ABSTRACT OF THE DISCLOSURE

The disclosure relates to tapered machine keys for holding a hub and shaft against rotation. Both the hub and shaft keyways have planar pressure faces and a non-pressure surface, and the key has upper and lower pairs of pressure faces as well as upper and lower non-pressure surfaces. The shaft keyway pressure faces are longitudinally parallel as are also the corresponding key pressure faces. As to the hub keyway pressure faces, these are longitudinally inclined together with the associated non-pressure surface, and the corresponding key pressure faces and non-pressure face are similarly inclined longitudinally.

RELATED APPLICATIONS

The present application is a continuation of my application Ser. No. 709,635, filed Jan. 17, 1958, now abandoned, and is also a continuation of Ser. No. 325,808, filed Nov. 19, 1963, also now abandoned.

BACKGROUND OF THE INVENTION

There is a basic theoretical and practical fault in the standard commercial straight-sided, square-seated, rectangular key, square type or flat, straight or tapered. Such a key, however well fitted, is not tight enough, and is not uniformly pressured on the lateral surfaces where it must carry the load. Therefore, it soon works loose under heavy reversing loads. This deficiency has been well recognized, even in public records, for many decades. The language, viewpoints and proposed remedies of the commentators vary, but the essence of the cited difficulty is the same. It is set forth in U.S. Patent No. 408,835 to Graton, issued Aug. 13, 1889; in the patent to De Bichtolsheim, French Patent No. 357,967, of Jan. 22, 1906; in U.S. Patent No. 867,468 to Von Bichtolsheim, issued Oct. 1, 1907; and in "Handbook for Machine Designers and Draughtmen" by F. A. Halsey. Quoting from this manual (1st ed., 1913, p. 47, "Keys and Keyways"): "The common driven key . . . is a poorly designed thing at best; and under heavy duty, especially when the stresses alternate in direction, . . . (it) is the source of much trouble. They seldom fail by shearing, but frequently fail from deformation due to the turning over tendency of the forces to which they are subjected. Calculations of dimensions based on shearing stress are, therefore, largely futile."

In the standard tapered rectangular key, and in the straight key also, if fitted to bear at top and bottom as recommended by some handbooks, there are three independent pairings of six elemental contact or pressure areas of the key: (1) the radial, i.e., between the floors of the two keyseats, with the pressure being certain and heavy in the case of the driven or tapered key; (2) between the two walls of the shaft keyseat, with the pressure being light, incomplete, and uncertain; (3) between the two walls of the hub keyseat, which is also light, incomplete, and uncertain. Moreover, there is no communication of pressure among the three pairs of areas, nor between any two of them. Thus the vertical or wedging pressure may be very great and the lateral pressures in the hub and shaft keyseats very light, or one of these may be heavy and the other have wide clearance, but without either affecting the other or affecting the vertical pressure in any degree.

Practical considerations which add to the above-mentioned problems, inherent in the case of the rectangular key, are: that the keyseat walls are of only rough to ordinary finish by reason of the cutting actions of the tools commercially usable, preventing continuous and durable fitted contact unless heavily pressured; that the spacing of the parallel walls is set by a cutter dimension which is subject to some gradual reduction by abrasion or dress; that the wall spacing may have further variation according to the dull or sharp condition of the cutting edges; that the keyseats in shaft and hub are cut by two different tools which have slight casual variation from each other both in cutting width and finish produced; and finally, that a single key, which is itself subject to variations in dimensions must be fitted in the opposed keyseats. Under these circumstances, only very imperfect results are obtainable, and then often only after laborious hand labor.

With square and flat keys, both tapered and straight, some actual relative motion of the key and the keyed members occurs from the start, usually with the first sharp direct reversal of loading. This results from lack of adequate pressure of the major working surfaces. With that initial motion, deformation and wear inevitably occur. Therefore, the motion can only increase. The lateral contact gaps can never be compensated nor the play eliminated; it can only progress until the accumulated damage renders the key unusable. For want of preloading, the standard rectangular key is destroyed by a key duty which is well within the actual shear capacity of the key.

