

INTERNAL MULTI-SPEED HUBS

SHIMANO INTER•7 SPEED

How It Works

The Shimano 7-speed hub is of very different design and construction from other internal hub gears, as is clear just from looking at the gear ratios. There is no unity ratio!

This results from the Shimano hub's unusual scheme for shifting gears: a rotating sleeve (cam) on the axle which, by its angle changes relative to the axle, opens up or blocks a number of different ratchets and pawls. This hub has four sun gears, in two compound planetary gear systems.

In all but the top two gears, drive from the sprocket is into the gear ring of the right-side planetary system. If the rightmost sun gear of this planetary system is stationary, the hub is in first gear. If the next sun gear to the left is held stationary, the hub is in second gear. The right-side planetary gear system can only gear down or transfer power at unity ratio, since drive can be input either at its planet cage or gear ring, and can not be output at its gear ring.

Gearing up is accomplished by a second planetary gear set at the left side of the hub. This is driven by the planet cage of the right side gear set. For 6th and 7th gear, a set of pawls is engaged to drive the right side planet cage directly at unity ratio, while the right side gear ring freewheels forward. The right side planet cage drives the left side planet cage, and depending on whether the right or left sun gear of the left planet cage is engaged, the hub is in 6th or 7th gear.

The most unusual feature of the hub is that its three middle gears use both planetary gear systems, gearing down at the right side of the hub and back up at the left side. The multiplication of ratios is comparable to that of a derailleur gearing system which uses different ratios at chainwheels and sprockets to reach the desired final drive ratio. 3rd gear of the Shimano hub is 1st x 6th; 4th is 2nd x 6th; and 5th is 2nd x 7th. You might ask why, if the right planetary system can transfer power at unity ratio, the middle gear is not unity ratio. The answer: this must have something to do with the hidden complexities of the shifting mechanism, since in theory, drive could be directly from the right to the left planet cage. Another possible explanation is that direct drive in 4th gear would reveal too clearly the hub's inefficiency in 3rd and 5th.

The 3rd and 5th gears must be achieved by using both planetary systems, since each planetary system has only two sets of pinions. The third and fifth gears, like the fourth, are achieved by multiplying one of the two ratios at the right side of the hub by another at the left side.

ALIGNMENT

This hub has an overlocknut spacing of 130mm, a rear chainline of 48mm. The spoking flange diameter is 87mm. The hub is available with 36 holes.

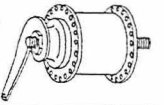
Advantages of this system are:

1. A very evenly-spaced range of gears, made possible by the flexibility in choosing the ratios of the two planetary systems;
2. The neat, compact shift linkage, which uses a single, conventional cable, does not require a hollow axle, is easily detached and reattached, and fits entirely inboard of the right forkend where it is relatively safe from damage.

EDITORIAL COMMENT.

SUTHERLAND'S

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SHIMANO INTER•7 SPEED (CONT'D)

Advantages of this system are: (cont'd)

3. Direct drive through the two planet cages to the brake clutch, giving constant brake leverage in all gears. This would not be possible if the left planet cage could gear down (i.e. with drive from the ring gear through the planet gears to the planet cage.)

Disadvantages are:

1. Efficiency reduction. Other planetary hubs are most efficient in the middle gear, which is unity ratio and does not use the gear train; efficiency is somewhat lower in the other gears, in which power passes through one planetary system. This hub, as already mentioned, passes power through two planetary systems in 3rd, 4th and 5th gears, and efficiency is bound to suffer.
2. Narrow gear teeth due to the number of gears which must be accommodated. Teeth of some of the planet pinions are only about 4 mm wide. Some pawls also are narrow. This raises questions about the durability of the hub.
3. Complexity of construction. This hub has nine different sets of pawls!

A mitigating factor for the complexity is that the hub comes apart into relatively few subassemblies, not to be disassembled further, as they are available only in assembled form as replacement parts. Both planet cage assemblies have an integral sun gear, so timing the gears is not necessary when reassembling the hub. While this is the most complicated internally-geared hub, ~~it is~~ ~~never~~ it is also one of the easiest to service if you are careful. But if you lose or damage one tiny pawl, you do have to replace an entire subassembly!

TESTING SHIFTER OPERATION

The cable may be replaced without removing the wheel from the bicycle.

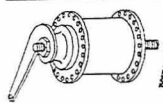
Removing the Inner Cable

To remove the inner cable, set shift lever to first gear position. Loosen setscrew of cassette joint. Push the cable through the housing from the hub end, and withdraw it from the shift lever.

Replacing the Inner Cable

Use index-shifter certified cable and housing. The inner cable has a conventional cylindrical ferrule at the shift lever end, and you may replace it with a derailleur cable that has a similar ferrule.

Set the shift lever to first gear position. Pass the inner cable through the hole of the lever. Lubricate it and pass it through the housing, then the adjuster barrel of the cassette joint. Tighten the setscrew with a 2.5 mm Allen key while pulling lightly on the inner cable. Cut off excess cable and cap or solder the end. Bend the end of the cable slightly toward the outside, so it can not drag on the sprocket. Check cable adjustment, as follows:



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Cable Adjustment

Set shift lever to 4th gear position. Check that red marks on cassette joint line up. If not, turn adjusting barrel at hub end of cable. Move shift lever to first gear and back to 4th, and recheck. If there is not sufficient adjustment range, loosen setscrew to reposition cable.

