# CONTENTS

## SECTION 8 MAST

## 1. STRUCTURE

This service manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.
This service manual mainly contains the necessary technical information for operations performed in a service workshop.
For ease of understanding, the manual is divided into the following sections.

**SECTION 1 GENERAL**
This section gives the general information of the machine and explains the safety hints for maintenance.

**SECTION 2 REMOVAL & INSTALLATION OF UNIT**
This section explains the procedures and techniques of removal and installation of each component.

**SECTION 3 POWER TRAIN SYSTEM**
This section explains the structure of the transmission as well as control valve and drive axle.

**SECTION 4 BRAKE SYSTEM**
This section explains the brake piping, each component and operation.

**SECTION 5 STEERING SYSTEM**
This section explains the structure of the steering unit, priority valve, trail axle as well as steering circuit and operation.

**SECTION 6 HYDRAULIC SYSTEM**
This section explains the structure of the gear pump, main control valve as well as work equipment circuit, each component and operation.

**SECTION 7 ELECTRICAL SYSTEM**
This section explains the electrical circuit and each component.
It serves not only to give an understanding electrical system, but also serves as reference material for troubleshooting.

**SECTION 8 MAST**
This section explains the structure of mast, carriage, backrest and forks.

The specifications contained in this service manual are subject to change at any time and without any advance notice. Contact your HYUNDAI distributor for the latest information.

## 2. HOW TO READ THE SERVICE MANUAL

**Distribution and updating**

Any additions, amendments or other changes will be sent to HYUNDAI distributors.
Get the most up-to-date information before you start any work.

**Filing method**

1. See the page number on the bottom of the page.
   File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1

   2 - 3
   - 2 : Item number(2. Structure and Function)
   - 3 : Consecutive page number for each item.

3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.

   10 - 4
   10 - 4 - 1 ┐
   10 - 4 - 2 ┘ Added pages
   10 - 5

**Revised edition mark**(①②③…)

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

**Revisions**

Revised pages are shown at the **list of revised pages** on the between the contents page and section 1 page.

**Symbols**

So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

| Symbol | Item | Remarks |
|---|---|---|
|  | Safety | Special safety precautions are necessary when performing the work. |
| | | Extra special safety precautions are necessary when performing the work because it is under internal pressure. |
|  | Caution | Special technical precautions or other precautions for preserving standards are necessary when performing the work. |

## 3. CONVERSION TABLE

Method of using the Conversion Table

The Conversion Table in this section is provided to enable simple conversion of figures. For details of the method of using the Conversion Table, see the example given below.

**Example**

1. Method of using the Conversion Table to convert from millimeters to inches
   Convert 55mm into inches.

   (1) Locate the number 50in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.

   (2) Locate the number 5in the row across the top, take this as ⓑ, then draw a perpendicular line down from ⓑ.

   (3) Take the point where the two lines cross as ⓒ. This point ⓒ gives the value when converting from millimeters to inches. Therefore, 55mm = 2.165 inches.

2. Convert 550mm into inches.

   (1) The number 550 does not appear in the table, so divide by 10(Move the decimal point one place to the left) to convert it to 55mm.

   (2) Carry out the same procedure as above to convert 55mm to 2.165 inches.

   (3) The original value(550mm) was divided by 10, so multiply 2.165 inches by 10(Move the decimal point one place to the right) to return to the original value.
   This gives 550mm = 21.65 inches.

Millimeters to inches

1mm = 0.03937 in

| | 0 | 1 | 2 | 3 | 4 | 5 ⓑ | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 0.039 | 0.079 | 0.118 | 0.157 | 0.197 | 0.236 | 0.276 | 0.315 | 0.354 |
| 10 | 0.394 | 0.433 | 0.472 | 0.512 | 0.551 | 0.591 | 0.630 | 0.669 | 0.709 | 0.748 |
| 20 | 0.787 | 0.827 | 0.866 | 0.906 | 0.945 | 0.984 | 1.024 | 1.063 | 1.102 | 1.142 |
| 30 | 1.181 | 1.220 | 1.260 | 1.299 | 1.339 | 1.378 | 1.417 | 1.457 | 1.496 | 1.536 |
| 40 | 1.575 | 1.614 | 1.654 | 1.693 | 1.732 | 1.772 | 1.811 | 1.850 | 1.890 | 1.929 |
| ⓐ 50 | 1.969 | 2.008 | 2.047 | 2.087 | 2.126 | ⓒ 2.165 | 2.205 | 2.244 | 2.283 | 2.323 |
| 60 | 2.362 | 2.402 | 2.441 | 2.480 | 2.520 | 2.559 | 2.598 | 2.638 | 2.677 | 2.717 |
| 70 | 2.756 | 2.795 | 2.835 | 2.874 | 2.913 | 2.953 | 2.992 | 3.032 | 3.071 | 3.110 |
| 80 | 3.150 | 3.189 | 3.228 | 3.268 | 3.307 | 3.346 | 3.386 | 3.425 | 3.465 | 3.504 |
| 90 | 3.543 | 3.583 | 3.622 | 3.661 | 3.701 | 3.740 | 3.780 | 3.819 | 3.858 | 3.898 |

Millimeters to inches

1mm = 0.03937in

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 0.039 | 0.079 | 0.118 | 0.157 | 0.197 | 0.236 | 0.276 | 0.315 | 0.354 |
| 10 | 0.394 | 0.433 | 0.472 | 0.512 | 0.551 | 0.591 | 0.630 | 0.669 | 0.709 | 0.748 |
| 20 | 0.787 | 0.827 | 0.866 | 0.906 | 0.945 | 0.984 | 1.024 | 1.063 | 1.102 | 1.142 |
| 30 | 1.181 | 1.220 | 1.260 | 1.299 | 1.339 | 1.378 | 1.417 | 1.457 | 1.496 | 1.536 |
| 40 | 1.575 | 1.614 | 1.654 | 1.693 | 1.732 | 1.772 | 1.811 | 1.850 | 1.890 | 1.929 |
| 50 | 1.969 | 2.008 | 2.047 | 2.087 | 2.126 | 2.165 | 2.205 | 2.244 | 2.283 | 2.323 |
| 60 | 2.362 | 2.402 | 2.441 | 2.480 | 2.520 | 2.559 | 2.598 | 2.638 | 2.677 | 2.717 |
| 70 | 2.756 | 2.795 | 2.835 | 2.874 | 2.913 | 2.953 | 2.992 | 3.032 | 3.071 | 3.110 |
| 80 | 3.150 | 3.189 | 3.228 | 3.268 | 3.307 | 3.346 | 3.386 | 3.425 | 3.465 | 3.504 |
| 90 | 3.543 | 3.583 | 3.622 | 3.661 | 3.701 | 3.740 | 3.780 | 3.819 | 3.858 | 3.898 |

Kilogram to Pound

1kg = 2.2046lb

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 2.20 | 4.41 | 6.61 | 8.82 | 11.02 | 13.23 | 15.43 | 17.64 | 19.84 |
| 10 | 22.05 | 24.25 | 26.46 | 28.66 | 30.86 | 33.07 | 35.27 | 37.48 | 39.68 | 41.89 |
| 20 | 44.09 | 46.30 | 48.50 | 50.71 | 51.91 | 55.12 | 57.32 | 59.5. | 61.73 | 63.93 |
| 30 | 66.14 | 68.34 | 70.55 | 72.75 | 74.96 | 77.16 | 79.37 | 81.57 | 83.78 | 85.98 |
| 40 | 88.18 | 90.39 | 92.59 | 94.80 | 97.00 | 99.21 | 101.41 | 103.62 | 105.82 | 108.03 |
| 50 | 110.23 | 112.44 | 114.64 | 116.85 | 119.05 | 121.25 | 123.46 | 125.66 | 127.87 | 130.07 |
| 60 | 132.28 | 134.48 | 136.69 | 138.89 | 141.10 | 143.30 | 145.51 | 147.71 | 149.91 | 152.12 |
| 70 | 154.32 | 156.53 | 158.73 | 160.94 | 163.14 | 165.35 | 167.55 | 169.76 | 171.96 | 174.17 |
| 80 | 176.37 | 178.57 | 180.78 | 182.98 | 185.19 | 187.39 | 189.60 | 191.80 | 194.01 | 196.21 |
| 90 | 198.42 | 200.62 | 202.83 | 205.03 | 207.24 | 209.44 | 211.64 | 213.85 | 216.05 | 218.26 |

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 0.264 | 0.528 | 0.793 | 1.057 | 1.321 | 1.585 | 1.849 | 2.113 | 2.378 |
| 10 | 2.642 | 2.906 | 3.170 | 3.434 | 3.698 | 3.963 | 4.227 | 4.491 | 4.755 | 5.019 |
| 20 | 5.283 | 5.548 | 5.812 | 6.6076 | 6.340 | 6.604 | 6.869 | 7.133 | 7.397 | 7.661 |
| 30 | 7.925 | 8.189 | 8.454 | 8.718 | 8.982 | 9.246 | 9.510 | 9.774 | 10.039 | 10.303 |
| 40 | 10.567 | 10.831 | 11.095 | 11.359 | 11.624 | 11.888 | 12.152 | 12.416 | 12.680 | 12.944 |
| 50 | 13.209 | 13.473 | 13.737 | 14.001 | 14.265 | 14.529 | 14.795 | 15.058 | 15.322 | 15.586 |
| 60 | 15.850 | 16.115 | 16.379 | 16.643 | 16.907 | 17.171 | 17.435 | 17.700 | 17.964 | 18.228 |
| 70 | 18.492 | 18.756 | 19.020 | 19.285 | 19.549 | 19.813 | 20.077 | 20.341 | 20.605 | 20.870 |
| 80 | 21.134 | 21.398 | 21.662 | 21.926 | 22.190 | 22.455 | 22.719 | 22.983 | 23.247 | 23.511 |
| 90 | 23.775 | 24.040 | 24.304 | 24.568 | 24.832 | 25.096 | 25.631 | 25.625 | 25.889 | 26.153 |

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 0.220 | 0.440 | 0.660 | 0.880 | 1.100 | 1.320 | 1.540 | 1.760 | 1.980 |
| 10 | 2.200 | 2.420 | 2.640 | 2.860 | 3.080 | 3.300 | 3.520 | 3.740 | 3.950 | 4.179 |
| 20 | 4.399 | 4.619 | 4.839 | 5.059 | 5.279 | 5.499 | 5.719 | 5.939 | 6.159 | 6.379 |
| 30 | 6.599 | 6.819 | 7.039 | 7.259 | 7.479 | 7.969 | 7.919 | 8.139 | 8.359 | 8.579 |
| 40 | 8.799 | 9.019 | 9.239 | 9.459 | 9.679 | 9.899 | 10.119 | 10.339 | 10.559 | 10.778 |
| 50 | 10.998 | 11.281 | 11.438 | 11.658 | 11.878 | 12.098 | 12.318 | 12.528 | 12.758 | 12.978 |
| 60 | 13.198 | 13.418 | 13.638 | 13.858 | 14.078 | 14.298 | 14.518 | 14.738 | 14.958 | 15.178 |
| 70 | 15.398 | 15.618 | 15.838 | 16.058 | 16.278 | 16.498 | 16.718 | 16.938 | 17.158 | 17.378 |
| 80 | 17.598 | 17.818 | 18.037 | 18.257 | 18.477 | 18.697 | 18.917 | 19.137 | 19.357 | 19.577 |
| 90 | 19.797 | 20.017 | 20.237 | 20.457 | 20.677 | 20.897 | 21.117 | 21.337 | 21.557 | 21.777 |

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 7.2 | 14.5 | 21.7 | 28.9 | 36.2 | 43.4 | 50.6 | 57.9 | 65.1 |
| 10 | 72.3 | 79.6 | 86.8 | 94.0 | 101.3 | 108.5 | 115.7 | 123.0 | 130.2 | 137.4 |
| 20 | 144.7 | 151.9 | 159.1 | 166.4 | 173.6 | 180.8 | 188.1 | 195.3 | 202.5 | 209.8 |
| 30 | 217.0 | 224.2 | 231.5 | 238.7 | 245.9 | 253.2 | 260.4 | 267.6 | 274.9 | 282.1 |
| 40 | 289.3 | 396.6 | 303.8 | 311.0 | 318.3 | 325.5 | 332.7 | 340.0 | 347.2 | 354.4 |
| 50 | 361.7 | 368.9 | 376.1 | 383.4 | 390.6 | 397.8 | 405.1 | 412.3 | 419.5 | 426.8 |
| 60 | 434.0 | 441.2 | 448.5 | 455.7 | 462.9 | 470.2 | 477.4 | 484.6 | 491.8 | 499.1 |
| 70 | 506.3 | 513.5 | 520.8 | 528.0 | 535.2 | 542.5 | 549.7 | 556.9 | 564.2 | 571.4 |
| 80 | 578.6 | 585.9 | 593.1 | 600.3 | 607.6 | 614.8 | 622.0 | 629.3 | 636.5 | 643.7 |
| 90 | 651.0 | 658.2 | 665.4 | 672.7 | 679.9 | 687.1 | 694.4 | 701.6 | 708.8 | 716.1 |
| 100 | 723.3 | 730.5 | 737.8 | 745.0 | 752.2 | 759.5 | 766.7 | 773.9 | 781.2 | 788.4 |
| 110 | 795.6 | 802.9 | 810.1 | 817.3 | 824.6 | 831.8 | 839.0 | 846.3 | 853.5 | 860.7 |
| 120 | 868.0 | 875.2 | 882.4 | 889.7 | 896.9 | 904.1 | 911.4 | 918.6 | 925.8 | 933.1 |
| 130 | 940.3 | 947.5 | 954.8 | 962.0 | 969.2 | 976.5 | 983.7 | 990.9 | 998.2 | 10005.4 |
| 140 | 1012.6 | 1019.9 | 1027.1 | 1034.3 | 1041.5 | 1048.8 | 1056.0 | 1063.2 | 1070.5 | 1077.7 |
| 150 | 1084.9 | 1092.2 | 1099.4 | 1106.6 | 1113.9 | 1121.1 | 1128.3 | 1135.6 | 1142.8 | 1150.0 |
| 160 | 1157.3 | 1164.5 | 1171.7 | 1179.0 | 1186.2 | 1193.4 | 1200.7 | 1207.9 | 1215.1 | 1222.4 |
| 170 | 1129.6 | 1236.8 | 1244.1 | 1251.3 | 1258.5 | 1265.8 | 1273.0 | 1280.1 | 1287.5 | 1294.7 |
| 180 | 1301.9 | 1309.2 | 1316.4 | 1323.6 | 1330.9 | 1338.1 | 1345.3 | 1352.6 | 1359.8 | 1367.0 |
| 190 | 1374.3 | 1381.5 | 1388.7 | 1396.0 | 1403.2 | 1410.4 | 1417.7 | 1424.9 | 1432.1 | 1439.4 |

kgf/cm² to lbf/in²

1kgf / cm² = 14.2233lbf / in²

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 14.2 | 28.4 | 42.7 | 56.9 | 71.1 | 85.3 | 99.6 | 113.8 | 128.0 |
| 10 | 142.2 | 156.5 | 170.7 | 184.9 | 199.1 | 213.4 | 227.6 | 241.8 | 256.0 | 270.2 |
| 20 | 284.5 | 298.7 | 312.9 | 327.1 | 341.4 | 355.6 | 369.8 | 384.0 | 398.3 | 412.5 |
| 30 | 426.7 | 440.9 | 455.1 | 469.4 | 483.6 | 497.8 | 512.0 | 526.3 | 540.5 | 554.7 |
| 40 | 568.9 | 583.2 | 597.4 | 611.6 | 625.8 | 640.1 | 654.3 | 668.5 | 682.7 | 696.9 |
| 50 | 711.2 | 725.4 | 739.6 | 753.8 | 768.1 | 782.3 | 796.5 | 810.7 | 825.0 | 839.2 |
| 60 | 853.4 | 867.6 | 881.8 | 896.1 | 910.3 | 924.5 | 938.7 | 953.0 | 967.2 | 981.4 |
| 70 | 995.6 | 1010 | 1024 | 1038 | 1053 | 1067 | 1081 | 1095 | 1109 | 1124 |
| 80 | 1138 | 1152 | 1166 | 1181 | 1195 | 1209 | 1223 | 1237 | 1252 | 1266 |
| 90 | 1280 | 1294 | 1309 | 1323 | 1337 | 1351 | 1365 | 1380 | 1394 | 1408 |
| 100 | 1422 | 1437 | 1451 | 1465 | 1479 | 1493 | 1508 | 1522 | 1536 | 1550 |
| 110 | 1565 | 1579 | 1593 | 1607 | 1621 | 1636 | 1650 | 1664 | 1678 | 1693 |
| 120 | 1707 | 1721 | 1735 | 1749 | 1764 | 1778 | 1792 | 1806 | 1821 | 1835 |
| 130 | 1849 | 2863 | 1877 | 1892 | 1906 | 1920 | 1934 | 1949 | 1963 | 1977 |
| 140 | 1991 | 2005 | 2020 | 2034 | 2048 | 2062 | 2077 | 2091 | 2105 | 2119 |
| 150 | 2134 | 2148 | 2162 | 2176 | 2190 | 2205 | 2219 | 2233 | 2247 | 2262 |
| 160 | 2276 | 2290 | 2304 | 2318 | 2333 | 2347 | 2361 | 2375 | 2389 | 2404 |
| 170 | 2418 | 2432 | 2446 | 2460 | 2475 | 2489 | 2503 | 2518 | 2532 | 2546 |
| 180 | 2560 | 2574 | 2589 | 5603 | 2617 | 2631 | 2646 | 2660 | 2674 | 2688 |
| 200 | 2845 | 2859 | 2873 | 2887 | 2901 | 2916 | 2930 | 2944 | 2958 | 2973 |
| 210 | 2987 | 3001 | 3015 | 3030 | 3044 | 3058 | 3072 | 3086 | 3101 | 3115 |
| 220 | 3129 | 3143 | 3158 | 3172 | 3186 | 3200 | 3214 | 3229 | 3243 | 3257 |
| 230 | 3271 | 3286 | 3300 | 3314 | 3328 | 3343 | 3357 | 3371 | 3385 | 3399 |
| 240 | 3414 | 3428 | 3442 | 3456 | 3470 | 3485 | 3499 | 3513 | 3527 | 3542 |

**TEMPERATURE**

Fahrenheit-Centigrade Conversion.

A simple way to convert a fahrenheit temperature reading into a centigrade temperature reading or vice verse is to enter the accompanying table in the center or boldface column of figures.

These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

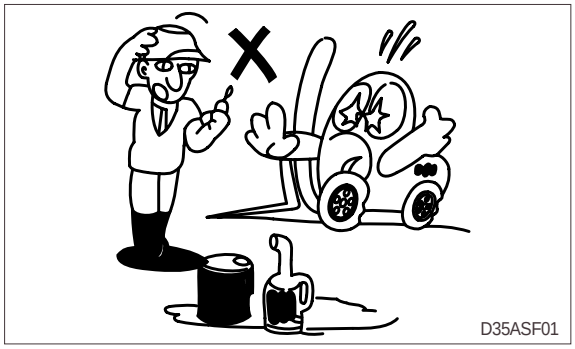
| °C | | °F | °C | | °F | °C | | °F | °C | | °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -40.4 | -40 | -40.0 | -11.7 | 11 | 51.8 | 7.8 | 46 | 114.8 | 27.2 | 81 | 117.8 |
| -37.2 | -35 | -31.0 | -11.1 | 12 | 53.6 | 8.3 | 47 | 116.6 | 27.8 | 82 | 179.6 |
| -34.4 | -30 | -22.0 | -10.6 | 13 | 55.4 | 8.9 | 48 | 118.4 | 28.3 | 83 | 181.4 |
| -31.7 | -25 | -13.0 | -10.0 | 14 | 57.2 | 9.4 | 49 | 120.2 | 28.9 | 84 | 183.2 |
| -28.9 | -20 | -4.0 | -9.4 | 15 | 59.0 | 10.0 | 50 | 122.0 | 29.4 | 85 | 185.0 |
| -28.3 | -19 | -2.2 | -8.9 | 16 | 60.8 | 10.6 | 51 | 123.8 | 30.0 | 86 | 186.8 |
| -27.8 | -18 | -0.4 | -8.3 | 17 | 62.6 | 11.1 | 52 | 125.6 | 30.6 | 87 | 188.6 |
| -27.2 | -17 | 1.4 | -7.8 | 18 | 64.4 | 11.7 | 53 | 127.4 | 31.1 | 88 | 190.4 |
| -26.7 | -16 | 3.2 | -6.7 | 20 | 68.0 | 12.8 | 55 | 131.0 | 32.2 | 90 | 194.0 |
| -26.1 | -15 | 5.0 | -6.7 | 20 | 68.0 | 12.8 | 55 | 131.0 | 32.2 | 90 | 194.0 |
| -25.6 | -14 | 6.8 | -6.1 | 21 | 69.8 | 13.3 | 56 | 132.8 | 32.8 | 91 | 195.8 |
| -25.0 | -13 | 8.6 | -5.6 | 22 | 71.6 | 13.9 | 57 | 134.6 | 33.3 | 92 | 197.6 |
| -24.4 | -12 | 10.4 | -5.0 | 23 | 73.4 | 14.4 | 58 | 136.4 | 33.9 | 93 | 199.4 |
| -23.9 | -11 | 12.2 | -4.4 | 24 | 75.2 | 15.0 | 59 | 138.2 | 34.4 | 94 | 201.2 |
| -23.3 | -10 | 14.0 | -3.9 | 25 | 77.0 | 15.6 | 60 | 140.0 | 35.0 | 95 | 203.0 |
| -22.8 | -9 | 15.8 | -3.3 | 26 | 78.8 | 16.1 | 61 | 141.8 | 35.6 | 96 | 204.8 |
| -22.2 | -8 | 17.6 | -2.8 | 27 | 80.6 | 16.7 | 62 | 143.6 | 36.1 | 97 | 206.6 |
| -21.7 | -7 | 19.4 | -2.2 | 28 | 82.4 | 17.2 | 63 | 145.4 | 36.7 | 98 | 208.4 |
| -21.1 | -6 | 21.2 | -1.7 | 29 | 84.2 | 17.8 | 64 | 147.2 | 37.2 | 99 | 210.2 |
| -20.6 | -5 | 23.0 | -1.1 | 35 | 95.0 | 21.1 | 70 | 158.0 | 51.7 | 125 | 257.0 |
| -20.0 | -4 | 24.8 | -0.6 | 31 | 87.8 | 18.9 | 66 | 150.8 | 40.6 | 105 | 221.0 |
| -19.4 | -3 | 26.6 | 0 | 32 | 89.6 | 19.4 | 67 | 152.6 | 43.3 | 110 | 230.0 |
| -18.9 | -2 | 28.4 | 0.6 | 33 | 91.4 | 20.0 | 68 | 154.4 | 46.1 | 115 | 239.0 |
| -18.3 | -1 | 30.2 | 1.1 | 34 | 93.2 | 20.6 | 69 | 156.2 | 48.9 | 120 | 248.0 |
| -17.8 | 0 | 32.0 | 1.7 | 35 | 95.0 | 21.1 | 70 | 158.0 | 51.7 | 125 | 257.0 |
| -17.2 | 1 | 33.8 | 2.2 | 36 | 96.8 | 21.7 | 71 | 159.8 | 54.4 | 130 | 266.0 |
| -16.7 | 2 | 35.6 | 2.8 | 37 | 98.6 | 22.2 | 72 | 161.6 | 57.2 | 135 | 275.0 |
| -16.1 | 3 | 37.4 | 3.3 | 38 | 100.4 | 22.8 | 73 | 163.4 | 60.0 | 140 | 284.0 |
| -15.6 | 4 | 39.2 | 3.9 | 39 | 102.2 | 23.3 | 74 | 165.2 | 62.7 | 145 | 293.0 |
| -15.0 | 5 | 41.0 | 4.4 | 40 | 104.0 | 23.9 | 75 | 167.0 | 65.6 | 150 | 302.0 |
| -14.4 | 6 | 42.8 | 5.0 | 41 | 105.8 | 24.4 | 76 | 168.8 | 68.3 | 155 | 311.0 |
| -13.9 | 7 | 44.6 | 5.6 | 42 | 107.6 | 25.0 | 77 | 170.6 | 71.1 | 160 | 320.0 |
| -13.3 | 8 | 46.4 | 6.1 | 43 | 109.4 | 25.6 | 78 | 172.4 | 73.9 | 165 | 329.0 |
| -12.8 | 9 | 48.2 | 6.7 | 44 | 111.2 | 26.1 | 79 | 174.2 | 76.7 | 170 | 338.0 |
| -12.2 | 10 | 50.0 | 7.2 | 45 | 113.0 | 26.7 | 80 | 176.0 | 79.4 | 172 | 347.0 |

# SECTION 1 GENERAL

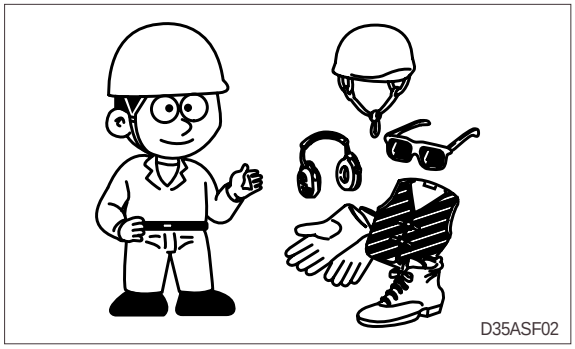
# GROUP 1 SAFETY HINTS

Careless performing of the easy work may cause injuries.
Take care to always perform work safely, at least observing the following.

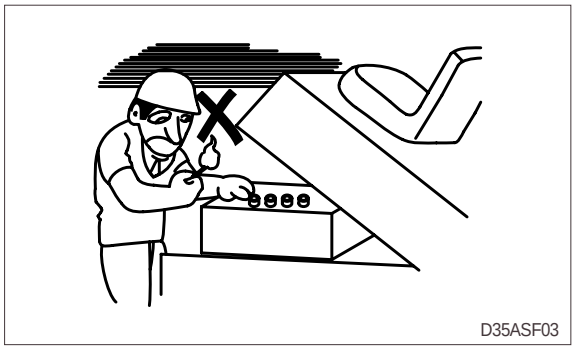
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.


D35ASF01

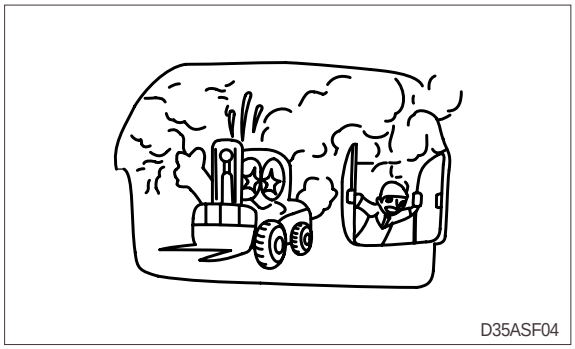
- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.


D35ASF02

- Flames should never be used instead of lamps. Never use a naked flame to check leaks or the level of oil or electrolyte.

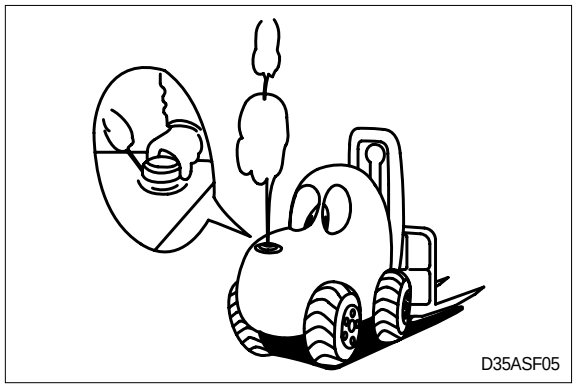

D35ASF03

- Exhaust gas is dangerous. Provide adequate ventilation when working a closed space.

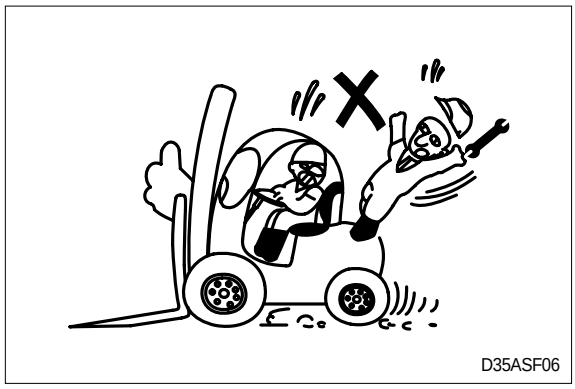

D35ASF04

⚠ Be particularly careful when removing the radiator cap and the hydraulic oil tank filler cap, if this is done immediately after using the machine, there is a danger that boiled oil may spurt out.

- The procedure for releasing the hydraulic pressure is as follows : lower the fork to the ground, and stop the engine(Motor), move the control levers to each position two or three times.

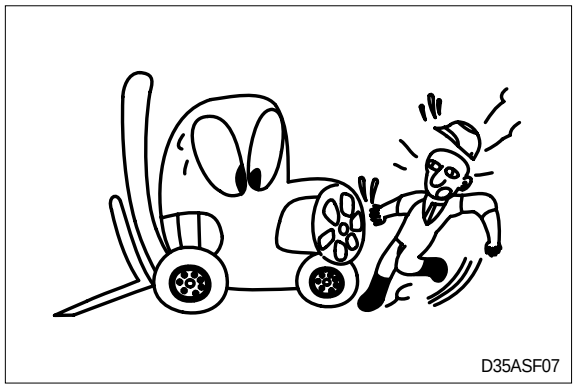

D35ASF05

- When working on top of the machine, be careful not to lose your balance and fall.


D35ASF06

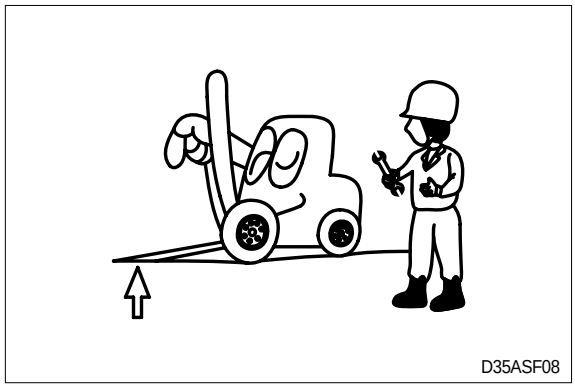
- Hand a caution sign in the operator's compartment (For example **Do not start** or **Maintenance in progress**).
  This will prevent anyone from starting or moving the machine by mistake.

⚠ It is extremely dangerous to try to check the fan belt tension while the engine is running.

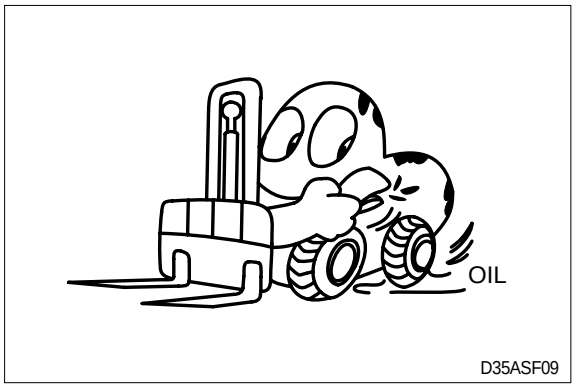

D35ASF07

When inspecting the engine is running parts, or near such parts, always stop the engine first.
Before checking or servicing accumulator or piping, depress brake pedal repeatedLy to release pressure.

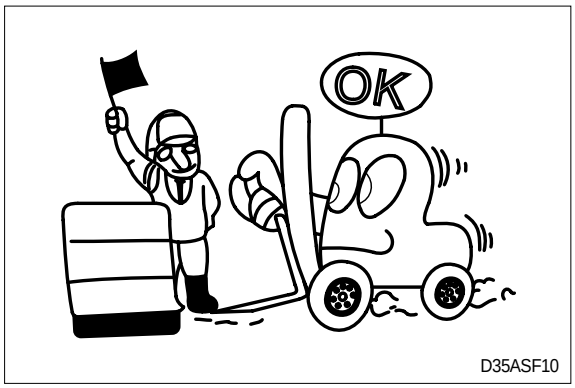
- Park the machine on firm, flat ground.
  Lower the fork to the ground and stop the engine.
  Return each lever to **NEUTRAL** and apply the brake lock.


D35ASF08

- Immediately remove any oil or grease on the floor of the operator's compartment, or on the handrail. It is very dangerous if someone slips while on the machine.




- When working with others, choose a group leader and work according to his instructions. Do not perform any maintenance beyond the agreed work.




- Unless you have special instructions to the contrary, maintenance should always be carried out with the engine stopped. If maintenance is carried out with the engine running, there must be two men present : one sitting in the operator's seat and the other one performing the maintenance. In such a case, never touch any moving part.

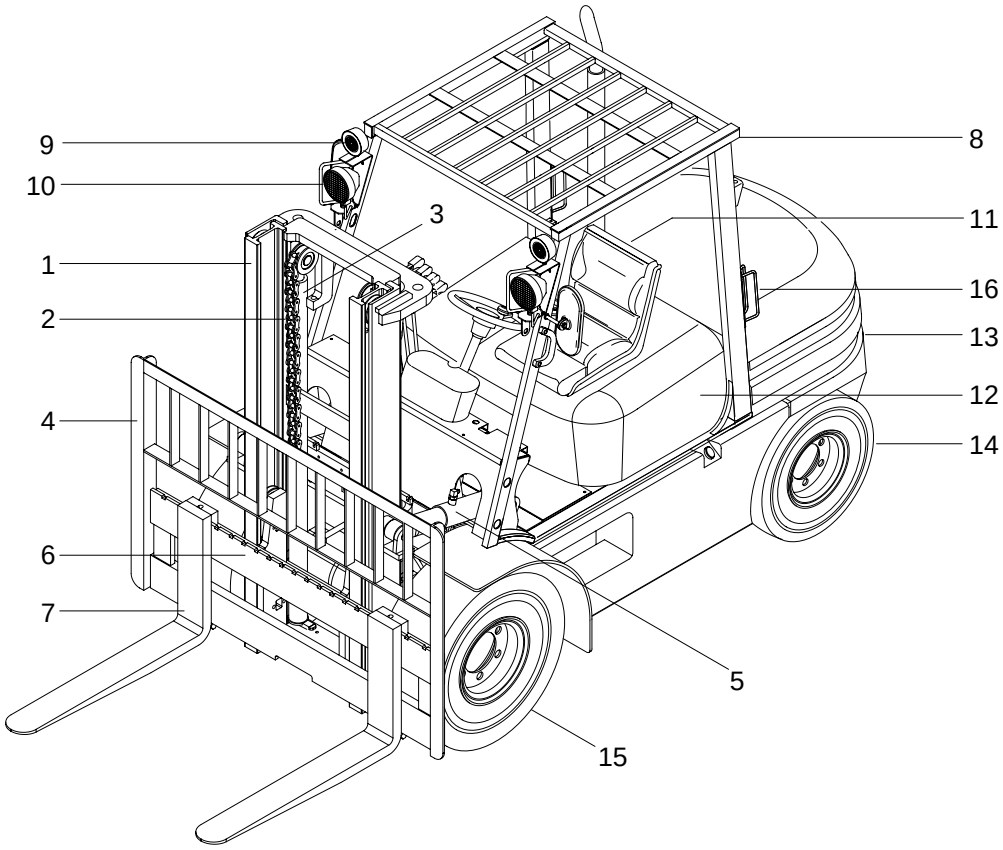
- Always remember that the hydraulic oil circuit is under pressure. When feeding or draining the oil or carrying out inspection and maintenance, release the pressure first.

- Thoroughly clean the machine. In particular, be careful to clean the filler caps, grease fittings and the area around the dipsticks. Be careful not to let any dirt or dust into the system.
- Always use HYUNDAI Forklift genuine parts for replacement.
- Always use the grades of grease and oil recommended by HYUNDAI Forklift.
  Choose the viscosity specified for the ambient temperature.
- Always use pure oil or grease, and be sure to use clean containers.
- When checking or changing the oil, do it in a place free of dust, and prevent any dirt from getting into the oil.
- Before draining the oil, warm it up to a temperature of 30 to 40$_{\circ}$C.
- After replacing oil, filter element or strainer, bleed the air from circuit.
- When the strainer is located in the oil filler, the strainer must not be removed while adding oil.
- When changing the oil filter, check the drained oil and filter for any signs of excessive metal particles or other foreign materials.
- When removing parts containing O-ring, gaskets or seals, clean the mounting surface and replace with new sealing parts.
- After injecting grease, always wipe off the oil grease that was forced out.
- Do not handle electrical equipment while wearing wet places, as this can cause electric shock.
- During maintenance do not allow any unauthorized person to stand near the machine.
- Be sure you fully understand the contents of the operation. It is important to prepare necessary tools and parts and to keep the operating area clean.
- When checking an open gear case there is a risk of dropping things in. Before removing the covers to inspect such cases, empty everything from your pockets. Be particularly careful to remove wrenches and nuts.
- Way to use dipstick
  Push the dipstick fully into the guide, and then pull out.

Carrying out other difficult maintenance work carelessly can cause unexpected accidents. If you consider the maintenance is too difficult, always request the HYUNDAI Forklift distributor to carry out it.

# GROUP 2 SPECIFICATIONS

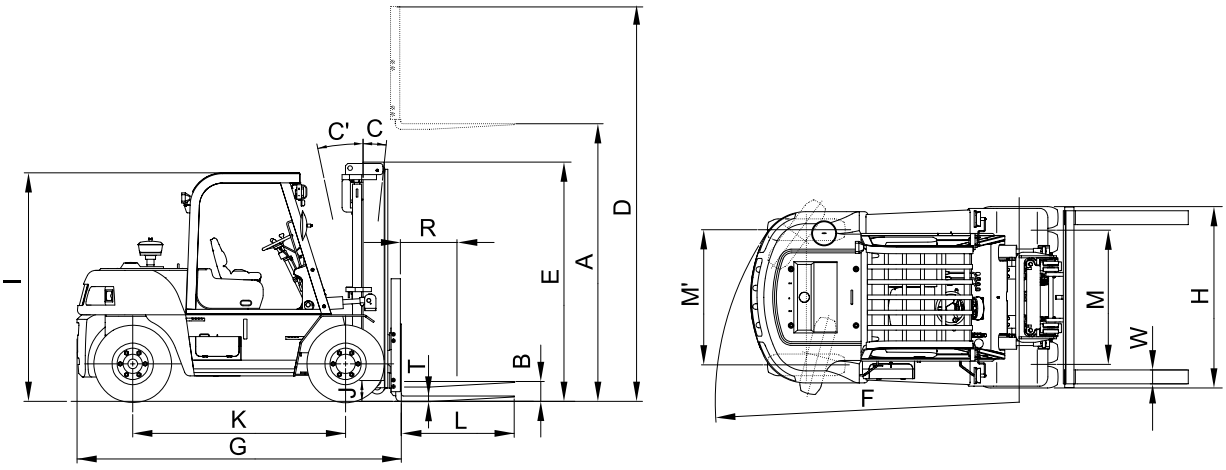
## 1. GENERAL LOCATIONS




D35AOM54

| | | | | | |
|---|---|---|---|---|---|
| 1 | Mast | 7 | Forks | 13 | Counterweight |
| 2 | Lift chain | 8 | Overhead guard | 14 | Rear wheel |
| 3 | Lift cylinder | 9 | Turn signal lamp | 15 | Front wheel |
| 4 | Backrest | 10 | Head lamp | 16 | Rear combination lamp |
| 5 | Tilt cylinder | 11 | Operator's seat | | |
| 6 | Lift bracket | 12 | Bonnet | | |

## 2. SPECIFICATIONS




D35ASP01

| Model | | | Unit | HDF 35III | HDF 45III |
|---|---|---|---|---|---|
| Capacity | | | kg | 3500 | 4500 |
| Load center | | R | mm | 600 | ← |
| Weight(Unloaded) | | | kg | 5746 | 6631 |
| Fork | Lifting height | A | mm | 3000 | ← |
| | Free lift | B | mm | 120 | ← |
| | Lifting speed(Unload/Load) | | mm/sec | 575/520 | 495/440 |
| | Lowering speed(Unload/Load) | | mm/sec | 400/500 | 305/380 |
| | L×W×T | L,W,T | mm | 1070×127×50 | 1220×150×50 |
| Mast | Tilt angle forward/backward | C/C' | degree | 6/12 | ← |
| | Max height | D | mm | 4236 | 4221 |
| | Min height | E | mm | 2235 | 2210 |
| Body | Travel speed | | km/h | 21.0 | 24.1 |
| | Gradeability | | degree | 23.0 | 25.7 |
| | Min turning radius(Outside) | F | mm | 2500 | 2535 |
| ETC | Max hydraulic pressure | | $kgf/cm^2$ | 188 | ← |
| | Hydraulic oil tank | | ℓ | 58 | ← |
| | Fuel tank | | ℓ | 85 | ← |
| Overall length | | G | mm | 3059 | 3186 |
| Overall width | | H | mm | 1423 | 1773 |
| Overhead guard height | | I | mm | 2316 | 2291 |
| Ground clearance | | J | mm | 158 | 133 |
| Wheel base | | K | mm | 2000 | 2000 |
| Wheel tread front/rear | | M, M' | mm | 1185/1120 | 1311/1120 |

## 3. SPECIFICATION FOR MAJOR COMPONENTS

### 1) ENGINE

| ITEM | UNIT | SPECIFICATION |
|---|---|---|
| Model | - | HYUNDAI D4DA-C1 |
| Type | - | 4 cycle turbocharged diesel type |
| Cooling Method | - | Water cooling |
| Number of cylinders and arrangement | - | 4 cylinders, In-line |
| Firing order | - | 1-3-4-2 |
| Combustion chamber type | - | Direct injection |
| Cylinder bore X stroke | mm(in) | 104×115(4.1×4.5) |
| Piston displacement | cc(cu in) | 3907(238) |
| Compression ratio | - | 16.5 : 1 |
| Rated gross horse power | hp/rpm | 95/2400 |
| Maximum gross torque at rpm | kgf · m/rpm | 31/1700 |
| Engine oil quantity | ℓ (U.S.gal) | 8.5(2.2) |
| Dry weight | kg(lb) | 350(772) |
| High idling speed | rpm | 2640 ±20 |
| Low idling speed | rpm | 850 ±50 |
| Rated fuel consumption | g/ps.hr | 157 |
| Starting motor | V-kW | 24-5 |
| Alternator | V-A | 24-40 |
| Battery | V-AH | 24-75 |
| Fan belt deflection | mm(in) | 10~15(0.39~0.59) |

### 2) MAIN PUMP

| ITEM | UNIT | SPECIFICATION |
|---|---|---|
| Type | - | Fixed displacement gear pump |
| Capacity | cc/rev | 49.35 |
| Maximum operating pressure | bar | 207 |
| Rated speed (Max/Min) | rpm | 2500/500 |

### 3) MAIN CONTROL VALVE

| ITEM | UNIT | SPECIFICATION |
|---|---|---|
| Type | - | Sectional |
| Operating method | - | Mechanical |
| Main relief valve pressure | bar | 185/150 |
| Flow capacity | lpm | 135 |

### 4) POWER TRAIN DEVICES

| Item | | | | | Specification |
|---|---|---|---|---|---|
| Torque converter | Model | | | | ZF W280 |
| | Type | | | | 3 Element, 1 stage, 2 phase |
| | Stall ratio | | | | 2.39 : 1 |
| Transmission | Type | | | | Full-automatic power shift |
| | Gear shift(FR/RR) | | | | 1/1, 2/1 |
| | Adjustment | | | | Electrical single lever type, kick-down system |
| | Overhaul ratio | 1/1 | FR | | 18.571 : 1 |
| | | | RR | | 18.994 : 1 |
| | | 2/1 | FR | F1 | 22.846 : 1 |
| | | | | F2 | 14.923 : 1 |
| | | | RR | | 18.994 : 1 |
| Axle | Type | | | | Front-wheel drive type, fixed location |
| | Gear | | | | Hyoid gear type |
| Wheels | Q'ty(FR/RR) | | | | Single : 2/2 (35III), Double : 4/2 (45III) |
| | Front (Drive) | Single | | | 8.25-15-14 PR (35III) |
| | | Double | | | 7.5-15-12 PR (45III) |
| | Rear(steering) | | | | 7.0-12-12 PR |
| Brakes | Travel | | | | Front wheel, duo-servo & auto adjustment type |
| | Parking | | | | Toggle, internal expanding mechanical type |
| Steering | Type | | | | Full hydraulic, power steering |
| | Steering algle | | | | 80 ° to both right and left angle, respectively |

## 4. TIGHTENING TORQUE OF MAJOR COMPONENTS

| NO | ITEMS | | SIZE | kgf · m | lbf · ft |
|---|---|---|---|---|---|
| 1 | Engine | Engine mounting bolt, nut | M16×2.0 | 7.5 | 54 |
| 2 | | Radiator mounting bolt, nut | M10×1.5 | 6.9±1.4 | 50±10 |
| 3 | Hydraulic system | MCV mounting bolt, nut | M12×1.75 | 12.8±3.0 | 93±22 |
| 4 | | Steering unit mounting bolt | M10×1.5 | 5.0±1.0 | 36±7.2 |
| 5 | | Priority valve mounting bolt | M 8×1.25 | 2.5±0.5 | 18.1±3.6 |
| 6 | Power train system | Transmission mounting bolt, nut | M10×1.5 | 6.9±1.4 | 50±10 |
| 7 | | Drive axle mounting bolt, nut | M12×1.75 | 12.8±3.0 | 93±22 |
| 8 | | Steering axle mounting bolt, nut | M14×2.0 | 19.6±2.9 | 142±21 |
| 9 | | Front wheel mounting nut | M28×1.5 | 25 | 181 |
| 10 | | Rear wheel mounting nut | M20×1.5 | 40±10 | 289±72 |
| 11 | Others | Counterweight mounting bolt | M30×3.0 | 215±33 | 1555±239 |
| 12 | | Operator's seat mounting nut | M 8×1.25 | 2.5±0.5 | 18.1±3.6 |
| 13 | | Head guard mounting bolt | M14×2.0 | 19.3±3.0 | 140±22 |

## 5. TORQUE CHART

Use following table for unspecified torque.

### 1) BOLT AND NUT - Coarse thread

| Bolt size | 8T | | 10T | |
|---|---|---|---|---|
| | kgf · m | lbf · ft | kgf · m | lbf · ft |
| M 6 × 1.0 | 0.85 ~ 1.25 | 6.15 ~ 9.04 | 1.14 ~ 1.74 | 8.2 ~ 12.6 |
| M 8 × 1.25 | 2.0 ~ 3.0 | 14.5 ~ 21.7 | 2.7 ~ 4.1 | 19.5 ~ 29.7 |
| M10 × 1.5 | 4.0 ~ 6.0 | 28.9 ~ 43.4 | 5.5 ~ 8.3 | 39.8 ~ 60.0 |
| M12 × 1.75 | 7.4 ~ 11.2 | 53.5 ~ 81.0 | 9.8 ~ 15.8 | 70.9 ~ 114 |
| M14 × 2.0 | 12.2 ~ 16.6 | 88.2 ~ 120 | 16.7 ~ 22.5 | 121 ~ 163 |
| M16 × 2.0 | 18.6 ~ 25.2 | 135 ~ 182 | 25.2 ~ 34.2 | 182 ~ 247 |
| M18 × 2.0 | 25.8 ~ 35.0 | 187 ~ 253 | 35.1 ~ 47.5 | 254 ~ 344 |
| M20 × 2.5 | 36.2 ~ 49.0 | 262 ~ 354 | 49.2 ~ 66.6 | 356 ~ 482 |
| M22 × 2.5 | 48.3 ~ 63.3 | 349 ~ 458 | 65.8 ~ 98.0 | 476 ~ 709 |
| M24 × 3.0 | 62.5 ~ 84.5 | 452 ~ 611 | 85.0 ~ 115 | 615 ~ 832 |
| M30 × 3.0 | 124 ~ 168 | 898 ~ 1214 | 169 ~ 229 | 1223 ~ 1656 |
| M36 × 4.0 | 174 ~ 236 | 1261 ~ 1704 | 250 ~ 310 | 1808 ~ 2242 |

### (1) Fine thread

| Bolt size | 8T | | 10T | |
|---|---|---|---|---|
| | kgf · m | lbf · ft | kgf · m | lbf · ft |
| M 8 × 1.0 | 2.2 ~ 3.4 | 15.9 ~ 24.6 | 3.0 ~ 4.4 | 21.7 ~ 31.8 |
| M10 × 1.2 | 4.5 ~ 6.7 | 32.5 ~ 48.5 | 5.9 ~ 8.9 | 42.7 ~ 64.4 |
| M12 × 1.25 | 7.8 ~ 11.6 | 56.4 ~ 83.9 | 10.6 ~ 16.0 | 76.7 ~ 116 |
| M14 × 1.5 | 13.3 ~ 18.1 | 96.2 ~ 131 | 17.9 ~ 24.1 | 130 ~ 174 |
| M16 × 1.5 | 19.9 ~ 26.9 | 144 ~ 195 | 26.6 ~ 36.0 | 192 ~ 260 |
| M18 × 1.5 | 28.6 ~ 43.6 | 207 ~ 315 | 38.4 ~ 52.0 | 278 ~ 376 |
| M20 × 1.5 | 40.0 ~ 54.0 | 289 ~ 391 | 53.4 ~ 72.2 | 386 ~ 522 |
| M22 × 1.5 | 52.7 ~ 71.3 | 381 ~ 516 | 70.7 ~ 95.7 | 511 ~ 692 |
| M24 × 2.0 | 67.9 ~ 91.9 | 491 ~ 665 | 90.9 ~ 123 | 658 ~ 890 |
| M30 × 2.0 | 137 ~ 185 | 990 ~ 1339 | 182 ~ 248 | 1314 ~ 1796 |
| M36 × 3.0 | 192 ~ 260 | 1390 ~ 1880 | 262 ~ 354 | 1894 ~ 2562 |

### 2) PIPE AND HOSE(FLARE TYPE)

| Thread size(PF) | Width across flat(mm) | kgf · m | lbf · ft |
|---|---|---|---|
| 1/4" | 19 | 4 | 28.9 |
| 3/8" | 22 | 5 | 36.2 |
| 1/2" | 27 | 9.5 | 68.7 |
| 3/4" | 36 | 18 | 130.2 |
| 1" | 41 | 21 | 151.9 |
| 1-1/4" | 50 | 35 | 253.2 |

### 3) PIPE AND HOSE(ORFS TYPE)

| Thread size(UNF) | Width across flat(mm) | kgf · m | lbf · ft |
|---|---|---|---|
| 9/16-18 | 19 | 4 | 28.9 |
| 11/16-16 | 22 | 5 | 36.2 |
| 13/16-16 | 27 | 9.5 | 68.7 |
| 1-3/16-12 | 36 | 18 | 130.2 |
| 1-7/16-12 | 41 | 21 | 151.9 |
| 1-11/16-12 | 50 | 35 | 253.2 |

### 4) FITTING

| Thread size(PF) | Width across flat(mm) | kgf · m | lbf · ft |
|---|---|---|---|
| 1/4" | 19 | 4 | 28.9 |
| 3/8" | 22 | 5 | 36.2 |
| 1/2" | 27 | 9.5 | 68.7 |
| 3/4" | 36 | 18 | 130.2 |
| 1" | 41 | 21 | 151.9 |
| 1-1/4" | 50 | 35 | 253.2 |

## 6. RECOMMENDED LUBRICANTS

Use only oils listed below or equivalent.
Do not mix different brand oil.

| Service point | Kind of fluid | Capacity ℓ (U.S.gal) | Ambient temperature ℃ (℉) |
|---|---|---|---|
| | | | -20 (-4) / -10 (14) / 0 (32) / 10 (50) / 20 (68) / 30 (86) / 40 (104) |
| Engine oil pan | Engine oil | 8.5 (2.2) | SAE 30<br>SAE 10W<br>SAE 10W-30<br>SAE 15W-40 |
| Torque converter transmission | ATF | 14.5 (3.8) | DEXRON III |
| Axle | Gear oil | 11.5 (3.0) | SAE 80W-90/API GL-5 |
| Hydraulic tank | Hydraulic oil | 58 (15.3) | ISO VG32<br>ISO VG46<br>ISO VG68 |
| Fuel tank | Diesel fuel | 85 (22.5) | ASTM D975 No.1<br>ASTM D975 No.2 |
| Fitting (Grease nipple) | Grease | - | NLGI No.1<br>NLGI No.2 |
| Brake reservoir tank | Brake oil | 0.5 (0.13) | SAE J1703e |
| Radiator | Antifreeze:Water 50:50 | 17 (4.5) | Ethylene glycol base permanent type |

**NOTES :**

**① SAE numbers given to engine oil should be selected according to ambient temperature.**

**② For engine oil used in engine oil pan, use SAE 10W oil when the temperature at the time of engine start up is below 0℃, even if the ambient temperature in daytime is expected to rise to 10℃ or more.**

**③ If any engine oil of API service class CC is used instead of class CD engine oil, the frequency of oil change must be doubled.**

## GROUP 3 PERIODIC REPLACEMENT

For operation safety, never fail to perform periodic maintenance or make periodic replacement of the consumable parts listed in the following.

These parts may deteriorate in time and are susceptible to wear. It is difficult to estimate the degrees of wear at time of periodic maintenance; therefore, even if no apparent wear is found, always replace with new parts within the prescribed period of replacement(or earlier if trouble is found).

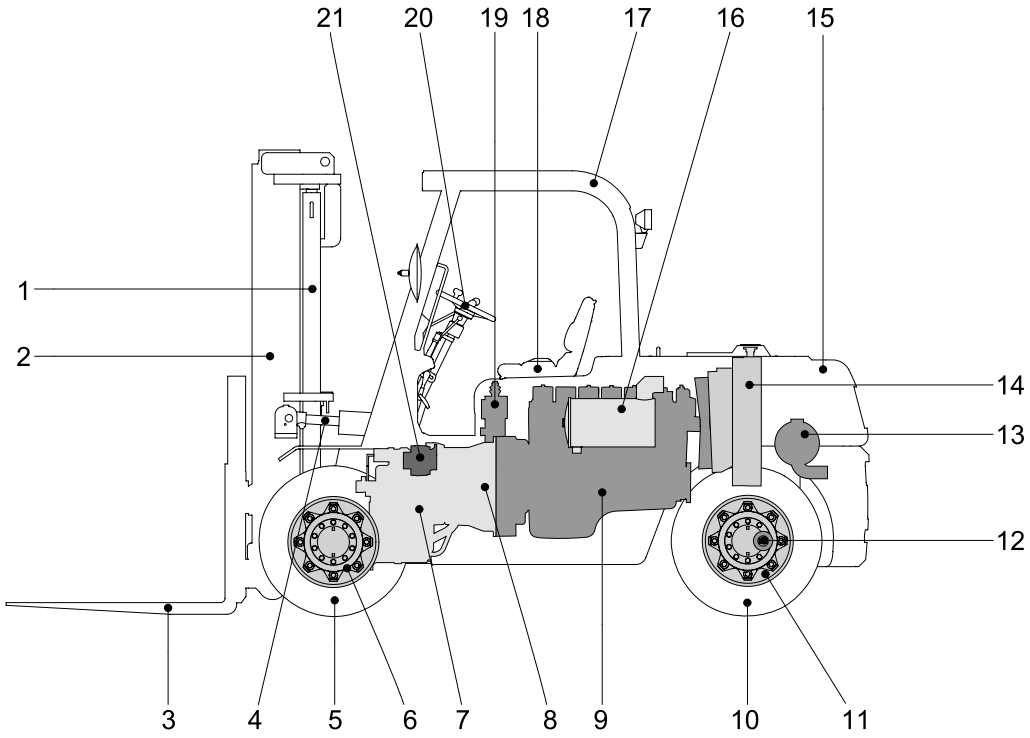
**※ Replacement of consumable service parts in not covered under warranty.**

| No | Description | Period of replacement |
|---|---|---|
| 1 | Master cylinder and wheel cylinder caps, dust seals | Every 1 year |
| 2 | Brake hose or tube | Every 1 or 2 years |
| 3 | Brake reservoir tank and tube | Every 2 to 4 years |
| 4 | Power steering hose | Every 2 years |
| 5 | Stop lamp switch(oil pressure type) | Every 2 years |
| 6 | Fuel hose | Every 2 to 4 years |
| 7 | Rubber parts of power steering | Every 2 to 4 years |
| 8 | Lift chain | Every 2 to 4 years |
| 9 | Hose of load handling | Every 1 or 2 years |

# SECTION 2 REMOVAL AND INSTALLATION OF UNIT

# SECTION 2 REMOVAL & INSTALLATION OF UNIT

## GROUP 1 MAJOR COMPONENTS




D353RE01

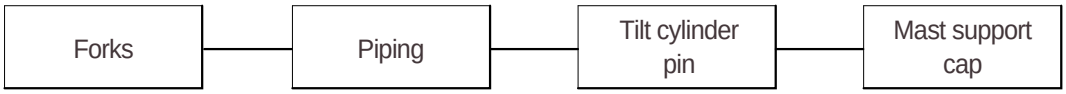
| | | | |
|---|---|---|---|
| 1 | Lift cylinder | 12 | Steering cylinder |
| 2 | Mast | 13 | Muffler |
| 3 | Fork assy | 14 | Radiator |
| 4 | Tilt cylinder | 15 | Counterweight |
| 5 | Front wheel | 16 | Air cleaner |
| 6 | Drive axle | 17 | Overhead guard |
| 7 | Transmission | 18 | Operator's seat |
| 8 | Torque converter | 19 | Control valve |
| 9 | Engine | 20 | Steering wheel |
| 10 | Rear wheel | 21 | Hydraulic pump |
| 11 | Steering axle(rear axle) | | |

## GROUP 2 REMOVAL AND INSTALLATION OF UNIT

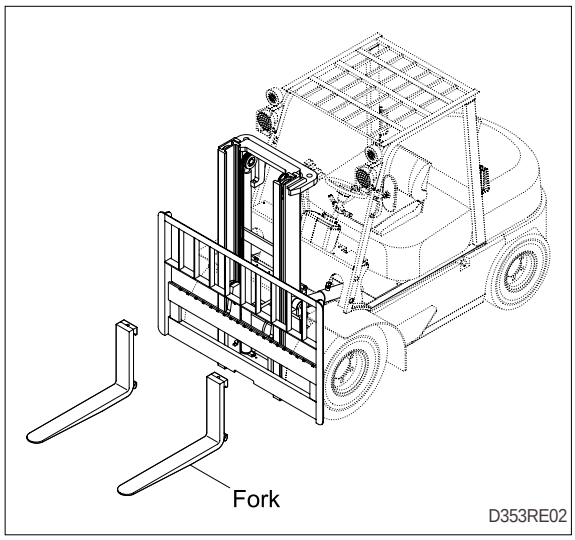
Remove and install the following units as explained in the flow chart.

### 1. MAST

#### 1) REMOVAL




**(1) Forks**

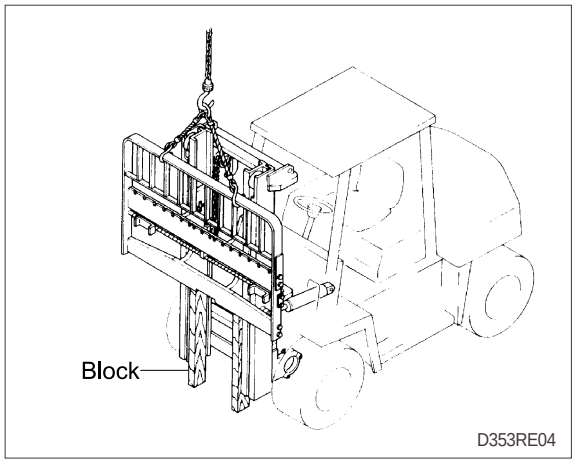



**(2) Piping**

Raise the fork carriage to make it easy to remove the piping. Remove the piping and the return hose from the control valve.

※ Put blind plugs in the piping immediately after removing it. This prevents the hydraulic oil from flowing out and also prevents dust and dirt from getting in.

※ Insert blocks to prevent the lift bracket carriage from coming down.

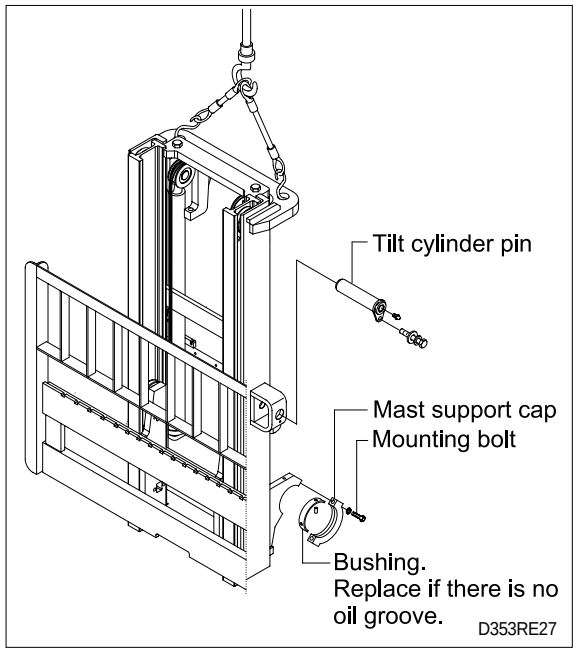


**(3) Tilt cylinder pin**

**(4) Mast support cap**

Attach a crane to the stay at the top of the outer mast, and raise. Remove the mounting bolts of the cap from under the machine, then slowly raise.

※ This operation is carried out from under the machine, so use a pit, or if there is no pit, jack up the machine and loosen with an impact wrench.



### 2) INSTALLATION

**(1) Mast support cap**

Check the mast support bushing for wear, then tighten the cap mounting bolts.

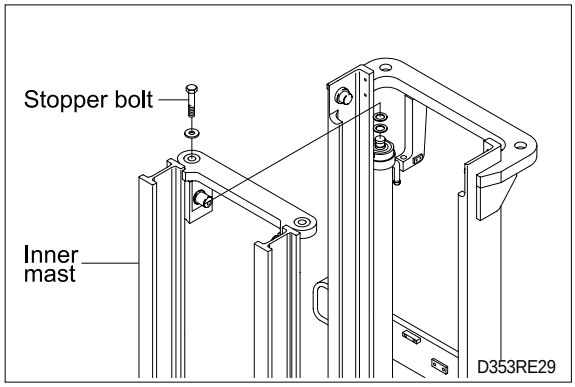
· Tighten torgue : 19.9 ~ 27.0 kgf · m (144 ~ 195 lbf · ft)

**(2) Tift cylinder pin**

Hold the mast with a crane, operate the tilt control lever and align the holes, then knock in the pin.

## 2. LIFT CYLINDER

Only one end of the lift cylinder is removed.




### 1) REMOVAL

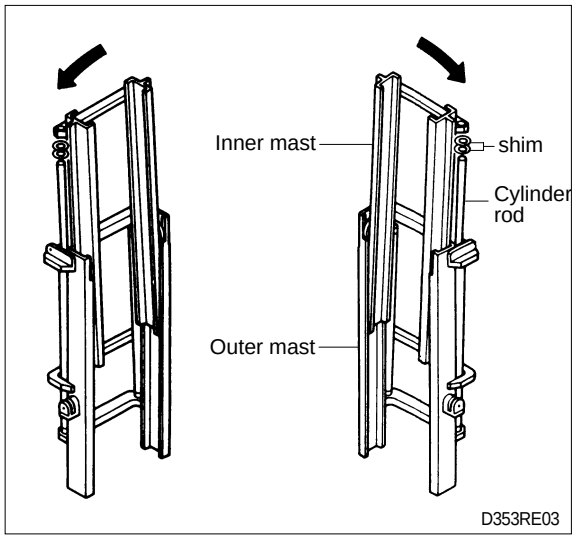
(1) Remove the stopper bolt connecting the lift cylinder rod and the inner mast, then raise the inner mast.

