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[54] **TORQUE LIMITED DRIVE FOR MANUAL VALVES**

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[52] **U.S. Cl.** ..... **251/81**; 192/56 R

[58] **Field of Search** ..... 192/54, 55, 56 R; 251/79, 80, 81

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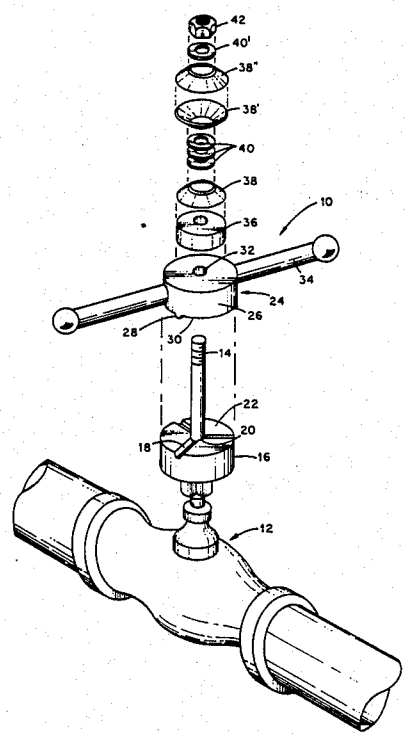
[57] **ABSTRACT**

The present invention is directed to a torque-limiting handwheel device for preventing manual valves from being damaged due to the application of excessive torque during the opening or closing operation of the valves. Torque can only be applied when ridges in the handwheel assembly engage in channels machined in the face of the baseplate. The amount of torque required for disengagement of the ridges from the channels is determined by the force exerted by various Bellville springs and the inclination of the side faces of the channels.