REMOVAL OF WHEEL FROM FRAME

Remove cable end assembly from hub only after removing wheel from frame. You may, however, replace the cable itself without removing the wheel: see "Replacing and Adjusting Cable," below.

Loosen axle nuts. Slip wheel from dropout slots, taking care not to kink the shift cable. Turn tab of cassette joint fixing ring 45 degrees counterclockwise. Cassette joint and fixing ring may now be lifted over axle nut and tab washer, and you may remove the drive chain past the right end of the axle.

ASSEMBLY OF WHEEL TO FRAME

Install sprocket and clip ring to hub driver.

Install shift cable assembly to hub as follows, before installing wheel in frame.

If the drive chain has not been disconnected, place it over the sprocket now. Set shift lever to 1. Make sure cable housing is seated in ferrules at both ends. Rotate pulley at hub end of cable clockwise with yellow marks facing upwards until they line up. Then align them over yellow marks at right end of hub. Position cassette joint fixing ring also with yellow marks aligned, press it down and rotate it 45 degrees clockwise to lock.

Check operation of shift lever. If there is a yellow pin in cassette joint which prevents shift pulley from turning, remove the pin.

Check that red marks on cassette joint line up with shift lever in 4th gear position. If not, see "Replacing and Adjusting Cable," below.

Position the shift cable on the frame and insert the hub into the rear fork.

Align the cassette joint nearly parallel to the chainstay and install the non-turn washer on the right end of the hub axle, with the tab projecting into the forkend slot, facing toward the ~~outer~~ end of the slot. The flats of the axle and of the non-turn washer are not parallel to the forkend slot. Black non-turn washer is for forward-facing slot and gold washer is for rear-facing (track-type) slot. Install a serrated washer without tab on the left end of the axle.

Install axle nuts, adjust chain slack and secure nuts. Secure the brake arm to the frame with the brake arm clip. Multi-hole strap must be cinched tightly around chainstay, not looped loosely over it.

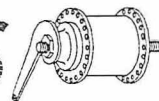
Adjust position of cable on frame, and secure it with cable bands.

Needs an illustration

✓ See Shimano instruction

open

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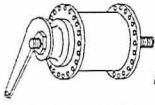
Troubleshooting Chart – Shimano Inter-7 Speed

SYMPTOMS

Resulting from wear, improper lubrication or abuse

Resulting from improper assembly or installation

1. Brake grabs or squeals.	Incorrect or insufficient internal lubrication.	Brake arm loose at frame.
2. Stiff running, noisy.	Brake arm forcing brake cone out of line. One pawl of a pair faulty. Dropouts not parallel. Chain too tight. Cones too tight. Bent dustcap. Broken or chipped gear teeth. Ball retainer damaged or broken.	Ball retainer (17) (left side) installed upside down. Friction spring of gear ring (5) reversed. One pawl of a pair improperly installed. E-clip missing.
3. Carrier (4) covers or partly covers E-clip groove of axle.		Ball retainer H (right side) installed flat side down. Friction spring of ring gear unit 1 improperly seated. Sun gear 2 and 3 assembly inverted. Gears or pawls not properly seated.
4. Hub jams in one or more gears.	Axle bent. Pawls inside sun gear (4, 6a, 6b) or in driver jammed. Broken or displaced parts inside hub.	
5. Hub will not shift to all gears (cable slack in lower gear; or lever will not move to higher gear).	Axle sleeve bent, worn or chipped. Helical springs inside driver weak or damaged.	Cable too tight or loose. Cassette joint assembly incorrectly installed.
6. Jumps to next higher or lower gear.	Cable frayed, kinked or unlubricated.	
7. Slips in 1st and 2nd.	External pawls of planet carrier (4) do not engage.	
8. Slips in 1st and 3rd.	Axle pawls engaging sun gear (6b) (tiny pawls!) do not engage.	
9. Slips, and brake release is erratic, in 1st through 5th.	Driver pawls that should engage gear ring (8) retracted or damaged	Forced assembly has displaced axle pawls engaging sun gear 1. They should point counterclockwise, looking from left end of axle.
10. 1st instead of 2nd; 3rd instead of 4th.	Pawls of sun gear (6a) retracted or damaged. Narrower teeth of pinions in planet carrier (7) stripped.	
11. 1st instead of 3rd; 2nd instead of 4th and 5th; "3rd" (unity ratio) instead of 6th and 7th.	Sun gear (6a) stripped. Pawls of gear ring (6b) retracted or damaged.	