※ Insert a block to prevent the inner mast from coming down.

(2) Remove the cylinder clamp and the piping from the down control valve, then raise about 300㎜(12in) with a crane and pull out from the bottom.

※ Insert a blind plug immediately after removing the piping.

### 2) INSTALLATION AND ADJUSTMENT




(1) Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

(2) Assemble the cylinder rod to the inner mast, and check the left-to-right play of the mast at the maximum lifting height.

※ If play is to LEFT, install adjustment shim to LEFT cylinder

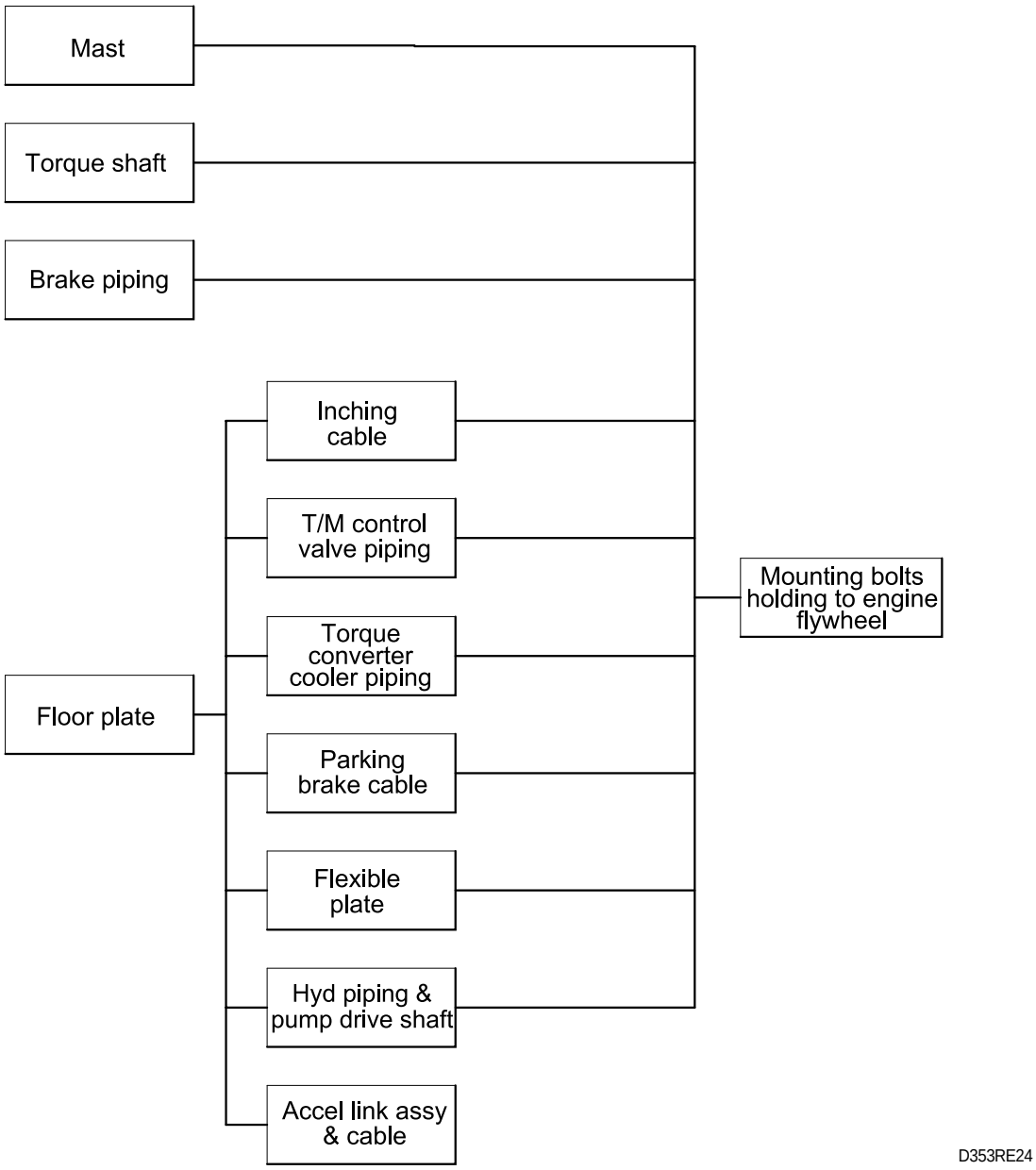
※ If play is to RIGHT, install adjustment shim to RIGHT cylinder.

· Shim thickness : 1.0㎜(0.04in)

## 3. TORQUE CONVERTER + TRANSMISSION + FRONT AXLE(POWER TRAIN ASSEMBLY)

Leave the engine inside the frame, move the power train assembly as a unit to the front and remove.

### 1) REMOVAL

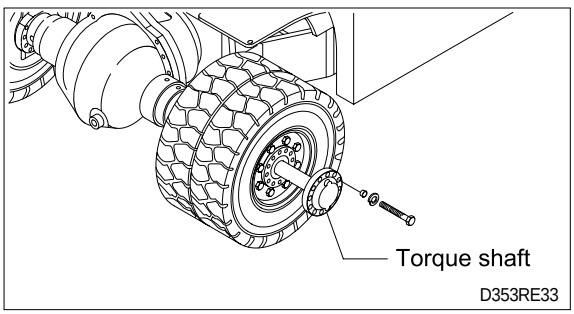



**(1) Mast**

See section on mast.(Page 2-2)

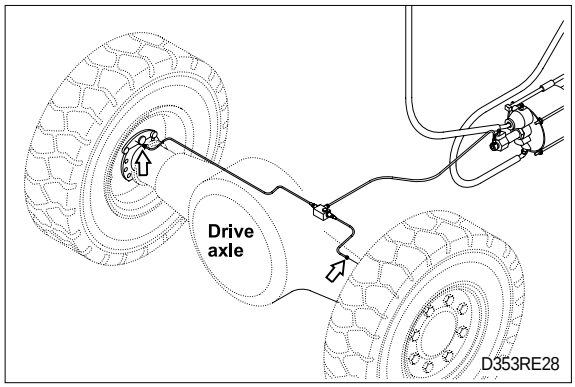
**(2) Torque shaft**

Pull out about 200㎜(7.9in) to make the front wheel free.

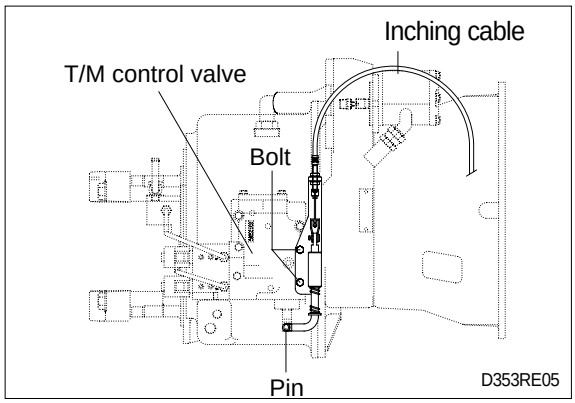


**(3) Brake piping**

Disconnect the brake piping from the wheel cylinder end.




(4) Remove the bolts, clevis pin and self locking pin.

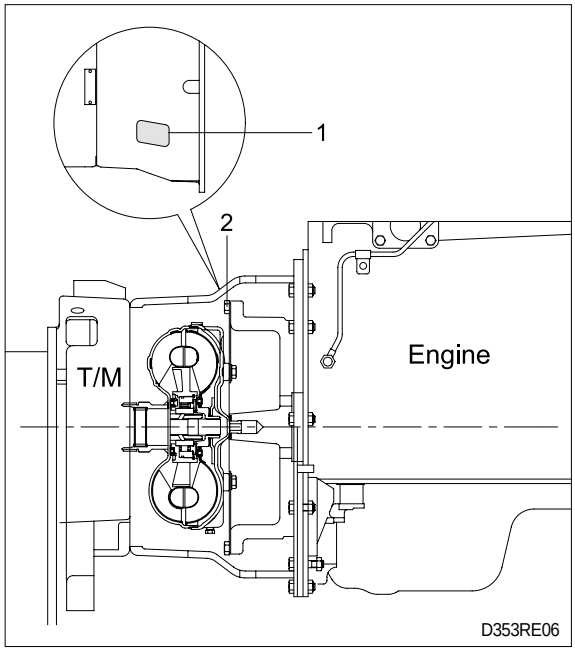



**(5) Control valve piping**

Remove the hose because it is in the way when pulling the power train assembly out to the front. Fit blind plugs to prevent dust or dirt from entering.

**(6) Flexible plate**

Remove the cover(1) on the top face of the torque converter housing then remove the 8 mounting bolts(2) installed to the engine flywheel. To rotate the flywheel, remove 1 mounting bolt, then insert a turning tool in the mounting hole. One man must turn the engine fan by hand while the other turns the flywheel.



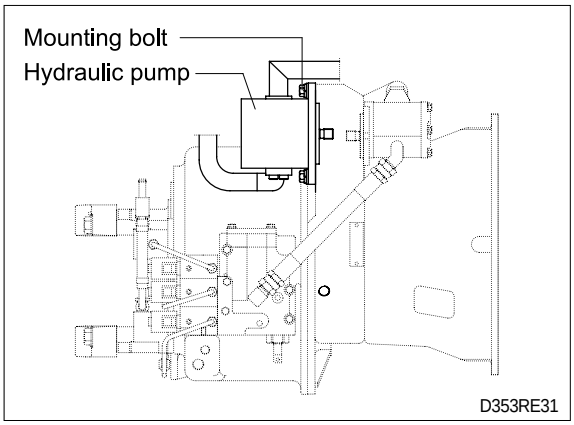
**(7) Hydraulic piping**

Remove the pipe for the hydraulic pump installed on the transmission side PTO.

If the hose hangs down, a large amount of hydraulic oil will come out, so install a blind plug.

**(8) Pump drive shaft**

Remove 2 mounting bolts for pump drive shaft tightened to the transmission.

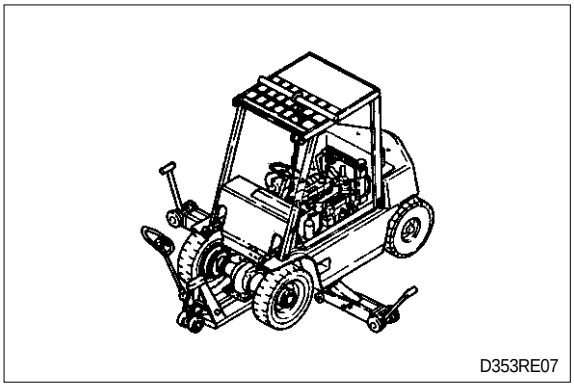


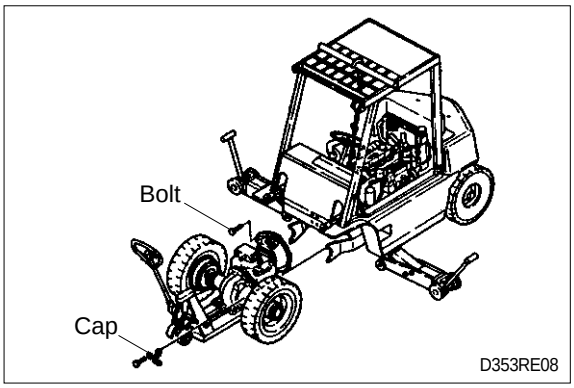

**(9) Mounting bolts holding to flywheel housing**

① Using a chain block, raise the engine to the overhead guard. Put jacks under the frame on both sides(or attach a crane to the tilt cylinder notches on the dashboard), and support the bottom of the transmission on a truck.

② Remove the front axle caps and the mounting bolts installed to the engine flywheel. Insert a screwdriver in the join and disconnect.

Operating the jacks on the left and right, raise the front of the frame and pull out slowly. When doing this, be careful not to catch the wiring harnesses, hoses and pipes.

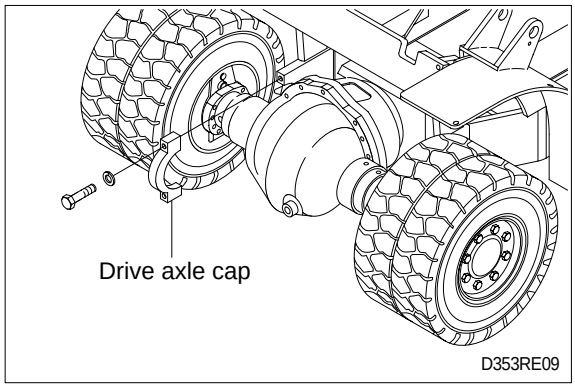


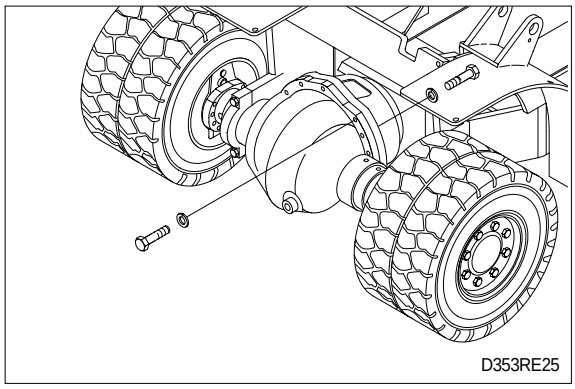
**2) INSTALLATION**

Installation is in the reverse order to removal, but be careful of the following points.

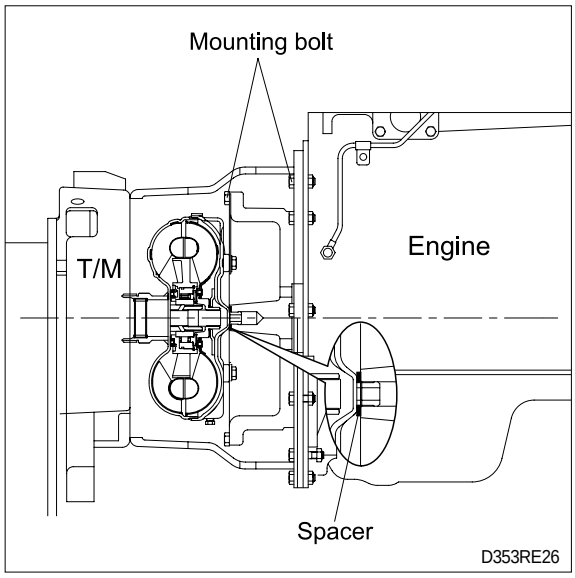
(1) Tightening torque of mounting bolt for drive axle cap.
· 26.8~32.0kgf · m(194~231lbf · ft)




(2) Tightening torque of mounting bolt for transmission and drive axle.
· 7.29kgf · m(52.7lbf · ft)



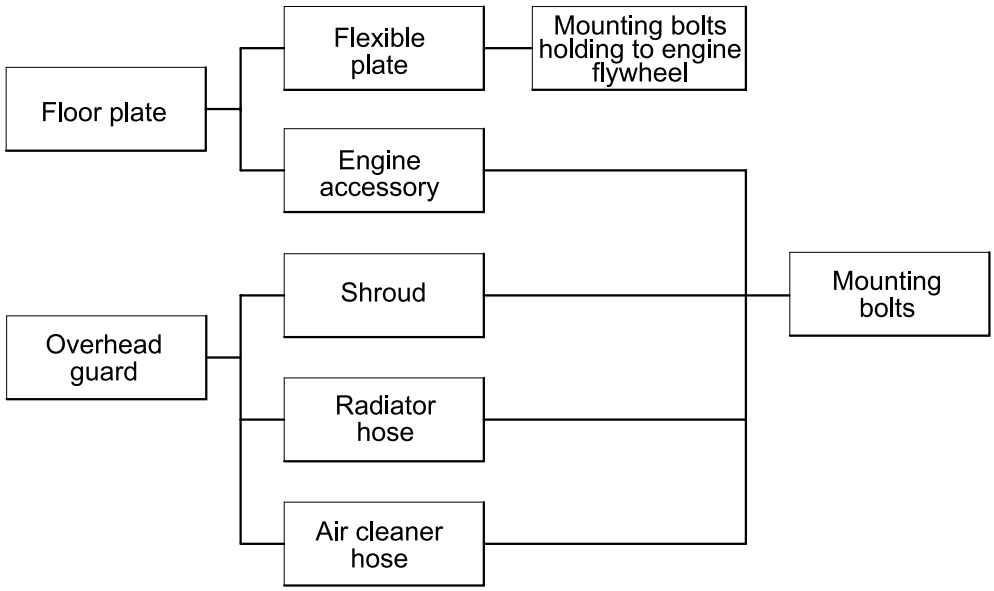

(3) Tightening torque of mounting bolt for transmission and engine.
· 4.17kgf · m(30.2lbf · ft)



## 4. ENGINE

Lever the torque converter, transmission and front axle inside the frame, then remove the engine assembly.

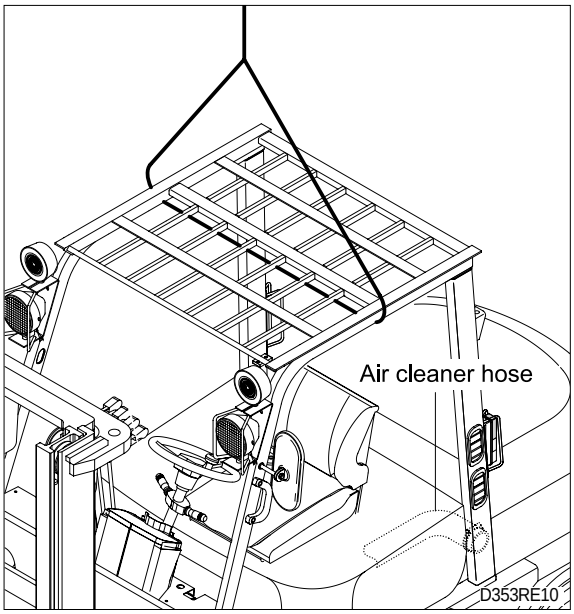
### 1) REMOVAL




D35ARE22

**(1) Overhead guard**

Remove the wiring for the rear combination lamp on the rear stay of the overhead guard and air cleaner hose, then raise together with the bonnet.



(2) Flexible plate, mounting bolts installed to flywheel housing.
For details, see page 2-6.

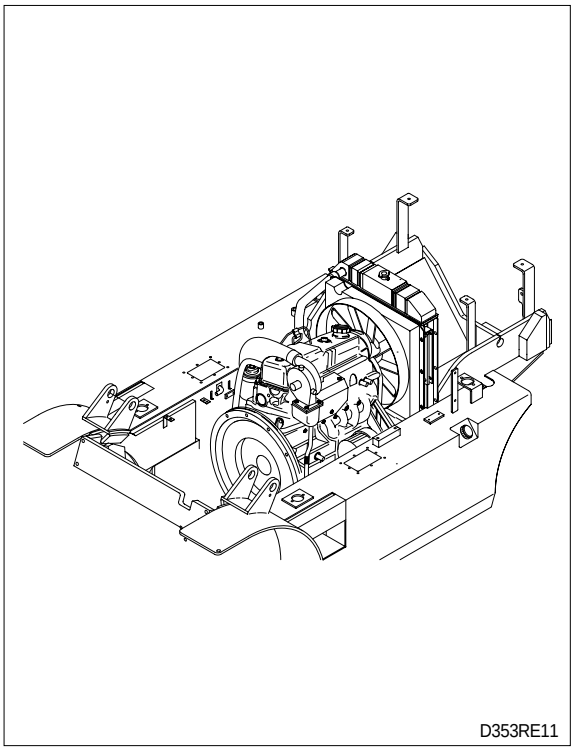
**(3) Engine accessory**

Remove all wiring harnesses, cables and hoses between the engine and the dashboard and frame.

① Wiring harness to alternator and starter.
② Wiring harness for oil pressure and engine water temperature gauges.
③ Cables for meters, buttons and accelerator pedal.
④ Hoses to fuel tank and air cleaner.
⑤ Exhaust pipe.

**(4) Radiator hose**

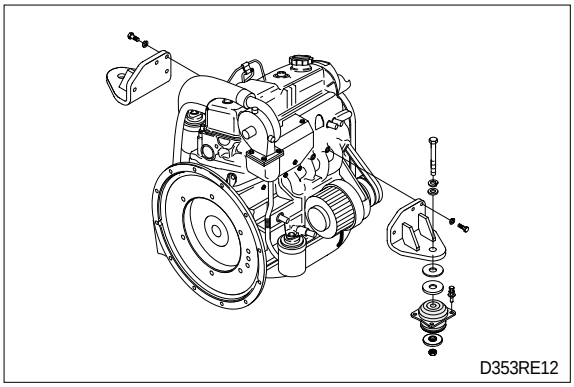
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.


D353RE11

**(5) Mounting bolt**

Attach a crane to the engine hook and raise, then remove the left and right mounting bolts. Raise the engine slightly, slide towards the radiator, then lift up.

※ When sliding the engine, if it hits the radiator it will damage the radiator, so it is better to remove the radiator if possible.


D353RE12

**2) INSTALLATION**

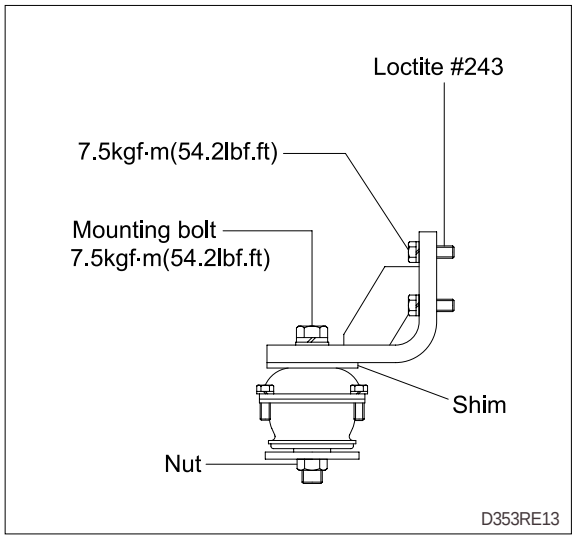
Installation is in the reverse order to removal, but be careful of the following points.

(1) Tighten the engine mounting bolts and nuts.

**(2) Tighten the engine mounting bracket bolts.**

※ Do not remove the bolts unless necessary. Loctite is coated on the thread of bolt. So if the bolts must be removed, coat the loctite(#243) when installing.

※ Before installing the bolts, loctite in the holes should be removed by a tap.




(3) Tightening torque of mounting bolt installing to flywheel housing.

· 4.17kgf · m(30.2lbf · ft)

**(4) Radiator hoses**

· Distance to insert hose : 30mm(1.18in)

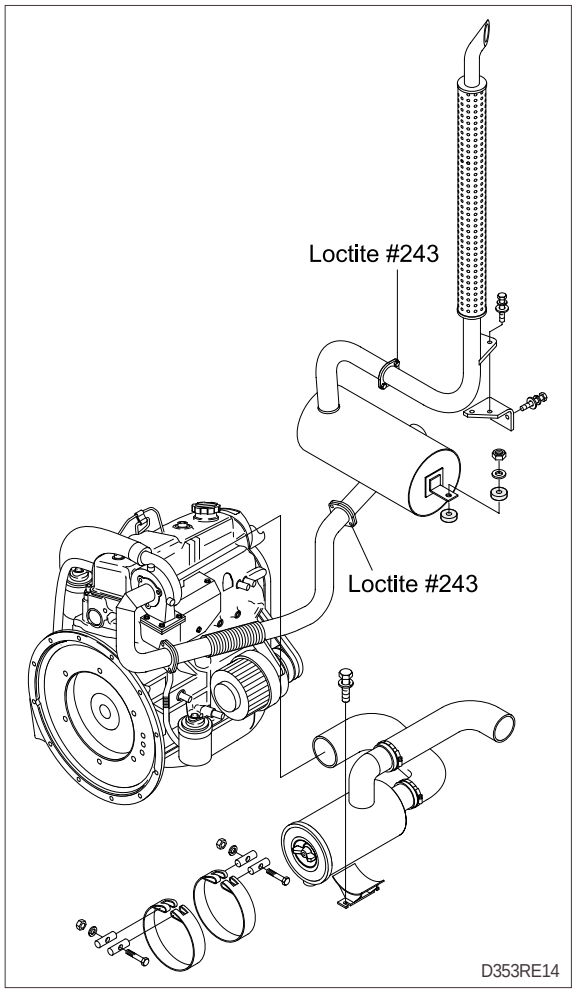
**(5) Air cleaner hose**

Insert the air cleaner hose securely and fit a clamp.

Distance to insert hose

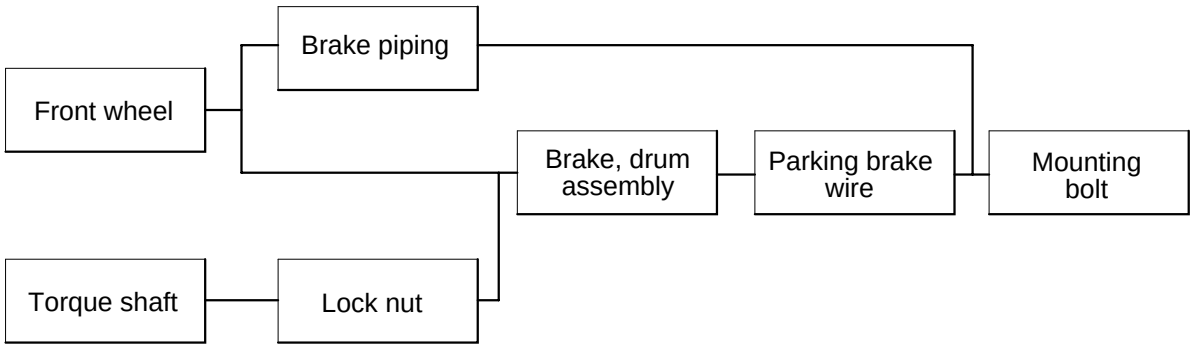
· Air cleaner hose : 40mm(1.57in)

· Engine end : 30mm(1.18in)



## 5. WHEEL BRAKE

### 1) REMOVAL

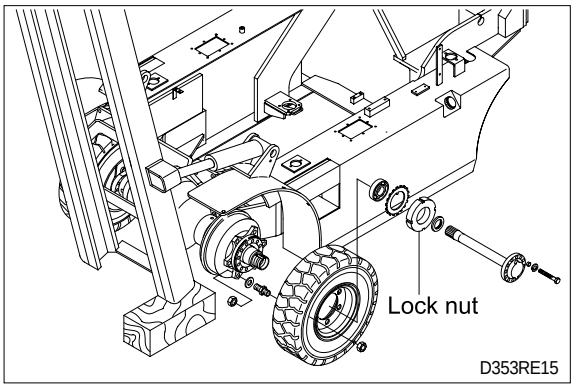



**(1) Front wheel**

Put a block under the mast and tilt forward, or jack up the bottom of the frame to raise the front wheels off the ground, then remove the front wheels.

**(2) Lockout**

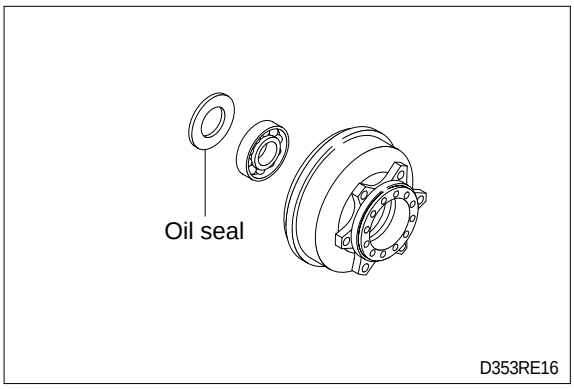
Raise the lock plate, and remove the lockout(width across flats: 95㎜) with a hub nut wrench.




**(3) Brake, drum assembly**

The oil seal inside the hub acts as a seal for the axle shaft end. Therefore when removing or installing the brake and drum assembly, remove or install in a straight line to prevent twisting the seal up and down or to the right and left.

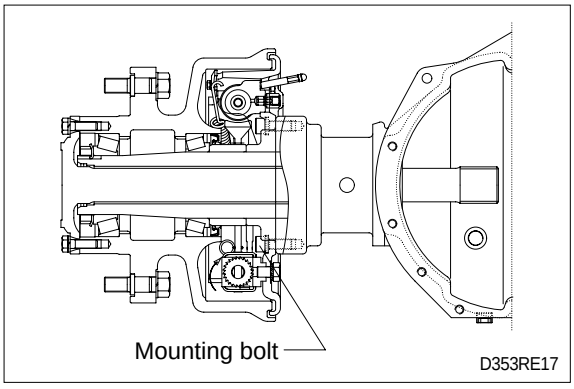
When the brake and drum assembly is removed, the oil seal is connected to the inside of the hub.



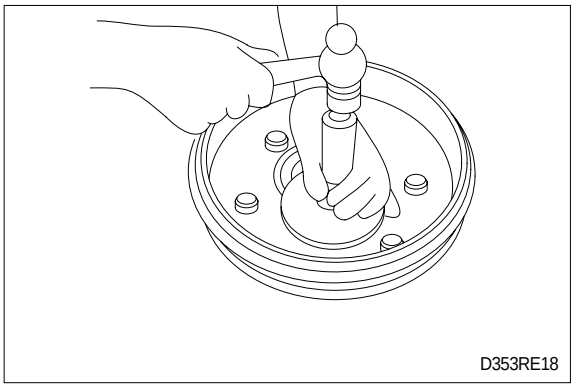

### 2) INSTALLATION

Installation is in the reverse order to removal, but be careful of the following points.

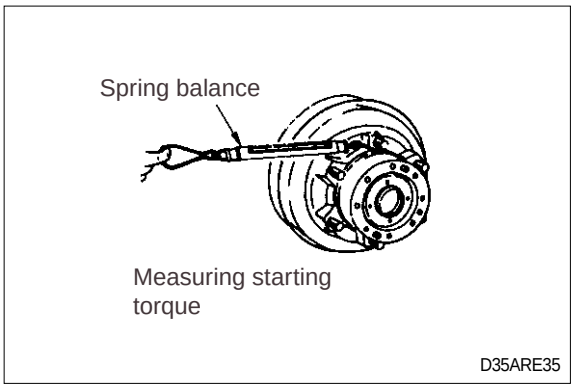
(1) Coat the mounting bolts with Loctite and tighten to 26㎏f · m(188lbf · ft).



(2) When replacing the oil seal inside the hub, be careful to install the seal facing in the correct direction(Lip on outside) and knock into place.




(3) Wipe the inside of the brake drum clean, coat the lip of the seal with grease, and assemble the brake and drum assembly. Adjust the starting torque with the nut.
Attach a spring balance to the hub bolt and adjust the nut to give a starting force of 12 to 20kgf(27~44lbf).

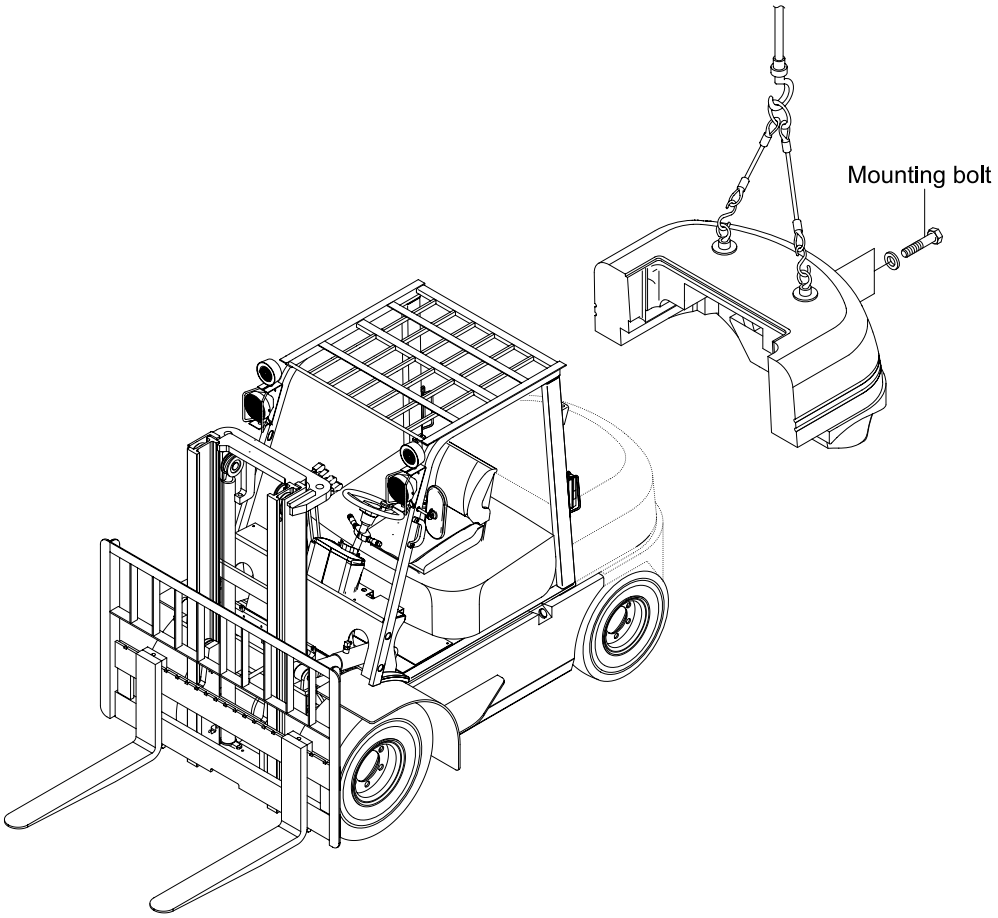



(4) Tightening torque of hub nut for front wheel.
· 35kgf · m(253lbf · ft)
Coat the hub bolt with molybdenum disulphide.

## 6. REAR AXLE

### 1) REMOVAL

Counter weight → Rear wheel (Left side) → Hose → Mounting bolt



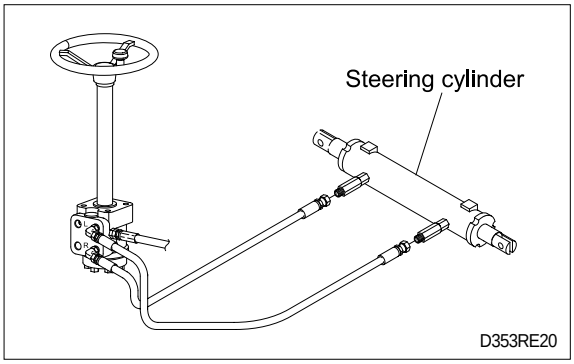

D353RE19

**(1) Counterweight**

Install a lifting tool in the hole in the counterweight, and raise with a crane.
Remove the mounting bolts, raise slightly and move to the rear.

· Weight of counterweight(standard)
HDF35III : 1,900kg(4,189lb)
HDF45III : 2,650kg(5,842lb)

**(2) Hose**

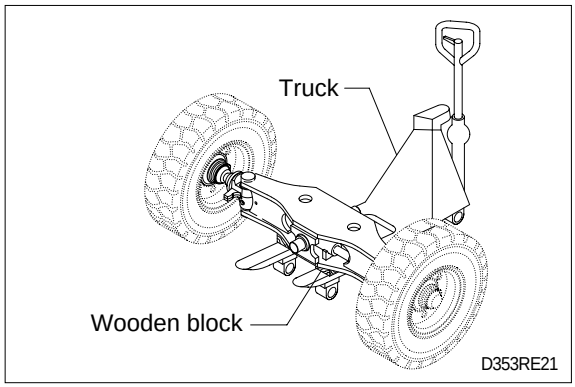



D353RE20

**(3) Mounting bolt**

Put a block under the rear axle, support on a truck, and raise the frame with a crane. Remove the mounting bolts installing to the frame, and pull out to the rear.

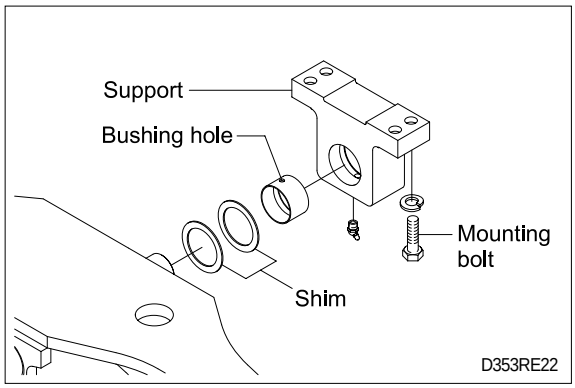
There are shims between the support and rear axle to prevent play.




**2) INSTALLATION**

Installation is in the reverse order to removal, but be careful of the following points.

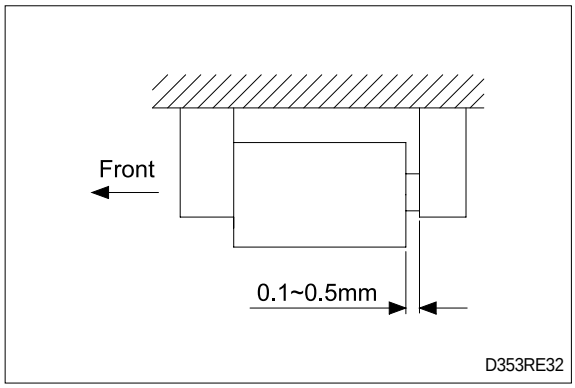
(1) When replacing the bushing at the support, install so that the hole in the bushing faces up.




(2) Install the support so that the clearance is under 0.5mm when the support is pushed fully to the rear.

Tightening torque of mounting bolt for support.

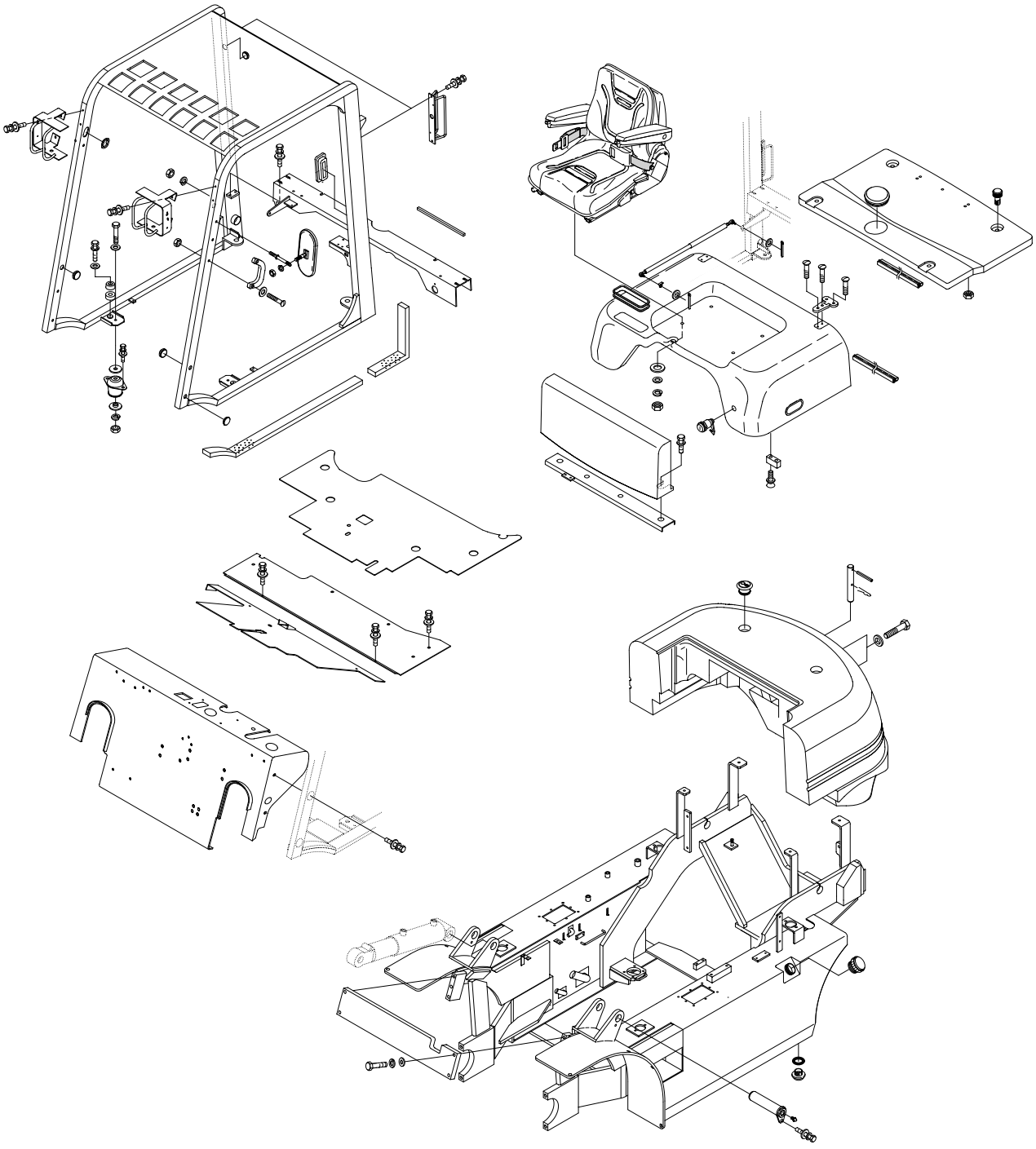
· 16.7~22.5kgf · m(116~166lbf · ft)




(3) When installing the rear wheel, coat the hub bolt with molybdenum disulphide, and tighten the nut to 35kgf · m(253lbf · ft).

(4) When installing the counterweight, align with the center of frame. Coat the mounting bolt with molybdenum disulphide and tighten 215±33 kgf · m(1555±239lbf · ft).

## 7. OUTER PANELS



D353RE23

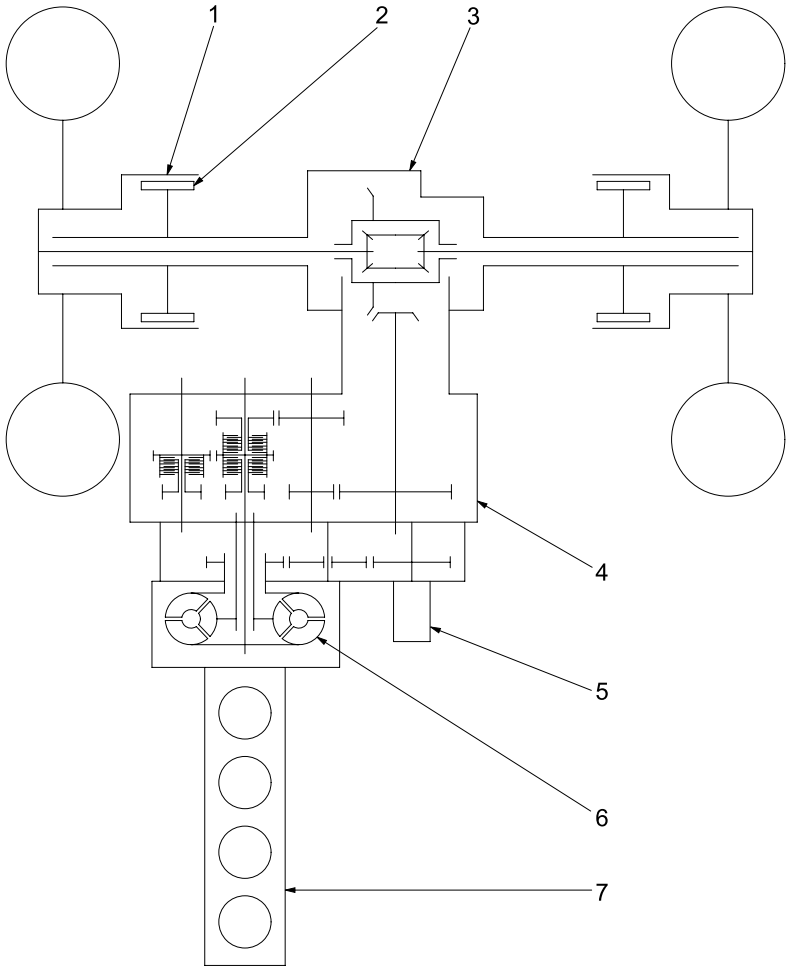
# SECTION 3 POWER TRAIN SYSTEM

# SECTION 3 POWER TRAIN SYSTEM

## GROUP 1 STRUCTURE AND OPERATION

### 1. POWER TRAIN DIAGRAM

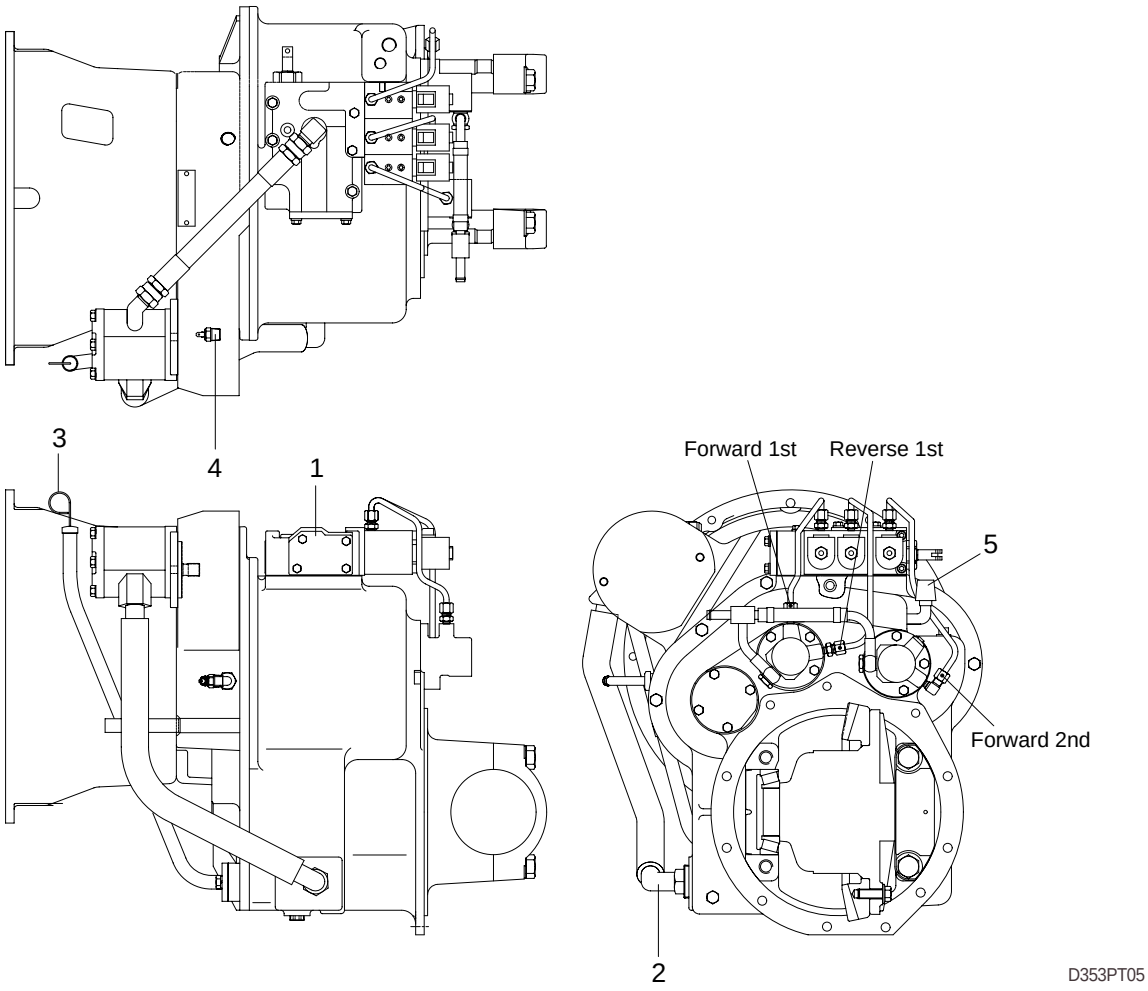
The TORQFLOW transmission uses two-speed forward and one-speed reverse transmission.
The torque converter, differential, and final drives are strengthened to match them with increased engine output and machine traveling performance.




D353PT26

1 Brake drum
2 Brake
3 Drive axle
4 Transmission
5 Hydraulic gear pump
6 Torque converter
7 Engine

## 2. INSTALLATION VIEW

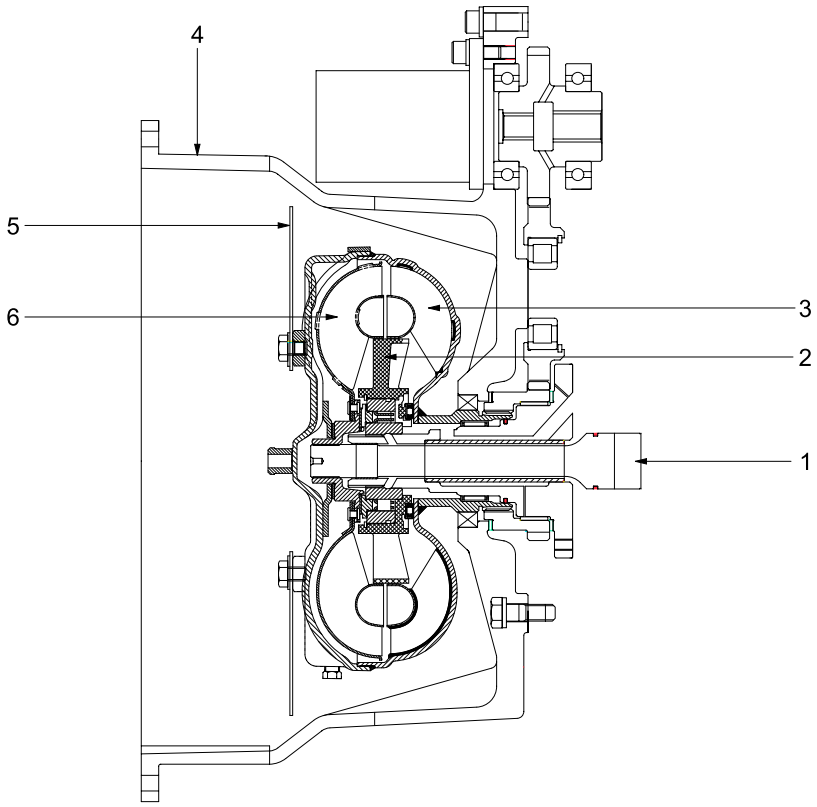



1 Control valve
2 Suction filter
3 Dipstick
4 Thermostat switch
5 Air breather

## 3. TRANSMISSION

### 1) TORQUE CONVERTER

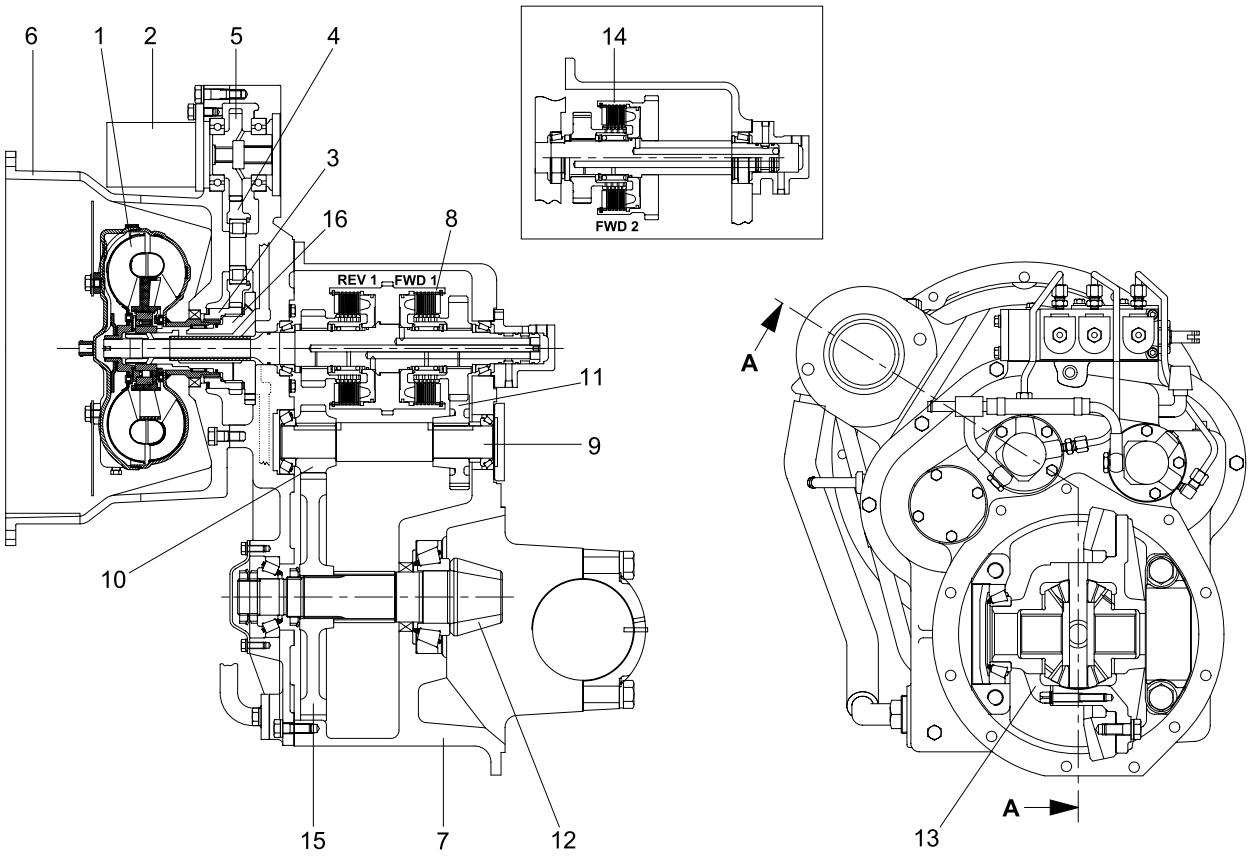
The torque converter is directly bolted to the engine flywheel housing.
Engine output is delivered from the flywheel to the flexible plate.



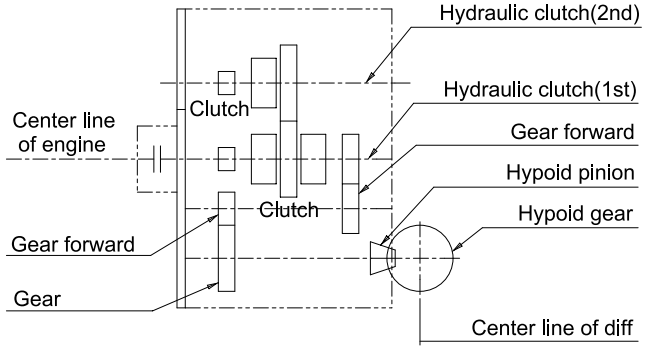

D353PT27

| | | |
|---|---|---|
| 1 | Turbine shaft | · 3-element, 1-stage, 2-phase |
| 2 | Stator | · Size : 279.4mm(11in) |
| 3 | Impeller | · Stall speed : 2075rpm |
| 4 | Housing | · Maximum input pressure : 7kgf/cm$^2$ |
| 5 | Flexible plate | |
| 6 | Turbine | |

## 2) TORQFLOW TRANSMISSION




**SECTION A - A**




| | F1 | F2 | R |
|---|---|---|---|
| Gear ratio | 22.846 | 14.923 | 18.994 |
| 8 | Z=27 | Z=39 | Z=22 |
| 14 | | Z=39, Z=28 | |
| 11 | Z=31 | | |
| 10 | Z=21 | | |
| 15 | Z=75 | | |
| 12 | Z=39, Z=7 | | |

D353PT01

| | | | | | |
|---|---|---|---|---|---|
| 1 | Torque converter | 7 | Transmission case | 13 | Differential |
| 2 | Gear pump | 8 | Hydraulic clutch(1st) | 14 | Hydraulic clutch(2nd) |
| 3 | Torque converter gear | 9 | Forward shaft | 15 | Drive gear |
| 4 | Idler gear | 10 | Forward gear | 16 | Stator hub |
| 5 | Gear pump drive | 11 | Forward gear | | |
| 6 | Torque converter housing | 12 | Hypoid gear set | | |

### 3) OPERATION

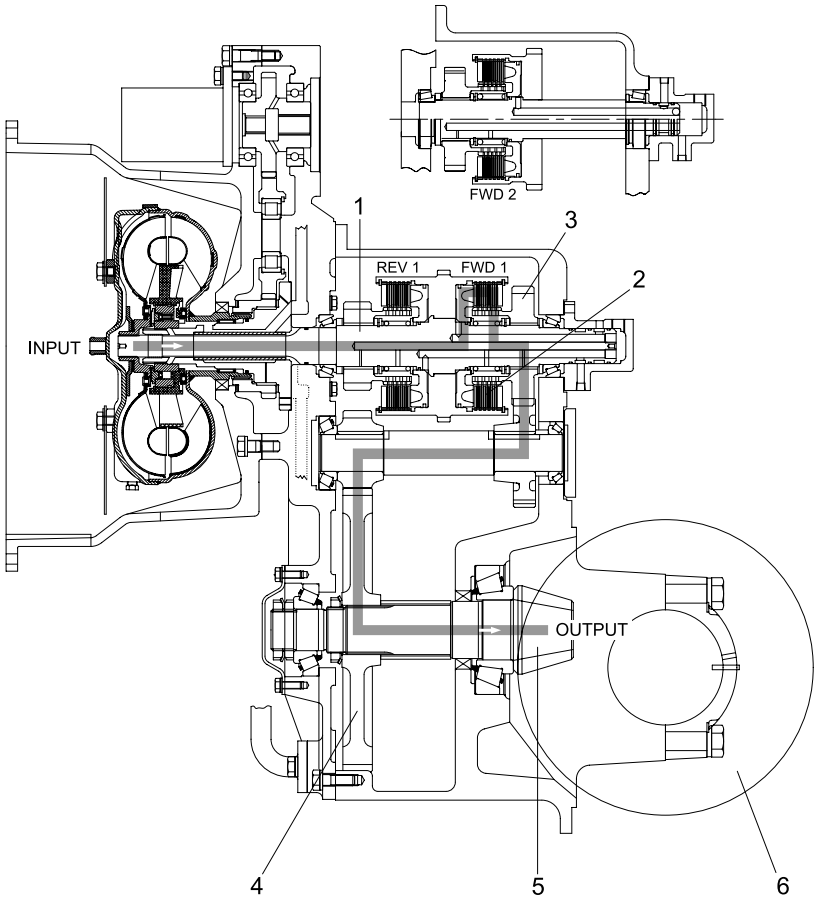
The torque converter consists of three elements; an impeller wheel connected to the input side and a turbine wheel and stator wheel connected to the output side. The torque converter is filled with oil. The engine rotates the impeller wheel and the impeller blade will give the fluid energy. Oil flows out along the path by centrifugal force, and this energy will give the turbine wheel torque. The fluid passing through the rotating turbine wheel generates counter torque of the stator while its flow is changed by the stator. Counter torque is added to the turbine, and as the result of this, the output torque is increased several times as engine torque.

The torque converter gives the maximum output torque when the truck starts running. When the truck runs at high speed, high torque is not required and output torque is gradually reduced. Since the engine and driven axle are connected through the fluid, return vibrations or shocks from the axle is absorbed and the longevity of the power transmission system is extended. Truck speed cannot cause the engine to stall. Torque is automatically converted according to the trucks speed. This makes the drive operation much easier and work can be done more efficiently.

The power of the engine is transferred from the turbine shaft to the clutch shaft through the torque converter, and the forward/reverse rotation is selected by the hydraulic clutch. The power is transferred from the forward drive gear to the driven gear of the hypoid pinion through the drive shaft and gear. For reverse, the power is transferred from the reverse drive gear of the clutch to the driven gear of the hypoid pinion through the reverse shaft and gear, drive shaft and gear to reversely rotate the pinion.

## 4) TRANSMISSION OPERATING MODES

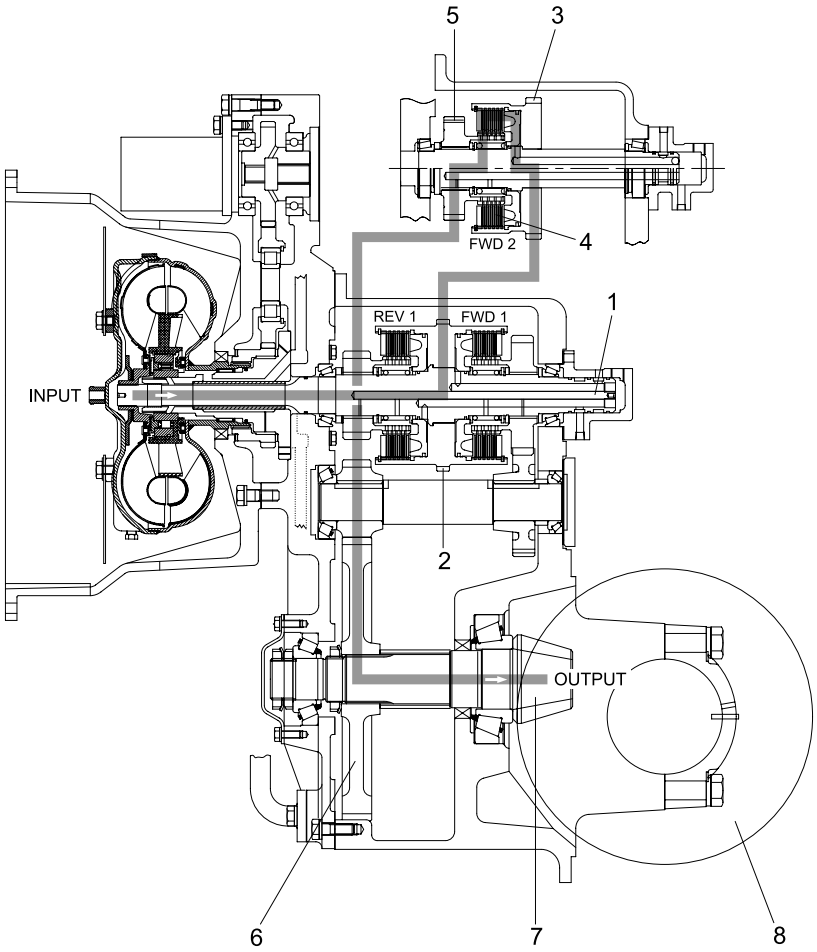
### (1) Forward 1st




D353PT02

In forward 1st the torque converter is turned by the engine. The torque converter turbine shaft turns the 1st forward/reverse clutch pack shaft(1) and clutch packs at turbine speed. The piston in the forward 1st clutch pack(2) is pressurized by transmission fluid from the control valve. The piston applies pressure to the discs in the clutch pack, causing the clutch to engage. As the clutch engages, it turns the low forward output gear(3). The low forward output gear engages the forward shaft gear and turns the forward shaft. The gear on the other end of the forward shaft engages the pinion shaft spur gear(4) which turns the pinion shaft and pinion gear(5). The pinion gear then turns the ring gear(6) in a forward direction, moving the machine forward.