The machine key structure of this invention distinguishes patentably over the key structures disclosed on the Grafton and Von Bichtolsheim patents mentioned above. In Grafton, the hexagonal key is longitudinally tapered on all six sides and thus has the shape of the lower part of a regular hexahedral pyramid. Because of its configuration, such a key cannot possibly fit a shaft keyway of uniform depth. It might be contended that, in the light of the Von Bichtolsheim patent referred to above, which does show a key having a lower non-pressure face lying in a plane parallel to the bottom of a keyway of uniform depth, it would be obvious to modify Grafton in accordance with Von Bichtolsheim and thereby produce a machine key system which is anticipatory of the present invention. Such a contention entirely overlooks, however, another crucial distinction between the key of this invention and the prior art. Thus, according to the present invention, the hub key and keyway surfaces are not all tapered as in Grafton but are instead longitudinally parallel while, at the same time, beinginclined longitudinally in a direction parallel to the median plane of the key. And, although Von Bichtolsheim may disclose longitudinal inclination of the key hub faces, that reference does not show that the hub keyway faces are planar, and, as will be shown hereinafter, a true wedging of the key in the keyway is impossible when the hub pressure faces on both key and keyway comprised curved surfaces as in Von Bichtolsheim.

SUMMARY OF THE INVENTION

The machine key structure of the present invention is designed to remedy the above-described deficiency. Basically, the machine key structure of this invention employs a key which is of generally hexagonal cross-section. The shaft and hub keyways are designed to provide a clearance over the entire length of the key between its top and bottom surfaces and the corresponding keyway surfaces. The remaining key surfaces are, in general, pressure surfaces all of which are planar. The shaft keyway pressure faces are longitudinally parallel as are also the corresponding
key pressure faces, and the shaft keyway is of uniform depth and width over its entire length. The hub keyway pressure faces are also longitudinally parallel, but they, together with the associated non-pressure surface, are longitudinally inclined to provide a keyway of varying depth over its length. The corresponding key pressure faces and associated non-pressure surface are similarly inclined.

Deformation and wear of the key and the keyway faces are avoided or greatly reduced by pre-stressing the working faces which carry the combined non-loadings, the primary two-way, tangential power load and the lighter, secondary, radial pressure for gripping the hub against casual axial displacement. In the basically hexagonal key of my invention, equalization or proration of all initial working face pressure is inherent in its principle. Installation requires no selective adaptation or surface reductions for fit. The driving of the key compensates and adjusts automatically for the flattening of any surface irregularities and/or depth-and-width deviations in the key itself and in either or both keysets. Any loss of pressure which may result from a slight to moderate variations in operation is fully compensatable by drive-tightening of the key.

The initial normal force on each of the four working faces may be considered as the combination or resultant of two elemental forces, a radial and a tangential, the latter having the same direction and point (or area) of application for the effective force developed in the operation of the machine. Of these initial component forces, each is balanced against a corresponding force on another face, the radial forces opposing each other, the tangential like-wise. There are four pairings of forces, but they are not segregated or isolated in their oppositions; no increase or decrease of pressure can occur in one pair alone as all pressure change occurs simultaneously in all four.

The theory then of the construction herein shown and described is that a driving force imposed upon any given face, from either steady or impact torque and of a magnitude less than the initial pressure, will never entirely relieve the effective pressure of the corresponding, inactive face circumferentially opposed to the given power-loaded face; that, because of this residual pressure, both relative shift and rotational motion of the key (upon its own axis) are prevented; and that thus a rigid and simultaneous two-way fixity of the keyed members is obtained. The fixity is maintained up to, or nearly to, the shear-yield value of the key, thus preventing the destruction of the keyway by forces representing a minor fraction of its actual shear capacity and so meeting the weakness of standard keys as observed by Halsey.

