

Chapter 8

Brakes, wheels and tyres

Refer to the beginning of Chapter 1 for model identification details

Contents

Brake cables – renewal	10	Front wheel and hub assembly – removal and installation	13
Brake fluid level check	see <i>Daily (pre-ride) checks</i>	General information	1
Brake light switches – check and renewal	see Chapter 9	Rear disc brake – inspection, removal and installation	6
Brake hoses, pipes and unions – inspection and renewal	7	Rear wheel and hub assembly – removal and installation	14
Brake shoe/pad wear check	see Chapter 1	Tyres – general information and fitting	16
Brake system bleeding (disc brake models)	8	Tyres – pressure, tread depth and condition see <i>Daily (pre-ride) checks</i>	
Brake system check	see Chapter 1	Wheels – general check	see Chapter 1
Drum brakes (front and rear) – check and shoe renewal	9	Wheel bearings – check	see Chapter 1
Front brake calliper – removal, overhaul and installation	3	Wheel bearings – removal, inspection and installation	15
Front brake disc – inspection, removal and installation	4	Wheels – alignment check	12
Front brake master cylinder – removal and installation	5	Wheels – inspection and repair	11
Front brake pads – removal, inspection and renewal	2		

Degrees of difficulty

Easy, suitable for
novice with little
experience



Fairly easy, suitable
for beginner with
some experience



Fairly difficult,
suitable for competent
DIY mechanic



Difficult, suitable for
experienced DIY
mechanic



Very difficult,
suitable for expert
DIY or professional



Specifications

Brakes (disc type)

Fluid type	DOT 4
Pad minimum thickness	1.5 mm
Disc maximum runout	0.1 mm

Brakes (drum type)

Lining minimum thickness	1.5 mm
Brake lever freeplay	10 to 15 mm

Wheels

Maximum wheel runout (front and rear)	
Axial (side-to-side)	2.0 mm
Radial (out-of-round)	2.0 mm
Maximum axle runout (front and rear)	0.2 mm

Tyres

Tyre pressures and sizes	see Chapter 1
------------------------------------	---------------

Torque settings

Front brake pad pins	19 to 25 Nm
Brake calliper mounting bolts	20 to 25 Nm
Front brake disc bolts	
All LX, GT, Zip models, B125, X8 and X9 models	5 to 6.5 Nm
All other models	8 to 10 Nm
Brake hose banjo bolts	15 to 25 Nm
Front wheel bolts (monoshock models)	20 to 25 Nm
Front hub nut (monoshock models)	
Super Hexagon 125	85 Nm
All other models	75 to 90 Nm
Front axle nut (telescopic fork models)	40 to 50 Nm
Front axle pinch-bolts	7 Nm
Rear hub nut	104 to 126 Nm
Rear wheel bolts (disc brake models)	
B125	34 to 38 Nm
NRG MC ³ DD and Power DD, Hexagon, Super Hexagon, X9 125, all GT models	20 to 25 Nm

1 General information

The front brake system is either a cable-operated single leading shoe drum (mainly early models) or a single hydraulic disc (twin discs on the X9). The disc brake caliper designs vary; single piston and twin piston floating calipers and opposed piston calipers are fitted across the range. The master cylinder is either mounted on the right handlebar and operated by the integral lever or mounted on the steering stem and operated by a short cable from the brake lever.

The rear brake system is either a cable-operated single leading shoe drum or a hydraulically-operated disc. The brake master cylinder is integral with the fluid reservoir on the left handlebar. On X9 models, the operation of the front left-hand and rear disc brakes is linked.

All models covered in this manual are fitted with cast alloy wheels designed for tubeless tyres only.

Caution: Disc brake components rarely require disassembly. Do not disassemble components unless absolutely necessary. If a hydraulic brake line is loosened, the entire system must be disassembled, drained, cleaned and then properly filled and bled upon reassembly. Do not use solvents on internal brake components. Solvents will cause the seals to swell and distort. Use only clean brake fluid or denatured alcohol for cleaning. Use care when working with brake fluid as it can

injure your eyes and it will damage painted surfaces and plastic parts.

2 Front brake pads – removal, inspection and renewal



Warning: The dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any of it. An approved filtering mask should be worn when working on the brakes.

Note: On some models, due to a lack of clearance, it may be necessary to either displace the brake caliper or remove the front wheel to enable the pads to be removed.

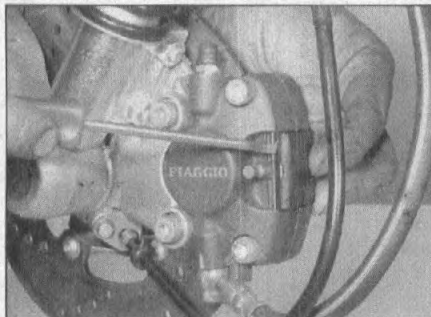
Opposed piston caliper

1 Where fitted, remove the pad cover from

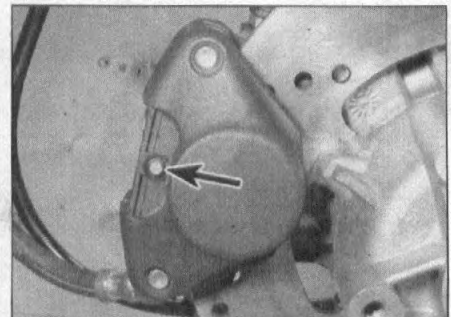
the caliper (see illustration). Remove the E-clip from the end of the pad retaining pin, then withdraw the pin, noting how it keeps the pad spring pressed onto the pads, and remove the spring, noting which way round it fits (see illustrations). If required, drive the pin out from the inside using a suitable drift and draw it out using pliers (see illustrations). Lift the pads out of the caliper (see illustrations).

2. Inspect the surface of each pad for contamination and check that the friction material has not worn to or beyond the minimum thickness of 1.5 mm (see illustration). If either pad is worn down to, or beyond, the service limit, fouled with oil or grease, or heavily scored or damaged by dirt and debris, both pads must be renewed as a set. **Note:** It is not possible to degrease the friction material; if the pads are contaminated in any way they must be renewed.

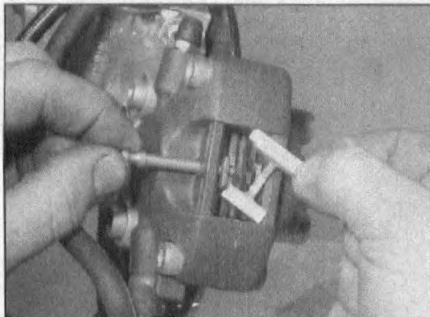
3 If the pads are in good condition clean them carefully, using a fine wire brush which is



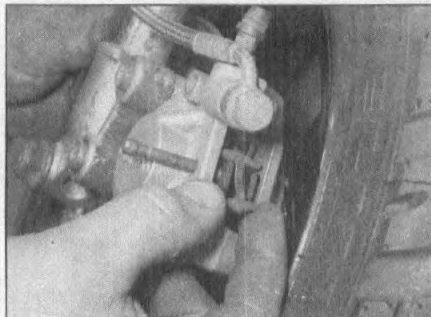
2.1a Remove the cover ...



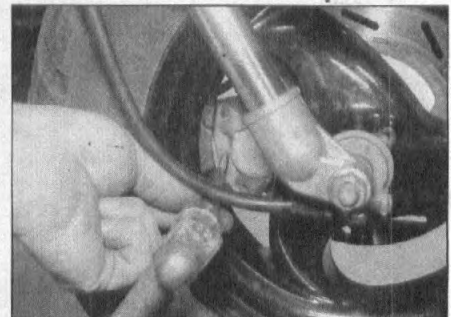
2.1b ... then remove the E-clip



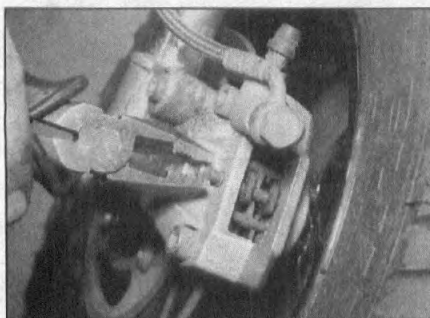
2.1c Withdrawing the pad pin and removing the spring – Piaggio type caliper



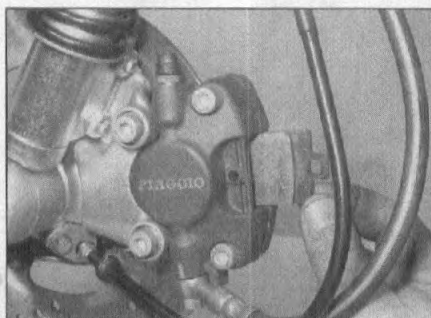
2.1d Withdrawing the pad pin and removing the spring – Brembo type caliper



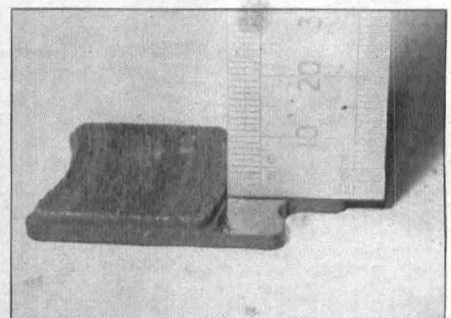
2.1e Use a drift to drive out the pin ...



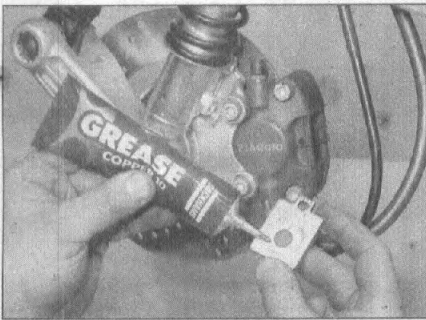
2.1f ... and withdraw it using a pair of pliers



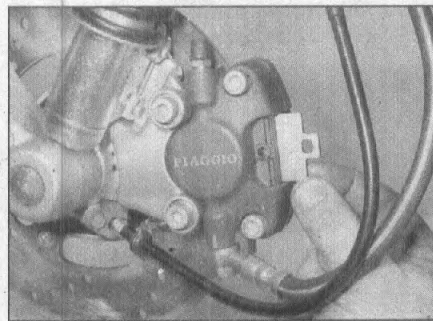
2.1g Withdraw the pads from the caliper



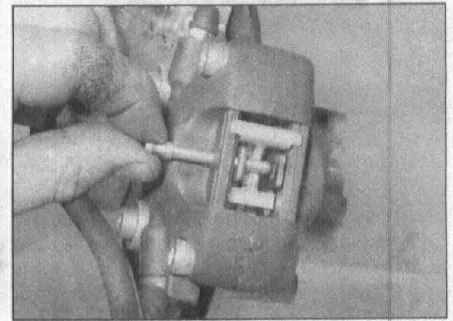
2.2 Check the amount of friction material remaining on each pad



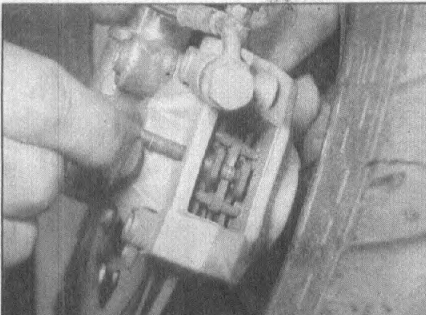
2.7 Apply copper grease to the back of each pad . . .



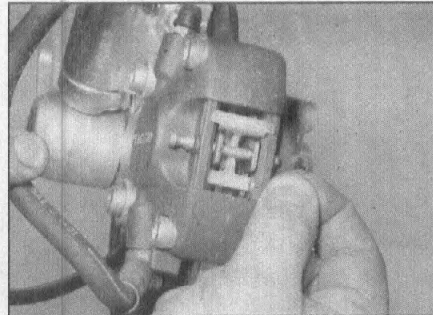
2.8a . . . then install the pads



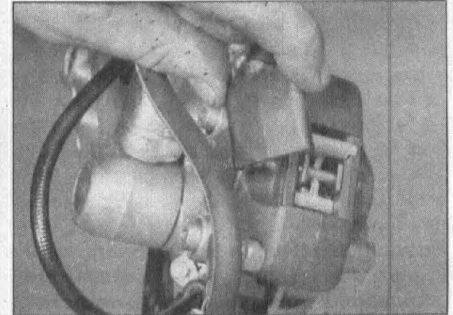
2.8b Fitting the pad pin and spring – Piaggio type caliper



2.8c Fitting the pad pin and spring – Brembo type caliper



2.8d Fit the E-clip onto the end of the pin . . .



2.8e . . . then fit the cover

completely free of oil and grease to remove all traces of road dirt and corrosion. Any areas of glazing may be removed using emery cloth.

4 Check the condition of the brake disc (see Section 4).

5 Remove all traces of corrosion from the pad pin. Inspect the pin and spring for signs of wear and renew them if necessary.

6 If new pads are being fitted, push the pistons as far back into the caliper as possible using hand pressure or a piece of wood as leverage. Due to the increased friction material thickness of new pads, it may be necessary to remove the master cylinder reservoir cover and diaphragm and syphon out some fluid.

7 Smear the backs of the pads and the shank of the pad pin with copper-based grease, making sure that none gets on the front or sides of the pads (see illustration).

8 Installation of the pads is the reverse of removal. Insert the pads into the caliper so that the friction material faces the disc, then slide the pad retaining pin through the hole in the outer pad (see illustration). Fit the pad spring, making sure it locates correctly onto the pads (see illustrations). Press down on the spring and slide the pin across so that it locates in the groove in the middle of the spring and passes through the hole in the inner pad. Tap on the end of the pin to make sure it is fully home, then fit the retaining clip onto its end (see illustration). Where fitted, install the pad cover (see illustration).

9 Top up the master cylinder reservoir if necessary (see *Daily (pre-ride) checks*), and refit the reservoir cover and diaphragm.

10 Operate the brake lever several times to

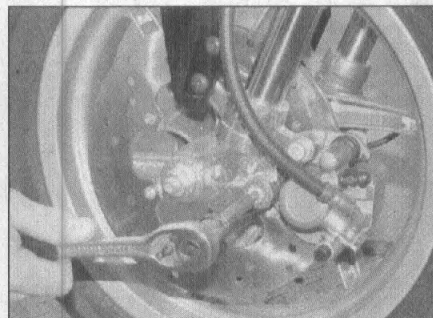
bring the pads into contact with the disc. Check the operation of the brake before riding the scooter.

Single piston floating caliper

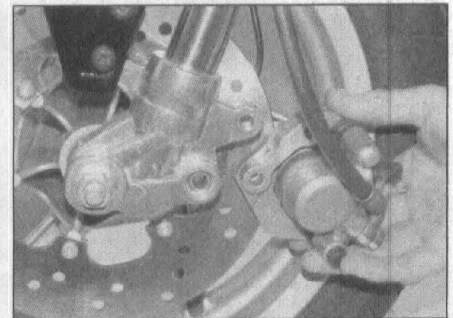
11 Undo the caliper mounting bolts and remove the bolts and washers, then slide the

caliper off the disc (see illustrations). Note that the lower bolt is longer than the upper bolt.

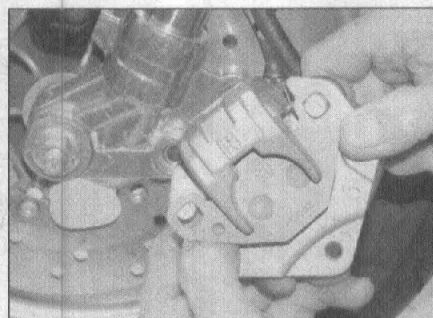
12 Push the piston as far back into the caliper as possible using hand pressure or a piece of wood as leverage, then lift the outer (larger) pad off the pad pins (see illustrations). Lift



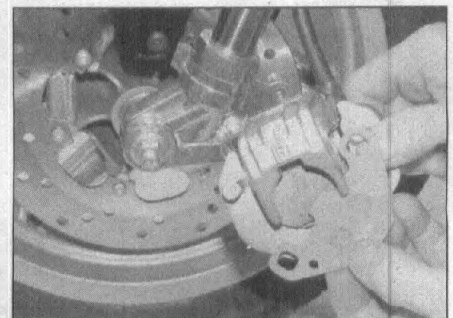
2.11a Remove the caliper mounting bolts . . .



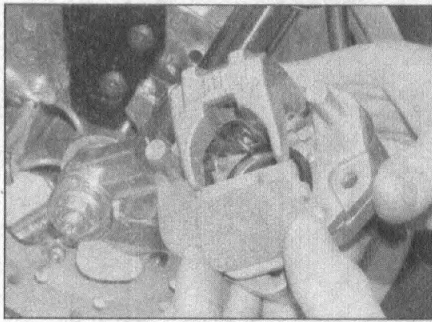
2.11b . . . and slide the caliper off the disc



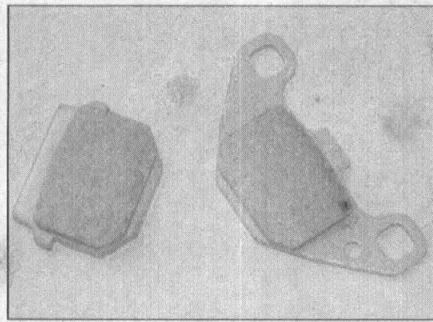
2.12a Push the piston back . . .