4 Claims, 2 Drawing Sheets



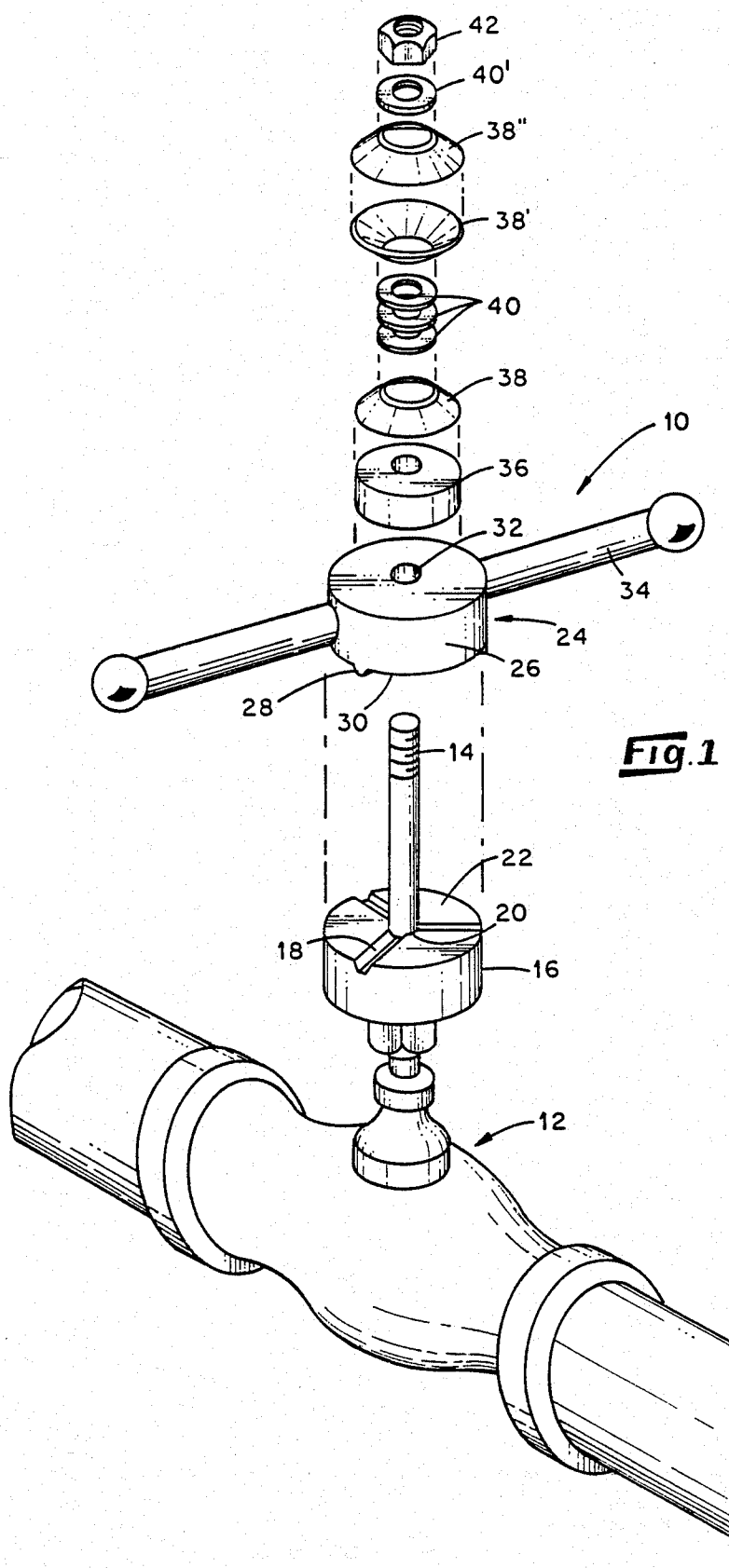


Fig. 1

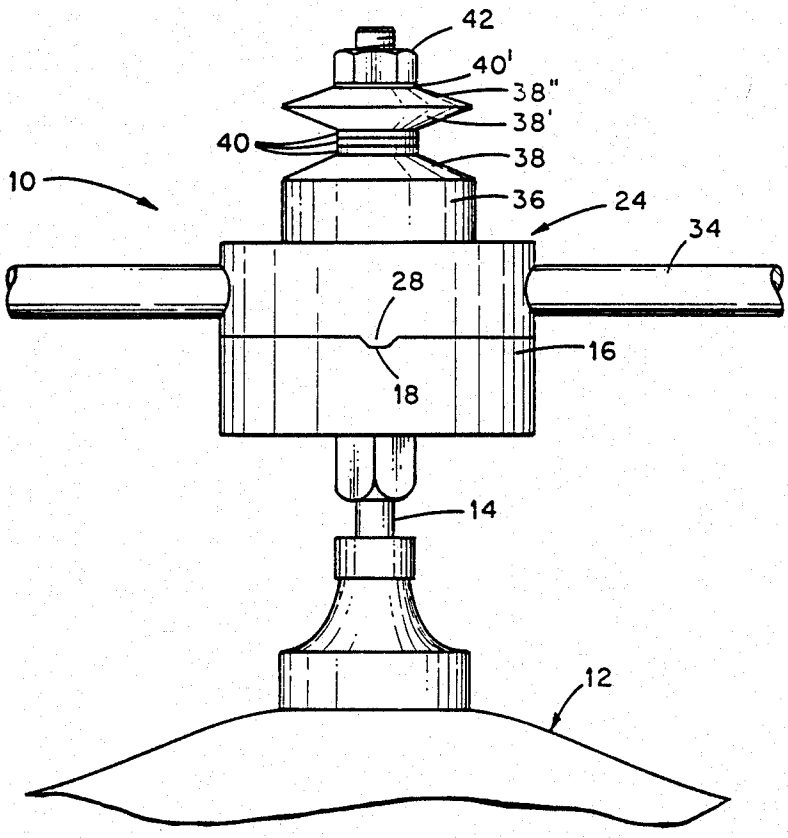


Fig. 2

TORQUE LIMITED DRIVE FOR MANUAL VALVES

This invention was made as a result of the work done under contract DE-AC05-840R21400 with Martin Marietta Energy Systems, Inc., and the U.S. Department of Energy.

BACKGROUND OF THE INVENTION

The present invention relates generally to a torque limiting handwheel for preventing manual valves from being damaged because of the excessive application of torque during the opening and closing operation of the valves.

Because of the variety (manufacturer and size) of valves, it is difficult for operators to keep up with the torque limits of each particular valve. The application of excessive torque has been the cause of many valve failures. Operator judgment becomes a frequent substitute for a torque wrench. When excessive valve seat leakage occurs, it is a natural tendency to apply excessive torque to the valve to correct the valve seat leakage. It is costly and time consuming to replace the damaged valve seats due to excessive torquing by the operators.

It is, accordingly, a general object of this invention to develop a torque-limiting handwheel which when installed on a valve, prevents the valve from being damaged through the application of excessive torque during operation of the valve.

Another more particular object of the invention is to provide a torque-limiting handwheel wherein an almost infinite range of maximum torque levels may be achieved.

Yet another object of the invention is to provide a torque-limiting device for manual valves wherein a common set of hardware can accommodate a wide range of valves having different allowable operating torques.

Another object of the invention was to devise a torque limiting feature for manual valves which can be applied as an integral part of a valve handwheel, the valve lazy rod, separate from the valve or be incorporated into a valve wrench.