The pre-loading does not in any degree reduce or limit the useful net power-transmitting capacity of the key as it does in certain dual keyways. The static or pre-load forces, being a balanced system, do not exert any shear upon the key, but only compression. It is only as the circumferentially balancing pressure is reduced at one side of the key that actual shear develops, and this can only come from relative displacement forces in the keyed members.

In the accompanying drawings, wherein reference letters are used to indicate parts generally and numerals particular points, lines, surfaces and areas, wherein all key taper angles are exaggerated for clarity of exposition:

FIGURE 1 is a side elevation view of a headless machine key made in accordance with this invention and having triangular or transition areas at the sides, with adjacent portions of a shaft grooved for use of the key;

FIGURE 2 is an end view of the key in FIGURE 1, at the left-hand, larger end;

FIGURE 3 is an enlarged elevation of the key of FIGURE 1 viewed from the right-hand, smaller end, at 3-3 in FIGURE 1;

FIGURE 4 is a plan view of the key and shaft keyway of FIGURE 1;

FIGURE 5 is a side elevation of a headed key made in accordance with this invention but without triangular transition areas at the sides, such as are shown in FIGURE 1;

FIGURE 6 is a left-hand end view of the key of FIGURE 5 from the smaller, right-hand end;

FIGURE 7 is an enlarged view of the key of FIGURE 5 from the smaller, right-hand end;

FIGURE 8 is a top plan view of the key and shaft keyway of FIGURE 5;

FIGURE 9 is a side elevation of a key made in accordance with this invention but of basically square cross section;

FIGURE 10 is an end view of the left-hand, larger end of the key of FIGURE 9;

FIGURE 11 is an enlarged end view at the right or smaller end of the key of FIGURE 9;

FIGURE 12 is a top plan view of the key and shaft keyway of FIGURE 9;

FIGURE 13 is an elevational view of a crank arm provided with an alternative embodiment of the machine key structure of this invention;

FIGURE 14 is an end elevation of the parts shown in FIGURE 13;

FIGURE 15 is an enlarged elevation of the block key of FIGURES 13 and 14;

FIGURE 16 is a side elevational view of a key of the present invention illustrating in combination certain optional features, including a shim or liner for key positioning;

FIGURE 17 is a right-hand end view, enlarged, of the key and shim of FIGURE 16;

FIGURE 18 is a top plan view of the key and shim of FIGURE 16 with an outline of a portion of the keyway as formed by end milling;

FIGURE 19 diagrammatically illustrates the result obtainable with a key having curved pressure faces as in the prior art; and

FIGURE 20 diagrammatically illustrates the result obtainable with a key having planar pressure faces as in the present invention.

FIGURES 1-12, and 16–18, are illustrative of the use of the key of this invention in various adaptive combinations of features for holding machine members having cylindrical surfaces of contact. FIGURES 13, 14 and 15 illustrate an adaptation of the key for holding members having flat surfaces of contact.