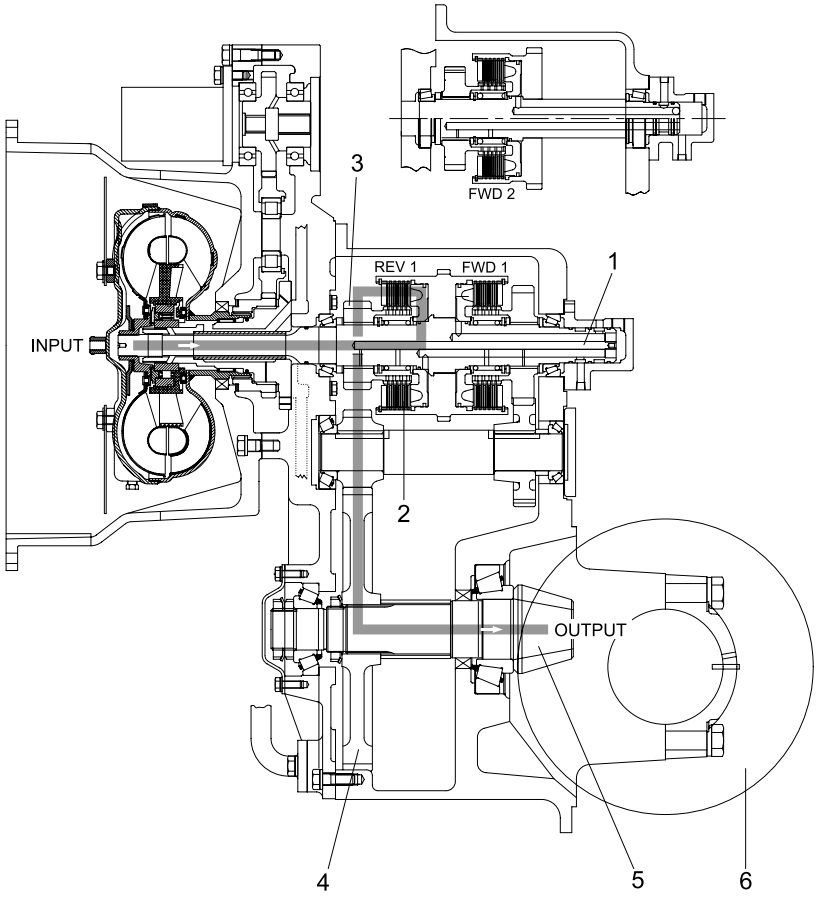
**(2) Forward 2nd**




D353PT03

In forward 2nd the torque converter is turned by the engine. The torque converter turbine shaft turns the 1st forward/reverse clutch pack shaft(1) and clutch packs. The gear(2) welded between the clutch packs turns with the shaft. This gear engages the gear(3) welded to the 2nd forward clutch pack(4), turning the clutch pack. The piston in the 2nd forward clutch pack is pressurized by transmission fluid from the control valve. The piston applies pressure to the discs in the clutch pack, causing the clutch to engage. As the clutch engages, turns the 2nd forward output gear(5). The 2nd forward output gear engages the pinion shaft spur gear(6) turning it. The pinion shaft and the pinion gear(7) also turn. The pinion gear the turns the ring gear(8) in a forward direction, moving the true forward.

**(3) Reverse**

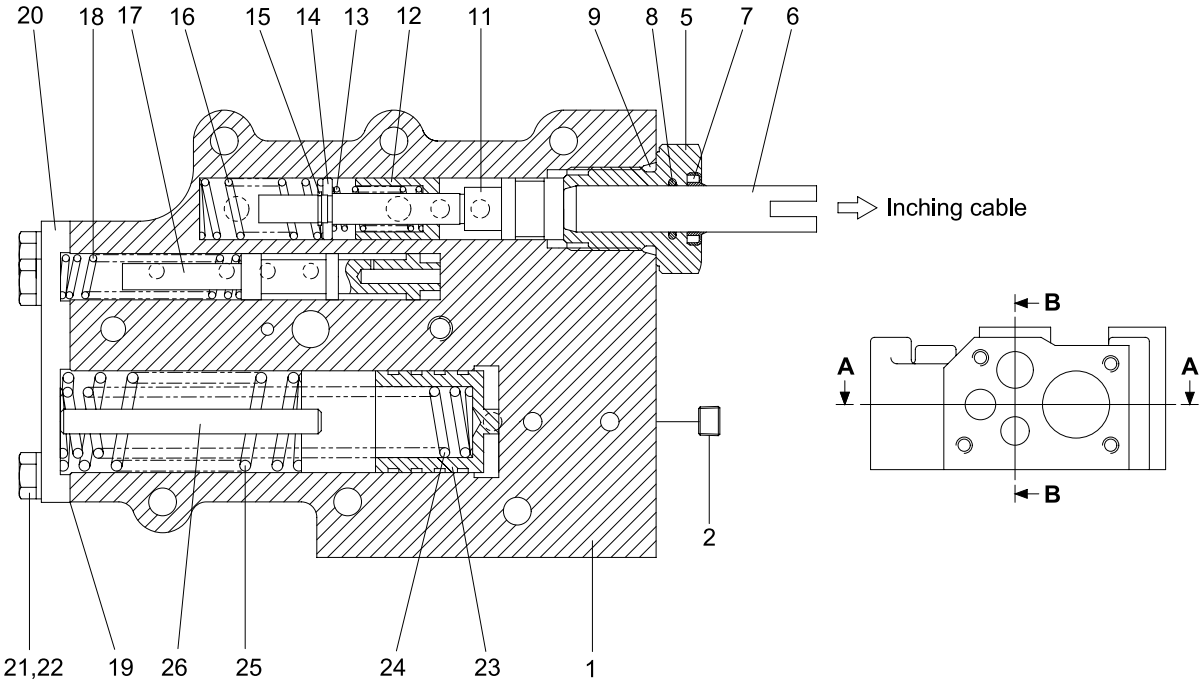



D353PT04

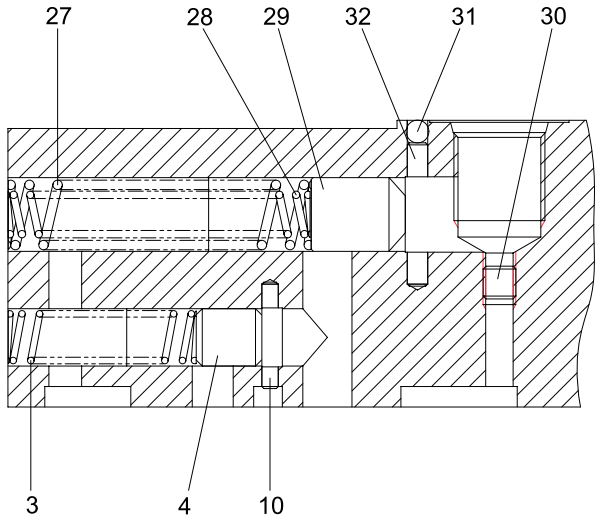
In reverse the torque converter is turned by the engine. The torque converter turbine shaft turns the 1st forward/reverse clutch pack shaft(1) and clutch packs. The piston in the reverse clutch pack(2) is pressurized by transmission fluid from the control valve. The piston applies pressure to the discs in the reverse clutch pack, causing the clutch to engage. As the clutch engages, it turns the reverse output gear(3) the reverse output gear engages the pinion shaft spur gear(4), turning the spur gear, the pinion shaft, and the pinion gear(5). The pinion gear then turns the ring gear(6) in a rearward direction moving the truck in reverse.

## 4. CONTROL VALVE

### 1) STRUCTURE



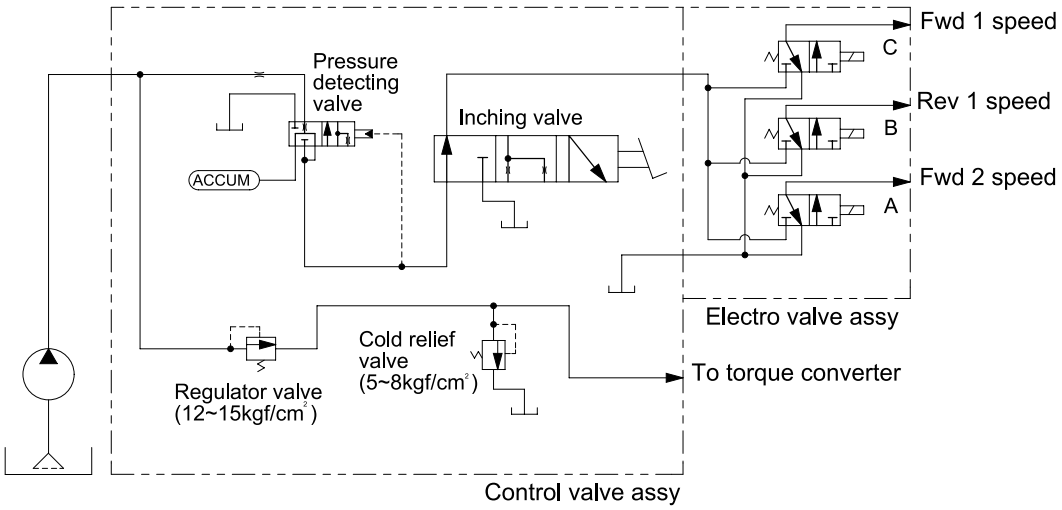

SECTION A - A




SECTION B - B

| | |
|---|---|
| 1 | Body |
| 2 | Cap plug |
| 3 | Spring |
| 4 | Piston |
| 5 | Cap |
| 6 | Piston |
| 7 | Dust seal |
| 8 | O-ring |
| 9 | O-ring |
| 10 | Pin |
| 11 | Inching spool |
| 12 | Piston |
| 13 | Spring |
| 14 | Washer |
| 15 | Snap ring |
| 16 | Spring |
| 17 | Spool |
| 18 | Spring |
| 19 | Gasket |
| 20 | Cover |
| 21 | Hexagon bolt |
| 22 | Spring washer |
| 23 | Piston |
| 24 | Spring |
| 25 | Spring |
| 26 | Stopper |
| 27 | Spring |
| 28 | Spring |
| 29 | Piston |
| 30 | Orifice |
| 31 | Steel ball |
| 32 | Pin |

## 2) HYDRAULIC CIRCUIT (2-SPEED)




D353PT11

## 3) OPERATION

The control valve mainly consists of the regulator valve, cold relief valve, pressure detecting valve, inching valve and electro valve.

The discharged oil from the gear pump enters regulator valve of the control valve and its pressure is adjusted 12~15kg/cm² (171~213psi).

The oil sent from the regulator valve flows into the torque converter. The cold relief valve is built into the torque converter to prevent excessively raising the oil pressure in the converter due to oil viscosity rising when cold.

Pressure adjusted oil passes through pressure decting valve, inching valve and electro valve, and operates the forward or reverse hydraulic clutch.

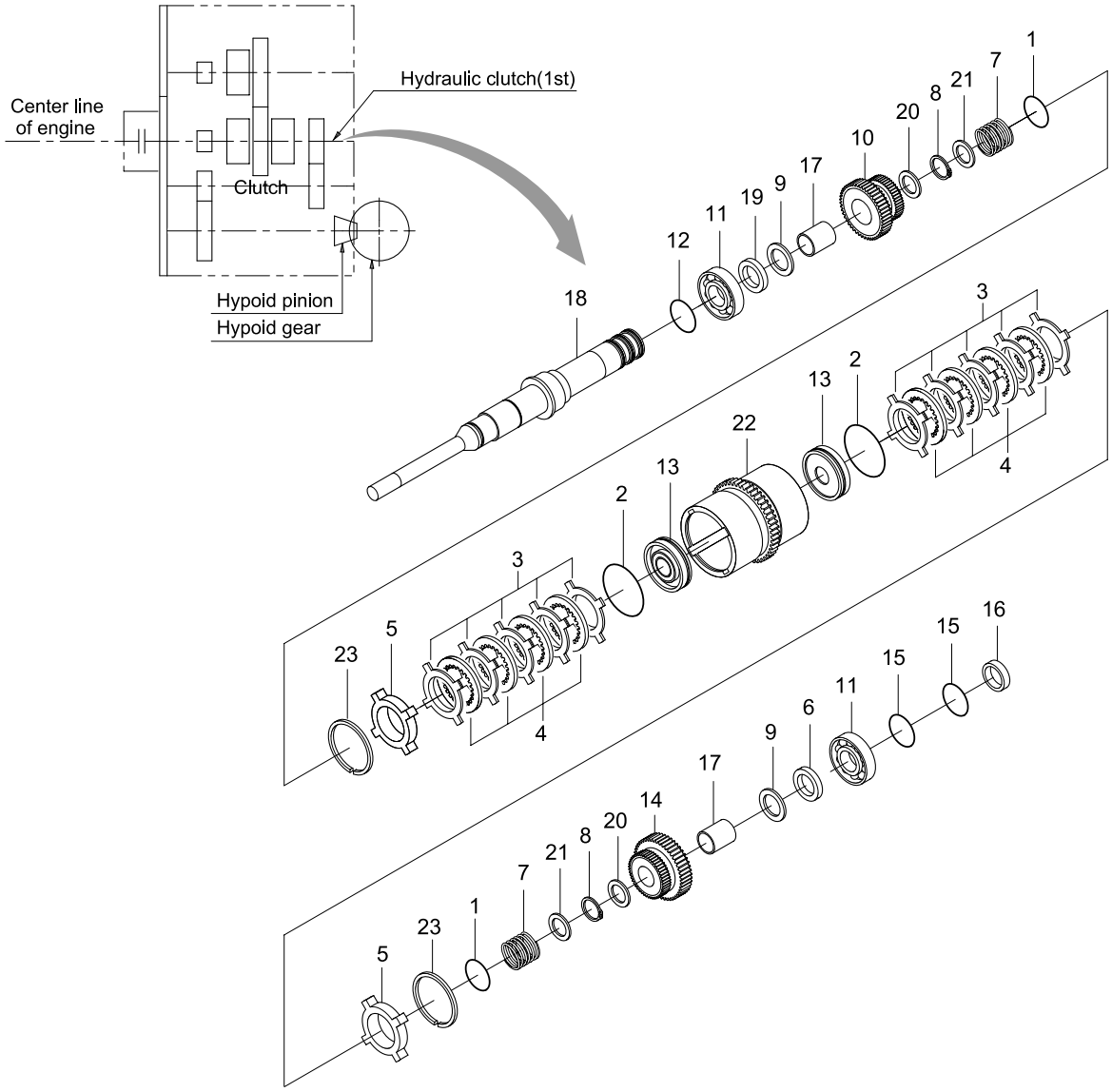
The pressure detecting valve and built in accumulator provide a soft plugging when changing gears. The pressure detecting valve allows the accumulator to absorb the small shocks of rapid pressure build-up and quick release during gear changes. When full pressure builds up, the pressure detecting valve shuts the accumulator off and allows it to empty so it is ready to function again during gear change.

The inching control is actuated through the inching pedal. This permits the clutch to partially disengage, so that engine rpm can be increased for lifting while travel speed remains low.

## 5. HYDRAULIC CLUTCH

### 1) STRUCTURE

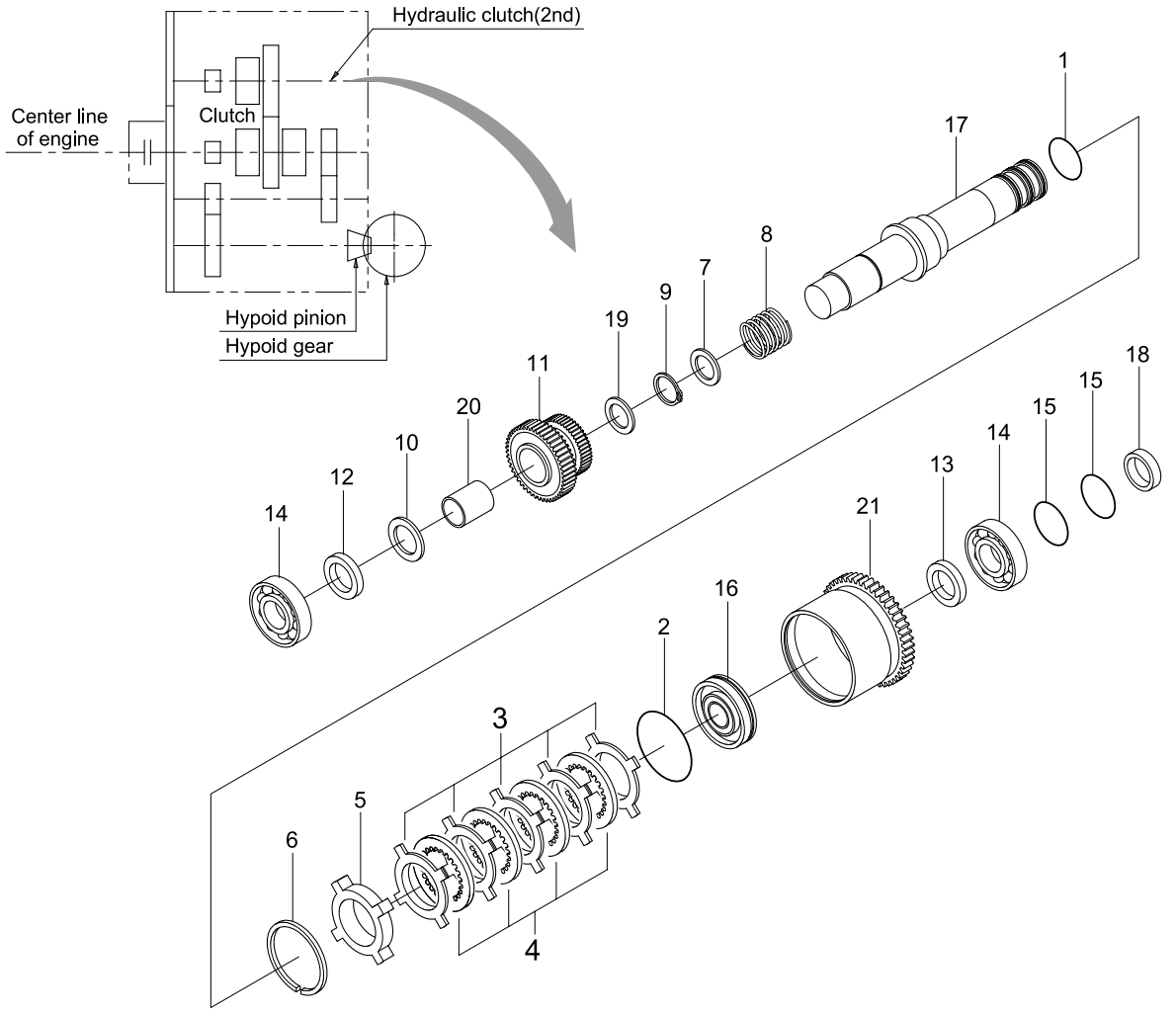
#### (1) Reverse and forward 1st




D353PT12

| | | | | | |
|---|---|---|---|---|---|
| 1 | Piston ring | 9 | Thrust washer | 17 | Bushing |
| 2 | Piston ring | 10 | Gear | 18 | Shaft |
| 3 | Drive plate | 11 | Taper roller bearing | 19 | Washer |
| 4 | Friction plate | 12 | Seal ring | 20 | Washer |
| 5 | Back plate | 13 | Piston | 21 | Washer |
| 6 | Washer | 14 | Gear | 22 | Drum |
| 7 | Spring | 15 | Seal ring | 23 | Snap ring |
| 8 | Snap ring | 16 | Ball plug | | |

### (2) Forward 2nd




| | | | | | |
|---|---|---|---|---|---|
| 1 | Piston ring | 8 | Spring | 15 | Seal ring |
| 2 | Piston ring | 9 | Snap ring | 16 | Piston |
| 3 | Drive plate | 10 | Spring | 17 | Input shaft |
| 4 | Friction plate | 11 | Gear | 18 | Ball plug |
| 5 | Back plate | 12 | Washer | 19 | Piston ring |
| 6 | Snap ring | 13 | Washer | 20 | Bushing |
| 7 | Washer | 14 | Taper roller bearing | 21 | Drum |

## 2) CLUTCH PACKS

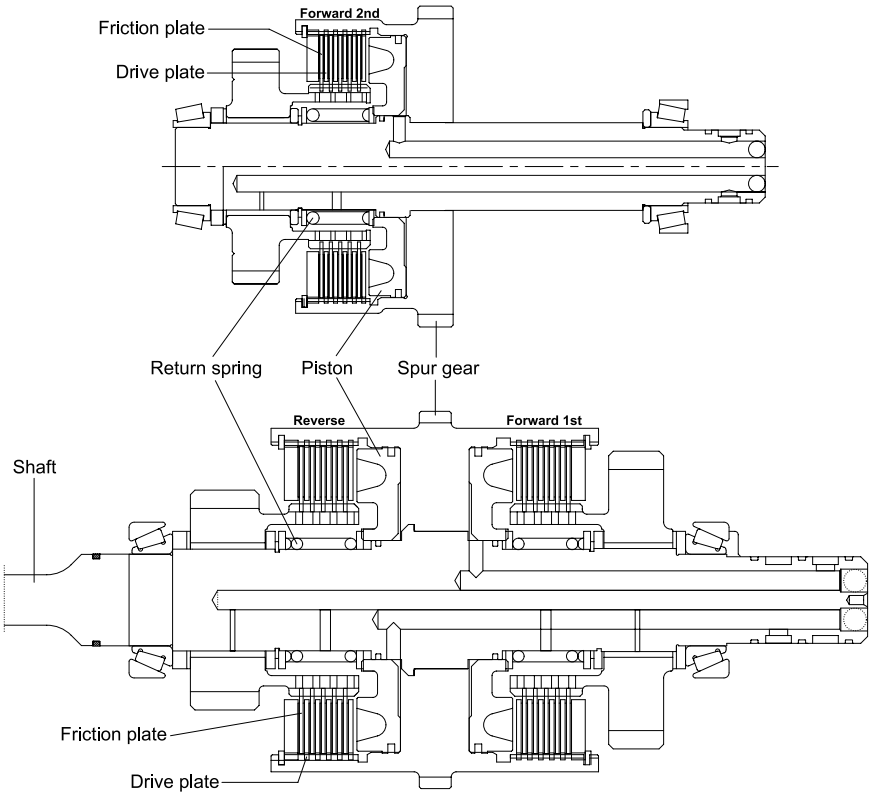
The clutch packs have a driving side and a driven side for each gear selection, a total of three(2 forward, 1 reverse). One clutch pack assembly has two selections on the same shaft, forward 1st and reverse, and the clutches are back to back with a spur gear in the middle. The other has only one selection on the shaft, forward 2nd, with a spur gear welded to it.

The forward 1st/reverse clutch pack is driven by the turbine shaft of the torque converter. The spur gear on the forward 1st/reverse clutch pack drives the spur gear on the forward 2nd clutch pack in a counter-rotating direction. The assembly makes up the main part of the driving sides of the three clutch packs. This assembly is rotating at turbine speed whenever the torque converter turbine is rotating, no matter what gear is selected, including neutral.

Into each of these driven clutch pack bodies fits a hydraulic piston, and a set of alternating drive plates(steel) and friction plates(fiber faced). The steel plates have teeth on the outer edge which slide into the slots in the clutch pack body, and rotate with the clutch pack. Each of the fiber faced plates have teeth on the inner edge which engage a spline on a driven gear. A return spring on the shaft keeps the piston from engaging the clutch when there is no hydraulic pressure from the control valve.

A driven gear(or output gear) slides over the clutch pack shaft and engages the teeth on the inside edge of the friction plates.

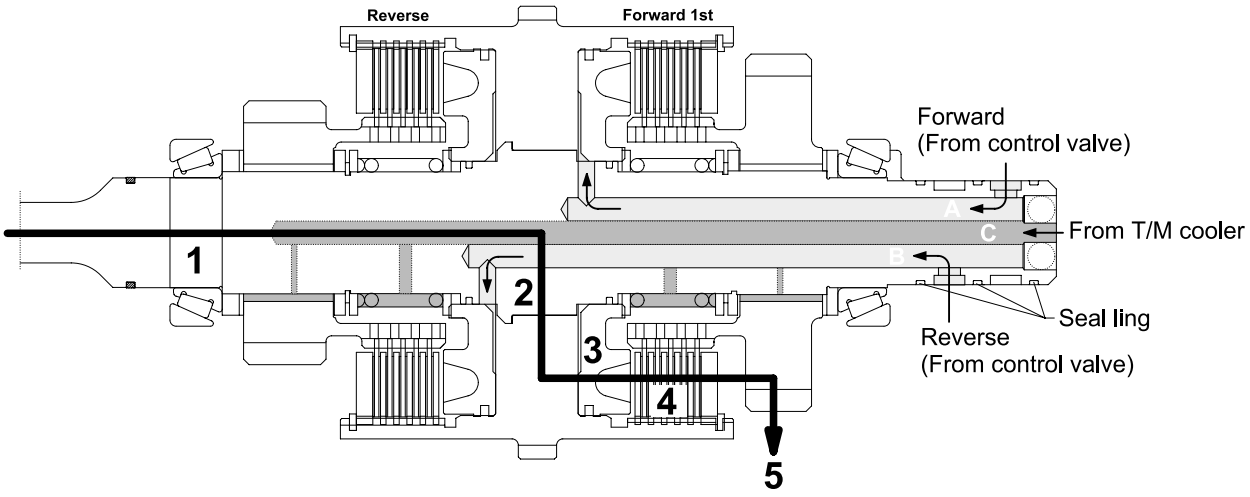
**Forward 2nd clutch pack assembly**




**Forward 1st/reverse clutch pack assembly**

D353PT23

### 3) OPERATION




D353PT24

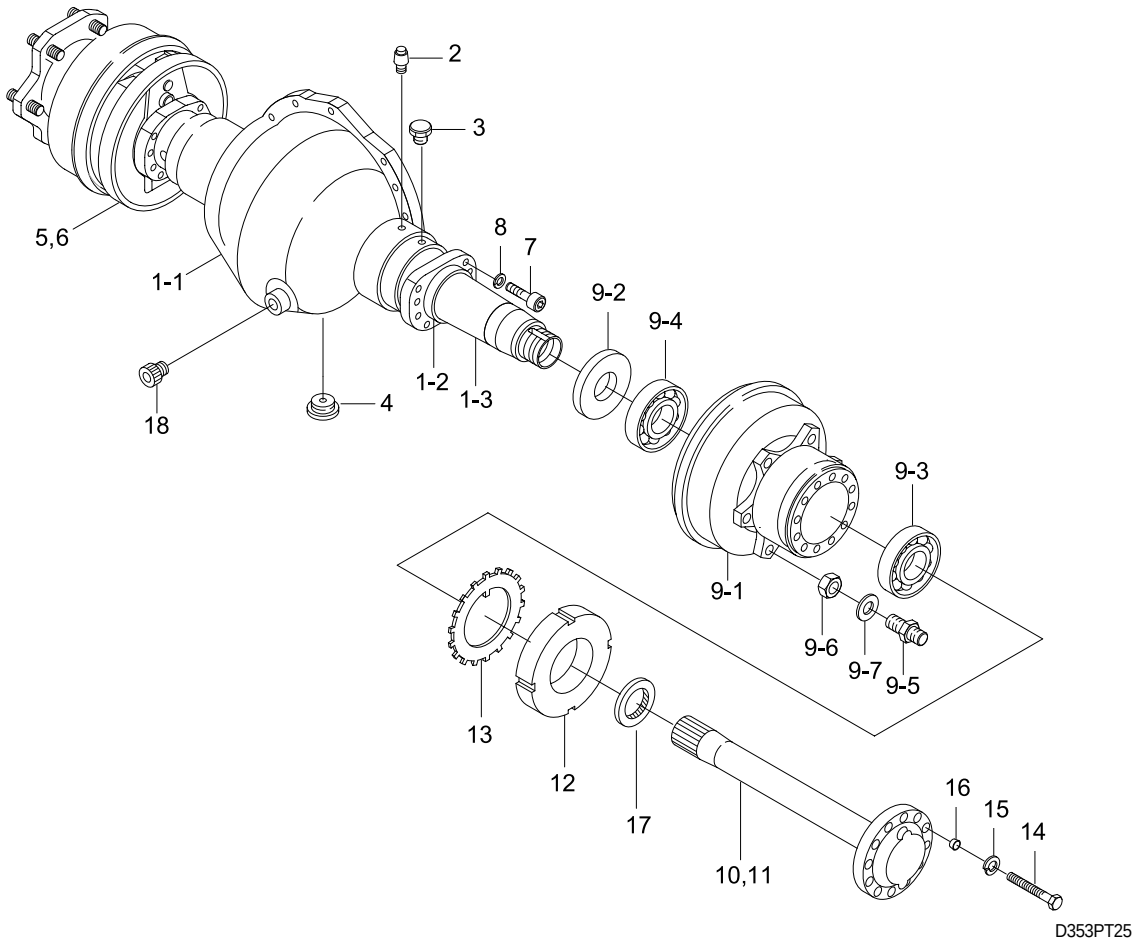
When a gear is selected by the operator, the following happens.

**1** The clutch pack shaft is being driven by the torque converter.
**2** The spur gear and clutch pack body is attached to shaft and rotates with it.
**3** The clutch piston is pressurized by transmission fluid from the control valve.
**4** The pressurized piston compresses the drive plates and the friction plates, causing them to rotate together.
**5** The driven(or output) gear rotates with the clutch pack body and drives the forward shaft gear or pinion spur gear, depending on gear selection.

There are three oil ports that enter the clutch pack shafts through the manifold caps. Two(A, B) are for supplying transmission fluid to the clutch pistons. The third(C) is to supply lubrication to the gears and clutch discs. Seal rings separate oil flow from manifold cap.

## 6. DRIVE AXLE

### 1) STRUCTURE




| | | | | | |
|---|---|---|---|---|---|
| 1 | Housing assy | 8 | Washer | 10 | Drive axle shaft-RH |
| 1-1 | Housing | 9 | Hub assy | 11 | Drive axle shaft-LH |
| 1-2 | Sleeve | 9-1 | Hub | 12 | Lock nut |
| 1-3 | Spacer | 9-2 | Oil seal | 13 | Washer |
| 2 | Air breather | 9-3 | Taper roller bearing | 14 | Bolt |
| 3 | Plug | 9-4 | Taper roller bearing | 15 | Spring washer |
| 4 | Plug | 9-5 | Bolt | 16 | Washer |
| 5 | Wheel brake assy-RH | 9-6 | Hexagen nut | 17 | Oil seal |
| 6 | Wheel brake assy-LH | 9-7 | Washer | 18 | Plug |
| 7 | Socket bolt | | | | |

### 2) OPERATION

Both sides of the housing are supported by the frame and the center is mounted on the transmission case with bolts(11EA).

The mast is installed on the front of the drive axle housing through the trunnion. The final deceleration and differential device built in the housing guarantee accurate rotation and smooth operation. The power from the transmission in transferred through the hypoid pinion, hypoid gear, differential case, the pinion of the differential device and the side gear to the drive axle shaft by the side gear spline and to the hub and wheel mounted on the shaft by high tension bolts.

## GROUP 2 TROUBLESHOOTING

| Problem | Probable cause | Remedy |
|---|---|---|
| **1. Excessive oil temperature rise** | | |
| 1) Torque converter | · Improper oil level. | · Check oil level. Add or drain oil as necessary. |
| | · Impeller interfering with surroundings. | · After draining oil from oil tank and transmission, check and replace interfering parts. |
| | · Stator and free wheel malfunctioning. | · Check engine (stalling) speed. If necessary, replace. |
| | · Air sucked in. | · Check the inlet side joint or pipe. If necessary, retighten joint or replace gasket. |
| | · Water intruding into transmission case | · Check drained oil. If necessary, change oil. |
| | · Bearing worn or seizing. | · Disassemble, inspect, repair or replace. |
| | · Gauge malfunctioning. | · Check and, if necessary, replace. |
| 2) Transmission | · Clutch dragging. | · Check to see whether or not machine moves even when transmission is placed in neutral position. If so, replace clutch plate. |
| | · Bearing worn or seized. | · Disassemble, check and replace. |
| **2. Noise operation** | | |
| 1) Torque converter | · Cavitation produced. | · Change oil, replace parts leaking air. |
| | · Flexible plate damaged. | · Listen to rotating sound at lowspeed operation. If necessary, repacle flexible plate. |
| | · Bearing damaged or worn. | · Disassemble, check and replace. |
| | · Gear damaged. | · Disassemble, check and replace. |
| | · Impeller interfering with surroundings. | · Check impeller or check drained oil for mixing of foreign matter. If necessary, change oil. |
| | · Bolt loosening. | · Disassemble and check. If necessary, retighten or replace. |
| | · Spline worn. | · Disassemble, check and replace. |
| | · Noise gear pump operation. | · Disassemble, check and replace. |
| 2) Transmission | · Dragging caused by seizing clutch. | · Check to see whether or not machine moves even when transmission is in neutral position. If so, replace clutch plate. |
| | · Bearing worn or seizing. | · Disassemble, check and replace |
| | · Gear damaged. | · Disassemble, check and replace |
| | · Bolt loosening. | · Disassemble, check and retighten or replace |
| | · Spline worn. | · Disassemble, check and replace |

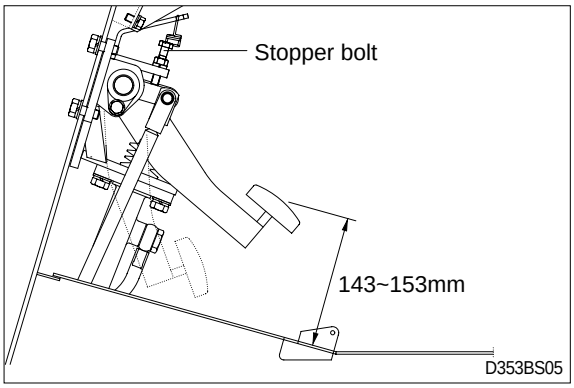
| Problem | Probable cause | Remedy |
|---|---|---|
| **3. Low output power** | | |
| 1) Torque converter | · Insufficient hydraulic pressure : | |
| | - Low oil level. | - Check oil level and add oil |
| | - Air sucked in. | - Check joints and pipes. If necessary, retighten joint or replace packing. |
| | - Oil filter clogging. | - Check and replace |
| | - Oil pump worn. (Low delivery flow) | - Check oil pressure. If necessary replace pump. |
| | - Regulator valve coil spring fatigued. | - Check spring tension. If necessary, replace. |
| | - Control valve spool malfunctioning. | - Disassemble, check and repair or replace. |
| | - Piston or O-ring worn. | - Disassemble, check measure and replace. |
| | · Stator free wheel cam damaged. | - Check stalling speed. (Increased engine load will cause excessive drop of stalling speed.) |
| | | - Check oil temperature rise. If any, replace free wheel. |
| 2) Transmission | · Flexile plate deformed | · Replace flexible plate |
| | · Stator free wheel seizing. | - Check temperature plate. (No-load will cause temperature rise) |
| | | - Replace free wheel if a drop of starting output is found. |
| | · Impeller damaged for interfering with the surroundings. | - Check drained oil for foreign matter. If any, change oil. |
| | · Use of poor quality of oil or arising of air bubbles. | - Check and change oil. |
| | - Air sucked in from inlet side. | - Check joints and pipes. If necessary, retighten joint or replace packing. |
| | - Low torque converter oil pressure accelerates generation of air bebbles. | - Check oil pressure. |
| | - Oil mixing with water. | - Check drained oil and change oil. |
| | - Inching rod out of adjustment. | - Check and adjust. |
| | · Clutch slipping | |
| | - Lowering of weight. | - Check oil pressure. |
| | - Piston ring or O-ring worn. | - Disassemble, check, measure and replace. |
| | - Clutch piston damaged. | - Disassemble, check and replace. |
| | - Clutch plate seizing or dragging. | - Check to see whether or not machine moves even when transmission is in neutral position. If so, replace. |

| Problem | Probable cause | Remedy |
|---|---|---|
| **4. Unusual oil pressure** | | |
| 1) Oil pressure is high | · Control valve malfunctioning. | (1)Check for spool operation. If necessary, replace valve.<br>(2)Check for clogging of small hole in valve body. If necessary, clean or repair. |
| | · Cold weather. (high oil viscosity) | · When atmospheric temp is below freezing point (when normal oil pressure is recovered if heated to 60 ~ 80℃), change oil. |
| | · Use of improper oil. | · Check and change oil. |
| 2) Oil pressure is low | · Gear pump malfunctioning(worn). | · Disassemble, check and replace. |
| | · Oil leaks excessively :<br>(1)Control valve oil spring defective. | · Check spring tension (see spring specification). If necessary replace. |
| | (2)Control valve spool defective. | · Disassemble, check, and repair or replace valve. |
| | · Air sucked in. | · Check joints and pipes. If necessary, retighten joint or replace packing. |
| | · Low oil level. | · Check oil level and add oil. |
| | · Oil filter clogging. | · Check and replace. |
| 3) Transmission | · Oil leaks excessively. | · Disassemble, check (piston ring and O-ring for wear and other defects), and replace. |
| **5. Power is not transmitted** | | |
| 1) Torque converter | · Clutch plate damaged. | · Check for damage by listening to abnormal sounds at a low converter speed and replace. |
| | · Low oil level. | · Check oil level and add oil |
| | · Oil pump driving system faulty. | · Disassemble and check for wear of pump gear, shaft and spline. Replace defective parts. |
| | · Shaft broken. | · Check and replace. |
| | · Lack of oil pressure. | · Check oil pump gear for wear and for oil suction force. If necessary, replace pump. |

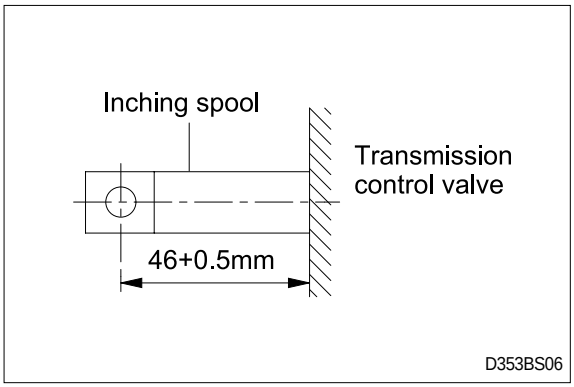
| Problem | Probable cause | Remedy |
|---|---|---|
| **5. Power is not transmitted**<br>2) Transmission | · Low oil level. | · Check oil level and add oil. |
| | · Inching valve and link lever improperly positioned. | · Check measure and adjust. |
| | · Forward/reverse spool and link lever improperly positioned. | · Check and adjust. |
| | · Clutch fails to disengage :<br>(1)Clutch case piston ring defective. | · Disassemble, check and replace |
| | (2)Main shaft plug slipping out. | · Disassemble, check and repair or replace |
| | · Clutch seizing. | · Check to see whether or not machine moves even then transmission is in neutral position. If so, replace. |
| | · Shaft broken off. | · Disassemble, check(main shaft, etc.), and replace. |
| | · Clutch drum damaged (spring groove). | · Disassemble, check and replace. |
| | · Clutch snap ring broken. | · Disassemble, check and repair or replace. |
| **6. Oil leakage**<br>(Transmission and torque converter) | · Oil leaks from oil seal. | · Disassemble and check for wear of seal lips and mating sliding surfaces (pump boss, coupling etc.)<br>Replace oil seal, pump boss, coupling, etc. |
| | · Oil leaks from case joining surfaces. | · Check and retighten or replace packing. |
| | · Oil leaks from joint or pipe. | · Check and repair or replace gasket. |
| | · Oil leaks from drain plug. | · Check and retighten or gasket. |
| | · Oil leaks from a crack. | · Check and replace cracked part. |

## 1. INCHING PEDAL

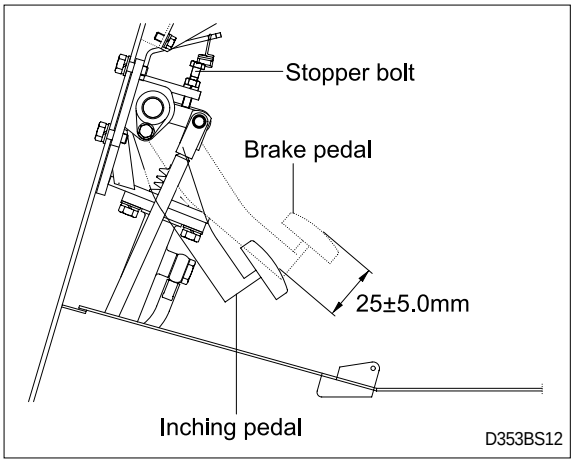
1) Depress inching pedal fully, and move gear shift lever to FORWARD or REVERSE. Check that machine does not move even when engine speed is increased slightly.
2) Adjust stopper bolt so that pedal height is 143~153mm (5.6~6.0in).




3) Adjust inching cable so that length of inching spool is 46+0.5mm(1.8in) when pedal height is 143~153mm (5.6~6.0in).




4) Adjust bolt so that brake pedal interconnects with inching pedal stroke 25±5.0mm.



## 2. HYDRAULIC PRESSURE

1) Block wheels of truck, and pull parking lever. Install oil pressure gauge at inlet of control valve.
2) Move direction control lever to FORWARD or REVERSE, depress accelerator pedal and run engine at 1500rpm. Measure clutch pressure and torque converter pressure and check that they are within specified range.

## 3. ENGINE STALL SPEED

Move direction control lever to FORWARD or REVERSES, and run engine at maximum speed. Check that maximum engine speed is within specified range.

※ **This check raises the temperature of the oil in the torque converter, so do not run this test for a long period.**

| Stall speed | rpm |
|---|---|
| HYUNDAI D4DA-C1 | 1980 |

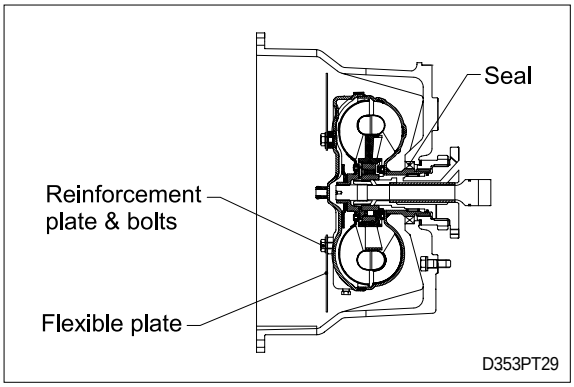
## 1. TRANSMISSION

### 1) DISASSEMBLY

#### (1) Torque converter

① Remove the torque converter assembly from the torque converter housing.

② Loosen the bolts to repair flexible plate.

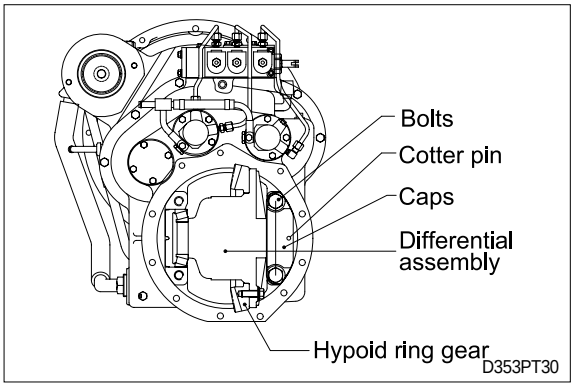



#### (2) Differential and caps

① Remove the locking cotter pins.

② Remove the differential cap bolts and caps. Using the hoist and sling, remove the differential and hypoid ring gear.

※ Install pinion holding tool to retain the pinion shaft position during disassembly.

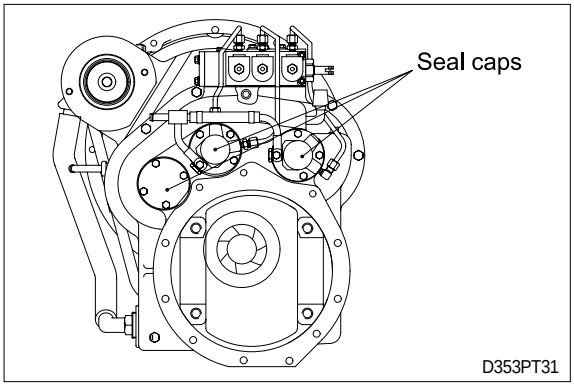



#### (3) Seal ring caps

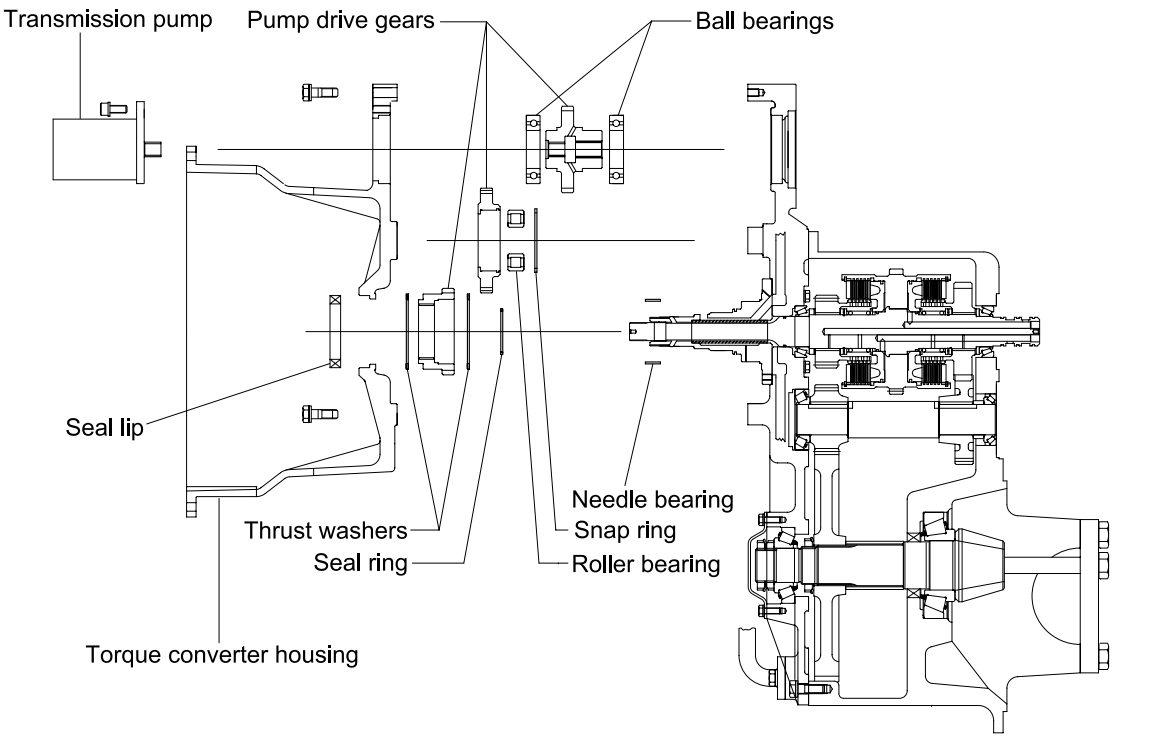
① Remove the seal caps and shims from the transmission.

② Check the shim thickness.

③ Remove the seals on shafts.



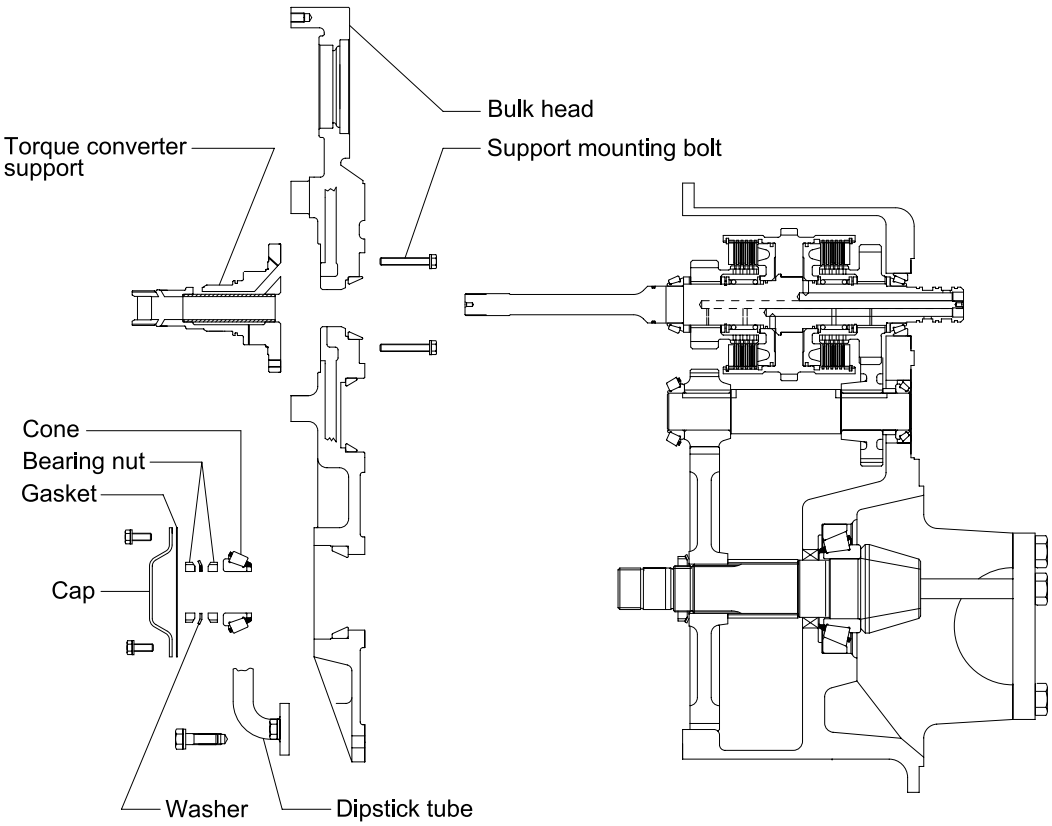
### (4) Pump drive




D353PT32

① Remove the transmission pump from the torque converter housing.
② Remove the bolts holding the pump drive gears in the bulkhead plate.
③ Remove the pump drive gear and bearings by tapping them out from the torque converter side.
④ Use a wood block or soft plastic drift to tap the pump drive.

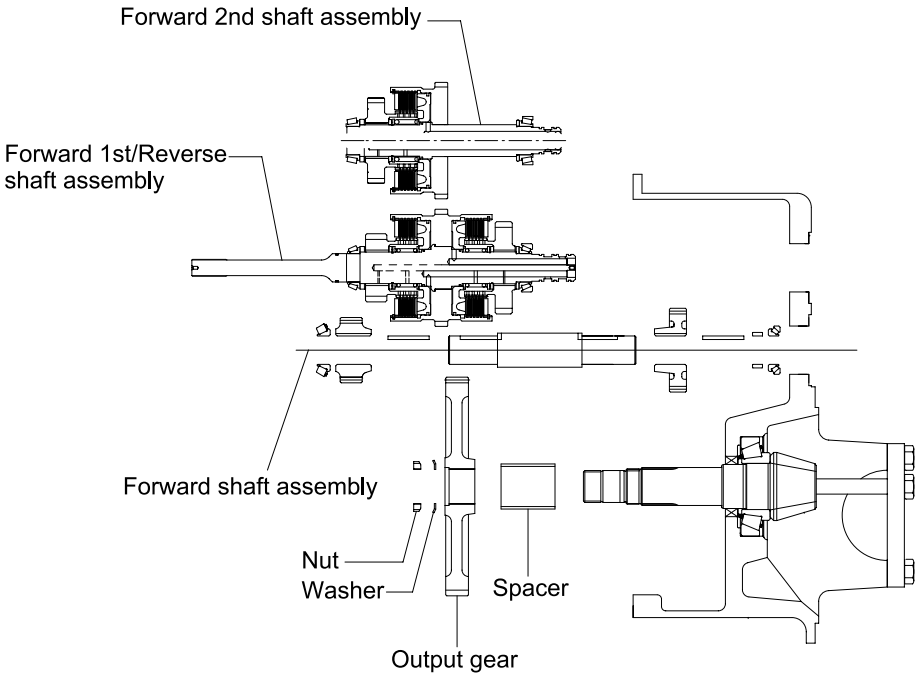
### (5) Bulk head




D353PT33

① Remove the pinion shaft cap and gasket from the bulkhead plate.
② Using a hammer and punch, bend back the locking tabs on the washer located between the two bearing nut on the pinion shaft.
③ Remove the bearing nut, washer, and the retaining bearing nut from the pinion shaft.
④ Attach a lifting sling or hook to the bulkhead plate casting, and remove the bolts attaching the bulkhead plate to the transmission case.
⑤ Remove the bulkhead plate.

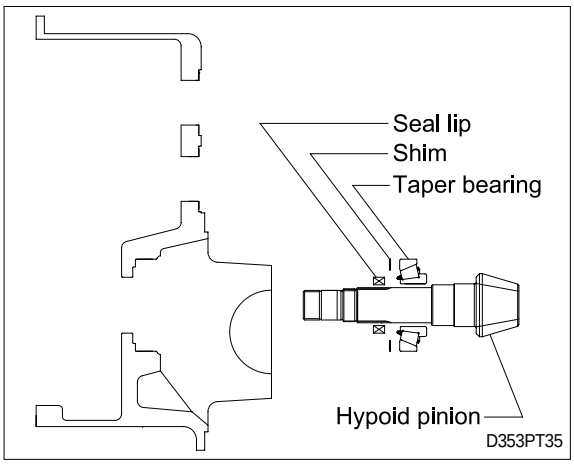
### (6) Shaft assembly




① The pinion shaft and output gear are now supported by the pinion holding tool on the pinion gear.
② Bend back the locking tabs on the washer and remove the nut, washer, and the output gear.
※ Watch for burrs and sharp edges when handling gears.
③ Slide spacer sleeve off of pinion gear shaft.
④ Slide out both clutch packs and the forward shaft.
⑤ Start with the forward 2nd clutch pack. Then remove the forward 1st/reverse clutch pack, and finally the forward shaft.

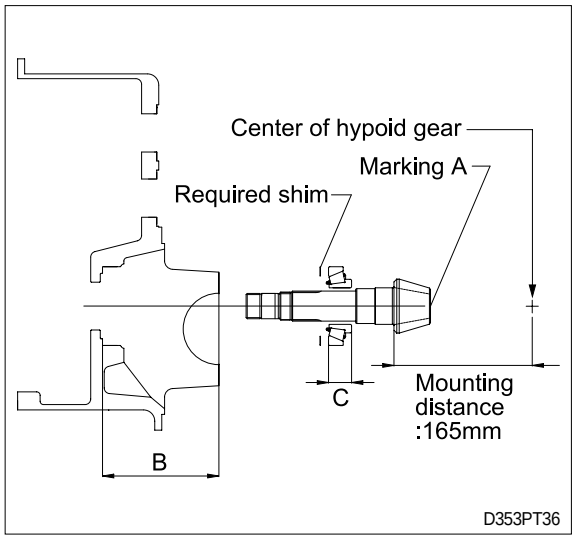
### (7) Hypoid pinion assembly

① Remove the pinion holding tool and slide the pinion gear, shaft, and bearing out the differential end of the transmission.
② Using a slide hammer, remove the pinion bearing race.
Also remove the shims behind the bearing race and the oil seal that separates the transmission fluid from the differential gear oil.



**2) ASSEMBLY**

**※ Before beginning assembly of the transmission, be sure all parts are clean. Replace all O-ring, oil rings, and seals when putting transmission back together.**




**(1) Hypoid pinion assembly**

① Install pinion shaft seal, shims, bearing, and the pinion shaft and gear.

※ Be sure each component is seated correctly in place.

② Install pinion holding tool to retain pinion in position during assembly.

**③ Selecting method of required shim thickness.**

· Hypoid pinion mounting distance : 165㎜

· Marking of hypoid gear error on pinion gear : A

· Measuring distance from differential bearing center to pinion bearing seat of case : B

· Actual bearing width : C

· Required shim thickness : Z

$$Z = B - C - (165 + A)$$

④ Select required shim thinkness within 0.05mm error from above calculation.

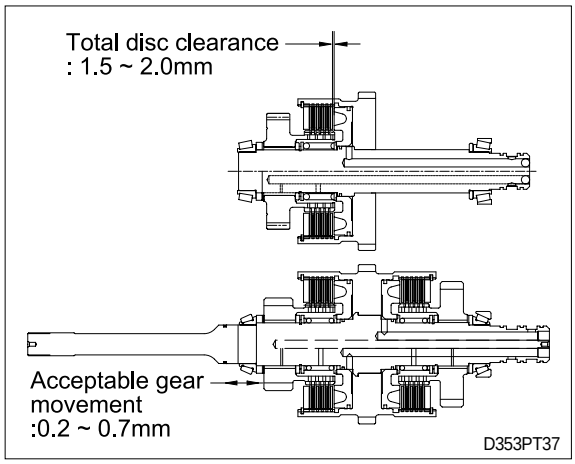
**(2) Shaft assembly**

※ Keep the parts very clean to avoid leakage problem.

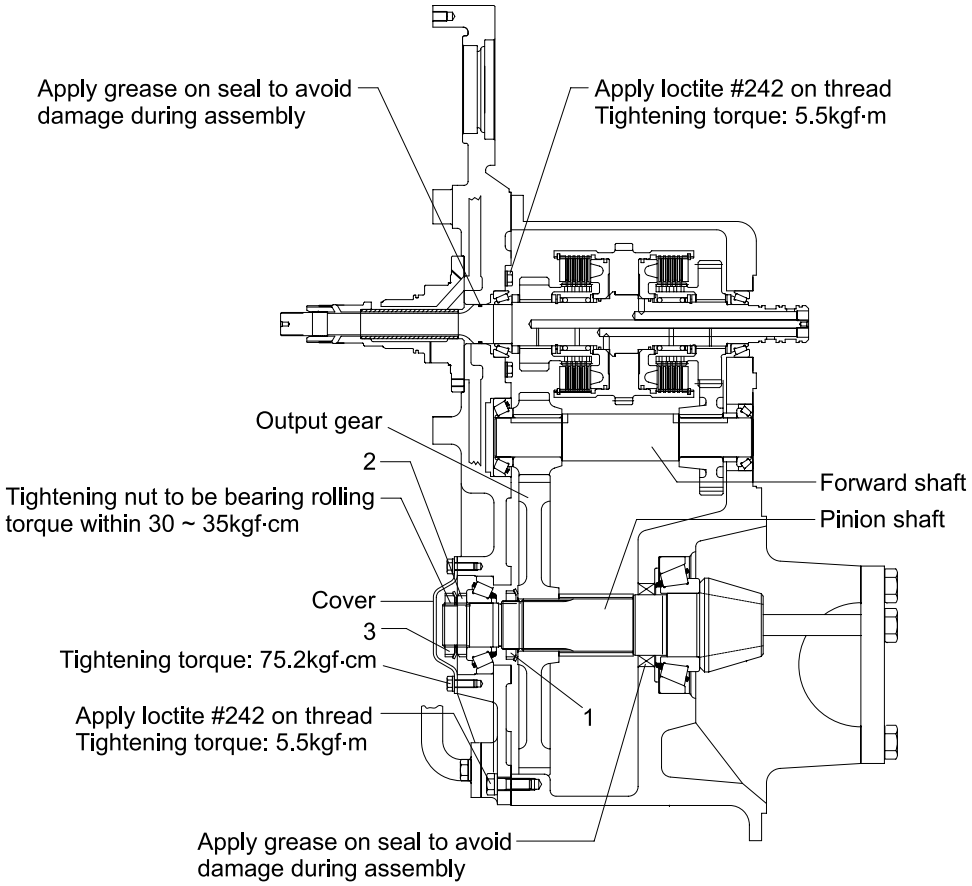
① Slide the forward shaft and clutch packs back into place in reverse order of disassembly.

② The total clearance of discs should be 1.5~2.0㎜.

③ Gear movement should be 0.2~0.7㎜.



**(3) Bulk head**

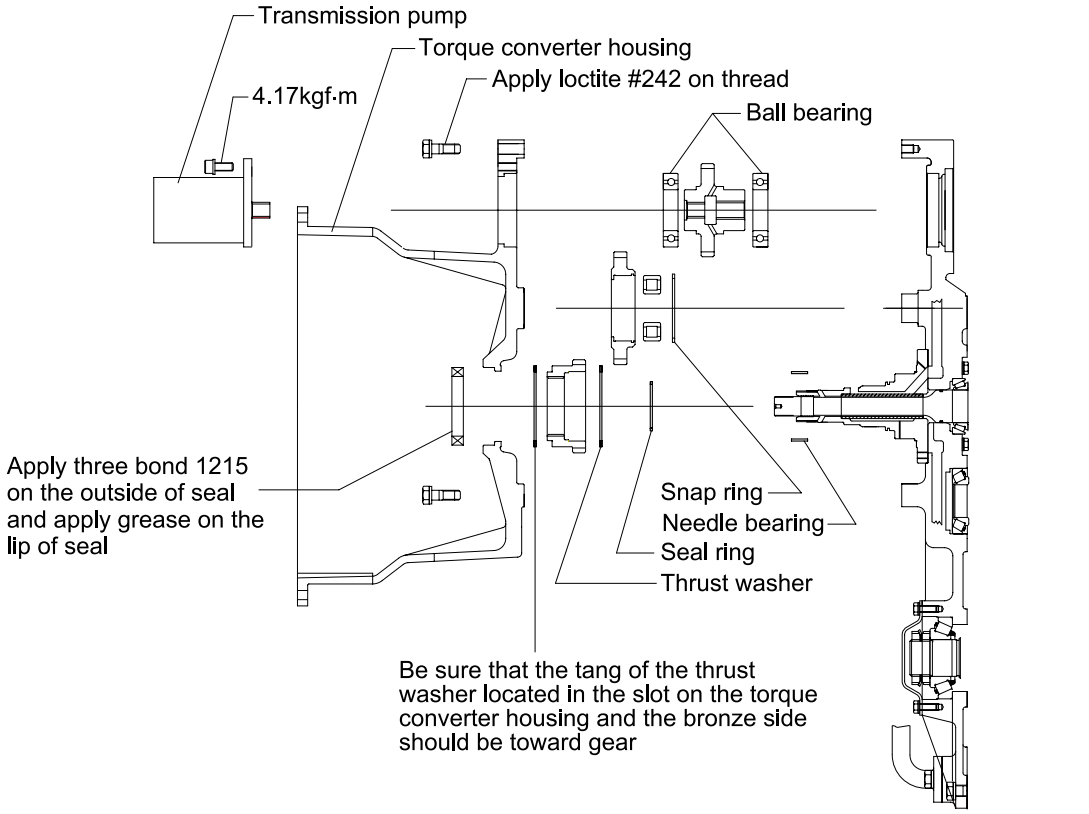



① Slide the spacer back onto the pinion shaft.
② Slide the output gear back onto the pinion shaft. It may be necessary to lift the clutch packs and forward shaft slightly to slide output gear into position.
③ Slide washer onto end of pinion shaft and seat tab in slot. Install nut(1) and tighten.
Bend washer tabs to retain nut.
④ Install bulkhead plate on transmission case.
※ Be sure to install **O-ring** in bulkhead plate hole where transmission fluid is supplied to torque converter from control valve.
⑤ Install the pinion shaft bearing, retaining nut(2). Remove the pinion holding tool.
⑥ Install pinion shaft retainer washer and nut(3). Tighten nut and bend tabs on washer to secure retainer.
⑦ Install the pinion shaft cover and gasket. Apply sealer to gasket. Torque cover bolts.

※ **Pinion bearing rolling torque process.**

· Tightening nut about 3kgf · m for and loosen again.
· Measure the required rolling torque to turn pinion shaft : A
· Tightening nut to add rolling torque 30~35 kgf · cm over measured rolling torque A.

