SAFETY

Safety - consult Blakeborough publication 'Safety' before starting any maintenance work.

The valve and actuator should be handled and installed with care. Consult publication 'Good Installation Practices' for details.

Before any maintenance work it is essential to ensure that the actuator is isolated and depressurised.

GENERAL

In the 'normal' position (with the handwheel in neutral and no air pressure on the diaphragm) the stem of the reverse acting actuator is held in an extended position by means of the spring. An increase in air pressure in the lower diaphragm chamber thrusts the actuator stem upwards and compresses the spring; decreasing the air pressure allows the spring to return the stem and diaphragm assembly back to its normal position.

- When mounted on pull-stem-to-open valves, the reverse acting diaphragm actuator opens the valve upon increasing the air pressure in the lower diaphragm chamber.

- When mounted on push-stem-to-open valves, the reverse acting diaphragm actuator closes the valve upon increasing the air pressure in the lower diaphragm chamber.

Raised metal pads on the yoke casting are provided for the mounting of accessories. All accessories should be removed before dismantling the actuator. Remove the actuator from the valve bonnet assembly as outlined in the instructions covering the valve in use.

The side mounted handwheel provides means for limiting actuator stem travel, thereby preventing either full valve opening or full valve closure during automatic operation. In order to limit the actuator stem extension turn the handwheel counterclockwise when the stem is at its highest position of travel. In order to limit the actuator stem retraction turn the handwheel clockwise when the stem is at its lowest position of travel. The valve can be manually positioned by means of the handwheel when instrument control is cut off either by air failure or intentional shut down.

ACTUATOR DISASSEMBLY

WARNING

Do not remove the diaphragm case screw nuts until the spring compression has been relieved.

To remove the diaphragm:

1. Set the handwheel to neutral position.

2. Remove the cover plate (16) from the spring barrel assembly (21) by removing four screws (13).

3. Remove spring compression by inserting a rod or screwdriver into the holes in the spring adjuster (11) and turn anti-clockwise.

4. Remove the diaphragm case screws and nuts (9 and 10), then lift off the upper diaphragm case (1).

5. Remove the actuator stem nut (17), diaphragm plate (8), diaphragm plate stop (8A) and the diaphragm (15).

6. Lift the lower diaphragm button (18) off the actuator stem (20).

Spring barrel and actuator stem removal:

1. Lift the travel stop (30) over the actuator stem (20).

2. Remove the cover plate (63), then, working through the hole in the spring barrel, unscrew the clamp nut (41) from the bearing retainer (42).

3. Loosen the lower travel stop nut set screw (19) and unscrew the travel stop nut (3) from the actuator stem (20). Note: do not lose the small disc (62) which bears against the stem threads when the set screw is tightened.

4. Raise the spring barrel case assembly (21) off the yoke (31) and unscrew the lower bridge (24) out of the bottom of the barrel. Holes are provided for the use of a spanner pin wrench to remove the lower bridge.

5. With the lower bridge unscrewed from the barrel, loosen the upper travel stop nut set

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screws (19) and unscrew the travel stop nut (3) from the actuator stem (20).

6. Unscrew the spring adjuster (11) down the actuator stem, remove the needle bearings (33) and spring button (5) from the actuator stem.

7. Remove the spring (29) from the spring barrel assembly (21).

Disassembly of the jacking screw:

1. Using the handwheel turn the jackscrew (36) downward as far as it will go.

2. When the end of the jackscrew passes beyond the key (43) the jackscrew itself will rotate with the worm wheel (46). Complete the removal by turning the jackscrew out of the worm wheel by hand.

3. Remove the handwheel travel indicator screw and the indicator (49 and 61) from the jackscrew. This step is only necessary if the jackscrew or indicator is to be replaced.

4. Remove the bearing retainer screw and lockwasher (44 and 45) then unscrew and remove and remove the bearing retainer (42) from the yoke (31).

5. Remove the retaining ring (65) and jackscrew key (43) from the bearing retainer (42).

6. Lift the needle bearing (47) with the two bearing races (48) (one race above and one below the needles) from the top of the worm wheel (46).