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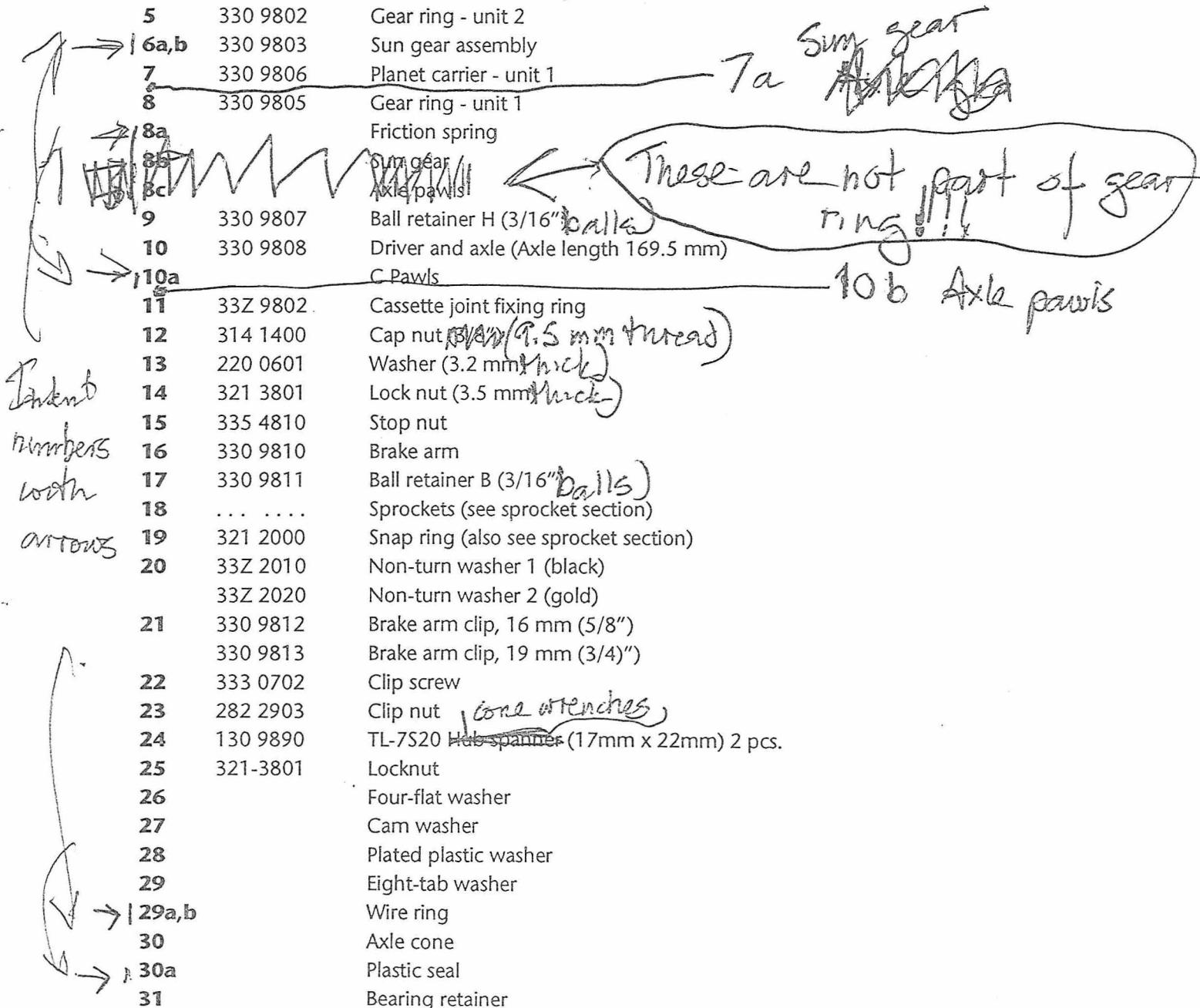
Troubleshooting Chart – Shimano Inter*7 Speed

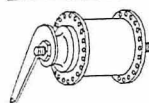
SYMPTOMS	Resulting from wear, improper lubrication or abuse	Resulting from improper assembly or installation
12. 4th instead of 5th; 6th instead of 7th.	Pawls of sun gear 3 retracted or damaged.	
13. 2nd instead of 6th; "4th" (1st x 7th) instead of 7th.	Forward-driving pawls of driver which should engage ratchet at right end of planet carrier (7) are damaged, or remain retracted in 6th and 7th.	
14. 1st instead of 3rd; 2nd instead of 4th; "4th" (unity ratio) instead of 6th.	<div>Pawls of sun gear 4 (in planet carrier assembly 4) retracted or damaged.</div> <div>Sun gear (4a) (in planet carrier assembly 4) stripped.</div> <div>Narrower teeth of pinions in planet carrier (4) stripped.</div>	
15. Hub occasionally jumps forward when power is applied in 3rd through 7th.	Pawl retractor sleeve of gear ring (5) damaged.	Pawl retractor sleeve of gear ring (5) missing.
16. Excessive pedal travel before brake engages.	<div>Brake shoe or hub shell glazed or worn.</div> <div>Wrong lubricant.</div> <div>Friction spring of gear ring (8) weak.</div>	Friction spring of gear ring (8) absent.
17. No brake	<div>Rollers of roller clutch of planet carrier (4) do not turn freely.</div> <div>Friction spring of planet carrier (4) weak.</div>	Friction spring of planet carrier (4) absent.
18. Brake does not release or releases erratically in 3rd through 7th.		Reverse (clockwise, seen from left end of axle) pawls of driver damaged or retracted.

