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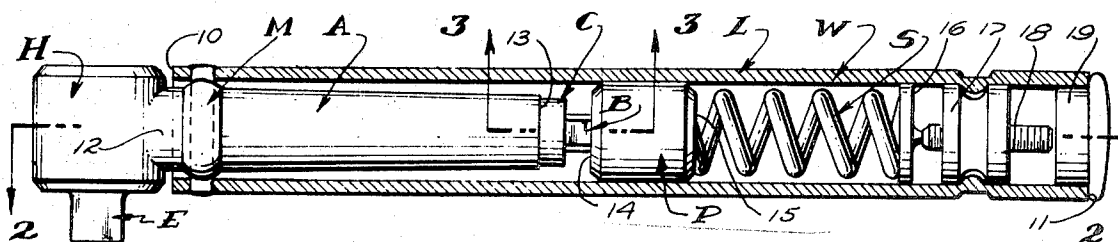
[54] CAM MEANS FOR TORQUE WRENCHES
6 Claims, 14 Drawing Figs.

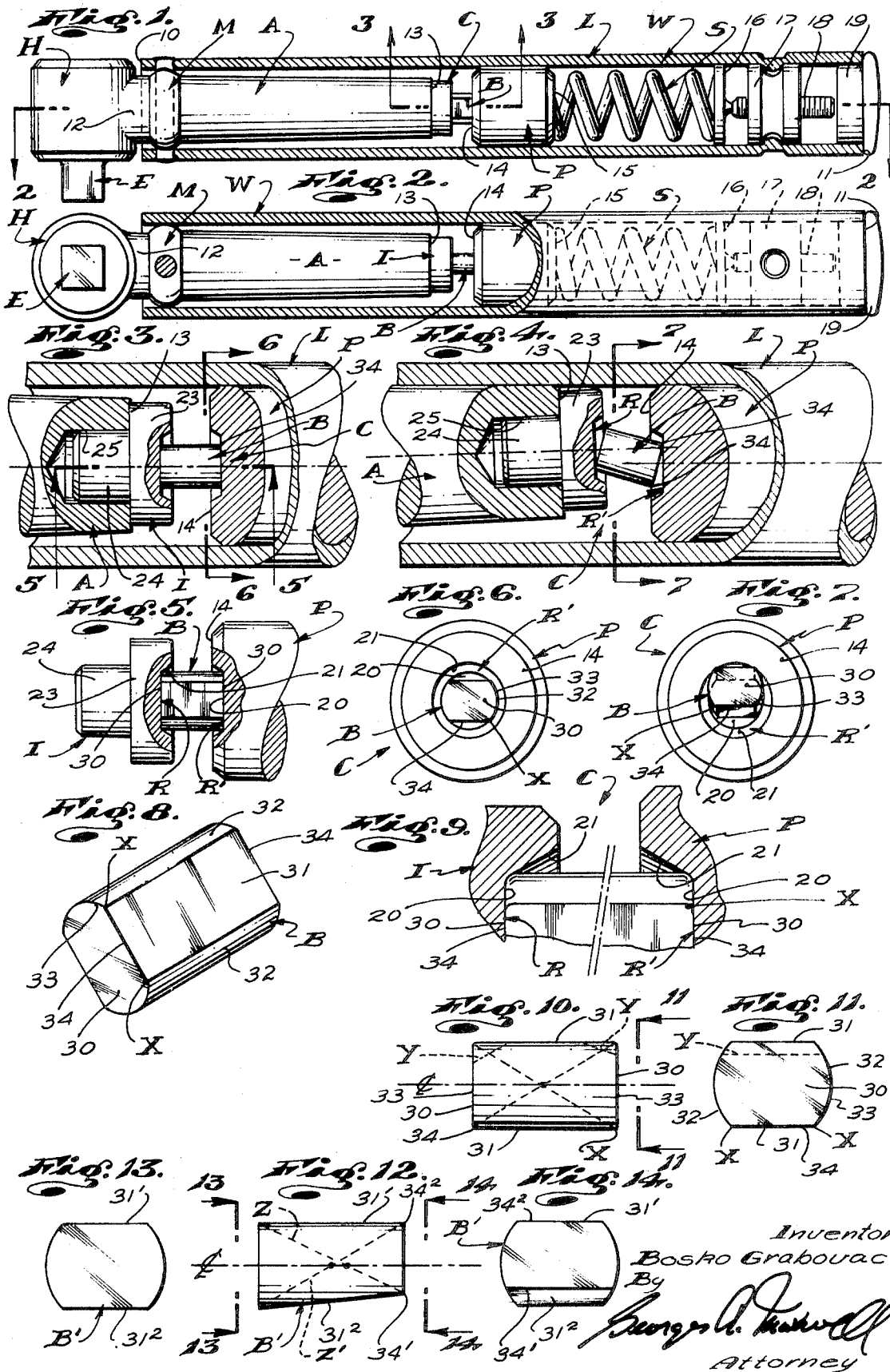
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ABSTRACT: A self-centering cam means for use in torque wrenches comprising axially spaced, normally aligned, axially inwardly opening and opposing truncated conical recesses in spaced, normally opposing ends of a laterally shiftable spring-loaded plunger, and an elongate normally axially extending cam block between the arm and plunger, with flat opposite ends normally establishing flat seated engagement on the bottoms of the recesses, flat, laterally outwardly disposed longitudinal sides on planes normal to the pivotal axis of the arm and converging with the ends to define straight pivot edges extending along cord lines across the bottoms of the recesses and radially outwardly disposed longitudinally extending convex intermediate sides, the ends of which define arcuate edges, the radiuses of which are equal with the radiuses of bottoms of the recesses and which normally engage in the corners established by the bottoms and side of the recesses.