In the embodiment of the invention shown in FIGURES 1-4 the key A has top and bottom surfaces 1 and 2, respectively. Surfaces 1 and 2 are planar, as shown, and top surface 1 slopes or converges toward bottom surface 2 at one end of the key. Upwardly convergent planar side faces 3 engage corresponding faces in the keyway of the hub C, and downwardly convergent planar side faces 4 engage the shaft B on sloping walls 6 as shown in FIGURE 4. Side triangular faces 5 are vertical, planar, and parallel, extending longitudinally of the key and are relieved slightly by the corresponding hub keyway surfaces 25 (FIGURE 3). The shaft and hub keyway floors 7 and 8, respectively, have substantial clearances from the top and bottom faces of the key, and thus only the four flank faces 3 and 4 of the key have contact in the keyways. Arc 9 (FIGURES 2 and 3) is the line of exterior shaft surface. The narrow flat shoulders or relief areas 10 formed at the sides of the shaft keyway lower the actual shaft keyway line from the normal position 24 (FIGURE 1) to the level of the shoulder. The transition face 5 of the key A is accordingly extended down to the level of the shoulder. This shoulder or relief area feature is optional and may be used also with the keys of FIGURES 5-8, 9-12, and 16-18. Its advantage is two-fold, first, strengthening the flank of the keyway line and the wall itself, even beyond the basic strength improvement inherent in the key form, and second, the provision of a small, appropriately-shaped space for the accommodation of any lip swelling which may occur at very high loading of the key, thus avoiding or minimizing shaft lip impaction against the bore lip and consequent difficulty in disassembly due to shaft seizure in the hub.
In the headed key D of FIGURES 5–8 the top and bottom surfaces 11 and 12, respectively, and also the upper and lower pairs of pressure faces 13 and 14, are all planar. Arc 21 indicates the exterior surface of shaft E, and F represents the hub. A gib or head piece G having a face 15 may be arc or resistance-welded to an extension of the key body to facilitate extraction in the manner usual with gib keys. In this key, which may be cut from regular hexagonal stock, the planes of the faces 13 directly intersect those of faces 14 along the lines 20. Each line 20 slopes downwardly, as shown in FIGURE 5, with reference to shaft keyway line 17. The end or runout of the slope of the upper three faces 13, 11, 13 is shown at 23. The lower three faces 14, 12, 14 may be used as drawn, with no machining. The line 20 may be placed entirely above lip line 17 or entirely below it, but, for the purpose of minimizing and dividing the void, line 20 is here placed to cross 17 at the midheight 16 of the key body. This disposition produces, at each side of the key, two small voids 19, 19 (FIGURE 7) in the hub keyway at the larger end of the key, and 18–18 in the shaft keyway at the smaller end.

In the key H of FIGURES 9–12, the upper pressure faces 28 converge at a right angle at the top 26 and, lower faces 29 similarly at the bottom 27. At the sides are elongated, triangular connective faces 30 modifying the generally square cross-section of the key. Faces 30 are planar and parallel. The shape, purpose, clearance and options as to location of these side faces with reference to the lip line 31 of shaft keyway 33 are generally similar to the case of key A (FIGURES 1–4) and so need not be described again. Arc 32 (FIGURES 10 and 11) is the surface line of the shaft J, while K designates the hub. In the use of this form of key, it is recommended as a practical matter that the pressure faces should not be extended to a literally sharp corner. Both strength of hub and maintenance of keyway cutting tools are greatly served by a small rounding or flat area at these points, with the key slightly clearing the keyway in order to ensure against a false bearing of the key in driving.

In the key of FIGURES 13–15 the body of the key L is essentially the same as that of FIGURE 1 except in relative length, and so need not be described again. Clearances are the same or proportional. The plane 41 of keyed contact of the crank arm S and block R, corresponding to the curved surfaces of shafts in the other constructions, intersects at its edges the keyway pressure faces in crank arm S. Alternative key positions 36, 37, and 38 are shown with the block B and the pivot 10, the reciprocating bar Q in the recess of the arm S and hence in angular reference to the shaft P, thus relocating the swing or oscillating range of arm S and shaft P. A pocket 40 is formed incidently in the floor of the recess in milling the web keyways. An extension of the body of the key L shown at 43, passes through one of three holes 39 which are drilled in line with the keyways and carries compression spring M, which may be seated in a countersink 42 at the back of the arm S. The nuts N, threaded on the end of key extension 43, are turned to set up a full and some reserve spring pressure and key tension, and then locked. If, then, in the course of operation, the initial fit of the key L yields, due to seating or settling of faces, occasional severe overload, or spring of the members, the expansion force of the spring M pulls the key into tighter setting, preventing play from developing. This adjustment occurs automatically during operation of the machine, without the attention and regardless of the inattention of the operator.