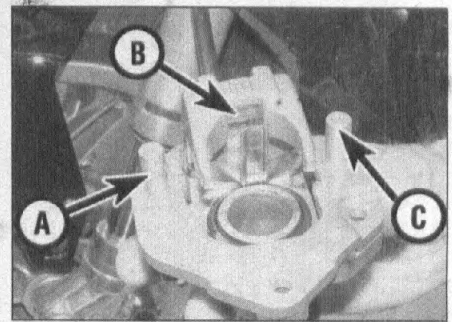
2.12b . . . then remove the outer brake pad . . .



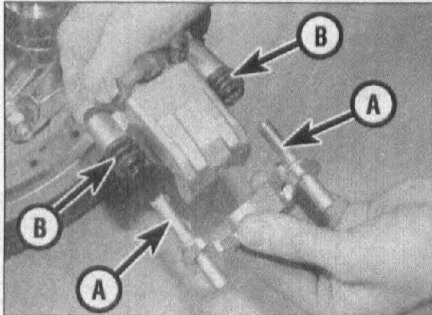
2.12c ... and the inner brake pad



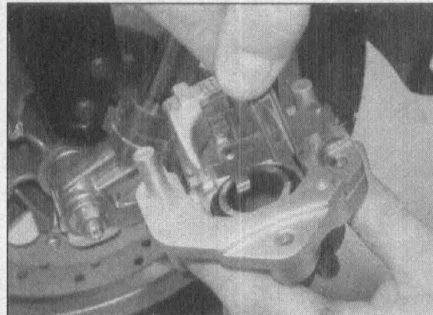
2.13a Inspect the friction material for wear and contamination



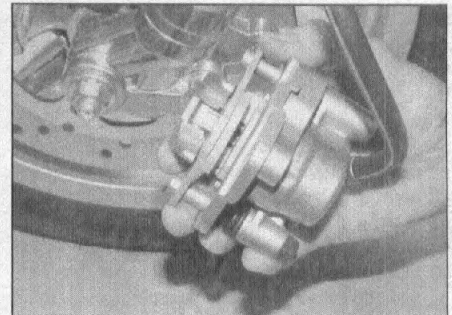
2.13b Inspect the pad pins (A) and spring (B)



2.13c Inspect the slider pins (A) and pin seals (B)



2.16a Ensure the pad spring is correctly installed



2.16b Install the pads as described

the inner pad out of the caliper, noting how it fits (see illustration).

13 Follow the procedure in Steps 2 to 5 to inspect and clean the pads and disc (see illustration). If required, remove any corrosion

from the pad pins and spring (see illustration). Check that the caliper bracket slides freely in and out of the caliper – if not, pull it all the way out, clean any old grease or corrosion off the slider pins, then smear them with fresh grease

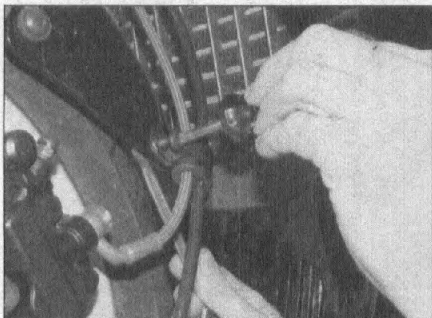
(see illustration). Renew the pin seals if they are damaged, then slide the bracket back into the caliper.

14 If new pads are being fitted, push the piston as far back into the caliper as possible using hand pressure or a piece of wood as leverage. Due to the increased friction material thickness of new pads, it may be necessary to remove the master cylinder reservoir cover and diaphragm and syphon out some fluid.

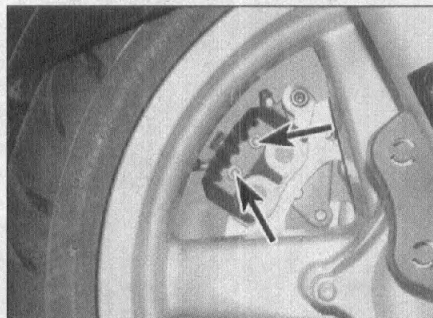
15 Smear the backs of the pads and the shanks of the pad pins with copper-based grease, making sure that none gets on the front or sides of the pads.

16 Ensure the pad spring is correctly fitted inside the caliper (see illustration). Install the pads in the reverse order of removal so that the friction material faces the disc, then slide the caliper onto the disc (see illustration).

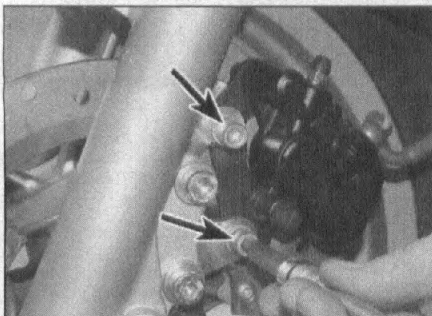
17 Install the caliper mounting bolts and washers, noting that the longer bolt is fitted in the lower position, then tighten the bolts to the torque setting specified at the beginning of the Chapter.



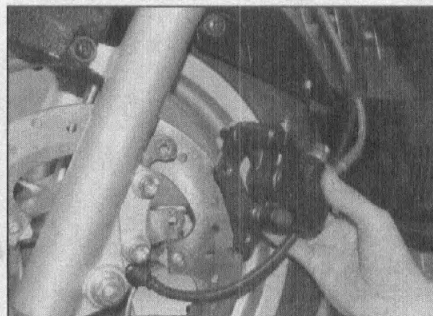
2.18a Free the brake hose from the clip



2.18b Loosen the pad retaining pins (arrowed)



2.19a Remove the caliper mounting bolts ...

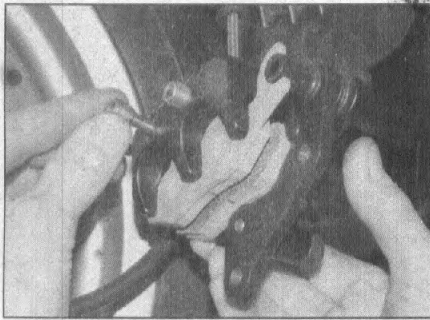


2.19b ... and slide the caliper off the disc

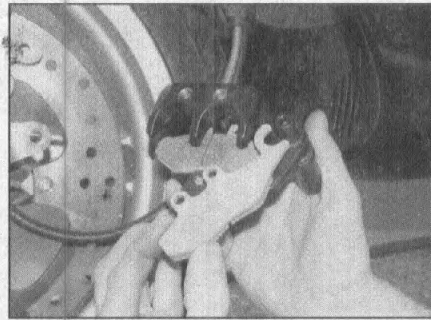
Two-piston floating caliper

18 Where fitted, free the brake hose from the clip on the front mudguard (see illustration). Before displacing the brake caliper, loosen the pad retaining pins from the opposite side of the front wheel (see illustration).

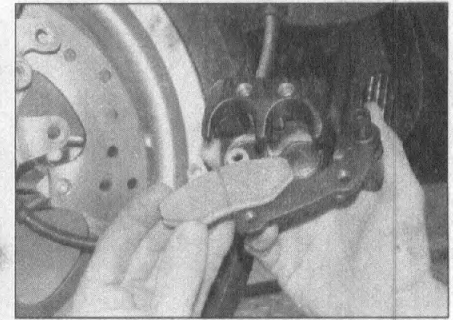
19 Undo the caliper mounting bolts and remove the bolts and washers, then slide the caliper off the disc (see illustrations).



2.20a Remove the pad pins . . .



2.20b . . . then lift out the outer brake pad . . .



2.20c . . . and the inner brake pad

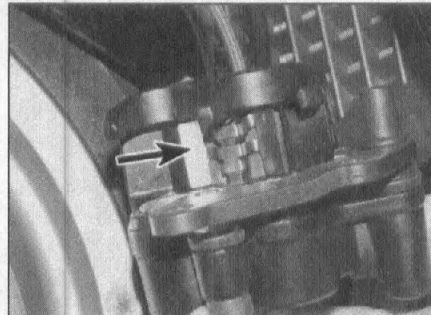
20 Remove the pad pins and lift the outer pad out of the caliper, noting how it locates, then lift out the inner pad (see illustrations). Note the location of the pad spring (see illustration).

21 Follow the procedure in Steps 2 to 5 to inspect and clean the pads and disc (see illustration). If required, remove any corrosion from the pad pins and spring. Check that the caliper bracket slides freely in and out of the caliper – if not, pull it all the way out, clean any old grease or corrosion off the slider pins, then smear them with fresh grease (see illustrations). Renew the pin seals if they are damaged, then slide the bracket back into the caliper.

22 If new pads are being fitted, push the pistons as far back into the caliper as possible using hand pressure or a piece of wood as leverage (see illustration). Due to the increased friction material thickness of new pads, it may be necessary to remove the master cylinder reservoir cover and diaphragm and syphon out some fluid.

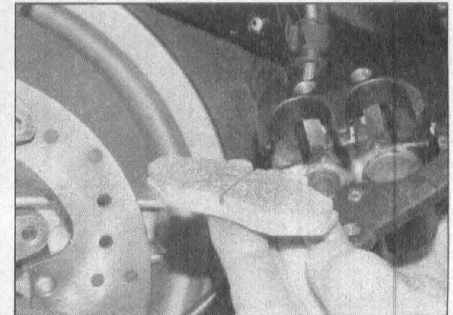
23 Smear the backs of the pads and the shanks of the pad pins with copper-based grease, making sure that none gets on the front or sides of the pads.

24 Ensure the pad spring is correctly fitted inside the caliper (see illustration 2.20d). Install the pads in the reverse order of removal so that the friction material faces the disc, then push the pads against the pad spring and insert the pad pins (see illustration). Apply a suitable non-permanent thread locking compound to the threads of the pad pins, then



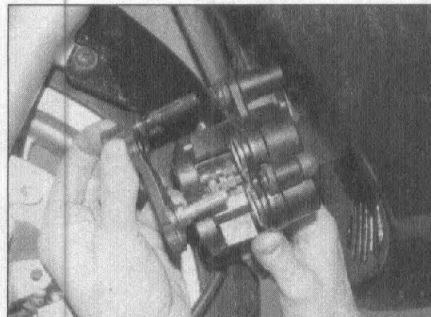
2.20d Note the location of the pad spring (arrowed)

tighten them to the torque setting specified at the beginning of the Chapter (see illustration). Alternatively, tighten the pad pins once the caliper has been installed.

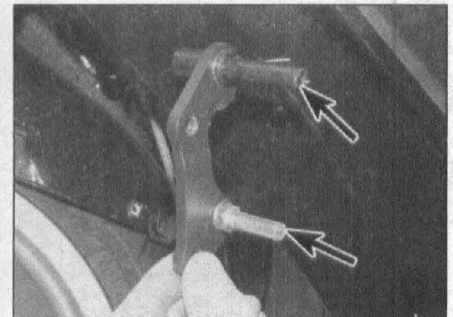


2.21a Inspect the friction material for wear and contamination

25 Slide the caliper onto the disc. Install the caliper mounting bolts and washers, then tighten the bolts to the torque setting specified at the beginning of the Chapter.



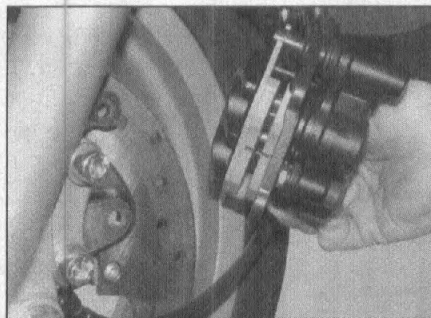
2.21b Pull the bracket out of the caliper . . .



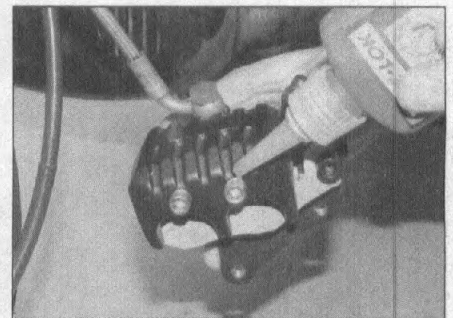
2.21c . . . then clean and lubricate the slider pins (arrowed)



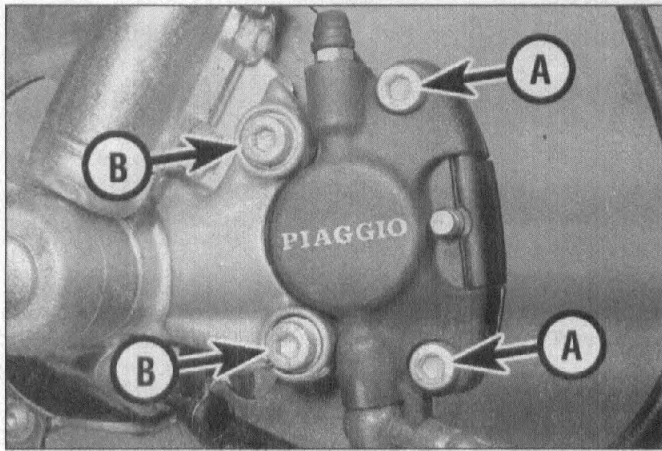
2.22 Push the pistons back into the caliper



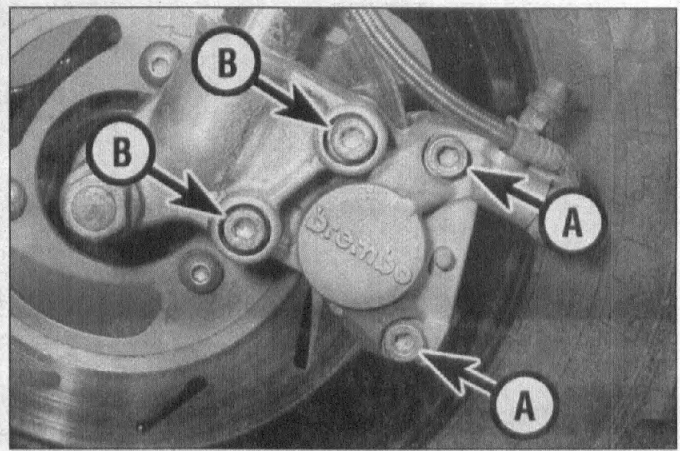
2.24a Install the pads as described



2.24b Apply thread locking compound to the pad pins



3.1a Caliper half joining bolts (A), caliper mounting bolts (B) – Piaggio type caliper



3.1b Caliper half joining bolts (A), caliper mounting bolts (B) – Brembo type caliper

3 Front brake caliper – removal, overhaul and installation



Warning: If a caliper indicates the need for an overhaul (usually due to leaking fluid or sticky operation), all old brake fluid should be flushed from the system. Also, the dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any of it. An approved filtering mask should be worn when working on the brakes. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use clean brake fluid, brake cleaner or denatured alcohol only.

Note 1: There is no clear information as to the availability of caliper rebuild kits for the models covered. Before overhauling the caliper, check with a Piaggio dealer as to the availability of seals and pistons for your model. Otherwise an entire new caliper must be installed.

Note 2: On some models, due to a lack of clearance, it may be necessary to remove the front wheel to enable the caliper to be removed.

Opposed piston caliper

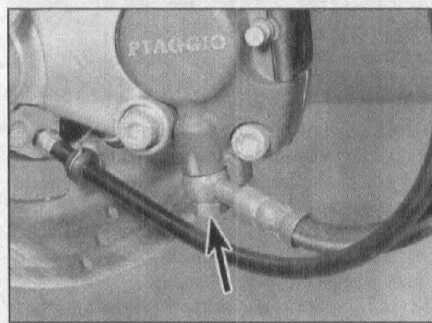
Removal

1 If the caliper is being overhauled (see **Note 1** overleaf), remove the brake pads (see Section 2), then slacken and lightly retighten the bolts which join the caliper halves (see illustrations). If the caliper is just being removed, the pads can be left in place and the caliper half joining bolts should not be disturbed.

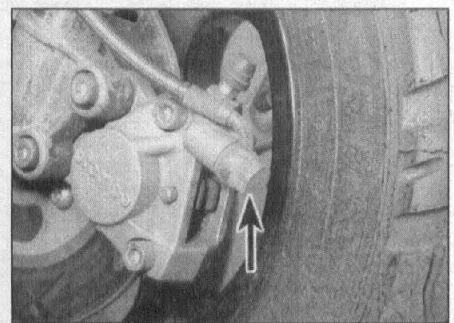
2 If the caliper is just being displaced and not completely removed or overhauled, do not disconnect the brake hose. If the caliper is being overhauled, note the alignment of the hose on the caliper, then remove the brake

hose banjo bolt and separate the hose from the caliper (see illustrations). Plug the hose end or wrap a plastic bag tightly around it to minimise fluid loss and prevent dirt entering the system. Discard the sealing washers, as new ones must be used on installation. **Note:** If you are planning to overhaul the caliper and don't have a source of compressed air to blow out the pistons, just loosen the banjo bolt at this stage and retighten it lightly. The bike's hydraulic system can then be used to force the pistons out of the body once the pads have been removed. Disconnect the hose once the pistons have been sufficiently displaced.