CAM MEANS FOR TORQUE WRENCHES

This invention has to do with improved cam means for torque wrenches.

Throughout the industrial arts, there is wide demand and use of that class of tool or wrench, employed to apply torque to pieces of work and which is such that the foot pounds of force applied to the work can be conveniently and accurately determined. This class of tool is commonly referred to as a torque wrench.

The most satisfactory, accurate and dependable torque wrench construction, which construction has been adapted by all major manufacturers of torque wrenches, includes an elongate, tubular lever arm or handle, having front and rear ends, an elongate pivot or cam arm, with front and rear ends engaged in the front portion of the lever in coaxial alignment therewith, pivot means pivotally connecting the front portion of the arm to the front end of the lever on an axis normal to the axes of the arm and lever, a head on the forward end of the arm and having or carrying a work engaging member, the axis of which is parallel with the pivotal axis of the arm; a plunger slidably engaged in the lever rearward of the arm, a pivot or cam block between the plunger and the arm, and adjustable spring means in the lever rearward of the plunger and normally yielding urging the plunger forwardly toward the arm and holding the block in yielding pressure engagement between the plunger and arm.

The pivot block in such wrench constructions is normally and basically a simple metal block of precise predetermined axial extent with flat axially disposed end faces and of any suitable or desirable cross section; such blocks having been provided with cylindrical, square, rectangular and various other polygonal cross section.

The rear ends of the arms and the opposing, forward ends of the plungers in such wrenches are provided with central rearwardly and forwardly opening recesses having flat rearwardly and forwardly opening recesses having flat rearwardly and forwardly disposed bottom surfaces corresponding substantially in plane configuration with the cross section of the pivot blocks related thereto and adapted to normally establish flat, seated bearing engagement with the opposing adjacent ends of the pivot block related thereto. The recesses are further provided with outwardly divergent or inclined sidewalls to provide clearance between the said walls and the sides of the block so that the block is free to pivot or tip freely in and relative to the recesses.

The sides of the above referred to recesses define abutments which serve to prevent radial or lateral shifting of the blocks between and relative to the arms and plungers and cooperate with their flat bottoms to define corners in which portions of the edges of the blocks pivotally engage or seat when the blocks are caused to pivot and tip between the arms and plungers.

In operation of such wrenches, the arms, blocks and plungers are urged and maintained in coaxial alignment with each other and within the levers by the force of the spring means, with the bottoms of the recesses in flat bearing engagement with their opposing ends of the block. When sufficient torsional force is exerted onto the heads of the wrenches to cause the arms to pivot about their pivotal axis and their rear ends to swing laterally and out of axial alignment with the plungers and levers, the blocks are caused to tip or rock laterally in the direction in which the rear end of the arms swing, camming the plunger rearwardly against the resistance of the spring means. The arms strike and are stopped by the insides of the levers transmitting audible signals, which, coupled with the detectable movement of parts, signals the operators of the wrenches that the forces at which the wrenches have been set to actuate have been reached.