7. Unscrew the handwheel stem nut (55) from the gearbox. Rotate the handwheel slowly to disengauge the worm (52) from the worm wheel (46). Withdraw the handwheel stem assembly (56) (with worm and outer thrust bearing (54) attached) from the gearbox as a unit. If the inner thrust bearing and races (53 and 54) do not come out with the stem, remove them from the housing.

8. Remove the worm wheel (46) and the lower thrust bearing with races (47 and 48) from the housing.

Handwheel stem disassembly:

To save time in reassembling, do not disassemble this unit unless it is necessary to repair or replace parts. If disassembly is necessary proceed as outlined below:

1. Slide the worm (52) and the inner thrust bearing with its races, off the handwheel stem and remove the woodruff key (57).

2. Slide the handwheel stem nut (55) and the outer thrust bearing races (53 and 54) off the stem.

3. Remove the handwheel nut (60) and washer (59) then remove the handwheel (58) and the second woodruff key (57).

ASSEMBLY

Assembling the handwheel stem unit:

1. Place the handwheel woodruff key (57) on the stem (56) then slip the handwheel (58) and indicator plate (58A) onto the stem and key. Secure the handwheel with lockwasher and nut (59 and 60).

2. Slide the handwheel stem nut (55) (flange end first) onto the stem (56).

3. Make up a bearing unit (thrust bearing) (54) between two races (53) and slip the unit onto the stem against the handwheel stem nut.

4. Position the second woodruff key (57) on the stem then slide the worm (52) onto the stem and key.

5. Make up another thrust bearing unit as in step 3 above, then slip this unit onto the stem against the end of the worm.

6. The handwheel stem unit is now ready for insertion into the bearing housing as directed below.

Assembling the jacking screw mechanism:

1. Clean the gear box and all parts thoroughly.

2. Make up a bearing unit, consisting of a bearing (47) between two races (48), and place it on the shoulder at the bottom of the gear box.
3. Place the worm wheel (46) in the housing so that it rests on the bearing race.

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4. Insert the handwheel stem (56) assembly into the gearbox. Rotate the handwheel to mesh the worm and worm wheel.

5. Screw in the handwheel stem nut (55) to secure the stem assembly.

6. Make up another thrust bearing unit (see step 2) and place the unit on top of the worm gear.

7. Screw the bearing retainer (42) into the top of the gearbox. With the holes in the housing and retainer aligned install the bearing retainer screw and lockwasher (44 and 45).

8. Turn the jack screw (36) (by hand) into the gear box until the upper end of the screw is 6mm above the top race of the upper thrust bearing.

9. Rotate the jackscrew to line up the keyway with the internal slot in the bearing retainer (42) then insert the key (43) and lock it in place with the retaining ring (65).

10. If the handwheel travel indicator (61) was removed, replace it on the lower end of the jackscrew.

11. Dimension 'Y' listed below is provided for setting the jack screw (handwheel) in neutral position. The bonnet mount hole size in the bottom of the yoke for the actuator being serviced determines the measurement used.

    a. Place a straightedge across the lower machined surface of the borehole inside the bottom of the yoke (31).

    b. Position the jackscrew (36) (by handwheel) so that a vertical measurement taken from the contacting surface of the straightedge to the end of the jackscrew, is in accordance with dimension 'Y'.

Yoke mtg dia	Travel	'Y'
71	38	242
90		248
	57	248
127		334
90	89	320
127		380

    c. If necessary, loosen the handwheel travel indicator scale holding screws, then adjust the scale (37) so that the centre mark (neutral) is in line with the indicator (61).

12. To facilitate installation of the spring barrel case assembly, lower the jackscrew (by handwheel) until the upper end of the screw is approximately level with the top of the bearing retainer.

Assembly of the diaphragm (when actuator has been fully disassembled):

1. Examine the diaphragm (15) checking for signs of wear or porosity. Replace if necessary.

2. Slide the diaphragm button (18), rounded edge upwards, over the actuator stem (20) to rest on the chamfered area of the stem.

3. Dust the diaphragm (15) with talcum powder to prevent abrasion; place the diaphragm over the actuator stem to rest on the diaphragm button (18) with the concave side uppermost on the button.

4. Place the diaphragm plate (8) over the actuator stem (20), then lock the assembly together with the actuator stem nut (17).

