 15/085 takes precedence)}
- F16F 15/06 . . . with metal springs (with rubber springs also F16F 15/08)
- F16F 15/063 {with bars or tubes used as torsional elements}
- F16F 15/067 using only wound springs
- F16F 15/073 using only leaf springs
- F16F 15/08 . . . with rubber springs {(grommet- or bushing-type resilient mountings F16F 1/3732, F16F 1/38); with springs made of rubber and metal (arrangement of internal-combustion or jet-propulsion units B60K 5/12; mounting of propulsion plants on vessels B63H 21/30; mounting of vehicle drivers' cabs B62D 33/0604)}
- F16F 15/085 {Use of both rubber and metal springs}
- F16F 15/10 . . Suppression of vibrations in rotating systems by making use of members moving with the system (by balancing F16F 15/22; {yielding couplings F16D 3/00} ; with flywheels acting variably or intermittently F16H; {construction providing resilience or vibration-damping for gear elements F16H 55/14})
- F16F 15/12 . . using elastic members or friction-damping members, e.g. between a rotating shaft and a gyratory mass mounted thereon ({F16F 15/14} , F16F 15/16 take precedence)
- F16F 15/1201 . . . {for damping of axial or radial, i.e. non-torsional vibrations (F16F 15/13107 takes precedence)}
- F16F 15/1202 . . . {the damping action being at least partially controlled by centrifugal masses (F16F 15/13128 takes precedence)}
- F16F 15/1203 . . . {characterised by manufacturing, e.g. assembling or testing procedures for the damper units (F16F 15/13142 takes precedence)}
- F16F 15/1204 . . . {with a kinematic mechanism or gear system (F16F 15/1202, F16F 15/13157 take precedence)}
- F16F 15/1205 {with a kinematic mechanism, i.e. linkages, levers}
- F16F 15/1206 {with a planetary gear system}
- F16F 15/1207 . . . {characterised by the supporting arrangement of the damper unit (F16F 15/1238, F16F 15/13164 take precedence)}
- F16F 15/1208 {Bearing arrangements}
- F16F 15/1209 {comprising sliding bearings}

F16F 15/121	. . .	using springs as elastic members, e.g. metallic springs (F16F 15/133 takes precedence)
F16F 15/1211	. . . .	{C-shaped springs}
F16F 15/1212	. . . . .	{disposed around axis of rotation}
F16F 15/1213	. . . . .	{Spiral springs, e.g. lying in one plane, around axis of rotation}
F16F 15/1214	. . . . .	{Folded springs, i.e. made of band-like material folded in an enclosing space}
F16F 15/1215	. . . . .	{Leaf springs, e.g. radially extending}
F16F 15/1216	. . . . .	{Torsional springs, e.g. torsion bar or torsionally-loaded coil springs}
F16F 15/1217	. . . . .	{Motion-limiting means, e.g. means for locking the spring unit in pre-defined positions (F16F 15/1202 , F16F 15/1338 take precedence)}
F16F 15/1218	. . . . .	{by means of spring-loaded radially arranged locking means}
F16F 15/1219	. . . . .	{by means of spring-loaded axially arranged locking means}
F16F 15/123	. . . . .	Wound springs (F16F 15/1213 , F16F 15/1216 , F16F 15/127 take precedence)
F16F 15/12306	. . . . .	{Radially mounted springs}
F16F 15/12313	. . . . .	{characterised by the dimension or shape of spring-containing windows}
F16F 15/1232	. . . . .	{characterised by the spring mounting (F16F 15/12306 , F16F 15/12313 take precedence)}
F16F 15/12326	. . . . .	{End-caps for springs}
F16F 15/12333	. . . . .	{having internal abutment means}
F16F 15/1234	. . . . .	{Additional guiding means for springs, e.g. for support along the body of springs that extend circumferentially over a significant length}
F16F 15/12346	. . . . .	{Set of springs, e.g. springs within springs}
F16F 15/12353	. . . . .	{Combinations of dampers, e.g. with multiple plates, multiple spring sets, i.e. complex configurations}
F16F 15/1236	. . . . .	{resulting in a staged spring characteristic, e.g. with multiple intermediate plates}
F16F 15/12366	. . . . .	{acting on multiple sets of springs}
F16F 15/12373	. . . . .	{the sets of springs being arranged at substantially the same radius}
F16F 15/1238	. . . . .	{with pre-damper, i.e. additional set of springs between flange of main damper and hub}
F16F 15/12386	. . . . .	{Pre-damper cage construction}
F16F 15/12393	. . . . .	{pre-damper springs are of non-wound type, e.g. leaf springs}
F16F 15/124	. . . . .	Elastomeric springs (F16F 15/123 , F16F 15/127 take precedence)
F16F 15/1245	. . . . .	{Elastic elements arranged between substantially-radial walls of two parts rotatable with respect to each other, e.g. between engaging teeth}
F16F 15/126	. . . . .	consisting of at least one annular element surrounding the axis of rotation
F16F 15/127	. . . . .	using plastics springs combined with other types of springs