SUMMARY OF THE INVENTION

A torque-limiting drive for preventing manual valves from being damaged due to the application of excessive torque during the opening or closing operation of the valves is provided in accordance with this invention. The torque-limiting device comprises a base plate member having channels radially disposed on its upper surface from a central bore. A handwheel member with ridges radially disposed on its lower surface at corresponding radial positions respectively engage and disengage the aforesaid channels to limit the torque on the device. Torque can only be applied when the ridges in the handwheel assembly are engaged in the channels machined in the baseplate of the device. Compression of various Bellville springs, and the inclination of the engaging side surfaces of the respective ridges and channels determine the amount of torque which will cause disengagement of the ridges from the channels. Therefore, valve torque limits can be adjusted with a single set of hardware by simply adjusting the compression of the Bellville springs.

It is, accordingly, a general object of the invention to provide a torque-limiting handwheel which when installed on valves, prevents the valves from being damaged by the application of excessive torque during the valve operation.

Other and further objects will be obvious upon an examination of the illustrative embodiment about to be described or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded isometric view showing the torque-limiting fixture in accordance with the present invention.

FIG. **2** is an assembled side view of the torque-limiting fixture.

DETAILED DESCRIPTION OF THE INVENTION

As briefly mentioned above, the present invention is directed to providing a torque-limiting handwheel device for preventing manual valves from being damaged by an excessive application of torque during the opening and closing operation of the valves. The torque-limiting device consists of a valve assembly with a steel baseplate having radially disposed channels or grooves on its upper surface and a handwheel member with ridges on its lower surface that respectively engage and disengage the channels to limit the torque on the device.

Described in general detail and with reference to the accompanying drawings, the torque-limiting device assembly is shown at **10** in FIG. **1** where it is used in conjunction with a valve assembly **12** having a threaded valve stem **14**. Threaded valve stem **14** accommodates a heat treated baseplate member **16** having channels or grooves **18** radially disposed at 120° intervals from central bore **20**, on its upper surface **22**.

Handle wheel assembly **24**, includes an upper plate **26** defining ridges **28** on its lower surface **30**, which are radially disposed from central bore **32** at 120° intervals so as to engage channels **18** in baseplate member **16** when the handle assembly is being operated within its torque limits. Handle **34** attached to upper plate **26** allows for a rotating movement of plate **26** about stem **14** during opening or closing of valve assembly **12**. As shown, handle wheel assembly **24** further includes spacer **36**, a plurality of Bellville springs **38**, **38'**, **38''** and spacers **40–40'** disposed coaxially on threaded valve stem **14**. Nut **42** on threaded valve stem **14** completes the assembly.

In operation, valve assembly **12** with threaded valve stem **14** being centrally disposed and fixably attached to baseplate **16**, along with handwheel assembly **24**, which is rotatably supported on valve stem **14**, allows member **24** to rotate independently about threaded valve stem **14** when the torque limits of the subject device are exceeded and ridges **28** are disengaged from channels **18**. The interface of surfaces **22** and **30** are provided with a grease lubricant to improve the repeatability of the maximum torque levels achieved during cyclic functioning of the device.

The amount of torque required to release baseplate **16** from handwheel assembly **24** is a function of the forces applied to members **16** and **24** by the plurality of stacked Bellville springs **38–38'–38''** and washers **40** and **40'** and

the inclination of the slopng side surfaces of channels **18** and ridges **28**.

In the preferred embodiment, channels **18** in surface **22** of baseplate **16** have a depth of 0.10-inch, a top width of 0.20-inch, tapering downward at a 45° angle to a bottom width of 0.10-inch. Ridges **28** in handwheel assembly **26** thus are machined correspondingly to mate with channels **12**.

A wide range of torque levels is achievable within the limits imposed by the strength of materials from which the device is fabricated. Variations in torque-resistance or resilience are obtained initially by selecting the angle of the incline of the side surfaces channels **18** and ridges **28** by which the two main members, baseplate **16** and handwheel assembly **24** are engaged with smaller singles providing lower torque limits.

The effect on torque (in./lbs.) of increasing the number of washers **40** between Bellville springs to increase the spring compression can be seen in table 1 where, in a typical test, 25 data points for each variation was made. The effect of changing the number of spacing washers **40** is to increase or decrease the deflection of the Bellville springs, thereby providing an increase or decrease in the force driving baseplate **16** and upper plate **26** together. Larger forces between plates **16** and **26** will provide a corresponding increase in the torque needed to cause relative rotation of those plates due to the engagement of ridges **28** in grooves **18** with greater force will be more resistant to disengagement.