5. Coat 'O' rings (22 and 23) lightly with silicone grease and install them (two internal and one external) in the packing box (2) grooves. Slip the packing box onto the shoulder of the spring barrel upper bridge. Install and tighten the packing box washer (28) and packing box screws (14).

6. Slip the upper travel stop (30) over the stem to rest on the packing box.

7. Lower the actuator stem assembly through the packing box (2) into the spring barrel assembly (21) (care should be taken when lowering the actuator stem threads through the packing box 'O' rings) (22).

8. Lower the spring (29) into the spring barrel assembly (21), screw the spring adjuster assembly onto the stem. These parts are spring adjuster (11), bearings (33 and 38) and spring button (5). Ensure that the smaller raised face surface on the spring seat (5) contacts with the spring.

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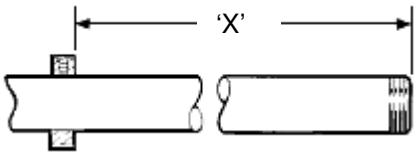
9. Screw the spring adjuster (11) upwards until resistance indicates that the spring (29) is just starting to compress.

Positioning the upper travel stop:

1. Screw the upper travel stop (3) up the actuator stem (20). The upper travel stop must be positioned on the actuator according to dimension 'X' shown below. Determine the bonnet mount hole by measuring the actuator, then refer to the nameplate for the actuator stroke and determine dimension 'X' to be used.



Positioning of Upper Travel Stop on Stem

Yoke mtg dia	Travel	'X'	'B' (see drg)
71	38	327	127
90		295	165
	57	314	146
127		322	223
90	89	449	167
127		450	223

2. After the position of the upper travel stop has been determined on the actuator stem unscrew the stop and apply 'Loctite 241' to the actuator threads where the upper travel will be finally positioned.

3. Finally position the upper travel stop on the actuator stem to dimension 'X'.

4. Install the setscrew discs (62) into the set screw holes in the travel stop nut (3), then install and tighten the set screws (19) to secure the stop nut at its correct setting.

5. Slip the lower bridge (24) (counterbored face up) over the bearing retainer (42), then place the lower bridge clamp nut (41) in position on top of the bearing retainer threads.

Note: Do not screw the nut down on the threads as the nut and lower bridge both must be raised in order to install the lower bridge in the spring barrel.

Spring barrel assembly:

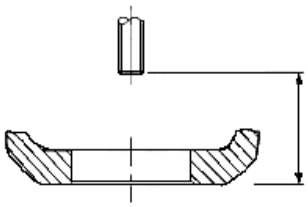
1. Lower the spring barrel (21) onto the lower bridge (24). Raise the lower bridge and clamp nut (24 and 41) and screw the bridge into the bottom of the spring barrel until the upper edge of the bridge is just below the bottom edge of the access hole at the bottom of the spring barrel.

2. Holes are provided in the underside of the lower bridge for insertion of a spanner pin wrench.

3. Lower the spring barrel case assembly (21) into place on the yoke (31) shoulder, then rotate the barrel so that the dust cover slot is in vertical alignment with the bearing retainer screw (44).

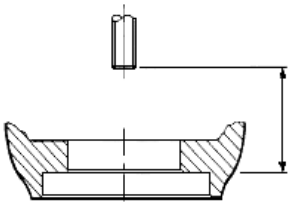
4. Screw the clamp nut (41) onto the bearing retainer (42) (working through the access hole in the barrel) and tighten it securely.

5. Put the diaphragm case assembly (1) in place and insert a case screw to maintain alignment. Insert all case screws and nuts (9 & 10), tighten then by hand, and then carefully tighten diametrically opposed case screws to ensure a tight diaphragm seal. Check dimension 'B' is in accordance with the dimension shown in the table opposite.



Dimension 'B' Actuator Stem Up 71mm & 90mm Yoke Mounting

Positioning the lower travel stop:



Dimension 'B' Actuator Stem Up 127mm Yoke Mounting

1. With the handwheel at neutral and the spring (29) slightly compressed proceed as follows:

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a. Determine the valve travel from the nameplate, add 1.5mm and call this dimension 'D'.

b. Screw the travel stop nut (3) onto the actuator stem (20) and position the nut so that its top surface is below the end of the jackscrew (36) by a distance equal to 'D'. Tighten the travel stop nut set screws (19) securely.