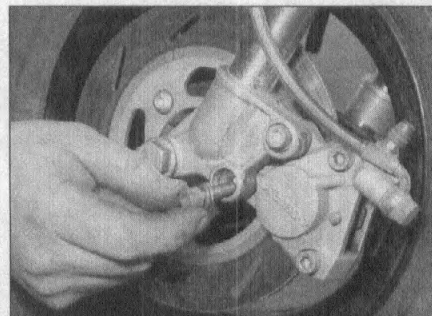
3 Unscrew the caliper mounting bolts (see illustrations 3.1a and 3.1b), and slide the caliper off the disc (see illustrations).



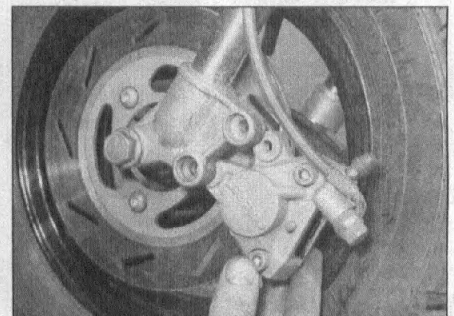
3.2a Brake hose alignment and banjo bolt (arrowed) – Piaggio type caliper



3.2b Brake hose alignment and banjo bolt (arrowed) – Brembo type caliper



3.3a Remove the caliper mounting bolts ...

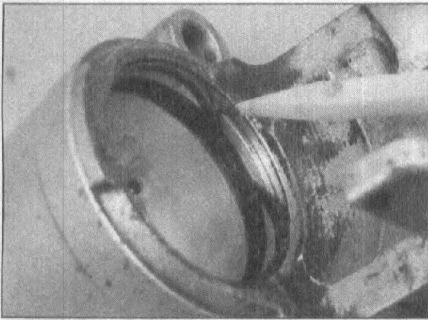


3.3b ... and slide the caliper off the disc

Overhaul

4 Clean the exterior of the caliper with denatured alcohol or brake system cleaner.

5 Displace the pistons as far as possible from the caliper body, either by pumping them out by operating the front brake lever, or by forcing them out using compressed air. If the compressed air method is used, place a wad of rag between the pistons and the caliper to act as a cushion, then use compressed air directed into the fluid inlet to force the pistons out of the body. Use only low pressure to ease the pistons out and make sure both pistons are displaced at the same time. If the air pressure is too high and the pistons are forced out, the caliper and/or pistons may be damaged. Unscrew the joining bolts and separate the caliper halves.



3.6 Remove the dust seal with a plastic or wooden tool (a pencil works well) to avoid damage to the bore and seal groove

Mark each piston head and caliper body with a felt marker to ensure that the pistons can be matched to their original bores on reassembly. Remove the caliper O-ring seal from either half of the caliper body and discard it, as a new one must be used.



Warning: Never place your fingers in front of the pistons in an attempt to catch or protect them when applying compressed air, as serious injury could result.

6 Using a wooden or plastic tool, remove the dust seals from the caliper bores (see illustration). Discard them, as new ones must be used on installation. If a metal tool is being used, take great care not to damage the caliper bores.

7 Remove and discard the piston seals in the same way.

8 Clean the pistons and bores with denatured alcohol, clean brake fluid or brake system cleaner. If compressed air is available, use it to dry the parts thoroughly (make sure it's filtered and unlubricated).

Caution: Do not, under any circumstances, use a petroleum-based solvent to clean brake parts.

9 Inspect the caliper bores and pistons for signs of corrosion, nicks and burrs and loss of plating. If surface defects are present, the caliper assembly must be renewed. If the caliper is in bad shape the master cylinder should also be checked.

10 Lubricate the new piston seals with clean brake fluid and install them in their grooves in the caliper bores.

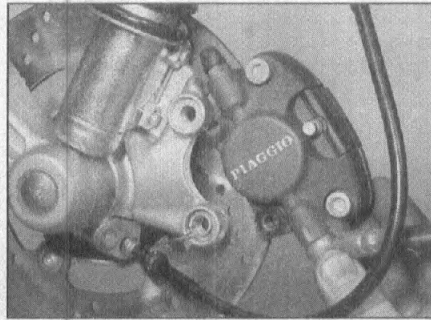
11 Lubricate the new dust seals with clean brake fluid and install them in their grooves in the caliper bores.

12 Lubricate the pistons with clean brake fluid and install them closed-end first into the caliper bores. Using your thumbs, push the pistons all the way in, making sure they enter the bore squarely.

13 Fit a new caliper seal into one half of the caliper body, then join the halves together and tighten the bolts. If required, to provide support, they can be fully tightened after the calipers have been installed.

Installation

14 Install the caliper on the brake disc making



3.14 Slide the caliper onto the disc . . .

sure the pads sit squarely each side of the disc (if they weren't removed) (see illustration).

15 Install the caliper mounting bolts, and tighten them to the torque setting specified at the beginning of the Chapter (see illustration).

16 If the caliper was overhauled and the joining bolts were not fully tightened earlier, tighten them securely.

17 If removed, connect the brake hose to the caliper, using new sealing washers on each side of the fitting. Align the hose as noted on removal (see illustrations 3.2a and 3.2b). Tighten the banjo bolt to the torque setting specified at the beginning of the Chapter. Top-up the master cylinder reservoir with DOT 4 brake fluid (see Daily (pre-ride) checks) and bleed the hydraulic system as described in Section 8.

18 If removed, install the brake pads (see Section 2).

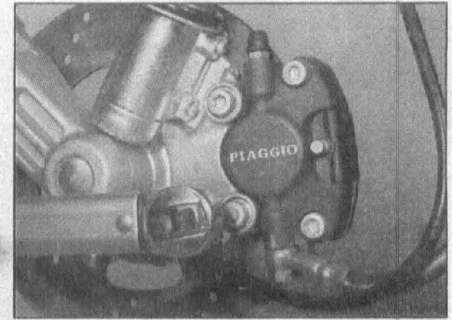
19 Check for leaks and thoroughly test the operation of the brake before riding the scooter.

Single piston floating caliper

Removal

20 If the caliper is just being displaced and not completely removed or overhauled, do not disconnect the brake hose. If the caliper is being overhauled, note the alignment of the hose on the caliper, then remove the brake hose banjo bolt and separate the hose from the caliper. Plug the hose end or wrap a plastic bag tightly around it to minimise fluid loss and prevent dirt entering the system. Discard the sealing washers, as new ones must be used on installation. **Note:** If you are planning to overhaul the caliper and don't have a source of compressed air to blow out the piston, just loosen the banjo bolt at this stage and retighten it lightly. The bike's hydraulic system can then be used to force the piston out of the body once the pads have been removed. Disconnect the hose once the piston has been sufficiently displaced.

21 If the caliper is being overhauled (see Note 1 overleaf), remove the brake pads, pull the caliper bracket off and prise out the pad spring (see Section 2). If the caliper is just being removed, the pads and bracket can be left in place.



3.15 . . . then install the bolts and tighten them to the specified torque

Overhaul

22 Clean the exterior of the caliper with denatured alcohol or brake system cleaner.

23 Displace the piston as far as possible from the caliper body, either by pumping it out by operating the front brake lever, or by forcing it out using compressed air. If the compressed air method is used, place a wad of rag between the piston and the caliper to act as a cushion, then use compressed air directed into the fluid inlet to force the piston out of the body. Use only low pressure to ease the piston out – if the air pressure is too high and the piston is forced out, the caliper and/or piston may be damaged.



Warning: Never place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air, as serious injury could result.

24 Using a wooden or plastic tool, remove the dust seal from the caliper bore, taking care not to damage the surface of the bore (see illustration 3.6). Discard it, as new one must be used on installation.

25 Remove and discard the piston seal in the same way.

26 Clean the piston and bore with denatured alcohol, clean brake fluid or brake system cleaner. If compressed air is available, use it to dry the parts thoroughly (make sure it's filtered and unlubricated).

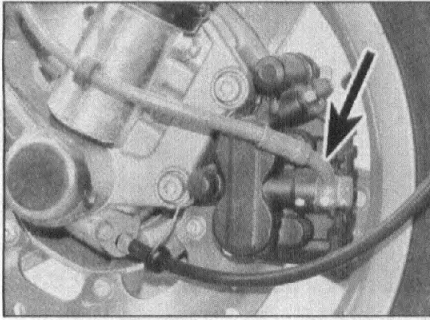
Caution: Do not, under any circumstances, use a petroleum-based solvent to clean brake parts.

27 Inspect the caliper bore and piston for signs of corrosion, nicks and burrs and loss of plating. If surface defects are present, the caliper assembly must be renewed. If the caliper is in bad shape the master cylinder should also be checked.

28 Lubricate the new piston seal with clean brake fluid and install it in its groove in the caliper bore.

29 Lubricate the new dust seal with clean brake fluid and install it in its groove in the caliper bore.

30 Lubricate the piston with clean brake fluid and install it closed-end first into the caliper bore. Using your thumbs, push the piston all the way in, making sure it enters the bore squarely.



3.36 Note the alignment of the brake hose – GT model shown

Installation

- 31 If removed, install the pad spring, caliper bracket and brake pads (see Section 2).
- 32 Install the caliper on the brake disc making sure the pads sit squarely each side of the disc (see illustration 2.16b).
- 33 Install the caliper mounting bolts, and tighten them to the torque setting specified at the beginning of the Chapter (see Step 2.17).
- 34 If removed, connect the brake hose to the caliper, using new sealing washers on each side of the fitting. Align the hose as noted on removal. Tighten the banjo bolt to the torque setting specified at the beginning of the Chapter. Top-up the master cylinder reservoir with DOT 4 brake fluid (see *Daily (pre-ride) checks*) and bleed the hydraulic system as described in Section 8.
- 35 Check for leaks and thoroughly test the operation of the brake before riding the scooter.

Two-piston floating caliper

Removal

- 36 If the caliper is just being displaced and not completely removed or overhauled, do not disconnect the brake hose. If the caliper is being overhauled, note the alignment of the hose on the caliper, then remove the brake hose banjo bolt and separate the hose from the caliper (see illustration). Plug the hose end or wrap a plastic bag tightly around it to minimise fluid loss and prevent dirt entering the system. Discard the sealing washers, as new ones must be used on installation. **Note:** *If you are planning to overhaul the caliper and don't have a source of compressed air to blow out the piston, just loosen the banjo bolt at this stage and retighten it lightly. The bike's hydraulic system can then be used to force the piston out of the body once the pads have been removed. Disconnect the hose once the piston has been sufficiently displaced.*
- 37 If the caliper is being overhauled (see Note 1 overleaf), remove the brake pads, pull the caliper bracket off and prise out the pad spring (see Section 2). If the caliper is just being removed, the pads can be left in place.

Overhaul

- 38 Clean the exterior of the caliper with

denatured alcohol or brake system cleaner.

39 Displace the pistons as far as possible from the caliper body, either by pumping them out by operating the front brake lever, or by forcing them out using compressed air. If the compressed air method is used, place a wad of rag between the pistons and the caliper to act as a cushion, then use compressed air directed into the fluid inlet to force the pistons out of the body. Use only low pressure to ease the pistons out and make sure both pistons are displaced at the same time. If the air pressure is too high and the pistons are forced out, the caliper and/or pistons may be damaged. Mark each piston head and the caliper body with a felt marker to ensure that the pistons can be matched to their original bores on reassembly.

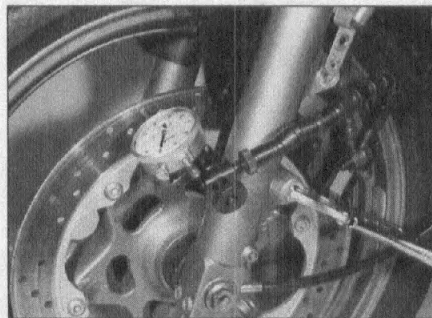


Warning: *Never place your fingers in front of the pistons in an attempt to catch or protect them when applying compressed air, as serious injury could result.*

- 40 Follow the procedure in Steps 24 to 30 to remove the old seals, inspect the pistons and caliper bores, and install new seals.

Installation

- 41 If removed, install the pad spring, caliper bracket and brake pads (see Section 2). Don't forget to apply a suitable non-permanent thread locking compound to the threads of the pad pins before final tightening (see illustration 2.24b).
- 42 Install the caliper on the brake disc making sure the pads sit squarely each side of the disc (see illustration 2.24a).
- 43 Install the caliper mounting bolts, and tighten them to the torque setting specified at the beginning of the Chapter (see Step 2.25).
- 44 If removed, connect the brake hose to the caliper, using new sealing washers on each side of the fitting. Align the hose as noted on removal. Tighten the banjo bolt to the torque setting specified at the beginning of the Chapter. Top-up the master cylinder reservoir with DOT 4 brake fluid (see *Daily (pre-ride) checks*) and bleed the hydraulic system as described in Section 8.
- 45 Check for leaks and thoroughly test the operation of the brake before riding the scooter.



4.2 Set up a dial gauge with the probe contacting the brake disc, then rotate the wheel to check for runout

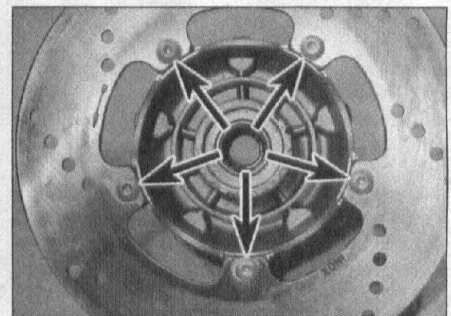
4 Front brake disc – inspection, removal and installation

Inspection

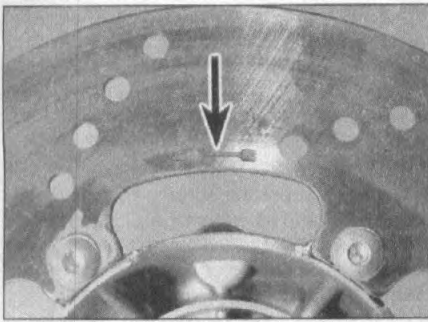
- 1 Visually inspect the surface of the disc for score marks and other damage. Light scratches are normal after use and won't affect brake operation, but deep grooves and heavy score marks will reduce braking efficiency and accelerate pad wear. If a disc is badly grooved it must be machined or renewed.
- 2 To check the disc runout, position the scooter upright so that the wheel is raised off the ground. Mount a dial gauge on a fork leg or the steering stem, with the plunger on the gauge touching the surface of the disc about 13 mm (1/2 in) from the outer edge (see illustration). Rotate the wheel and watch the gauge needle, comparing the reading with the limit listed in the Specifications at the beginning of the Chapter. If the runout is greater than the service limit, check the wheel bearings for play (see Chapter 1). If the bearings are worn, renew them (see Section 15) and repeat this check. If the disc runout is still excessive, it will have to be renewed, although machining by an engineer may be possible.
- 3 The disc must not be allowed to wear or be machined too thin. Piaggio provide no minimum thickness specification, although if the disc is obviously worn where the pads are in contact, and a substantial ridge can be felt between the rim and the contact area, it must be renewed.

Removal

- 4 Remove the front wheel (see Section 13). On models with monoshock front suspension, also remove the wheel hub assembly. **Caution:** *Do not lay the wheel down and allow it to rest on the disc – the disc could become warped. Set the wheel on wood blocks so the disc doesn't support the weight of the wheel.*
- 5 Mark the relationship of the disc to the wheel or hub assembly, so it can be installed in the same position. Unscrew the disc retaining bolts, loosening them a little at a time in a criss-cross pattern to avoid distorting the disc, then remove the disc (see illustration).



4.5 Brake disc mounting bolts



4.6 Disc directional arrow

Installation

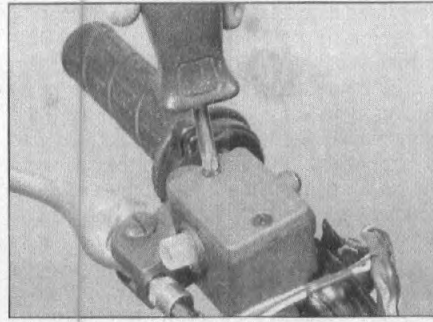
- 6 Install the disc, making sure the directional arrow points in the direction of normal wheel rotation (see illustration). Align the previously-applied matchmarks (if you're reinstalling the original disc).
- 7 Apply a suitable non-permanent thread locking compound to the disc retaining bolts, then install the bolts and tighten them in a criss-cross pattern evenly and progressively. Clean off all grease from the brake disc using acetone or brake system cleaner. If a new brake disc has been installed, remove any protective coating from its working surfaces.
- 8 Install the wheel hub assembly (monoshock models) and the wheel (see Section 13).
- 9 Operate the brake lever several times to bring the pads into contact with the disc. Check the operation of the brakes carefully before riding the scooter.

