Universal joint assembly pdf

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Back in 1935, George W. Curtis developed a way to disassemble and assemble a universal compound without damaging components. This TakeApart feature has saved companies a lot of time and money in three ways. Read on... Since our founding in 1935, we have been producing universal compounds used in a wide variety of applications. Watch the video... Available in our 7⁄8 to 4 diameter joints, Take-Apart Collaborative is designed to disassemble and assemble without damaging components. Watch the video... Some days, a little creativity is needed to do driving and drive shafts come together. Somehow, someone got the size of a shaft a little bit... Read on... U-joint redirects here. For plumbing, see U-bend. The versatile joint universal joint (universal compound, U-joint, Cardan joint, Spicer or Hardy Spicer joint, or hook joint) is a joint or compound connecting hard rods whose axes are prone to each other, and is commonly used in mines that transmit rotating motions. It consists of a pair of loops located close to each other, oriented 90 degrees to each other, connected by a cross shaft. A universal joint is not a compound at a constant rate. History Play Media This video shows the different parts and exploitation of the universal shaft. The basic concept of the universal compound is based on the design of the Gymbals, which have been used since antiquity. One of the anticipations of the universal connection was its use by the ancient Greeks on the ballistics. In Europe, the universal joint is often referred to as a cardinal joint or Cardan shaft, after the Italian mathematician Gerolamo Cardano; however, in his writings he mentioned only the carb attachments, not the universal joints. The mechanism was later described in Technica curiosa sive mirabilia artis (1664) by Gaspar Schott, who mistakenly claimed that it was a joint at a constant speed. Shortly thereafter, between 1667 and 1675, Robert Hook analyzed the compound and found that its rotational speed was non-uniform, but this property could be used to track the movement of shadows on the face of the sun. In fact, the component of the time equation, which accounts for the tilt of the equatorial plane in relation to the ecliptic, is completely similar to the mathematical description of the universal joint. The first recorded use of the term universal connection for this device was Hooke in 1676, in his book Helioscopes. In 1678, he published a description that used the term connection of Hook in the English-speaking world. In 1683, Hook proposed a solution for the non-uniform rotating speed of the universal joint: a pair of hook joints 90 degrees out of phase at both ends of the intermediate shaft, location, now known as a type of connection at a constant speed. Christopher Polhem of Sweden later remouted the universal joint, which gave rise to the name Polhemsknut Polhemsknut Swedish. In 1841, the English scientist Robert Willis analyzed the movement of the universal joint. By 1845, the French engineer and mathematician, Jan-Victor Ponzele, had analyzed the movement of the universal joint using spherical trigonometry. The term universal joint was used in the 18th century and was common in the 19th century. Edmund Morewood's 1844 patent for a metal coating machine called for universal connection, by that name, in order to accommodate small alignment errors between the engine and the rolling mill shafts. For example, the 1881 Ephriam Shay locomotive patent used double universal connections in the locomotive's drive mine. Charles Amidon used a much smaller all-purpose joint in his bit bracket, patented in 1884. The spherical, rotary, high-speed steam engine Beauchamp Tower used the adaptation of the universal connection around 1885. The term Cardan joint seems to be late for English. Many early uses in the 19th century appear in French translations or are strongly influenced by French use. Examples include an 1868 report on the 1867 Universelle exhibition and an article on the dynamometer translated from French in 1881. The variable motion equation for a universal connection. The axis is 1 perpendicular to the red plane, and the axis is 2 perpendicular to the blue plane at all times. These aircraft are under β in relation to each other. The angular shift (rotation position) of each axis is given γ 1 display (gamma){1} and γ 2 display (gamma {2}) respectively, which are the corners of the vectors of unit x No. 1 display (hat x {1}) and x2 display style hat x {2} in relation to their original positions along the axis x and y. Vectors x-1 display (hat) {1} and x 2 display (hatx'{2}) are fixed by the carb connecting the two apens, and are therefore limited by the fact that they are always perpendicular to each other. The angular (rotating) velocity of the output shaft No. 2 (display) compared to the {2} rotation angle γ 1 (display) gamma ({1}), for different angles of bending β display (beta) of the rotation angle jointOutput, γ 2 gamma display {2}, compared to the rotation angle of the entrance shaft, γ 1 gamma display {1}),) for different angles of bending, β display beta , from the joint Cardan joint suffers from one serious problem : Even when the axis of the input shaft rotates at a constant speed, the output drive of the shaft of the axis rotates at variable speed, causing vibration and wear. The change in the velocity of the controlled shaft depends on the configuration of the joint, which is determined by three variables: γ 1 display (gamma){1} rotation angle 1 γ 2 display gamma ({2}) rotation angle for axis 2 β displaystyle joint, or angle ail towards each other, with zero to be parallel or straight through. These variables are illustrated in the chart on the right. Also shown are a set of fixed coordinate axes with x and display vectors (hat) hat (mathbf) and y displaystyle hat hat mathbf y and the rotation plane of each axis. These rotation planes are perpendicular to the rotation axe and do not move as the axes rotate. The two ess are connected by a carbala, which is not shown. However, the axis 1 attaches to the carb in red dots on the red rotating plane on the diagram, and the axis 2 is attached to the blue dots on the blue plane. The co-ords fixed for rotating axes are defined as having their own x-axis unit vectors (x-axis unit vectors (x-1 displaystyle (hat mathbf (x) {1}) and x 2 display (x) {2}) indicating from origin to one of the connection points. As shown in the diagram, the x No. 1 display (hat mathbf (x) {1} is at an angle γ 1 display gamma {1} in relation to its top position along x Axis and x 2 display (hat) mathbf (x) {2}) is at an angle γ 2 display (gamma){2} relation to its original position along the axis of y. x No. 1 display (hat)hat (mathbf) (x) ({1}) is limited to the red plane on the chart and is associated with γ 1 displaystyle (gamma) {1} by: x No 1 , cos γ 1 , грех γ 1 , 0 шляпа «mathbf » (x) »{1}»слева, потому что «гамма »{1}»,,»,,«грех »гамма»{1},,,,0»0»x »2 »displaystyle »hat »mathbf »x»{2} » ограничен «голубой плоскости» на диаграмме и является результатом вектора единицы на оси x x - 1 , 0 , 0 »дисплей »шляпа »x»1,0,0 » вращается через углы Euler , π / 2 , β , 0 «дисплей »pi »!/2 », (,,,0) : x No 2 , cos β грех γ 2 , cos γ 2 , грех β грех γ 2 » » »displaystyle »шляпа »mathbf »x»-{2}»-cos «бета грех гамма »{2} ,,, «потому что гамма »{2}»,, «грех »бета »грех »{2}» ограничение на x »1 »дисплей стиль »шляпа »матбф »x» »{1}» и x »2 »displaystyle »hat »mathbf »x» {2} векторов является то, что, поскольку они зафиксированы в gimbal, они должны оставаться под прямым углом друг к другу. This happens when their point product is zero: x 1 x 1 · {2} x x 2 x 0 display (hat) matchuf {1} Thus, the equation of motion, Related to two corner positions, given: tan γ 1 and cos β tan γ 2 display tan gamma {1} cos beta-tan gamma {2} {2} with a formal solution for γ 2 display (gamma-{2}) : γ 2 - tan 1 - tan γ 1 cos β Tan -1 left-wing fracas tan gamma {1} kos beta (right) solution for γ 2 display gamma {2} is not unique The arc function is multivalent, but it takes a long way to make sure that the solution for the γ 2 display gamma ({2}) is continuous over the corners of interest. For example, the following explicit solution using atan2 (y, x) feature will be valid for No. π qlt; γ 1 zlt; π display - pi zlt;gamma -{1}'lt'pi : γ 2 γ atan2 (sin γ 1 , cos β cos γ 1) display gamma {2} Time function will have The name of the operator is atan2 (sin gamma{1}, cos beta, kos gamma ({1}) - corners γ 1 display (gamma-{1}) and γ 2 display (gamma-{2}) in a rotating joint. The differentiation of the motion equation in relation to time and the use of the motion equation itself to eliminate the variable gives a link between angular speeds No. 1 and d γ 1 / {1} d t Gamma-gamma ({1}/dt) and No. 2 th d γ 2 / d t display (omega-{2}-gamma {2}/dt) : 2 - 1 β 1 - sin 2 β cos 2 γ 1 display omega {2} frak (omega {1} beta1-sin ({2}-beta) (cos){2}-gamma ({1}) As shown in the areas, angular velocity is not linearly related, but rather intermittently with a period of twice, That'a_{2} a_{1} s from rotating shaft γ β β s. β sin 2 β sin 2 γ 1 (1 β sin 2 β cos 2 γ 1) 2 display a_{2} frak a_{1} beta No1-Sin ({2}-beta) , braids ({2}-gamma) {1}-frak (omega) {1}{2} cos (beta-{2})beta-beta 2 gamma ({1}) Left (1-sin ({2}-beta (kos){2}-gamma ({1}) {2} Double cardan shaft Universal joints in configuration known as the cardan dual joint drive shaft partially overcomes the jerky rotation problem. This configuration uses two U-connections connected by an intermediate shaft, with the second U-joint phased in relation to the first U-joint, In this configuration, the angular velocity of the controlled shaft will correspond to the speed of the moving shaft, provided that both the moving shaft and the controlled shaft are at equal angles relative to the intermediate shaft (but not necessarily in the same plane) and that the two universal connections are 90 degrees outside the phase. where it is known as a drive shaft or screw (propeller) shaft. Even when the drive and control shafts are at equal angles in relation to the intermediate shaft, if these angles are more than zero, the oscillating points apply to the three shafts when they turn. They tend to bend them in the direction perpendicular to the general plane of the shafts. This applies force to support bearings and can lead to in rear-wheel-drive cars. The intermediate shaft will also have a sinusitis component of its angular velocity, which promotes vibration and stress. Mathematically, this can be shown as follows: if γ 1 display gamma {1} and γ 2 gamma display {2} are angles for the input and output of a universal joint, connecting drive and intermediate shafts respectively, and γ 3 gamma display {3}, and γ 4 gamma {4} display, are angles for the entry and output of a universal connection, connecting intermediate and weekend shafts respectively, and each pair is at an angle β display beta in relation to each other, then: tan γ 2, because β tan γ 1 tan γ 4 β tan γ 1 3 display tan gamma {2} cos beta, gamma {1}quad tan gamma {4} cos beta, gamma {3}) If the second universal joint rotates 90 degrees relative to the first, then γ 3 γ 2nd π / 2 display (gamma{3} gamma ({2})pi/2. that tan (γ and π / 2) 1 / tan γ display tan (Gamma-Pi /2) 1 / tan Gamma gives: tan γ 4 th β tan γ 2 and 1 tan γ 1 tan γ (γ 1 1 and π 2) tan Gamma ({4}) Frak (kos) (beta) tan Gamma ({2}) Frak {1}-tan gamma ({1}) tan (left) gamma-{1} frakpi ({2}) and it is seen that the output drive is only 90 degrees from the entrance of the shaft, that gives a constant speed of drive. NOTE: The reference to the measuring angles of the entrance and output shafts of the universal connection is a mutually perpendicular alys. Thus, in the absolute sense, the forks of the intermediate shaft are parallel to each other. (Because one fork acts as an input and the other fork acts as a power output for the shafts, and the difference in the phase above 90 degrees is mentioned between the forks.) Double Cardan Joint Home Article: Permanent Joint Speed - Double Cardan Double Cardan Joint consists of two versatile joints set back to back with a central needle; the central needle replaces the intermediate shaft. Provided that the angle between the entrance shaft and the central needle is equal to the corner between the central needle and the exit shaft, the second Cardan joint will correct the speed errors introduced by the first Cardan connection, and the leveled double cardan joint will act as a CV joint. Thompson Connections Home article: Constant Speed Joint and Thompson Links Thompson is an exquisite version of the double-cardan joint. It offers somewhat increased efficiency with the punishment of a significant increase in complexity. See also Canfield Joint Elastic Communication Gear Connection Hotchkiss Drive Rag Joint Constant Speed Joint Twin Spring Connection Joint Links Theory Machines 3 from the National University of Ireland - UjjwalRane (July 8, 2010). Cinematics with - Ch02 J Hooks Collaborative. Archive from the original on March 11, 2016. Received on May 4, 2018 - via YouTube. See: Universal Collaborative - Invented by Gerolamo Cardano Archive copy. Archive from the original for 2017-04-22. Received 2017-04-21.CS1 maint: archived copy as headline (link) - See: Tony Rothman (2013) Cardano v. Tartaglia: The Great Feud Goes Supernatural, page 25. Available online by Arxiv.org. (Note that Rothman mentions Wikipedia's error regarding Cardano's alleged invention of the universal joint.) Hans-Christophe Seherr-Theosh, Friedrich Smeltz, Erich Auctor, Universal Joints and Driveshafts: Analysis, Design, Applications (Berlin, Germany: Springer Verlag, 1992), page 1. Marie Boas, Scientific Renaissance: 1450-1630 (New York, New York: Harper Brothers, 1962), p. 186 Archive 2016-04-11 by Wayback Machine. James Ackman, Jerome Cardan (Baltimore, Maryland: The Johns Hopkins Press, 1946.), page 77. Hieronymici Kardanime (Gerolamo Cardano), De Subtilit Libri XXI. (On the Subtle Things in 21 Books) (Basel, Switzerland: Sebastian Henrik Petrie, 1553), Liber XVII. De Artibus, Artificiosisque; Puzzle. (Book 17. on crafts and ingenious devices), page 817. (Note: (1) This book is a reissue of the original of 1500. (2) In reserve p. 817 is printed: Sedes mira (wonderful chair).) From page 817: Archive 2017-10-11 at Wayback Machine Simili ratione inventũ est, ut Cesaris sedes ita disrepontur, ut quoque situ constituatur, ille immobilis, ac commode dum vehitur sedeat. Hoc tractum ex armillarum ratione: cum enim circuli tres chalybei constituentur, polis sursum, deorsum, ante, retro, dextra ac sinistra mobilibus, cum plures non possint esse situs, necesse est ipsedo quomumumoque ag quiescere. (According to similar reasoning, it has been established that the imperial armchair can be so arranged, It is based on the logic of the carb installation: three steel rings are positioned by movable poles (i.e. ends of axes up, down, forwards, backwards, right and left, when it is impossible to allow more movements because it is necessary that it in the carriage somehow remained motionless permanently.) , Mediolanensis Philosophi ac Medici Celeberrimi Operum (From the very famous works of the Milanese philosopher and doctor) (Lyon (Lugdongum), France: Jean Antoine Huguetan and Marc Antoine Ravaud, 1663), vol. 10: Opuscula miscellanea (Various Works), Paralypomen (Supplement), Liber W. De Rebus Factuals raris and artificiis (Book 5. About Rare and Ingeniously Made Things), Caput VII. De Armillarum Instrument (Chapter 7. On the armrest), page 488-489. b c Mills, Allan, Robert Hook's Universal Joint and its application to sundials and sundials, Notes Royal Society, 2007, access online Archive 2015-09-25 on Wayback Machine 2010-06-16 - Gasparis Schotti, Technica Curiosa, sive Mirabilia Artis, Libris XII.... Curious works of craftsmanship, or wonderful works of craftsmanship (Nurnberg), (Germany): Johannes Andreas Endter and Wolfgang Ender, 1664), Liber IX. Mirabilia Chronometry, ... (Book 9. Wonderful Clock, ...), Caput V. Signa chronometrica optica, seu indices. (Chapter 5. Wonderful visual clock, or clock with hands), page 664-665: Propositio XX. Indices sinuosum and obliquatum on anfractus quosvis, sine Rotis dentatis quocumque lubet educere. (Offer 20. Like, without any gear, lead a twisting, swivel pointer (i.e. a shaft that controls the hands of the watch) through any bend that pleases.) In the field printed: Vide iconism. VII. Pic. 32. (See Plate 7, Figure 32.), which depicts Schott's universal joint. Schott initially notes that there may be cases where the gear clock is running and his face cannot be conveniently aligned; for example, public clocks installed in towers. He then mentions, in the description of its construction (Technasma, the