Completing Assembly (refer to items 1 to 4 only if the diaphragm alone is to be replaced):

1. Examine the diaphragm (15) checking for signs of wear or porosity. Replace if necessary.

2. Slide the diaphragm button (18), rounded edge upwards, over the actuator stem (20) to rest on the chamfered area of the stem.

3. Dust the diaphragm (15) with talcum powder to prevent abrasion; place the diaphragm over the actuator stem to rest on the diaphragm button (18) with the concave side uppermost on the button.

4. Place the diaphragm plate (8) over the actuator stem (20), then lock the assembly together with the actuator stem nut (17).

5. Line up the holes in the diaphragm with the holes in the lower diaphragm case. Note: to facilitate assembly, the spring adjuster (11) can be turned upward or downward (to reposition the spring) so that the diaphragm rests smoothly onto the case screw flange.

6. Place the upper diaphragm case assembly (1) over the diaphragm, aligning the case screw holes with those in the diaphragm case.

7. Insert the diaphragm case screws (9). Add nuts (10) and tighten up evenly and secure to obtain a good seal.

ADJUSTMENTS

1. To set the diaphragm pressure range, the spring is compressed just enough to counterbalance the upward thrust of the diaphragm when air pressure in the lower chamber is at the preload pressure. Once the starting point has been established, the spring design ensures that the stem will be fully retracted when air pressure reaches the upper range value.

Note: The handwheel must be in NEUTRAL position while the adjustments are being carried out.

a. Connect an air gauge and a 0 to 4 bar (0 to 60 PSI) regulator to an air line leading to the chamber above the diaphragm.

b. Turn the spring adjuster (11) upward until there is a positive indication of spring compression.

c. Determine the lower value of the diaphragm pressure range from the nameplate.

d. Gradually increase the air pressure to the lower diaphragm chamber and determine at what pressure the stem starts to move upwards.

e. Adjust the spring compression by moving the spring adjuster (11) and again increase the air pressure gradually. Repeat this testing and adjusting procedure until the actuator stem just starts to move as the increasing air pressure passes the lower value of the pressure range. The diaphragm pressure range has now been established.

f. Replace the dust cover (16)

Note: Spring design limits the amount of possible 'jackup' compression. Too much initial compression leaves insufficient spring deflection for full actuator stroke.