5 Front brake master cylinder – removal and installation



Note 1: Master cylinder rebuild kits are not available for the models covered. If the master cylinder is leaking fluid, or if the lever does not produce a firm feel when the brake is applied, bleeding the brakes does not help (see Section 8) and the hydraulic hoses are all in good condition, then the master cylinder must be renewed.

Note 2: On models with a handlebar-mounted master cylinder, the master cylinder and lever assembly can be displaced from the



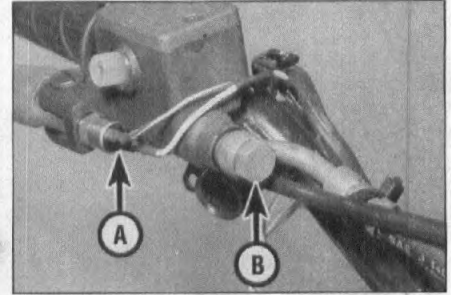
5.2 Slacken the reservoir cover screws

handlebars without any disassembly of its related components if required – follow Steps 6 and 8.

Handlebar-mounted

Removal

- 1 The front brake master cylinder is mounted on the right handlebar. The master cylinder has an integral reservoir and is activated directly by pressure from the brake lever. Remove the handlebar covers for access (see Chapter 7).
- 2 Loosen, but do not remove, the screws holding the reservoir cover in place (see illustration).
- 3 Remove the front brake lever (see Chapter 6).
- 4 Disconnect the electrical connectors from the brake light switch (see illustration). If required, remove the switch.
- 5 Unscrew the brake hose banjo bolt and separate the hose from the master cylinder, noting its alignment (see illustration 5.4). Discard the two sealing washers as they must be renewed. Wrap the end of the hose in a clean rag and suspend it in an upright position or bend it down carefully and place the open end in a clean container. The objective is to prevent excessive loss of brake fluid, fluid spills and system contamination.
- 6 Unscrew the master cylinder clamp bolts, then lift the master cylinder and reservoir away from the handlebar (see illustration).
- 7 Remove the reservoir cover retaining screws and lift off the cover, the diaphragm plate and the rubber diaphragm. Drain the brake fluid from the reservoir into a suitable container. Wipe any remaining fluid out of the reservoir with a clean rag.



5.4 Brake switch electrical connectors (A), brake hose banjo bolt (B)

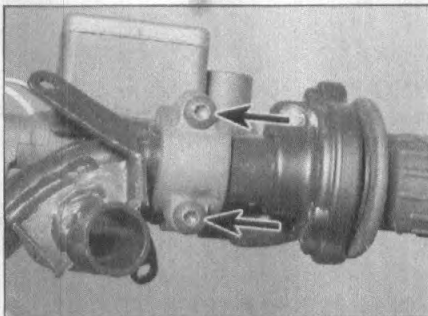
Installation

- 8 Attach the master cylinder to the handlebar and fit the clamp, then tighten the bolts securely (see illustration 5.6).
- 9 Connect the brake hose to the master cylinder, using new sealing washers on each side of the union, and aligning the hose as noted on removal (see illustration 5.4). Tighten the banjo bolt to the torque setting specified at the beginning of this Chapter.
- 10 Install the brake lever (see Chapter 6).
- 11 If removed, install the brake light switch and connect the wiring connectors (see illustration 5.4).
- 12 Fill the fluid reservoir with new DOT 4 brake fluid as described in *Daily (pre-ride) checks*. Refer to Section 8 of this Chapter and bleed the air from the system.
- 13 Fit the rubber diaphragm, making sure it is correctly seated, the diaphragm plate and the cover onto the master cylinder reservoir (see illustration).
- 14 Check the operation of the front brake before riding the scooter.

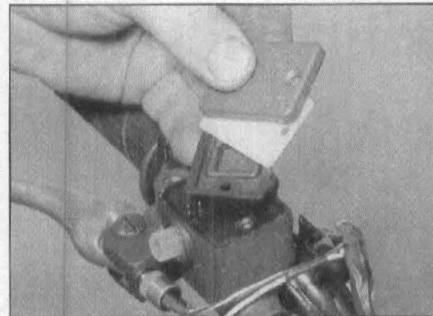
Steering stem-mounted

Removal

- 15 Where the master cylinder is mounted on the steering stem, it is activated by a cable from the brake lever, and there is a separate reservoir mounted behind the kick panel. Remove the front panel for access (see Chapter 7).
- 16 Remove the E-clip on the cable pivot pin, then draw or drive out the pin and detach the cable from the master cylinder lever arm (see illustration).
- 17 Unscrew the brake hose and separate the



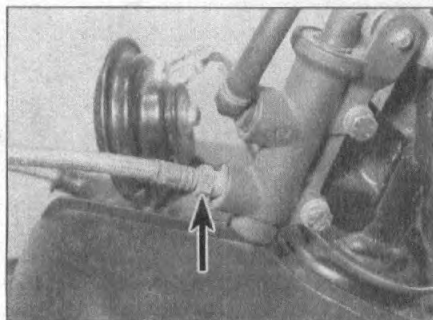
5.6 Master cylinder clamp bolts (arrowed)



5.13 Fit the diaphragm, plate and cover onto the reservoir

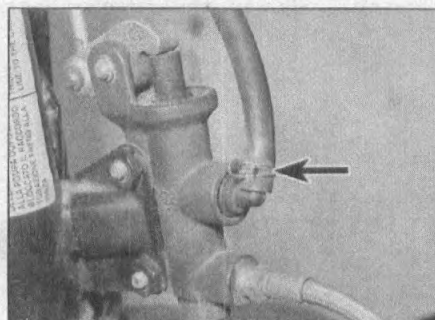


5.16 Remove the E-clip and draw out the pin



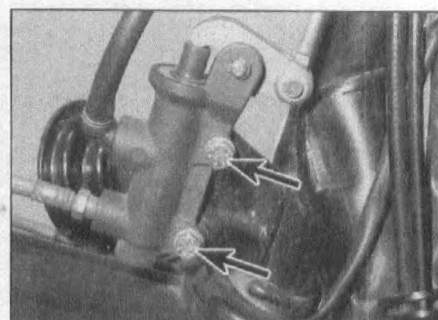
5.17 Unscrew and detach the caliper brake hose (arrowed)

hose from the master cylinder (see illustration). Wrap the end of the hose in a clean rag and suspend it in an upright position or bend it down carefully and place the open end in a clean container. The objective is to prevent excessive loss of brake fluid, fluid spills and system contamination.



5.18 Release the clip (arrowed) and detach the reservoir brake hose

18 If not already done when removing the front panel, remove the screw securing the reservoir, then remove the reservoir cap and drain the brake fluid from the reservoir into a suitable container. Release the clamp securing the reservoir hose to the union on the master cylinder, then detach the reservoir hose from



5.19 Master cylinder mounting bolts (arrowed)

its union (see illustration). Wipe any remaining fluid out of the reservoir with a clean rag.

19 Unscrew the master cylinder bolts and remove the cylinder (see illustration).

Installation

20 Install the master cylinder onto the steering stem bracket and tighten its mounting bolts securely (see illustration 5.19).

21 Secure the fluid reservoir to the kick panel with its screw. Ensure that the hose is correctly routed, then connect it to the union on the master cylinder and secure it with the clamp (see illustration 5.18). Check that the hose is secure and clamped at the reservoir end as well. If the clamps have weakened, use new ones.

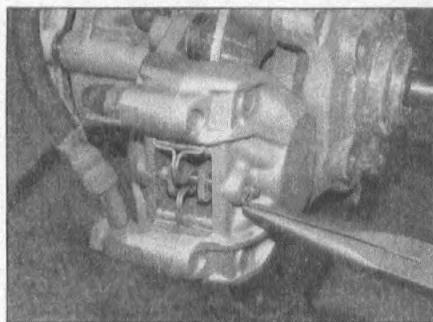
22 Connect the brake hose to the master cylinder and tighten it securely, but take care not to overtighten it (see illustration 5.17).

23 Align the cable end with the lever arm, then install the pivot pin and secure it with the E-clip, using a new one if the old one was deformed on removal (see illustration 5.16).

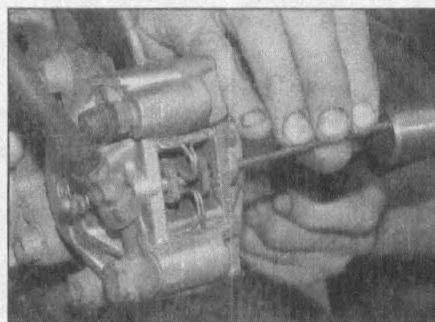
24 Fill the fluid reservoir with new DOT 4 hydraulic fluid (see Daily (pre-ride) checks) and bleed the system following the procedure in Section 8.

25 Install the front panel (see Chapter 7).

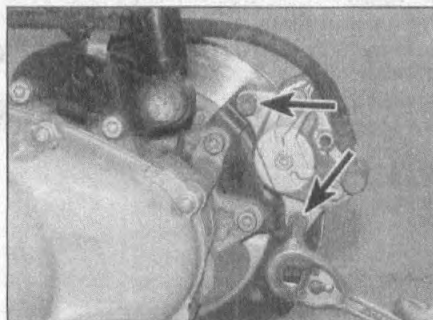
26 Check the operation of the brake carefully before riding the scooter.



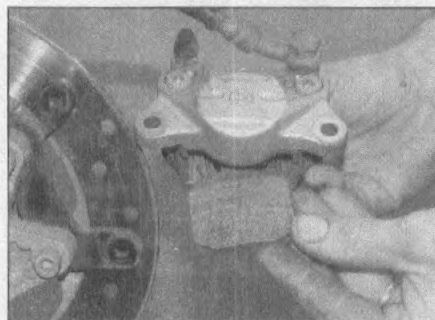
6.2a Remove the E-clip ...



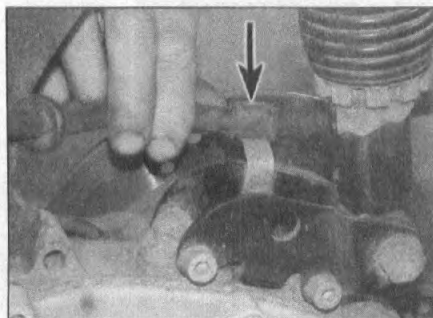
6.2b ... then drive out the pad retaining pin



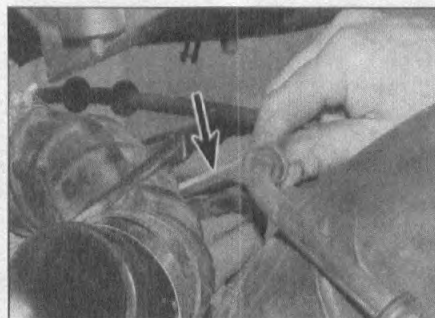
6.3a Undo the caliper mounting bolts (arrowed)



6.3b Remove the pads from the caliper



6.3c Brake hose is clipped forward of the left-hand shock ...



6.3d ... and forward of the rear hugger

6 Rear disc brake – inspection, removal and installation

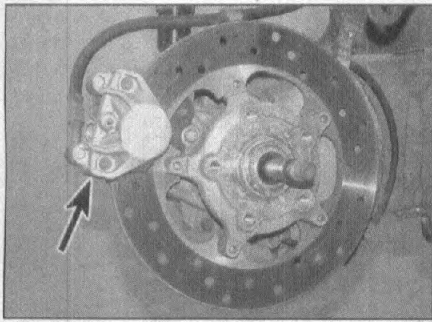


1 The procedures for removal, inspection and renewal of the rear disc brake pads, caliper, disc and master cylinder are the same as for the front brake, with the following additions.

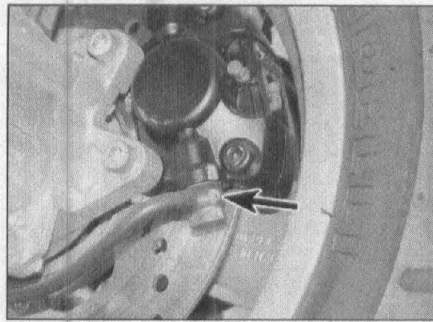
NRG MC³ DD and Power DD, Hexagon, Beverly, X9 and all GT models

2 Remove the rear wheel (see Section 14). Remove the E-clip and pad retaining pin, noting the location of the pad spring (see illustrations).

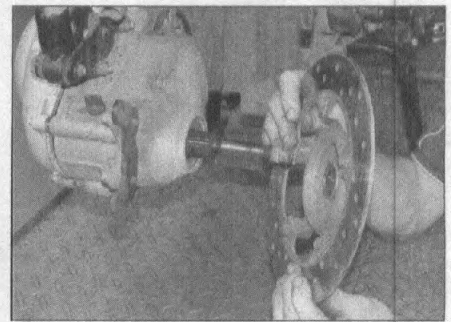
3 On some models the caliper must be displaced before the pads can be removed – a flexible brake hose will be fitted to these models. Undo the caliper mounting bolts and draw the caliper off the disc, then withdraw the pads from the caliper (see illustrations).



6.5a Remove the brake caliper (arrowed)



6.5b Note the alignment of the banjo union (arrowed) with the caliper – GT model shown



6.6 Draw the hub assembly off the driveshaft

Follow the procedure in Section 2, Steps 2 to 10, for inspection and installation of the pads.

Note: Do not operate the brake lever while the caliper is off the disc. Note the routing of the rear brake hose (see illustrations).

4 On models fitted with a rigid brake pipe, withdraw the pads from the top of the caliper.

5 To remove the disc and hub assembly, first displace the caliper. On models fitted with a flexible brake hose, undo the caliper mounting bolts and slide the caliper off the disc, then secure the caliper to the machine with a cable tie to avoid straining the hose (see illustration). On models fitted with a rigid brake pipe, note the alignment of the banjo union on the caliper, then remove the banjo bolt and separate the union from the caliper (see illustration). Discard the sealing washers as new ones must be used on installation. Undo the caliper mounting bolts and slide the caliper off the disc. **Note:** Do not operate the brake lever while the caliper is off the disc.

6 Draw the hub off the driveshaft, noting which way round it fits (see illustration). Note the directional arrow on the disc (see illustration 4.6). Mark the relationship of the disc to the wheel so it can be installed in the same position. Unscrew the disc retaining bolts, loosening them a little at a time in a criss-cross pattern to avoid distorting the disc, then remove the disc (see illustration 4.5).

X8 models

7 Remove the exhaust silencer (see Chapter 4).

8 Undo the caliper mounting bolts and slide the caliper off the disc (see illustrations).

Note: Do not operate the brake lever while the caliper is off the disc.

9 Remove the R-clip then pull out the pad retaining pin (see illustration). Lift out the pad spring, then draw the brake pads out from the caliper. Follow the procedure in Section 2, Steps 2 to 10, for inspection and installation of the pads. On installation, apply a suitable non-permanent thread locking compound to the threads of the caliper mounting bolts.

10 To remove the disc, follow the procedure in Section 14, Steps 22 to 26, and remove the wheel. Note the directional arrow on the disc (see illustration 4.6). Mark the relationship of the disc to the wheel so it can be installed in the same position. Unscrew the disc retaining bolts, loosening them a little at a time in a criss-cross pattern to avoid distorting the disc, then remove the disc (see illustration 4.5).

All models

11 Follow the procedure in Section 3, Steps 4 to 13, to overhaul the brake caliper.

12 Follow the procedure in Section 4 for inspection of the disc.

13 To install the disc, position it onto the wheel or hub as applicable, making sure the directional arrow points in the direction of normal wheel rotation. Align the previously-applied matchmarks (if you're reinstalling the original disc).

14 Install the bolts and tighten them in a criss-cross pattern evenly and progressively.

Clean off all grease from the brake disc using acetone or brake system cleaner. If a new brake disc has been installed, remove any protective coating from its working surfaces.

15 Install the remaining components in the reverse order of removal.

16 The rear brake master cylinder has an integral reservoir and is mounted on the left handlebar.

17 Operate the brake lever several times to bring the pads into contact with the disc. Check the operation of the brakes carefully before riding the scooter.

7 Brake hoses, pipes and unions – inspection and renewal

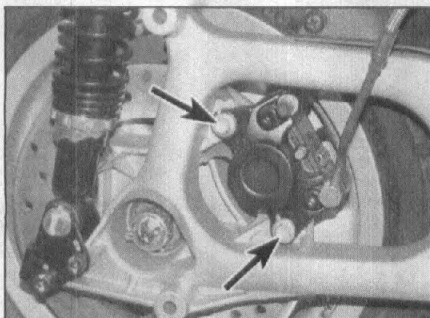


Inspection

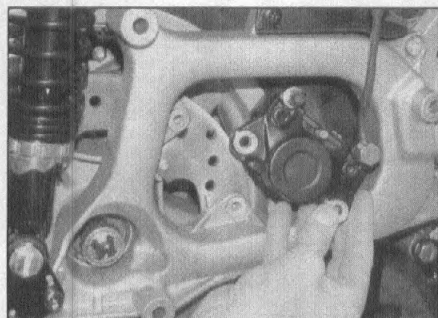
Note: On models fitted with a rear disc brake it will be necessary to remove the floor panel to inspect the rear brake pipe (see Chapter 7).