When the wrenches are actuated in the above manner, the blocks are not tilted or pivoted over center, so that when the forces are relieved, the force of the spring means will urge the

constructions back to their normal, aligned, unactuated positions.

The force required to actuate the above-noted type or class of torque wrench is determinable by the stability of the block and the pressure of the spring means. The stability of the block is a function of its length relative to its effective width, that is, its width on the plane in which it tips, or the plane in which the arm swings. With the stability of the block established and known, the force required to actuate the construction can be conveniently and accurately adjusted and set by varying the force or resistance afforded by the spring means.

In the course of manufacturing such wrenches in mass, extreme care must and is exercised to make all elements and parts to predetermined dimensions and making the springs employed to predetermined ratings or force characteristics.

It has been determined that the cam blocks are the most critical parts to produce and are best employed to make final adjustments in establishing a necessary balance of parts for an accurate and dependable product.

In the course of establishing the blocks, using economically practical and feasible manufacturing techniques, tolerances of plus or minus 0.002" in both axial and lateral extent is all that can be anticipated. However, a differential of 0.001" in axial or lateral extent of the block can result in an error of as much as 10 foot pound of torque in the operation of the finished wrench. It has been determined that in order to obtain desired end results, the axial dimensions of the blocks must be kept within tolerances of plus or minus 0.005". Accordingly, it has become common practice to grind and dress the ends of the blocks to establish their axial extent to within allowable tolerances. Such grinding and dressing of the blocks is costly and time consuming.

Due to the fact that the ends of the block must properly seat on the bottoms of their related recesses and the edges of the ends of the blocks must properly engage and seat in the corners established by the bottoms and sides of the recesses when the blocks are tipped, it has been determined that grinding and dressing of the sides of the blocks for improving the accuracy of the constructions is not practical and such has not become the practice in the manufacture of such wrenches.

An object of the present invention is to provide a novel cam means for the general class of torque wrench referred to above wherein opposite sides of the cam block are ground and dressed to adjust and fix the effective dimensions of the block to within allowable tolerances.

Yet another object of the present invention is to provide a novel cam means of the character referred to wherein the supporting and pivoting engagement of the block in its related recesses is unaffected by dressing of the opposite sides and altering of the lateral extent of the block.

Still further, it is an object of my invention to provide a cam block of the character referred to which is such that both the ends and opposite sides of the block can be advantageously ground and dresses to adjust both the axial and lateral extent of the block and can be adjusted to within fine tolerances, as desired and as circumstances require.

A feature of the present invention is to provide an elongate cam block with flat axially disposed ends, two flat, parallel, longitudinal, laterally outwardly disposed opposite sides and two outwardly disposed, convex, longitudinal intermediate sides, the radii of which are concentric with the longitudinal axis of the block.

Another feature of the instant invention is to provide central frustoconical recesses in the opposing ends of the arm and plunger, and having flat, axially disposed bottom surfaces, the radii of which substantially correspond with the radii of the intermediate sides of the block whereby the sides of the recesses normally maintain the block in coaxial alignment in the recesses and with the plunger and arm and serve as abutments against which the end corners of the flat sides engage when the block is tipped between the plunger and arm.

Another object and feature of this invention is to provide a cam means of the character referred to wherein the corners

established by the bottoms and sides of the recesses and by the ends and the sides of the block are provided with substantially complimentary radii whereby the construction is free of fragile and weak corners and edges and the edges and/or corners of the block roll or turn in and establish smooth camming action with the noted corners in the recesses when the block is tipped to and from its normal and actuated positions.

Yet another object of my invention is to provide a cam means of the character referred to wherein at least one of the flat sides of the block is out of parallel with central axis of the block whereby the effective lateral extent of one end of the block is different from the other end thereof and whereby the block affords greater stability and resistance to tipping in one direction than in the other and so that a wrench which will actuate to one set force in a clockwise and to another or different set force in the opposite or counterclockwise direction can be advantageously established.