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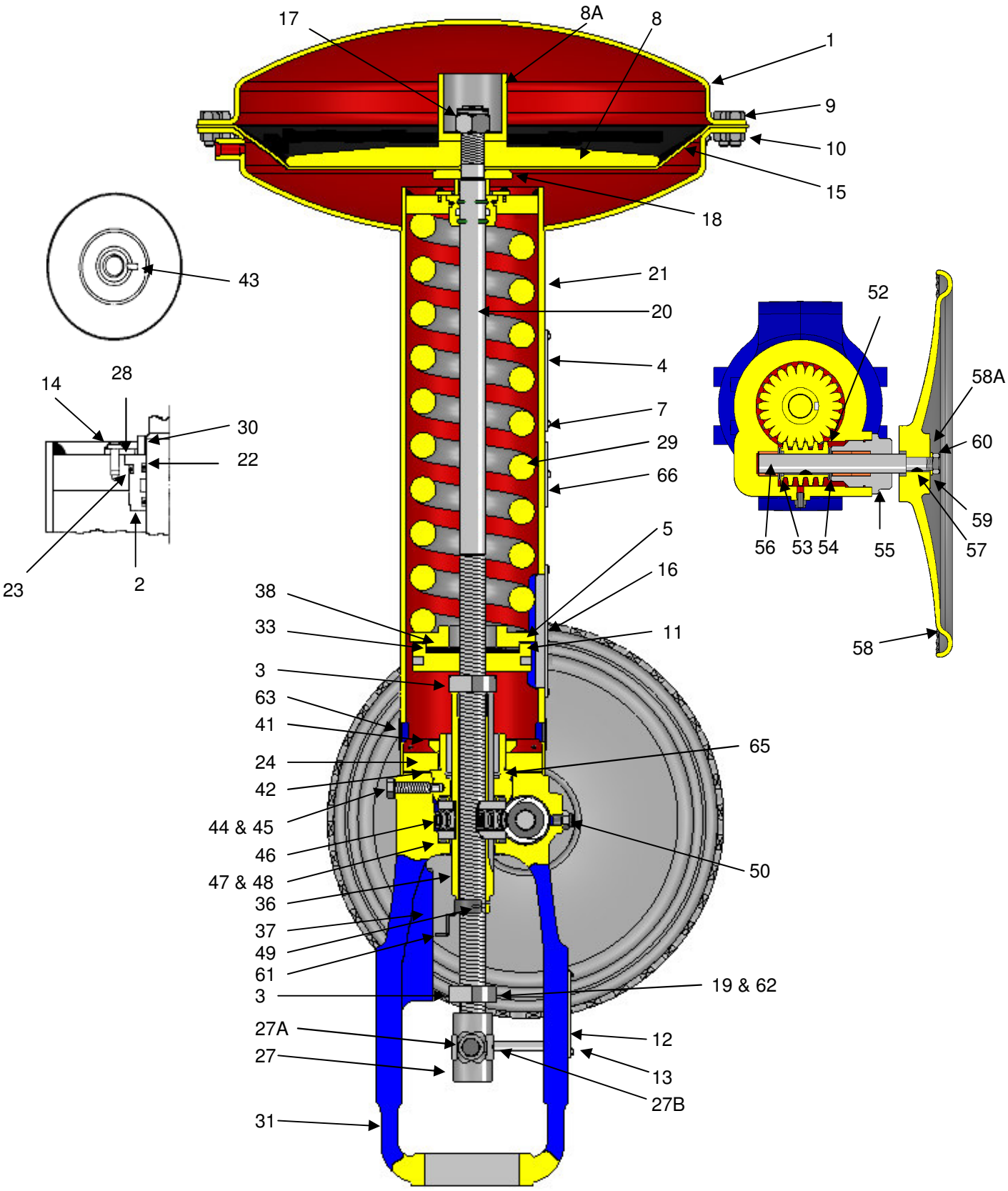

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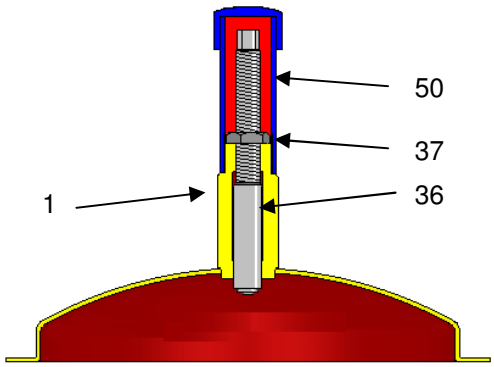
ACTUATOR PARTS LIST	
1	Upper diaphragm case assembly
2	Packing box
3	Travel stop nuts
4	Nameplate
5	Spring button
7	Nameplate screws
8	Diaphragm plate
8A	Diaphragm plate stop
9	Case screws
10	Case screw nuts
11	Spring adjuster
12	Travel indicator scale
13	Fixing screws
14	Packing box screws
15*	Diaphragm
16	Dust cover assembly
17	Actuator stem nut
18	Diaphragm button
19	Travel stop nut set screw
20	Actuator stem
21	Spring barrel case assembly
22*	Packing box 'O' rings
23*	Packing box 'O' rings
24	Lower bridge
27	Stem connector
27A	Stem connector screw
27B	Stem connector screw nut
28	Packing box retainer
29	Spring
30	Upper travel stop collar
31	Yoke
33	Thrust bearing
36	Jack screw
37	Handwheel travel scale
38	Thrust washers
41	Clamp nut
42	Bearing retainer
43	Key (jacking screw)
44	Bearing retainer screw
45	Bearing retainer lock washer
46	Worm wheel
47	Bearing (worm gear)
48	Thrust race (worm gear)
49	Travel indicator screw
50	Lubricator
52	Worm
53	Thrust race
54	Thrust bearing
55	Handwheel stem nut assy
56	Handwheel stem
57	Keys (handwheel stem)
58	Handwheel
58A	Indicator plate
59	Handwheel lock washers
60	Handwheel nut
61	Handwheel travel indicator
62	Set screw disc
63	Cover plate
65	Retaining ring
66	Valve nameplate
*	Recommended spare parts

TYPE A41J TOP MOUNTED LIMIT STOP

The A41J limitstop assembly when added to the upper diaphragm case is used to limit the travel of the valve plug in the upwards direction.



