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(54) Title: DUAL MASS FLYWHEEL WITH CAM PLATE

(57) Abstract: A dual mass flywheel includes a rotatable primary mass and a secondary mass being rotatable relative to the primary mass. A cam plate is fixed for rotation with the primary mass and includes a plurality of circumferentially spaced apart cams. A hub is fixed for rotation with the secondary mass. Links are pivotally coupled to the hub. Each link includes a roller follower biased into engagement with one of the cams to dampen torsional vibrations at the primary mass.

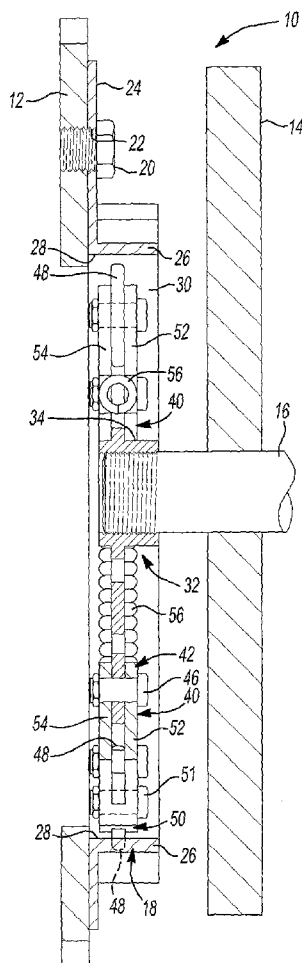


Fig-1



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DUAL MASS FLYWHEEL WITH CAM PLATE

FIELD

[0001] The present disclosure relates to a torsional vibration
5 damper for use within a drive train of a vehicle. More particularly, a dual mass
flywheel may be configured as a torsional damper including cam surfaces
driving spring loaded pivot arms with roller followers.

BACKGROUND

10 [0002] In general, a dual mass flywheel functions to filter out engine
torque fluctuations prior to transferring torque to a vehicle transmission. In
one embodiment, a dual mass flywheel includes a primary rotary inertia
connected to a crankshaft of an internal combustion engine. A second rotary
inertia is coupled to an input shaft of the transmission. A rotary spring
15 interconnects the primary rotary inertia and the secondary rotary inertia.
Several arc springs having different lengths are implemented such that the
springs become engaged at various degrees of mutual rotary displacement
between the primary and secondary inertia. As a result, the dual mass
flywheel stiffness varies in several discrete steps. Engine operation does not
20 necessarily match the discrete steps in dual mass flywheel stiffness.
Therefore, undesirable torque fluctuations may be input to the transmission.
Furthermore, in at least one known design, the springs are arranged as
compression spring coils that may be completely collapsed against one
another. This loading condition may negatively affect the fatigue life of the
25 springs.

SUMMARY

[0003] This section provides a general summary of the disclosure,
and is not a comprehensive disclosure of its full scope or all of its features.
30 [0004] A dual mass flywheel includes a rotatable primary mass and
a secondary mass being rotatable relative to the primary mass. A cam plate

is fixed for rotation with the primary mass and includes a plurality of circumferentially spaced apart cams. A hub is fixed for rotation with the secondary mass. Links are pivotally coupled to the hub. Each link includes a roller follower biased into engagement with one of the cams to dampen torsional vibrations at the primary mass.

[0005] In another form, a dual mass flywheel includes a rotatable primary mass and a secondary mass being rotatable relative to the primary mass. A cam plate is fixed for rotation with the primary mass and includes a plurality of circumferentially spaced apart cams. A hub is fixed for rotation with the secondary mass. Links are pivotally coupled to the hub. A roller follower is rotatably coupled to each link. A plurality of springs bias each roller follower into engagement with one of the cams to dampen torsional vibrations. Each spring has a first end coupled to the hub and a second end coupled to one of the links.

[0006] Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

20

DRAWINGS

[0007] The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

[0008] Figure 1 is a fragmentary cross-sectional view of a dual mass flywheel constructed in accordance with the teachings of the present disclosure;

[0009] Figure 2 is a partial perspective view of the dual mass flywheel depicted in Figure 1;

[0010] Figure 3 is a fragmentary exploded perspective view showing a hub, a link and a roller follower of the dual mass flywheel; and

[0011] Figure 4 is a fragmentary plan view of an asymmetrical cam.

[0012] Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

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DETAILED DESCRIPTION

[0013] Example embodiments will now be described more fully with reference to the accompanying drawings.

[0014] Figures 1 and 2 depict a dual mass flywheel including a primary mass 12 and a secondary mass 14. Primary mass 12 is adapted to
10 be fixed for rotation with a crankshaft of an internal combustion engine (not shown). Secondary mass 14 is adapted to be fixed for rotation with an input shaft 16 of a transmission (not shown). Primary mass 12 may rotate relative to secondary mass 14.

[0015] A cam plate 18 is fixed to primary mass 12 by a plurality of
15 fasteners 20. More particularly, fasteners 20 extend through apertures 22 formed in a flange 24 of cam plate 18. Cam plate 18 also includes a wall 26 extending substantially perpendicular to flange 24. An internal surface 28 of wall 26 defines a plurality of circumferentially spaced apart cams 30. Cams 30 are defined by a number of curved surfaces as will be described in greater
20 detail herein. Cam plate 18 may be formed as a monolithic member such as a sheet having a substantially constant thickness.

[0016] A hub 32 includes a hollow cylindrical portion 34 and a plurality of substantially radially extending arms 36. Hub 32 is fixed for rotation with input shaft 16. A splined connection may be used to couple
25 cylindrical surfaces. A flanged coupling (not shown) may alternatively be implemented.

[0017] A plurality of links 40 are circumferentially spaced apart from one another and circumscribed by wall 26. A first end 42 of each link 40 is rotatably coupled to a distal end 44 of each arm 36 by a pin 46. A roller
30 follower 48 is rotatably coupled to a second end 50 of each link 40 by a pin 51. As shown in Figure 3, links 40 may be formed as stampings constructed from a sheet of material having a substantially constant thickness. Each link

40 includes spaced apart walls 52, 54 positioned on opposite sides of the corresponding arm 36. Walls 52, 54 are also positioned on opposite sides of each roller follower 48.

5 **[0018]** A plurality of springs 56 biasedly engage roller followers 48 with cams 30. A first end 58 of each spring 56 is coupled to one of arms 36. A second end 60 of each spring 56 is coupled to one of links 40 at a position intermediate first end 42 and second end 50. Springs 56 are maintained in a pre-stressed condition such that each roller follower 48 is constantly in contact with one of cams 30.

10 **[0019]** Figure 2 depicts each roller follower 48 at a first or most radially outward position. Springs 56 are compressed a minimum amount when roller followers 48 are at this position. Accordingly, a minimal torque is required to rotate cam plate 18 relative to hub 32 when roller followers 48 are at the first position. As relative rotation between cam plate 18 and hub 32
15 continues, cams 30 drive roller followers 48 radially inwardly. Due to the rotatable connection between links 40 and arms 36, compression springs 56 are further compressed as roller followers 48 move radially inwardly. Accordingly, resistance to further relative rotation between cam plate 18 and hub 32 increases as springs 56 are compressed. Stated another way, springs
20 56, links 40 and rollers followers 48 impart a torque upon cam plate 18 urging roller followers 48 toward their first position depicted in Figure 2. This torque increases as springs 56 are compressed.

25 **[0020]** The rate of change of the torque applied by roller followers 48 to cam plate 18 may be defined by the spring rate of each spring 56 as well as the shape of cams 30. Cams 30 may include profiles designed to result in a continuously changing, predetermined stiffness/deflection profile. The stiffness of dual mass flywheel 10 may be custom tailored to a specific hardware configuration. Based on the arrangement of links 40, springs 56 and roller followers 48 in cooperation with cams 30, the dampening
30 characteristic of dual mass flywheel 10 is independent of the rotational speed of primary mass 12 and/or secondary mass 14. Furthermore, it should be appreciated that dual mass flywheel 10 is an efficient torque coupling as well

as a damper. Roller followers 48 engage cams 30 in a rolling manner, not in a less efficient sliding interface. Springs 56 store the energy provided by primary mass 12 for later transfer. Minimal energy loss occurs during operation of dual mass flywheel 10.

5 **[0021]** As shown in Figure 4, it is contemplated that each cam 30 may include a first profile 30a that may be engaged by roller followers 48 when cam plate 18 rotates relative to hub 32 in a first direction. A different, second profile 30b, may be formed on each cam 30 as well. The second cam profile is contacted by each roller follower 48 when cam plate 18 rotates
10 relative to hub 32 in the opposite direction as first described. As such, each cam 30 may be asymmetrical about a line passing through the rotational center of hub 32 and a roller follower to cam contact point when the roller follower is at the first position.

[0022] Dual mass flywheel 10 may also act as a clutch by allowing
15 cam plate 18 to rotate relative to hub 32 at angles greater than defined by a singular cam 30. If a torque greater than a predetermined magnitude is attempted to be transferred across dual mass flywheel 10, each roller follower 48 will pass through the cam 30 of its current location and enter an adjacent cam 30. It should be appreciated that a convex surface 62 interconnects
20 each pair of adjacent cams 30. Convex surfaces 62 are located at predetermined radially inward positions to assure that springs 56 are not compressed to a condition of complete spring solidification when roller followers 48 are driven to a second most radially inward position during the transition from one cam 30 to an adjacent cam 30.

25 **[0023]** The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected
30 embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a

departure from the invention, and all such modifications are intended to be included within the scope of the disclosure.

CLAIMS

What is claimed is:

- 5 1. A dual mass flywheel, comprising:
a rotatable primary mass;
a secondary mass being rotatable relative to the primary mass;
a cam plate fixed for rotation with the primary mass and including a plurality of circumferentially spaced apart cams;
a hub fixed for rotation with the secondary mass; and
10 a plurality of links pivotally coupled to the hub, each link having a roller follower rotatably coupled thereto, wherein each roller follower is biased into engagement with one of the cams to dampen torsional vibrations at the primary mass.
- 15 2. The dual mass flywheel of claim 1 further including a plurality of circumferentially spaced apart springs being placed in compression between the hub and the links.
- 20 3. The dual mass flywheel of claim 2 wherein the cam plate includes a continuous uninterrupted surface including each cam.
4. The dual mass flywheel of claim 3 wherein the uninterrupted surface circumscribes the roller followers, the links and the hub.
- 25 5. The dual mass flywheel of claim 3 wherein each cam includes a concave surface.
6. The dual mass flywheel of claim 1 wherein the cams are asymmetrical.

7. The dual mass flywheel of claim 1 wherein the cam plate may be rotated relative to the hub an amount sufficient to cause each roller follower to engage an adjacent cam.

5 8. The dual mass flywheel of claim 2 wherein a maximum torque transferrable between the primary and secondary masses is defined at least in part by a maximum output force of the springs.

9. The dual mass flywheel of claim 2 wherein the springs remain
10 extended a distance greater than that at a fully collapsed condition during operation.

10. The dual mass flywheel of claim 1 wherein the plurality of links includes four links equally circumferentially spaced apart from one another.

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11. The dual mass flywheel of claim 1 wherein the cam plate includes a substantially constant thickness sheet forming a flange portion and the cams, the flange being coupled to the primary mass.

12. A dual mass flywheel, comprising:
20 a rotatable primary mass;
a secondary mass being rotatable relative to the primary mass;
a cam plate fixed for rotation with the primary mass and including a plurality of circumferentially spaced apart cams;
a hub fixed for rotation with the secondary mass;
25 a plurality of links pivotally coupled to the hub, each link having a roller follower rotatably coupled thereto; and

a plurality of springs biasing each roller follower into engagement with one of the cams to dampen torsional vibrations, wherein each spring has a first end coupled to the hub and a second end coupled to one of the links.

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13. The dual mass flywheel of claim 12 wherein each of the springs extends perpendicularly to two other of the springs.

14. The dual mass flywheel of claim 13 wherein each link includes a substantially constant cross-sectional thickness.

- 5 15. The dual mass flywheel of claim 14 wherein the cam plate includes a continuous uninterrupted surface including each cam and circumscribing the roller followers, the links and the hub.

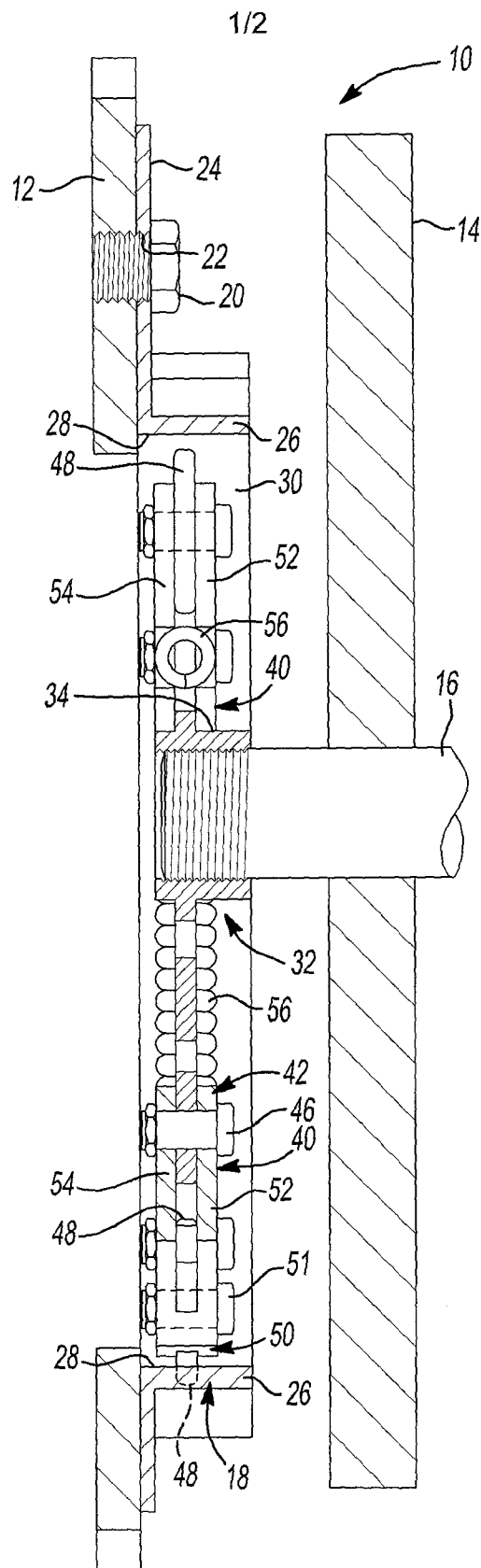
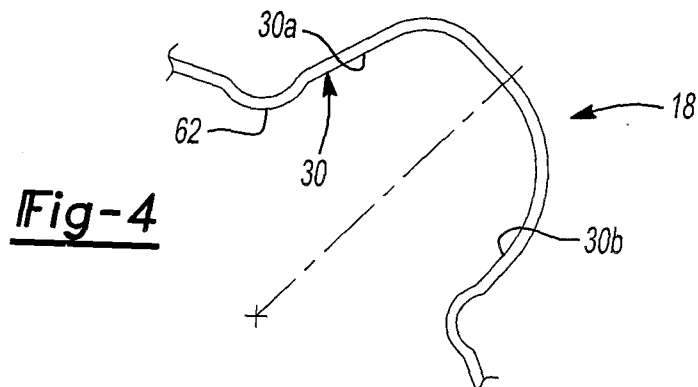
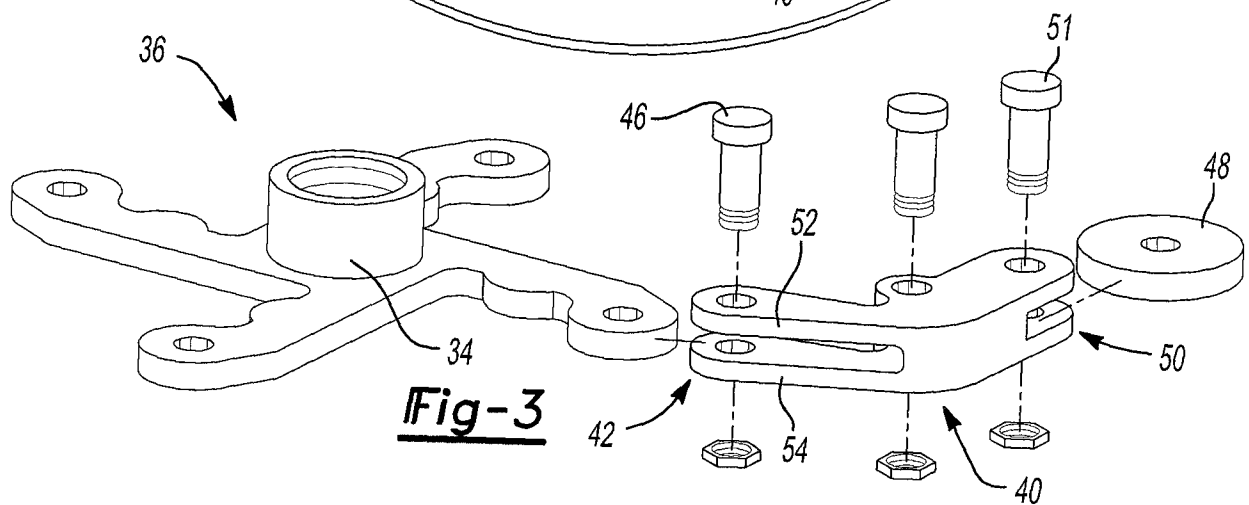
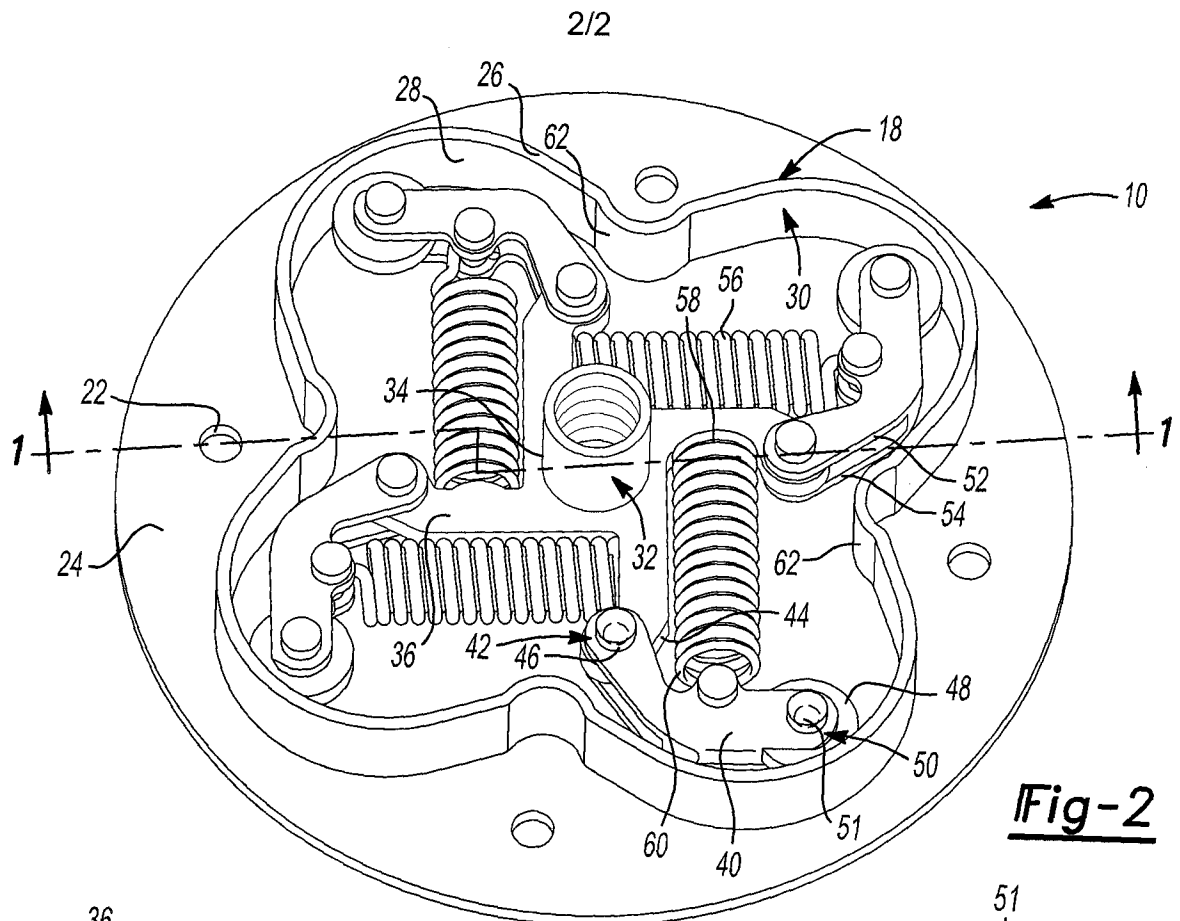


Fig-1



INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2010/001140

A. CLASSIFICATION OF SUBJECT MATTER IPC: F16F 15/134 (2006.01) , F16F 15/315 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC(2006): F16F USPC: 74, 267 CPC: 74, 267 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used) EPOQUE (EPODOC, COMBI, X-FULL) flywheel, mass, link+, roller, follower, cam, spring, wheel		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	GB 219,975 A (RUPPERT, W.) 02 October 1924 (02-10-1924) * Whole document *	1-15
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
Date of the actual completion of the international search 17 November 2010 (17-11-2010)	Date of mailing of the international search report 21 December 2010 (21-12-2010)	
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Authorized officer Gilbert Plouffe (819) 997-9811	

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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