The prior art has taught the use of cam blocks which are cylindrical in cross section. It has been asserted that such blocks, when tipped or actuated within and between their related recesses, establish point contact therewith and afford less friction. While the above might be true, it has been determined that point contact established in the above manner is unsatisfactory since the forces encountered are substantial and the points establishing such contact crush, bread and otherwise fail, rendering the constructions defective.

As a result of the above, square blocks are commonly employed. Such blocks establish pivotal edges about which the blocks pivot. The extent of such edges provide considerably more structural strength than in required to withstand the forces encountered and establish some excessive and undesirable friction.

An object and feature of the present invention is to provide a cam means of the character referred to which is such that the pivotal edges of the block, can be made considerably shorter than similar edges in square blocks, affording less resistance, and are of sufficient extent to provide more than adequate structural strength to withstand the forces to be encountered.

A disadvantage to be found in cam blocks of square cross section resides in the fact that the opposite, flat sides thereof must be maintained parallel, else the camming edges established thereby will be out of parallel and will not establish line contact with the bottoms of the recesses when the blocks are tipped. The greater the longitudinal extent of these edges are, the greater is the effect of misalignment of the sides.

It is another object and feature of the present invention to provide a block of the character referred to above wherein the camming edges defined by the ends and the sides of the block are of limited longitudinal extent whereby the effect of slight misalignment of the sides of the block is materially reduced.

The foregoing and other objects and features of my invention will be apparent and fully understood from the following detailed description of typical preferred forms and applications of my invention, throughout which description reference is made to the accompanying drawings, in which:

FIG. 1 is a longitudinal sectional view of a wrench embodying the present invention;

FIG. 2 is a view taken substantially as indicated by line 2-2 on FIG. 1;

FIG. 3 is a sectional view taken substantially as indicated by line 3-3 on FIG. 1;

FIG. 4 is a view similar to FIG. 3 and showing parts in another position;

FIG. 5 is a fragmentary view taken substantially as indicated by line 5-5 on FIG. 3;

FIG. 6 is a view taken as indicated by line 6-6 on FIG. 3;

FIG. 7 is a view taken as indicated by line 7-7 on FIG. 4;

FIG. 8 is a n isometric view of my new cam block;

FIG. 9 is an enlarged fragmentary view of a portion of the structure shown in FIG. 5;

FIG. 10 is a side elevational view of my new block;

FIG. 11 is a view taken as indicated by line 11-11 on Fig. 10;

FIG. 12 is a view similar to FIG. 10 showing a modified form of cam block;

FIG. 13 is a view taken as indicated by line 13-13 on FIG. 12; and,

FIG. 14 is a view taken as indicated by line 14-14 on FIG. 12.

In FIGS. 1 and 2 of the drawings, I have shown a typical, conventional torque wrench construction W with the novel cam means C provided by my invention related thereto.

The wrench construction W includes an elongate tubular lever or handle L with front and rear ends 10 and 11, an elongate cam arm A with front and rear ends 12 and 13 and arranged in the forward portion of the handle L, pivot means M pivotally connecting the forward end portion of the arm to the forward end portion of the handle on an axis normal to the axes of the handle and arm and parallel with the central longitudinal vertical plane of said handle and arm. The arm is provided with a head H at its forward end, forward of the forward end of the handle. The head H is adapted to support or has a work engaging parts E formed integrally therewith, the axis of which part is parallel with the axis of the pivot means M.

The construction W further includes an elongate plunger P with front and rear ends 14 and 15 slidably engaged on the handle L, rearward of the arm A, and spring means S in the handle rearwardly of the plunger to engage and normally yieldingly urge the plunger forwardly in the handle.

The spring means S is shown as including a helical compression spring in the handle with a forward end seated on the rear end 15 of the plunger, a spring seat washer 16 engaged with the rear end of the spring C, a plug 17 fixed in the handle rearward of the washer 16, a central axially extending adjusting screw 18 carried by the plug 17, engageable from the open rear end of the handle and engaging the washer 16.

In practice, the open rear end of the handle can be closed by a suitable removable cap 19.