**(4) Pump drive**



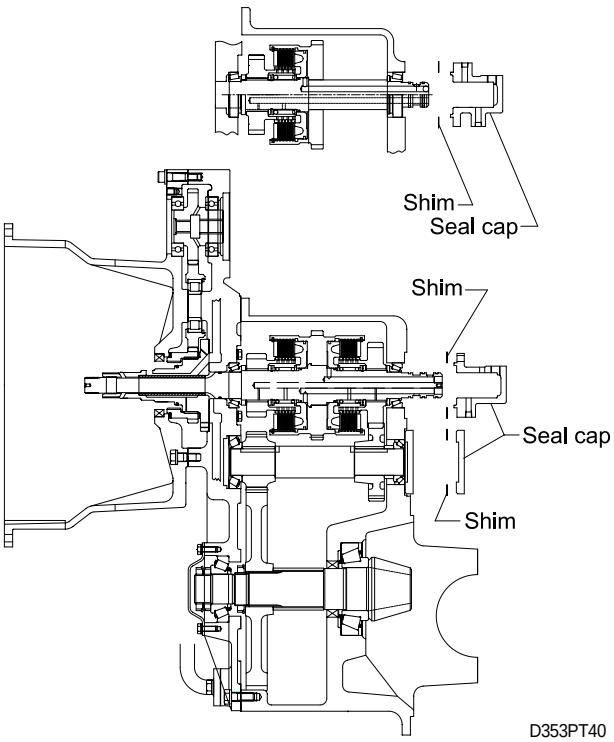

**(5) Seal caps**

① Install seal ring caps on transmission case.

② Measure clearance between caps and case without shims with thickness gauge.

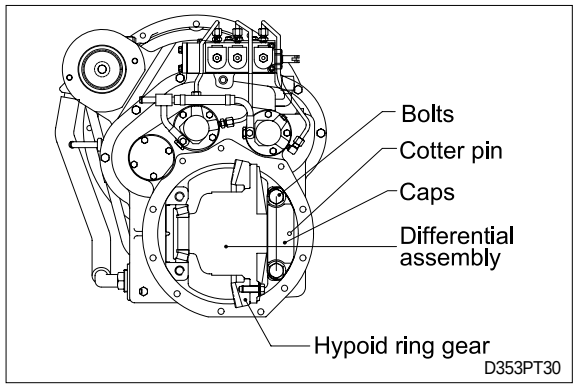
③ Select shim thickness over 0.2~0.4㎜ from the above measurement.

④ Insert shims and confirm that the shaft could be turned by hand without locking.



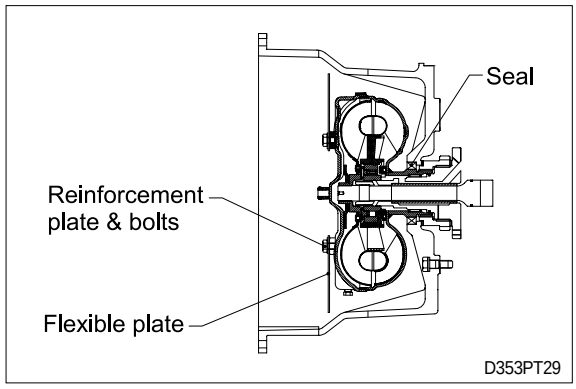
**(6) Differential and hypoid gear**

① Using a sling and hoist, install the differential assembly, including bearings, in the carrier.
② Set gear backlash between 0.2~0.3㎜.
③ Tighten screw nut of bearing as 2.7~3.4kgf · m.
④ Tighten cap bolt as 35~40kgf · m.
⑤ Recheck backlash of 0.2~0.3㎜.
⑥ Install cotter pins through holes in caps to secure adjusting nuts.
Bend ends of cotter pins over to secure.



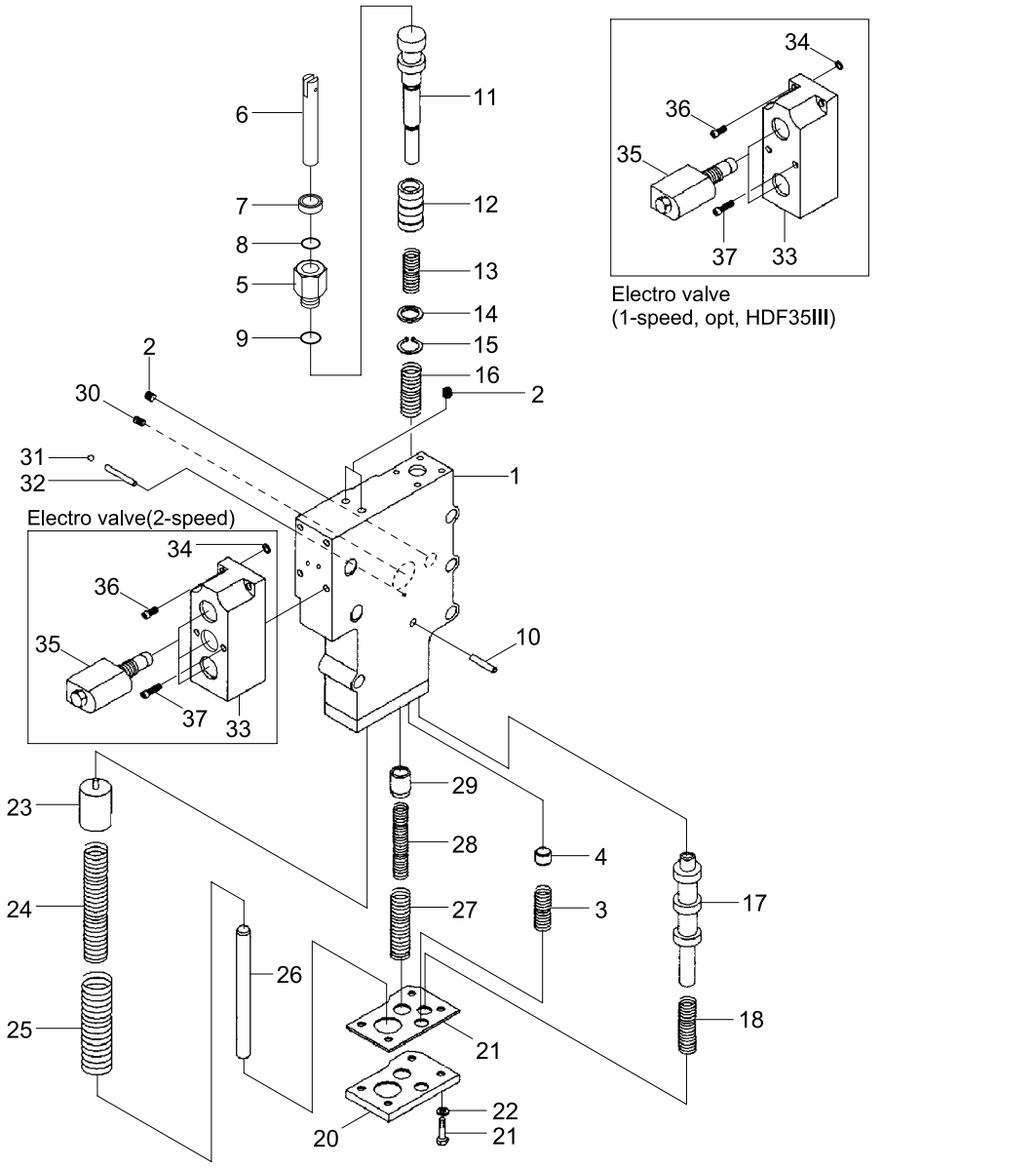

**(7) Torque converter**

① Install torque converter.
② Apply loctite 242 on the thread.
③ Tightening torque of flexible plate mounting bolt : 4.5kgf · m.
④ Apply on the converter pilot molybdenum grease when connecting to the engine.



## 2. CONTROL VALVE

### 1) STRUCTURE




| | | | | | |
|---|---|---|---|---|---|
| 1 | Body | 14 | Washer | 26 | Stopper |
| 2 | Plug | 15 | Snap ring | 27 | Spring |
| 3 | Spring | 16 | Spring | 28 | Spring |
| 4 | Piston | 17 | Spool | 29 | Piston |
| 5 | Cap | 18 | Spring | 30 | Orifice |
| 6 | Piston | 19 | Gasket | 31 | Ball |
| 7 | Dust seal | 20 | Cover | 32 | Pin |
| 8 | O-ring | 21 | Hexagon bolt | 33 | Block |
| 9 | O-ring | 22 | Spring washer | 34 | O-ring |
| 10 | Pin | 23 | Piston | 35 | Solenoid valve |
| 11 | Inching spool | 24 | Spring | 36 | Hexagon bolt |
| 12 | Piston | 25 | Spring | 37 | Hexagon bolt |
| 13 | Spring | | | | |

**2) TOOLS**

- Socket : 13 & 38㎜
- Torque wrench
- Hexagon wrench : 4 & 5㎜
- Loctite(242)
- Hammer
- Snap-ring plyer

**3) CLEANING AND PREPARING COMPONENT**

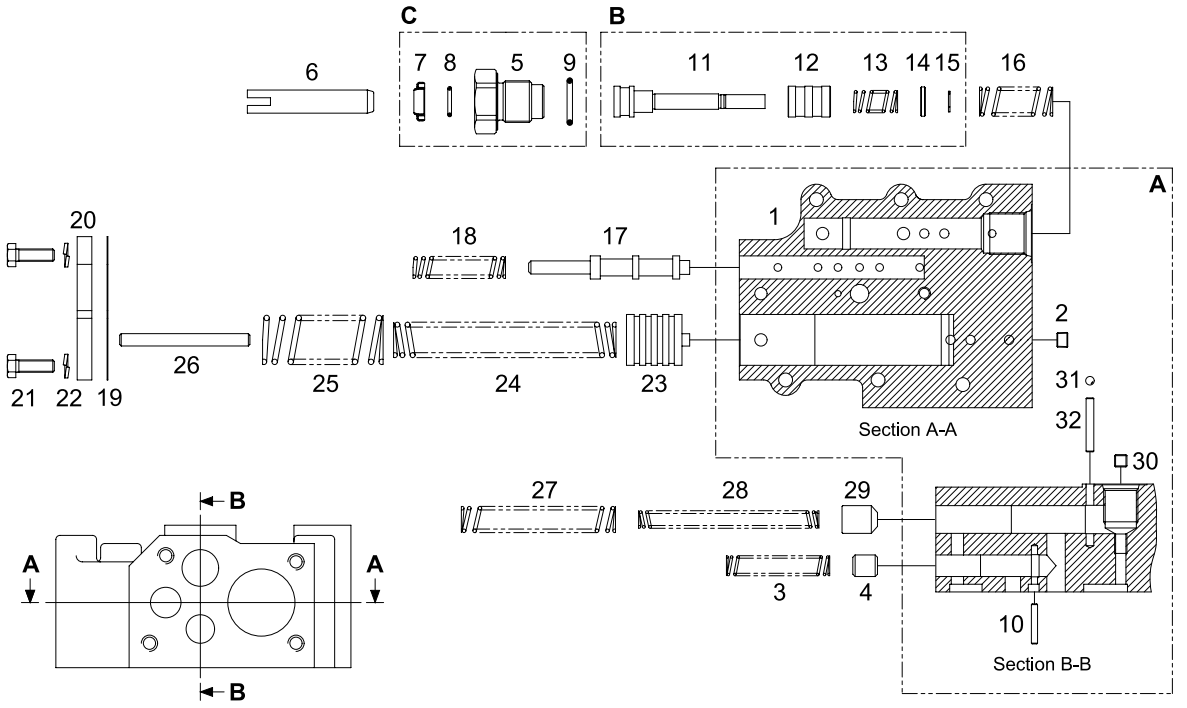
**(1) Cleaning**

Wash body with high pressure washer(3 step) and then clean it with TCE(Tri Chioro Ethylene). Blow body with pressurized air.

**(2) Preparing**

Confirm that there are no scratches or cracks on the worked surface, and also check on the chips or burrs finally. Arrange components in process order and lubricate the seals with grease.

## 4) DISASSEMBLY




D353PT41

**A. Body**

① **Inching spool part**

- Pull out piston(6) and release cap(5) with 38㎜ socket.
- Tilt the body(1) and slide inching spool(11) down by itself.
- Confirm spring output.

② **Cover**

- Release 4 bolts(20, M8) with 13㎜ socket.

③ **Spool**

Tilt the body(1) and pull out spools, pistons and springs from 4 holes.

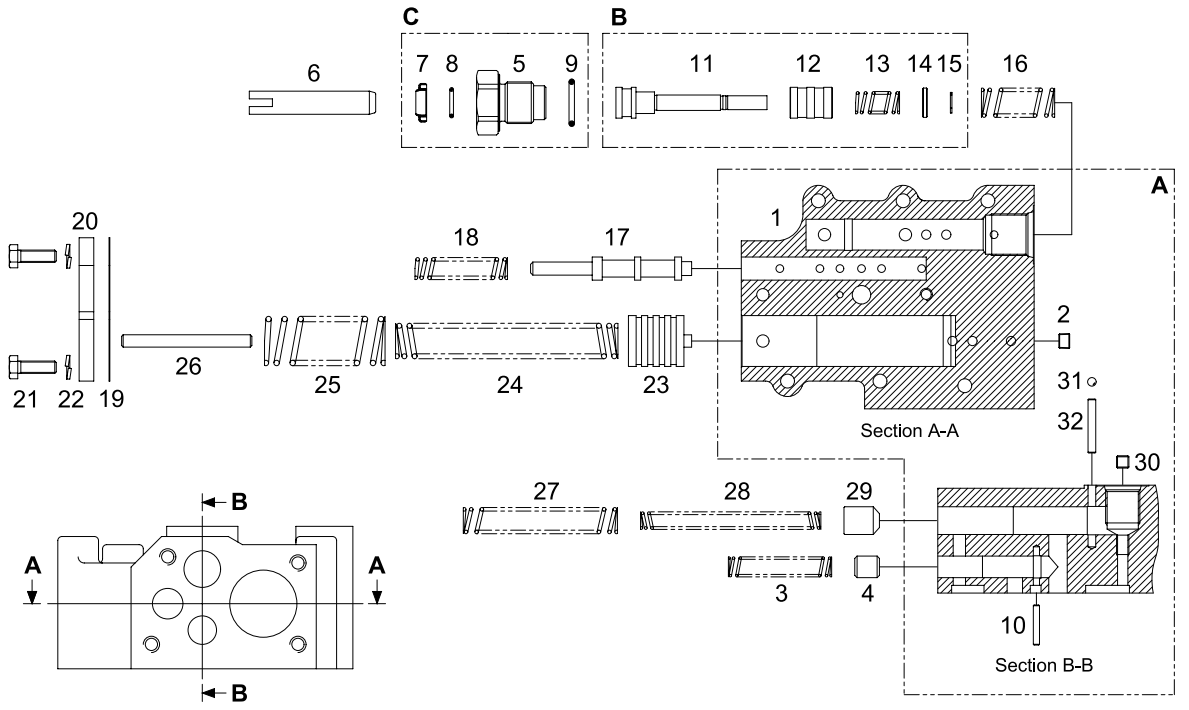
**B. Inching spool**

- Pull out snap ring(15) while pressing washer(14) and spring(13).
- Remove inching spool(11), piston(12), spring(13) and washer(14) respectively.

**C. Cap**

- Remove O-ring with a pin with attention of wear.

## 5) ASSEMBLY




D353PT41

**A. Body**

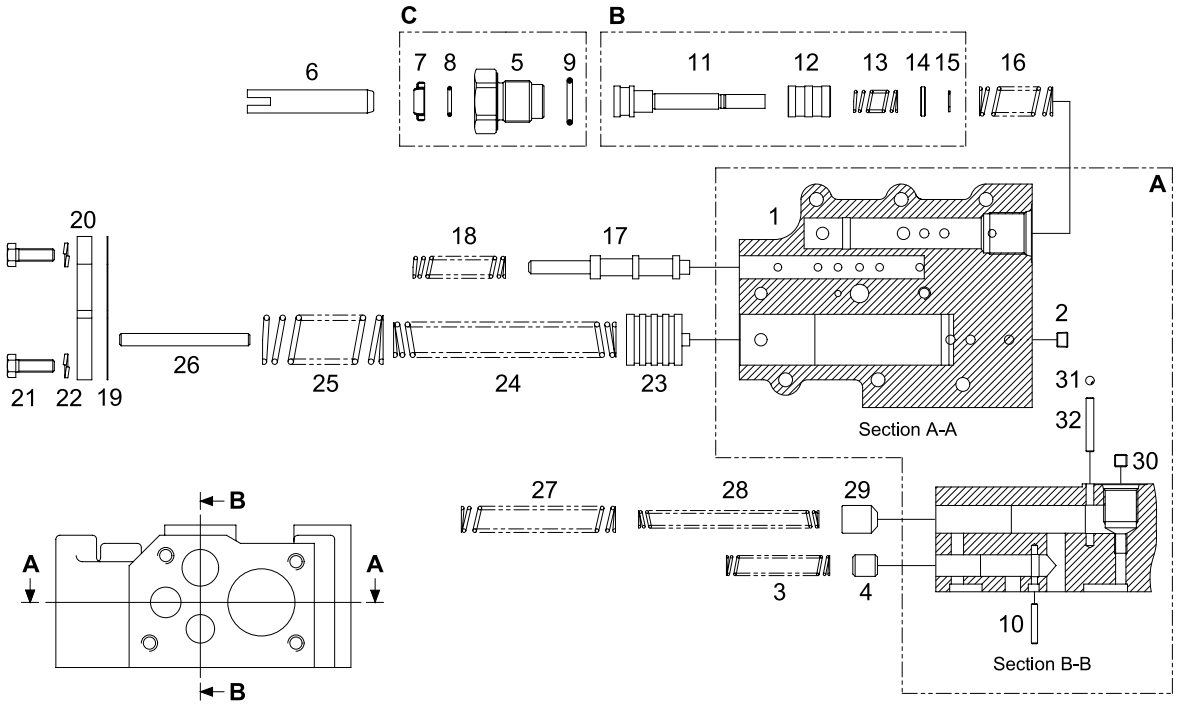
① Install PT 1/8 plug(2) with 5㎜ wrench after injecting loctite 242 on the plug.
② Put the pins(10, 32) into the pin hole and then adjust location.
③ Press the ball(31) into the orifice side hole, and hammer it so that the ball can be inserted over 2/3 of hole depth.
④ Assemble orifice(30) with 4㎜ wrench, and then cock 3 points to fix it firmly.

**B. Inching spool**

① Install piston(12), spring(13) and washer(14) orderly.
② Fix the inching spool by means of snap ring(15).

**C. Cap**

① Install lubricated O-ring(P15) into the cap, and then press dust seal(7) with concaved surface inside the cap.




D353PT41

**D. Total installstion**

**(1) Spool**

① Insert piston(23), 2 springs(24, 25) and stopper(26) orderly into the biggest hole(Ø33).
② Insert piston and 2 springs(27, 28) orderly into the second biggest hole(Ø18).
③ Insert spool(17), and spring(18) into Ø15 hole.
④ Lastly insert piston(4) and spring(3) into Ø14 hole.
⑤ Make sure that the each spool and piston move well whenever installed.

**(2) Cover**

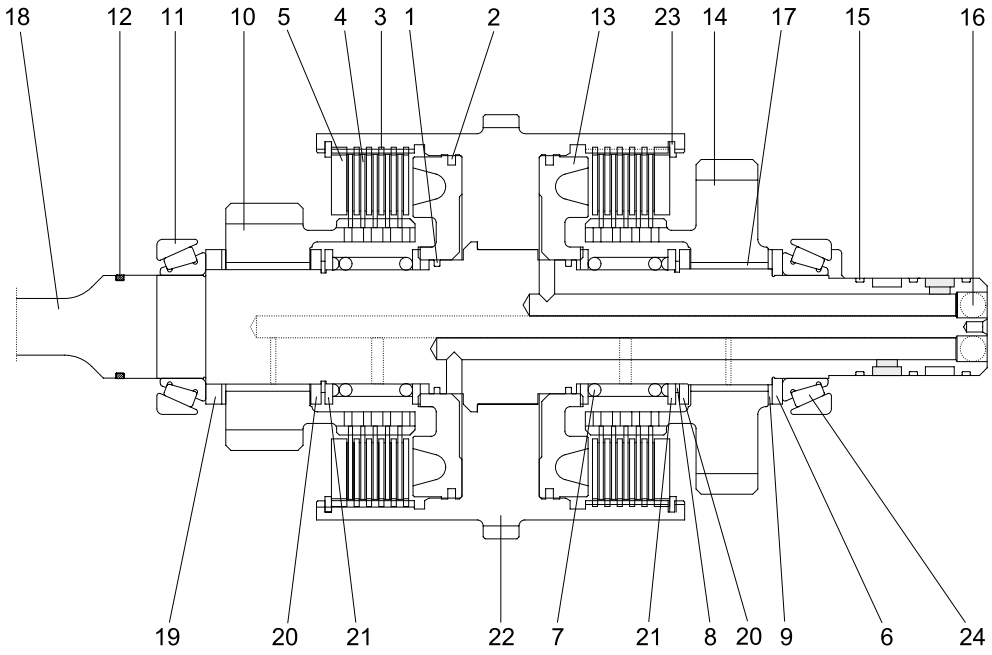
① Place body with the gasket hole side up, and then put the gasket(19) on the hole correctly.
② Put the cover(3) on the gasket, and then assemble them with bolts(21).
③ Confirm that gasket holes are coincident with body holes and springs are attached to the cover safely.
④ Tool : 13㎜ socket
· Tightening torque : 280㎏f · ㎝

**(3) Inching spool**

① Insert spring(16) and inching spool orderly into the hole.
② Tighten sub assembled cap(5) and then insert piston(6).
③ Tool : 38㎜ socket
④ Push the piston to check the spool operation.

## 3. CLUTCH PACK

### 1) STRUCTURE




D353PT21

| | | | | | |
|---|---|---|---|---|---|
| 1 | Piston ring | 9 | Thrust washer | 17 | Bushing |
| 2 | Piston ring | 10 | Gear | 18 | Input shaft |
| 3 | Drive plate | 11 | Taper roller bearing | 19 | Washer |
| 4 | Friction plate | 12 | Seal ring | 20 | Washer |
| 5 | Back plate | 13 | Piston | 21 | Washer |
| 6 | Washer | 14 | Gear | 22 | Drum |
| 7 | Spring | 15 | Seal ring | 23 | Snap ring |
| 8 | Snap ring | 16 | Ball plug | 24 | Taper roller bearing |

### 2) DISASSEMBLY

(1) Remove clutch pack from transmission(See transmission disassembly procedure in this section).

(2) Set clutch pack up on end for servicing.

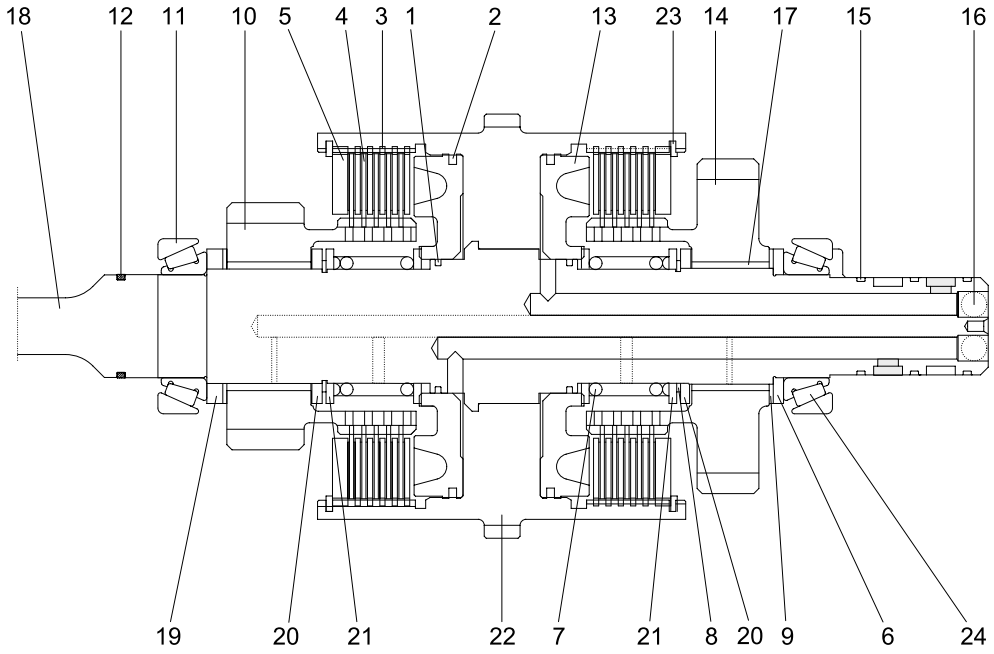
⚠ **Since the clutch pack is very unstable when up on end, it is necessary to place it in either a clutch pack holding fixture or a vise with soft jaws.**

(3) Remove the seal ring(15) from the end of the shaft. There are three rings on the manifold end and one ring on the torque converter end.

(4) Use a puller to remove the bearing(24) from the end of the shaft. To avoid damaging the thrust washer(9) between the bearing(24) and gear(14)(if there is not enough clearance to get the puller between the bearing and thrust washer) you can grip the gear and use it to pull the bearing. If you pull only the bearing, the gear will lift off.

(5) Pry out the snap ring(23) that holds the back plate(5) in the clutch pack.

(6) Lift out the back plate(5) and the clutch plates. Note that the drive plate(3) and friction plate(4) alternate in the clutch pack.




(7) Remove the snap ring(8) on the clutch pack shaft and lift out the piston return spring(7) and two washers(20, 21).
(8) Slide the clutch piston(13) up out of the drum(22). Inspect all parts for wear or distortion.
(9) Replace the large piston ring(2) on the clutch piston.
(10) Replace the small piston ring(1) on the clutch pack shaft where the piston rides.

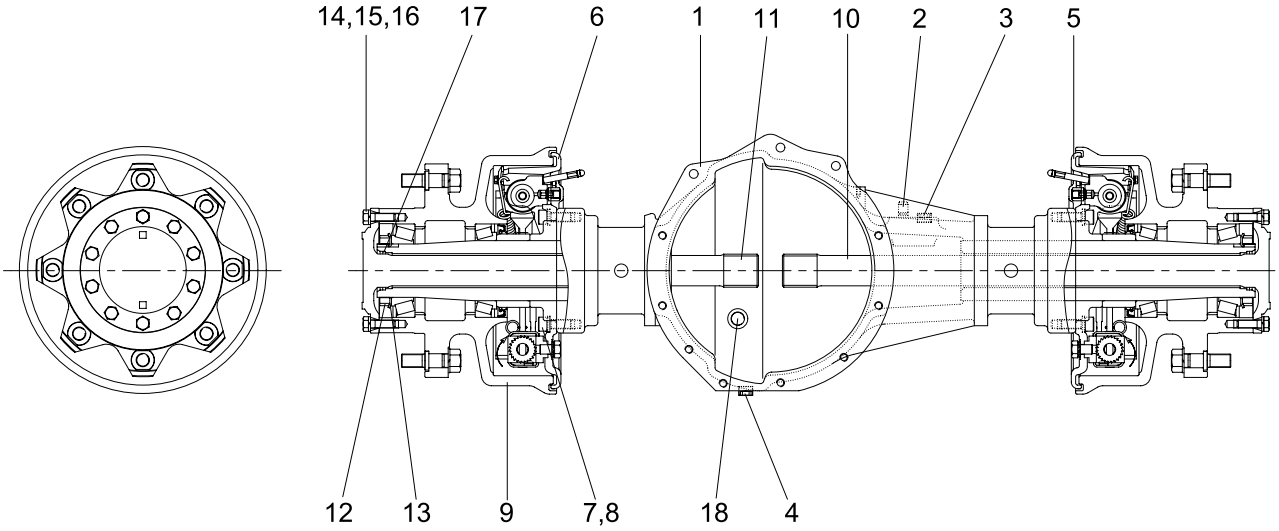
※ **Inspect the pressure relief hole in the clutch pack piston and make sure it is clean and free of dirt. Blow out with an air gun and clean with solvent if dirty, and allow to dry.**

**3) ASSEMBLY**

(1) Install piston in the drum(22).
(2) Place the piston return spring(7) and two washers(20, 21) on the shaft. Slide the snap ring down the shaft until it meets the top washer. Then use an arbor press to compress the spring and seat the snap ring.
The order of installation is 1. Washer - 2. Spring - 3. Washer - 4. Snap Ring. The two washers are interchangeable.
(3) Install all new drive(3) and friction(4) plates. Do not mix new and used plates. Install the back plate(5) and snap ring(23). Stepped sided of end plate faces the snap ring.
(4) Inspect the bushing(17) inside the output gear for wear and damage. Replace if necessary.
(5) There are two thrust washers(9), one for either side of the output gear. The washers have a bronze surface on only one side. The bronze side should face the gear.
(6) Line up the teeth on the friction plates and slide the output gear and thrust washers into place on the clutch pack shaft(18). A slight twisting motion of the gear will help the gear splines line up with the clutch teeth.
(7) Install the bearing washer and drive a new bearing into place, making sure it is firmly seated.
(8) Install new seal ring(15) on shaft.
(9) Repeat procedure for each clutch pack.

## 4. DRIVE AXLE

### 1) STRUCTURE




D353PT10

| | | | | | |
|---|---|---|---|---|---|
| 1 | Housing & sleeve | 7 | Socket bolt | 13 | Lock washer |
| 2 | Air breather | 8 | Hardened washer | 14 | Bolt |
| 3 | Square plug | 9 | Hub assembly | 15 | Spring washer |
| 4 | Plug | 10 | Drive axle shaft-RH | 16 | Cone washer |
| 5 | Wheel brake assembly-RH | 11 | Drive axle shaft-LH | 17 | Oil seal |
| 6 | Wheel brake assembly-LH | 12 | Lock nut | 18 | Socket plug |

### 2) DRIVE AXLE SHAFT

#### (1) Disassembly

① Remove ten bolts(14) housing axle shaft flange to wheel hub(9)
Remove the spring washer(15). The cone washers(16) will probably remain in the flange.
If they are loose, remove them to avoid loosing them when axle is pulled.

② The axle flange can now be separated from the hub. If the flange sticks to the hub (due to paint, dirt, sediment, etc.) you can tap with a rawhide or plastic mallet to loosen axle.

③ Remove the drive axle shaft(10) from housing(1).

④ Pull the oil seal(17) out of the end of the axle housing tube.

#### (2) Assembly

① Install axle shaft(10) in housing(1), rotating axle shaft to align splines of shaft and differential.

② Install all of the cone washers(16) in the holes in the axle shaft flange.

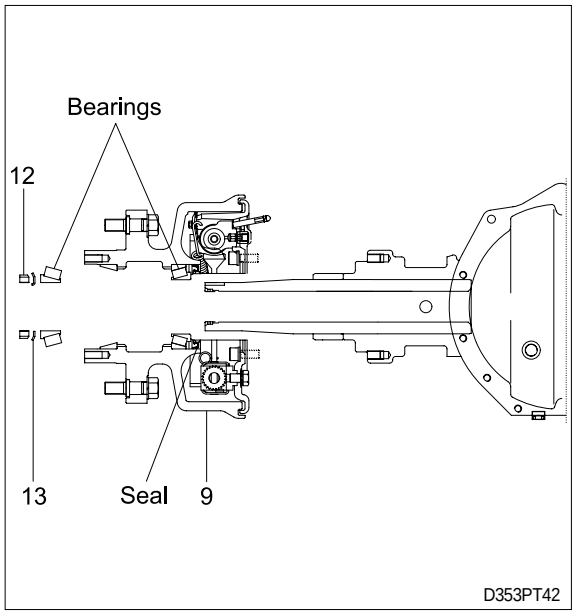
③ Install bolts(14) and spring washer(15).

· Tighten torque : 12kgf · m(86.8lbf · ft)

### 3) WHEEL HUB ASSEMBLY

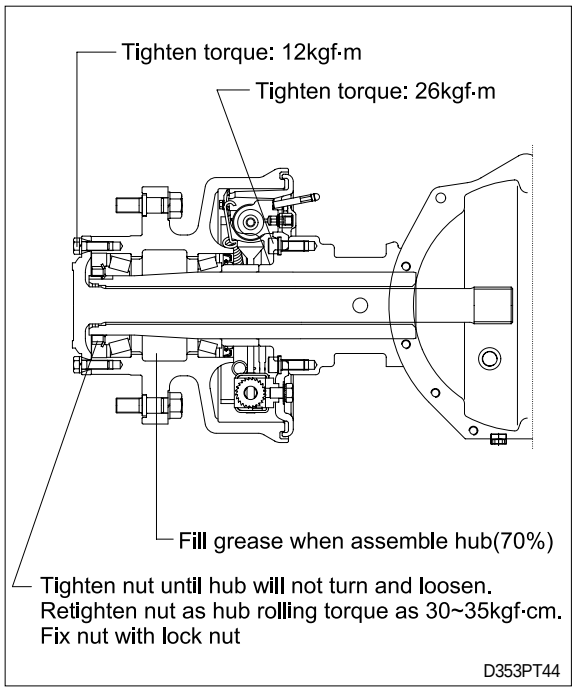
#### (1) Disassembly

① Bend taps back on lock washer securing lock nut on end of axle housing tube.
② Remove lock nut(12) and lock washer(13).
③ Lock hub assembly(9) slightly to unseat outer bearing.
Support weight of hub and slide bearing off of axle housing tube.
④ Lift hub off of axle housing tube.
Hub is heavy enough that you may wish to use a hoist or dolly to avoid damaging hub or axle housing tube. Be careful not to score tube or damage threads on end of tube.
⑤ Remove seal from inner lip of hub.
⑥ Using a bearing puller, remove outer bearing races for inner and outer bearings from hub.




#### (2) Assembly

① Press or drive bearing races into hub.
② Install new seal in hub.
③ Install inner bearing.
④ Install hub on housing tube so that inner race is positioned on tube.
While supporting hub weight, slide outer bearing into position on tube until it is positioned in axle.
⑤ Install lock washer and run lock nut in.
Tighten finger tight.
⑥ While rotating hub, tighten lock nut.
⑦ Bend tabs on lock washer to secure lock nut.
⑧ Install drive axle shaft using a new seal inside end of axle housing tube.



# SECTION 4 BRAKE SYSTEM

# SECTION 4 BRAKE SYSTEM

## GROUP 1 STRUCTURE AND FUNCTION

### 1. OUTLINE

There are two brake systems, the foot brake system and the hand brake system.

In the foot brake system, oil pressure is generated in the master cylinder by treading on the brake pedal. This pressure causes the wheel cylinder pistons to extend, expanding the brake shoes and pressing them against the brake drums to attain braking force.

In the hand brake system, the brake shoes are expanded by operating the brake lever.
Force from the lever is transmitted to the brake shoes through the hand brake cables and a lever arm in each wheel brake assembly.

The wheel brake is the duo-servo type. With force applied to both the primary and secondary shoes, this type provides a large amount of brake force.
In addition, the brake equipped with automatic adjusters which constantly adjust the clearance between the shoe and the drum, compensation for wear due to the shoe friction and thus keeping the clearance constant.

### 2. SPECIFICATION

#### 1) WHEEL BRAKE

| Item | | Specification |
|---|---|---|
| Type | | Front wheel, duo-servo & auto adjustment type |
| Brake shoe size | | 314×80mm |
| Wheel cylinder bore diameter | | 34.93mm |
| Master cylinder diameter | | 22.22mm |
| Pedal adjustment | Free height | 143~153mm |
| | Pedal play | 10mm |
| Brake drum diameter | Normal | 315mm |
| Wheel cylinder installation torque | | 2.04~2.55kgf · m |
| Backing plate installation torque | | 26kgf · m |
| Brake oil | | Only use for brake fluid DOT3 |

#### 2) PARKING BRAKE

| Item | Specification |
|---|---|
| Type | Toggle, internal expanding mechanical type |
| Parking lever stroke | 214mm |
| Parking cable stroke | 18.1mm |

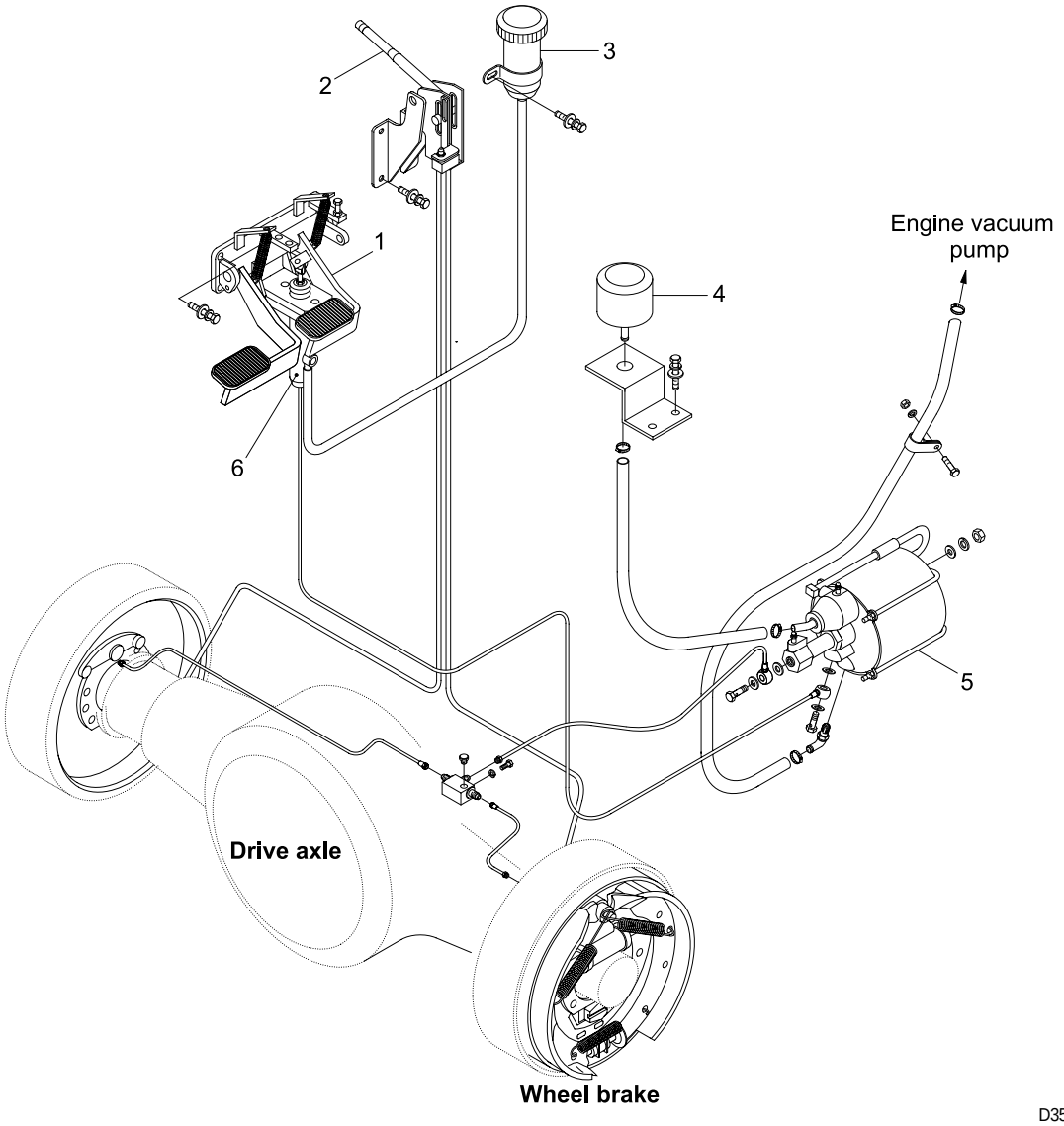
## 3. BRAKE PEDAL AND PIPING

The brake system provides two systems, a foot brake and a parking brake.

In the foot brake system, the oil pressure which is generated in the master cylinder when the brake pedal is depressed is transmitted to the wheel cylinders. The piston of the wheel cylinder presses the brake shoes and then moves outward causing contact with the drums and braking force is obtained. In the parking brake system, the force is transmitted to move the brake shoe through a brake cable to activate the brake when the brake lever is operated.

The wheel brake is a dual servo type in which the actuating force is applied to both the primary and secondary shoes. Even if the applied force is small, a large braking force will be obtained.

These brakes are equipped with self adjusters which continuously adjusts the brakes in small increments in direct proportion to the wear of the linings.



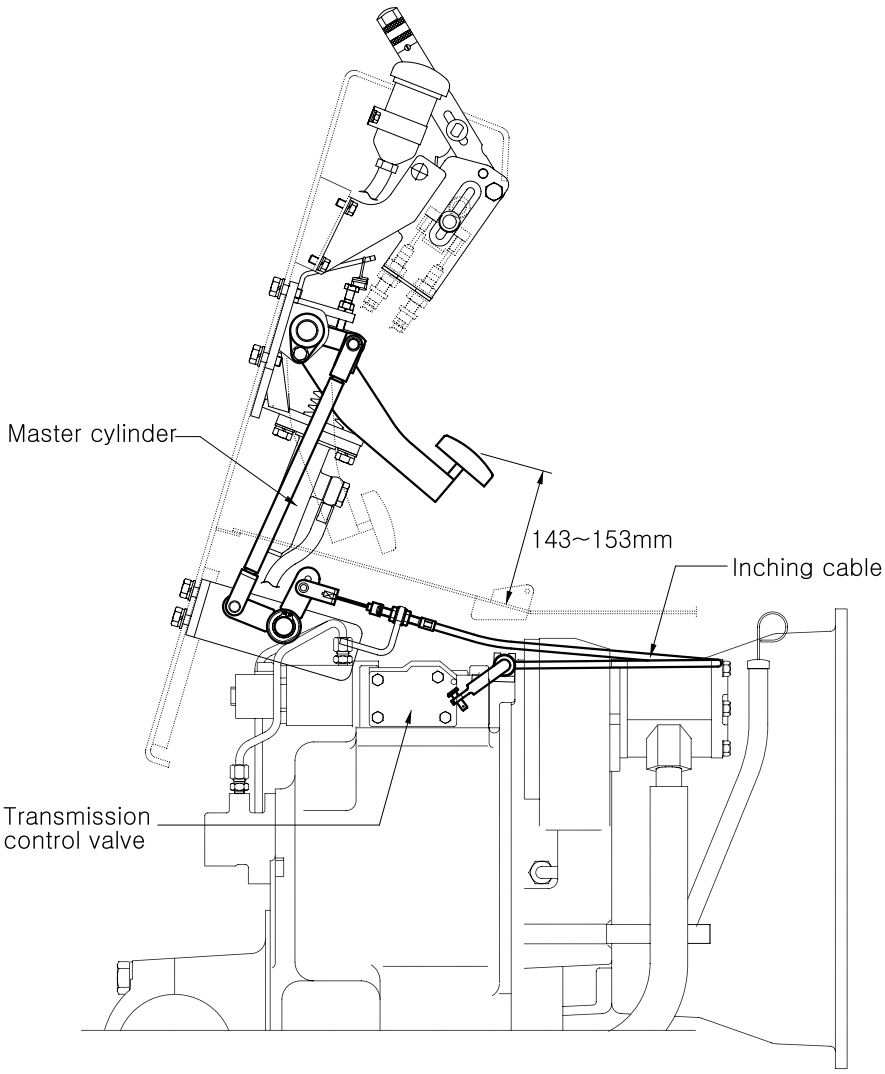

D353BS03

| | | | |
|---|---|---|---|
| 1 | Brake pedal & bracket assy | 4 | Air cleaner assy |
| 2 | Parking lever assy | 5 | Hydro master assy |
| 3 | Reservoir tank assy | 6 | Master cylinder |

## 4. INCHING PEDAL AND LINKAGE

The brake pedal serves to actuate the hydraulic brakes on the front axle.

At the beginning of the pedal stroke, the inching spool of the transmission control valve is actuated to shift the hydraulic clutch to neutral and turn off the driving force. By treading the pedal further, the brake are applied.

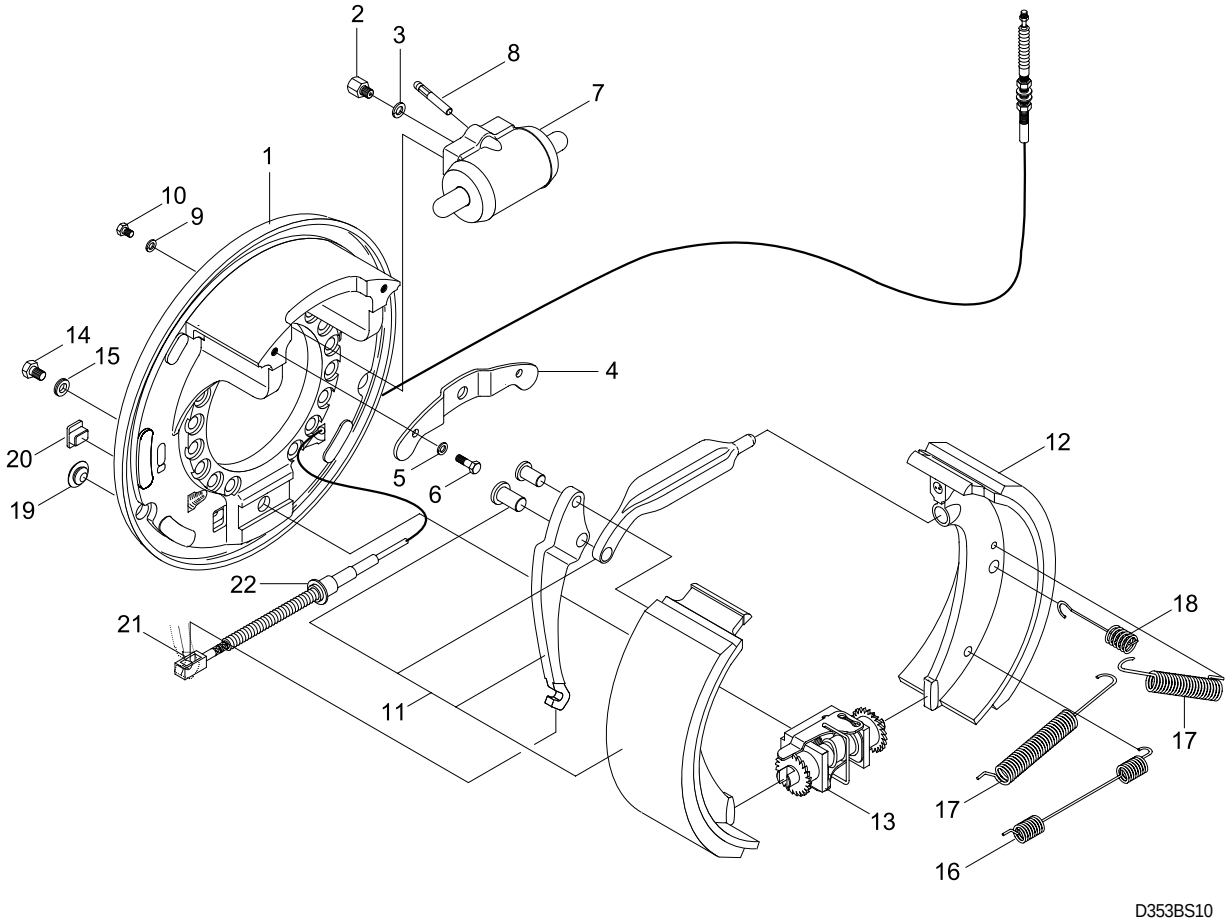


## 5. WHEEL BRAKE

### 1) STRUCTURE

The wheel brake assembly mounts to the flange on the drive axle housing casting and is basically contained within the hub assembly.

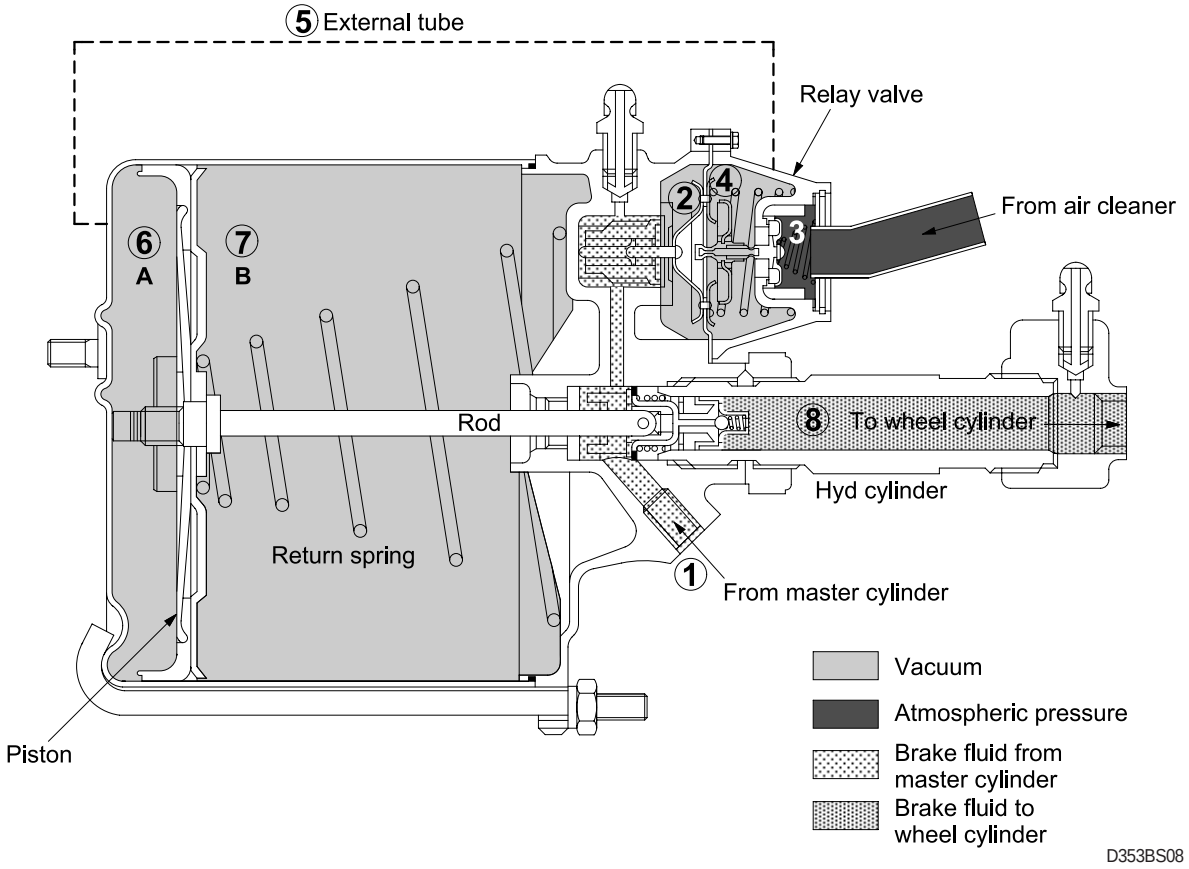
The inside of the hub is machined and acts as the brake drum.




| | | | | | |
|---|---|---|---|---|---|
| 1 | Back plate-LH/RH | 9 | Spring washer | 16 | Return spring |
| 2 | Adapter | 10 | Cylinder bolt | 17 | Return spring |
| 3 | Adapter washer | 11 | Lever shoe assembly-LH/RH | 18 | Pressure spring |
| 4 | Holder | 12 | Brake shoe assembly | 19 | Plug |
| 5 | Spring washer | 13 | Adjuster assembly | 20 | Plug |
| 6 | Holder bolt | 14 | Adjuster bolt | 21 | Parking cable-LH/RH |
| 7 | Cylinder assembly | 15 | Lock washer | 22 | E-ring |
| 8 | Air breather | | | | |

## 6. HYDRO MASTER

### 1) BRAKES NOT APPLIED (STATIC MODE)




① Brake fluid from master cylinder is not under pressure since pedal is not applied. This fluid is supplied to the hydraulic cylinder, then to the relay valve.

② Vacuum is applied to the vacuum side of the relay valve.

③ Atmospheric pressure is applied to the ambient side of the relay valve. This air is supplied via a remote mounted air cleaner.

④ Since no brake fluid pressure is applied to this relay valve. The center chamber of the valve is open on the vacuum side and closed on the ambient side applying vacuum to the center chamber.

⑤ The center chamber of the relay valve is connected to chamber A of the Hydro master by an external pipe(shown here by the dotted line).

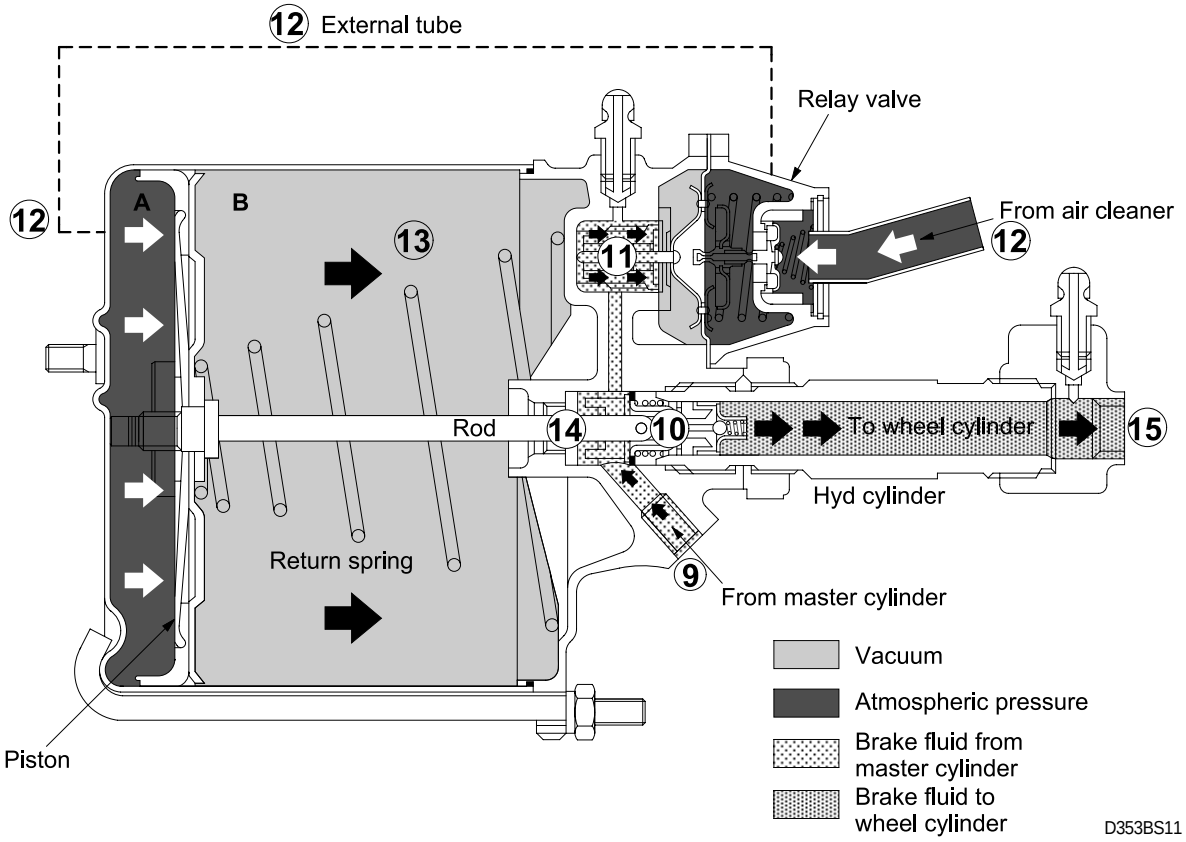
⑥ Vacuum is applied to chamber A of the Hydro master via the relay valve and external pipe.

⑦ Vacuum is applied directly to chamber B of the Hydro master at all times.

Since vacuum is applied to both chambers(A & B) of the Hydro master there is equal pressure on both sides of the large Hydro master piston. The return spring keeps the piston to the full left position as shown in the illustration.

⑧ Since the rod attached to the Hydro master piston is fully extended, it is not applying any pressure to the brake fluid in the hydraulic cylinder. Since this cylinder supplies the wheel cylinders, the brakes remain in the released position.

## 2) BRAKE APPLIED (DYNAMIC MODE)




⑨ When the brakes are applied, foot pressure from the brake pedal is transformed to hydraulic pressure by the master cylinder (not shown). This hydraulic pressure is applied, at the Hydro master, to the hydraulic cylinder and to the relay valve.

⑩ Hydraulic pressure from the master cylinder is applied to the hydraulic cylinder. This has the same effect as "manual" brakes, applying an equivalent pressure to the wheel cylinders, with no power assist.

⑪ Hydraulic pressure from the master cylinder is applied to the relay valve. This causes the diaphragm, valve stems, etc inside the relay valve to move (to the right in the illustration). This motion closes the valve between the vacuum side of the relay valve and the center chamber, shutting off the vacuum source. At the same time, it unseats the valve on the ambient side, allowing air at atmospheric pressure to rush in.

⑫ The air at atmospheric pressure flows to chamber A of the Hydro master via the external tube.

⑬ Vacuum is still applied to chamber B of the Hydro master.
With vacuum applied to chamber "B", and atmosphere pressure applied to chamber "A", a pressure differential created across the hydro master piston. This pressure difference is great enough to overcome the resistance of the return spring and the piston moves(to the right in the illustration).

⑭ As the Hydro master piston moves (to the right), the rod applies pressure to the piston in the hydraulic cylinder.

The force against the piston in the hydraulic cylinder is now the sum of the master cylinder hydraulic pressure (manual braking) and the force of the rod against the piston (power assist).

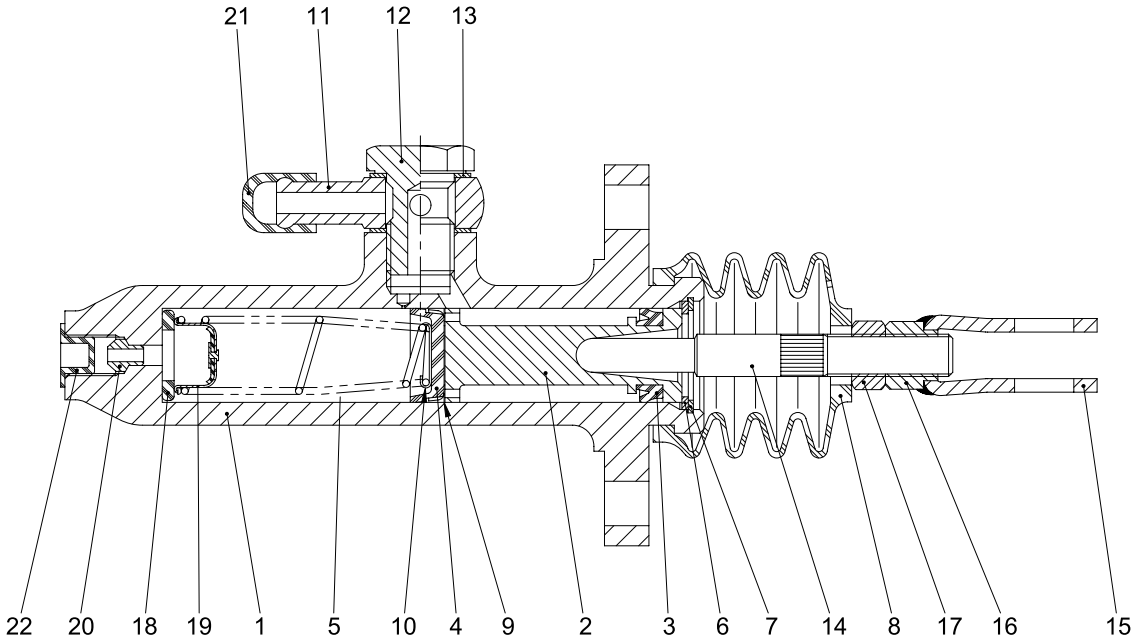
⑮ The hydraulic cylinder now applies power assistance pressure to the wheel cylinders, applying the brakes.

### 3) RETURN TO STATIC

When the pedal is released, the relay valve closes off ambient side (atmospheric pressure) and re opens vacuum side. This applies vacuum to chamber A and the return spring moves the piston back (to the left) as the pressures on both sides of the piston equalize. At the same time the master cylinder pressure against the hydraulic cylinder piston is relieved, and the brakes are released.

## 7. MASTER CYLINDER

### 1) STRUCTURE




| | | | | | |
|---|---|---|---|---|---|
| 1 | Body | 8 | Boot | 15 | Head |
| 2 | Piston | 9 | Spacer | 16 | Head pin |
| 3 | Secondary cup | 10 | Spring seat | 17 | Nut |
| 4 | Primary cup | 11 | Union | 18 | Valve seat |
| 5 | Spring | 12 | Union bolt | 19 | Check valve |
| 6 | Plate | 13 | Washer | 20 | Seat |
| 7 | Snap ring | 14 | Rod | 21 | Cap |
| | | | | 22 | Cap |

### 2) DISASSEMBLY

(1) Remove the master cylinder boot(8) and remove the rod(14).

(2) Remove the snap ring(7) and take out the plate(6), the piston(2), the piston primary cup(4), the piston spring(5), the check valve(19), and valve seat(20).

(3) Specification of master cylinder.

- Cylinder bore diameter : 22.22㎜
- Piston stroke : 35.0㎜

### 3) INSPECTION

(1) Clean and check these components.

※ Use isopropyl alcohol or brake fluid for washing the components. Do not use gasoline, kerosene or any other mineral oils. When using alcohol, do not leave rubber parts in the liquid for more than 30 seconds.

(2) Inspect the inside wall of the master cylinder, and if any faults are found, replace the cylinder assembly.

(3) Replace the boot(8), the primary cup(4), piston(2) and the check valve(19), if deformation or any other defect is found.

### 4) ASSEMBLY

※ Prior to assembly make sure again of no contaminant of the components. Apply a thin coat of brake oil to the components.

· Assembly is in opposite order to disassembly.

## GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

### 1. OPERATIONAL CHECKS

#### 1) BRAKE PIPING

(1) Check pipes, hoses and joints for damage, oil leakage or interference.
(2) Operate brake pedal and check operating force when pedal in depressed. Check also change in operating force, and change in position of pedal when pedal is kept depressed.

#### 2) WHEEL BRAKE

**Compact wheel base chassis**

(1) Measure lining at point with most wear, and check that lining thickness is at least 2.0mm(0.08in).
(2) Hold lining surface with screwdriver to prevent piston from coming out, depress brake pedal and check movement of shoe.
(3) Remove brake shoe from anchor pin, and check for rust or wear.
When assembling, coat sliding parts with special brake grease.

#### 3) BRAKE DRUM

(1) Measure inside diameter of drum, and check that it is within 315mm(12.4in).
(2) Tighten mounting bolt of drum 1.08 ~ 1.28kgf · m(7.8 ~ 9.3lbf · ft).

#### 4) BACKING PLATE

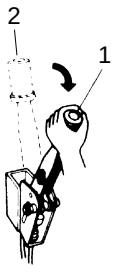
(1) Check visually for deformation or cracks.
Check particularly for deformation at outside circumference of plate and at mounting bolt.
(2) Coat mounting bolt with loctite and tighten : 2.6kgf · m(18.8lbf · ft).

#### 5) BRAKING FORCE

(1) Select a dry, flat, paved surface and drive truck at maximum speed. When signal is given, stop truck immediately and measure distance from point where signal was given to point where truck stopped. (unloaded)
· Stopping distance : Within 5m(197in)
(2) Check that there is no pulling of steering wheel, pulling by brakes to one side or abnormal noise when making emergency stops.

#### 6) PARKING BRAKE

(1) Operating force of parking lever is 20 - 30 kgf · m(44 - 66lbf).
(2) Check that parking brake can hold machine in position when loaded on 15% slope. If there is no slope available, travel at low speed and check braking effect of parking brake.