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PARTS LIST FOR SHIMANO INTER•7-SPEED WITH COASTER BRAKE SG-7C21

1	33Z 9801	Internal Assembly (Axle length 169.5 mm)
2	330 9801	Brake shoe <i>Circle P</i>
3	325 3200	Stop ring (9 mm diameter)
4	330 9804	Planet carrier assembly - unit 2
5	330 9802	Gear ring - unit 2
6a,b	330 9803	Sun gear assembly
7	330 9806	Planet carrier - unit 1
8	330 9805	Gear ring - unit 1
8a		Friction spring
8b		Sun gear
8c		Axle pawls
9	330 9807	Ball retainer H (3/16" <i>balls</i>)
10	330 9808	Driver and axle (Axle length 169.5 mm)
10a		C Pawls
11	33Z 9802	Cassette joint fixing ring
12	314 1400	Cap nut <i>over (9.5 mm thread)</i>
13	220 0601	Washer (3.2 mm <i>thick</i>)
14	321 3801	Lock nut (3.5 mm <i>thick</i>)
15	335 4810	Stop nut
16	330 9810	Brake arm
17	330 9811	Ball retainer B (3/16" <i>balls</i>)
18	...	Sprockets (see sprocket section)
19	321 2000	Snap ring (also see sprocket section)
20	33Z 2010	Non-turn washer 1 (black)
	33Z 2020	Non-turn washer 2 (gold)
21	330 9812	Brake arm clip, 16 mm (5/8")
	330 9813	Brake arm clip, 19 mm (3/4")
22	333 0702	Clip screw
23	282 2903	Clip nut <i>cone wrenches</i>
24	130 9890	TL-7S20 Hub spanner (17mm x 22mm) 2 pcs.
25	321-3801	Locknut
26		Four-flat washer
27		Cam washer
28		Plated plastic washer
29		Eight-tab washer
29a,b		Wire ring
30		Axle cone
30a		Plastic seal
31		Bearing retainer





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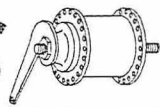
PARTS LIST FOR SHIMANO INTER•7-SPEED WITH COASTER BRAKE SG-7C21 (CONT'D)

RAPIDFIRE LEVER ST-7S20 FOR 7-SPEED

1	61W 9804	R.H. shift lever unit
2	61W 9801	Bracket fixing screw (M5 x 18) and nut
3	61W 9802	Lever fixing bolt (M5 x 13) and spring washer
4	61W 9803	Cable adjusting barrel unit
5	749 9804	Cassette joint unit for SG-7C21
	749 9803	Cassette joint unit for SG-7C20
6	749 9802	Cable adjusting barrel and spring for cassette joint
7	33Z 9802	Cassette joint fixing ring for SG-7C21
		[also #11 in parts list for hub, above]
	749 1200	Cassette joint fixing ring for SG-7C20
8	600 9851	Inner cable box (Stainless/100 pcs.)
9	60B 1385-1	SIS-SP outer casing (1380mm/black)
	60B 1485-1	SIS-SP outer casing (1480mm/black)
	60B 1565-1	SIS-SP outer casing (1560mm/black)
	60B 1705-1	SIS-SP outer casing (1700mm/black)
10	620 9803	Inner end cap (1.2 mm diameter/100 pcs.)

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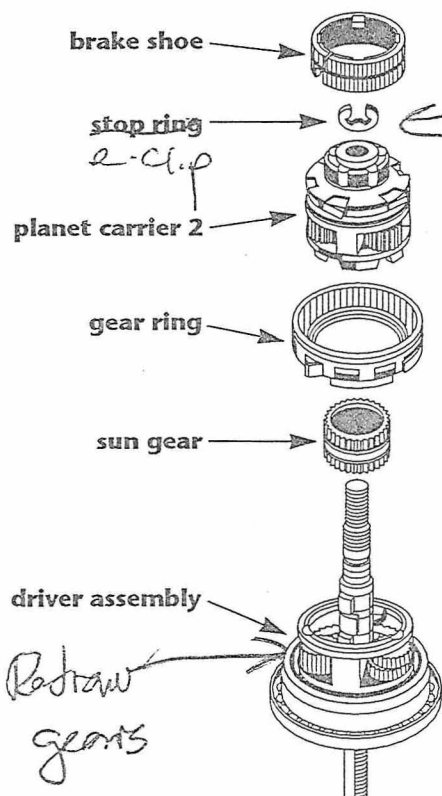
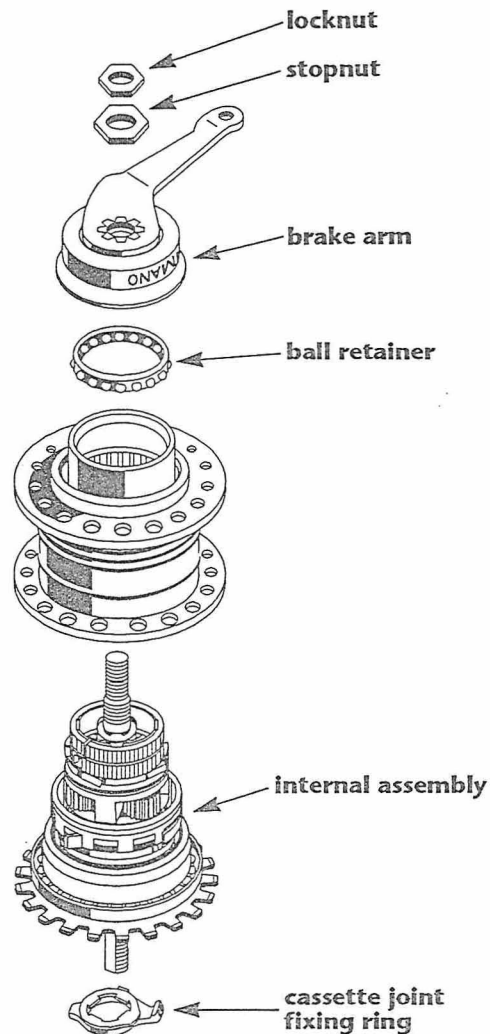
DISASSEMBLY INSTRUCTIONS FOR SHIMANO INTER•7 SPEED