F16F 15/129	. . .	characterised by friction-damping means (F16F 15/1202 , F16F 15/1238), F16F 15/131 take precedence)
F16F 15/1292	. . . .	{characterised by arrangements for axially clamping or positioning or otherwise influencing the frictional plates}
F16F 15/1295	. . . .	{characterised by means for interconnecting driven plates and retainer, cover plates}
F16F 15/1297	. . . .	{Overload protection, i.e. means for limiting torque}
F16F 15/131	. . .	the rotating system comprising two or more gyratory masses
F16F 15/13107	. . . .	{for damping of axial or radial, i.e. non-torsional vibrations}
F16F 15/13114	. . . .	{characterised by modifications for auxiliary purposes, e.g. provision of a timing mark}
F16F 15/13121	. . . .	{characterised by clutch arrangements, e.g. for activation; integrated with clutch members, e.g. pressure member}
F16F 15/13128	. . . .	{the damping action being at least partially controlled by centrifugal masses (flywheels characterised by means to vary the moment of inertia F16F 15/31)}
F16F 15/13135	. . . . .	{simple connection or disconnection of members at speed}
F16F 15/13142	. . . .	{characterised by the method of assembly, production or treatment (F16F 15/13114 takes precedence)}
F16F 15/1315	. . . . .	{Multi-part primary or secondary masses, e.g. assembled from pieces of sheet steel}
F16F 15/13157	. . . .	{with a kinematic mechanism or gear system, e.g. planetary (F16F 15/13128 takes precedence)}
F16F 15/13164	. . . .	{characterised by the supporting arrangement of the damper unit}
F16F 15/13171	. . . . .	{Bearing arrangements (F16F 15/13192 takes precedence)}
F16F 15/13178	. . . . .	{comprising slide bearings}
F16F 15/13185	. . . . .	{Bolting arrangements (F16F 15/13171 takes precedence)}
F16F 15/13192	. . . . .	{Thermal shielding}
F16F 15/133	. . . .	using springs as elastic members, e.g. metallic springs
F16F 15/1331	. . . . .	{C-shaped springs}
F16F 15/1332	. . . . .	{disposed around axis of rotation}
F16F 15/1333	. . . . .	{Spiral springs, e.g. lying in one plane, around axis of rotation}
F16F 15/1335	. . . . .	{Folded springs, i.e. made of band-like material folded in an enclosing space}
F16F 15/1336	. . . . .	{Leaf springs, e.g. radially extending}
F16F 15/1337	. . . . .	{Torsional springs, e.g. torsion bar or torsionally-loaded coil springs}
F16F 15/1338	. . . . .	{Motion-limiting means, e.g. means for locking the spring unit in pre-defined positions (F16F 15/13128 takes precedence)}
F16F 15/134	. . . . .	Wound springs (F16F 15/1333 , F16F 15/1337 , F16F 15/137 take precedence)}
F16F 15/13407	. . . . .	{Radially mounted springs}
F16F 15/13415	. . . . .	{characterised by the dimension or shape of spring-containing windows}