The cam means C is tipping block-type cam means and is arranged within the handle H between the rear end 13 of the arm and the front end 14 of the plunger in substantially the same manner that old, conventional cam means are related to the same or similar parts in similar torque wrench constructions provided by the prior art.

The wrench construction W thus far described and illustrated in the drawings is a typical or conventional wrench construction familiar and well known to those skilled in the art and is intended to illustrate one basic form of wrench construction with which my new cam means C can be advantageously related.

Since the basic wrench construction W illustrated is old and well known in the art, further detailed description of the construction can and will be dispensed with.

Referring now to the novel cam means C that I provide and which is illustrated in FIGS. 1 through 11 of the drawings, that means includes front and rear, central, normally axially aligned recesses R and R' in rear end of the arm A and the front end of the plunger P, and a cam block B engaged between the arm and plunger and cooperatively engaged in the recesses R and R'.

The recesses R and R' are frustoconical, axially opening recesses having flat, axially disposed bottom surfaces 20 and axially and radially outwardly inclined sides 21. The sides 21 of the recesses are inclined at about 30 degrees. The radius of the bottom surfaces 20 and the corresponding minor radius of the sides 21 of the recesses are of fixed predetermined extent.

The corners established by the bottom surfaces 20 and sides 21 of the recesses R and R' are radiused as clearly illustrated in FIG. 9 of the drawings.

In practice, the recesses R and R' can be established in the rear end of the arm A and in the forward end of the plunger or can be established in separate inserts suitably engaged with the related ends of the arm and plunger.

In the case illustrated, the recess R' is formed in the front end of the plunger P, while the recess R is established in an insert I suitably related to the rear end 13 of the arm A. The in-

sert I includes a cylindrical head portion 23 with the recess R formed therein and seated on the rear end of the arm, a central, forwardly projecting, cylindrical stem portion 24 slidably engaged in a central, rearwardly opening bore 25 in the rear end of the arm A.

With the structure set forth above, the insert I and plunger P are rather small parts which lend themselves to having the recess R and R' formed therein by cold heading process and are such that they can be advantageously and economically heat-treated to harden the wearing surfaces of the recesses and provide a structure which is exceedingly strong, durable, and long-wearing.

It is to be noted that the recess R' could be established in an insert identical to the insert I and related to the plunger P, and that the recess R could be formed in the rear end 13 of the arm A without departing from the spirit of this invention.

The block B is an elongate metal part having flat, opposite and axially disposed ends 30, a pair of diametrically opposite, longitudinally extending, laterally outwardly disposed, flat, primary sides 31 and a pair of diametrically opposite, longitudinally extending, laterally outwardly disposed, convex secondary or intermediate sides 32.

The convex, secondary sides 32 are substantially equal in radial extent with the radial extent of the bottom surfaces 20 and the minor radii of the sides 21 of the recesses R and R' and can be of any desired circumferential extent.

In the case illustrated, the sides 32 are shown as being substantially 90° in circumferential extent.

The ends of the convex secondary sides 32 join or converge with the ends 30 of the block to define arcuate secondary edges 33, which edges are radiused, as shown in FIG. 9 of the drawings, so as to cooperatively engage in and with the radiused corners established by the bottom surfaces 20 and sides 21 of the recesses R and R'.

The flat, primary sides 31 of the block B are parallel with the central longitudinal axes of the block and are in parallel planes with each other.

The ends of the primary sides 31 join or converge with the ends 30 of the block to define straight, parallel, laterally spaced, pivotal edges 34, at each end of the block spaced substantially equidistance from the central axis of the block.

The straight pivot edges 34 are suitably radiused as illustrated in FIG. 9 of the drawings.

The edges 34 extend along parallel cord lines between their related ends of the arcuate edges 33 of the block.

The block is normally arranged in axial alignment between the arm and plunger with its ends 30 in flat seated engagement on the bottom 20 of the recesses, with its radiused arcuate edges 33 in cooperated seated engagement in adjacent portions of the radiused corners between the bottoms and sides of the recesses and with its straight pivot edges along parallel cord lines across the bottoms 20 of the recesses and between the ends of the above-referred to portions of the radiused corners of the recesses.