TABLE I

Data Points	Torque (in/lbs) for Washers, number						
	0	1	2	3	4	5	6
	115	127	130	167	177	216	228
	103	112	152	149	176	193	211
	110	134	144	145	179	184	198
	110	123	135	161	171	196	218
5	112	115	150	147	179	201	208
	100	128	145	164	174	184	210
	112	122	147	159	183	193	206
	113	113	145	150	177	199	208
	98	132	132	166	166	183	201
10	115	123	145	155	177	196	211
	105	113	140	142	169	196	210
	96	128	134	164	167	184	198
	110	117	142	154	177	198	211
	103	112	132	145	177	191	208
15	96	130	149	162	167	186	203
	112	120	144	159	177	198	210
	101	113	132	144	177	199	208
	95	130	149	161	167	184	203
	110	120	144	162	176	198	211
20	105	113	127	152	174	199	208
	100	127	152	164	166	184	199
	108	113	144	162	176	199	208
	103	128	135	147	174	188	204
	100	123	149	161	167	181	199
25	108	127	145	161	176	183	210
Average	106	121	142	156	174	193	207

Torque was measured electronically utilizing strain gages affixed to a simulated valve stem and calibrated to cover the range of 0 to 2400 in. lbs. Increasing the numbers of 0.010 washer results in a generally linear increase in torque from 106 in. lbs. to 207 in. lbs. for a case using the 0.047-in Bellville springs.

Turning to Table II, estimated torques are given for the invention wherein three Bellville springs are used in combination with various numbers of washers. Using three types of Bellville springs (Type I =0.047-inch, Type II=0.087-inch, Type III=0.112-inch) and the indicated number of washers, maximum operating torques of from 33–2100 in. lbs. are achievable.

TABLE II

Torques achievable with this device, inch-pounds	Three Bellville Springs, Type	0.010 Washers, Quantity
33	I	0
61	I	1
89	I	2
100	II	0
116	I	3
144	I	4
172	I	5
200	I	6
300	II	1
350	III	0
500	II	2
700	III	1
700	II	3
900	II	4
1050	III	2
1100	II	5
1400	III	3
1750	III	4
2100	III	5

On the basis of this data it is now possible to utilize a common set of hardware to accommodate a plurality of commercial valves having a wide range of allowable operating torques. Thus, by varying spacer thickness and/or number; varying Bellville spring thickness and/or number; or by varying the Bellville spring arrangement, all within a constant space, a predetermined and precise torque can be supplied for any given application.

The foregoing description of a preferred embodiment of the invention has been presented for purposes of illustration and description and is not intended to be exhaustive or to limit the invention to the precise form disclosed. It was chosen and described in order to best explain the principles of the invention and their practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. For example, further variations in torque resistance or resilience may be obtained by varying the angle of the incline of the channels and ridges by which the two main members are engaged. One skilled in the art will also recognize that it is now possible to utilize a common set of hardware to accommodate a plurality of commercial valves having a wide range of allowable operating torques. It will also be recognized that a variation in torque limit can be achieved without the use of different numbers of spacer washers by simply advancing or withdrawing nut **42** along the threaded end of stem **14** to effect a greater or lesser compression of the Bellville springs **38**. Calibrating marks could be provided on stem **14** to indicate the axial position of nut **42** and the torque limit associated with that position. It is intended that the scope of the invention be defined by the claims appended hereto.

We claim:

1. In a manually operated valve assembly including a rotatable valve stem for opening and closing the valve assembly, the improvement comprising a torque-limiting handwheel for preventing damage to said valve assembly caused by the excessive application of torque to said stem, said handwheel comprising:

a first plate fixably attached to said stem and rotatable therewith, said first plate having a generally planar

surface disposed orthagonal to the longitudinal axis of said stem and defining at least one radially extending groove;

a second plate rotatably attached to said stem having a generally planar surface disposed orthagonal to the longitudinal axis of said stem and defining at least one radially extending ridge shaped to mate with said groove in said first plate, said planer surfaces in said first and second plates being disposed in a continuous manner with said ridge and channels in said respective plates being engaged when said valve is operating within defined torque limits;

means for manually imparting torque to said second plate to rotate said second plate during valve operation;

means urging said first and second plates together to maintain said ridge and grove in mating relationships during normal valve operation.

2. The improvement of claim **1** wherein there are three radially extending grooves spaced 120° apart in said first plate and three radially extending ridges spaced 120° apart in said second plate.

3. The improvement of claim **1** wherein said means for urging said first and second plate together comprises at least one Bellville spring disposed on said stem and means compressively securing and spring against said second plate to force said second plate against said first plate.

4. The improvement of claim **3** further including at least one spacer washer mounted on said shaft to maintain a selected level of compression of said Bellville spring.

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