1 Brake hose and pipe condition should be checked regularly and the hoses renewed at the specified interval (see Chapter 1).

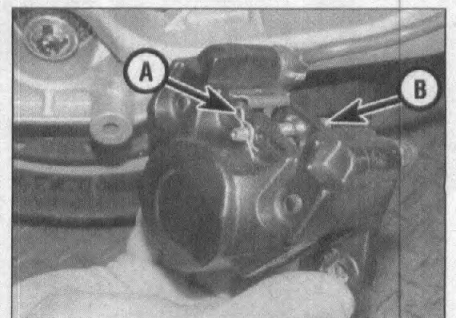
2 Twist and flex the hose while looking for cracks, bulges and seeping fluid. Check extra carefully around the areas where the hose connects with the master cylinder and caliper, as these are common areas for hose failure. On models where the master cylinder is mounted on the steering stem (see Section 5), refer to the procedure in Chapter 7 and remove the front panel to check the hose connections.



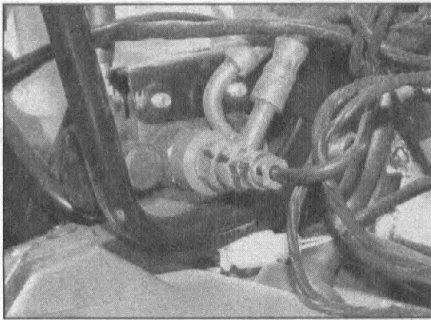
6.8a Remove the caliper mounting bolts (arrowed) ...



6.8b ... and slide the caliper off



6.9 Remove the R-clip (A) then pull out the pad pin (B)



7.2 Hose unions on the X9 linked brake splitter valve

On X9 models, remove the front panel to inspect the unions on the linked brake splitter valve (see illustration).

3 Inspect the union fittings connected to the brake hose. If the fittings are rusted, scratched or cracked, renew them.

Renewal

4 Cover the surrounding area with plenty of rags and unscrew the banjo bolt or nut at each end of the hose, noting its alignment. Free the hose from any clips or guides and remove it. Discard the sealing washers as new ones must be used.

5 Position the new hose, making sure it isn't twisted or otherwise strained, and abut the tab on the hose union with the lug on the component casting, where present. Otherwise align the hose as noted on removal. Install the hose banjo bolts using new sealing washers on both sides of the unions. Tighten the banjo bolts to the torque setting specified at the beginning of this Chapter. Make sure the hoses are correctly aligned and routed clear of all moving components.

6 Keep the hydraulic reservoir topped-up with new DOT 4 brake fluid and flush the old brake fluid from the system (see *Daily (pre-ride) checks*) and bleed the air from the system (see Section 8). Check the operation of the brake carefully before riding the scooter.

8 Brake system bleeding (disc brake models)



1 Bleeding the brakes is simply the process of removing all the air bubbles from the brake fluid reservoir, master cylinder, the hose and the brake caliper. Bleeding is necessary whenever a brake system hydraulic connection is loosened, when a component or hose is renewed, or when the caliper is overhauled. Leaks in the system may also allow air to enter, but leaking brake fluid will reveal their presence and warn you of the need for repair.

2 To bleed the brake, you will need some new DOT 4 brake fluid, a length of clear vinyl or plastic tubing, a small container partially-filled with clean brake fluid, some rags and a spanner to fit the brake caliper bleed valve.

3 Cover any painted components to prevent damage in the event that brake fluid is spilled.

4 As applicable, remove the body panels for access to the fluid reservoir (see Chapter 7).

5 Remove the reservoir cap or cover, diaphragm plate and diaphragm and slowly pump the brake lever a few times, until no air bubbles can be seen floating up from the holes in the bottom of the reservoir. Doing this bleeds the air from the master cylinder end of the line. Loosely refit the reservoir cap or cover.

6 Pull the dust cap off the bleed valve. Attach one end of the clear vinyl or plastic tubing to the bleed valve and submerge the other end in the brake fluid in the container (see illustration). On X9 models, the operation of the front left-hand and rear disc brakes is linked via a splitter valve (see illustration). Bleed air from the splitter valve first, then the rear caliper and then the front caliper.

7 Remove the reservoir cap or cover and check the fluid level. Do not allow the fluid level to drop below the lower mark during the bleeding process.

8 Carefully pump the brake lever three or four

times and hold it in while opening the caliper bleed valve. When the valve is opened, brake fluid will flow out of the caliper into the clear tubing and the lever will move toward the handlebar.

9 Retighten the bleed valve, then release the brake lever gradually. Repeat the process until no air bubbles are visible in the brake fluid leaving the caliper and the lever is firm when applied. On completion, disconnect the bleeding equipment, then tighten the bleed valve and fit the dust cap.



Old brake fluid is invariably much darker in colour than new fluid, making it easy to see when all old fluid has been expelled from the system.

10 Install the reservoir cap or diaphragm and cover assembly, wipe up any spilled brake fluid and check the entire system for leaks.

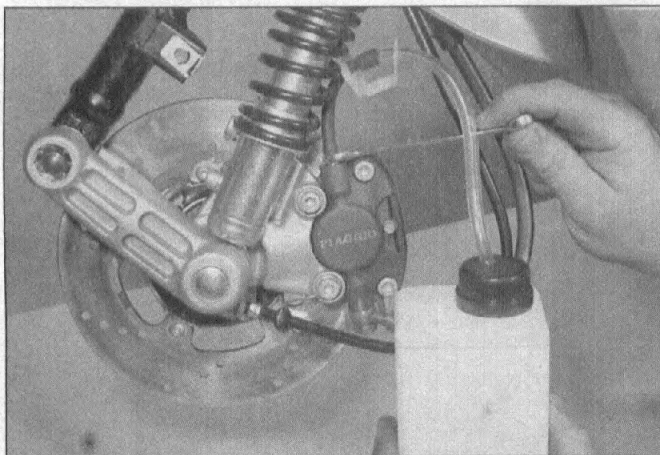


If it's not possible to produce a firm feel to the lever the fluid may be aerated. Let the brake fluid in the system stabilise for a few hours and then repeat the procedure when the tiny bubbles in the system have settled out. To speed this process up, tie the brake lever to the handlebar so that the system is pressurised.

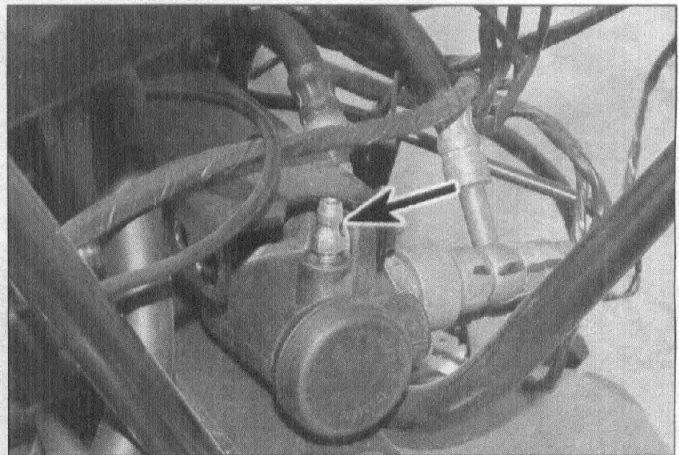
9 Drum brakes (front and rear) – check and shoe renewal



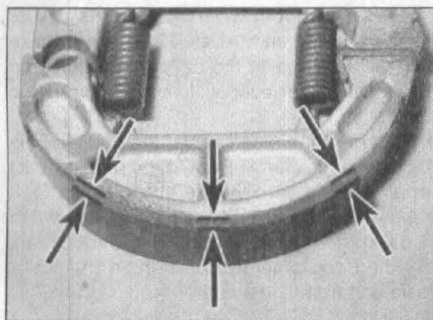
Warning: The dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any



8.6a To bleed the brakes, you need a spanner, a short section of clear tubing, and a clear container half-filled with brake fluid



8.6b Bleed valve (arrowed) on the X9 linked brake splitter valve



9.2 Check the amount of friction material remaining on each shoe

of it. An approved filtering mask should be worn when working on the brakes.

Check

1 Remove the wheel (see Section 13 or 14). On Zip models (front wheel), remove the brake plate from the wheel. Remove the brake shoes (see below).

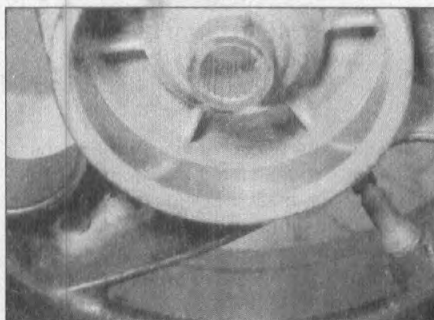
2 Check the condition of the friction material on the brake shoes (see illustration). No minimum thickness specification is given, but if the thickness of material remaining at the cam end (the thinnest point) of the shoe is 1.5 mm or less, the shoes should be renewed.

3 Inspect the surface of each shoe for contamination. If either shoe is fouled with oil or grease, or heavily scored or damaged by dirt and debris, both shoes must be renewed as a set. Note that it is not possible to degrease the friction material; if the shoes are contaminated in any way they must be renewed.

4 If the shoes are in good condition clean them carefully, using a fine wire brush which is completely free of oil and grease to remove all traces of road dirt and corrosion. If the material appears glazed, roughen up the surface using emery cloth, bearing in mind the **Warning** above.

5 Check the condition of the brake shoe springs and renew them if they appear weak or are obviously deformed or damaged.

6 Clean the brake drum surface using brake cleaner or a rag soaked in solvent. Examine the surface for scoring and excessive wear (see illustration). While light scratches are expected, any heavy scoring or cracks will impair braking and there is no satisfactory way of removing them; in this event the wheel should be renewed,



9.6 Check the surface of the drum for scoring and wear

although you could consult an engineer who might be able to skim the surface.

7 Check that the brake cam operates smoothly and to its full limits of travel by operating the lever arm. Clean off all traces of old and hardened grease from the cam. If the bearing surfaces of the cam are worn or damaged it should be renewed.

Shoe renewal

8 Remove the wheel (see Section 13 or 14). On Zip models (front wheel), remove the brake plate from the wheel.

9 Grasp the outer edge of each shoe and fold them upwards and inwards to form a V (see illustration 9.11c), noting that they are under pressure from the springs, then remove them from the plate noting how they locate around the cam and the pivot. Remove the springs from the shoes.

10 Check the shoes and the drum as outlined above.

11 Apply some copper grease to the bearing surfaces on the cam, taking care not to apply too much as it could find its way onto the shoes (see illustration). Install the brake shoes in a reverse of the removal procedure. Fit the springs onto the shoes and position them so that the flat end of each shoe fits on the cam and the rounded end on the pivot (see illustration). Make sure the shoes sit correctly on each side of the cam and the pivot as you fold them flat onto the plate (see illustration). Operate the lever arm to check that the cam and shoes work correctly.

12 Install the wheel. Check the operation of the brake before riding the scooter.



9.11a Apply some copper grease to the cam

10 Brake cables – renewal

Front brake cable

Zip and Sfera with drum brake

1 Release the outer cable from its housing at the lower end.

2 Fully unscrew the adjuster nut on the lower end of the inner cable, then draw the cable out of the brake lever arm.

3 Remove the handlebar front cover (see Chapter 7).

4 Draw the outer cable out of the brake lever bracket and free the inner cable nipple from its socket in the underside of the lever (see illustrations 10.17a and 10.17b).

5 Withdraw the cable, noting its routing and any guides it passes through.

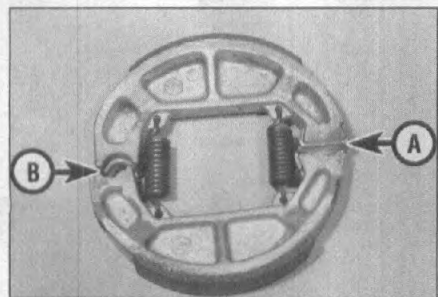
6 Install the new cable in a reverse of the removal procedure. Apply some grease to the nipple on the end of the inner cable at the top, and to the roller in the brake lever arm. Check and adjust the cable freeplay (see Chapter 1).

All other models

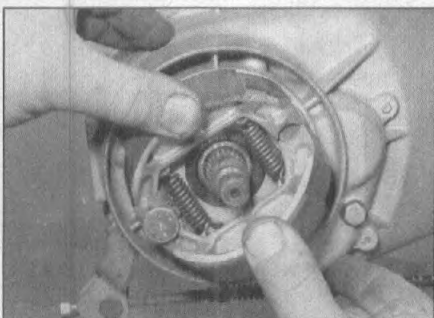
7 Remove the fairing (see Chapter 7).

8 Remove the E-clip on the cable pivot pin, then draw or drive out the pin and detach the cable from the master cylinder lever arm (see illustration 5.16).

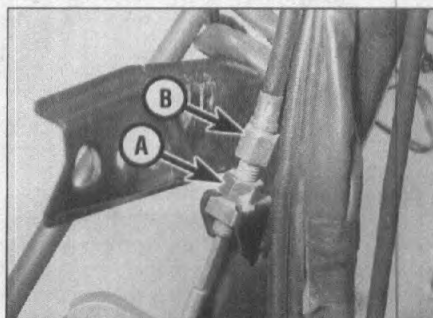
9 Slacken the cable adjuster locknut, then thread the adjuster out of its holder (see illustration).



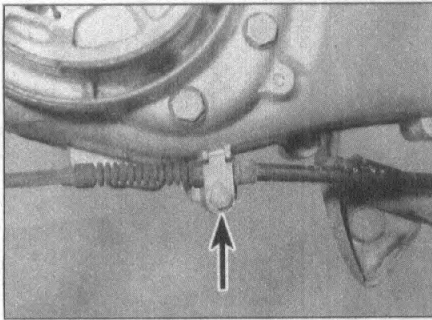
9.11b Fit the springs and locate the flat ends (A) against the cam and the rounded ends (B) against the pivot



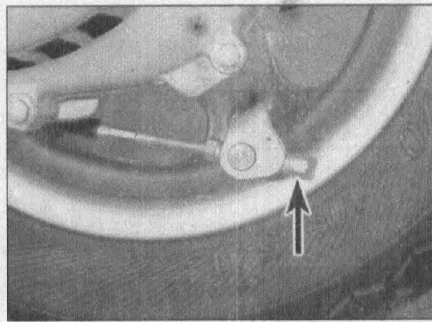
9.11c Installing the brake shoes



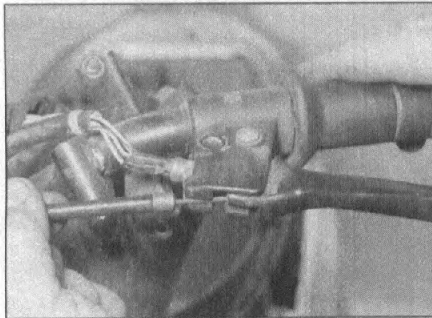
10.9 Slacken the locknut (A) and unscrew the adjuster (B)



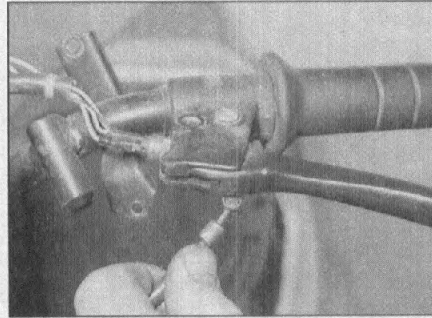
10.14 Unscrew the bolt (arrowed), remove the clamp and release the outer cable



10.15 Unscrew and remove the adjuster nut (arrowed)



10.17a Draw the outer cable from the bracket . . .



10.17b . . . and release the inner cable nipple from the lever

10 Remove the handlebar front cover (see Chapter 7).

11 Draw the outer cable out of the brake lever bracket and free the inner cable nipple from its socket in the underside of the lever (see illustrations 10.17a and 10.17b).

12 Withdraw the cable, noting its routing and any guides it passes through.

13 Install the new cable in a reverse of the removal procedure. Apply some grease to the ends of the inner cable. Check and adjust the cable freeplay (see Chapter 1).

Rear brake cable

14 Remove the outer cable clamp bolt at the lower end of the cable and free the cable from its holder (see illustration). On some models the bolt fits from the outside.

15 Fully unscrew the adjuster nut on the lower end of the cable, then draw the cable out of the brake lever arm (see illustration).

16 Remove the handlebar front cover (see Chapter 7).

17 Draw the outer cable out of the brake lever bracket and free the inner cable nipple from its socket in the underside of the lever (see illustrations).

18 Referring to Chapter 7, remove the legshield panel and footboard to enable access to the cable's guides and indicate correct routing. Withdraw the cable, noting its routing and any guides it passes through.

19 Install the new cable in a reverse of the removal procedure. Apply some grease to the nipple on the end of the inner cable at the top, and to the roller in the brake lever arm.

Check and adjust the cable freeplay (see Chapter 1).

11 Wheels – inspection and repair

1 In order to carry out a proper inspection of the wheels, it is necessary to support the scooter upright so that the wheel being inspected is raised off the ground. Clean the wheels thoroughly to remove mud and dirt that may interfere with the inspection procedure or mask defects. Make a general check of the wheels (see Chapter 1) and tyres (see *Daily (pre-ride) checks*).

2 Attach a dial gauge to a fork leg or the steering stem (front, as applicable) or the transmission casing (rear) and position its stem against the side of the rim (see illustration). Spin the wheel slowly and check the axial (side-to-side) runout of the rim. In order to accurately check radial (out of round) runout with the dial gauge, the wheel would have to be removed from the machine, and the tyre from the wheel. With the axle clamped in a vice or jig and the dial gauge positioned on the top of the rim, the wheel can be rotated to check the runout.

3 An easier, though slightly less accurate, method is to attach a stiff wire pointer to the fork leg or steering stem (front, as applicable) or the transmission casing (rear) and position the end a fraction of an inch from the wheel (where the wheel and tyre join). If the wheel is true, the distance from the pointer to the rim

will be constant as the wheel is rotated. **Note:** If wheel runout is excessive, check the wheel or hub bearings (front) or transmission driveshaft bearings (rear) very carefully before renewing the wheel.

4 The wheels should also be visually inspected for cracks, flat spots on the rim and other damage. Look very closely for dents in the area where the tyre bead contacts the rim. Dents in this area may prevent complete sealing of the tyre against the rim, which leads to deflation of the tyre over a period of time. If damage is evident, or if runout in either direction is excessive, the wheel will have to be renewed. Never attempt to repair a damaged cast alloy wheel.

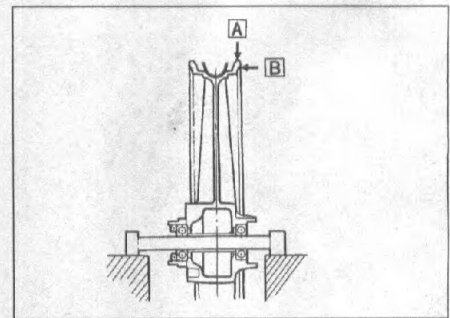
12 Wheels – alignment check

1 Misalignment of the wheels can cause strange and possibly serious handling problems. Note that the wheels are unlikely to go out of alignment on this type of machine, and alignment need only be checked if the scooter has been involved in an accident or if a handling problem occurs. Poor wheel alignment will most likely be due to bent frame or suspension components, although check that the wheel bearings are not at fault. Have the frame checked by a Piaggio dealer.

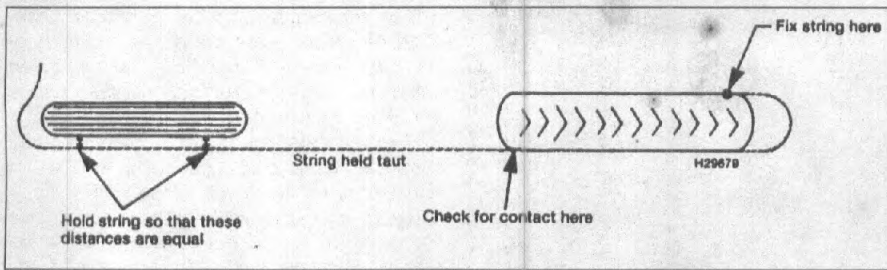
2 To check the alignment you will need an assistant, a length of string or a perfectly straight piece of wood and a ruler. A plumb bob or other suitable weight will also be required.

3 In order to make a proper check of the wheels it is necessary to support the scooter in an upright position on its centre stand. Measure the width of both tyres at their widest points. Subtract the smaller measurement from the larger measurement, then divide the difference by two. The result is the amount of offset that should exist between the front and rear tyres on both sides. Note that certain models use the same diameter tyres front and back.

4 If a string is used, have your assistant hold one end of it about halfway between the floor



11.2 Check the wheel for radial (out-of-round) runout (A) and axial (side-to-side) runout (B)



12.5 Wheel alignment check using the string method
Tyres of different widths front and rear illustrated

and the rear axle, touching the rear sidewall of the tyre.

5 Run the other end of the string forward and pull it tight so that it is roughly parallel to the floor. Slowly bring the string into contact with the front sidewall of the rear tyre, then turn the front wheel until it is parallel with the string. Measure the distance from the front tyre sidewall to the string (see illustration).

6 Repeat the procedure on the other side of the scooter. The distance from the front tyre sidewall to the string should be equal on both sides. Where the tyre diameters are the same front and back, the string should of course touch the front tyre sidewall directly.

7 As was previously pointed out, a perfectly straight length of wood may be substituted for the string. The procedure is the same (see illustration).

13 Front wheel and hub assembly – removal and installation



Monoshock models

Wheel removal and installation

1 Position the scooter upright so that the front wheel is off the ground; make sure it is properly supported.

2 On Sfera 50/80 models with a drum front brake, the procedure for removing the front wheel is similar to that for the rear wheel – refer to Section 14 for details. On all other models, unscrew the five bolts securing the wheel to the hub assembly and draw the

wheel off the hub, noting the large washer on the inside of the wheel (see illustrations).

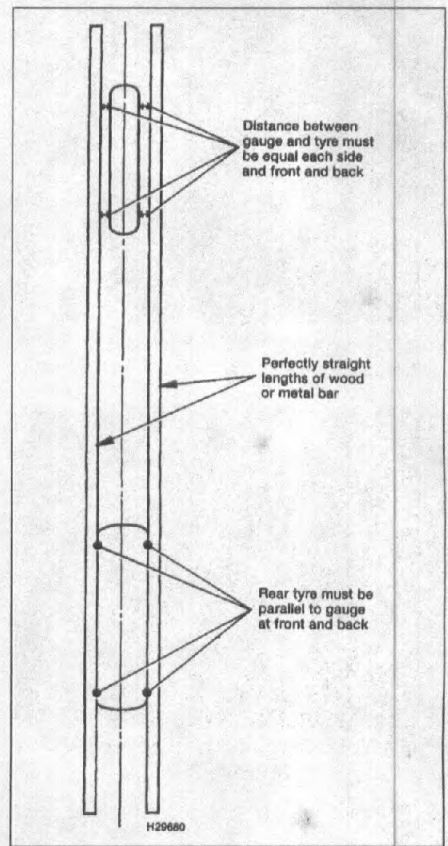
3 Fit the washer to the inside of the wheel, then install the bolts with their washers and tighten them to the torque setting specified at the beginning of the Chapter (see illustration).

Hub assembly removal

4 Remove the wheel (see above). Detach the speedometer cable from the hub and withdraw the drive gear (see Chapter 9).

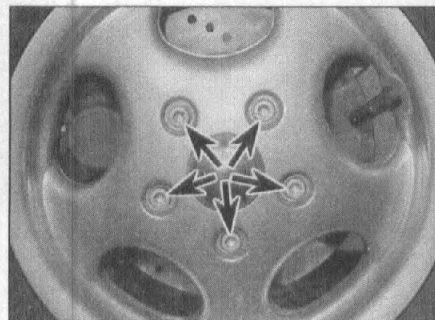
5 On models with a disc brake, remove the brake caliper mounting bolts and slide the caliper off the disc (see Section 3). Support the caliper with a piece of wire or a bungee cord so that no strain is placed on its hydraulic hose. There is no need to disconnect the hose from the caliper. **Note:** Do not operate the brake lever with the caliper removed.

6 Remove the split pin from the hub cage nut and remove the cage nut (see illustrations). Discard the split pin; a new one must be used.



12.7 Wheel alignment check using a straight-edge

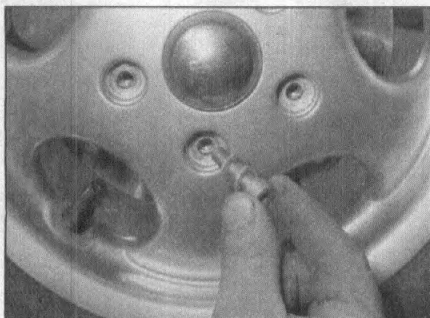
Tyres of different widths front and rear illustrated



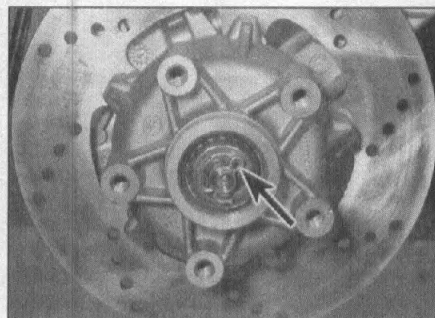
13.2a Unscrew the bolts (arrowed) ...



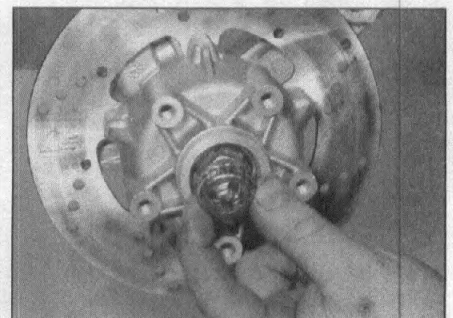
13.2b ... and remove the wheel



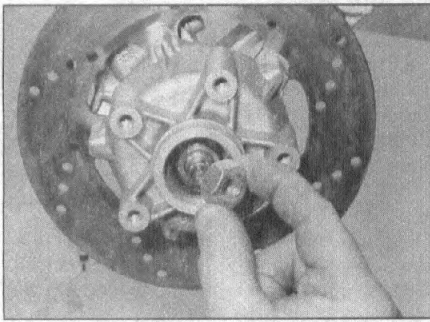
13.3 Do not omit the washers with each bolt



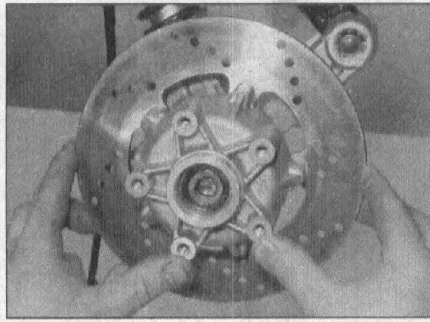
13.6a Remove the split pin (arrowed) ...



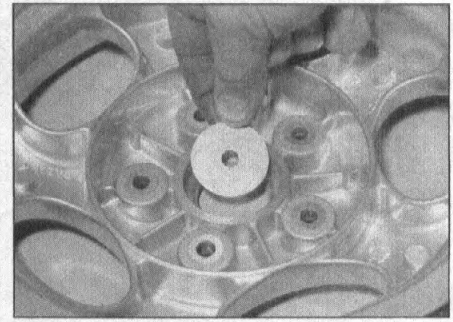
13.6b ... and the cage nut



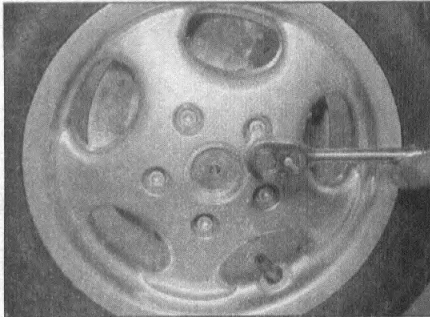
13.7 Remove the hub nut



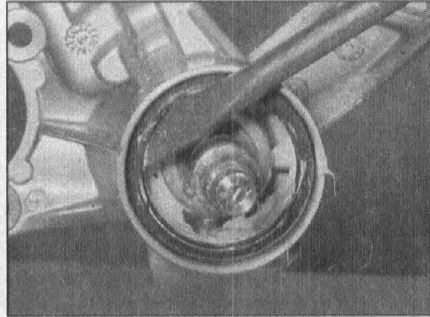
13.8a Draw the hub assembly off the axle



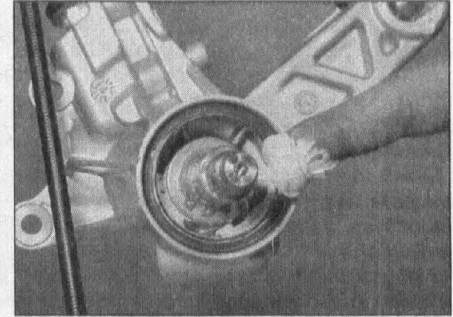
13.8b Fit the washer into the inside of the wheel . . .



13.8c . . . and tighten the bolts as described



13.9 Lever out the old seal using a screwdriver



13.10a Apply grease to the axle and drive housing seal

7 Unscrew the hub nut (see illustration).

8 Draw the hub assembly off the axle (see illustration). The hub assembly is quite a tight fit – if it is difficult to remove, fit a strong washer with an external diameter the same as the recess in the wheel and with an internal diameter smaller than the diameter of the axle (so that the washer cannot slide over the axle) into the wheel (see illustration). Place the wheel against the axle, then install the wheel bolts and tighten them evenly and a little at a time in a criss-cross sequence until the hub is drawn off (see illustration).

9 Check the condition of the bearings in the hub (see Section 15), and of the grease seal in the speedometer drive gear housing. Lever out the old seal from the drive housing and fit a new one if it is worn, damaged or deteriorated (see illustration).

Hub assembly installation

10 Installation is the reverse of removal, noting the following:

- a) Apply grease to the axle, and to the bearings and speedometer drive in the hub (see illustration).
- b) Tighten the hub nut to the torque setting specified at the beginning of the Chapter (see illustration).
- c) Use a new split pin to secure the cage nut (see illustration) and bend its ends correctly (see illustration 13.6a).

Telescopic fork models

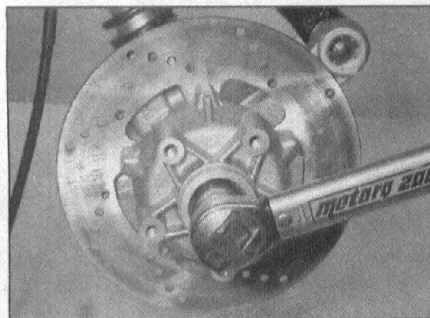
Wheel removal

11 Position the scooter so that its front wheel is off the ground. Always make sure the scooter is properly supported.

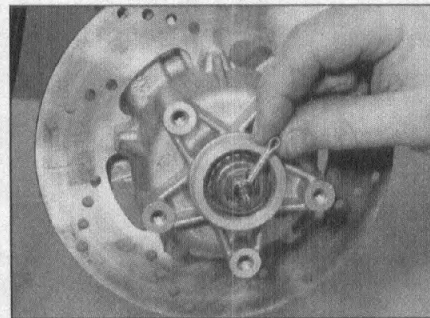
12 On Zip models with a drum brake, disconnect the brake cable (see Section 10). On all other models, remove the brake caliper mounting bolts and slide the caliper off the disc (see Section 3). Support the caliper with a piece of wire or a bungee cord so that no strain is placed on its hydraulic hose. There is no need to disconnect the hose from the caliper. **Note:** Do not operate the front brake lever with the caliper removed.

13 Pull back the rubber boot on the end of the speedometer cable, then unscrew the knurled ring and draw the cable out of the drive gear housing. **Note:** Some later models are fitted with electronically-operated speedometers – do not try to disconnect the cable from the drive gear housing (see Chapter 9).

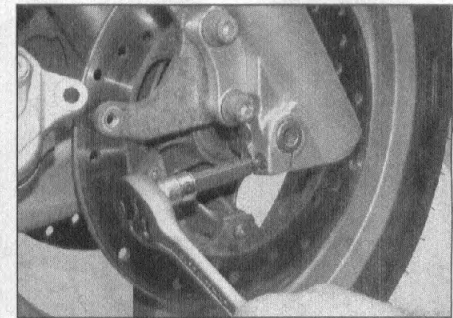
14 Where fitted, loosen the axle pinch-bolts (see illustration). Unscrew the axle nut, then



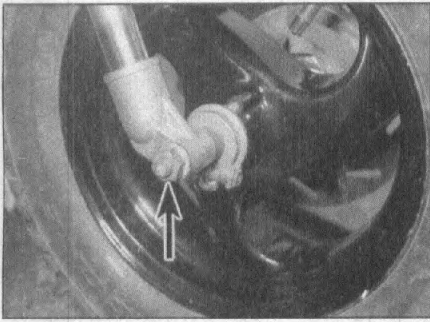
13.10b Tighten the hub nut to the specified torque



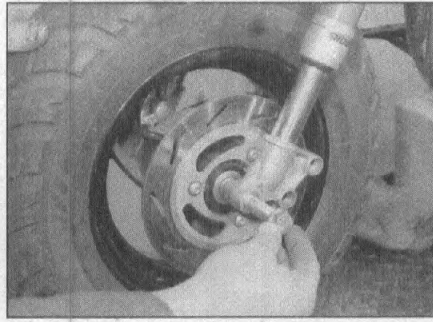
13.10c Use a new split pin to secure the cage nut



13.14a Loosen the axle pinch-bolts



13.14b Unscrew the axle nut (arrowed) . . .



13.14c . . . then withdraw the axle

support the wheel and withdraw the axle from the wheel (see illustrations). Use a drift to knock the axle through if necessary. Remove the speedometer drive housing and thrustwasher, where fitted, noting how they fit.

Caution: Don't lay the wheel down and allow it to rest on the disc – the disc could become warped. Set the wheel on wood blocks so the disc doesn't support the weight of the wheel.

15 Check the axle for straightness by rolling it on a flat surface such as a piece of plate glass (first wipe off all old grease and remove any corrosion using fine emery cloth). If the equipment is available, place the axle in V-blocks and measure the runout using a dial gauge. If the axle is bent or the runout exceeds the limit specified, renew it.

16 Check the condition of the wheel bearings (see Section 15).

Wheel installation

17 Manoeuvre the wheel into position, making sure the directional arrow is pointing in the normal direction of rotation. Apply some grease to the inside of the speedometer drive housing. If applicable, fit the thrustwasher, then install the drive housing onto the wheel, making sure the drive tab locates correctly (see illustrations). Apply a thin coat of grease to the axle.

18 Lift the wheel into place between the forks, making sure the stepped section on the outside of the speedometer drive housing locates correctly against the corresponding section on the inside of the bottom of the fork (see illustration). Install the axle.

19 Install the axle nut and tighten it to the torque setting specified at the beginning of the Chapter (see illustrations). If applicable, tighten the axle pinch-bolts to the specified torque setting.

20 Install the brake caliper, making sure the pads sit squarely on each side of the disc (see Section 3). Tighten the caliper mounting bolts to the specified torque setting.

21 If applicable, connect the speedometer cable and tighten the knurled ring. On Zip models with a drum brake, connect the brake cable (see Section 10).

22 With the exception of Zip models, apply the front brake a few times to bring the pads back into contact with the disc. Move the scooter off its stand, apply the front brake and pump the front forks a few times to settle all components in position.

23 Check for correct operation of the front brake before riding the scooter.

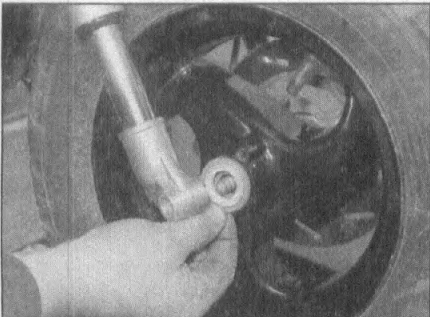
14 Rear wheel and hub assembly – removal and installation



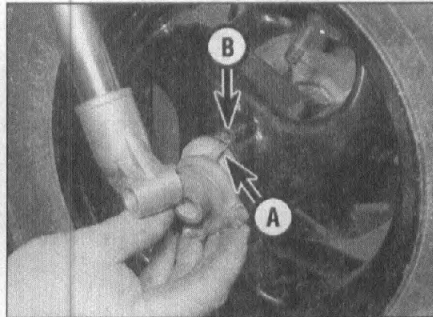
Drum brake models

Removal

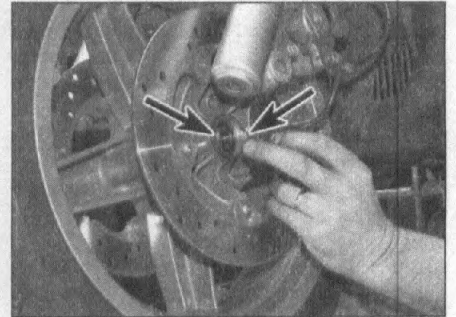
- 1 Position the scooter on its centre stand and support it so that the rear wheel is off the ground. Remove the silencer (see Chapter 4).
- 2 Lever off the wheel cover using a small



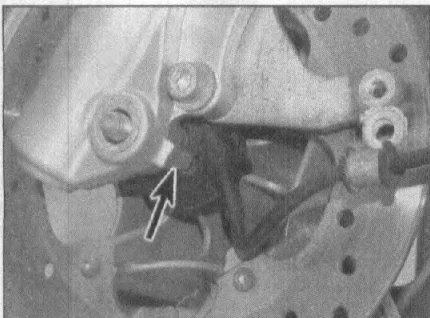
13.17a Fit the thrustwasher . . .



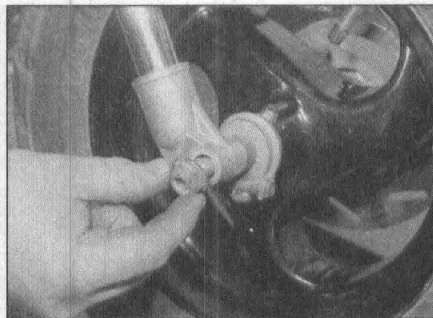
13.17b . . . and the speedometer drive, locating the tab (A) in the hole (B) . . .



13.17c . . . or aligning the tabs (arrowed) with the drive housing



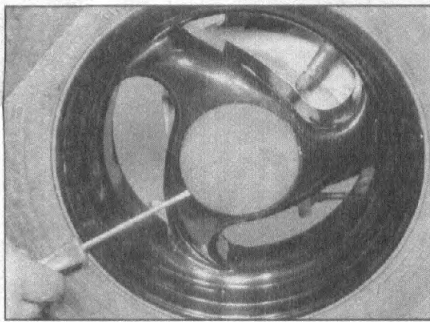
13.18 Speedometer drive housing should locate against lug (arrowed)



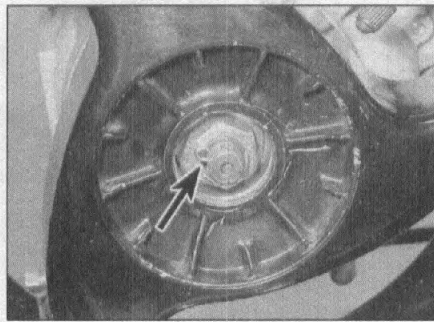
13.19a Fit the axle nut . . .



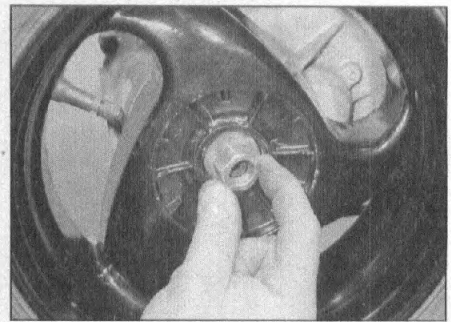
13.19b . . . and tighten it to the specified torque



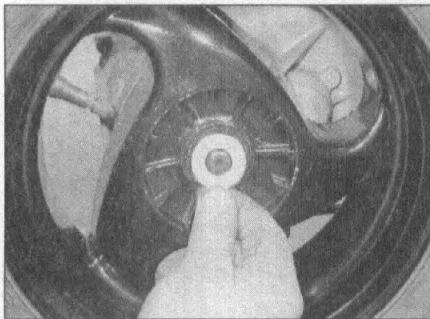
14.2a Lever off the cover ...



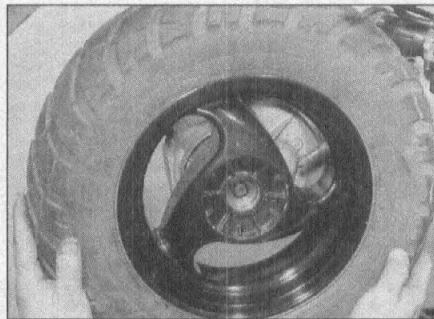
14.2b ... and remove the split pin (arrowed)



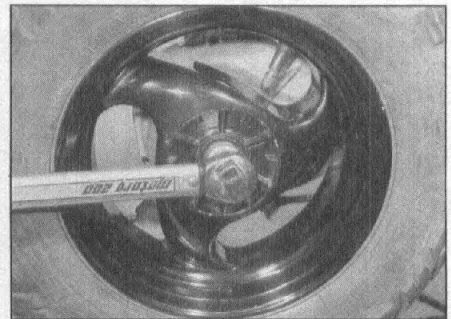
14.3a Unscrew the nut ...



14.3b ... remove the washer ...



14.3c ... and draw the wheel off the driveshaft



14.6 Tighten the nut to the specified torque

flat-bladed screwdriver (see illustration). Remove the split pin from the end of the axle then remove the cage nut (see illustration). Discard the split pin, as a new one must be used.

3 Unscrew the wheel nut, whilst applying the rear brake to prevent the wheel from turning (see illustration). Remove the washer and draw the wheel off the driveshaft (see illustrations).

4 Check the splines on the driveshaft and on the inside of the wheel for wear and damage and renew either or both components as required.

Installation

5 Apply some grease to the splines on the shaft and slide the wheel into position (see illustration 14.3c).

6 Fit the washer and the wheel nut (see illustrations 14.3b and 14.3a), then tighten the wheel nut to the torque setting specified at the beginning of the Chapter, applying the rear brake to prevent the wheel from turning (see illustration).

7 Fit the cage nut and secure the nut using a new split pin, bending its ends around the cage nut (see illustration).

8 Fit the wheel cover.

Disc brake models with single rear shock absorber

Removal

9 Position the scooter on its centre stand and support it so that the rear wheel is off the

ground. Remove the silencer (see Chapter 4).

10 Have an assistant apply the rear brake to prevent the wheel from turning, then undo the bolts securing the wheel to the hub assembly and lift the wheel off the hub.

11 If required, follow the procedure in Section 6 to remove the rear hub assembly.

12 Check the splines on the driveshaft and on the inside of the hub for wear and damage and renew either or both components as required.

Installation

13 If removed, install the hub assembly and install the rear brake caliper (see Section 6).

14 Fit the wheel onto the hub. Have an assistant apply the rear brake and tighten the wheel bolts to the torque setting specified at the beginning of the Chapter.

15 Install the remaining components in the reverse order of removal.

Disc brake models with twin rear shock absorbers

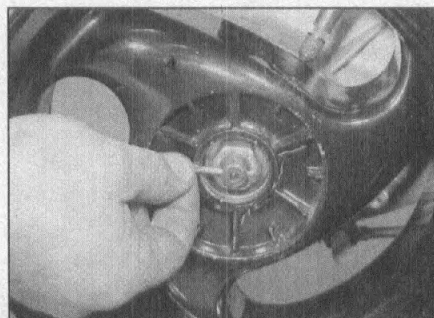
16 Position the scooter on its centre stand and support it so that the rear wheel is off the ground. Remove the silencer (see Chapter 4).

17 Where fitted, undo the screw securing the rear hugger to the subframe (see illustration).

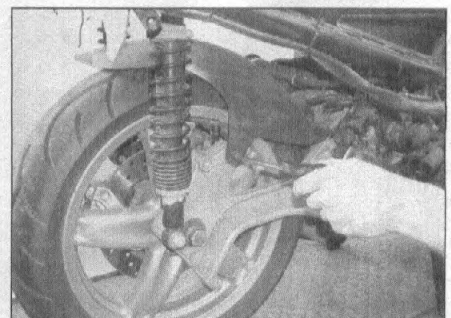
Removal – Hexagon, Beverly, X9 and all GT models

18 Undo the nut securing the lower end of the right-hand shock absorber to the subframe and displace the shock, then undo the bolts securing the subframe to the engine casing (see illustrations).

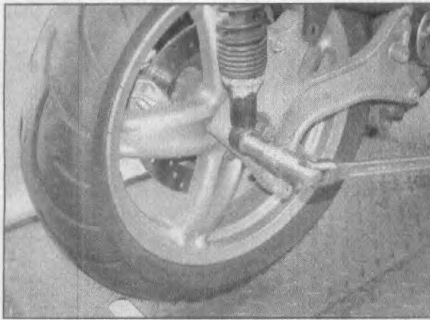
19 Remove the split pin from the end of the driveshaft then remove the cage nut (see illustration). Discard the split pin, as a new one must be used. Have an assistant apply the rear brake, then unscrew the hub centre



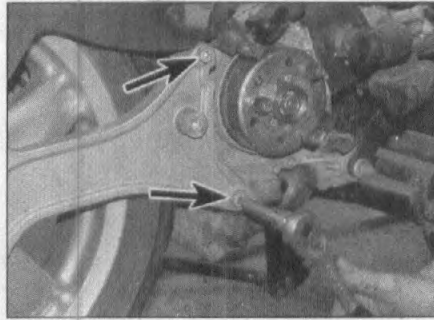
14.7 Use a new split pin (note that cage nut should be fitted first)



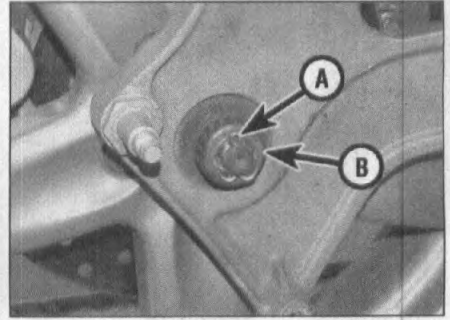
14.17 Remove the hugger fixing screws



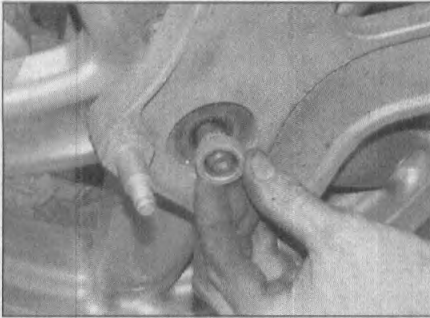
14.18a Undo the lower shock fixing ...



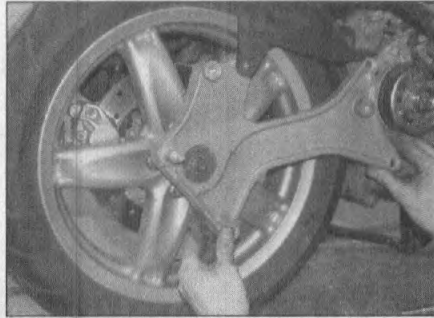
14.18b ... and the subframe mounting bolts



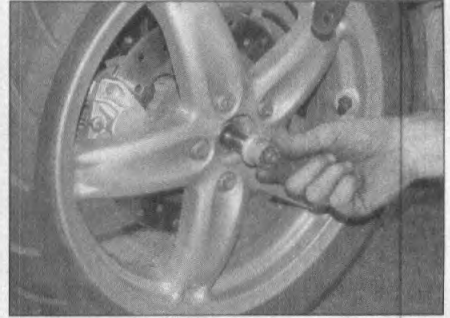
14.19a Remove the split pin (A) and the cage nut (B)



14.19b Note the position of the large washer



14.20a Remove the subframe ...



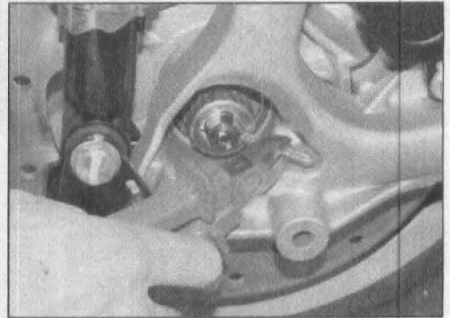
14.20b ... and slide the spacer off the driveshaft



14.21a Undo the bolts ...



14.21b ... and lift off the wheel



14.22a Pull out the split pin ...

nut and remove the nut and large washer (see illustration).

20 Lift off the subframe and slide the spacer off the driveshaft, noting which way round it fits (see illustrations).

21 Undo the bolts securing the wheel to the hub assembly and remove the wheel (see illustrations). If required, follow the procedure in Section 6 to remove the rear hub assembly.

Removal – X8 models

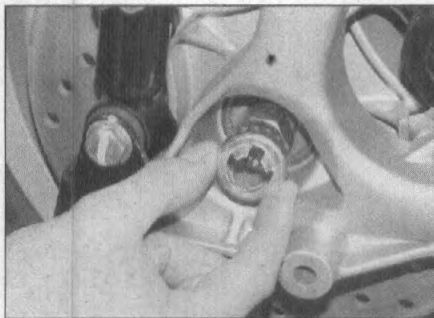
22 Remove the split pin from the end of the driveshaft then remove the cage nut (see illustrations). Discard the split pin, as a new one must be used. Have an assistant apply the rear brake, then unscrew the hub centre nut and remove the nut and large washer (see illustration).

23 Remove the brake caliper mounting bolts

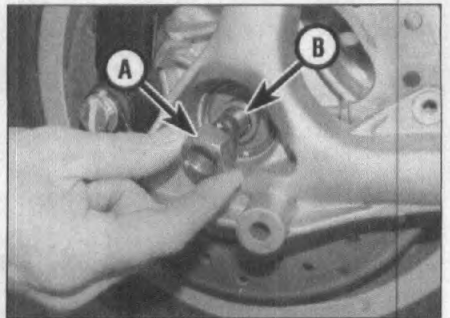
and displace the caliper (see illustrations 6.8a and 8b). Support the caliper with a piece of wire or a bungee cord so that no strain is placed on its hydraulic hose. There is no need

to disconnect the hose from the caliper. **Note:** Do not operate the front brake lever with the caliper removed.

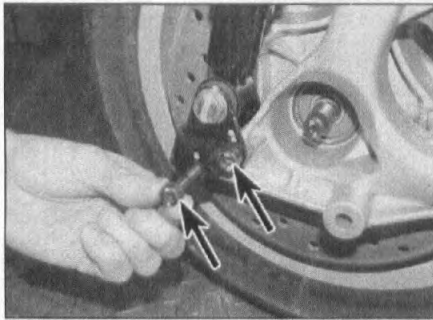
24 Undo the bolts securing the lower end of



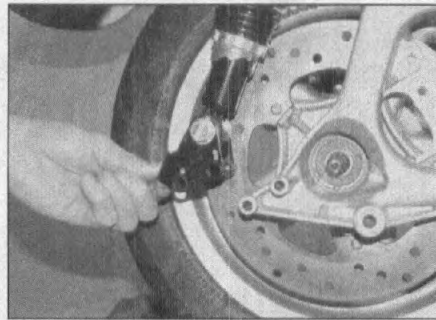
14.22b ... then remove the cage nut



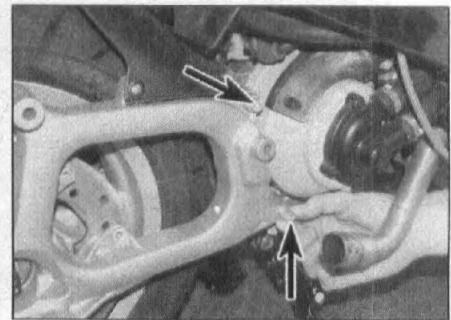
14.22c Remove the hub centre nut (A) and washer (B)



14.24a Remove the bolts (arrowed) . . .



14.24b . . . and displace the lower end of the shock



14.25a Undo the bolts (arrowed) . . .

the right-hand shock absorber to the subframe and displace the shock (see illustrations).

25 Undo the bolts securing the subframe to the engine casing and lift the subframe off (see illustrations).

26 Slide the spacer off the driveshaft, noting which way round it fits (see illustration). Draw the wheel off the driveshaft. If required, follow the procedure in Section 6 to remove the brake disc.

Caution: Don't lay the wheel down and allow it to rest on the disc - the disc could become warped. Set the wheel on wood blocks so the disc doesn't support the weight of the wheel.

Check - all models

27 Check the condition of the bearing in the subframe - the bearing is sealed on both sides (see Section 15, Step 7). If there is any doubt

about the condition of the bearing, renew it. Note that the bearing is retained by a circlip (see illustration). Remove the circlip, then drive the bearing out from the other side. Follow the procedure in Section 15, Step 14, to install the new bearing.

28 Check the splines on the driveshaft and on the inside of the hub for wear and damage and renew either or both components as required (see illustrations).

Installation - all models

29 Installation is the reverse of removal, noting the following:

- a) Tighten the wheel bolts securely.
- b) Install the spacer on the driveshaft between the wheel and the subframe.
- c) Install the large washer on the driveshaft, then the hub centre nut. Tighten the nut to the specified torque setting.

d) Fit the cage nut and secure the nut using a new split pin, bending its ends around the cage nut.

15 Wheel bearings - removal, inspection and installation

Front wheel bearings

Monoshock (except Sfera with drum brake)

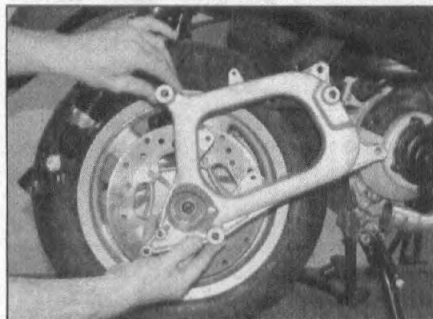
1 The bearings for the front wheel on these models are housed within the hub assembly. Remove the wheel and the hub assembly (see Section 13).

2 Remove the circlip retaining the caged ball-bearing using a pair of internal circlip pliers (see illustration). Also remove the grease seal on the inside of the hub.

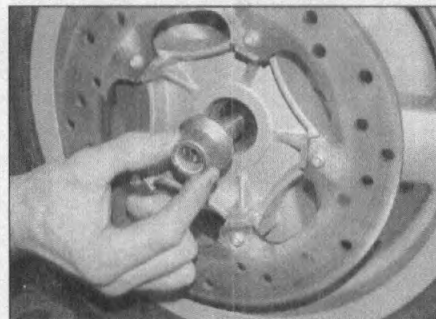
3 Set the hub assembly on blocks to allow the bearings to be driven out.

4 Using a metal rod (preferably a brass drift punch) inserted through the centre of the needle roller bearing on the inside of the hub, tap evenly around the outer race of the caged ball-bearing to drive it from the hub (see illustration).

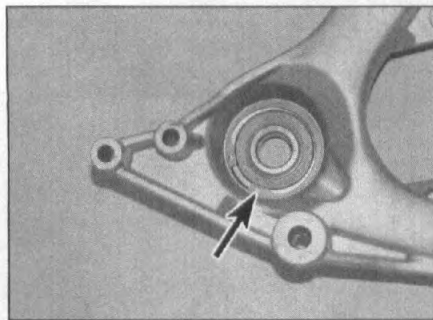
5 Lay the hub on its other side so that the needle roller bearing faces down. Drive the bearing out of the hub using the same technique as above. Note that the needle bearing cannot be re-used after it has been driven out.



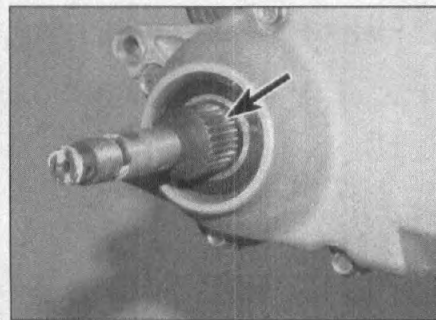
14.25b . . . and lift the subframe off



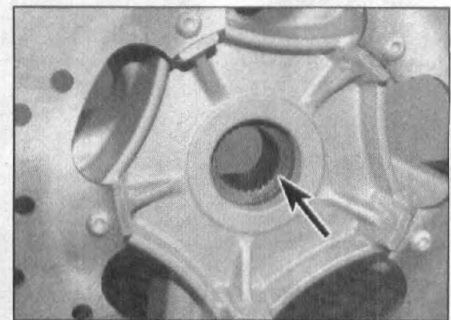
14.26 Slide the spacer off, noting how it fits



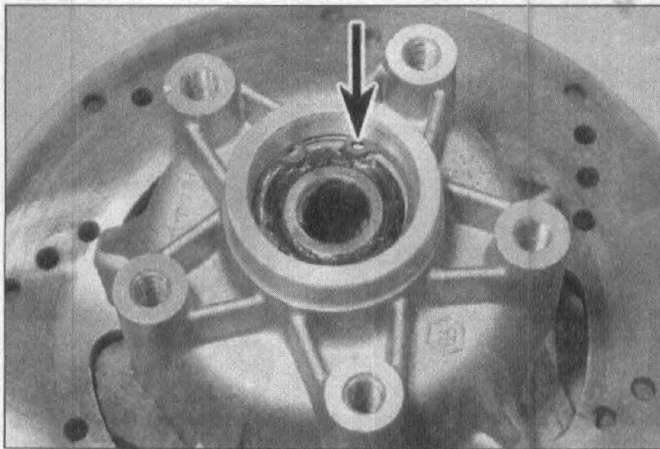
14.27 Subframe bearing is retained by a circlip (arrowed)



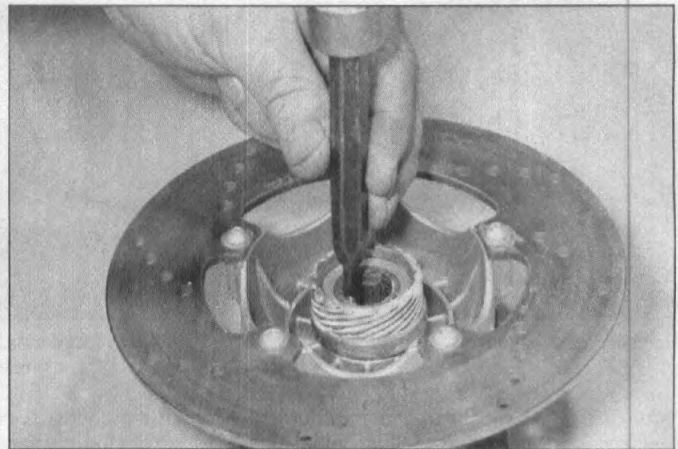
14.28a Check the condition of the splines on the driveshaft . . .



14.28b . . . and the corresponding splines inside the hub



15.2 Remove the circlip (arrowed)



15.4 Drive the bearing out

6 If the caged ball-bearing is of the unsealed type or is only sealed on one side, clean it with a high flash-point solvent (one which won't leave any residue) and blow it dry with compressed air (don't let the bearing spin as you dry it). Apply a few drops of oil to the bearing. **Note:** If the bearing is sealed on both sides don't attempt to clean it.

7 Hold the outer race of the bearing and rotate the inner race – if the bearing doesn't turn smoothly, has rough spots or is noisy, renew it (see illustration).

8 If the bearing is good and can be re-used, wash it in solvent once again and dry it, then pack the bearing with grease.

9 Thoroughly clean the assembly, then install the bearings. Apply grease to the outside of the new needle bearing and press, rather than drive, it home until it is fully seated. In the absence of a press, a suitable drawbolt arrangement can be made up as described below.

10 Obtain a long bolt or a length of threaded rod from a local engineering works or some other supplier. The bolt or rod should be about one inch longer than the combined width of the hub and bearing. Also required are suitable nuts and two large and robust washers having a larger outside diameter than the caged ball-bearing housing. In the case of the threaded rod, fit one nut to one end of the rod and stake it in place for convenience.

11 Fit one of the washers over the bolt or rod so that it rests against the head or staked nut, then pass the assembly through the hub from the outside. Over the projecting end place the needle bearing, which should be greased to ease installation, followed by the remaining washer and nut.

12 Holding the bearing to ensure that it is kept square, slowly tighten the nut so that the bearing is drawn into its bore.

13 Once it is fully home, remove the drawbolt arrangement. Install a new oil seal into the hub.

14 Install the caged ball-bearing with the marked or sealed side facing outwards. Using the old bearing (if a new one is being fitted), a bearing driver or a socket large enough to contact the outer race of the bearing, drive it in squarely until it is completely seated. Fit the bearing retaining circlip, making sure it fits properly in its groove.

15 Install the hub assembly and the wheel (see Section 13).

Telescopic forks (and Sfera with drum brake)

Note: Always renew the wheel bearings in pairs. Never renew the bearings individually. Avoid using a high pressure cleaner on the wheel bearing area.

16 Remove the wheel (see Section 13).

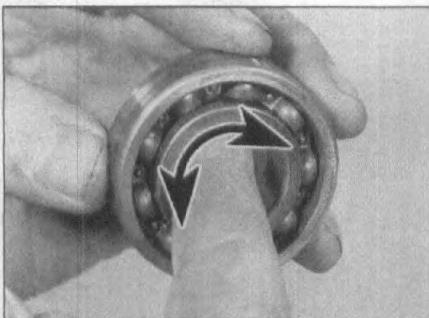
17 Set the wheel on blocks. Do not to allow

the weight of the wheel to rest on the brake disc (where applicable).

18 To remove the grease seals, which are metal and cannot, therefore, be levered out without damaging them, use either an expanding bearing puller and slide-hammer, or a suitable drift (such as a metal rod or a brass drift punch) inserted from the opposite side to the bearing being removed (see illustrations). The tool used must locate on the rim of the shouldered spacer which locates behind the seal. Drawing or driving out the spacer will bring the seal with it. If the bearings are being removed, rather than just inspected, it is possible to locate the tool on the bearing inner race and to draw or drive the bearing, spacer and seal out together. If a drift is being used, and it is difficult to locate on the spacer or bearing due to the steep angle (the bearing must be face down and the drift inserted from the top), locate it on the upper rim of the central bearing spacer, which will be just below the inner race of the top bearing, and drive the central spacer, bearing, spacer and seal out together.

Caution: If driving against the central spacer, make sure you have the drift correctly located and are not trying to drive the top bearing into the wheel.

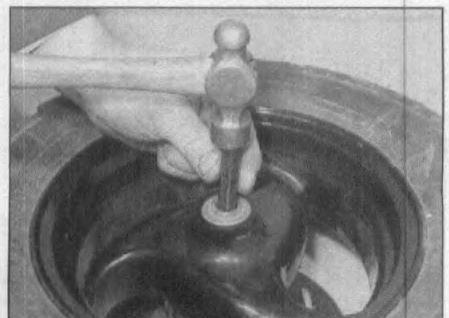
19 Lay the wheel on its other side and draw or drive the seal/spacer/bearing out of the wheel using the same technique as above.



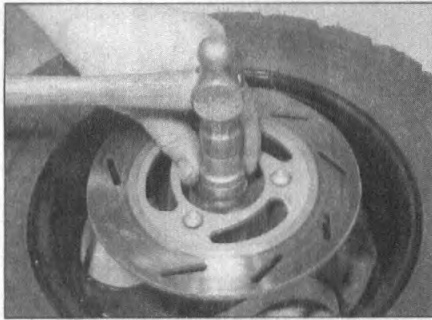
15.7 Hold the bearing outer race and listen whilst the inner race is spun



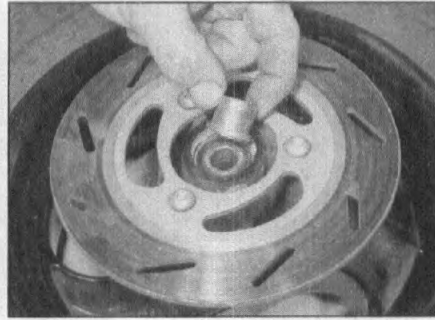
15.18a Using a puller to remove the seals and bearings



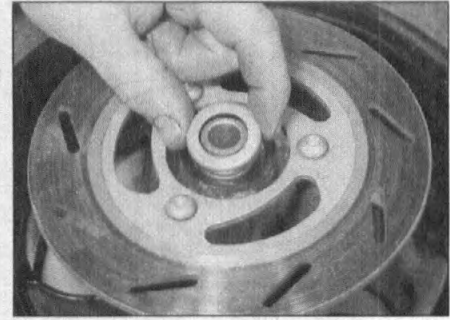
15.18b Using a drift to remove the seals and bearings



15.23 Using a socket to drive in the bearings



15.25a Fit the shouldered spacer . . .



15.25b . . . then the seal

20 If the bearings are of the unsealed type or are only sealed on one side, clean them with a high flash-point solvent (one which won't leave any residue) and blow them dry with compressed air (don't let the bearings spin as you dry them). Apply a few drops of oil to the bearing. **Note:** *If the bearing is sealed on both sides don't attempt to clean it.*

21 Hold the outer race of the bearing and rotate the inner race – if the bearing doesn't turn smoothly, has rough spots or is noisy, renew it (see illustration 15.7).

22 If the bearings are in good condition and can be re-used, wash them in solvent once again and dry them, then pack the bearings with grease.

23 Thoroughly clean the hub area of the wheel. First install a bearing into its recess in one side of the hub, with the marked or sealed side facing outwards. Using the old bearing (if new ones are being fitted), a bearing driver or a socket large enough to contact the outer race of the bearing, drive it in until it is completely seated (see illustration).

24 Turn the wheel over and install the bearing central spacer. Drive the other bearing into place as described above.

25 Fit the shouldered spacers onto the wheel

so that the shoulder is against the bearing, then press the grease seals into the wheel, using a socket to drive them into place if required (see illustrations).

26 With the exception of Zip and Sfera models, clean off all grease from the brake disc using acetone or brake system cleaner then install the wheel (see Section 13).

Rear wheel bearings

27 The rear wheel itself has no bearings. Refer to Chapter 2G for renewal of the driveshaft bearings in the gearbox. On models fitted with twin rear shock absorbers, also check the condition of the bearing in the rear subframe (see Section 14).

16 Tyres – general information and fitting

General information

1 The wheels fitted to all models are designed to take tubeless tyres only. Tyre sizes are given in the Specifications at the beginning of Chapter 1.

2 Refer to *Daily (pre-ride) checks* at the beginning of this manual for tyre maintenance.

Fitting new tyres

3 When selecting new tyres, refer to the tyre information label on the scooter and the tyre options listed in the owner's handbook. Ensure that front and rear tyre types are compatible, the correct size and correct speed rating; if necessary seek advice from a Piaggio dealer or tyre fitting specialist.

4 It is recommended that tyres are fitted by a motorcycle tyre specialist rather than attempted in the home workshop. This is particularly relevant in the case of tubeless tyres because the force required to break the seal between the wheel rim and tyre bead is substantial, and is usually beyond the capabilities of an individual working with normal tyre levers. Additionally, the specialist will be able to balance the wheels after tyre fitting.

5 Note that punctured tubeless tyres can in some cases be repaired. Piaggio recommend that such repairs are carried out only by an authorised dealer.