It is to be noted that the seated engagement of the arcuate edges 33 in their related portions of the corners in the recesses effectively centralize and maintain the block in central alignment with the arm and the plunger.

The flat primary sides 31 of the block are arranged between the arm and plunger with the planes of said sides on vertical planes, parallel with the vertical pivotal axis of the arm A, established by the means M.

When the means C is actuated, by lateral swinging of the rear end of the arm A, out of axial alignment with the plunger P and, as illustrated in FIGS. 4 and 7 of the drawings, the block B is caused to tip and in such a manner that its straight, radiused pivot edges 34 establish rolling pivotal engagement along their related cord lines on their adjacent bottoms 20 of the recesses R and R'.

It is important to note that when the block is caused to tip and pivot in the above-noted manner, the corners X established by the related ends of the edges 33 and 34 of the block establish point pivoted engagement in the corners

established by the bottoms and sides of the recesses R and R', at the ends of the cord lines on the bottoms 20 and along which the pivot edges 34 bear. With this relationship of parts, the ends of the block are effectively prevented from shifting or sliding laterally outwardly on the recess bottoms and relative to the central axes of the recesses when the construction is actuated.

It is important to note that the spacing apart of the sides 31 and the resulting effective lateral extent of the block can be altered and varied to an extreme extent, as desired and as circumstances require, without in any way affecting or altering the centering relationship and function afforded by the noted relationship of the edges 33 and the corners of the recesses. Further, the noted operational relationship and function of the straight pivot edges 34 and the bottoms 20 and the operative relationship between the noted corners X of the block in and with the corners of the recesses are unaffected by the spacing of the sides 31.

It will be further noted that so long as the primary sides 31 of the block are in planes so that their pivot edges are parallel with each other, they will function satisfactorily. One surface 31 can be closer or farther from the central axis of the block without adverse effects.

So long as the sides 31 are in parallel planes, the effective lateral extent of the block is equal at both ends and the stability of the block, to resist turning or tipping forces, will be equal in both directions with respect to laterally applied forces and it makes no difference if one of said sides is closer or farther from the central axis of the block than the other.

With the construction thus far described, it will be apparent that the block B is such that the sides 31 thereof can be effectively ground and dressed to alter, vary and adjust the effective lateral extent and stability of the block without in any way adversely affecting the satisfactory functioning of the cam means C and so as to provide such a means, which, when incorporated in a finished wrench construction, establishes a highly accurate torque wrench.

In practice, the longitudinal extent of the pivot edges 34 of the block must be sufficient to provide adequate structure and bearing surface to withstand the forces to be encountered during operation of the cam means. The necessary length of the edges 34 can be calculated and determined and the sides 31 can be ground and dressed so that the edges 34 are of the desired and necessary length.

Since the stability of the block to resist turning is a function of both its lateral extent and its longitudinal extent, the longitudinal extent of the block must be accurately controlled and might require adjustment by grinding and dressing one or both ends of the block, as desired or as circumstances require.

In practice, block blanks or approximately predetermined longitudinal extent and effective lateral extent and having convex secondary sides of predetermined radial extent are established. These blanks are suitably "miked" or measured to determine how close to allowable and acceptable tolerances they are in axial and effective lateral extent. When it is determined to which extent either or both of these controlling dimensions is off, one or both sides and/or one or both ends of the block can be ground and dressed to bring the block to desired, predetermined geometric characteristics.

With the structure here provided, grinding and dressing of the block to establish them to within allowable tolerances is not restricted to grinding and dressing one or both of the ends of the block, but can be effected by grinding and dressing one or both of the primary sides of the block, as well as one or both of the ends thereof. With this increased ability and latitude, the difficulty, time and costs involved in establishing satisfactory cam blocks is greatly reduced.

In practice and as indicated by dotted lines Y in FIGS. 10 and 11 of the drawings, it will be noted that the entire side 31 or sides 31 of the block need be ground and dressed to adjust the block, but that it is only necessary that the end portion of those sides, establishing the pivot edges need be ground and dressed. This type of partial dressing cannot be satisfactorily

effected by grinding and dressing the end portions of the sides of rectangular blocks since such adjustment would adversely affect the fit and/or relationship of the pivot edges of the blocks in their related recesses and permit excessive slipping and displacement of the blocks in the recesses when they are actuated.