1 DISASSEMBLY

Place the hub in axle vise, sprocket end down. You may leave the shifter mechanism and cable attached if you wish, for troubleshooting purposes: but in this case, put the shift lever into first gear position when installing or removing parts.

Using 22mm and 17mm cone wrenches (Shimano TL-7S20), loosen and remove lock nut and stop nut (15).

Remove brake arm unit (16) and ball retainer (17). Lift off the hub shell. If you are replacing the entire internal assembly, skip to Drawing 1, Assembly.

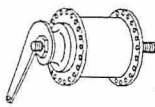


Perspective reversed

Redraw gears

2 DISASSEMBLY

Remove the brake shoe (2). Remove the E-clip (3), using a screwdriver. Remove gear ring (5) and carrier (4) at the same time while rotating gear ring (5) slightly to the left and right. Remove sun gear (6a and 6b) while turning them slightly to the left and right. Do not use excessive force, or you could damage the pawl springs inside them.



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SHIMANO INTER•7 SPEED (CONT'D)

3 DISASSEMBLY

Remove carrier (7). Remove gear ring (8) while turning it slightly to the left and right. Remove axle from vise and invert. Shake loose and remove ball retainer (9) while depressing pawls C of the driver and axle unit. Be careful not to bend ball retainer (9).

Shimano does not recommend the drive side of the hub be disassembled. The parts are not available.

AXLE DRIVER DISASSEMBLY

While Shimano does not give instructions to disassemble the axle from the driver, it is necessary to do this, to check, clean and relubricate the bearing between the driver and axle. The disassembly and reassembly pose no unusual problems if care is taken not to lose any of the parts — they can not be replaced individually! Be careful not only of the cone and other axle-end parts, but also of the small pawls just inboard of the driver.

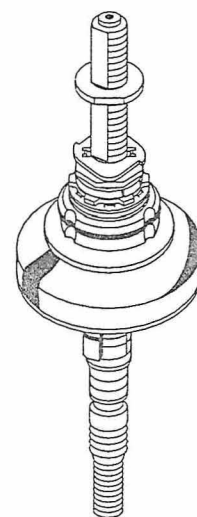
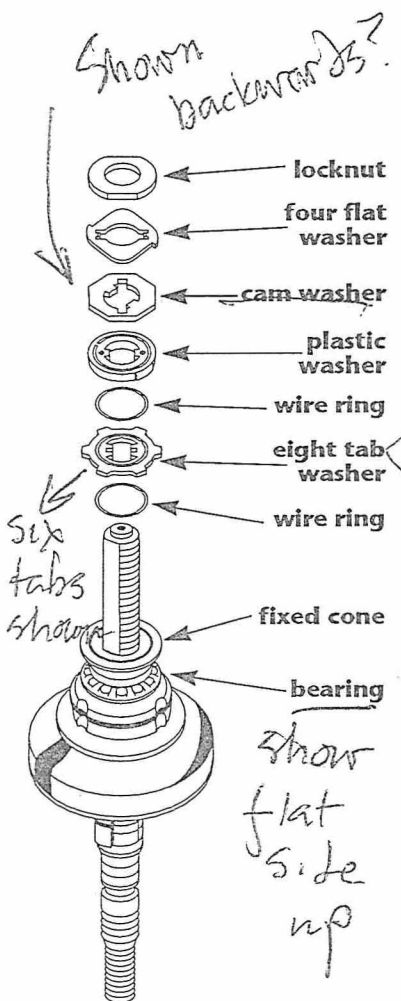
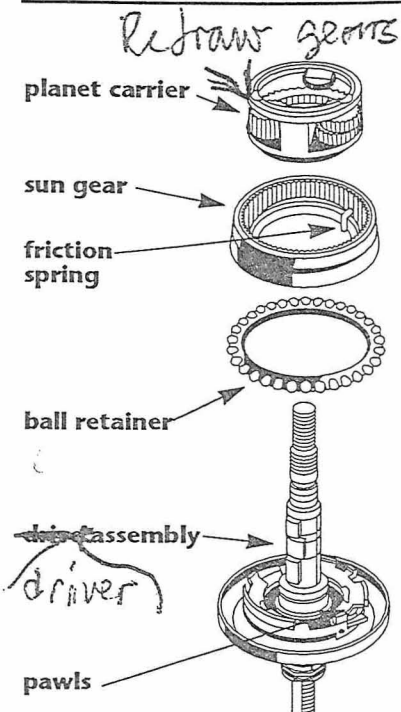
Insert the axle assembly in a vise with soft jaws just inboard of the left-end threads, driver end up.