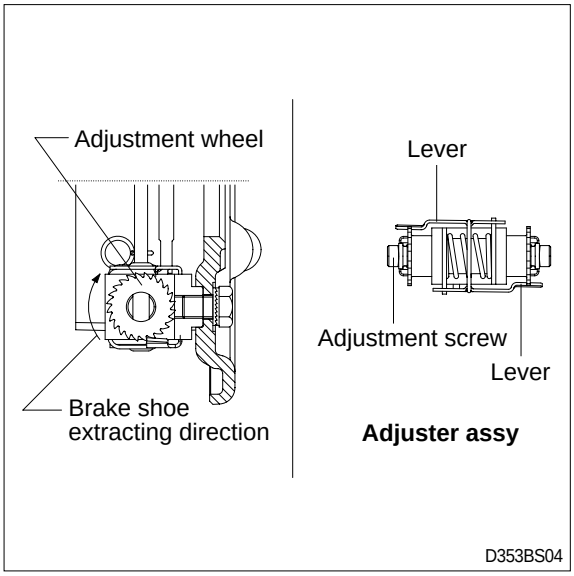
D35AtA19

## 2. TROUBLESHOOTING

| Problem | cause | Remedy |
|---|---|---|
| Insufficient braking force | · Hydraulic system leaks oil.<br>· Hydraulic system leaks air.<br>· Lining surface soiled with water or oil.<br>· Lining surface roughened or in poor contact with drum.<br>· Lining worn.<br>· Brake valve or wheel cylinder mal-functioning.<br>· Hydraulic system clogged. | · Repair and add oil.<br>· Bleed air.<br>· Clean or replace.<br>· Repair by polishing or replace.<br>· Replace.<br>· Repair or replace.<br>· Clean. |
| Brake acting unevenly. (Machine is turned to one side during braking.) | · Tires unequally inflated.<br>· Brake out of adjustment.<br>· Lining surface soiled with water or oil.<br>· Earth intruding into brake drum.<br>· Lining surface roughened.<br>· Lining in poor contact with drum.<br>· Lining worn.<br>· Brake drum worn or damaged (distortion or rusting).<br>· Wheel cylinder malfunctioning.<br>· Brake shoe poorly sliding.<br>· Back plate mounting bolt loose.<br>· Back plate deformed.<br>· Wheel bearing out of adjustment.<br>· Hydraulic system clogged. | · Adjust tire pressure.<br>· Adjust.<br>· Clean or replace.<br>· Clean.<br>· Repair by polishing or replace.<br>· Repair by polishing.<br>· Replace.<br>· Repair or replace.<br>· Repair or replace.<br>· Adjust.<br>· Retighten or replace.<br>· Replace.<br>· Adjust or replace.<br>· Clean. |
| Brake trailing. | · Pedal has no play.<br>· Brake shoe poorly sliding.<br>· Wheel cylinder mal-functioning.<br>· Piston cup faulty.<br>· Return spring fatigued or bent.<br>· Parking brake fails to return or out of adjustment.<br>· Brake valve return port clogged.<br>· Hydraulic system clogged.<br>· Wheel bearing out of adjustment. | · Adjust.<br>· Adjust.<br>· Repair or replace.<br>· Replace.<br>· Replace.<br>· Repair or adjust.<br>· Clean.<br>· Clean.<br>· Adjust or replace. |
| Brake chirps | · Brake trailing.<br>· Piston fails to return.<br>· Lining worn.<br>· Lining surface roughened. | · See above. Brake trailing.<br>· Replace.<br>· Replace.<br>· Repair by polishing or replace. |

| Problem | cause | Remedy |
|---|---|---|
| Brake squeaks | · Lining surface roughened.<br>· Lining worn.<br>· Poor shoe to lining contact.<br>· Excessively large friction between shoe and back plate.<br>· Foreign matter on drum sliding surface.<br>· Drum sliding surface damaged or distorted.<br>· Brake shoe deformed or poorly installed.<br>· Back plate mounting bolt loosening.<br>· Worn anchor or other contact portion.<br>· Lining poor contact with drum.<br>· Anti-rattle spring poorly installed. | · Repair by polishing or replace.<br>· Replace.<br>· Replace.<br>· Clean and apply brake grease.<br>· Clean<br>· Replace.<br>· Replace or repair.<br>· Retighten.<br>· Replace.<br>· Repair or replace.<br>· Repair or replace. |
| Brake rapping | · Drum sliding surface roughened.<br>· Drum eccentric or excessively distorted.<br>· Lining surface roughened. | · Repair by polishing or replace.<br>· Replace.<br>· Repair by polishing or replace. |
| Large pedal stroke | · Brake out of adjustment.<br>· Hydraulic line sucking air.<br>· Oil leaks from hydraulic line, or lack of oil.<br>· Lining worn.<br>· Shoe tilting or does not return completely.<br>· Lining in poor contact with brake drum. | · Adjust.<br>· Bleed air.<br>· Check and repair or add oil.<br>· Replace.<br>· Repair.<br>· Repair. |
| Pedal dragging. | · Twisted push rod caused by improperly fitted brake valve.<br>· Brake valve seal faulty.<br>· Flow control valve orifice clogged. | · Adjust.<br>· Replace.<br>· Clean or replace. |

## 1. ADJUSTMENT OF WHEEL BRAKE




⚠ **Adjust with engine stopped.**

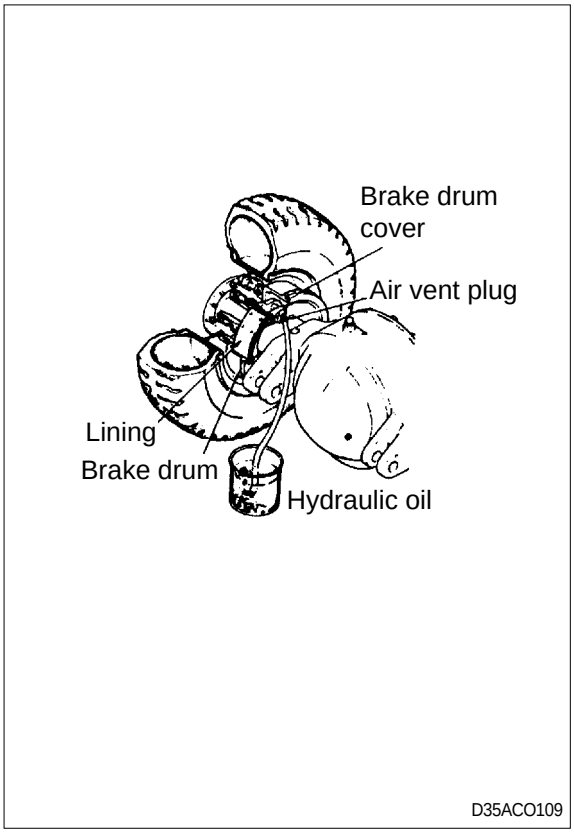
1) Jack up truck. Extend adjustment screw by clicking adjustment wheel teeth with a screwdriver until wheel(mounted on brake drum being adjusted) offers a light resistance when turned by hand. Back adjustment wheel by 25~30 teeth to shorten length of adjustment screw.

※ When backing adjustment wheel, be sure to adequately raise adjustment lever to keep it free from interference with adjustment wheel. If lever is bent by mistake, it loses proper function.

2) After adjusting brake, drive machine for about 500m, then check heat of brake drum at 4 points to confirm that brakes are not dragging.

3) After adjusting, confirm that brake stopping distance is within standard range.

## 2. AIR BLEEDING OF BRAKE SYSTEM




1) Air bleeding should be performed by two persons :
One rides on truck for depressing and releasing brake pedal : the other person is on the ground and removes cap from air vent plug on wheel cylinder.

2) Block the front wheel securely and apply parking brake.

3) Start the engine.

4) Attach a vinyl tube to air vent plug and immerse other end of tube into a vessel filled with hydraulic oil.

5) Loosen air vent plug by turning it 3/4 with a wrench. Depress brake pedal to drain oil mixed with air bubbles from plug hole.

6) Depress brake pedal until no air bubbles come out of air vent plug hole.

7) After completion of air bleeding, securely tighten air vent plug. Install cap on plug.

## 3. ADJUSTMENT OF PEDAL

### 1) BRAKE PEDAL

**(1) Pedal height from floor plate**

Adjust with stopper bolt.

· Pedal height : 143~153mm(5.7~6.0in)

**(2) Play**

Adjust with rod of master cylinder

· Play : 10mm(0.4in)

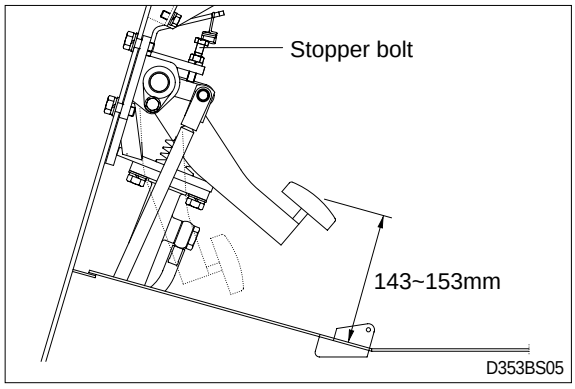
**(3) Micro switch for parking brake (if equipped)**

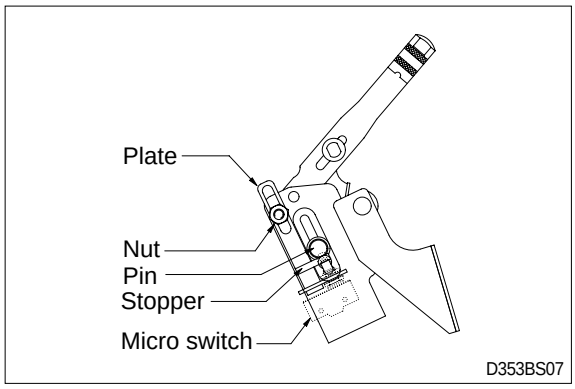
① After assembling parking brake and parking cable, put the parking brake lever released.

② Loosen the nut for parking brake plate to play up and down.

③ Move up the plate so that the stopper can be contacted with the pin and then reassemble nut.

· Micro switch stroke when parking brake is applied : 2~3mm




### 2) INCHING PEDAL

**(1) Pedal height from floor plate**

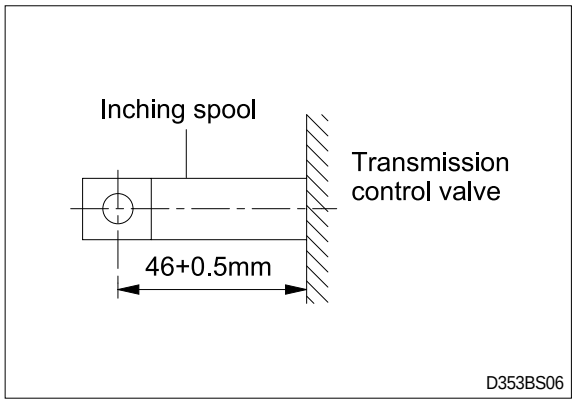
Adjust with stopper bolt.

· Pedal height : 143~153mm(5.7~6.0in)

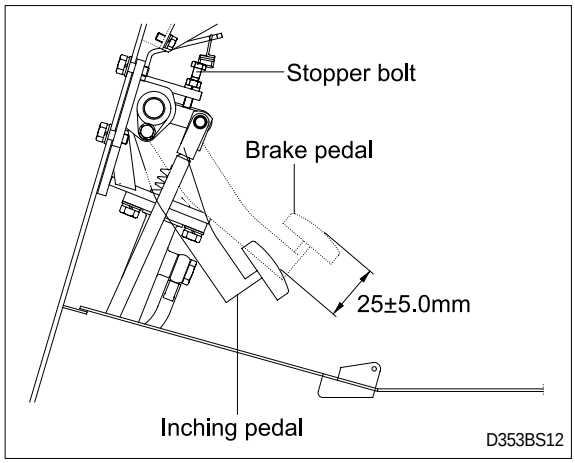
**(2) Inching spool protrusion**

Adjust with inching cable so that when the inching pedal is fully returned, the protrusion of spool from the end face of the control valve is the specified valve.

· Protrusion : 46~46.5mm(1.8in)




(3) Adjust bolt so that brake pedal interconnects with inching pedal at inching pedal stroke 25±5.0mm.



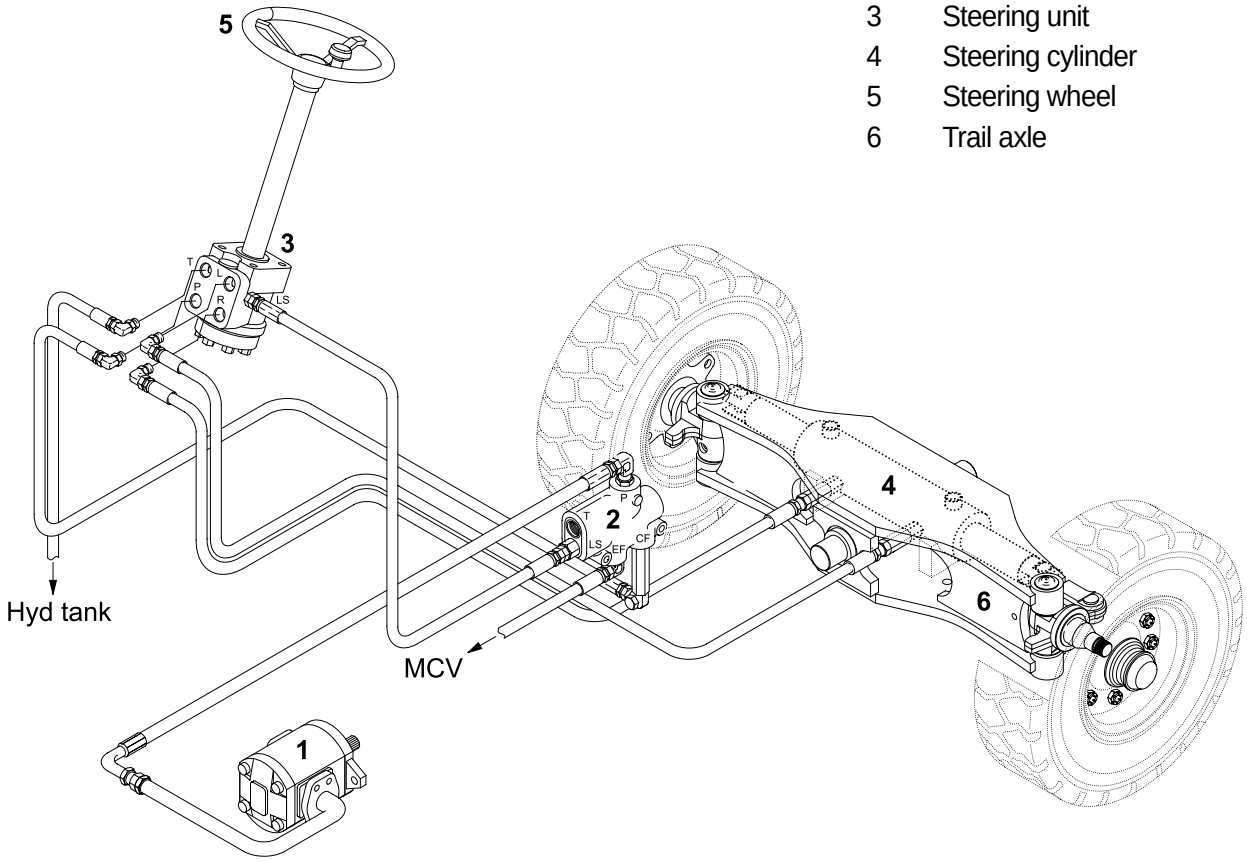
# SECTION 5 STEERING SYSTEM

# SECTION 5 STEERING SYSTEM

## GROUP 1 STRUCTURE AND FUNCTION

### 1. OUTLINE

1 Hydraulic gear pump
2 Priority valve
3 Steering unit
4 Steering cylinder
5 Steering wheel
6 Trail axle

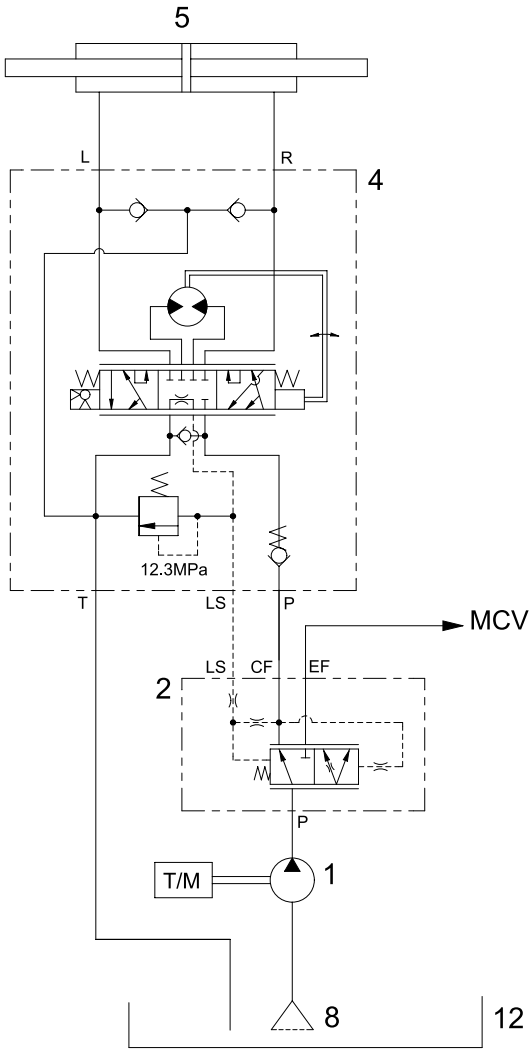



D353SE00

The steering system for this machine is composed of steering wheel assembly(5), steering unit(3), steering cylinder(4), trail axle(6) and pipings. The steering force given to the steering wheel enters the steering unit through the steering column. The required oil flow is sensed by the function of the control section of the unit, and pressurized oil delivered from the hydraulic pump(1) is fed to the steering cylinder. The force produced by the steering cylinder moves the knuckle of steering tires through the intermediate link.

The axle body is unit structure having steering knuckles installed to its both ends by means of kingpins. Hub and wheel are mounted through bearing to spindle of knuckle.

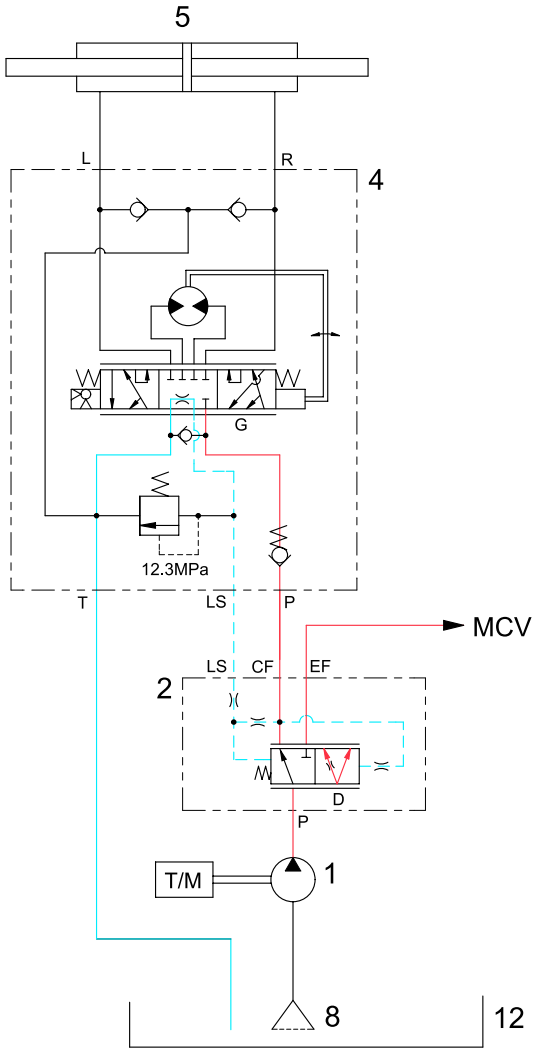
## 2. HYDRAULIC CIRCUIT




D353SE01

| | | | |
|---|---|---|---|
| 1 | Hydraulic gear pump | 5 | Steering cylinder |
| 2 | Priority valve | 8 | Suction filter |
| 4 | Steering unit | 12 | Hydraulic tank |

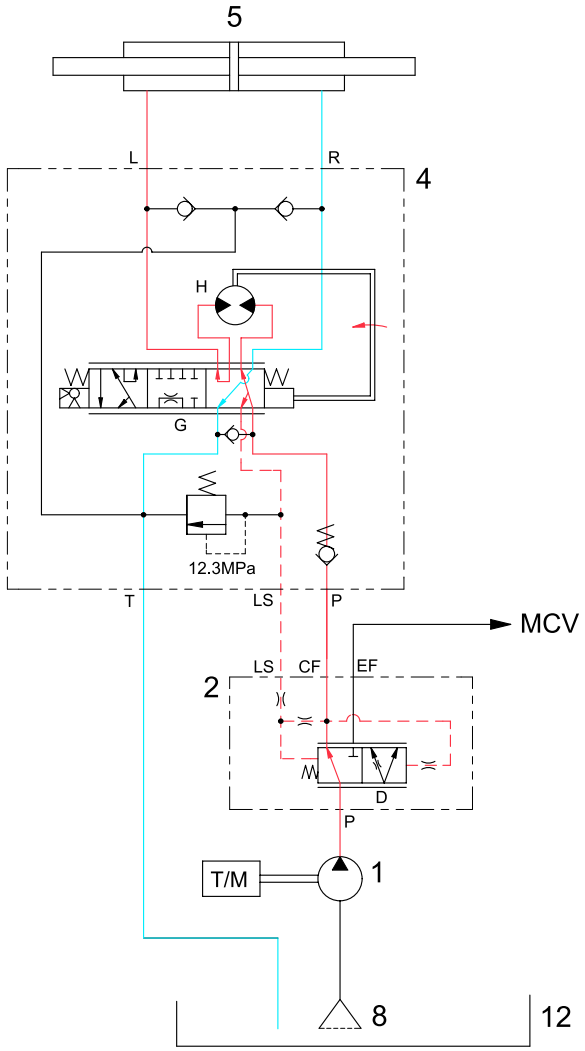
### 1) NEUTRAL




D353SE02

The steering wheel is not being operated so control spool(G) does not move.
The oil from hydraulic gear pump(1) enters port P of priority valve(2) and the inlet pressure oil moves the spool(D) to the left.
Oil flow into LS port to the hydraulic tank(12).
So, the pump flow is routed to the main control valve through the EF port.

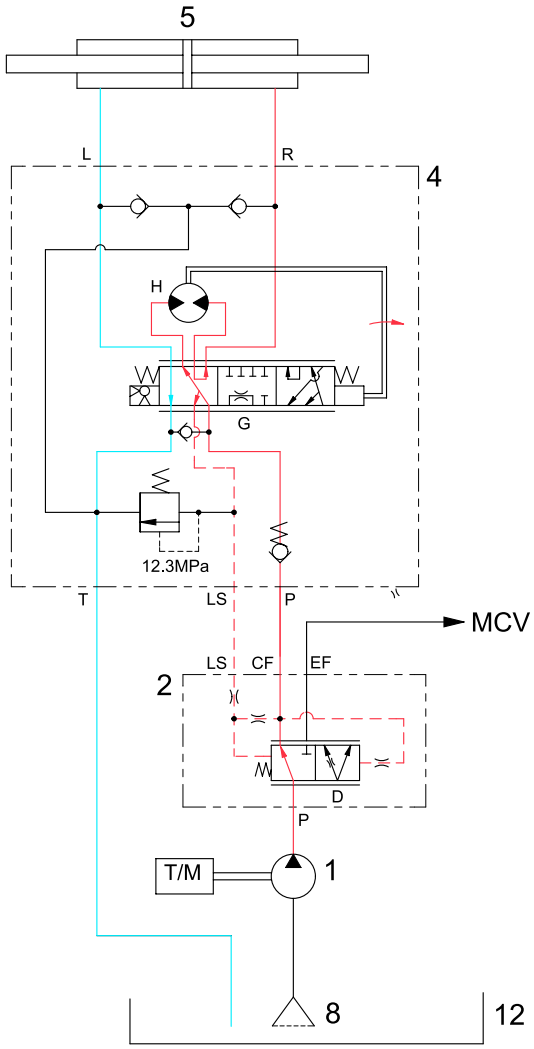
## 2) LEFT TURN




D353SE03

When the steering wheel is turned to the left, the spool(G) within the steering unit(4) connected with steering column turns in left hand direction.
At this time, the oil discharged from the pump flows into the spool(G) the steering unit through the spool(D) of priority valve and flows the gerotor(H).
Oil flow from the gerotor flows back into the spool(G) where it is directed out the left work port(L).
Oil returned from cylinder returns to hydraulic tank(12).
When the above operation is completed, the machine turns to the left.

### 3) RIGHT TURN

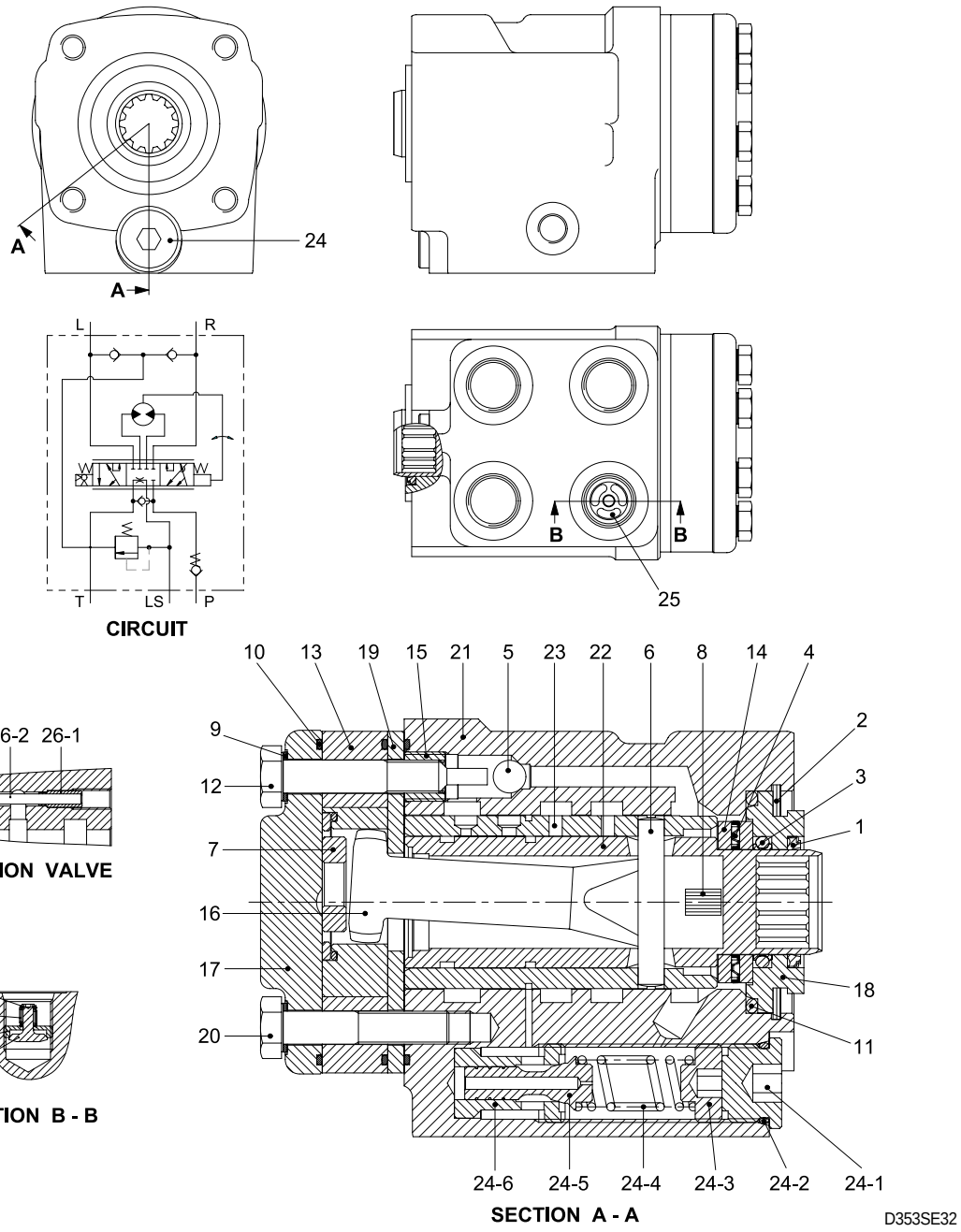



D353SE04

When the steering wheel is turned to the right, the spool(G) within the steering unit(4) connected with steering column turns in right hand direction.
At this time, the oil discharged from the pump flows into the spool(G) the steering unit through the spool(D) of priority valve and flows the gerotor(H).
Oil flow from the gerotor flows back into the spool(G) where it is directed out the right work port(R).
Oil returned from cylinder returns to hydraulic tank(12).
When the above operation is completed, the machine turns to the right.

## 3. STEERING UNIT

### 1) STRUCTURE




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Dust seal | 11 | O-ring seal | 21 | Housing | 25 | Check valve |
| 2 | Retaining ring | 12 | Rolled screw | 22 | Spool | 25-1 | Guide |
| 3 | Cap seal | 13 | Gerotor set | 23 | Sleeve | 25-2 | Shim |
| 4 | Thrust bearing | 14 | Bearing race | 24 | Relief valve | 25-3 | Spring |
| 5 | Ball | 15 | Bore screw | 24-1 | Plug | 25-4 | Washer |
| 6 | Pin | 16 | Drive shaft | 24-2 | O-ring | 26 | Suction valve |
| 7 | Spacer | 17 | End cap | 24-3 | Spring seat | 26-1 | Roll pin |
| 8 | Center spring | 18 | Bushing | 24-4 | Spring | 26-2 | Pin |
| 9 | Washer | 19 | Plate | 24-5 | Spool | 26-3 | Ball |
| 10 | O-ring | 20 | Cap screw | 24-6 | Bushing | | |

### 2) OPERATION

The steering unit is composed of the control valve(rotary valve) and the metering device. The control valve controls the flow of oil from the pump in the interior of the unit depending on the condition of the steering wheel. The metering device is a kind of hydraulic motor composed of a stator and a rotor. It meters the required oil volume, feeds the metered oil to the power cylinder and detects cylinder's motion value, that is, cylinder's motion rate.

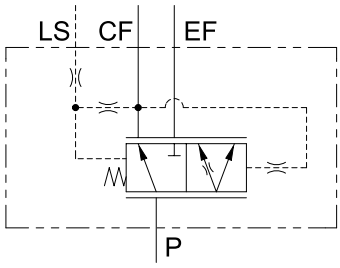
When the steering wheel is turned, the spool turns, the oil path is switched and the oil is fed into the metering device. As a result, the rotor is caused to run by oil pressure, and the sleeve is caused to run through the drive shaft and cross pin. Therefore, when the spool is turned, the spool turns by the same value in such a manner that it follows the motion of the spool. Steering motion can be accomplished when this operation is performed in a continuous state.

⚠ **If the hoses of the steering system are incorrectly connected, the steering wheel can turn very rapidly when the engine is started. Keep clear of the steering wheel when starting the engine.**

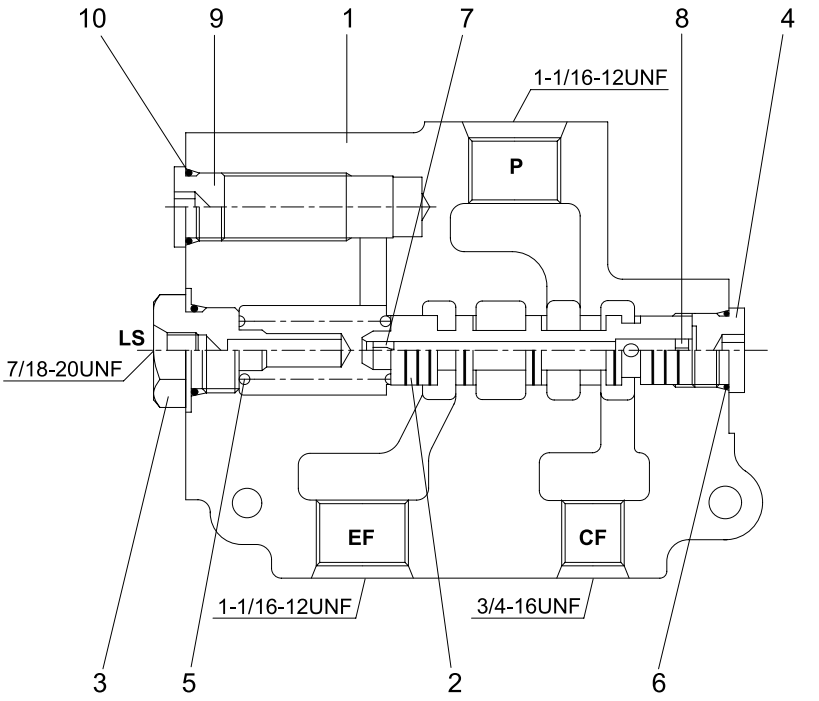
The centering spring for the spool and sleeve is provided to cause the valve to return to the neutral position. It is therefore possible to obtain a constant steering feeling, which is transmitted to the hands of the driver. Return to the center position occurs when the steering wheel is released.

## 4. PRIORITY VALVE

### 1) STRUCTURE




**HYDRAULIC CIRCUIT**




D353SE06

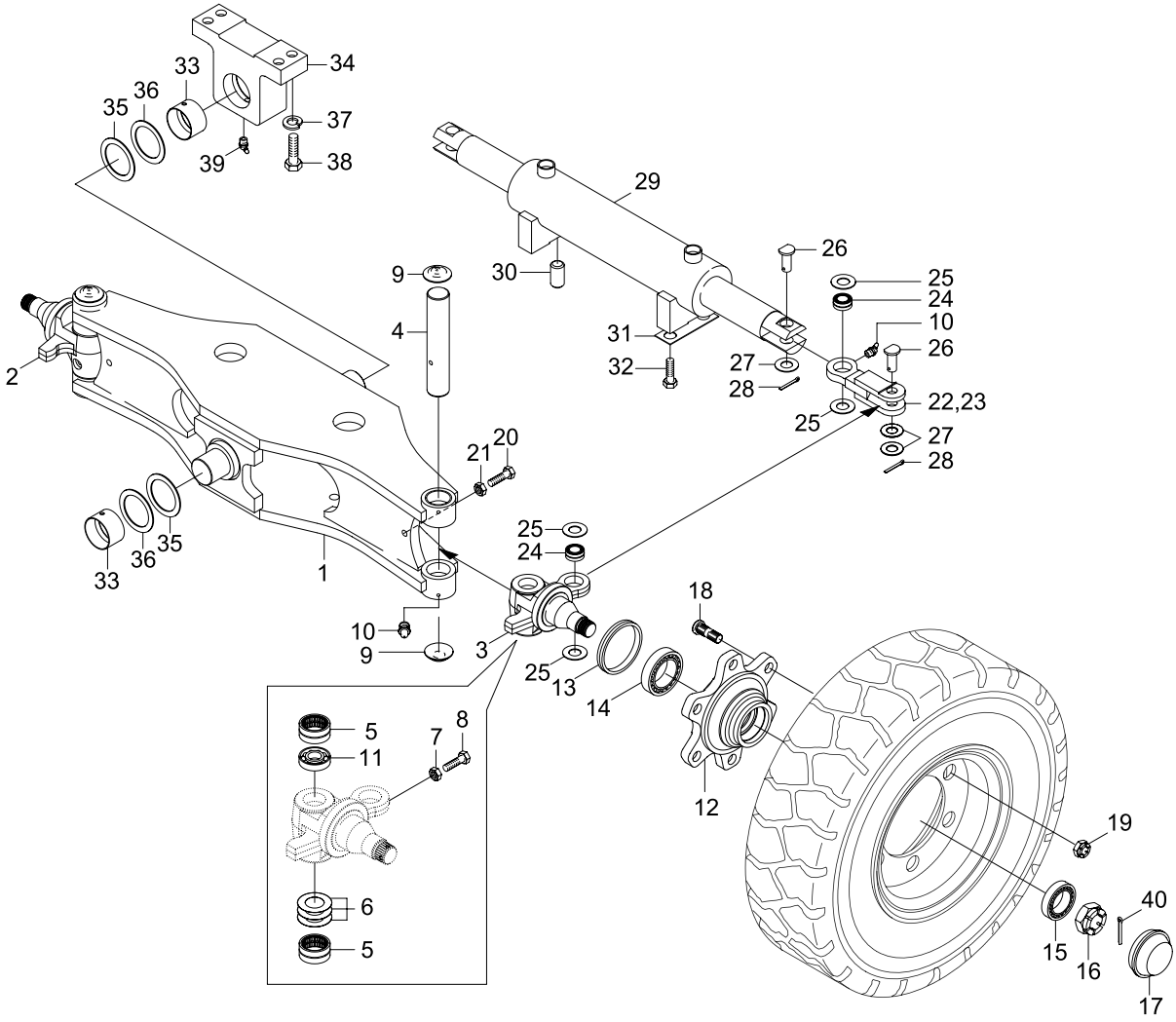
| | | | | | |
|---|---|---|---|---|---|
| 1 | Body | 5 | Spring | 9 | End plug |
| 2 | Spool | 6 | O-ring | 10 | O-ring |
| 3 | Spring pulg | 7 | Orifice | | |
| 4 | End plug | 8 | Orifice | | |

### 2) OPERATION

The oil from the hydraulic gear pump flows to the priority valve.
The priority valve supplies a flow of oil to the steering system and lift, tilt system.
The steering flow is controlled by the steering unit to operate the steering cylinder.
The remainder of the oil flow from the pump flows to the main control valve.

## 5. TRAIL AXLE

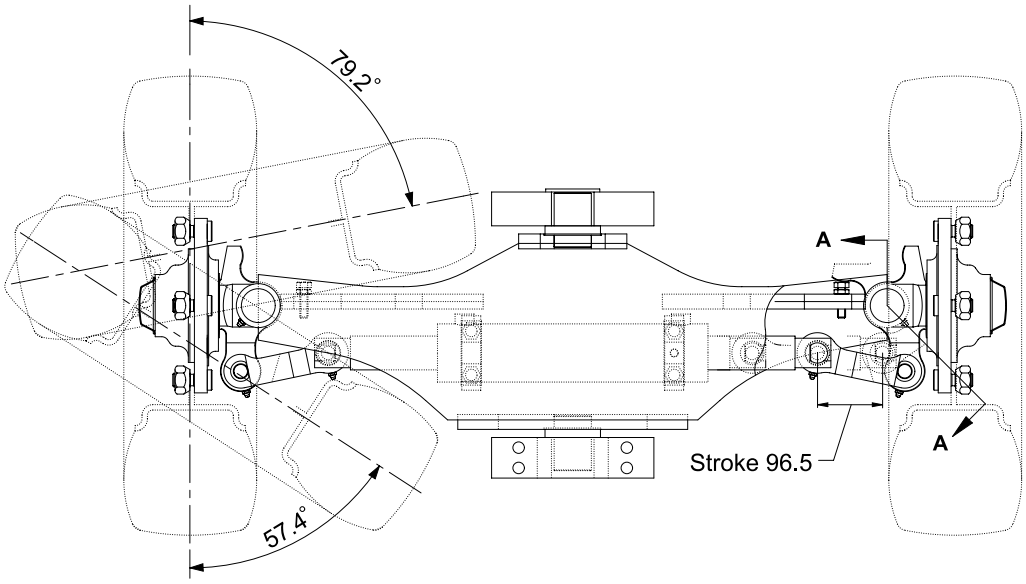
### 1) STRUCTURE

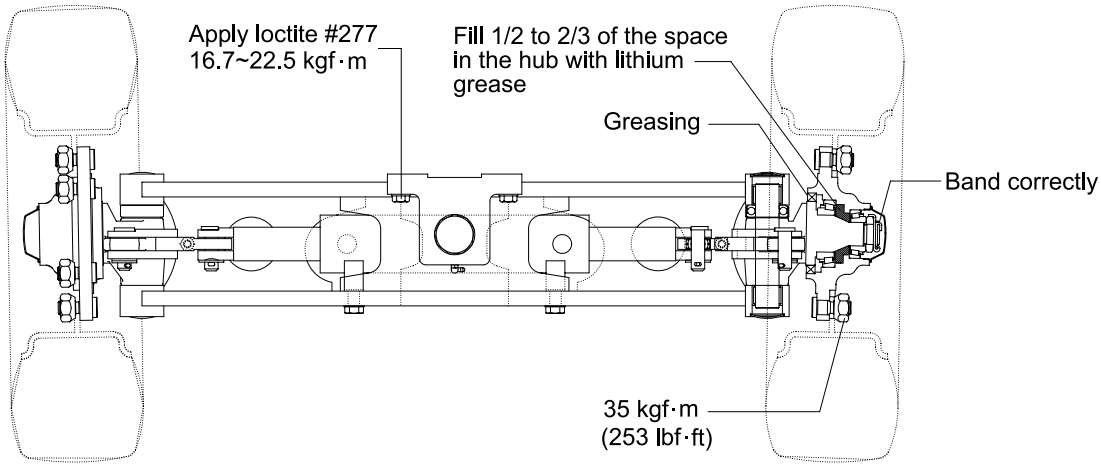



D353SE22

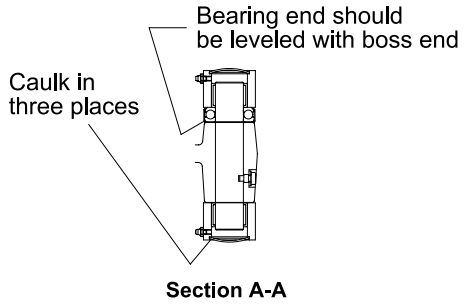
| | | | | | |
|---|---|---|---|---|---|
| 1 | Trail axle | 15 | Taper roller bearing | 28 | Split pin |
| 2 | Knuckle-RH | 16 | Slot nut | 29 | Steering cylinder assy |
| 3 | Knuckle-LH | 17 | Cap | 30 | Pin |
| 4 | Pin | 18 | Serration bolt | 31 | Lock plate |
| 5 | Needle bearing | 19 | Hub nut | 32 | Hexagon bolt |
| 6 | Shim(0.2t) | 20 | Full thread bolt | 33 | Bushing |
| 7 | Special bolt | 21 | Hexagon nut | 34 | Support |
| 8 | Spring washer | 22 | Link-RH | 35 | Shim(1.0t) |
| 9 | Plug | 23 | Link-LH | 36 | Shim(0.5t) |
| 10 | Grease nipple | 24 | Spherical plain bearing | 37 | Spring washer |
| 11 | Thrust bearing | 25 | Thrust washer | 38 | Hexagon bolt |
| 12 | Hub | 26 | Clevis pin | 39 | Grease nipple |
| 13 | Seal | 27 | Plain washer | 40 | Split pin |
| 14 | Taper roller bearing | | | | |

## 2) TIGHTENING TORQUE AND SPECIFICATION



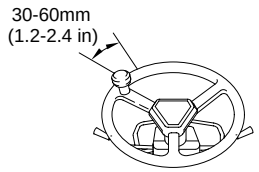

| Type | Unit | Center pin support single shaft |
|---|---|---|
| Structure of knuckle | - | Elliott type |
| Toe-in | degree | 0 |
| Camber | degree | 1 |
| Caster | degree | 0 |
| King pin angle | degree | 0 |
| Max steering angle of wheels(Inside/Outside) | degree | 79.2 / 57.4 |
| Tread | mm(in) | 1,120(44) |




D353SE08

# GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

## 1. OPERATIONAL CHECKS

<table>
<tr><th>Check item</th><th>Checking procedure</th></tr>
<tr><td>Steering wheel<br> 
</td><td>· Set rear wheels facing straight forward, then turn steering wheel to left and right. Measure range of steering wheel movement before rear wheel starts to move. Range should be 30~60㎜ at rin of steering wheel. If play is too large, adjust at gear box.<br>Test steering wheel play with engine at idling.</td></tr>
<tr><td>Knuckle</td><td>· Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear.</td></tr>
<tr><td>Steering axle</td><td>· Put camber gauge in contact with hub and measure camber. If camber is not within 1±0.5 °; rear axle is bent.<br>· Ask assistant to drive machine at minimum turning radius.<br>· Fit bar and a piece of chalk at outside edge of counterweight to mark line of turning radius.<br>· If minimum turning radius is not within±100㎜ (±4in)of specified value, adjust turning angle stopper bolt.<br>Min turning radius(Outside)
<table>
<tr><td>HDF 35III</td><td>2500㎜</td></tr>
<tr><td>HDF 45III</td><td>2535㎜</td></tr>
</table></td></tr>
<tr><td>Hydraulic pressure of power steering</td><td>Remove plug from outlet port of flow divider and install oil pressure gauge.<br>Turn steering wheel fully and check oil pressure.<br>※ Oil pressure : 100 ~ 105 ㎏f/㎠ (98 ~ 103㏜)</td></tr>
</table>

## 2. TROUBLESHOOTING

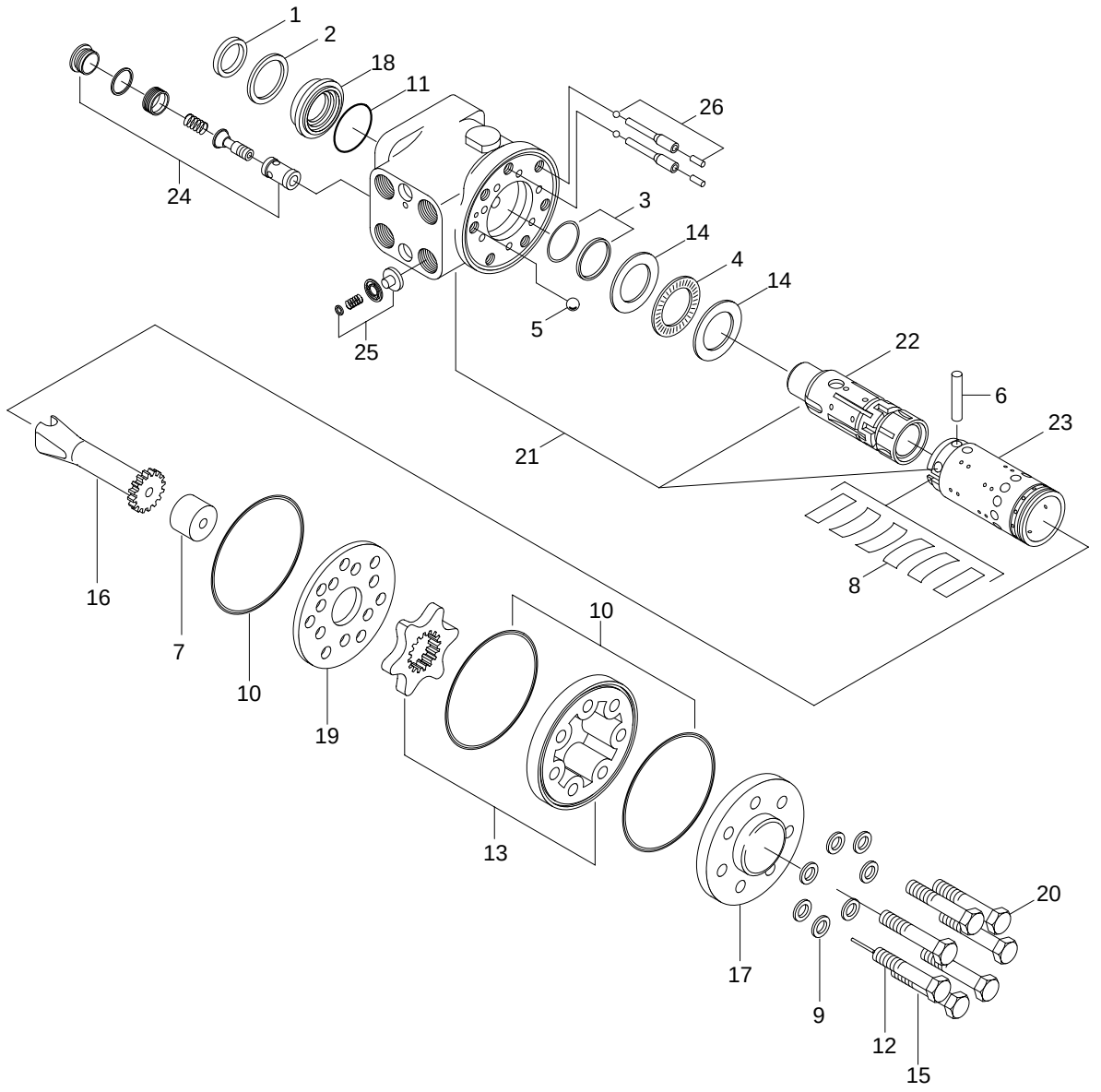
| Problem | cause | Remedy |
|---|---|---|
| Steering wheel drags. | · Low oil pressure.<br>· Bearing faulty.<br>· Spring spool faulty.<br>· Reaction plunger faulty.<br>· Ball-and-screw assembly faulty.<br>· Sector shaft adjusting screw excessi-vely tight.<br>· Gears poorly meshing.<br>· Flow divider coil spring fatigued. | · Check lockout. Repair.<br>· Clean or replace.<br>· Clean or replace.<br>· Replace.<br>· Clean or replace.<br>· Adjust.<br>· Check and correct meshing.<br>· Replace. |
| Steering wheel fails to return smoothly. | · Bearing faulty.<br>· Reaction plunger faulty.<br>· Ball-and-screw assy faulty<br>· Gears poorly meshing. | · Clean or replace.<br>· Replace.<br>· Clean or replace.<br>· Check and correct meshing. |

| Problem | cause | Remedy |
|---|---|---|
| Steering wheel turns unsteadily.<br>Steering system makes abnormal sound or vibration. | · Lockout loosening.<br>· Metal spring deteriorated.<br>· Gear backlash out of adjustment.<br>· Lockout loosening.<br>· Air in oil circuit. | · Retighten.<br>· Replace.<br>· Adjust.<br>· Retighten.<br>· Bleed air. |
| Abnormal sound heard when steering wheel is turned fully | Valve<br>· Faulty. (Valve fails to open.)<br>Piping<br>· Pipe(from pump to power steering cylinder) dented or clogged. | · Adjust valve set pressure and check for specified oil pressure.<br>· Repair or replace. |
| Piping makes abnormal sounds. | Oil pump<br>· Lack of oil.<br>· Oil inlet pipe sucks air.<br>· Insufficient air bleeding. | · Add oil.<br>· Repair.<br>· Bleed air completely. |
| Valve or valve unit makes abnormal sounds. | Oil pump<br>· Oil inlet pipe sucks air.<br>Valve<br>· Faulty. (Unbalance oil pressure)<br>Piping<br>· Pipe(from pump to power steering) dented or clogged.<br>· Insufficient air bleeding. | · Repair or replace.<br>· Adjust valve set pressure and check specified oil pressure.<br>· Repair or replace.<br>· Bleed air completely. |
| Insufficient or variable oil flow. | · Flow control valve orifice clogged. | · Clean |
| Insufficient or variable discharge pressure. | Piping<br>· Pipe(from tank to pipe) dented or clogged. | · Repair or replace. |
| Steering cylinder head leakage (Piston rod) | · Packing foreign materal.<br>· Piston rod damage.<br>· Rod seal damage and distortion.<br>· Chrome gilding damage. | · Replace<br>· Grind surface with oil stone.<br>· Replace<br>· Grind |
| Steering cylinder head thread (A little bit leak is no problem) | · O-ring damage. | · Replace |
| Welding leakage | · Cylinder tube damage. | · Tube replace. |
| Rod | · Tube inside damage.<br>· Piston seal damage and distortion | · Grind surface with oil store.<br>· Replace |
| Piston rod bushing inner diameter excessive gap | · Bushing wear. | · Replace |

## GROUP 3 DISASSEMBLY AND ASSEMBLY

### 1. STEERING UNIT

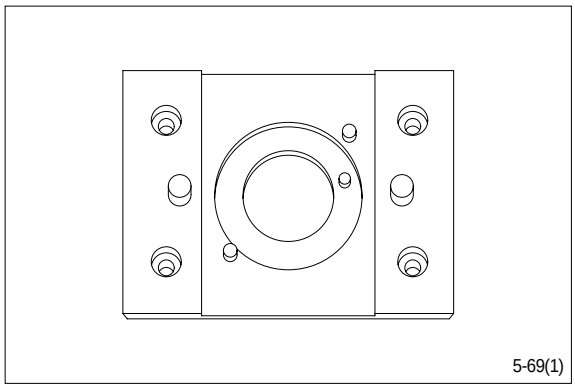
#### 1) STRUCTURE




| | | | | | |
|---|---|---|---|---|---|
| 1 | Dust seal | 10 | O-ring | 19 | Plate |
| 2 | Retaining ring | 11 | O-ring seal | 20 | Cap screw |
| 3 | Cap seal | 12 | Rolled screw | 21 | Housing |
| 4 | Thrust bearing | 13 | Gerotor set | 22 | Spool |
| 5 | Ball | 14 | Bearing race | 23 | Sleeve |
| 6 | Pin | 15 | Bore screw | 24 | Relief valve |
| 7 | Spacer | 16 | Drive shaft | 25 | Check valve |
| 8 | Center spring | 17 | End cap | 26 | Suction valve |
| 9 | Washer | 18 | Bushing | | |

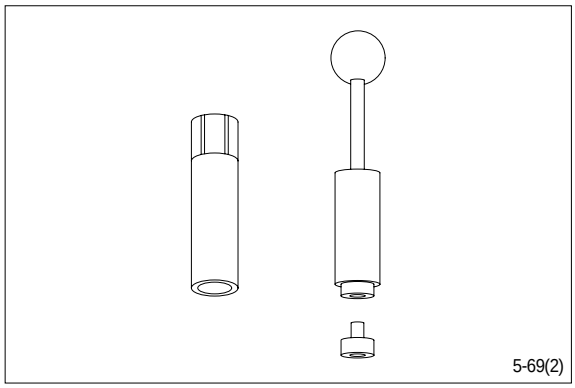
**2) TOOLS**

(1) Holding tool.



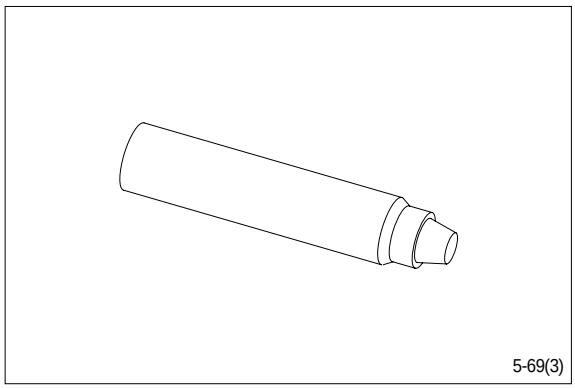
5-69(1)

(2) Assembly tool for O-ring and kin-ring.



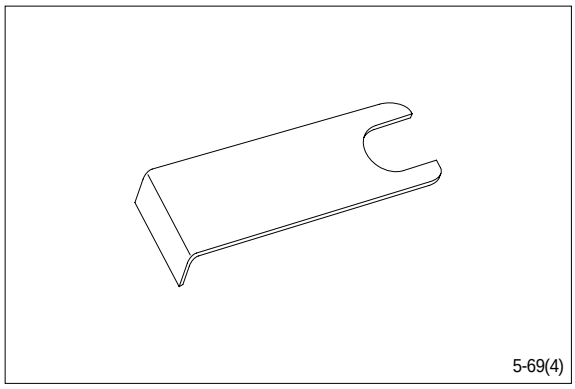
5-69(2)

(3) Assembly tool for lip seal.



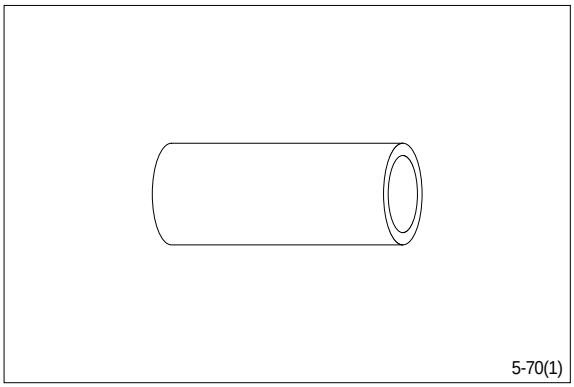
5-69(3)

(4) Assembly tool for cardan shaft.

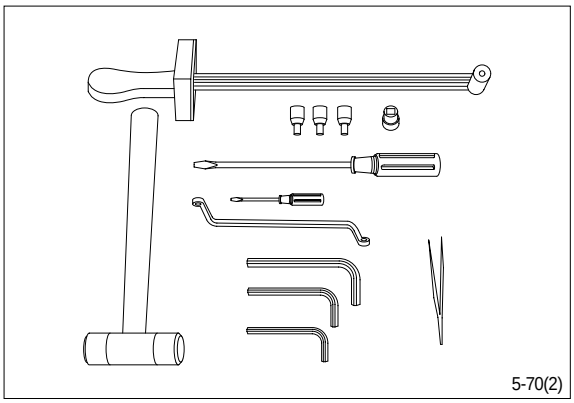


5-69(4)

(5) Assembly tool for dust seal.

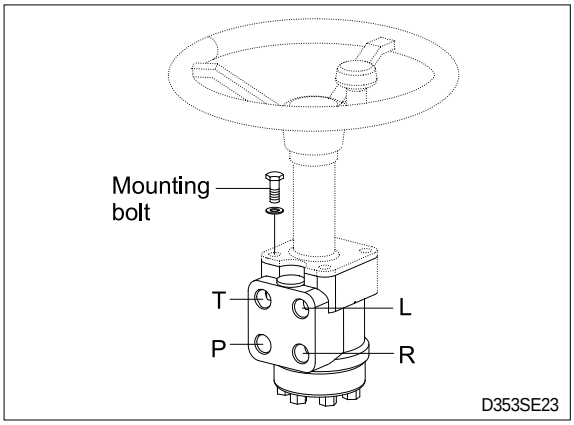

5-70(1)

(6) Torque wrench 0~7.1kgf · m
(0~54.4lbf · ft)
13mm socket spanner
6, 8mm and 12mm hexagon sockets
12mm screwdriver
2mm screwdriver
13mm ring spanner
6, 8 and 12mm hexagon socket spanners
Plastic hammer
Tweezers


5-70(2)

### 3) TIGHTENING TORQUE

L : Left port
R : Right port
T : Tank
P : Pump

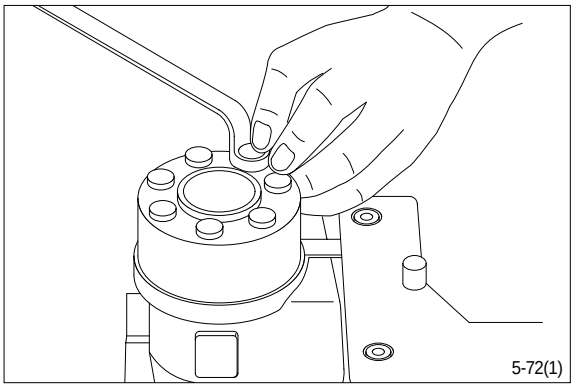


D353SE23

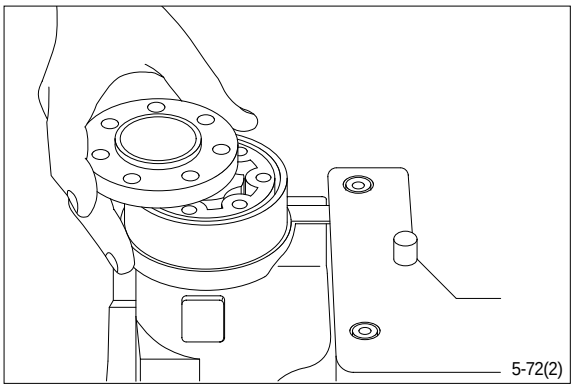
| Port | Size | Torque [kgf · m(lbf · ft)] |
|---|---|---|
| L | 3/4 UNF - 16 | 13 (94) |
| R | 3/4 UNF - 16 | 13 (94) |
| T | 3/4 UNF - 16 | 13 (94) |
| P | 3/4 UNF - 16 | 13 (94) |
| Mounting bolt | M10×1.5 | 5.0 ±1.0 (36±7.2) |

**4) DISASSEMBLY**

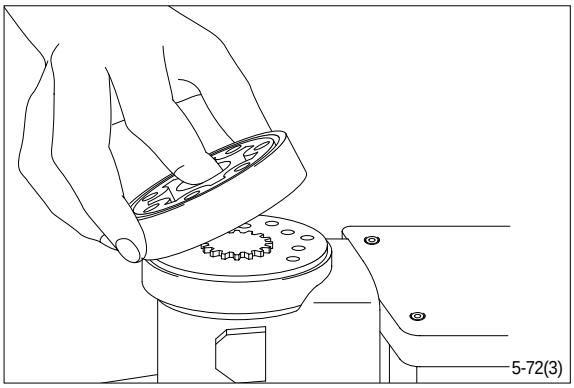
(1) Disassemble steering column from steering unit and place the steering unit in the holding tool.
Screw out the screws in the end cover(6-off plus one special screw).


5-72(1)

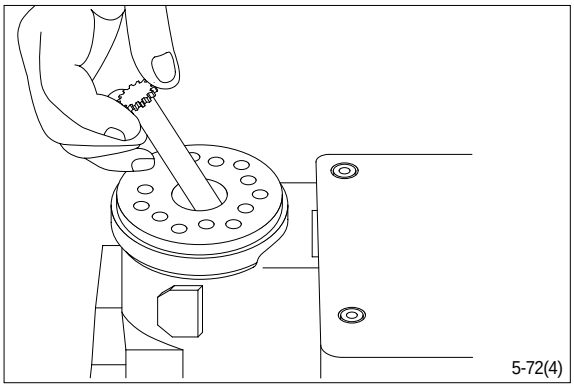
(2) Remove the end cover, sideways.


5-72(2)

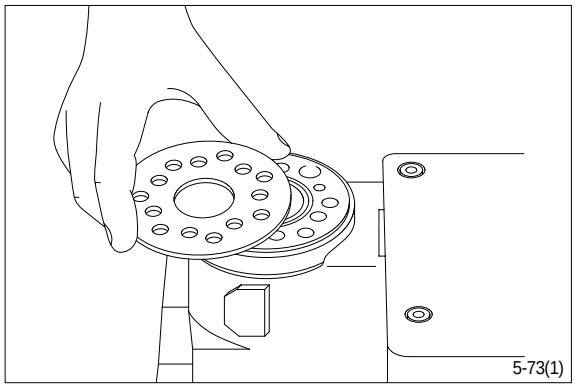
(3) Lift the gearwheel set(With spacer if fitted) off the unit.
Take out the two O-rings.


5-72(3)

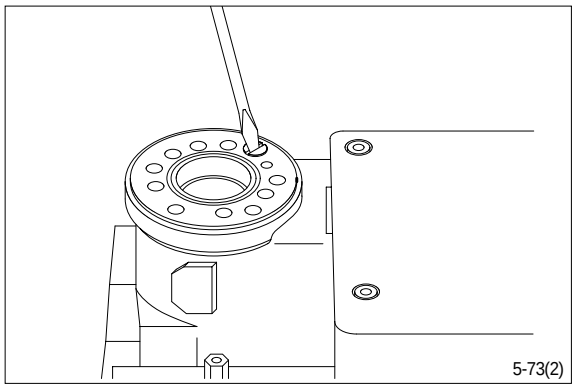
(4) Remove cardan shaft.


5-72(4)

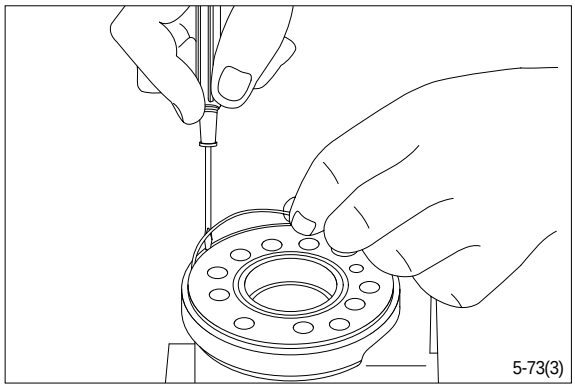
(5) Remove distributor plate.