In the construction of FIGURES 16, 17, 18, which combines lateral transition areas (as in FIGURE 1) with the direct lateral intersection of pressure faces (as in FIGURE 5), T designates a key having top and bottom surfaces 50 and 51, respectively, mounted in a shaft U and bolted in true position by a shim V, partially broken away at the forward end. The shimming may be either integral or laminated. The thickness of the single-face shim shown here is exaggerated for distinctness. The upper and lower pairs of pressure faces 52 and 53 are joined, through a rearward portion of their length, by lateral transition area 54 (FIGURE 16) of which sloping line 55 is the upper edge and 65 the lower, the latter located at the level of the shaft keyway lip line. Broken line 56 is for reference and is located at the end point of area 54. Line 57, extending from 56 to the end of the key is the direct intersection of faces 52 and 53. It is not aligned with either 55 or 65 and, as may be seen in FIGURE 18, recedes slightly from the plane of area 54. Point 58 (FIGURE 17), represents the intersection of arc 63, the line of shaft surface, with face 52 at the forward extremity of the key. Small triangular space 59 is a void resulting from the descent line 57 below the level of the lip line. This void tapers backward along the key to a point at line 56. Broken lines 61 are extensions of the lower flank faces of the key, which may intersect as far down as point 60, the axis of shaft U. The wall of the shaft keyway is shown at 62. Broken line 64 is for reference, to indicate an intermediate length of key.

This construction illustrates four things: a method of correlating the draft in this general key type with the practical object of a keyway system having a relatively great range of key lengths; a lesser proportionate basic height of key than that shown in the preceding figures; a disposition of lower flank faces approximately radially to the shaft; and the use of shimming.

FIGURES 19 and 20 illustrate diagrammatically highly significant difference between a key having hub having curved pressure faces as in FIGURE 19 and one having planar pressure faces as in FIGURE 20. Curved pressure faces are disclosed, for example, in the Von Bechtolsheim patent referred to above, whereas planar pressure faces in as FIGURE 20 are in accordance with the teachings of the present invention.

In FIGURE 19, the key having the curved pressure faces 70 and 71 and the planar top non-pressure faces 72 is shown as being fitted within the shaft keyway 73. The clearance between the pressure faces 70 and 71 of the key and the corresponding keyway pressure faces 74 and 75 has been greatly exaggerated for purposes of illustration. In FIGURE 20, the key has planar pressure faces 76 and 77 and also a planar non-pressure face 78. The respective opposed hub keyway pressure faces are designated as 79 and 80, respectively. Here again the clearance between opposed pressure faces has been illustrated in an exaggerated manner for clarity.

In each case, i.e. in both FIGURES 19 and 20, the driving of the key into the keyway results in forces being exerted between the key and keyway hub pressure faces in a direction normal to the contacting surfaces of the hub and shaft at the medium plane of the key. Referring first to FIGURE 20, it can readily be seen that the driving of the key into the keyway results in a uniform pressure over the respective pairs of pressure faces which comes about because of the equal distances between the opposed pressure faces in the effective direction of movement of the key. In other words, the distances 81, 82, 83, and 84 are all equal so that driving the key into the keyway results in uniform contact between opposed pressure faces over their entire surface. In contrast to this, in FIGURE 19, it can readily be seen that the limit of movement of the key relative to the keyway is determined by the distances 85 and 86, since when these are reduced to zero, the key will be in tight contact with the keyway. At such time, however, the pressure faces of the key will not be in uniform contact with the hub keyway pressure faces since the distances 87 and 88 are greater than the distances 85 and 86, and thus a gap will remain adjacent each lip of the key of FIGURE 19. Because of this, it is impossible to secure a true wedging action of a key when, as in FIGURE 19, it is provided with pressure faces which are not planar.
I desire it to be understood that I may practice the invention with such variations of construction as may fall within the scope of the appended claims. Examples of such variations which I consider to be within the spirit of the invention are: extension of the key more deeply into one machine member than into the other, in order to reduce relatively the unit pressure in the one member which may be made of softer material than the other; use of different angles of convergence of working faces than those here shown, so varying the relative magnitudes of the radial and axial elements of the force on the working faces of the key; and other variations of width to height of key, of the tape or wedge angle, and of the form of key head.