Loosen the right-side locknut (25) with a 17mm wrench while holding the axle flats with a thick 8mm wrench or adjustable wrench. Do not use a wrench on any part under the locknut. All of these parts are tabbed rather than threaded, and you could damage the tabs.

Lift off tabbed four-flat notched washer (26). Remove cam washer (27) by lifting it off the axle. Carefully remove plated plastic washer (28) by lifting it off the axle without losing the small wire ring (29a) under it. Remove the small wire ring from the top of the eight-tab washer on the axle or from the underside of the plated plastic washer which you have just removed.

Lift eight-tab washer (29) off the axle. Be careful not to lose the small wire ring (29b) under it. Remove small wire ring from groove in top of fixed cone on the axle or from underside of eight-tab washer which you have just removed.

Remove fixed cone (30) by sliding or prying it upward off the notches of the axle. Remove flexible, plastic seal (30a) from groove of fixed cone. Remove bearing retainer (31). Remove the driver assembly from the axle assembly.



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SHIMANO INTER•7 SPEED (CONT'D)

Cleaning

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning. If you have not disassembled the axle from the driver, do not clean the driver end of the axle-driver assembly, as you will be unable to relubricate it properly and may introduce dirt which you can not remove.

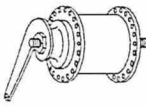
Points to Check

1. Pawls: 4 sets in driver/axle assembly (10); 2 sets in sun gear (6); 1 set in gear ring (5); 2 sets in carrier (4) — for chipped or rounded edges and for misalignment.
2. Pawl springs: 4 in driver/axle assembly (10); 2 sets in sun gear (6); 1 in gear ring (5); 2 sets in carrier (4) for shape and tension.
3. Ratchets: 2 in hub shell; 3 on axle (10); 1 inside gear ring (8); 2 inside and outside right end of carrier (7) for chipped or rounded edges.
4. Gear teeth of sun gear 6a and 6b; of sun and planet pinions of carrier (7) and carrier (4); of gear ring (8) and gear ring (5) — for wear and chipping.
5. 2 concentric helical shift sleeve return springs of axle (10); friction spring of gear ring (8); pawl retractor spring on outside of gear ring; ring spring of brake shoe assembly (2) for shape and tension.
6. Driver (10), brake cone (11) and hub shell bearing races for wear and pitting. Note: there is a concealed bearing between axle and driver. Unless you have disassembled it, test it by rotating it to feel for roughness.
7. Dustcaps, ball retainers (9), (17), E-clip (3) and axle (10) for straightness.
8. All threaded parts for damaged or stripped threads.
9. Brake shoes (2) and hub shell for wear or glazing.

Lubrication

Lubricate pinion pins by dripping a few drops of oil on their exposed ends. Lubricate pawl springs lightly with oil. Lubricate shifter springs, pawls and sleeve of axle-driver assembly lightly with oil. Use a good cycle oil. WD-40 is too light for lasting lubrication. 3-in-1 oil gums up with age.

Lubricate ball retainers by filling the spaces between the balls with grease. Lubricate hub shell, brake shoes (inside and out), axle assembly and pinion teeth liberally with grease: use Shimano 7-speed hub grease, part no. 041 3011.



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ASSEMBLY INSTRUCTIONS FOR SHIMANO INTER•7 SPEED

Note: all pawls point counterclockwise, looking from left end of axle, except:

1. Reverse pawls of driver for brake (at same diameter with counterclockwise pawls that retract in 1st through 5th gear);
2. Pawls of sun gear (6a).

Some pawls, particularly axle pawls engaging sun gear (6), are tiny and easily displaced. Do not force assembly.

AXLE DRIVER ASSEMBLY

Place the axle assembly in soft jaws of a vise by the part just inboard of the threads, spring end up.

Install the driver (10) over the end of the axle so it rests on the shifting mechanism.

The bearing retainer is not available as an individual part, but you may replace bearing balls in retainer (3/16" balls). Install bearing retainer (31), flat side up.

Install seal (30a) into groove around outside of fixed cone, smooth side up. Install fixed cone (30) over the notches of the axle, flat side up.

Apply grease to top surface of fixed cone and lay small wire ring (29b) into groove in top of fixed cone.

Install eight-tab washer (29), smoother side up, over ridges of axle.

Apply grease to top surface of eight-tab washer (29) and lay the remaining small wire ring (29a) into the groove on top of eight-tab washer.

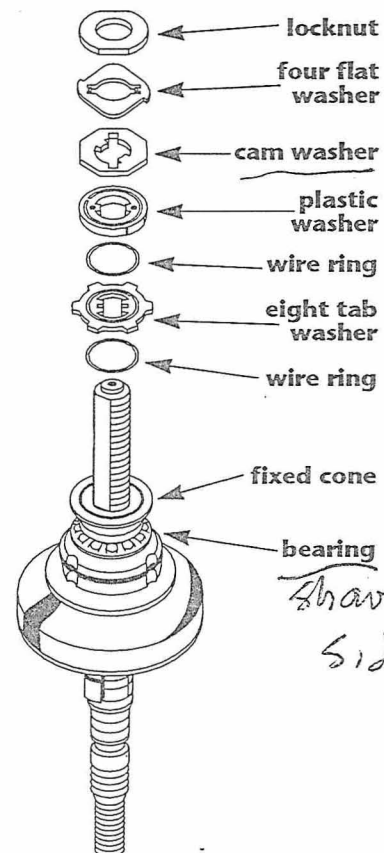
Install plated plastic washer (28), relieved (yellow marker) side up, with pins on underside mating with recesses of eight-tab washer and tabs mating with grooves of axle.