Disassembly

It is very important to remove the spring compression before preceeding with dismantling. Refer to disassembly instructions above. With the diaphragm case at atmospheric pressure:

1. Unscrew the plastic cover (50) from the diaphragm case assembly (1).

2. Unscrew and remove the locknut (37) from the handwheel stem (36).

3. Remove all the diaphragm case screws and nuts (9 and 10) and lift the upper diaphragm case (1) away from the actuator.

4. The handjack stem (36) can now be unscrewed from the handjack body.

Assembly

1. Screw the stem (36) into the handjack body.

2. Place the upper diaphragm case assembly (1) over the diaphragm, aligning the case holes with those in the diaphragm.

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3. Insert the diaphragm case screws (9 and 10) and tighten evenly.

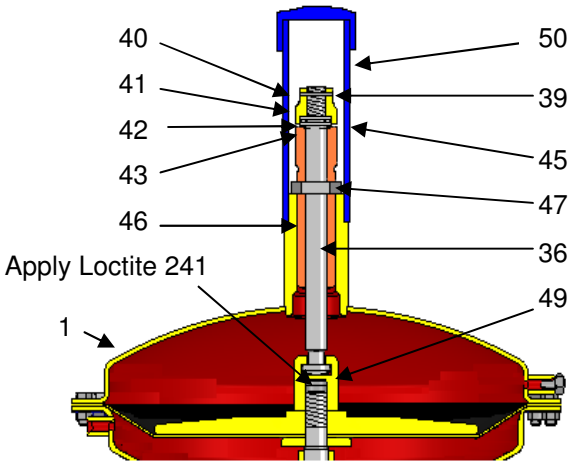
4. Screw locknut (37) onto the stem (36).

5. Refit the plastic cover (50).

PARTS LIST A41J HANDJACKS	
1	Diaphragm Case Assembly
36	Stem
37	Locknut
50	Limit Stop Cover

TYPE A41K TOP MOUNTED LIMITSTOP

The A41K limitstop assembly when added to the upper diaphragm case is used to limit the travel of the valve plug in the downward direction.



Disassembly

With the diaphragm case at atmospheric pressure proceed as follows:

1. Unscrew the plastic cover (50) from the diaphragm case assembly (1).

2. Drive the stem nut pin (39) out of the stem nut (40) and unscrew the stem nut from the handwheel stem (36).

3. Lift the two thrust bearings (41 and 42) from the jack screw (46).

4. Loosen the locknut (47) and revolve the stem in a clockwise direction until the retaining ring (43) is accessible. Remove the retaining ring.

5. Remove all the diaphragm case screws and nuts (9 and 10) and lift the upper diaphragm case (1) clear of the handwheel stem (36).

6. Disengauge and remove the handwheel stem (36) from the nut (49).

Assembly

1. Insert the stem (36) through the handjack body and engauge onto stem nut (49).

2. Place the upper diaphragm case assembly (1) over the diaphragm, aligning the case holes with those in the diaphragm.

3. Insert the diaphragm case screws (9 and 10) and tighten evenly.

4. Fit the retaining ring (43) onto the handjack stem (36). Replace the thrust bearings and washers (41 and 42).

5. The stem nut (40) is secured to the actuator stem with Loctite 241. Screw the stem nut (40) onto the stem (36) and replace the stem nut pin (39).

6. Refit the plastic cover (50).

PARTS LIST A41K HANDJACKS	
1	Diaphragm case
36	Stem
39	Stem nut pin
40	Stem nut
41	Thrust washer
42	Thrust bearing
43	Circlip
46	Jacking screw
47	Lock nut
49	Nut
50	Limit stop cover

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