What I claim is:

1. In combination, two machine members adapted to be driven together having flat surfaces in mutual contact; a key securing both said machine members in driving engagement; said key having on opposite sides two converging plane surfaces each having planar pressure contact with one of said machine members, and said key having on opposite sides two converging plane surfaces each having planar pressure contact with the other of said machine members; said key further having a plane surface at its top and another plane surface at its bottom, as the key is viewed in side elevation, the two last mentioned plane surfaces being at a slight angle longitudinally of the key relative to each other; the key having two other plane surfaces each on one side of the key being of narrow width and small area, as compared with the widths and areas of said plane pressure surfaces, said other plane surfaces being approximately vertical and approximately parallel on opposite sides of the key and each being located respectively between two plane pressure surfaces.

2. In combination, a longitudinally tapered machine key having eight longitudinal faces; two machine members having respectively contacting surfaces and each having a keyway formed therein; said members being held in relative position by the key; the keyway in one of said members embedding three faces of the key and engaging two of said three faces and the keyway in the other member embedding five faces of the key and engaging two of said five faces.

3. A machine key consisting of a solid elongated body having, at top and bottom, two flat faces, one of them being slightly inclined longitudinally with reference to the other, two upwardly convergent flat faces adjoining the top face and other two downwardly convergent flat faces adjoining the bottom face, each of the said six faces being of uniform width through at least a substantial portion of the engagement length of the key; and two other faces at the sides of the key each located between an upwardly convergent flat face and a downwardly convergent flat face.

4. A machine key consisting of a solid elongated body having eight longitudinal planar faces, six of the faces having parallel edges through at least a portion of their respective lengths and two faces on opposite sides of the key being parallel to each other and having longitudinal edges which are convergent.

5. A machine key consisting of a solid elongated body having eight flat longitudinal faces, two of these, one at the top of the key and one at the bottom, being relatively inclined longitudinally, two faces being upwardly convergent and adjoining the top face, two downwardly convergent and adjoining the bottom face, and two faces, one at each side, lying in planes which intersect in straight lines the planes of the said two upwardly convergent and two downwardly convergent faces.

6. Two machine members adapted to be driven together having flat faces in mutual contact, a key engaging both machine members and holding them in relative position, the key having true wedge taper into each of the machine members and being tapered longitudinally, there being flat surfaces at the top and bottom of the key, said tapers of the key into the machine members each terminating in one of said flat surfaces, the two longitudinal edges of each such flat surface being parallel, the contacts between the key and machine members being flat and having true and uniform bearing.

7. In combination, two machine members having surfaces in mutual contact, a longitudinally tapered machine key having two upwardly convergent and two downwardly convergent plane pressure faces, keyways in the said machine members being tapered longitudinally and being of true wedge taper, and a shim having true and uniform bearing between one of said pressure faces and the corresponding keyway surface whereby the gripping of the key is advanced in the drive, with equable pressure upon all of said pressure faces.

8. In combination, two machine members adapted to be driven together having flat surfaces in mutual contact; a key interrupting both flat surfaces and holding the machine members in their relative positions, said key being tapered longitudinally and having convergent plane walls entering each of said machine members; an extension fixed to and projecting from one end of the key; and means carried by said integral extension and engaging one of said machine members and automatically exerting a pull longitudinally of the key to tighten said key against said machine members.

9. The invention defined in claim 8, wherein said means comprises a coil spring and an adjusting nut threaded on the end of said integral extension for compressing said coil spring to bear with adjusted force against one of said machine members.

10. A machine key provided with a body having a pair of upper pressure faces converging toward a right angle at the top; a pair of lower pressure faces converging toward a right angle at the bottom; and on opposite sides, elongated triangular faces each of which connects the two pressure faces on that side; the key as a whole tapering uniformly longitudinally, that is, being of smaller cross section at one end than at the other.