Install cam washer (27), with notches counterclockwise of tabs, into grooves of axle.

Install four-flat tabbed washer (26) with tabs extending downward into notches of cam washer.

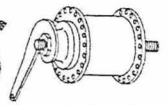
Thread locknut (25) over the end of the axle and tighten it with a 17 mm wrench while holding the axle from turning using a wide 8mm wrench or adjustable wrench on its flats.

Test assembly. It should be possible to install the cassette joint as described in the section on shifters and cables, secure it with the lockring and shift through the gears. At this stage, with the cassette joint and cable attached to the axle assembly alone, you will have to rotate the driver forward 1/2 turn or more before the hub will downshift all the way to 1st gear.



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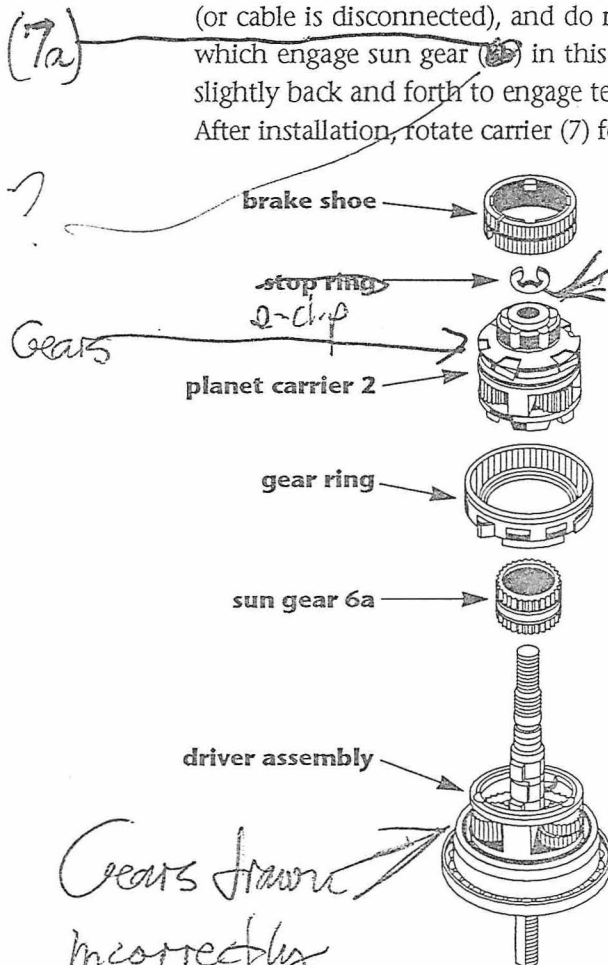
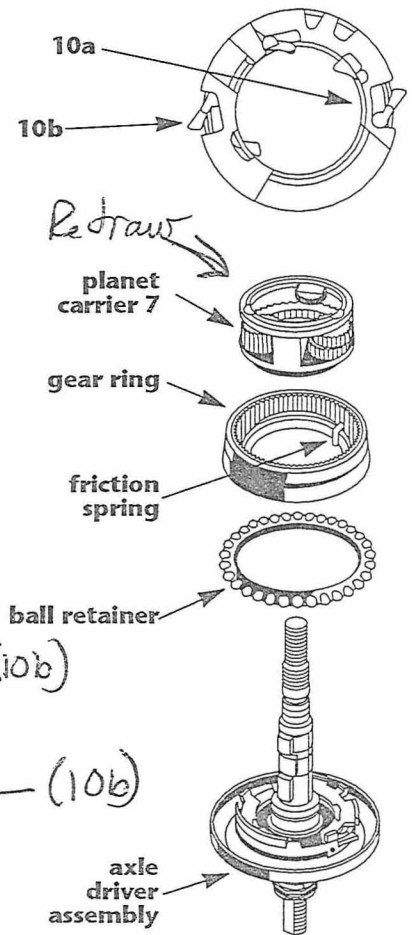
3 ASSEMBLY

Insert the axle-driver assembly into a vise, sprocket end down. If assembling with the shift lever and cable attached for troubleshooting purposes, place the shift lever in first gear position. Otherwise, you will not be able to seat some of the assemblies, and you may force some pawls out of position.

Install ball retainer (9) flat side up over one pawl (10a) of axle driver assembly (10). Then depress the other pawl (10b) with the tip of a screwdriver and pass ball retainer (9) into position beyond it. Be careful not to bend ball retainer (9).

Insert the end of friction spring (8a) of gear ring into the wide hole section B of the axle and driver unit; depress pawls (10a, b) and install gear ring (8). Face of gear ring should rest flat against ball retainer (9). Turn gear ring counterclockwise against resistance of friction spring (8a); pawls should click.