F16F 15/13423	. . . . .	{Disposition of material for damping or avoiding wear}
F16F 15/1343	. . . . .	{characterised by the spring mounting (F16F 15/13407 , F16F 15/13415 take precedence)}
F16F 15/13438	. . . . .	{End-caps for springs}
F16F 15/13446	. . . . .	{having internal abutment means}
F16F 15/13453	. . . . .	{Additional guiding means for springs}
F16F 15/13461	. . . . .	{Set of springs, e.g. springs within springs}
F16F 15/13469	. . . . .	{Combinations of dampers, e.g. with multiple plates, multiple spring sets, i.e. complex configurations}
F16F 15/13476	. . . . .	{resulting in a staged spring characteristic, e.g. with multiple intermediate plates}
F16F 15/13484	. . . . .	{acting on multiple sets of springs}
F16F 15/13492	. . . . .	{the sets of springs being arranged at substantially the same radius}
F16F 15/136	. . . . .	Plastics springs, e.g. made of rubber (F16F 15/134 , F16F 15/137 take precedence)
F16F 15/137	. . . . .	the elastic members consisting of two or more springs of different kinds, {e.g. elastomeric members and wound springs}
F16F 15/139	. . . . .	characterised by friction-damping means ({ F16F 15/13128 takes precedence})
F16F 15/1392	. . . . .	{characterised by arrangements for axially clamping or positioning or otherwise influencing the frictional plates}
F16F 15/1395	. . . . .	{characterised by main friction means acting radially outside the circumferential lines of action of the elastic members}
F16F 15/1397	. . . . .	{Overload protection, i.e. means for limiting torque}
F16F 15/14	. . . . .	using masses freely rotating with the system, {i.e.uninvolved in transmitting driveline torque, e.g. rotative dynamic dampers (compensation of inertia forces F16F 15/22 ; weights for balancing rotating bodies F16F 15/32)}
F16F 15/1407	. . . . .	{the rotation being limited with respect to the driving means}
F16F 15/1414	. . . . .	{Masses driven by elastic elements (F16F 15/145 , F16F 15/1464 take precedence)}
F16F 15/1421	. . . . .	{Metallic springs, e.g. coil or spiral springs}
F16F 15/1428	. . . . .	{with a single mass}
F16F 15/1435	. . . . .	{Elastomeric springs, i.e. made of plastic or rubber}
F16F 15/1442	. . . . .	{with a single mass}
F16F 15/145	. . . . .	{Masses mounted with play with respect to driving means thus enabling free movement over a limited range}
F16F 15/1457	. . . . .	{Systems with a single mass}
F16F 15/1464	. . . . .	{Masses connected to driveline by a kinematic mechanism or gear system (F16F 15/145 takes precedence)}
F16F 15/1471	. . . . .	{with a kinematic mechanism, i.e. linkages, levers}
F16F 15/1478	. . . . .	{with a planetary gear system}
F16F 15/1485	. . . . .	{the rotation being unlimited with respect to driving means (with a fluid connection between inertia member and rotating driving means F16F 15/167)}

- F16F 15/1492 {with a dry-friction connection}
- F16F 15/16 . . using a fluid {or pasty material} (F16F 9/53, F16F 15/13157 take precedence; devices connecting input and output members F16D)
- F16F 15/161 . . . {characterised by the fluid damping devices, e.g. passages, orifices (F16F 15/162 takes precedence)}
- F16F 15/162 . . . {with forced fluid circulation}
- F16F 15/163 . . . {fluid acting as a lubricant}
- F16F 15/164 . . . {characterised by manufacturing, e.g. assembling or testing procedures}
- F16F 15/165 . . . {Sealing arrangements}
- F16F 15/167 . . . having an inertia member, e.g. ring
- F16F 15/173 provided within a closed housing ((F16F 15/36 takes precedence))
- F16F 15/18 . . using electric, {magnetic or electromagnetic} means ({suppression of vibrations of rotating systems by use of non-rotating magnetic or electromagnetic means F16F 15/03; } dynamo-electric devices H02K; {control effected upon generator excitation circuit to reduce harmful effects of overloads or transients H02P 9/10})
- F16F 15/20 . Suppression of vibrations of rotating systems by favourable grouping or relative arrangements of the moving members of the system or systems ((F16F 15/24 takes precedence))
- F16F 15/22 . Compensation of inertia forces ({suppression of vibrations of rotating systems by favourable grouping or relative arrangements of the moving members of the system or systems F16F 15/20, counterweights F16F 15/28; correcting-weights for balancing rotating bodies F16F 15/32})
- F16F 15/223 . . {Use of systems involving rotary unbalanced masses where the phase-angle of masses mounted on counter-rotating shafts can be varied (generation of mechanical vibrations per se with such systems B06B 1/166)}
- F16F 15/226 . . {in star engine arrangements}
- F16F 15/24 . . of crankshaft systems by particular disposition of cranks, pistons, or the like ((shape of crankshafts or eccentric-shafts having regard to balancing F16C 3/20))
- F16F 15/26 . . of crankshaft systems using solid masses, other than the ordinary pistons, moving with the system, {i.e. masses connected through a kinematic mechanism or gear system (F16F 15/226 takes precedence)}
- F16F 15/261 . . . {where masses move linearly}
- F16F 15/262 . . . {Masses attached to pinions, camshafts or driving shafts for auxiliary equipment, e.g. for an oil pump}
- F16F 15/264 . . . {Rotating balancer shafts (F16F 15/262 takes precedence)}
- F16F 15/265 {Arrangement of two or more balancer shafts (F16F 15/267 takes precedence)}
- F16F 15/267 {characterised by bearing support of balancer shafts; Lubrication arrangements}
- F16F 15/268 {Hollow shafts}
- F16F 15/28 . Counterweights, {i.e. additional weights counterbalancing inertia forces induced by the reciprocating movement of masses in the system, e.g. of pistons attached to an engine crankshaft (rotating balancer shafts F16F 15/264; correcting-weights for balancing rotating bodies F16F 15/32)}; Attaching or mounting same

- F16F 15/283 . . {for engine crankshafts}
- F16F 15/286 . . . {Adjustable weights}
- F16F 15/30 . Flywheels ([F16F 15/16](#), [F16F 15/28](#) take precedence; suppression of vibrations in rotating systems using elastic members or friction-damping members moving with the system, {i.e. split flywheels or single masses connected to a hub by elastic members or friction-damping members} [F16F 15/12](#); rotary-body aspects in general [F16C 13/00](#), [F16C 15/00](#))
- F16F 15/302 . . {comprising arrangements for cooling or thermal insulation}
- F16F 15/305 . . made of plastics, e.g. fibre-reinforced plastics [FRP], {i.e. characterised by their special construction from such materials}
- F16F 15/31 . . characterised by means for varying the moment of inertia
- F16F 15/315 . . characterised by their supporting arrangement, e.g. mountings, cages, securing inertia member to shaft ([F16F 15/31](#) takes precedence)
- F16F 15/3153 . . . {Securing inertia members to the shafts}
- F16F 15/3156 . . . {Arrangement of the bearings}
- F16F 15/32 . Correcting- or balancing-weights or equivalent means for balancing rotating bodies, e.g. vehicle wheels {(suppression of vibrations in rotating systems by using freely rotating masses [F16F 15/14](#); compensation of inertia forces [F16F 15/22](#); compensating unbalance for testing purposes [G01M 1/30](#))}
- F16F 15/322 . . {the rotating body being a shaft ([F16F 15/34](#), [F16F 15/36](#) take precedence)}
- F16F 15/324 . . {the rotating body being a vehicle wheel ([F16F 15/36](#) takes precedence; tyre parts or constructions not otherwise provided for [B60C 19/00](#))}
- F16F 15/326 . . . {specially adapted for attachment to spokes}
- F16F 15/328 . . . {Multiple weights on adhesive strip}
- F16F 15/34 . . Fastening arrangements therefor