With the construction that I provide, if it is desired to establish a torque wrench that will actuate when subjected to one predetermined torsional force in one direction and another or different predetermined force in the other or opposite direction, the block B' of my invention can, as illustrated in FIGS. 12, 13 and 14 of the drawings, be dressed and adjusted so that the sides 31' and 31² are not in parallel planes, but are angularly related and so that the effective lateral extent of the block, in one direction is greater or lesser than the effective lateral extent of the block in the other direction.

In the case illustrated the side 31' is parallel with the axis of the block B', while the side 31² is (referring to FIG. 12) inclined upwardly to the right. As a result of the above, and as indicated by dotted diagonal lines Z and Z', it will be observed that the diagonal line Z is shorter than the diagonal line Z' and that the lines Z and Z' intersect the centerline of block at longitudinally or axially spaced points which represent the two distinct turning axes of the block. It will be apparent that the lower right-hand pivot edge 34' is considerably closer to the central axis of the block than the upper right-hand pivot edge 34² and that the block is less stable and will turn or tip more readily when its left end is urged downwardly than when its left end is urged upwardly.

In FIG. 10 of the drawings, diagonal dotted lines are applied between the related pivot edges 34. It will be noted that these lines are equal in length and intersect each other at the same point on the centerline of the block. Accordingly, the block B is a balanced block and affords equal stability and resistance to tipping in both directions.

Having described only typical preferred forms and applications of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any modifications and/or variations that may appear to those skilled in the art.

Having described my invention, I claim:

1. An improved cam means for torque wrenches engageable between the laterally shiftable free rear end of an elongate pivoted cam arm and the forward end of an axially shiftable plunger normally in axial alignment with the arm and normally in axial alignment with the arm and normally yieldingly urged forwardly toward the arm by spring means, said cam means including rearwardly and forwardly opening frustoconical recesses in the rear and in the front ends of the arm and

plunger and defining flat, axially disposed bottom surfaces, radially and axially outwardly inclined sides and annular inside corners where said bottom surfaces and sides converge an elongate cam block normally in axial alignment with the arm and plunger and having flat axially disposed ends normally establishing flat bearing engagement on the bottom surfaces, flat diametrically opposite, laterally outwardly disposed, longitudinal primary sides converging with the said ends to define straight, parallel, laterally spaced pivot edges at the ends of the block on cord lines across the bottom surfaces; convex diametrically opposite radially outwardly disposed, longitudinal secondary sides between the primary sides and converging with the ends to define arcuate outside corner edges substantially equal in radius with the radius of the inside corners in the recesses and normally cooperatively seated therein, said block adapted to pivot out of axial alignment with the plunger and the arm when the rear end of the arm is urged laterally and out of alignment with the plunger, said pivot edges establishing lineal bearing engagement on the bottom surfaces.

2. A structure as set forth in claim 1 wherein the end corners established by the adjacent converging ends of the pivot edges and outside corner edges establish stopped pivotal engagement in the inside corners of the recesses and prevent lateral shifting and displacement of the block when it is pivoted between the arm and plunger.

3. A structure as set forth in claim 2 wherein the lateral spacing of the primary sides of the block are spaced from the central axis of the block are spaced from the central axis of the block and relative to each other to establish the desired lateral extent and stability of the block to resist lateral shifting of the arm and resulting pivoting of the block.

4. A structure as set forth in claim 2 wherein the longitudinal spacing of the ends and the lateral spacing of the primary sides and the resulting effective axial and lateral extent of the block are selectively alterable to establish the desired stability of the block to resist lateral shifting of the arm and resulting pivoting of the block.

5. A structure as set forth in claim 1, wherein the lateral spacing of the primary sides of the block are spaced from the central axis of the block and relative to each other to establish the desired lateral extent and stability of the block to resist lateral shifting of the arm and resulting pivoting of the block.

6. A structure as set forth in claim 1 wherein the longitudinal spacing of the ends and the lateral spacing of the primary sides and the resulting effective axial and lateral extent of the block are selectively alterable to establish the desired stability of the block to resist lateral shifting of the arm and resulting pivoting of the block.

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