Greek word for art), that the universal joint resembles a carbala that is used to hold an oil lamp, so that it will not spill oil. Schott's joint consists of two forks (fusinula), each of which consists of a shaft to which a metal band is attached, bent in a semicircle. Next to each end of the semicircle, the hole is drilled. Also made a cross with four perpendicular hands (crux sive 4 brachia). The holes in each semicircle fit at the ends of the opposite pair of hands. The angle between the shafts should be larger than at right angles. When discussing the movement of the joint (Motus), Schott claims that the two shafts move at the same speed (i.e. they form a connection with a constant speed): ... horum autem ductum necesse est sequatur - altera fuscinula, parique cum priore illa feratur velocitate: unde si fuerit unius fuscinulae motus regularis circularis, erit similis and alterius ... (... but this movable fork must follow another fork, and it is born at a speed equal to the first: from where, if the movement of one fork was regularly circular, it will be similar to the other...). For the (partial) history of universal joints, see: Robert Willis, Principles of Mechanism ... , 2nd Ed. (London, England: Longmans, Green, and Co., 1870), Part Five: On Universal Joints, p. 437-457. Universal, a. (adv.) and n., para.13, Oxford English Dictionary Online, access 2010-06-16 - Hook first described the universal joint in Hevelius's instrument: Robert Hook, Animadversions on the first part of Machina Coelestis ... (London, England: John Martin, 1674), page 73. Here he calls the joint a universal tool. From page 73: I'll show ... what use I made out of it for a universal tool for For equal time, to make hand watches move in the shade of style, and to perform a host of other mechanical operations. The connection is depicted on Plate X, fig.s 22 and 23, which are available on: Posner Memorial Collection - Carnegie Mellon Archived University 2015-11-17 on Robert Hooke Wayback Machine, Description of Helioscopes, and some other instruments (London, England: John Martyn, 1676), p. 14. With page 14: Universal Joynt for all these ways of operations, not having time to describe the last exercise, I now explain in more detail. Illustrations of the universal hook joint appear on page 40, fig.s 9 and 10; Available by: ETU Library; Switzerland Archive 2015-09-23 on Wayback Machine. - b Review of Ferdinand Bertud's treatise on sea clocks, appendix Article VIII, Monthly Review or Literary Journal, Vol. L, 1774; See footnote, page 565. Gunther, Robert Theodore, Early Science at Oxford, vol. 7: The Life and Work of Robert Hook, Part II (Oxford, England: Dawsons from Pall Mall, 1930), page 621-622. Willis, Robert, Principles of Mechanisms, ... (London, England: John W. Parker, 1841), page 272-284. - J. V. Poncelet, Trait de m'canique applique aux machines, Part 1 (Liege, France: Librairie scientifique et industrielle, 1845), p. 121-124. Edmund. Morewood, Improvement in Iron and Copper Coating, U.S. Patent 3746, September 17, 1844. Ephraim Shay, Locomotive-Engine, U.S. Patent 242,992, June 14, 1881. Charles H. Amidon, Bit-Brace, U.S. Patent 298 542, May 13, 1884. Douglas Sam. The tower is a spherical engine. William. Blake, Report Commissioner of the Paris Exhibition, 1867, Chapter 1, Deals of the California State Agricultural Society, During 1866 and 1867, Vol X, Gelwicks, Sacramento, 1868. - Balance of Dynamometer, Van Nostrand Engineering Journal, Volume XXV, No CLVI (December 1881); page 471. - Electronically-controlled adjustable height bearing support bracket - U.S. Patent 6345680 Archive February 5, 2009, by Wayback Machine External LINKS DIY: Replacing Universal Joints in About.com. Thompson Connections Limited explanation of Thompson's connection. Universal Collaborative Failure - a custom solution to the common problems of Universal Joint Phase - The Concept and Importance of Drive Shaft Phasing and The Alignment of Thompson Connections - was invented by Glenn Thompson abc television (New Inventors, broadcast February 2007). U.S. Patent 7 144 326 (constant connection speed). About Universal Joints at McMaster Carr. 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