NOTE

Hand held gripping tools [B25B 7/00](#)

- F16F 15/345 . . . {specially adapted for attachment to a vehicle wheel}
- F16F 15/36 . . operating automatically, {i.e. where, for a given amount of unbalance, there is movement of masses until balance is achieved (damping vibrations of washing machines by displacing, supplying or ejecting a material, e.g. liquid, into or from counterbalancing pockets [D06F 37/245](#))}
- F16F 15/363 . . . {using rolling bodies, e.g. balls free to move in a circumferential direction}
- F16F 15/366 . . . {using fluid or powder means, i.e. non-discrete material}

F16F 2222/00**Special physical effects, e.g. nature of damping effects**

- F16F 2222/02 . temperature-related ([F16F 2228/002](#) takes precedence)
- F16F 2222/025 . . Cooling
- F16F 2222/04 . Friction
- F16F 2222/06 . Magnetic or electromagnetic
- F16F 2222/08 . Inertia
- F16F 2222/10 . Adhesion
- F16F 2222/12 . Fluid damping

- F16F 2222/123 . . decreasing with increasing flow
- F16F 2222/126 . . using gases
- F16F 2222/14 . superconducting

F16F 2224/00**Materials; Material properties**

- F16F 2224/005 . Combined materials of same basic nature but differing characteristics
- F16F 2224/02 . solids
 - F16F 2224/0208 . . Alloys
 - F16F 2224/0216 . . bimetallic
 - F16F 2224/0225 . . Cellular, e.g. micro-cellular foam
 - F16F 2224/0233 . . deforming plastically in operation
 - F16F 2224/0241 . . Fibre-reinforced plastics [FRP]
 - F16F 2224/025 . . Elastomers
 - F16F 2224/0258 . . Shape-memory metals, e.g. Ni-Ti alloys
 - F16F 2224/0266 . . porosity
 - F16F 2224/0275 . . Ceramics
 - F16F 2224/0283 . . piezoelectric; electro- or magnetostrictive
 - F16F 2224/0291 . . PTFE
- F16F 2224/04 . Fluids
 - F16F 2224/041 . . Dilatant
 - F16F 2224/043 . . electrorheological
 - F16F 2224/045 . . magnetorheological
 - F16F 2224/046 . . pneumatic
 - F16F 2224/048 . . High viscosity, semi-solid pastiness ([F16F 2224/041](#) takes precedence)

F16F 2226/00**Manufacturing; Treatments**

- F16F 2226/02 . Surface treatments
 - F16F 2226/023 . . by laser or similar treatment by rays
 - F16F 2226/026 . . low-friction
- F16F 2226/04 . Assembly or fixing methods; methods to form or fashion parts
 - F16F 2226/041 . . Clipping
 - F16F 2226/042 . . Gluing
 - F16F 2226/044 . . Snapping
 - F16F 2226/045 . . Press-fitting
 - F16F 2226/047 . . Sheet-metal stamping
 - F16F 2226/048 . . Welding

F16F 2228/00**Functional characteristics, e.g. variability, frequency-dependence**

- F16F 2228/001 . Specific functional characteristics in numerical form or in the form of equations
 - F16F 2228/002 . . Temperature
 - F16F 2228/004 . . Force or pressure

- F16F 2228/005 . . Material properties, e.g. moduli
- F16F 2228/007 . . . of solids, e.g. hardness
- F16F 2228/008 . . . of semi-solids or fluids, e.g. viscosity
- F16F 2228/04 . Frequency effects
- F16F 2228/06 . Stiffness
- F16F 2228/063 . . Negative stiffness
- F16F 2228/066 . . Variable stiffness
- F16F 2228/08 . pre-stressed
- F16F 2228/10 . with threshold or dead zone
- F16F 2228/12 . degressive
- F16F 2228/14 . progressive

F16F 2230/00

Purpose; Design features

- F16F 2230/0005 . Attachment, e.g. to facilitate mounting onto confer adjustability
- F16F 2230/0011 . Balancing, e.g. counterbalancing to produce static balance
- F16F 2230/0017 . Calibrating
- F16F 2230/0023 . protective
- F16F 2230/0029 . Location, co-location
- F16F 2230/0035 . Gripping
- F16F 2230/0041 . Locking; Fixing in position
- F16F 2230/0047 . Measuring, indicating
- F16F 2230/0052 . Physically guiding or influencing
- F16F 2230/0058 . . using inserts or exterior elements, e.g. to affect stiffness
- F16F 2230/0064 . . using a cam
- F16F 2230/007 . . with, or used as an end stop or buffer; Limiting excessive axial separation
- F16F 2230/0076 . . Pivoting
- F16F 2230/0082 . Dimensional tolerances, e.g. play between mechanical elements
- F16F 2230/0088 . Timing
- F16F 2230/0094 . Magnifying a physical effect
- F16F 2230/02 . Surface features, e.g. notches or protuberances
- F16F 2230/04 . Lubrication
- F16F 2230/06 . Fluid filling or discharging
- F16F 2230/08 . Sensor arrangement
- F16F 2230/10 . Enclosure elements, e.g. for protection
- F16F 2230/105 . . Flexible, e.g. bellows or bladder
- F16F 2230/12 . Gas generation, e.g. by mixing of chemicals
- F16F 2230/14 . Ball joints; Spherical support elements
- F16F 2230/16 . used in a strut, basically rigid
- F16F 2230/18 . Control arrangements
- F16F 2230/183 . . fluid actuated

- F16F 2230/186 . . with manual adjustments
- F16F 2230/20 . Location of equilibration chamber
- F16F 2230/22 . Pumps
- F16F 2230/24 . Detecting or preventing malfunction, e.g. fail safe
- F16F 2230/26 . Air gap
- F16F 2230/28 . Inclination of a suspension element
- F16F 2230/30 . Sealing arrangements
- F16F 2230/32 . Modular design
- F16F 2230/34 . Flexural hinges
- F16F 2230/36 . Holes, slots or the like
- F16F 2230/38 . Off-centre positioning
- F16F 2230/40 . Multi-layer
- F16F 2230/42 . Multiple pistons
- F16F 2230/46 . Maintenance
- F16F 2230/48 . Thermal insulation

F16F 2232/00**Nature of movement**

- F16F 2232/02 . Rotary
- F16F 2232/04 . Rotary-to-translation conversion
- F16F 2232/06 . Translation-to-rotary conversion
- F16F 2232/08 . Linear

F16F 2234/00**Shape**

- F16F 2234/02 . cylindrical
- F16F 2234/04 . conical
- F16F 2234/06 . plane or flat
- F16F 2234/08 . spherical

F16F 2236/00**Mode of stressing of basic spring or damper elements or devices incorporating such elements**

- F16F 2236/02 . the stressing resulting in flexion of the spring
- F16F 2236/022 . . of membrane-type springs
- F16F 2236/025 . . radial flexion of ring-type springs
- F16F 2236/027 . . of strip- or leg-type springs
- F16F 2236/04 . Compression
- F16F 2236/045 . . the spring material being generally enclosed
- F16F 2236/06 . Tension
- F16F 2236/08 . Torsion
- F16F 2236/085 . . the spring being annular
- F16F 2236/10 . Shear
- F16F 2236/103 . . linear

- F16F 2236/106
 - . . rotational
- F16F 2236/12
 - . loaded in combined stresses
- F16F 2236/123
 - . . loaded in compression and shear
- F16F 2236/126
 - . . . Neidhart-type rubber springs

F16F 2238/00**Type of springs or dampers**

- F16F 2238/02
 - Springs
- F16F 2238/022
 - . . leaf-like, e.g. of thin, planar-like metal
- F16F 2238/024
 - . . torsional
- F16F 2238/026
 - . . wound- or coil-like
- F16F 2238/028
 - . . . Winding direction thereof
- F16F 2238/04
 - Damper
- F16F 2238/045
 - . . Lead shear damper