11. In combination, a round shaft, a machine member having a bore fitting said round shaft and being mounted thereon; matching keyways respectively in said shaft and said bore, a key engaging said keyways; said shaft having formed thereon two narrow relief areas which are located outside of and at either side of, and contiguous to and parallel with the shaft keyway; a space of appreciable radial depth thus intervening between each of said relief areas and the bore surface.

12. In combination, a round shaft; a machine member bored to fit said shaft and mounted thereon; matching keyways in said shaft and said bore; a key engaging said keyways; said key having two upwardly convergent side faces and two downwardly convergent side faces; there being formed upon the shaft two narrow relief areas located outside of, and at either side of, and contiguous to and parallel with the shaft keyway; a space of appreciable radial depth thus intervening between said relief areas and the bore surface.

13. A machine key structure for operatively coupling a shaft and a hub including opposing keyways in the contacting surfaces of said hub and shaft and a key in said keyways, each said keyway comprising an elongate slot including:

(a) a non-pressure floor surface with parallel longitudinal edges extending transversely of the median plane of the key structure, and

(b) two longitudinally parallel elongate planar pressure faces which respectively join said keyway floor surface along a respective one of its parallel longitudinal edges and diverge at equal opposing keyway, said two shaft keyway pressure faces each having a substantially uniform width throughout their length and having upper edges adjacent the contacting surface of said shaft comprising two parallel lines respectively disposed on opposite sides of said median plane,
said pressure faces and said floor surface of said hub keyway all being inclined longitudinally at a predetermined angle relative to the plane defined by said two parallel lines, said key being adapted for forcible insertion into the keyspace formed by said keyways and comprising:
(a) top and bottom non-pressure faces each having parallel longitudinal edges,
(b) a first pair of longitudinally parallel planar pressure faces each joining said bottom non-pressure face along a respective one of its edges and diverging upwardly at equal angles relative to said median plane with the angle of divergence equalling the angle of divergence of said pressure faces of said shaft keyway,
(c) a second pair of longitudinally parallel planar pressure faces each joining said top non-pressure face along a respective one of its edges and diverging downwardly at equal angles relative to said median plane with the angle of divergence equalling the angle of divergence of said pressure faces of said hub keyway,
(d) said first pair of pressure faces and also said bottom non-pressure face of said key being longitudinally parallel to said two parallel lines when said key is in operative position,
(e) said second pair of longitudinally parallel planar pressure faces and also said top non-pressure face of said key being inclined longitudinally at said predetermined angle relative to said two parallel lines, the opposed non-pressure faces of both said key and each keyway being so contoured relative to each other as to provide a clearance therebetween which is longitudinally uniform over the entire length of said key when said key is forcibly driven into the opposed keyways and being of such relative widths as to ensure thereby a mutually reactive pressured contact of each key pressure face against only a corresponding keyway pressure face over substantially the entire engagement length of the key.

14. The combination of claim 13 in which each pressure face of a pair of pressure faces of said key member intersects a respective pressure face of the other pair in a straight line forming a longitudinal edge of said key member.

15. The combination of claim 13 in which said key member also includes a pair of planar non-pressure side surfaces each substantially parallel to said median plane and each joining an edge of one said pressure face of each pair of pressure faces.

16. The combination of claim 13 which further includes a shim between at least one of said key member pressure faces and its corresponding keyway pressure face.

17. The combination of claim 13 in which said pressure faces of said keyway in said shaft are both substantially parallel to radii of said shaft.

18. The combination of claim 13 in which said non-pressure surface of each said keyway is planar and substantially normal to the median plane of the key.

References Cited
UNITED STATES PATENTS
408,835 8/1889 Grafton 287—52.05
867,468 10/1907 von Bechtolsheim 287—52.05
CARL W. TOMLIN, Primary Examiner.
ANDREW V. KUNDRAK, Assistant Examiner.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,428,343 Dated February 18, 1969

Inventor(s) Robert R. Downie

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, line 70, after "equal" insert:

-- angles relative to said median plane toward the --

SIGNED AND SEALED
SEP 2 - 1969

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents