KOPP REPAIRS

Gears and Motors

Where variators are fitted with flange mounted reduction gears or motors, these will require to be removed prior to dismantling the Variator, giving access to both Variator shafts to permit setting adjustments to be made.

Dismantling the Variator

a) Empty the Variator of oil and if applicable, remove the fan and cowl.
b) Place the Variator on wooden blocks so that the shafts are vertical with the shaft nearest to the speed control uppermost.
c) Remove the handwheel control by loosening the grubscrew on the side of the control housing in the Variator body.
d) Remove the end cover screws from the input end cover and using a hide mallet, apply a few sharp blows on the Variator feet to detach the end cover. (Note: The shaft and bearing assembly should come away with the input end cover)
e) Remove the iris plate (inserting two Allen screws in the tapped holes will provide a means for lifting) when the guide rollers, guide balls, preload spring, roller cage assembly, second preload spring and drive cone, in that order.
f) Remove drive balls and ball spindles (Note that the drive balls are matched and MUST be kept in sets).
g) Remove the output drive cone and the second preload assembly. Remove the retaining ring (on some sizes removal of the output end cover is necessary before this can be done)
h) To remove the shaft from its end cover, slacken the adjustment disc locking screw, remove the disc and draw the shaft assembly OUTWARDS complete with bearings.
i) We do not recommend dismantling shaft assemblies but should it be necessary, force must not be applied to the outer races of the bearings.
j) VERTICAL VARIATORS. In these units a pump is incorporated and is driven from one end of the shafts by means of a pin. This prevents the pump assembly from being removed unless bearings are first withdrawn independently. After this has been done the pump end cover and internal components can be dismantled.

Inspection of Parts

1. Bearings:
Clean shaft bearings thoroughly with white spirit and check races and balls for smooth and quiet operation. If replacement of the bearings is necessary it is important that they be installed in the original position ad that they are identical. Alternative suppliers' bearings may not have the same capacity.

2. Splined Discs:
Check for evidence of wear on the inclined ramps. Heavy or severe indentations will necessitate replacing the splined disc as otherwise the torque responsive mechanism will not react properly.

3. Drive Cones:
Check the inclined ramps for evidence of wear. The drive surface of the cone must be inspected to ensure that it is free from pits, scuffs or cracks. If the cones have been in service for an extended period of time, it may be advantageous to replace them.

4. Drive Balls:
The drive balls should be inspected for cracks, pits or scuffing. Contact paths on the drive balls are usually in the form of polished rings, This is quite normal. Nevertheless, if the rings indicate that either the lower end or the top end of the speed range has been most frequently used, the balls can be inverted so that the drive cones will operate on relatively unused surfaces. THE DRIVE BALLS ARE INSTALLED AS A MATCHED SET AND SHOULD THEREFORE NOT BE SEPERATED. (i.e. all sets are matched in diameter to a specific tolerance.)

5. Roller Cage Assemblies and Rings:
Inspect the roller cage for nicks or dents and the rollers for indentations or flat spots. Also, check that the roller cage ring will fit into the roller cage assembly and rotate freely. Replace either if wear or damage appears excessive.

6. Preload Springs:
Check for wear and conformity of shape, and replace if necessary.

7. Retaining Ring:
Inspect the running surface for crack, pits and scuffing and replace if necessary.

8. Iris Plate:
Inspect the cam slots and gear teeth for damage which, if superficial, can usually be removed by hand-scraping or stoning.

9. Ball Spindle Assemblies:
a) Spindles:
These are of phosphor-bronze on sizes 312 to 315 and case hardened steel with needle rollers on sizes 316 upwards. Inspect for straightness and after cleaning, for signs of wear or permanent discolouration. Replace if necessary.
b) Needle Bearings:
These are usually of the split cage type. Inspect the cage and needle rollers for signs of damage or permanent discolouration. (the needle rollers many fall out of their cages, but providing they are still serviceable, they can be replaced.)
c) Guide Balls and Rollers:
Inspect for wear in the form of flats or any other damage, and fit replacements if required.

Spare Parts
A descriptive list of parts, together with their identity numbers, is given on page 12. All orders for spare parts should be accompanied by a reference to the Serial Number of the Variator, which is stamped on the nameplate and on the top of the body casing.
Damaged drive balls and drive cones may be returned to us if it appears that the damage is not excessive, as they can often be reground for a nominal charge and held as spares. It must be emphasised that all drive balls are supplied in MATCHED SETS and must be used as such.

Reduction Gears:
Reduction gears fitted are either those manufactured by Allspeeds Ltd or those of our suppliers such as Oppermans, Electropower, David Brown etc. Diagrams and a list of spare parts for the Allspeeds reduction gears will be found at the back of the book. Particulars of spares for other manufacturers reduction gears may be had on request.

Assembly of the Variator
When assembling the variator, it is essential that all working parts are lubricated with the specific Variator oil. GREASE MUST NEVER BE USED.

k) If the shaft assembly has been dismantled, care should be taken when reassembling that any angular contact bearings and shaft seals are positioned in accordance with the diagram. (**Note:** Sizes 322 and 324 have matched pairs of angular contact bearings)
l) Carefully insert the shaft assemblies in the end covers, fitting the seals and screwing the adjusting discs home until they are 1.5mm (1/16") proud of the end cover bosses.
m) Replace the retaining ring (and the output end cover and gasket, if these were removed). Place the Variator on blocks with the input side uppermost.
n) Replace the clutch assembly in the following order: preload spring, roller cage ring, roller cage, clutch rollers, second preload spring and output drive cone. IMPORTANT NOTE. Reference should be made to the diagram for the correct positioning of the preload springs.
o) Having ensured that the retaining ring is resting on the spring pins in the output end cover, place a matched set of drive balls on to the ball spindles and lower them into position as shown in the diagram.

(Note: Sizes 316 to 324 incorporate needle bearings on the spindles. Sizes 312 to 316 have bronze spindles with flats on the bearing diameters. **These flats must face inwards towards the cone).** Now set all the spindles approximately vertical and raise the retaining ring to encompass the drive balls.

p) Lay the input drive cone on the drive balls which are now held in position by the retaining ring.
q) Replace the iris plate, threading it carefully over the ends of the ball spindles: then replace guide balls and guide rollers.
r) Lay a preload spring roller cage ring, roller cage, clutch rollers and a second preload spring on top of the input drive cone, taking care to position the springs correctly. Centre these items accurately with the bore of the cone.
s) Position the gasket on the end cover flange and apply the end cover so that the dowel is in line with its locating hole in the body. Next carefully insert the inner end of the input shaft assembly into the input drive cone, seeking to ensure as the same time that the clutch rollers are at the bottom of the ramps in the drive cone and splined disc. Bed the end cover down to the body and drive the dowel home; then tighten the end cover screws as uniformly as possible. If difficulty is experienced in bedding down the end cover, gently rotate the input shaft in alternate directions to ensure that the clutch rollers are correctly engaged in the ramps.
t) Replace the handwheel control, (To reset the numerals follow the instructions on page 8).
u) Adjust to eliminate backlash in accordance with the instructions which follow.

Adjustment

v) Stand the Variator on its feet and using the key provided, screw in both adjustment discs until they are flush with the end cover bosses. Rotate the output shaft by hand and carefully move the speed control to the mean speed position (1:1 ratio)
w) With the grubscrew slackened off, test for rotational backlash between the input and output shafts by twisting them in opposed directions. If any backlash is present, screw in the adjustment disc to the point where the backlash is just eliminated (but no further) If, on the other hand, no backlash is apparent , release the adjustment disc until some slackness can be felt then proceed as above. When the adjustment is completed, ensure that the shafts rotate freely when turned by hand. The adjustment disc locking screws should then be firmly tightened.
x) Refill to the correct oil level (see page 2), and if possible run the Variator without load for 6 hours before putting into service. After this running-in period, check the adjustment again and re-tighten all the end cover fixing screws.

Fault-Finding

General:

Before starting up a newly installed Variator:

1. Check that the driven machine is free to rotate.
2. Confirm that the Variator is filled to the correct lever with **Variator oil**, and that the reduction gear is filled to its correct level with the recommended lubricant.
3. Verify that the motor is correctly connected.
4. Run the Variator and set the output speed to minimum before connecting it to the driven machine.
5. If possible, with the machine on load, check the motor current with an ammeter.

Our standard ¼ to 3 h.p motors are dual wound for 380/440v., or 220/250v., 3 phase, 50 Hz only. These motors are suitable for direct-on-line starting when connected in delta, or may be adapted for star-delta starting. In all cases, the motor nameplate will state the type of winding, the voltage and the full load current.

Operating Failures:

1. If the Motor will not start:

a) Check that the driven machine rotates easily.

b) Check motor and starter connections.

c) Check that the correct voltage is available on all phases.

2. If the Unit runs hot:

This could be due to a fault in the Variator, or to the motor if fitted.

Variator.

The Variator will operate successfully up to 82°C, (180°F.), measured on the body surface. Running temperatures above this figure could be caused by overloading, high ambient temperature, use of incorrect quantity or specified quality of oil, or by the need of adjustment.

Motor

Our standard motors comply with BS.3979 have Class E insulation and are suitable for a temperature rise of 75°C above 40°C, ambient. Verify that the supply voltage is the same as the voltage on the motor nameplate and that the full load current is not exceeded. Check the connections.

3. If the Variator will not change speed:

This could indicate a fault in the control system. In Handwheel controlled Variators an adjustable clutch, consisting of a spring loaded ball engaging in a dimple, is fitted. It should always be set by means of the grubscrew to slip if the handwheel is turned whilst the Variator is stationary. Excessive tightening will render the clutch inoperative. If the unit is controlled by other means, the control system should be examined for defects.

4. If the Variator output speed is unstable:

Firstly ensure that the Variator is correctly filled with one of our approved oils. Too much oil reduces efficiency and can cause the speed to fluctuate. Check the adjustment of the Variator.

5. Identify causes of breakdown:

a) Whilst repairing a Variator, the reason for failure may sometime be apparent from examination of the damaged parts. Since the pressure devices react to torque, the markings of the rollers on the ramps indicate the load transmitted by the Variator. If the ramps are deeply indented or the rollers have run over the ramps, this could indicate overload or the need for adjustment.

When starting against high inertia loads, it may be necessary to use a slipping coupling on the Variator input shaft. Alternatively, if the Variator can be set to a minimum output speed before it is stopped, the resulting increased torque available can be used to accelerate the high inertia load when starting.

b) On Sizes 312, 314 and 315 Variators, the phosphor-bronze ball spindles may be bent or broken, which can be another indication of overload or shortage of oil. Where the ball spindles are damaged without accompanying deep indentations of the clutch ramps, it is quite likely that the handwheel, with the clutch over-tightened, has been turned with the Variator stationary.

c) Lubrication and cooling of the internal parts is effected by oil picked up and distributed by the retaining ring. If the oil level fall too low, the Variator could seize or become excessively hot, resulting in the balls and cones (and possible the ball spindles) turning blue – which is indicative of loss of hardness and load carrying capacities.

d) Besides acting as a lubricant and coolant, the Variator oil provides and elasto-hydrodynamic film for power transmission. Only approved oils should therefore be used and additives should be avoided.

NOTTINGHAM ELECTRICAL TRANSMISSIONS

Northern Court, Vernon Road
Basford, Nottingham
UK. NG6 0BJ
Tel: +44 (0) 115 9753655
Fax: +44 (0) 115 9770366
Email: sales@net-eng.co.uk