Install carrier (7), small end down. Be especially careful that hub is in 1st gear (or cable is disconnected), and do not force assembly, as the tiny axle pawls which engage sun gear (6) in this unit are easily dislodged. Turn carrier (7) slightly back and forth to engage teeth of pinions with teeth of gear ring (8). After installation, rotate carrier (7) forward (counterclockwise) and check that both of the axle pawls inside sun gear (6) are ratcheting correctly.



2 ASSEMBLY

Install sun gear (6a,b) to mesh with planet pinions of carrier (7). Sun gear (6a), which is one piece with smooth middle ring of unit, must be at top. Work the unit into place by carefully rotating left and right. Do not use force, as this could damage the pawls.

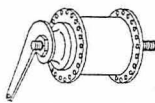
Place gear ring (5) over carrier (7), with the gear ring teeth facing upward.

Install planet carrier (4), turning the carrier unit slightly to the right and left to engage the teeth of the planet pinions in gear ring (5).

Push down carrier (4), and check that the full width of the circlip groove of the axle is visible over the upper edge of carrier (4). While pushing down on carrier, insert the E-clip (3) into the hub axle groove.

← Bold free this!!

SUTHERLAND'S



INTERNAL MULTI-SPEED HUBS

SHIMANO INTER•7 SPEED (CONT'D)

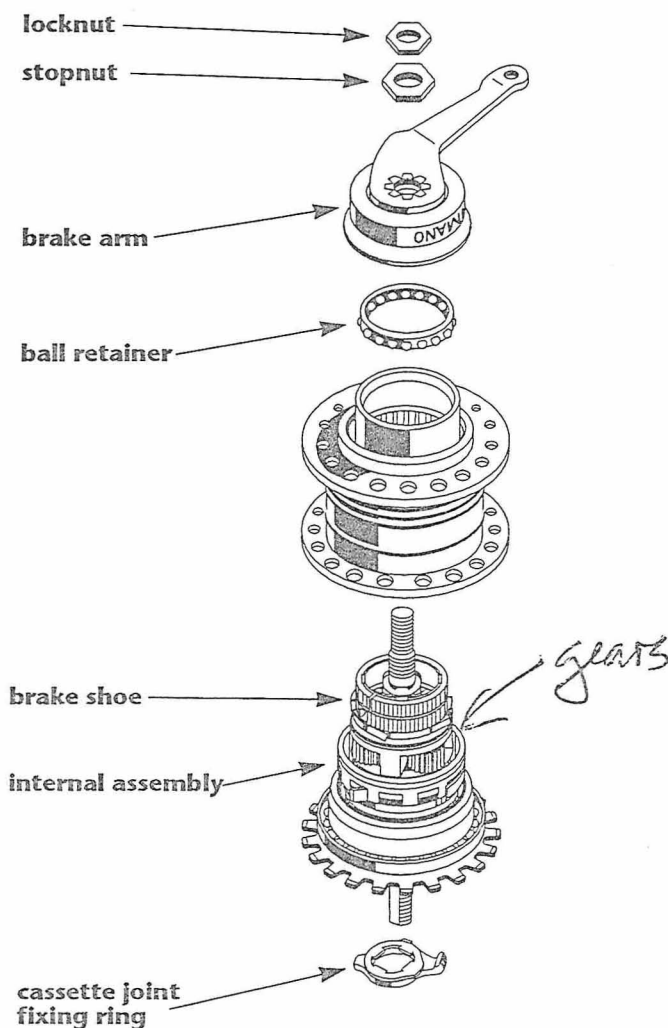
1 ASSEMBLY

Expand the brake shoe (2) over the roller clutch of carrier (4) four-notch side up, aligning the notched section between the two brake shoes at the underside with the end of the friction spring of carrier (4); then install the brake shoe.

Slip the hub shell over the assembly, turning it slightly to the left and right so that the sealing spring of the hub shell is positioned in the right hand dust cap of the internal assembly. Turn the hub shell counterclockwise to check that it turns smoothly.

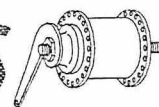
Reinstall ball retainer (17), flat side up. Reinstall brake arm (16), turning it to the right and left until the notches of the brake shoe engage with the tabs of the brake arm unit.

Reinstall the larger nut (15), flange down, and the smaller nut (14). Adjust bearings so hub shell can be turned freely, but without bearing play, and tighten nuts against each other using 22 mm and 17 mm cone wrenches.



SUTHERLAND'S

INTERNAL MULTI-SPEED HUBS



SHIMANO INTER•7 SPEED (CONT'D)

GEAR TABLE FOR INTERNALLY GEARED HUBS

Multiply by gear value obtained from chainwheel and rear sprocket gear charts.

Gear	1	2	3	4	5	6	7
Bendix							
Red Band	0.68	1.00					
Yellow Band	0.68	1.00					
Blue Band	1.00	1.47					
Sachs							
2-Speed	1.00	1.36					
3-Speed	0.73	1.00	1.36				
5-Speed	0.50	0.78	1.00	1.29	1.5		
7-Speed	0.59	0.67	.81	1.0	1.24	1.48	1.69
Shimano							
3-Speed	0.75	1.00	1.33				
7-speed	0.63	0.74	0.84	0.99	1.14	1.33	1.55
Sturmey Archer							
3-Speed	0.75	1.00	1.33				
4-Speed	0.67	0.79	1.00	1.27			
5-Speed	0.67	0.79	1.00	1.27	1.50		