5-73(1)

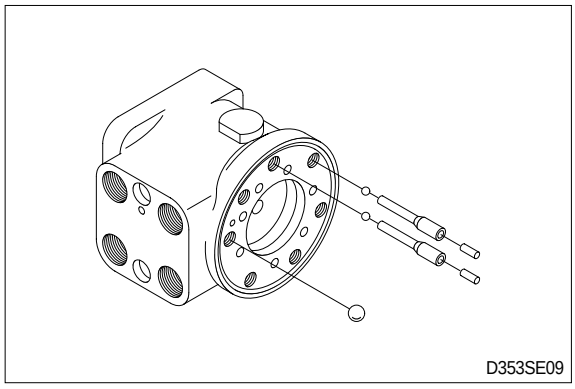
(6) Screw out the threaded bush over the check valve.


5-73(2)

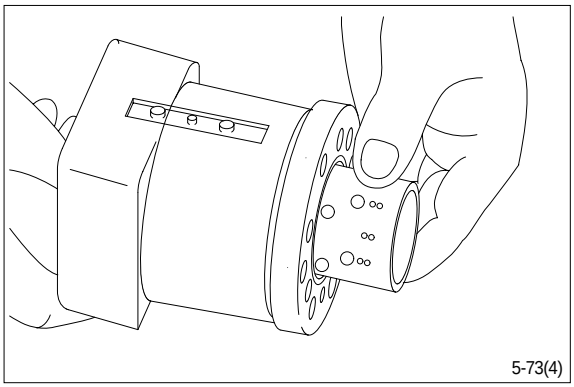
(7) Remove O-ring.


5-73(3)

(8) Shake out the check valve ball and suction valve pins and balls.

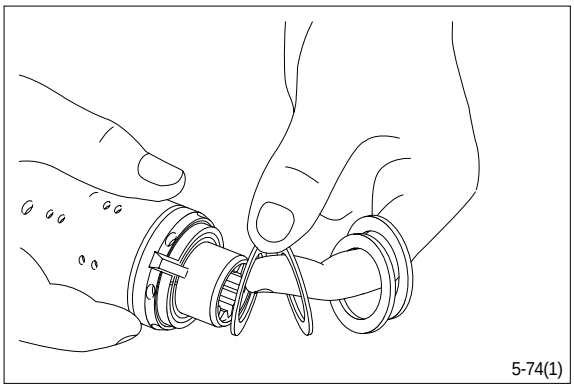

D353SE09

(9) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and thrust bearing will be pushed out of the housing together.



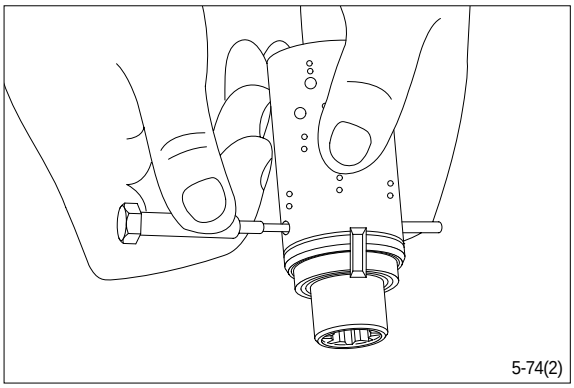
5-73(4)

(10) Take ring, bearing races and thrust bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.



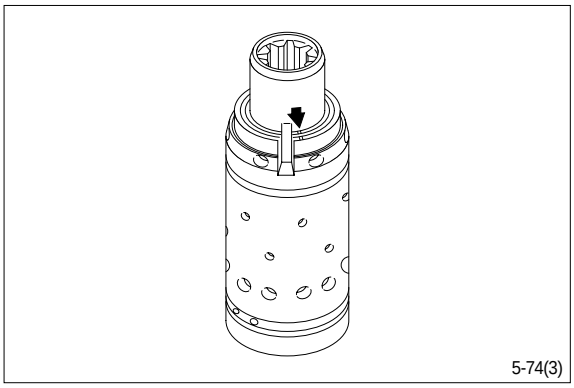
5-74(1)

(11) Press out the cross pin. Use the special screw from the end cover.



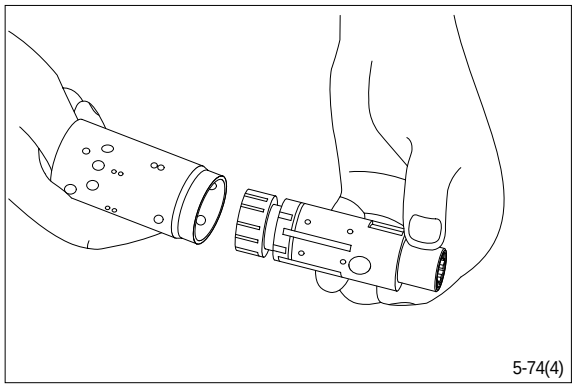
5-74(2)

※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs(See drawing).
If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.

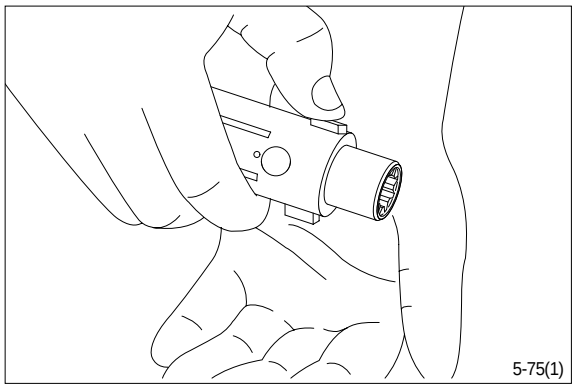


5-74(3)

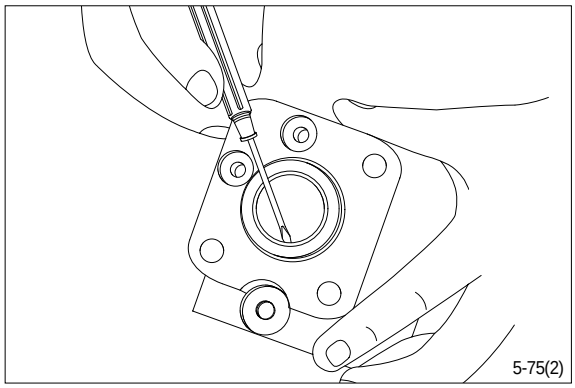
(12) Carefully press the spool out of the sleeve.


5-74(4)

(13) Press the neutral position springs out of their slots in the spool.

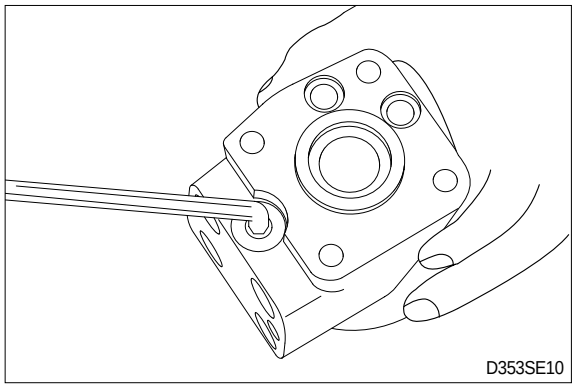

5-75(1)

(14) Remove dust seal and O-ring.

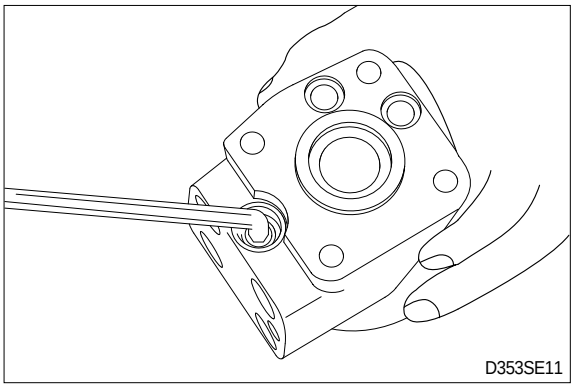

5-75(2)

**Disassembling the pressure relief valve**

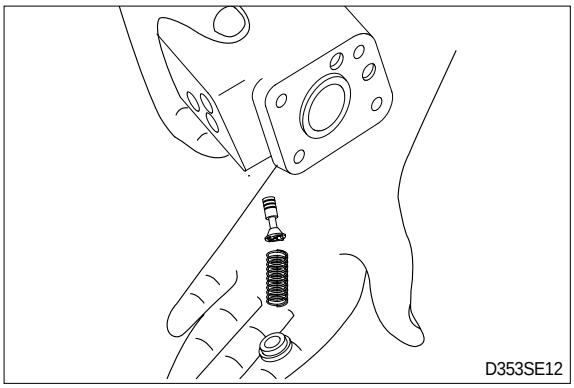
(14) Screw out the plug using an 8㎜ hexagon socket spanner.
Remove seal washers.


D353SE10

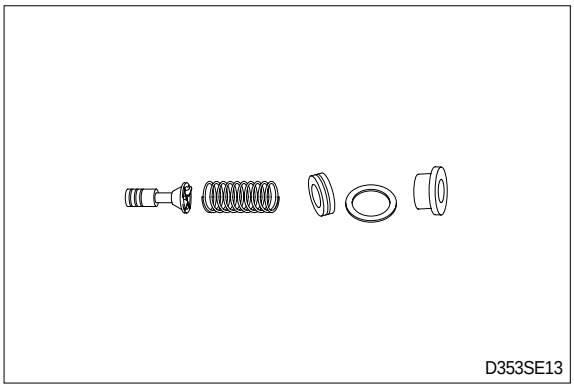
(15) Unscrew the setting screw using an 8mm hexagon socket spanner.




(16) Shake out spring and piston. The valve seat is bonded into the housing and cannot be removed.



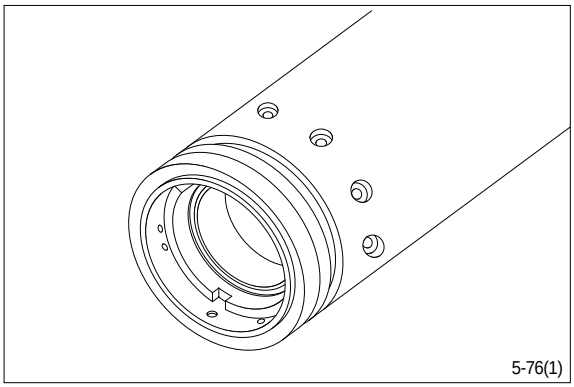

(17) The pressure relief valve is now disassembled.



**5) ASSEMBLY**

(1) Assemble spool and sleeve.

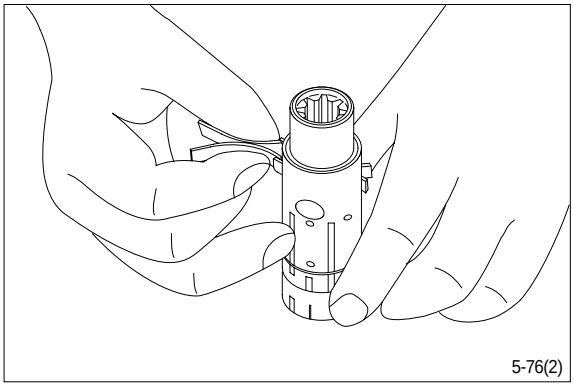
※ When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.



5-76(1)

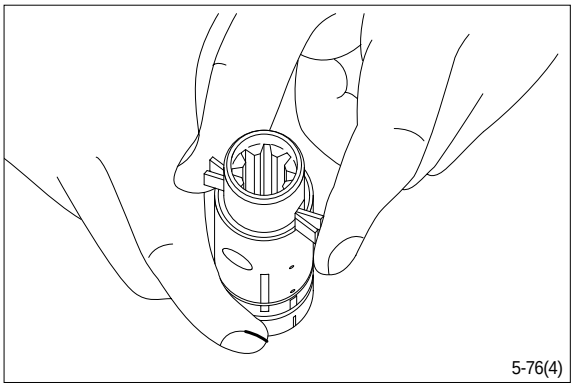
(2) Place the two flat neutral position springs in the slot.

Place the curved springs between the flat ones and press them into place (see assembly pattern).



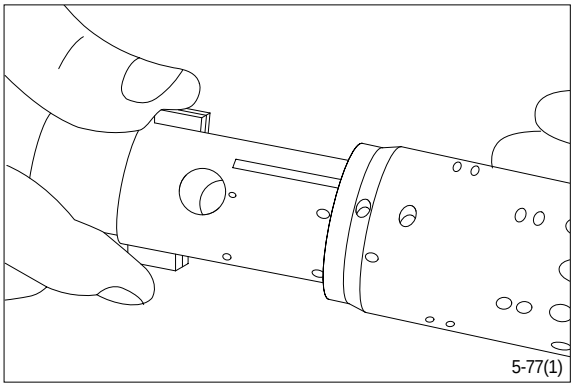
5-76(2)

(3) Line up the spring set.



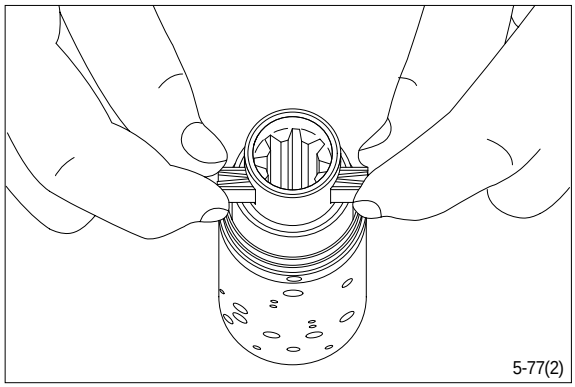
5-76(4)

(4) Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other.

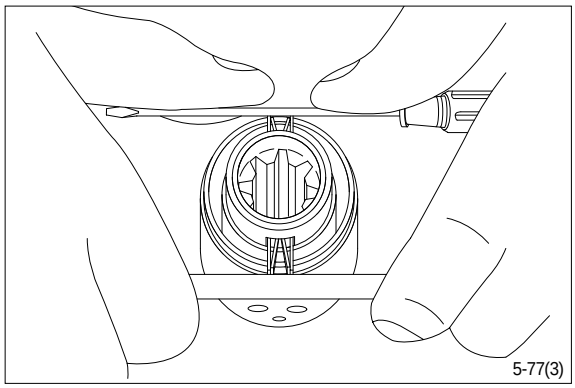


5-77(1)

(5) Press the springs together and push the neutral position springs into place in the sleeve.

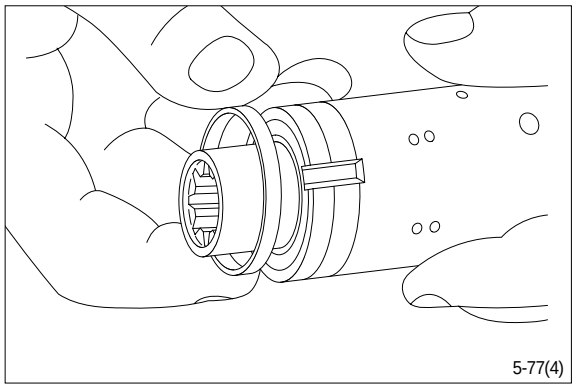

5-77(2)

(6) Line up the springs and center them.

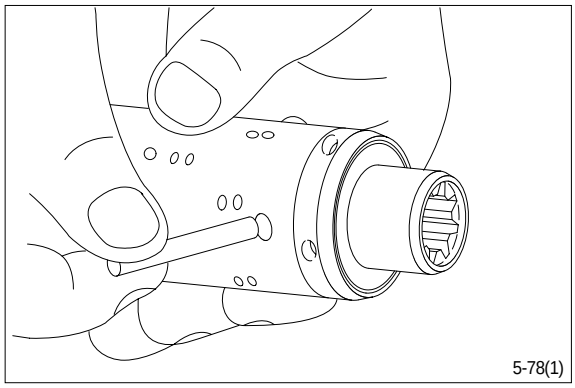

5-77(3)

(7) Guide the ring down over the sleeve.

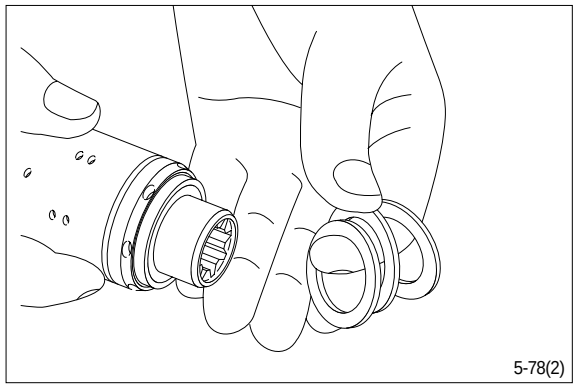
※ The ring should be able to rotate free of the springs.


5-77(4)

(8) Fit the cross pin into the spool / sleeve.

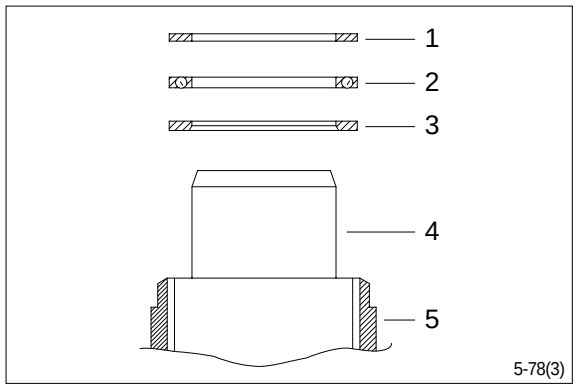

5-78(1)

(9) Fit bearing races and needle bearing as shown on below drawing.


5-78(2)

※ **Assembly pattern for standard bearings**

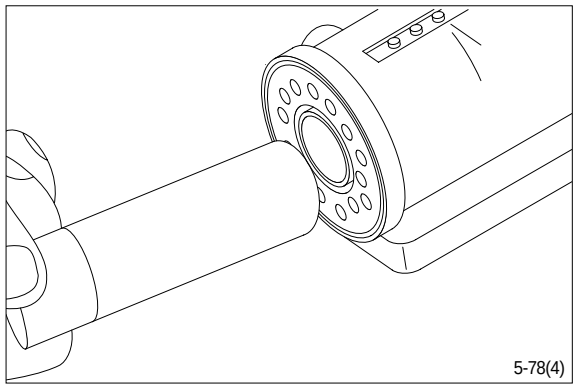
1 Outer bearing race
2 Thrust bearing
3 Inner bearing race
4 Spool
5 Sleeve



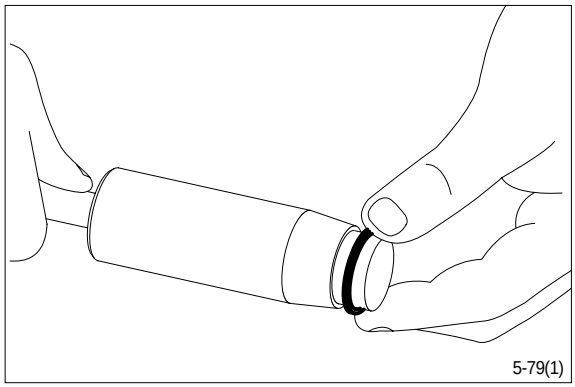
5-78(3)

**Installation instruction for O-ring**

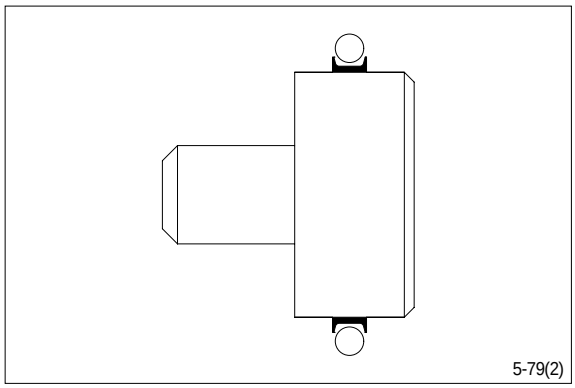
(10) Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool / sleeve.


5-78(4)

(11) Grease O-ring with hydraulic oil and place them on the tool.

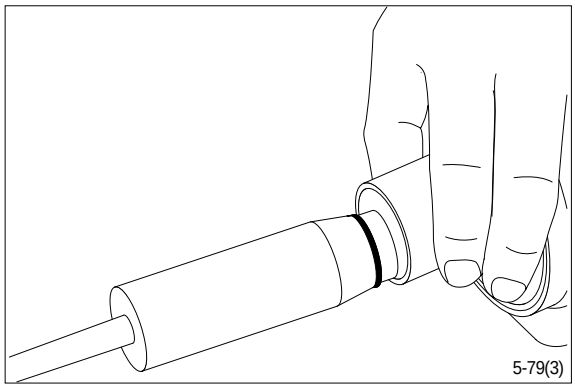


5-79(1)



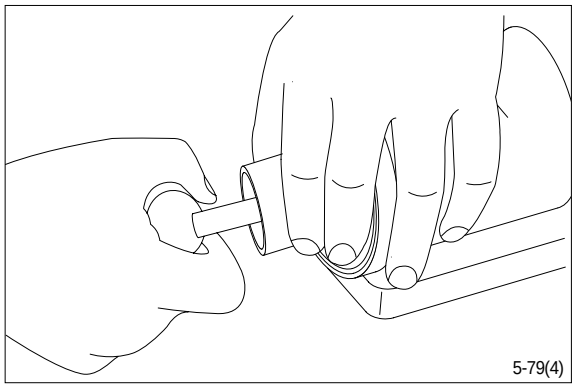
5-79(2)

(12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



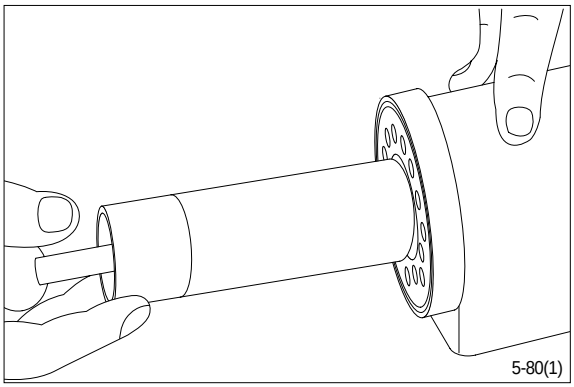
5-79(3)

(13) Press and turn the O-ring into position in the housing.



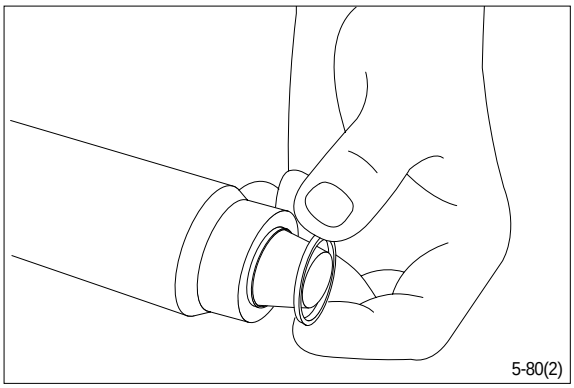
5-79(4)

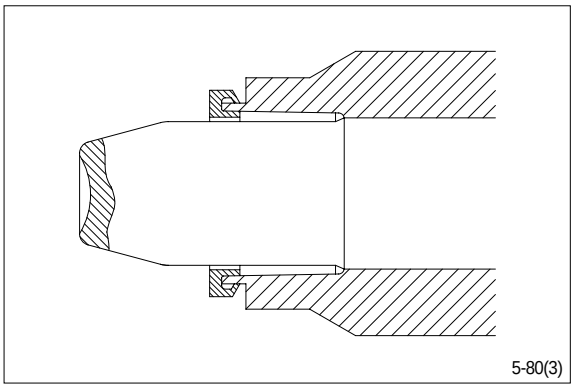
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.


5-80(1)

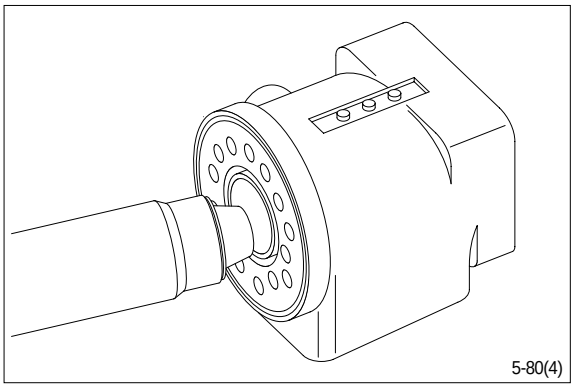
**Installation instructions for lip seal**

(15) Lubricate the lip seal with hydraulic oil and place it on the assembly tool.

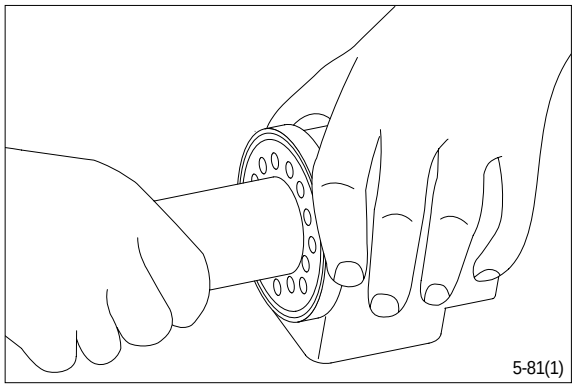

5-80(2)


5-80(3)

(16) Guide the assembly tool right to the bottom.

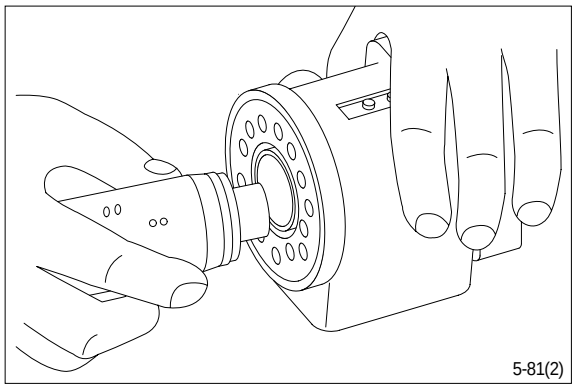

5-80(4)

(17) Press and turn the lip seal into place in the housing.

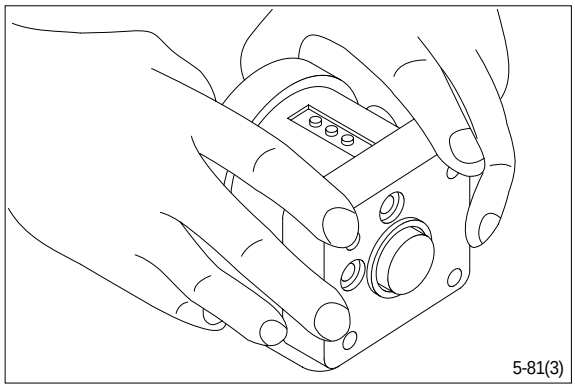

5-81(1)

(18) With a light turning movement, guide the spool and sleeve into the bore.

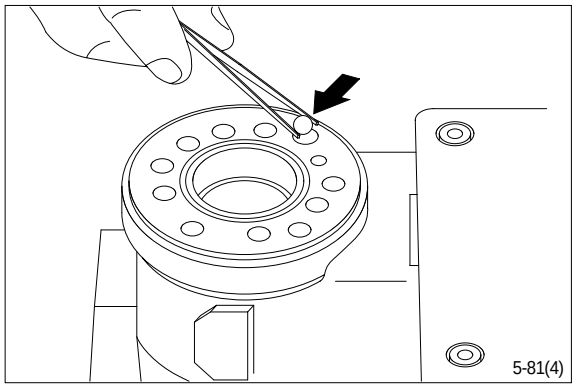
※ Fit the spool set holding the cross pin horizontal.


5-81(2)

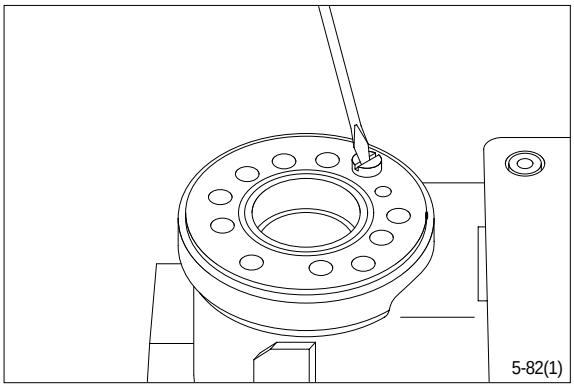
(19) The spool set will push out the assembly tool guide. The O-ring are now in position.


5-81(3)

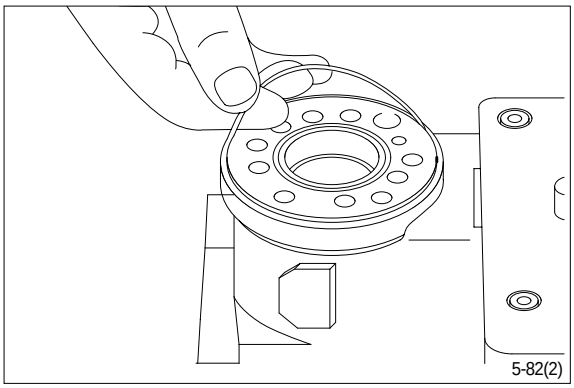
(20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.


5-81(4)

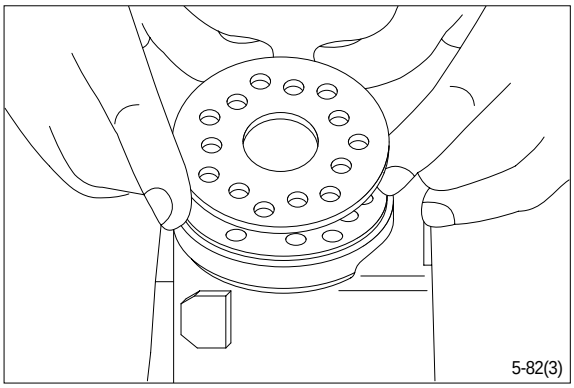
(21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.


5-82(1)

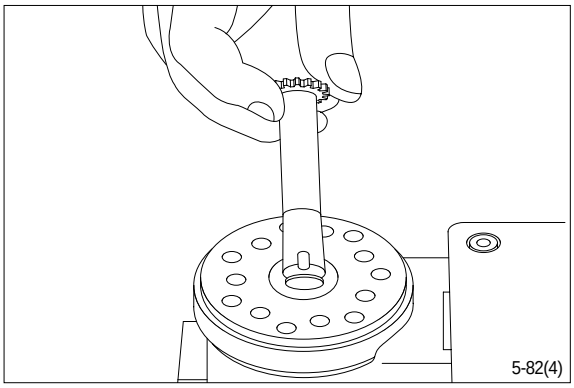
(22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20℃.


5-82(2)

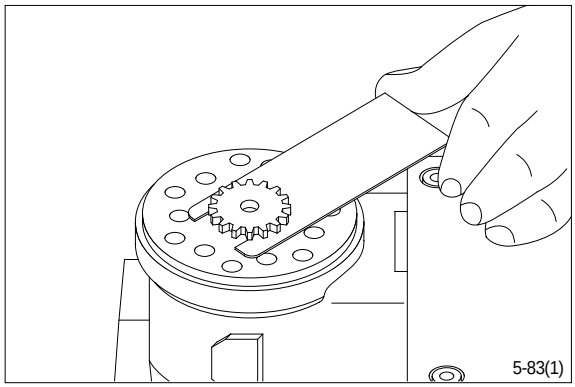
(23) Place the distributor plate so that the channel holes match the holes in the housing.


5-82(3)

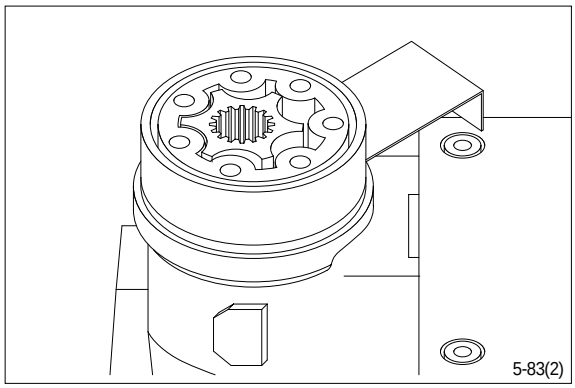
(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.


5-82(4)

(25) Place the cardan shaft as shown - so that it is held in position by the mounting fork.



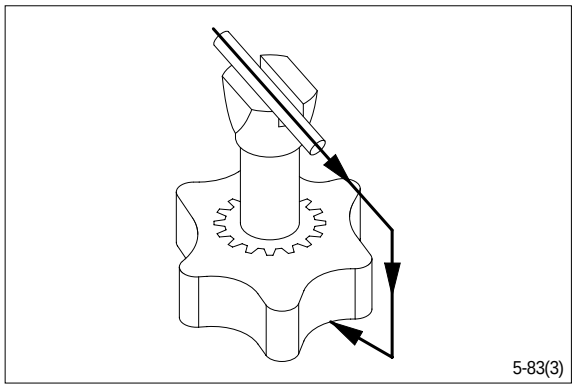

(26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20 ℃ and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



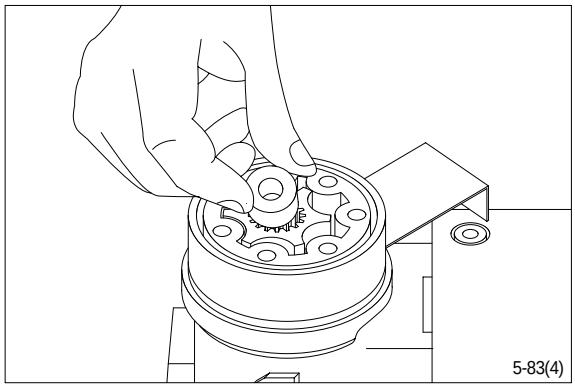

**(27) Important**

Fit the gearwheel(Rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown.

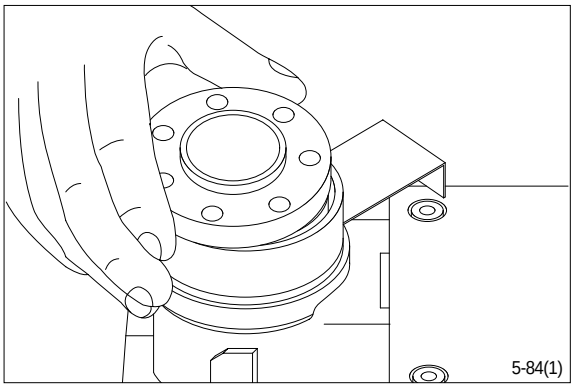
Turn the gear rim so that the seven through holes match the holes in the housing.



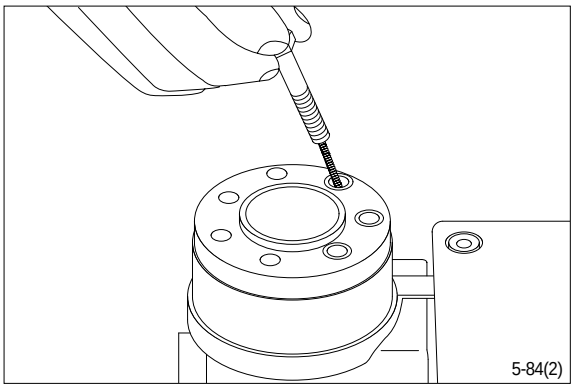

(28) Fit the spacer, if any.



(29) Place the end cover in position.

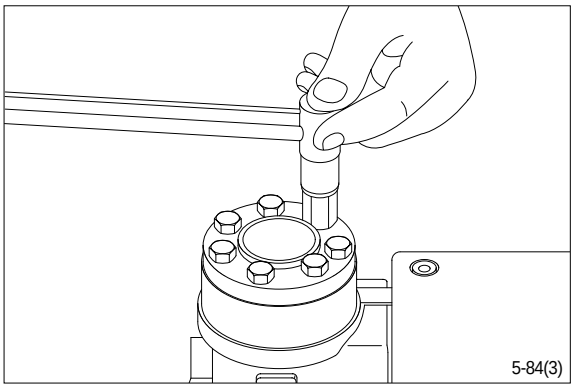

5-84(1)

(30) Fit the special screw with washer and place it in the hole shown.

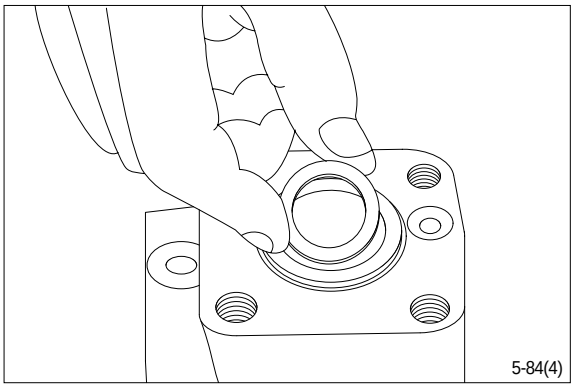

5-84(2)

(31) Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin.

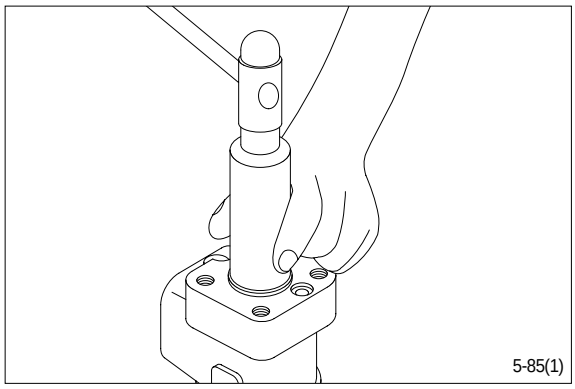
· Tightening torque : 4.0 ± 0.5kgf · m
(28.9 ± 3.6lbf · ft)


5-84(3)

(32) Place the dust seal ring in the housing.


5-84(4)

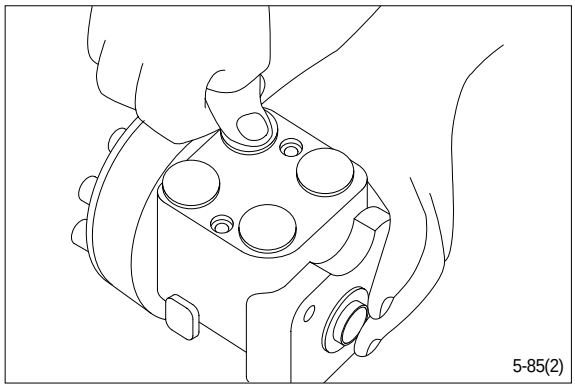
(33) Fit the dust seal ring in the housing.



5-85(1)

(34) Press the plastic plugs into the connection ports.

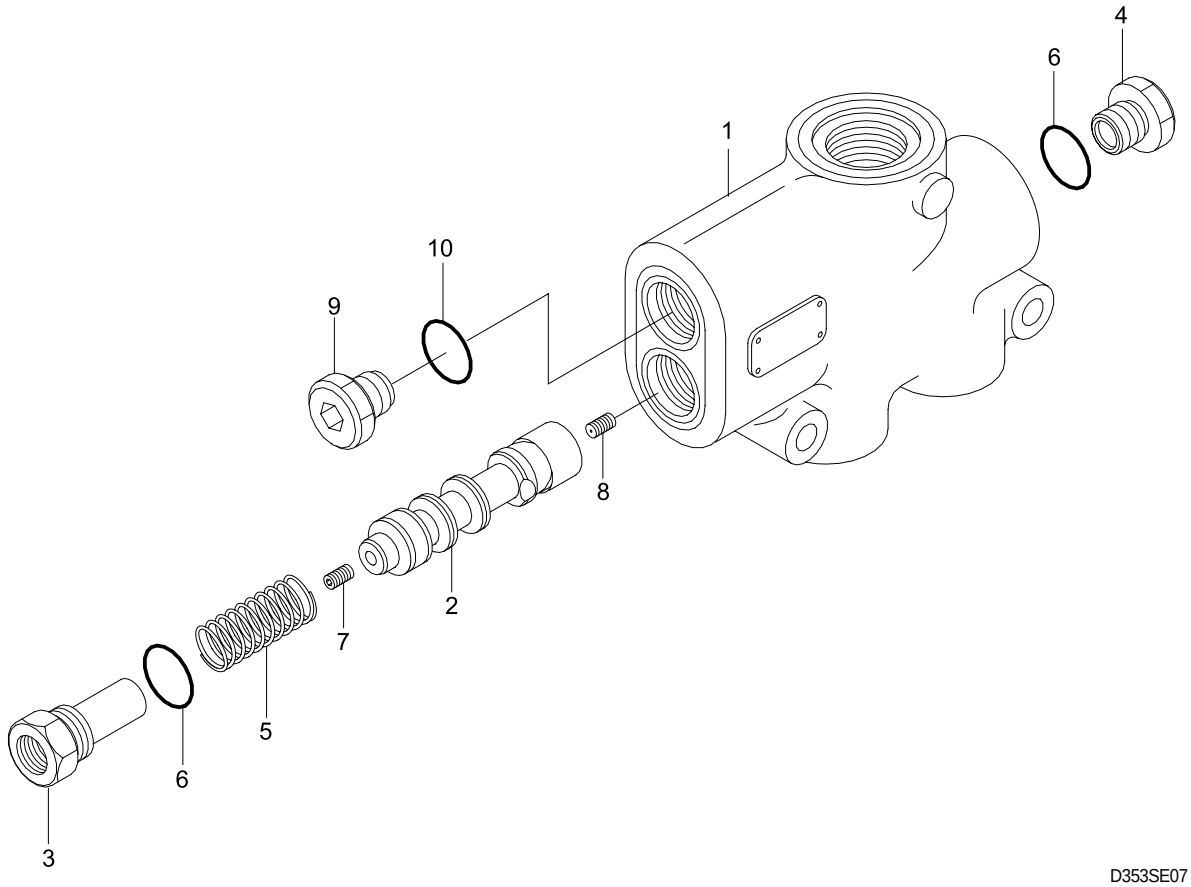
※ Do not use a hammer!



5-85(2)

## 2. PRIORITY VALVE

### 1) STRUCTURE

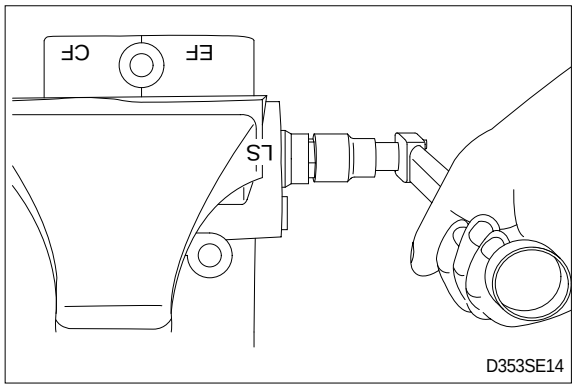



| | | | | | |
|---|---|---|---|---|---|
| 1 | Body | 5 | Spring | 9 | End plug |
| 2 | Spool | 6 | O-ring | 10 | O-ring |
| 3 | Spring plug | 7 | Orifice | | |
| 4 | End plug | 8 | Orifice | | |

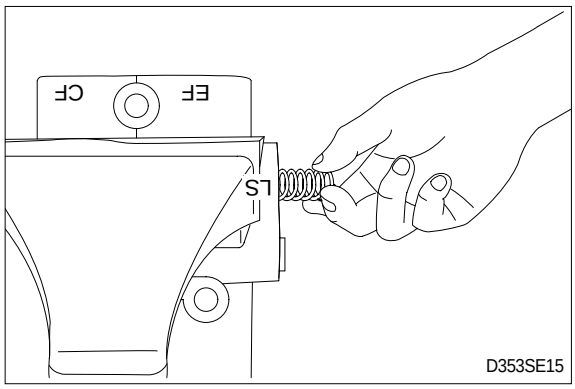
**2) DISASSEMBLY**

※ Cleanliness is the primary means of assuring satisfactory the priority valve life.
Select clean place.
Before removing the piping, clean the surrounding area of valve ports.

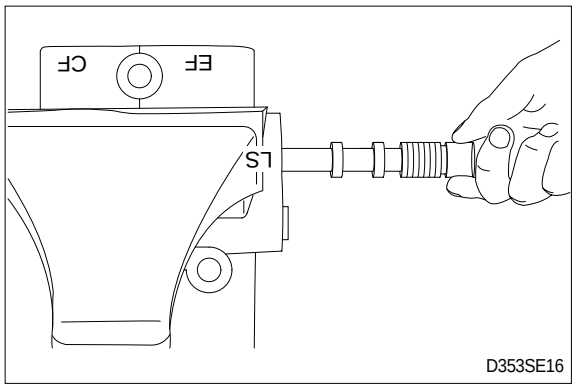
(1) Fix the body(1) in a vise with copper or lead sheets.
Do not over tighten jaws.
(2) Loosen plug(3) for LS port.



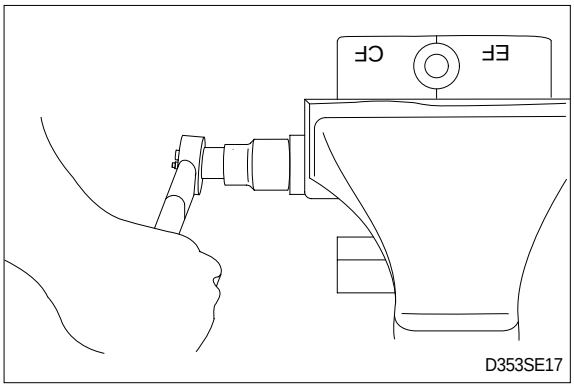

(3) Remove spring(5).




(4) Remove spool assy(2).
※ Can't remove the orifice(7) and orifice(8) from spool(2), because the orifices were locked at the spool.



(5) Remove plug(4) and separate O-ring(6) and plug(3, 4) individually.




### 3) ASSEMBLY

※ Clean all metal parts in clean solvent and blow dry with air and correct any damage, burrs and rust.

※ Do not wipe dry with cloth or paper towel.

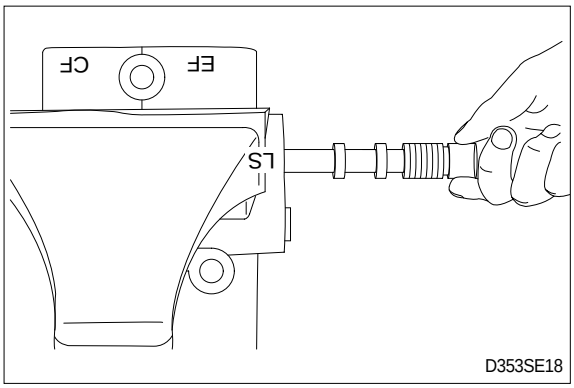
※ Replace seals such as O-ring with new ones as a rule and coat with grease.

(1) Fix the body(1) in a vise.

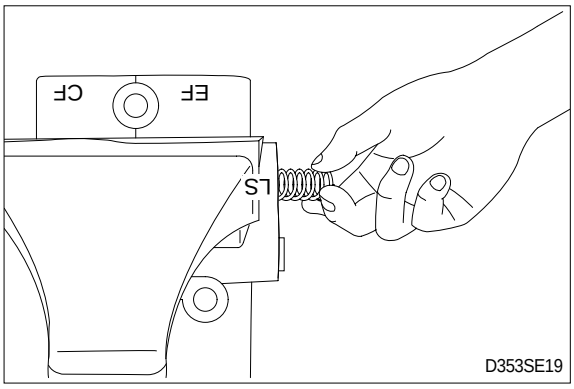
(2) Insert the spool(2).

※ Secure the spool(2) remain in their correct direction.

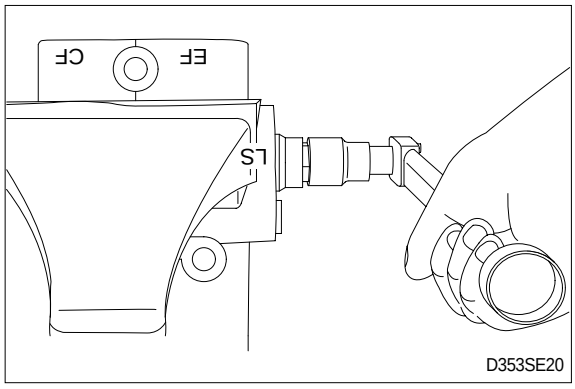
※ Secure the spool(2) to move smoothly by finger.




(3) Insert the spring(5) into the body(1).

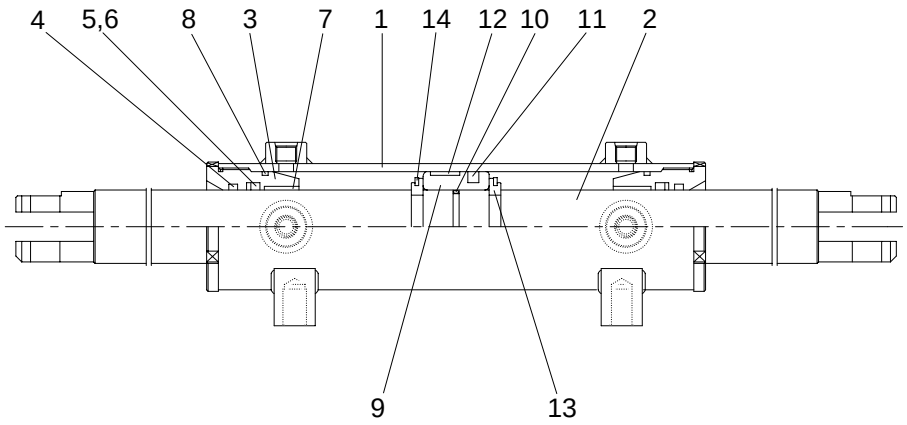


(4) Install the O-ring(6) onto plug(3, 4) and install the plug(3, 4) into the body(1).
· Tighten torque : 4.5kfg · m(32.5lbf · ft)



## 3. STEERING CYLINDER

### 1) STRUCTURE




D353SE21

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 6 | Back up ring | 11 | Piston seal |
| 2 | Rod | 7 | Bushing | 12 | Wear ring |
| 3 | Gland | 8 | O-ring | 13 | Ring |
| 4 | Dust wiper | 9 | Piston | 14 | Retaining ring |
| 5 | Rod seal | 10 | O-ring | | |

※ Specifications

- Inner diameter : 75mm
- Outer diameter : 86mm
- Stroke : 115mm
- Rod outer diameter : 50mm

### 2) DISASSEMBLY

※ Before disassembling steering cylinder, release oil in the cylinder first.

(1) Put wooden blocks against the cylinder tube, then hold in a vice.

(2) Remove the gland by hook a wrench in the notch of cylinder head and turn counter-clockwise.

(3) Remove the cylinder rod and piston from the tube.

(4) Check wear condition of the sealing parts. If there are some damage, replace with new parts.

### 3) CHECK AND INSPECTION

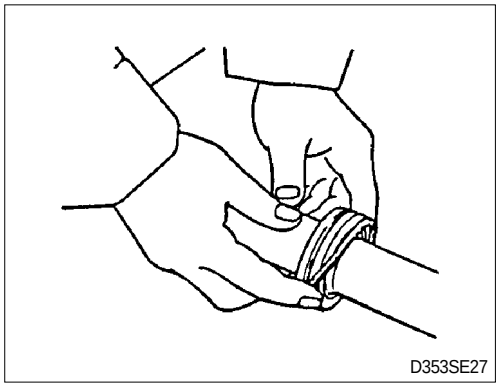
mm(in)

| Check item | Criteria | | Remedy |
|---|---|---|---|
| | Standard size | Repair limit | |
| Clearance between piston & cylinder tube | 0.064~0.137 (0.0025~0.0054) | 0.180 (0.0070) | Replace piston seal |
| Clearance between cylinder rod & bushing | 0.024~0.112 (0.0009~0.0044) | 0.120 (0.0049) | Replace bushing |
| Seals, O-ring | Damage | | Replace |
| Cylinder rod | Dents | | Replace |
| Cylinder tube | Biting | | Replace |

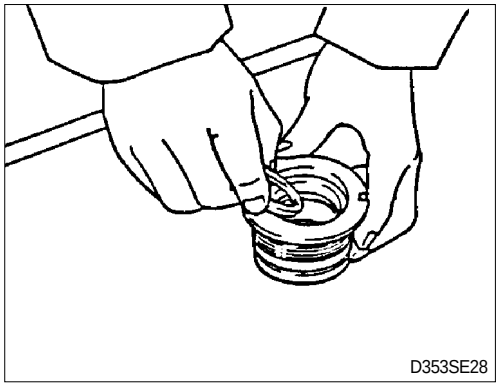
### 4) ASSEMBLY

(1) Install a new piston seal the groove on the piston.

※ Be careful not to scratch the seal too much during installation or it will not seat properly.

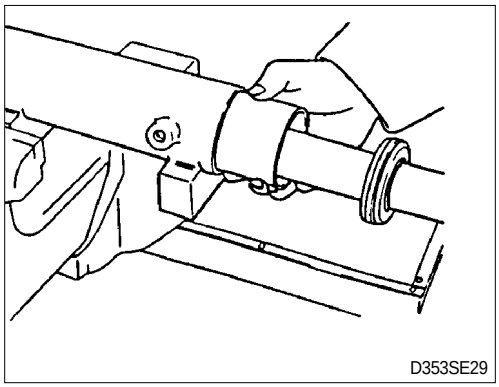

D353SE27

(2) Install the rod seal to the position in the gland applying a slight coat with grease prior to install.

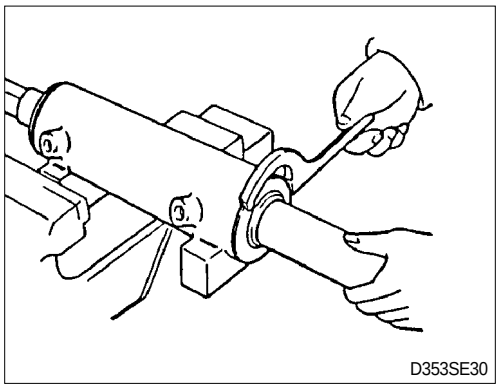

D353SE28

(3) Install the dust wiper to the gland using a special installing tool. Coat the dust wiper with grease slightly before installing.

(4) Set a special tool the cylinder, gland assembly into the cylinder tube.

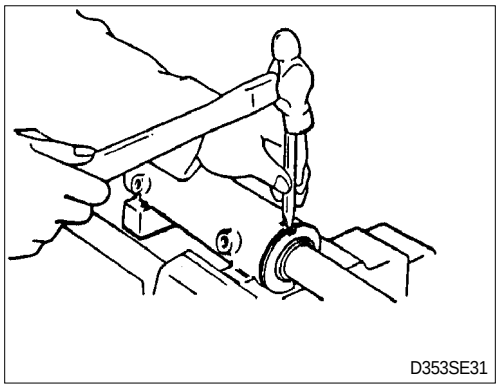

D353SE29

(5) Using a hook spanner, install the gland assembly, and tighten it with torque 40±4kgf · m (289±29lbf · ft).


D353SE30

(6) After the gland assembly was installed to the cylinder tube, calk at the tube end into the groove on the gland to prevent screw loosening.

※ If it need calking again, never using previous calking position.


D353SE31

(7) Move the piston rod back and forth several times for the full distance of its stroke. This helps to seat the ring and seals before applying full hydraulic pressure to the cylinder.

(8) Install cylinder into trail axle.

(9) While idling the engine with the rear wheels off the ground, operate the steering wheel left and right alternately.

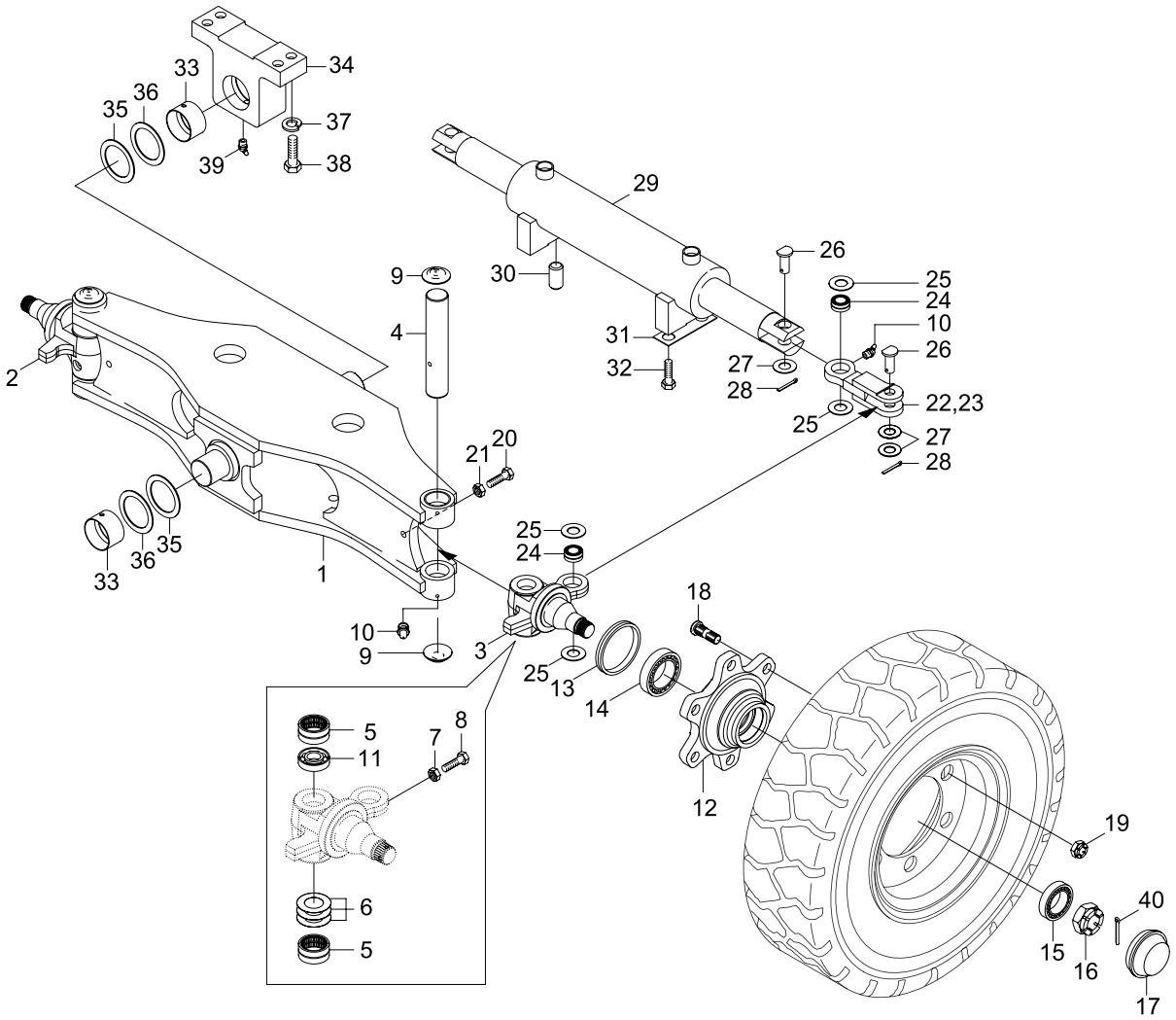
※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.

(10) Stop the engine, lower the floating rear wheels, and check pump joints for oil leaks and looseness and retighten, them as required.

## 4. TRAIL AXLE

### 1) STRUCTURE

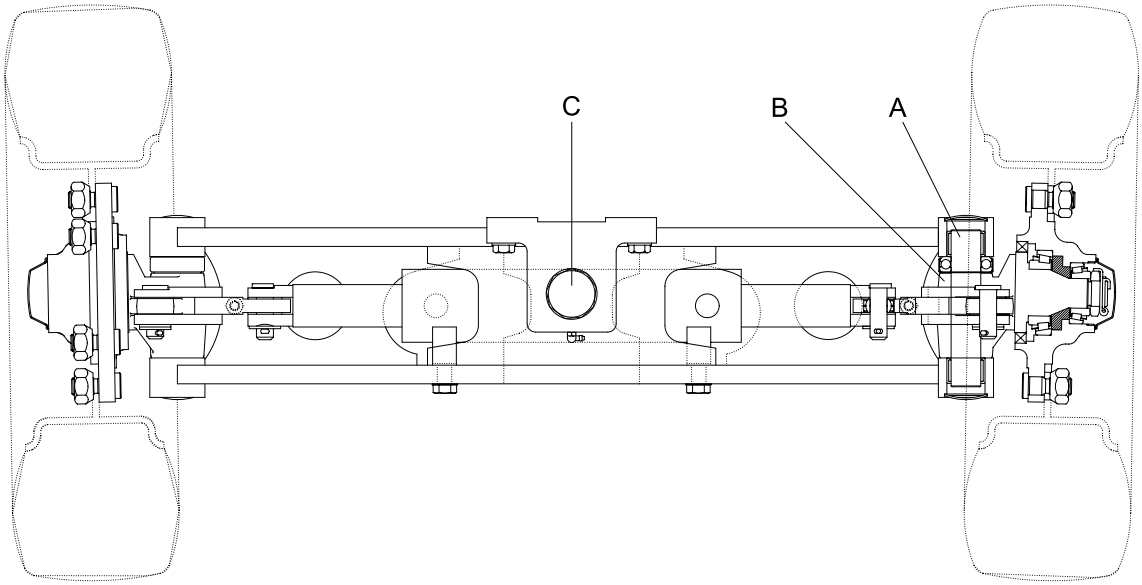
※ Do not remove the stopper bolt unless necessary.




D353SE22

| | | | | | |
|---|---|---|---|---|---|
| 1 | Trail axle | 15 | Taper roller bearing | 28 | Split pin |
| 2 | Knuckle-RH | 16 | Slot nut | 29 | Steering cylinder assy |
| 3 | Knuckle-LH | 17 | Cap | 30 | Pin |
| 4 | King pin | 18 | Serration bolt | 31 | Lock plate |
| 5 | Needle bearing | 19 | Hub nut | 32 | Hexagon bolt |
| 6 | Shim(0.2t) | 20 | Full thread bolt | 33 | Bushing |
| 7 | Special bolt | 21 | Hexagon nut | 34 | Support |
| 8 | Spring washer | 22 | Link-RH | 35 | Shim(1.0t) |
| 9 | Plug | 23 | Link-LH | 36 | Shim(0.5t) |
| 10 | Grease nipple | 24 | Spherical plain bearing | 37 | Spring washer |
| 11 | Thrust bearing | 25 | Thrust washer | 38 | Hexagon bolt |
| 12 | Hub | 26 | Clevis pin | 39 | Grease nipple |
| 13 | Seal | 27 | Plain washer | 40 | Split pin |
| 14 | Taper roller bearing | | | | |

## 2) CHECK AND INSPECTION




D353SE35

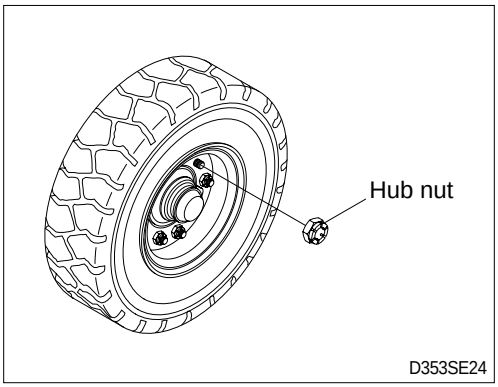
mm(in)

| No. | Check item | Criteria | | Remedy |
|---|---|---|---|---|
| | | Standard size | Repair limit | |
| A | Diameter of king pin | 35(1.38) | 34.8(1.370) | Replace |
| B | Vertical play of knuckle | - | 0.2(0.008) | Adjust with shims |
| C | Diameter of center pin | 55(2.12) | 54.5(2.1) | Replace |
| - | Rear axle, hub, knuckle, bearing | · Damage, wear<br>· Seizure, abnormal noise, defective rotation | | Replace |

### 3) DISASSEMBLY

※ Servicing work on the knuckle part can be carried out without removing the axle assy from chassis. The work can be done by jacking up the balance weight part of the truck.

(1) Loosen the hub nut and take off the steering wheel tire.




(2) Remove wheel cap.

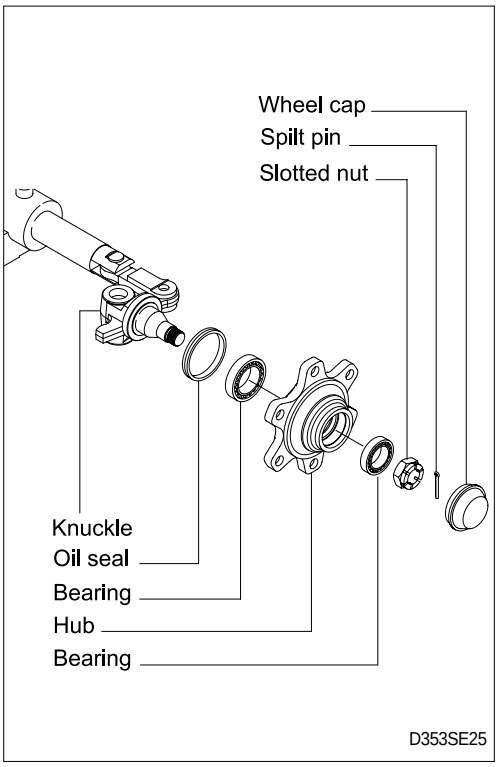
(3) Pull out split pin and remove slotted nut.

(4) Using the puller, take off the wheel hub together with the bearing.
Be very careful because just before the hub comes off, tapered roller bearing will fall out.

(5) After wheel hub is removed take off the inner race of bearing.

(6) Pull out oil seal.

※ Don't use same oil seal twice.




(7) Repeat the same procedure for the other side.
Moreover, when disassembling is completed, part the slotted nut in the knuckle to protect the threaded portion.

(8) Loosen special bolt (7) and washer (8).

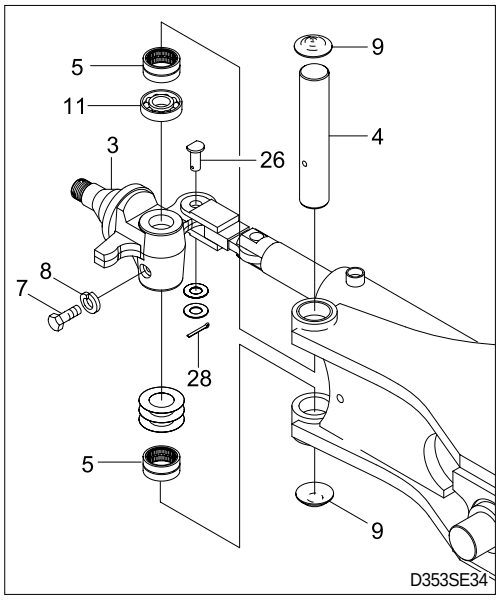
(9) Remove plug (9).

(10) Push out the king pin (4) without damaging the knuckle arm (3).

(11) Pull out the thrust bearing (11).
If defect is observed in needle bearing (5), pull it out by using extractor.

(12) Remove the spilt pin (28) and the clevis pin (26). Then, remove the knuckle arm (3).

※ Repeat the same procedure for the other side.




**4) ASSEMBLY**

※ In reassembling, have all parts washed, grease applied to lubricating parts, and all expendable items such as oil seal and spring washers replaced by new ones.

Perform the disassembly in reverse order.

(1) Tighten the special bolt(7) of king pin.

※ There is a notch in the middle of the king pin(4), make sure that this notch is on the special bolt side.

(2) Do not hammer to drive in needle bearing(5) because it will break.
Always use drive-in tool. In assembling the thrust bearing(11), be sure that the fixed ring of the bearing is placed in position facing the knuckle.

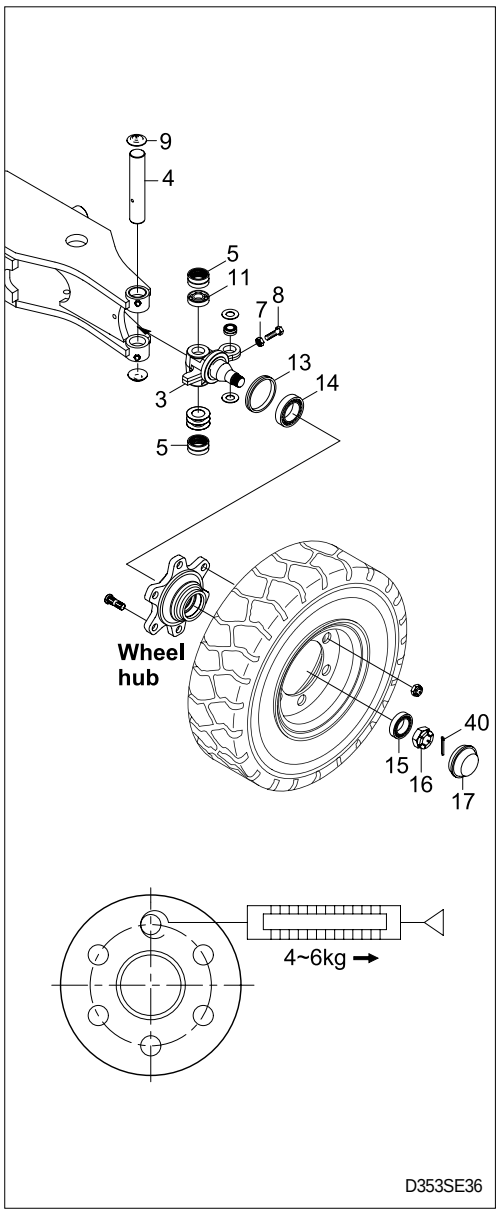
(3) Wheel hub

① Mount oil seal(13) and inner race of tapered roller bearing(14) on the knuckle(3). The bearing should be well greased before assembling.

② Install the outer race of the bearing(15) in the wheel center and assemble to the knuckle.

③ Tighten with nut(16) and locked with split pin(40). In locking with split pin, locate the hole for the split pin by turning the nut back 1/6 of a turn. Adjust the preload of bearing.

④ Mount the wheel cap(17).
Bearing should be well greased before assembling.

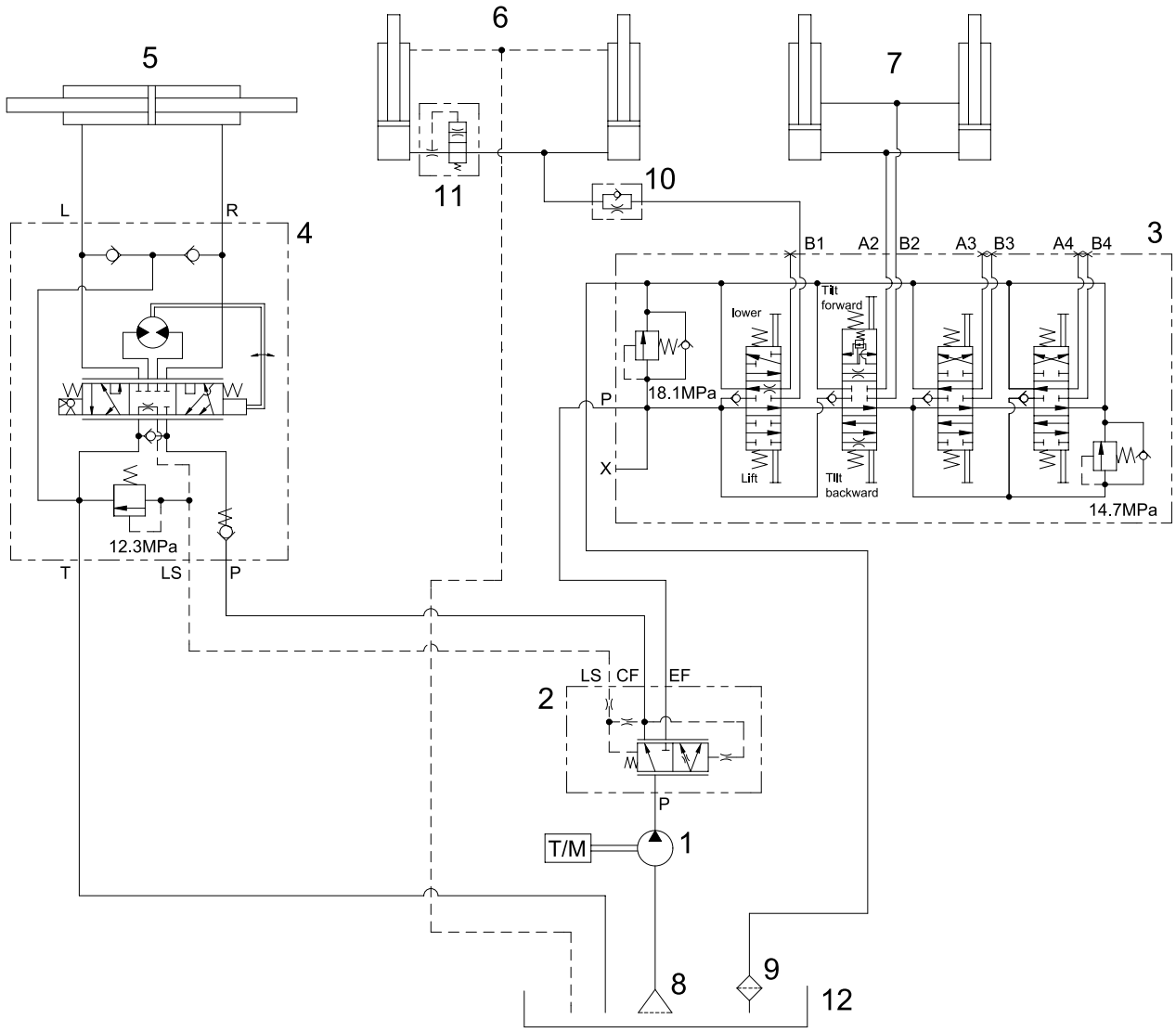


# SECTION 6 HYDRAULIC SYSTEM

# SECTION 6 HYDRAULIC SYSTEM

## GROUP 1 STRUCTURE AND FUNCTION

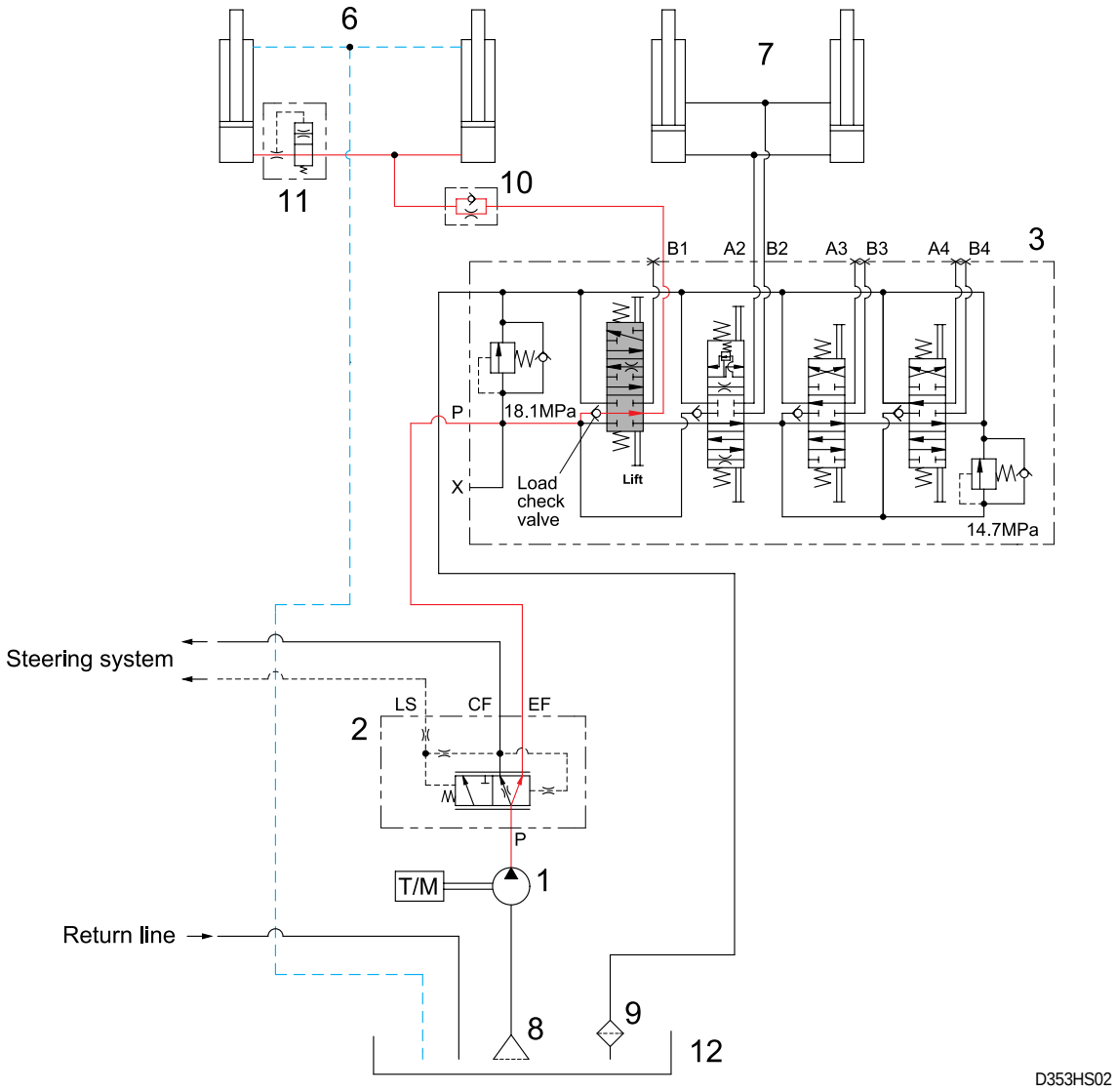
### 1. HYDRAULIC CIRCUIT




D353HS01

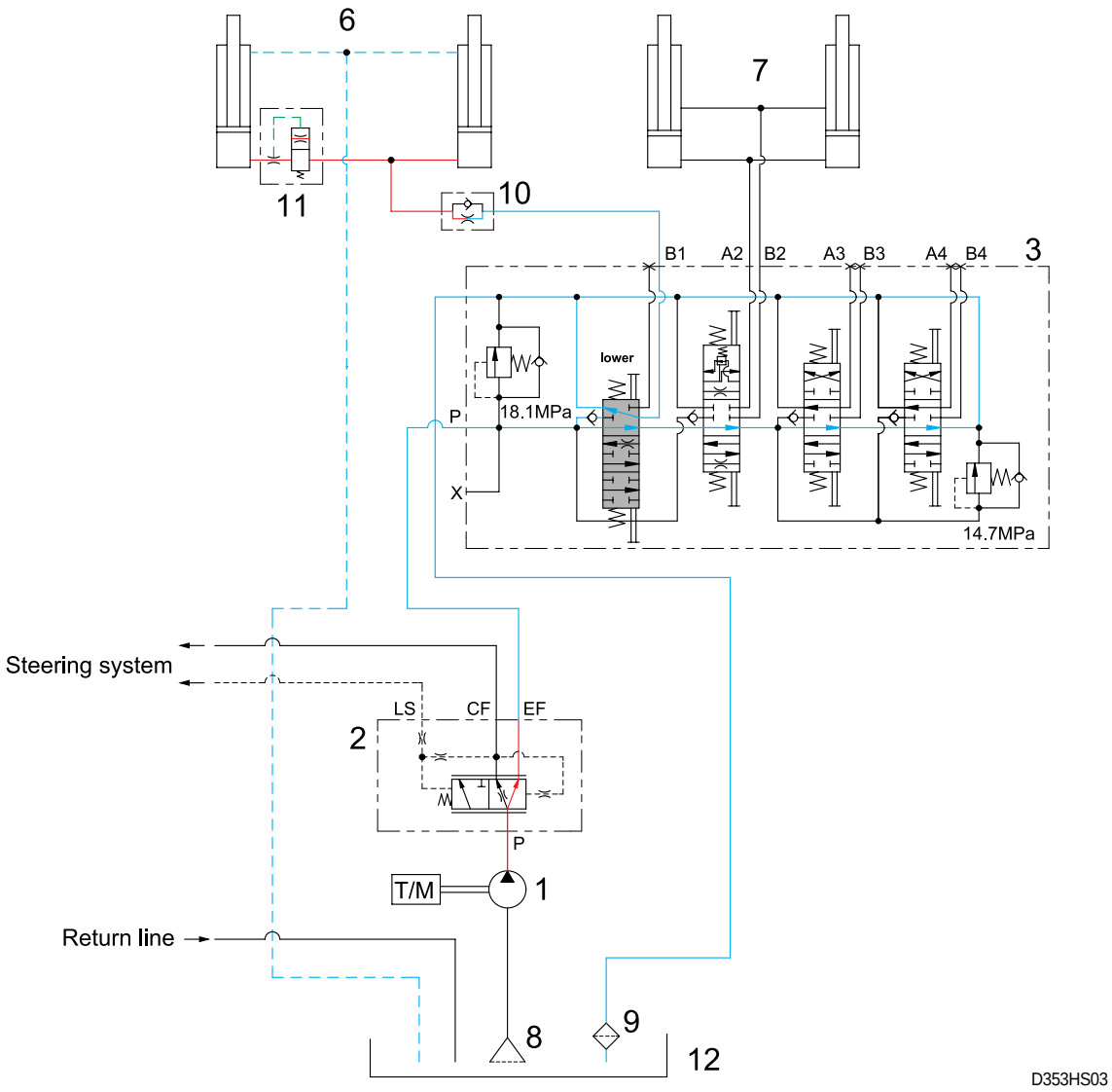
| | | | |
|---|---|---|---|
| 1 | Hydraulic gear pump | 7 | Tilt cylinder |
| 2 | Priority valve | 8 | Suction filter |
| 3 | Main control valve | 9 | Return filter |
| 4 | Steering unit | 10 | Down control valve |
| 5 | Steering cylinder | 11 | Down safety valve |
| 6 | Lift cylinder | 12 | Hydraulic tank |

## 1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



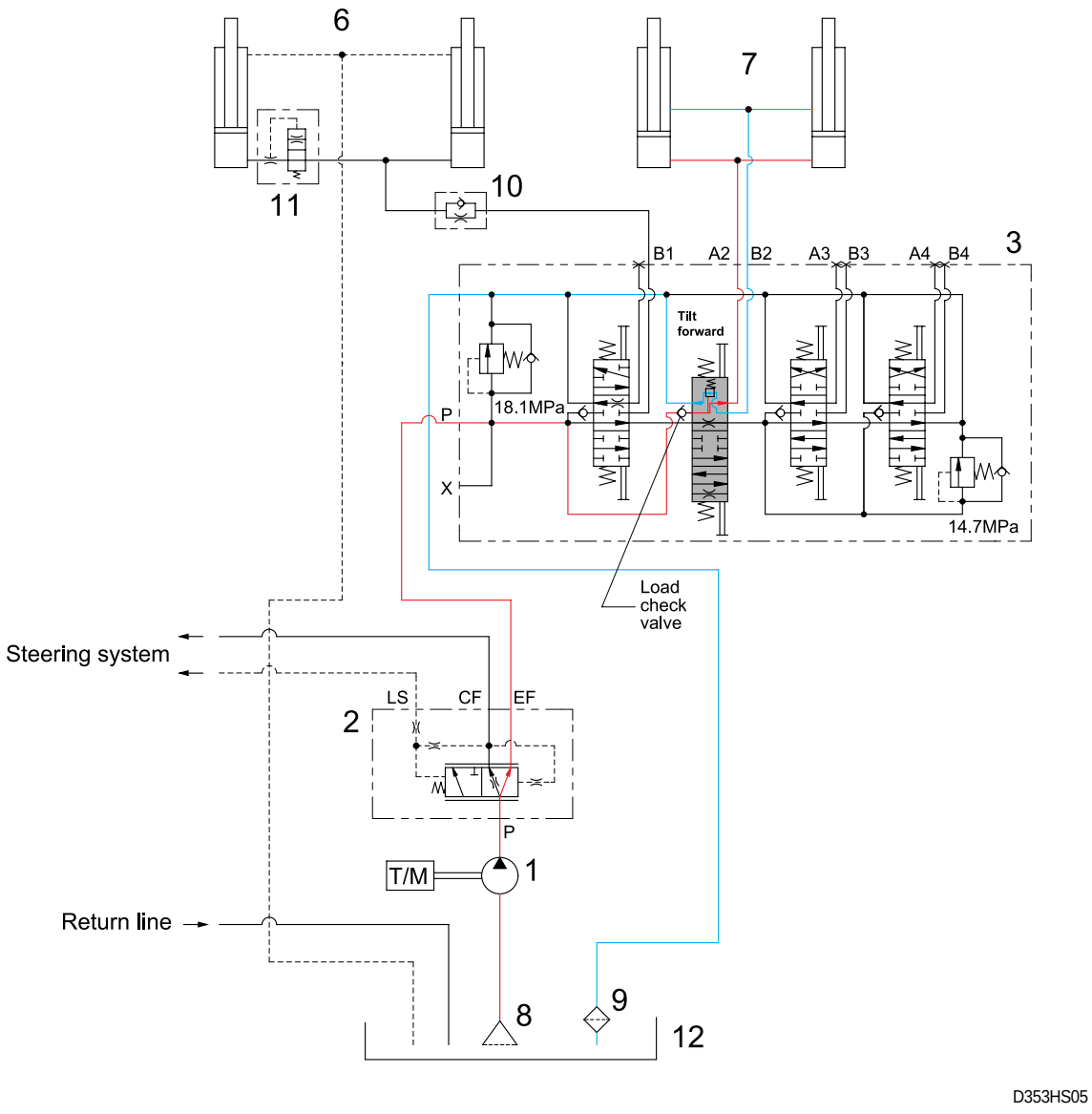

When the lift control lever is pulled back, the spool on the first block is moves to lift position.
The oil from hydraulic gear pump(1) flows into main control valve(3) and then goes to the large chamber of lift cylinder(6) by pushing the load check valve of the spool.
The oil from the small chamber of lift cylinder(6) returns to hydraulic oil tank(12) at the same time.
When this happens, the forks go up.

## 2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION




When the lift control lever is pushed forward, the spool on the first block is moved to lower position. The work port(B1) and the small chamber and the large chamber are connected to the return passage, so the lift will be lowered due to its own weight.

### 3) WHEN THE TILT CONTROL LEVER IS IN THE FORWARD POSITION



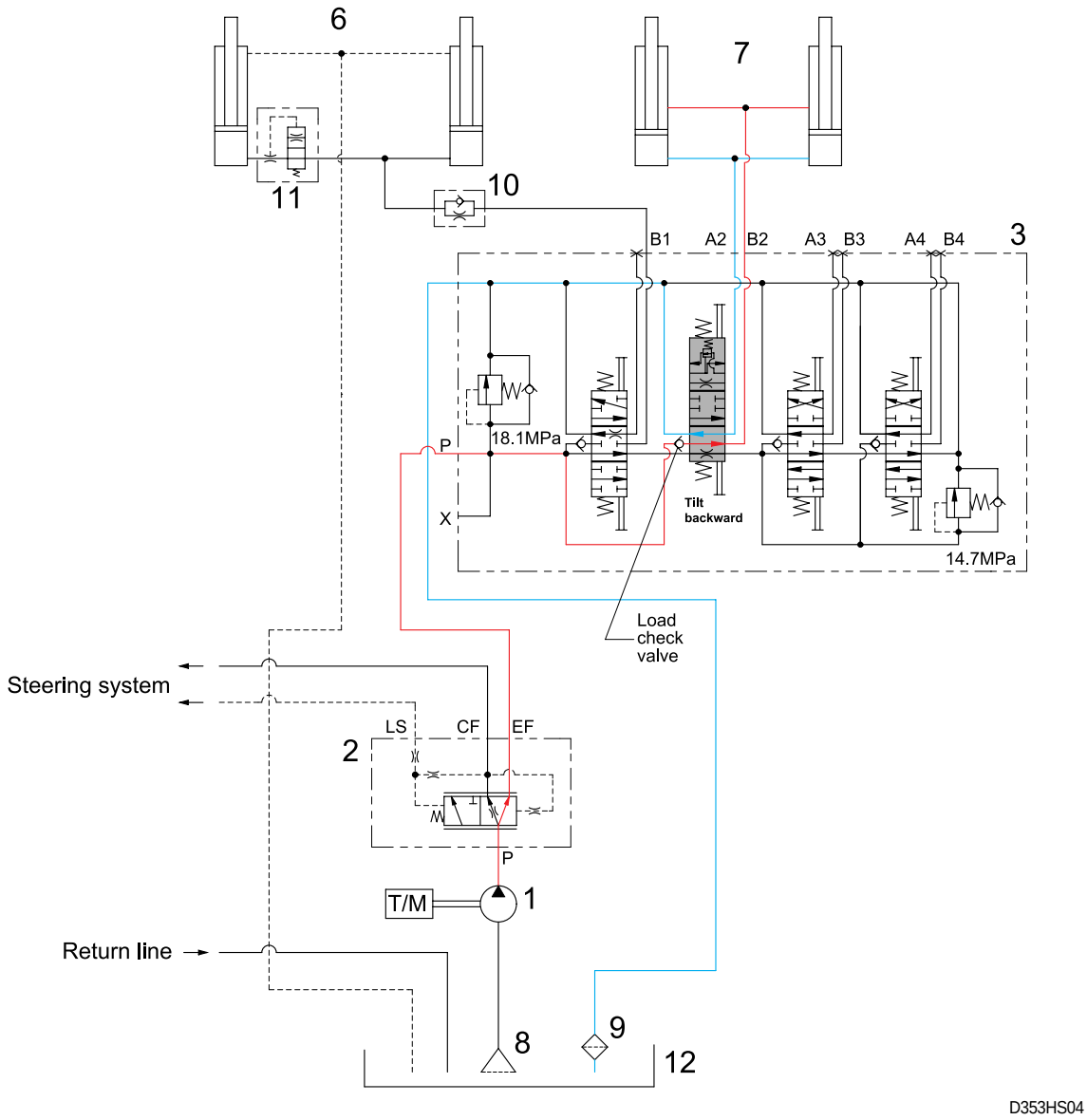

When the tilt control lever is pushed forward, the spool on the second block is moved to tilt forward position.

The oil from hydraulic gear pump(1) flows into main control valve(3) and then goes to the large chamber of tilt cylinder(7) by pushing the load check valve of the spool.

The oil at the small chamber of tilt cylinder(7) returns to hydraulic tank(12) at the same time.

When this happens, the mast tilt forward.

#### 4) WHEN THE TILT CONTROL LEVER IS IN THE BACKWARD POSITION




When the tilt control lever is pulled back, the spool on the second block is moved to tilt backward position.

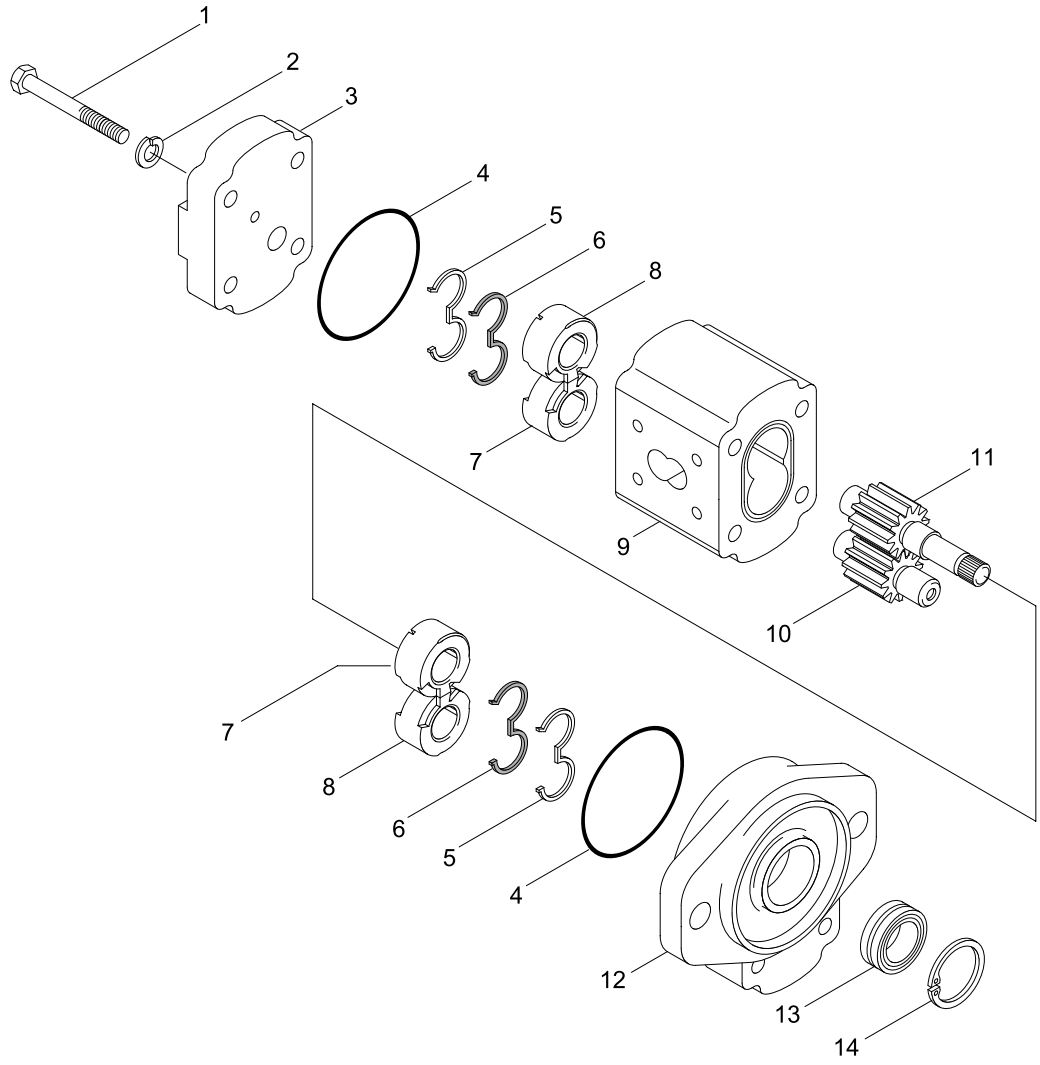
The oil from hydraulic gear pump(1) flows into main control valve(3) and then goes to the small chamber of tilt cylinder(7) by pushing the load check valve of the spool.

The oil at the large chamber of tilt cylinder(7) returns to hydraulic tank(12) at the same time.

When this happens, the mast tilt backward.

## 2. HYDRAULIC GEAR PUMP

### 1) STRUCTURE




D353HS06

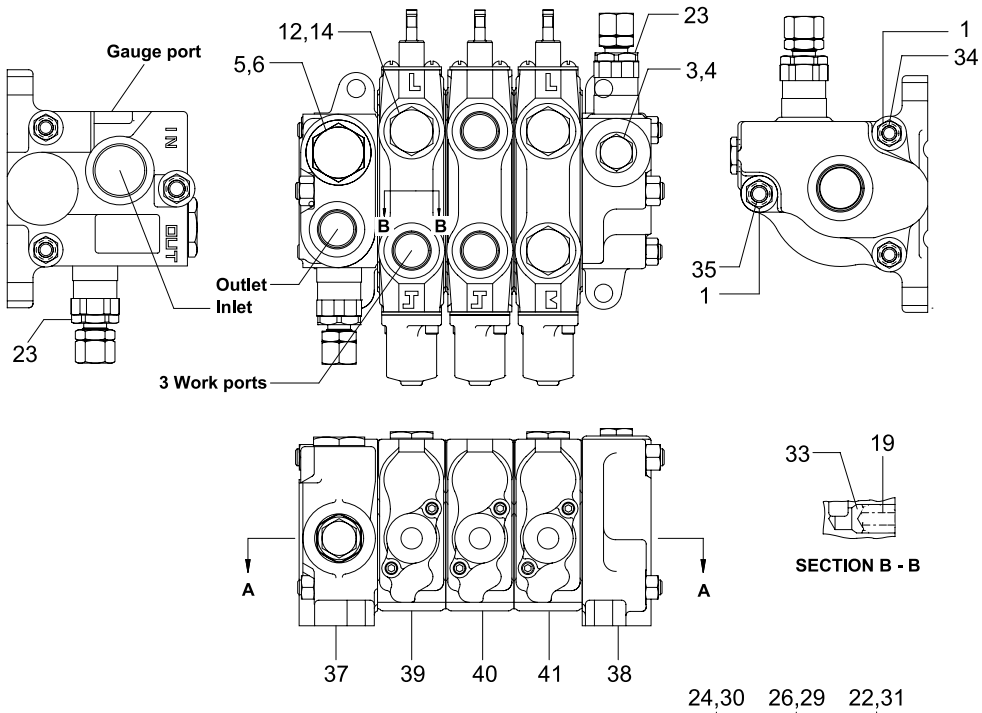
| | | | | | |
|---|---|---|---|---|---|
| 1 | Bolt | 6 | Seal | 11 | Drive gear |
| 2 | Spring washer | 7 | Bushing | 12 | Flange |
| 3 | End cover | 8 | Bushing | 13 | Shaft seal |
| 4 | O-ring | 9 | Body | 14 | Circlip |
| 5 | Back up seal | 10 | Driven gear | | |

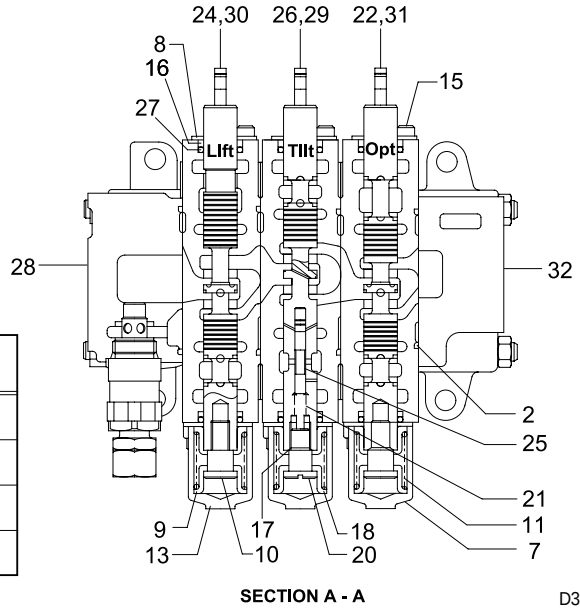
### 2) OPERATION

This pump comprised of an end cover, a body, bushings and a mounting flange bolted together with through bolts. The gear journals are supported in plane bearings within pressure balanced bushings to give high volumetric and mechanical efficiencies.

## 3. MAIN CONTROL VALVE

### 1) STRUCTURE (3 Spool)



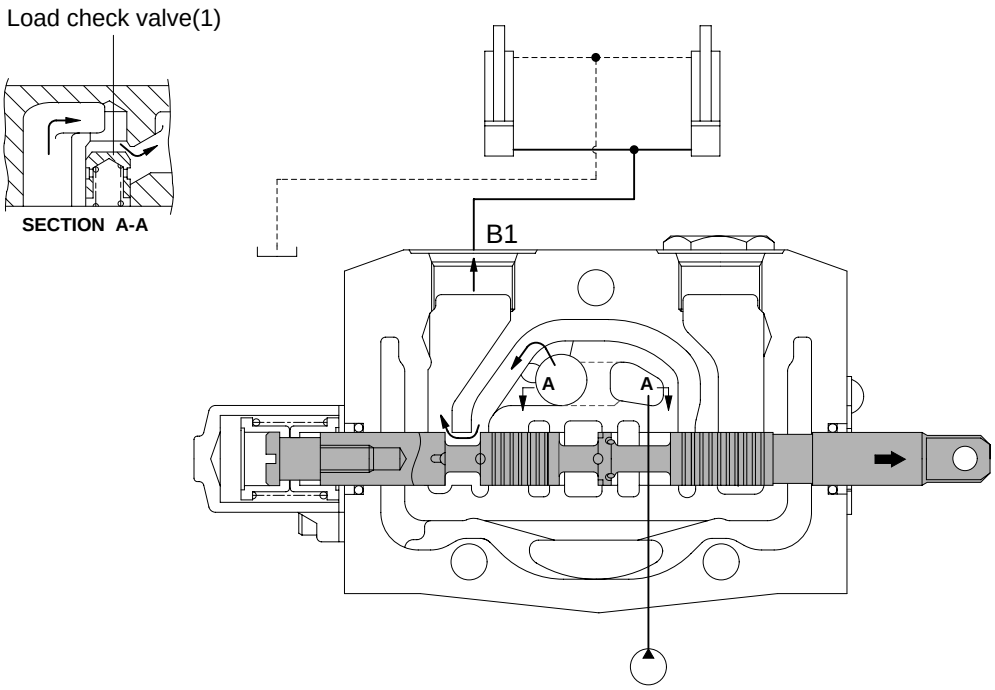

D353HS07

| Port name | Size |
|---|---|
| Inlet port | 1-5/16-12UN |
| Outlet port | 1-5/16-12UN |
| Gauge port | PF1/4 |
| Work port | 1-1/16-12UN |

| | | | | | |
|---|---|---|---|---|---|
| 1 | Special nut | 15 | Screw | 29 | Spool housing |
| 2 | O-ring | 16 | Wiper | 30 | Spool housing |
| 3 | Plug | 17 | O-ring | 31 | Spool housing |
| 4 | O-ring | 18 | Spring seat | 32 | Outlet housing |
| 5 | O-ring | 19 | Spring | 33 | Puppet |
| 6 | Plug | 20 | Spool end | 34 | Tie rod |
| 7 | Spool cap | 21 | Spring | 35 | Tie rod |
| 8 | Seal plate | 22 | Spool | 36 | Special nut |
| 9 | Spring seat | 23 | Main relief valve | 37 | Inlet section assy |
| 10 | Spool end | 24 | Spool | 38 | Outlet section assy |
| 11 | Spring | 25 | Piston | 39 | Spool section assy |
| 12 | O-ring | 26 | Spool | 40 | Spool section assy |
| 13 | Cap screw | 27 | O-ring | 41 | Spool section assy |
| 14 | Plug | 28 | Inlet housing | | |

## 2) LIFT SECTION OPERATION

### (1) Lift position




D353HS08

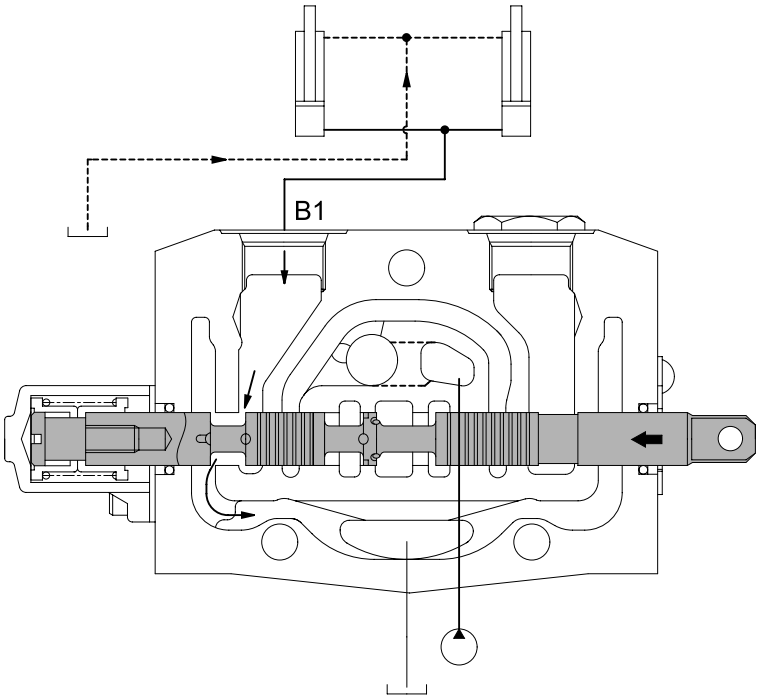
When the lift control lever is pulled back, the spool moves to the right and the neutral passage is closed.

The oil supplied from the pump pushes up the load check valve(1) and flow into lift cylinder port(B1).

The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.

The return oil from cylinder flows into the tank.

**(2) Lower position**

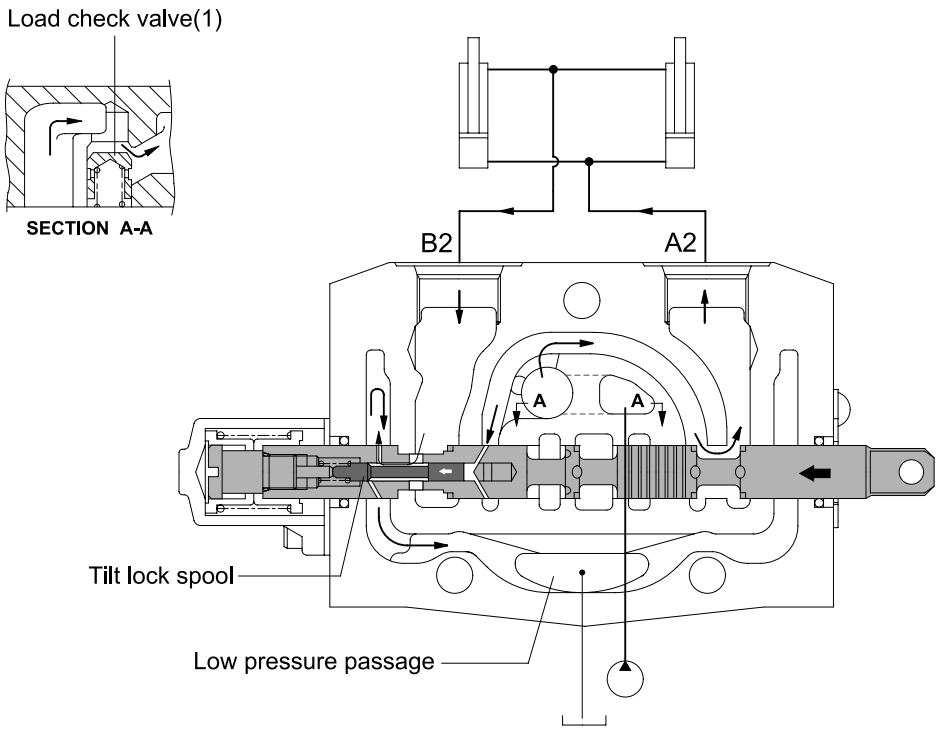



D353HS09

When the lift control lever is pushed forward, the spool moves to the left and the neutral passage is closed.
The spool moves to the lift lower position, opening up the neutral passage to tank and (B1)→T.
In lift lower position the fork drops due to its own weight.

### 3) TILT SECTION OPERATION

#### (1) Tilt forward position




D353HS10

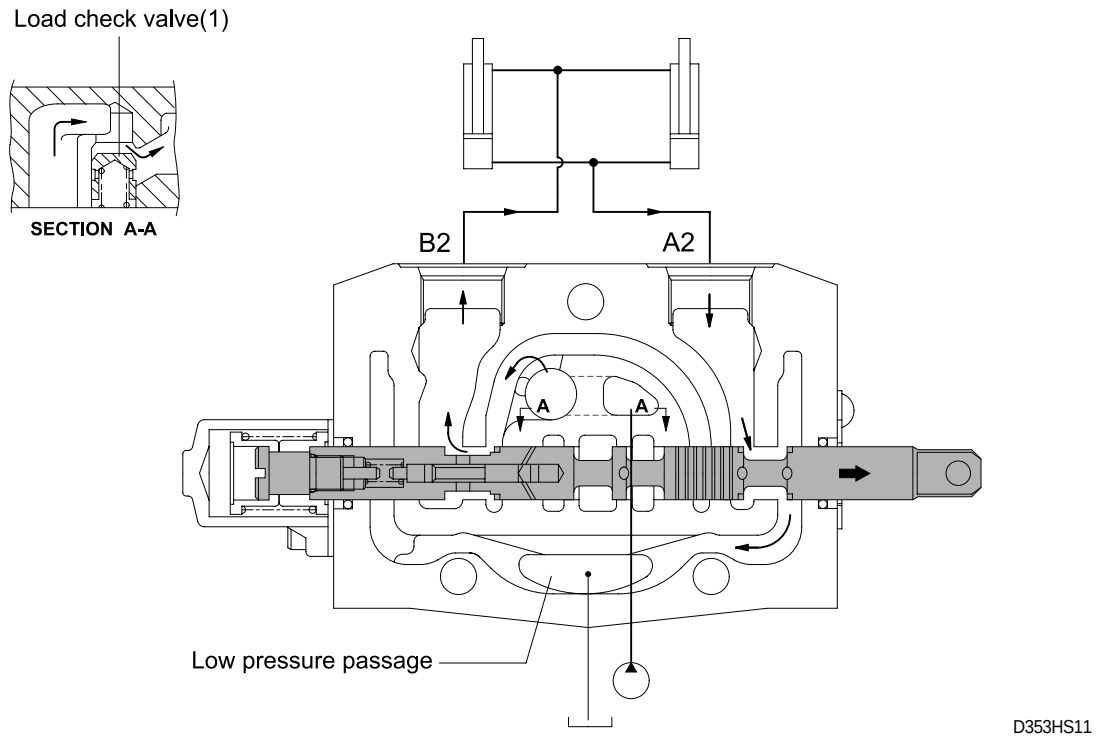
When the tilt control lever is pushed forward, the spool moves to the left and the neutral passage is closed.

The oil supplied from the pump pushes up the load check valve(1) and flow into tilt cylinder port(A2).

The pump pressure reaches proportionally the load of cylinders and fine control finished by closing the neutral passage.

The return oil from cylinder port(B2) flows into the tank through the hole of the tilt lock spool.

**(2) Tilt backward position**




When the tilt control lever is pulled back, the spool moves to the right and the neutral passage is closed.

The oil supplied from the pump pushes up the load check valve(1) and flows into tilt cylinder port(B2). The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.

The return oil from cylinder port(A2) flows into the tank via the low pressure passage.

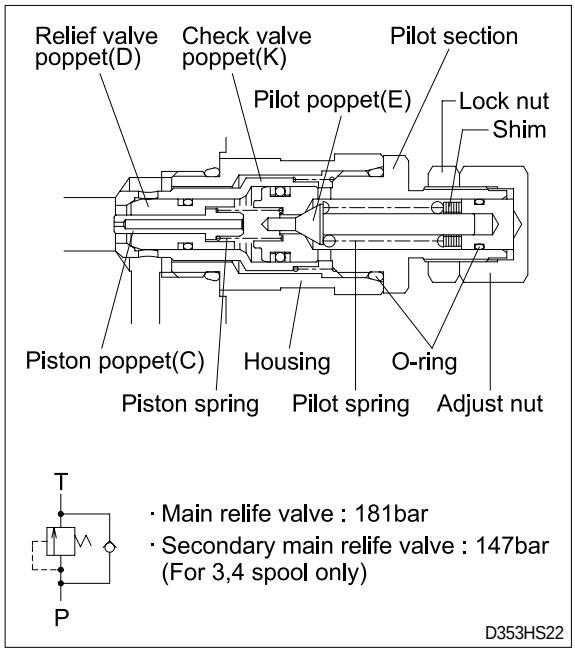
### 4) MAIN RELIEF VALVE

#### (1) Pressure setting

A good pressure gage must be installed in the line which is in communication with the work port relief. A load must be applied in a manner to reach the set pressure of the relief unit.

**Procedure**

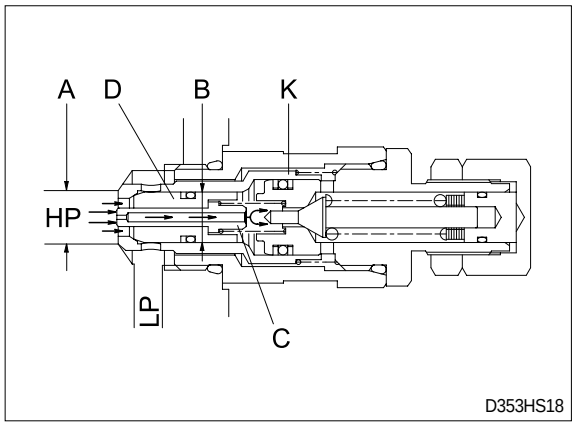
① Loosen lock nut.
② Set adjusting nut to desired pressure setting.
③ If desired pressure setting cannot be achieved, add or remove shims as required.
④ Tighten lock nut.
⑤ Retest in similar manner as above.



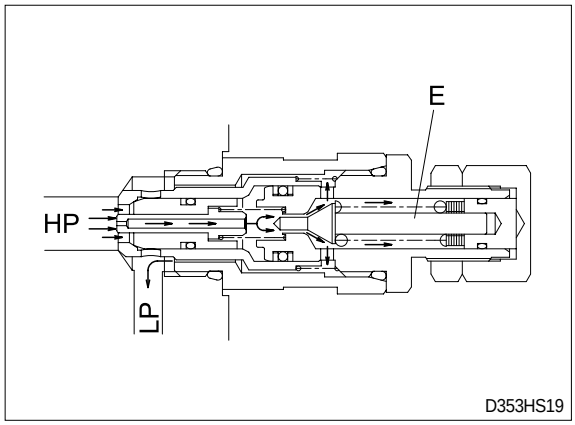

#### (2) Function

① **As work port relief**

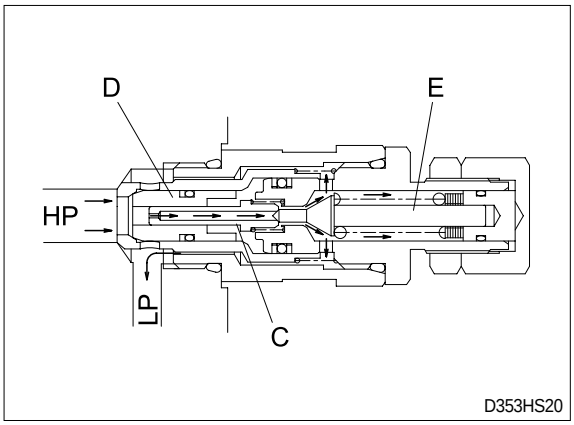
The relief valve is in communication between the high pressure port HP and low pressure LP. Oil is admitted through the hole in puppet C and because of the differential area between diameters A and B relief valve puppet D and check valve puppet K are tightly seated as shown.



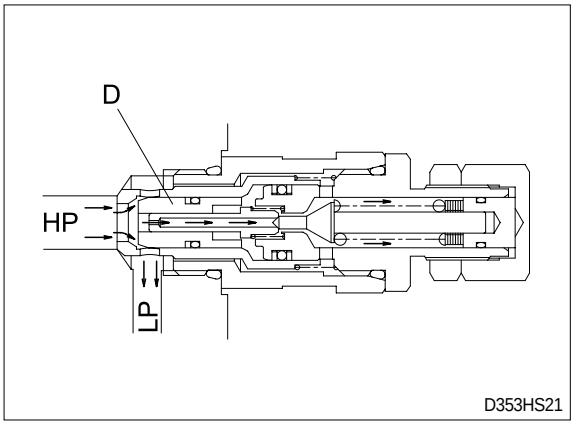

The oil pressure in the high pressure port HP has reached the setting of the pilot puppet spring force and unseats the pilot puppet E and oil flows around the puppet through the cross drilled holes and to the low pressure area LP.



The loss of oil behind puppet C, effected by the opening of pilot puppet E, causes puppet C to move back and seat against pilot puppet E. This shuts off the oil flow to the area behind relief valve puppet D, and causes a low pressure area internally.

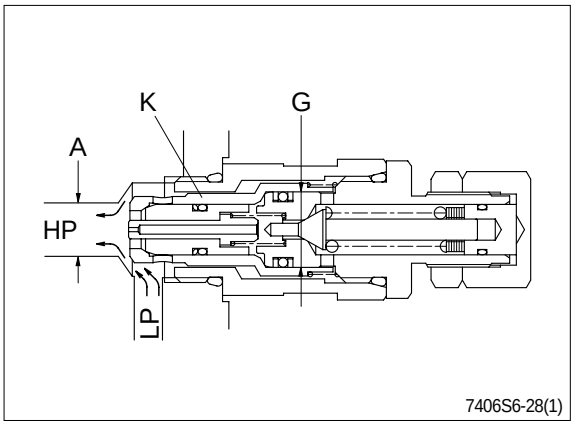



The imbalance of pressure on the inside as compared to that of the high pressure port HP, forces the relief valve puppet D to open and relieve the oil directly to the low pressure chamber LP in the valve.

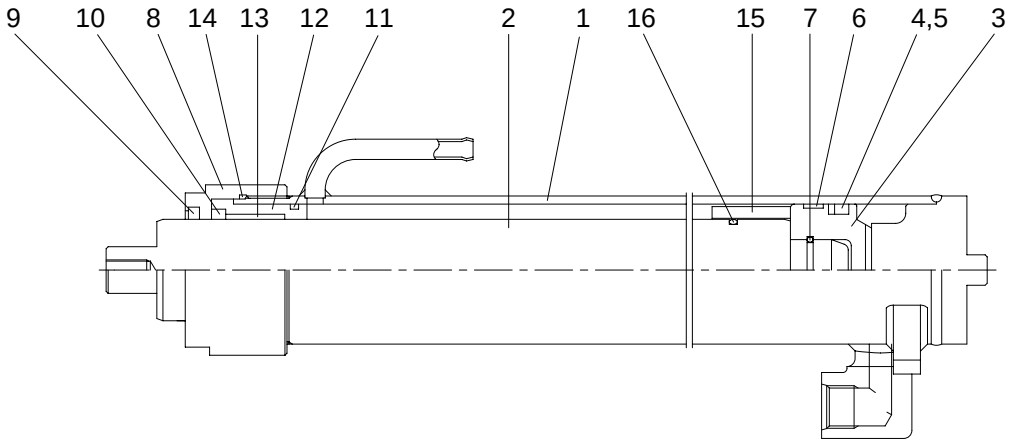



② **As anti void**

The anti-void unit supplies oil to the high pressure port HP when cavitation has occurred. A lower pressure exists in the port HP compared to the low pressure chamber LP. The difference between the effective area of diameter A and G causes imbalance of the check valve puppet K which unseats, thus allowing oil from the low pressure chamber LP to enter the port HP and fill the void.



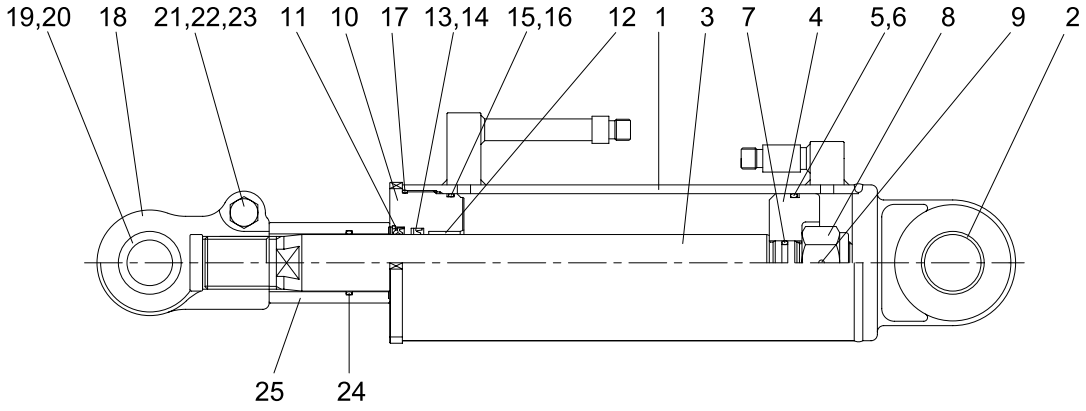
## 4. LIFT CYLINDER




D353HS12

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 7 | Retaining ring | 12 | Guide |
| 2 | Rod | 8 | Gland | 13 | Bushing |
| 3 | Piston | 9 | Dust wiper | 14 | O-ring |
| 4 | Piston seal | 10 | Rod seal | 15 | Spacer |
| 5 | Back up ring | 11 | O-ring | 16 | O-ring |
| 6 | Wear ring | | | | |

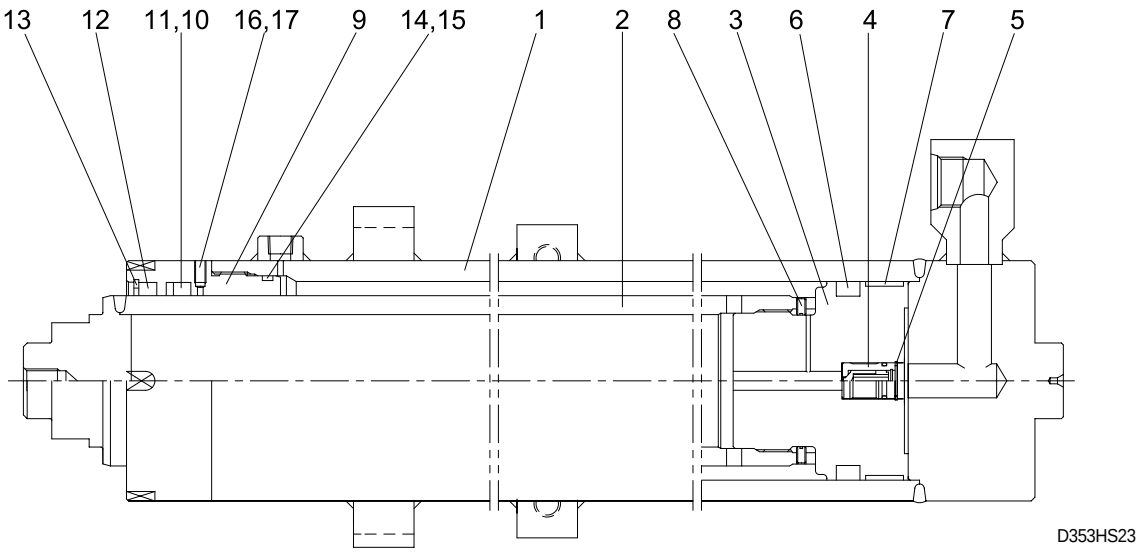
## 5. TILT CYLINDER




D353HS13

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 10 | Gland | 18 | Rod eye |
| 2 | Bushing | 11 | Dust wiper | 19 | Spherical bearing |
| 3 | Rod | 12 | Bushing | 20 | Retaining ring |
| 4 | Piston | 13 | Rod seal | 21 | Hexagon bolt |
| 5 | O-ring | 14 | Back up ring | 22 | Spring washer |
| 6 | Back up ring | 15 | O-ring | 23 | Hexagon nut |
| 7 | O-ring | 16 | Back up ring | 24 | O-ring (opt, 6/6 ˚) |
| 8 | Lock nut | 17 | O-ring | 25 | Spacer (opt, 6/6 ˚) |
| 9 | Spring pin | | | | |

## 6. FREE LIFT CYLINDER




| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assembly | 7 | Wear ring | 13 | Retaining ring |
| 2 | Rod assembly | 8 | Set screw | 14 | O-ring |
| 3 | Piston | 9 | Gland | 15 | Back up ring |
| 4 | Check valve | 10 | U-Packing | 16 | Steel ball |
| 5 | Retaining ring | 11 | Back up ring | 17 | Set screw |
| 6 | Piston seal | 12 | Dust wiper | | |

# GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

## 1. OPERATIONAL CHECKS

### 1) CHECK ITEM

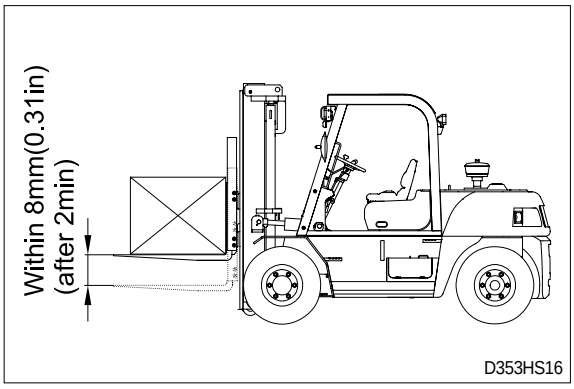
(1) Check visually for deformation, cracks or damage of rod.

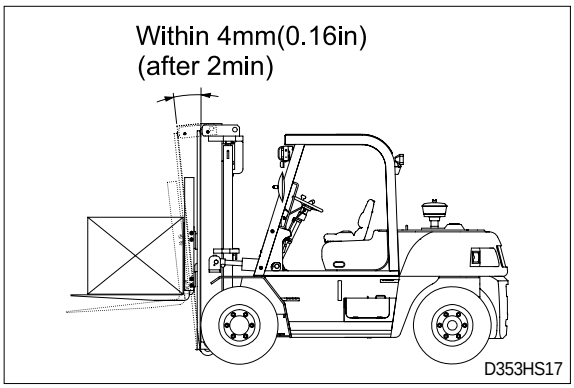
(2) Load maximum load, set mast vertical and raise 1m from ground. Wait for 2 minutes and measure hydraulic drift(amount forks move down and amount mast tilts forward).

· **Hydraulic drift**

- Down(Downward movement of forks)
  : Within 8mm(0.31in)
- Forward(Extension of tilt cylinder)
  : Within 4mm(0.16in)

If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.




(3) Check that clearance between tilt cylinder bushing and mounting pin is within standard range.

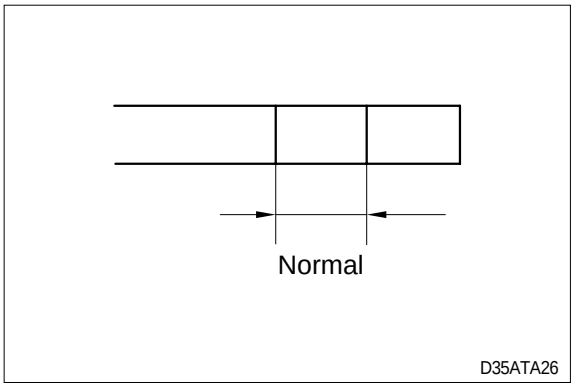
mm (in)

| | |
|---|---|
| Standard | Under 0.6 (0.02) |

### 2) HYDRAULIC OIL

(1) Using dipstick, measure oil level, and oil if necessary.

(2) When changing hydraulic oil, clean suction strainer(screwed into outlet port pipe) and line filter(screwed into inlet pipe). Line filter uses paper element, so replace periodically(every 6 months or 1200 hours)




### 3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil pressure.

Check that oil pressure is 180 - 185kgf/cm$^2$.

(2560 - 2631psi)

## 2. TROUBLESHOOTING

### 1) SYSTEM

| Problem | cause | Remedy |
|---|---|---|
| Large fork lowering speed. | · Seal inside control valve defective.<br>· Oil leaks from joint or hose.<br>· Seal inside cylinder defective. | · Replace spool or valve body.<br>· Replace.<br>· Replace packing. |
| Large spontaneous tilt of mast. | · Tilting backward : Check valve defective.<br>· Tilting forward : tilt lock valve defective.<br>· Oil leaks from joint or hose.<br>· Seal inside cylinder defective. | · Clean or replace.<br>· Clean or replace.<br>· Replace.<br>· Replace seal. |
| Slow fork lifting or slow mast tilting. | · Lack of hydraulic oil.<br>· Hydraulic oil mixed with air.<br>· Oil leaks from joint or hose.<br>· Excessive restriction of oil flow on pump suction side.<br>· Relief valve fails to keep specified pressure.<br>· Poor sealing inside cylinder.<br>· High hydraulic oil viscosity.<br>· Mast fails to move smoothly.<br>· Oil leaks from lift control valve spool.<br>· Oil leaks from tilt control valve spool. | · Add oil.<br>· Bleed air.<br>· Replace.<br>· Clean filter.<br>· Adjust relief valve.<br>· Replace packing.<br>· Change to SAE10W, class CD engine oil.<br>· Adjust roll to rail clearance.<br>· Replace spool or valve body.<br>· Replace spool or valve body. |
| Hydraulic system makes abnormal sounds. | · Excessive restriction of oil flow pump suction side.<br>· Gear or bearing in hydraulic pump defective. | · Clean filter.<br>· Replace gear or bearing. |
| Control valve lever is locked | · Foreign matter jammed between spool and valve body.<br>· Valve body defective. | · Clean.<br>· Tighten body mounting bolts uniformly. |
| High oil temperature. | · Lack of hydraulic oil.<br>· High oil viscosity.<br>· Oil filter clogged. | · Add oil.<br>· Change to SAE10W, class CD engine oil.<br>· Clean filter. |

### 2) HYDRAULIC GEAR PUMP

| Problem | Cause | Remedy |
|---|---|---|
| Pump does not develop full pressure. | · System relief valve set too low or leaking.<br>· Oil viscosity too low.<br>· Pump is worn out. | · Check system relief valve for proper setting.<br>· Change to proper viscosity oil.<br>· Repair or replace pump. |
| Pump will not pump oil. | · Reservoir low or empty.<br>· Suction strainer clogged. | · Fill reservoir to proper level.<br>· Clean suction strainer. |
| Noisy pump caused by cavitation. | · Oil too thick.<br>· Oil filter plugged.<br>· Suction line plugged or too small. | · Change to proper viscosity.<br>· Clean filters.<br>· Clean line and check for proper size. |
| Oil heating. | · Oil supply low.<br>· Contaminated oil.<br>· Setting of relief valve too high or too low.<br>· Oil viscosity too low. | · Fill reservoir to proper level.<br>· Drain reservoir and refill with clean oil.<br>· Set to correct pressure.<br>· Drain reservoir and fill with proper viscosity. |
| Foaming oil. | · Low oil level.<br>· Air leaking into suction line.<br>· Wrong kind of oil. | · Fill reservoir to proper level.<br>· Tighten fittings, check condition of line.<br>· Drain reservoir, fill with non-foaming oil. |
| Shaft seal leakage. | · Worn shaft seal.<br>· Worn shaft in seal area. | · Replace shaft seal.<br>· Replace drive shaft and seal. |

### 3) MAIN RELIEF VALVE

| Problem | Cause | Remedy |
|---|---|---|
| Can't get pressure | · Poppet D, E or K stuck open or contamination under seat. | · Check for foreign matter between poppets D, E or K and their mating parts. Parts must slide freely. |
| Erratic pressure | · Pilot poppet seat damaged.<br>· Poppet C sticking in D. | · Replace the relief valve.<br>· Clean and remove surface marks for free movement. |
| Pressure setting not correct | · Normal wear. Lock nut & adjust screw loose. | · See *How to set pressure on work main relief. |
| Leaks | · Damaged seats.<br>· Worn O-rings.<br>· Parts sticking due to contamination. | · Replace the relief valve.<br>· Install seal and spring kit.<br>· Disassemble and clean. |

★ A good pressure gauge must be installed in the line which is in communication with the main relief. A load must be applied in a manner to reach the set pressure of the main relief unit.
Then, follow these steps:

- Loosen lock nut.
- Set adjusting nut to desired pressure setting.
- If desired pressure setting cannot be achieved, add or remove shims as required.
- Tighten lock nut.
- Retest in similar manner as above.

### 4) LIFT CYLINDER

| Problem | Cause | Remedy |
|---|---|---|
| Oil leaks out from gland through rod. | · Foreign matters on packing.<br>· Unallowable score on rod.<br>· Unusual distortion of dust seal.<br>· Chrome plating is striped. | · Replace packing.<br>· Smooth rod surface with an oil stone.<br>· Replace dust seal.<br>· Replace rod. |
| Oil leaks out from cylinder gland thread. | · O-ring damaged. | · Replace O-ring. |
| Rod spontaneously retract. | · Scores on inner surface of tube.<br>· Unallowable score on the inner suface of tube.<br>· Foreign matters in piston seal. | · Smooth rod surface with an oil stone.<br>· Replace cylinder tube.<br>· Replace piston seal. |
| Wear(clearance between cylinder tube and wear ring) | · Excessive clearance between cylinder tube and wear ring. | · Replace wear ring. |
| Abnormal noise is produced during tilting operation. | · Insufficient lubrication of anchor pin or worn bushing and pin.<br>· Bent tilt cylinder rod. | · Lubricate or replace.<br>· Replace. |

## GROUP 3 DISASSEMBLY AND ASSEMBLY

### 1. HYDRAULIC GEAR PUMP

※ **Tools required**

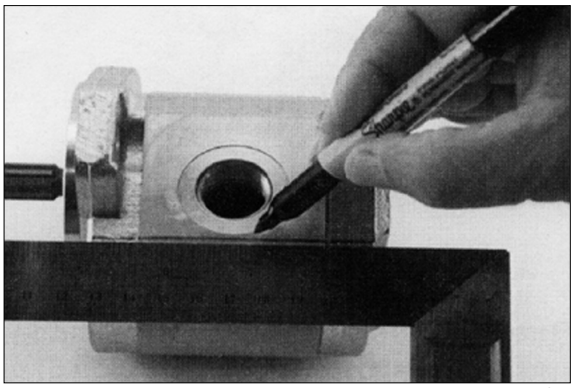
- Metric socket set
- Internal snap ring pliers
- Shaft seal sleeve
- Torque wrench : 13.8 kgf · m (100lbf · ft)

(1) It is very important to work in a clean work area when repairing hydraulic products. Plug ports and wash exterior of pump with a proper cleaning solvent before continuing.

(2) Remove port plugs and drain oil from pump.

(3) Use a permanent marker pen to mark a line across the mounting flange, gear housing and end cover. This will assure proper reassembly and rotation of pump.

(4) Remove key from drive shaft if applicable.

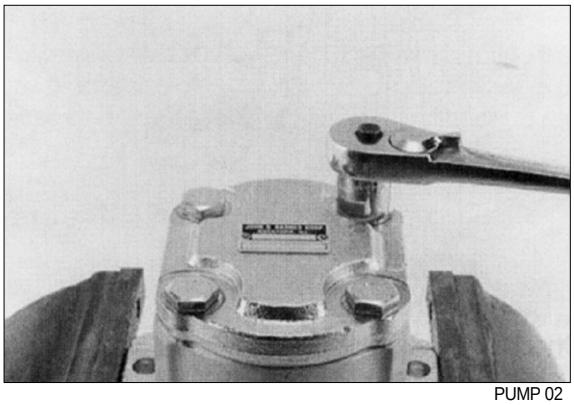


PUMP 01

(5) Clamp mounting flange in a protected jaw vise with pump shaft facing down.

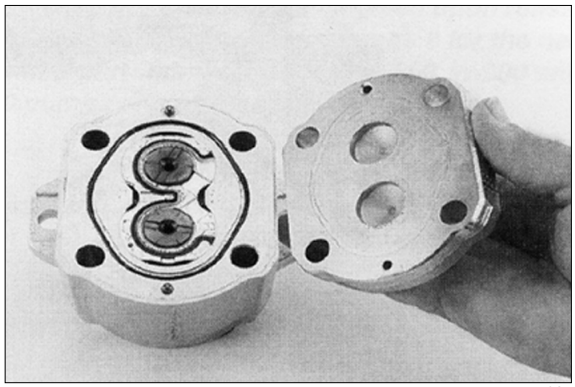
(6) Loosen the four metric hexagon head bolts.

(7) Remove pump from vise and place on clean work bench, remove the four hexagon head bolts and spacers applicable.



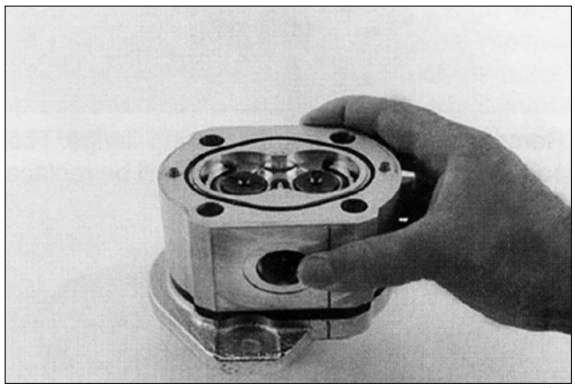
PUMP 02

(8) Lift and remove end cover.



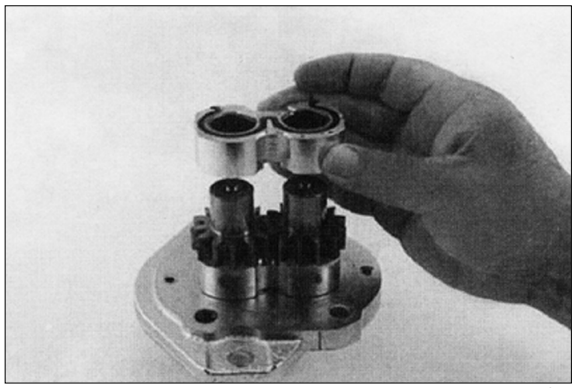
PUMP 03

(9) Carefully remove gear housing and place on work bench. Make sure the rear bearing block remains on the drive and idler shafts.



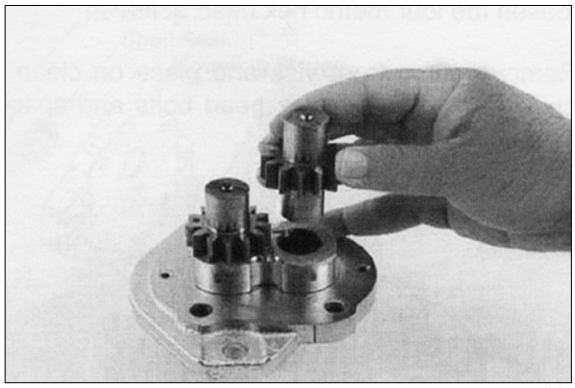
PUMP 04

(10) Remove rear bearing block from drive and idler shafts.



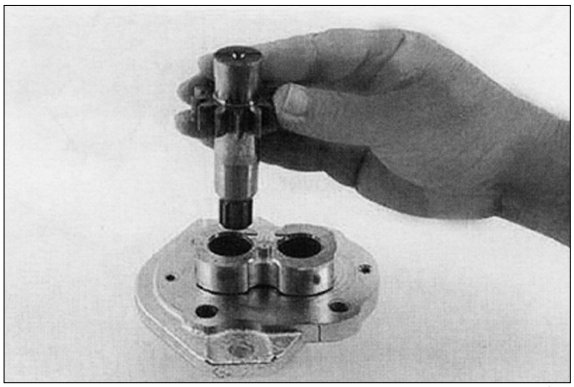
PUMP 05

(11) Remove idler shaft from bearing block.



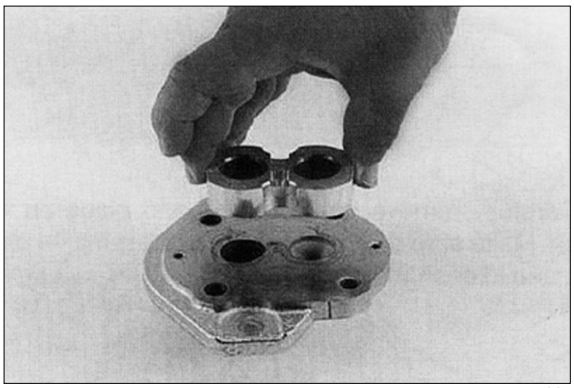
PUMP 06

(12) Remove drive shaft from mounting flange. There is no need to protect the shaft seal as it will be replaced as a new item.



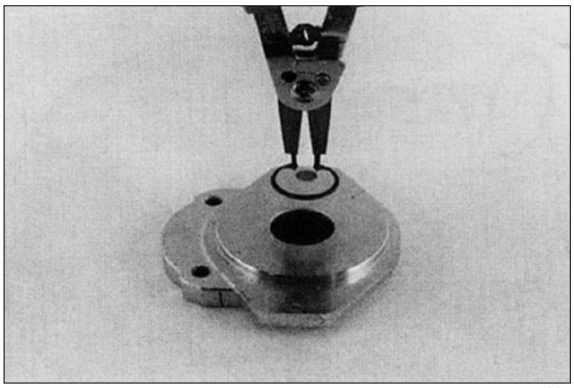
PUMP 07

(13) Remove the front bearing block.



PUMP 08

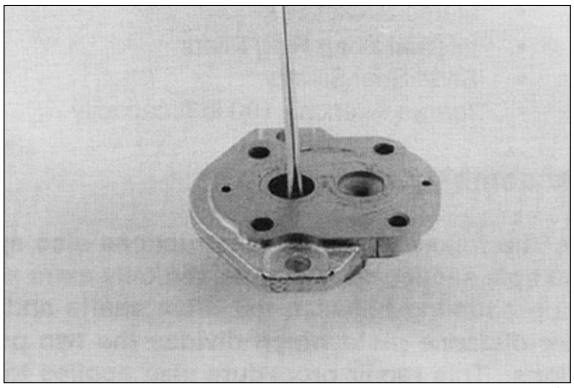
(14) Turn mounting flange over, with shaft seal up, and remove the retaining ring with proper snap ring pliers.



PUMP 09

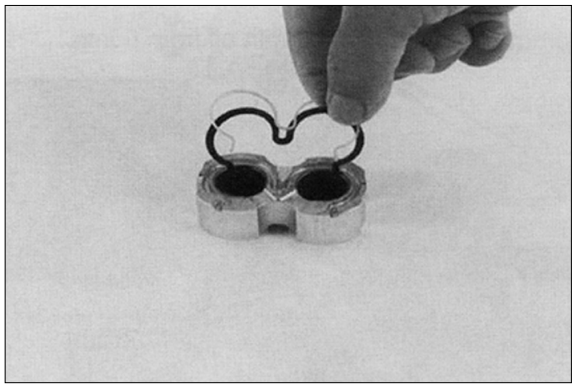
(15) Remove the oil seal from mounting flange, be careful not to mar or scratch the seal bore.

(16) Remove the dowel pins from the gear housing. Do not lose pins.



PUMP 10

(17) Remove seals from both bearing blocks and discard.



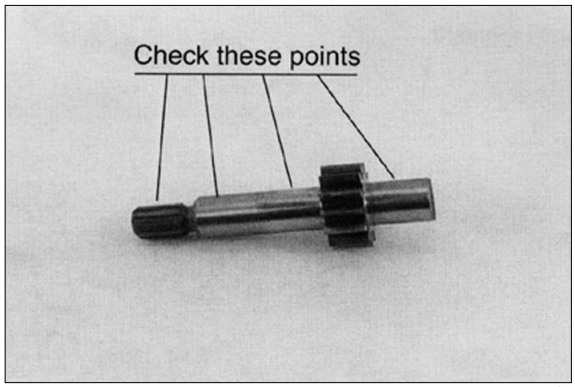
PUMP 11

**2) INSPECT PARTS FOR WEAR**

(1) Clean and dry all parts thoroughly prior to inspection. It is not necessary to inspect the seals as they will be replaced as new items.

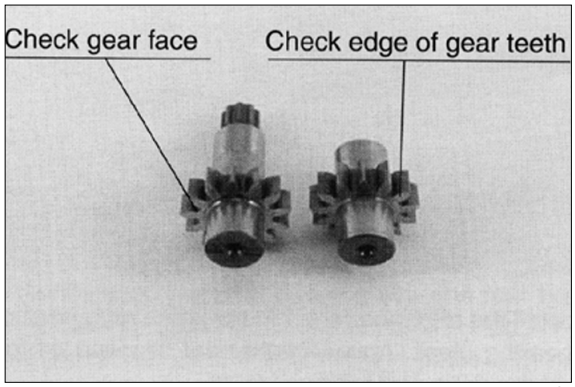
(2) Check drive shaft spline for twisted or broken teeth, check keyed drive shaft for broken or chipped keyway. No marks or grooves on shaft in seal area, some discoloration of shaft is allowable.

(3) Inspect both the drive gear shaft and idler gear shafts at the bearing points and seal area for rough surfaces and excessive wear.




PUMP 12

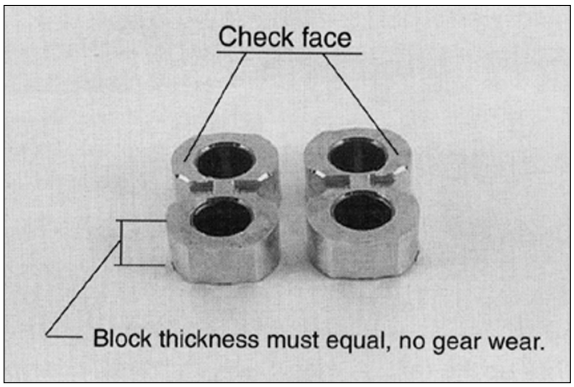
(4) Inspect gear face for scoring or excessive wear. If the face edge of gear teeth are sharp, they will mill into the bearing blocks. If wear has occurred, the parts are unusable.




PUMP 13

(5) Inspect bearing blocks for excessive wear or scoring on the surfaces which are in contact with the gears. Also inspect the bearings for excessive wear or scoring.

(6) Inspect the area inside the gear housing. It is normal for the surface inside the gear housing to show a clean "wipe" on the inside surface on the intake side. There should not be excessive wear or deep scratches and gouges.



PUMP 14

※ **General information**

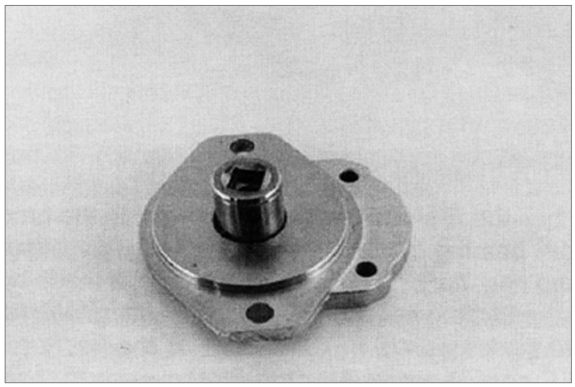
It is important that the relationship of the mounting flange, bearing blocks and gear housing is correct. Failure to properly assemble this pump will result with little or no flow at rated pressure.

※ **This pump is not bi-rotational.**

### 3) ASSEMBLY

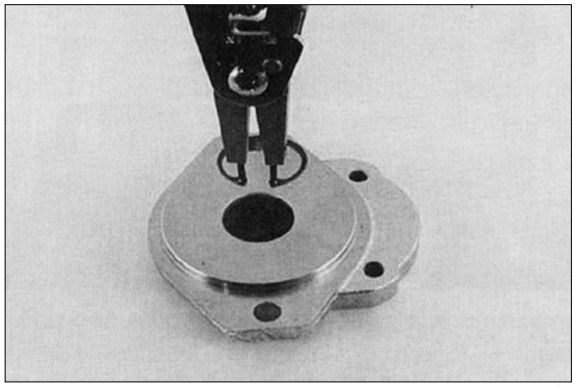
※ New seals should be installed upon reassembly of pump.

(1) Install new shaft seal in mounting flange with part number side facing outboard. Press the seal into the seal bore until the seal reaches the bottom of the bore. Uniform pressure must be used to prevent misalignment or damage to the seal.



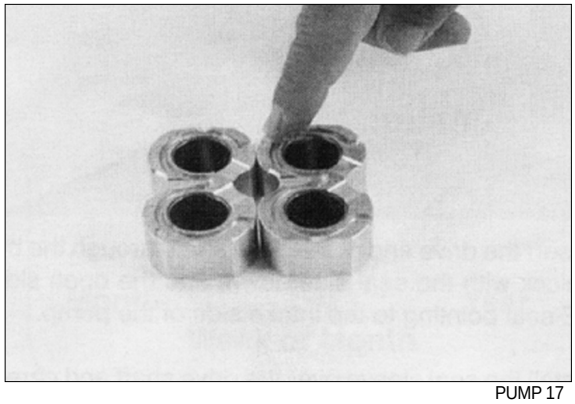
PUMP 15

(2) Install retaining ring in groove in seal bore of mounting flange.



PUMP 16

(3) Place front and back bearing blocks on a clean surface with the E-seal grooves facing up. Apply a light coating of petroleum jelly in the grooves. Also coat the E-seal and backup with the petroleum jelly, this will help keep the seals in place during assembly.

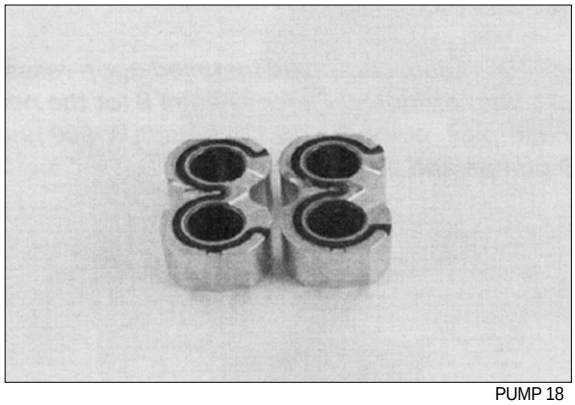


PUMP 17

(4) Place the E-seals, flat side outward, into the grooves in both bearing blocks. Follow by carefully placing the backup ring, flat side outward, in the groove made by the E-seal and the groove in the bearing block.

(5) Place mounting flange, with shaft seal side down, on a clean flat surface.

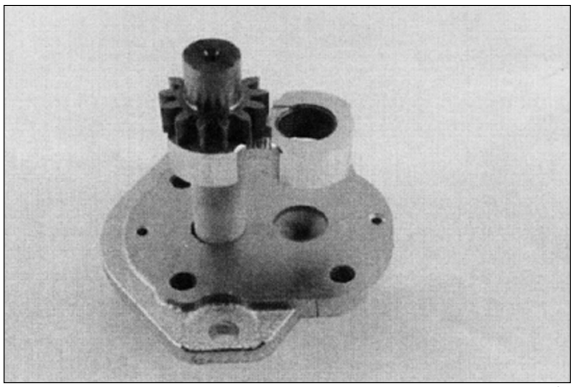
(6) Apply a light coating of petroleum jelly to the exposed face of the front bearing block.



PUMP 18

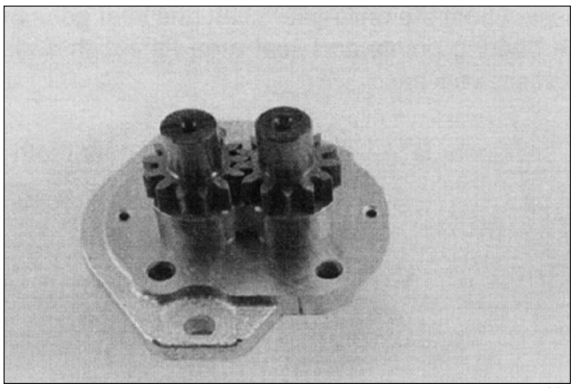
(7) Insert the drive end of the drive shaft through the bearing block with the seal side down, and the open side of the E-seal pointing to the intake side of the pump.

(8) Install the seal sleeve over the drive shaft and carefully slide the drive shaft through the shaft seal. Remove the seal sleeve from shaft.



PUMP 19

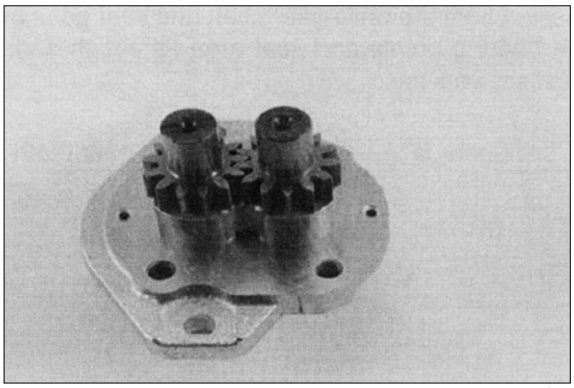
(9) Install the idler gear shaft in the remaining position in the bearing block. Apply a light coat of clean oil to the face of the drive and idler gears.



PUMP 20

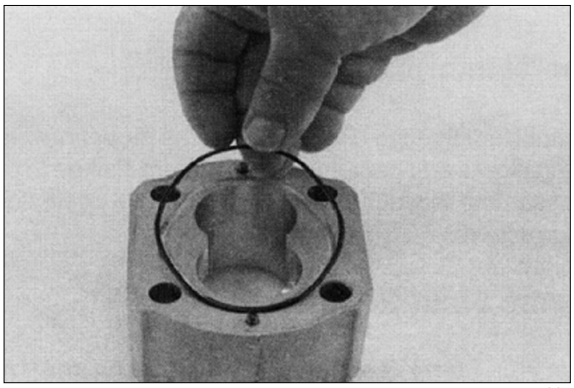
(10) Pick up the rear bearing block, with seal side up and with open end of the E-seal facing the intake side of the pump, place over the drive and idler gear shafts.

(11) Install two dowel pins in the holes in the mounting flange or two long dowel pins through gear housing if pump is a multiple section pump.



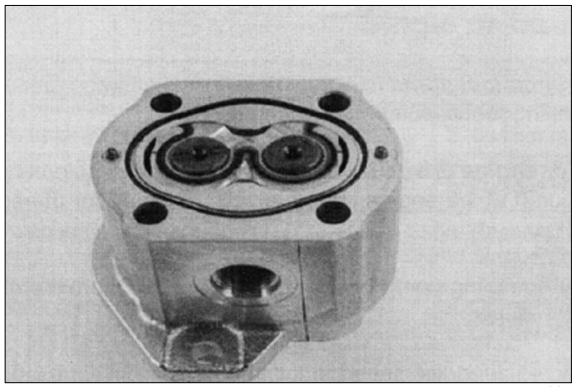
PUMP 21

(12) To install the O-rings in the gear housing, apply a light coating of petroleum jelly in the grooves on both sides of the gear housing.
Also coat the new O-ring and install them in the grooves.



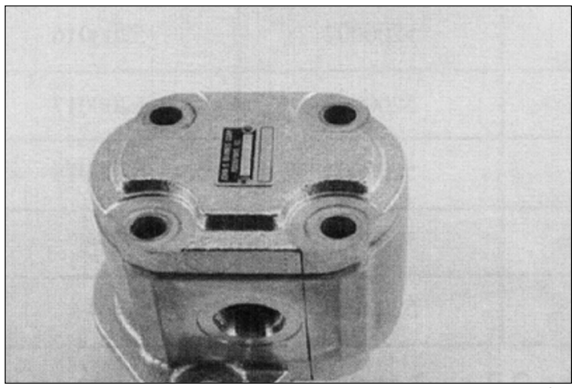
PUMP 22

(13) Gently slide the gear housing over the rear bearing block assembly, slide housing down until the housing engages the dowel pins. Press firmly in place with hands, do not force or use any tool.
Check to make sure the intake port in the housing in on the same side as the open end of the E-seal and that the marked lines on the mounting flange and gear housing are in alignment.

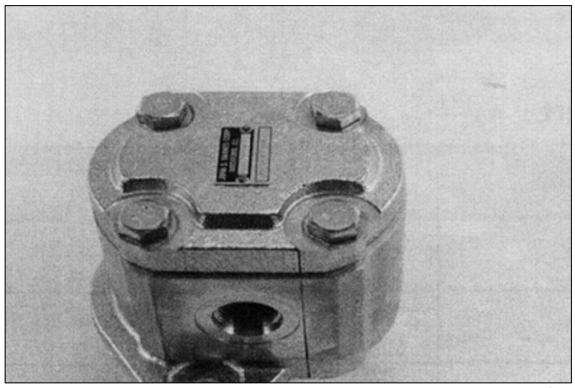

PUMP 23

(14) The surface of the rear bearing block should be slightly below the face of the gear housing. If the bearing block sits higher then the rear face of the gear housing then the E-seal or O-ring have shifted out of the groove. If this is the case, remove the gear housing and check for proper seal installation.

(15) Install the two remaining dowel pins in the rear of the gear housing and place the end cover over the back of the pump.


PUMP 24

(16) Install the four spacers and hexagon head bolts through the bolt holes in the end cover, hand tighten.

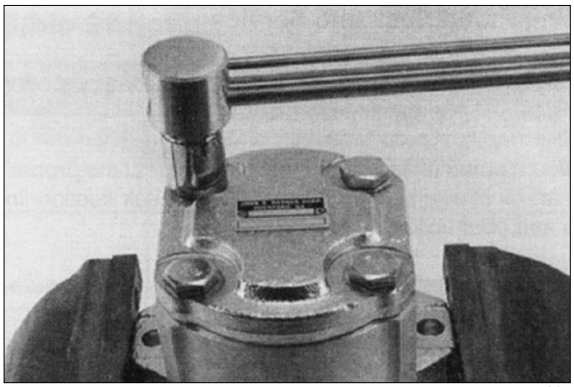

PUMP 25

(17) Place mounting flange of the pump back in the protected jawed vise and alternately torque the bolts.

・Tighten torque : 11.1~11.8kgf・m
(80~85lbf・ft)

(18) Remove pump from vise.

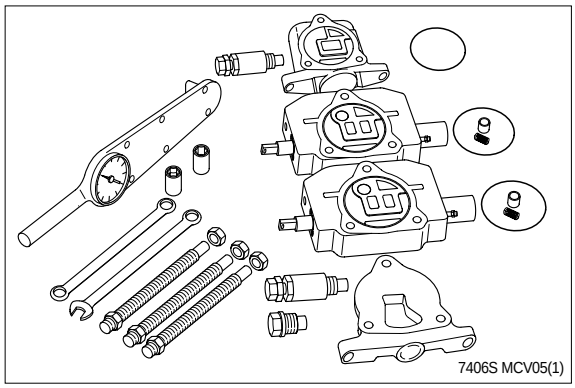
(19) Place a small amount of clean oil in the inlet of the pump and rotate the drive shaft away from the inlet one revolution. If the drive shaft binds, disassemble the pump and check for assembly problems, then reassemble the pump.



PUMP 26

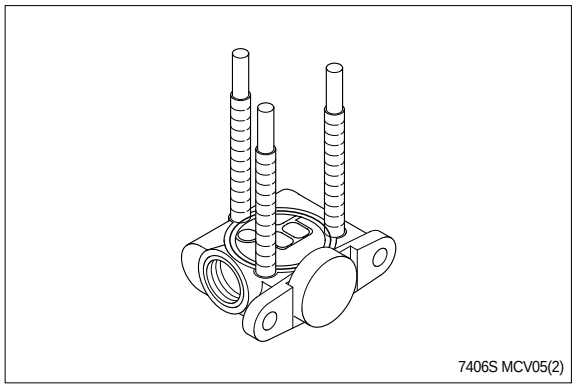
## 2. MAIN CONTROL VALVE

1) Lay out valve components on a clean, flat working surface. The inlet assembly will include an O-ring, and the spool section(s) include an O-ring, a load check puppet and a load check spring. Tools required for basic valve assembly include 3/4 and 11/16 open or box end wrenches and a torque wrench with thin wall sockets.



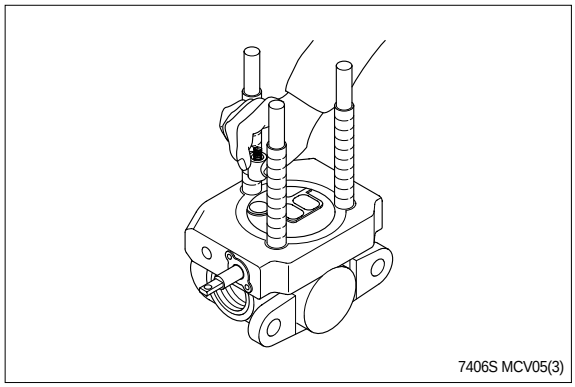
7406S MCV05(1)

2) Assemble tie rod nuts to one end of each tie rod with one or two threads showing. Insert tie rods through tie rod holes of inlet(Large tie rod at top). Lay inlet on end with tie rods up, place O-ring into position.



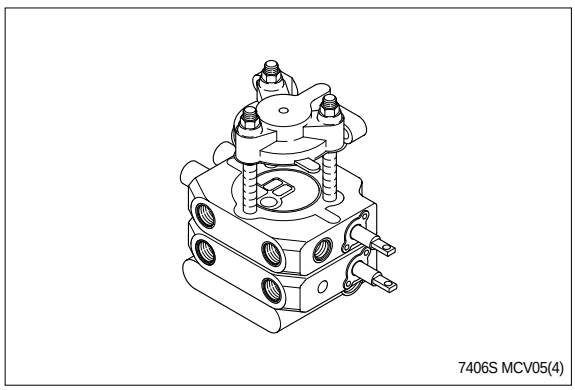
7406S MCV05(2)

3) Place first spool section(O-ring side up) on inlet section, position O-ring and insert load check puppet(nose down) and spring(behind puppet) into load check cavity as shown. Repeat this procedure for each spool section ; The load check springs are compressed by the following sections during assembly.



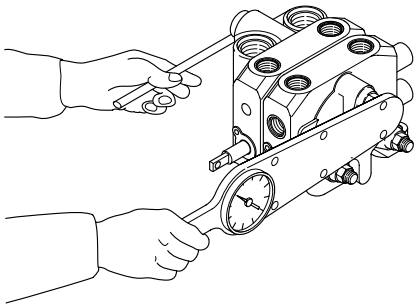
7406S MCV05(3)

4) Position end section on last spool section as shown and hand tighten tie rod nuts. The end section on picture is a "turn around" section without ports. Universal outlet/power beyond section and power beyond and closed center sections are also used as end sections. These end sections do not have O-ring grooves.



7406S MCV05(4)

5) Position valve assembly with the mounting pads of the end sections on a flat surface. To obtain proper alignment of end sections relative to the spool sections apply downward pressure to the end sections ; Snug tie rod nuts to about 10lbf · ft.
Final torque the two 11/16 nuts to 48±lbf · ft
Final torque one 3/4 nut to 74±8lbf · ft.
Check for proper spool movement.

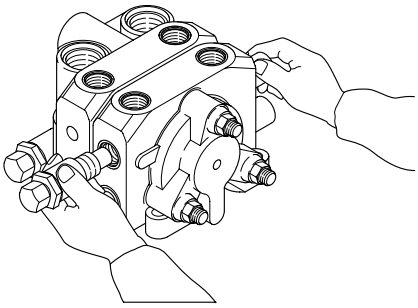

7406S MCV06(1)

6) Install auxiliary valves and plugs and torque to proper specifications.

※ **General assembly notes**:

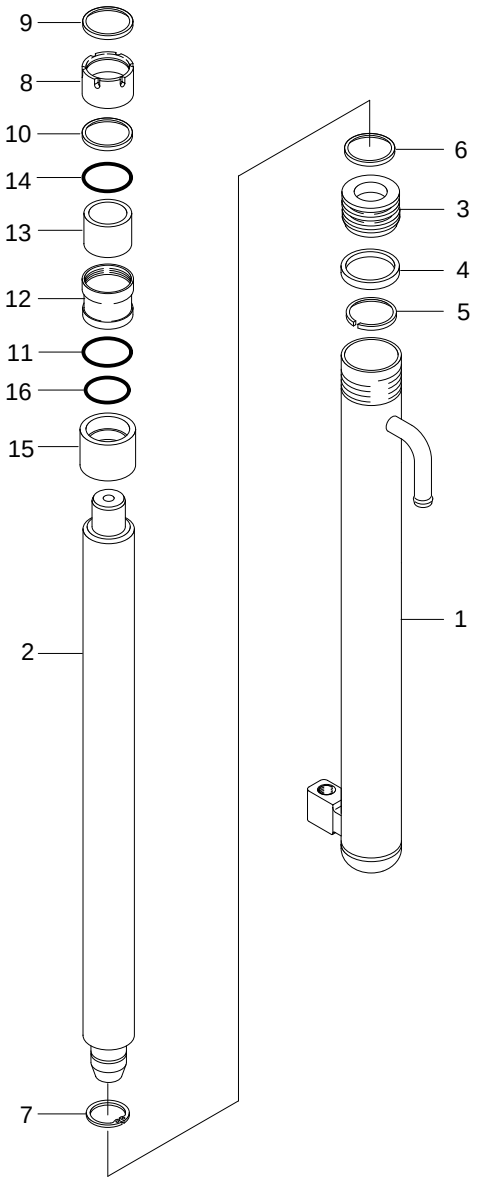
A. Lever assemblies can be installed on section before or after complete valve assembly.

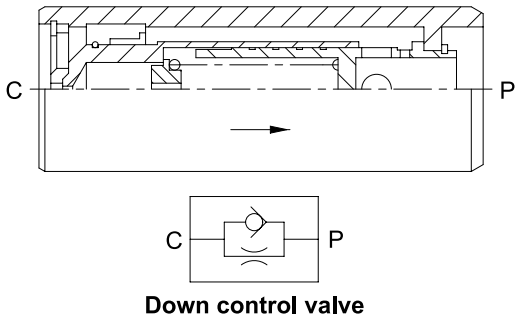
B. The load check and spring may be omitter from assembly in certain circuit conditions(i.e., motor spools).


7406S MCV06(2)

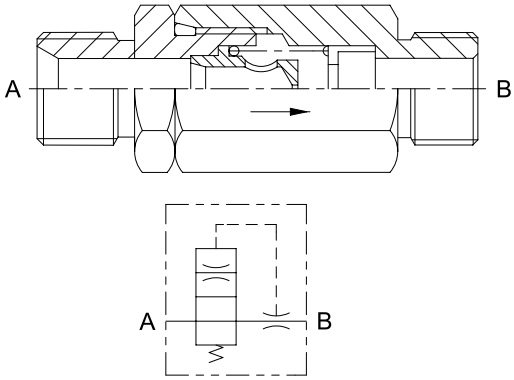
## 3. LIFT CYLINDER

### 1) STRUCTURE




**Down control valve**




**Down safety valve**

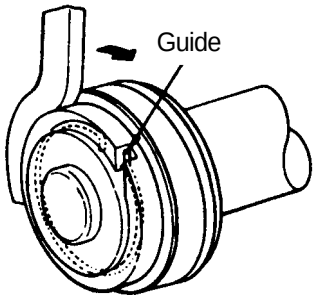
- I.D ×O.D×Stroke (standard)
  3.5 ton : 65×73×1335 mm
  (2.6×2.9×52.6 in)
  4.5 ton : 70×82×1335 mm
  (2.8×3.2×52.6 in)
- Rod O.D : 50mm (2 in)

D353HS14

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 7 | Retaining ring | 12 | Guide |
| 2 | Rod | 8 | Gland | 13 | Bushing |
| 3 | Piston | 9 | Dust wiper | 14 | O-ring |
| 4 | Piston seal | 10 | Rod seal | 15 | Spacer |
| 5 | Back up ring | 11 | O-ring | 16 | O-ring |
| 6 | Wear ring | | | | |

**2) DISASSEMBLY**

(1) Hold the cylinder tube in a vice, loosen the cylinder head and remove it.
Remove the spacer from the cylinder tube and knock out the bushing. Hook a wrench in the hole in the retainer at the piston end and turn. Lever up the edge of the guide, then turn the guide in again and the guide can be removed.



D35ACO168

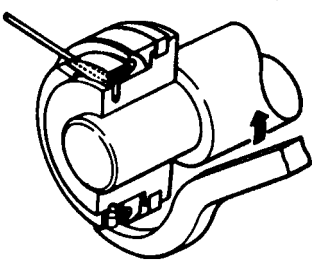
**3) CHECK AND INSPECTION**

mm(in)

| Check item | Standard size | Repair limit | Remedy |
|---|---|---|---|
| Clearance between cylinder rod & bushing | 0.072~0.288 (0.003~0.011) | 0.5 (0.020) | Replace bushing |
| Clearance between piston ring & tube | 0.05~0.030 (0.002~0.012) | 0.5 (0.020) | Replace piston ring |

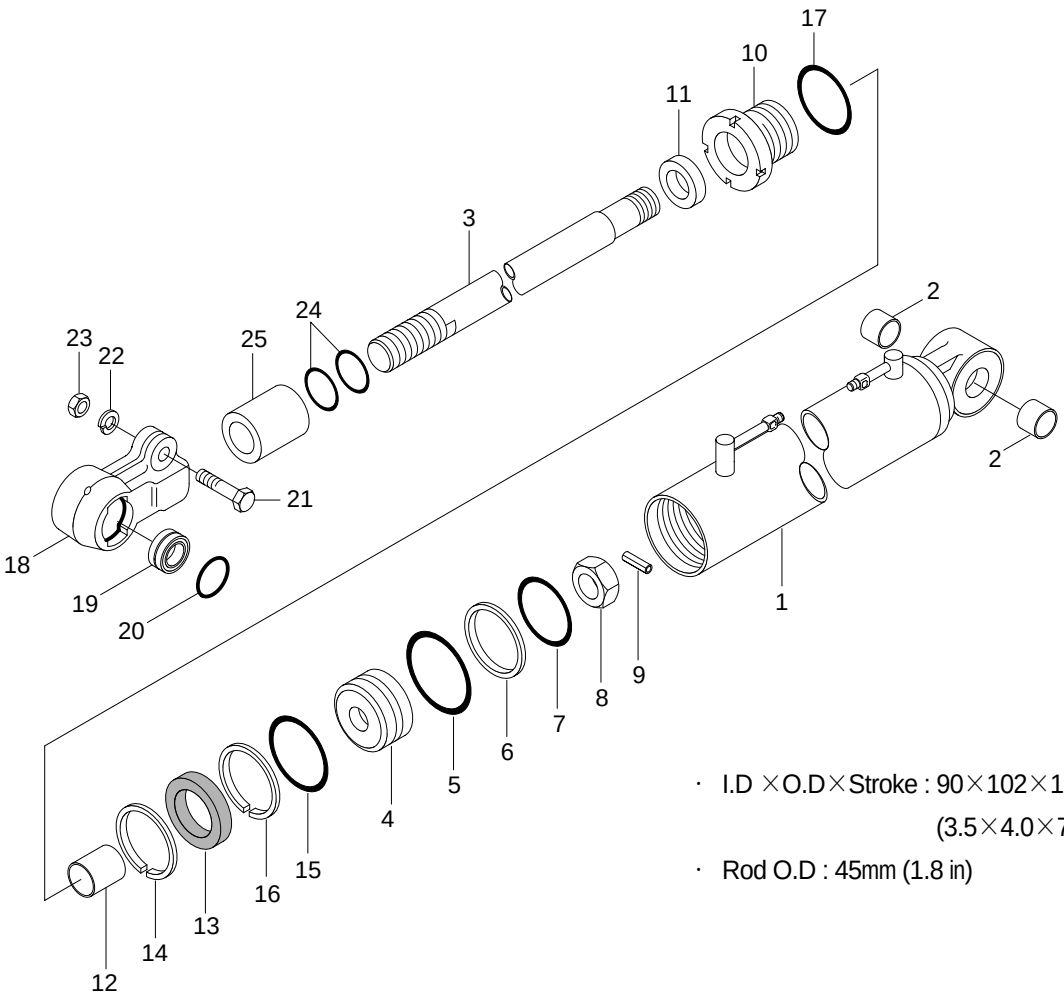
**4) ASSEMBLY**

(1) Soak the piston ring in hydraulic oil at a temperature of 40 to 50°C, expand the inside diameter and assemble on the piston. Install a piston seal.
Bend the edge of the guide and rotate it to install the guide completely.


D35ACO169

## 4. TILT CYLINDER

### 1) STRUCTURE

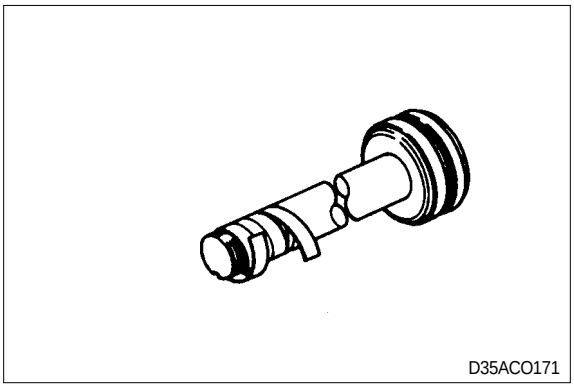



D353HS15

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 10 | Gland | 18 | Eye |
| 2 | Bushing | 11 | Dust wiper | 19 | Spherical bearing |
| 3 | Rod | 12 | Bushing | 20 | Retaining ring |
| 4 | Piston | 13 | Rod seal | 21 | Hexagon bolt |
| 5 | O-ring | 14 | Back up ring | 22 | Spring washer |
| 6 | Back up ring | 15 | O-ring | 23 | Hexagon nut |
| 7 | O-ring | 16 | Back up ring | 24 | O-ring |
| 8 | Lock nut | 17 | O-ring | 25 | Spacer |
| 9 | Spring pin | | | | |

### 2) DISASSEMBLY

(1) Hold the parallel parts of the cylinder tube bottom in a vice and mark the rod head end to show how much it is screwed in, then remove the rod head. Next, hook a wrench into the notch at the cylinder head and remove the cylinder head from cylinder tube.
When doing this, wind tape round the threaded part of the rod and be careful not to damage the dust seal and rod seal inside cylinder head.


D35ACO171

### 3) CHECK AND INSPECTION

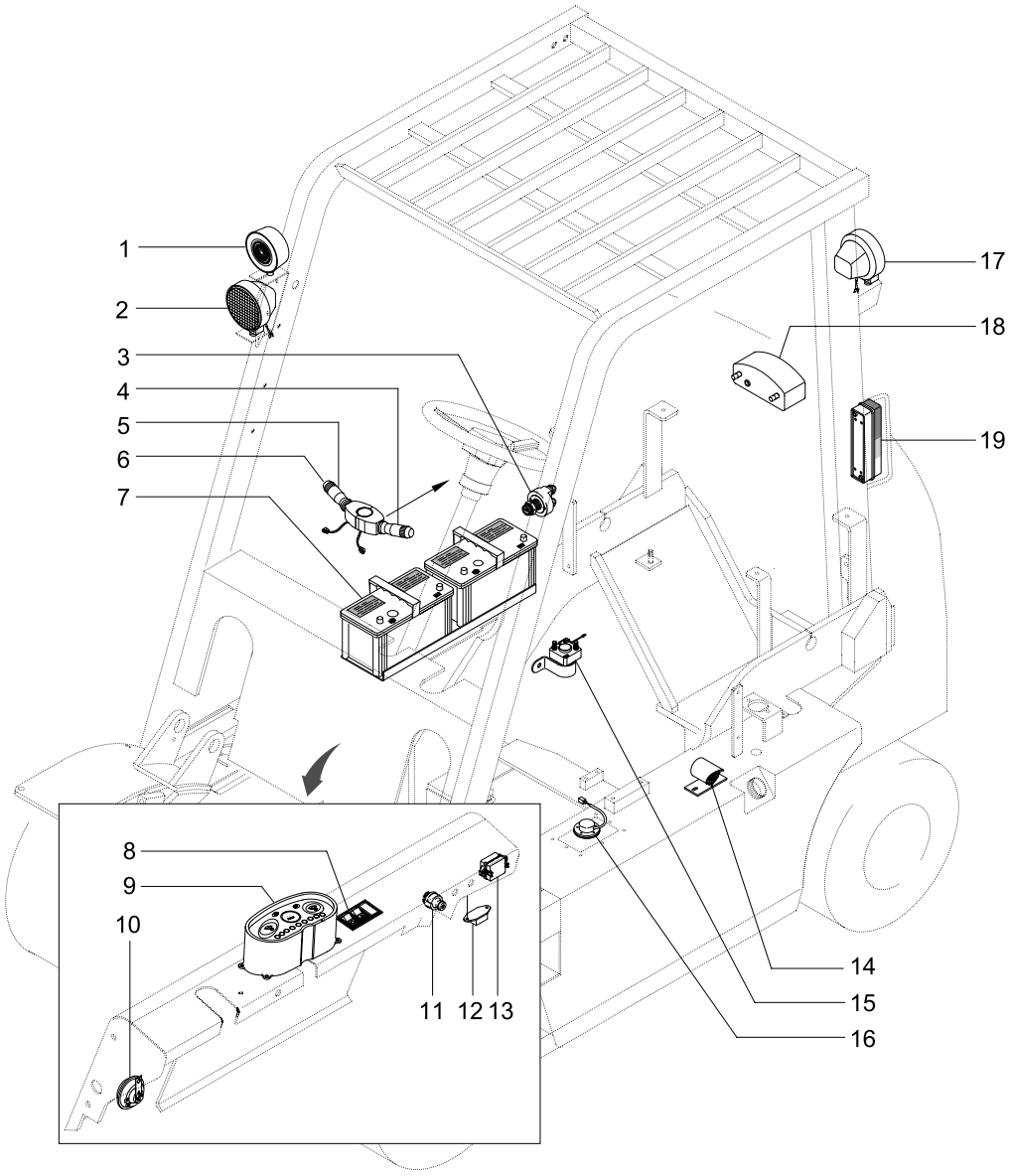
mm(in)

| Check item | Standard size | Repair limit | Remedy |
|---|---|---|---|
| Clearance between cylinder rod & bushing | 0.072~0.288 (0.003~0.011) | 0.5 (0.020) | Replace bushing |
| Clearance between rod head bushing & pin | 0.10~0.35 (0.004~0.014) | 0.6 (0.024) | Replace bushing |

# SECTION 7 ELECTRICAL SYSTEM

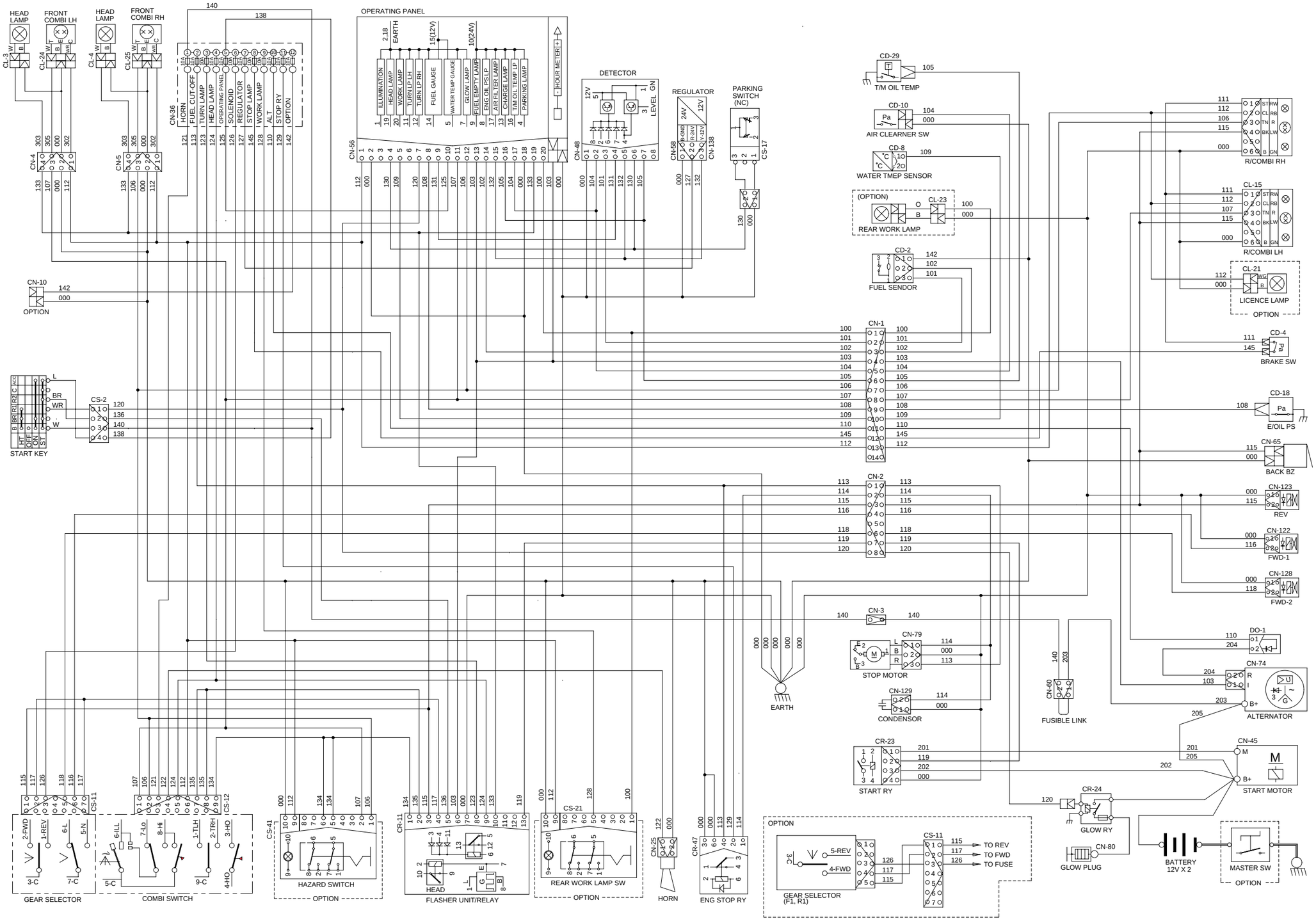
# SECTION 7 ELECTRICAL SYSTEM

## GROUP 1 COMPONENT LOCATION




| | | | |
|---|---|---|---|
| 1 | Flasher lamp | 11 | Start switch |
| 2 | Head lamp | 12 | Regulator |
| 3 | Master switch | 13 | Fuse box |
| 4 | Gear selector | 14 | Back horn |
| 5 | Combination switch | 15 | Start relay |
| 6 | Horn button | 16 | Fuel level sender |
| 7 | Battery | 17 | Rear work lamp |
| 8 | Work light, Hazard switch | 18 | License lamp |
| 9 | Operating panel | 19 | Combination lamp |
| 10 | High horn | | |

## GROUP 2 ELECTRICAL CIRCUIT



## 1. POWER CIRCUIT

The negative terminal of the battery is grounded to the machine chassis.
When the start switch is in the off position, the current flows from the positive battery terminal.

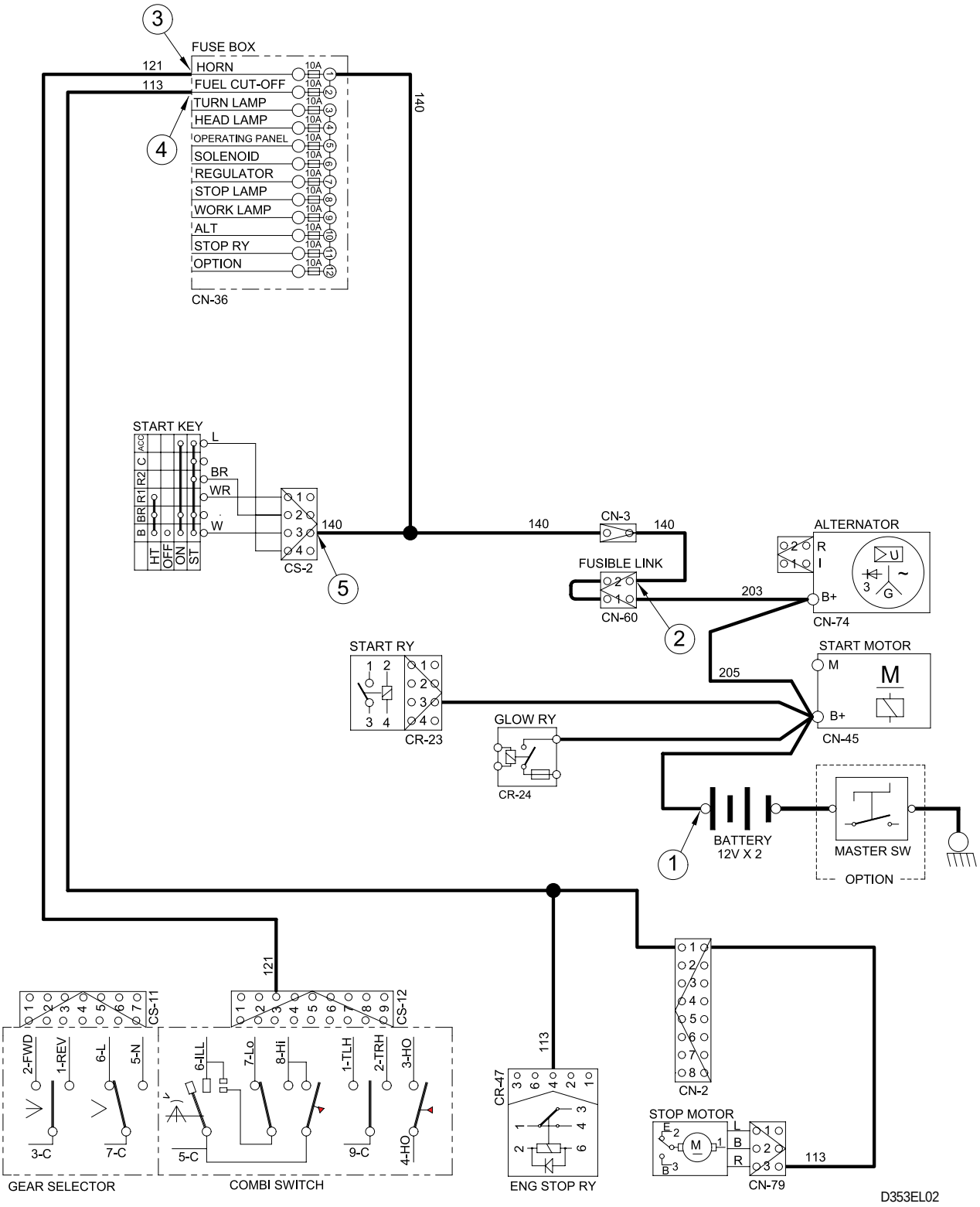
### 1) OPERATING FLOW

Battery(+) → Start motor[CN-45(B+)] → Glow relay[CR-24]
→ Start relay[CR-23(3)]
→ Alternator[CN-74(B+)] → Fusible link[CN-60] → [CN-3] → I/conn[CS-2(3)] → Start switch OFF
→ Fuse box[CN-36(1)] → Combi switch[CS-12(3)]
→ Fuse box[CN-36(2)] → Engine stop relay[CR-47(4)]
→ I/conn[CN-2(1)] → Stop motor[CN-79(3)]

### 2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| OFF | OFF | ① - GND (Battery(+))<br>② - GND (Fusible link)<br>③ - GND (Fuse No.1)<br>④ - GND (Fuse No.2)<br>⑤ - GND (Start key) | 20 ~ 25V |

## POWER CIRCUIT



## 2. STARTING CIRCUIT

### 1) OPERATING FLOW

Battery(+) terminal → Start motor[CN-45(B+)] → Fusible link[CN-60] → Start switch[CS-2(3)]
Start motor[CN-45(B+)] → Start relay[CR-23(3)]

**※ The engine can be started only when the gearshift is in neutral position.**

**(1) When start key switch is in ON position**

Start switch ON [CS-2(4)] → Fuse box[No.5 →11] → Engine stop relay[CR-47(2)]
→ Engine stop relay ON → Engine stop relay[CR-47(4) → (1)] → I/conn[CN-2(2)]
→ Stop motor[CN-79(1)] → Stop motor ON.

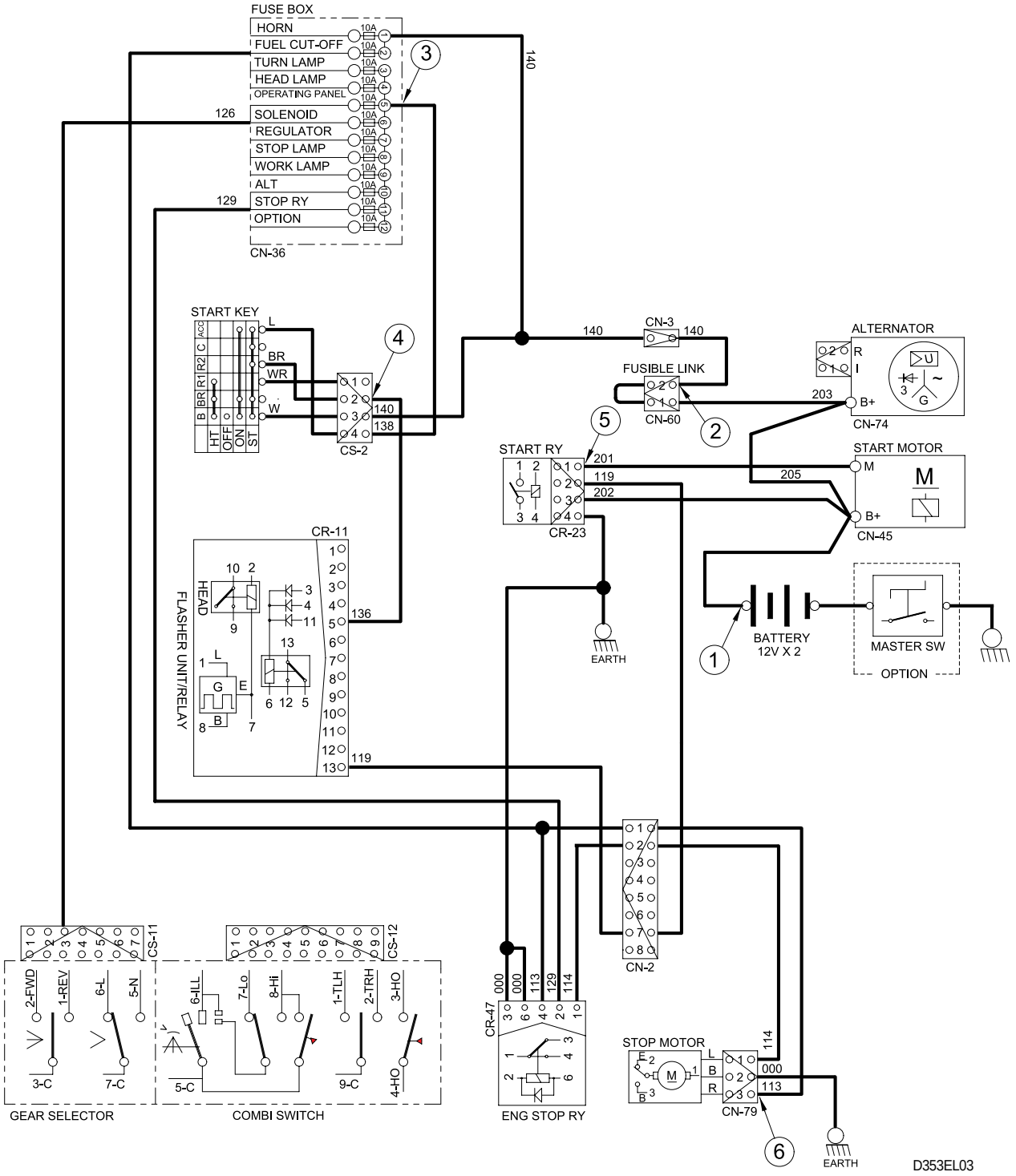
**(2) When start key switch is START position**

Start switch START[CS-2(2)] → Flasher unit/Relay[CR-11(5) → (13)]
→ I/conn[CN-2(7)] → Start relay ON → Start relay[CR-23(3) → (1)]
→ Starter

### 2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| Running | ON | ① - GND (Battery B+)<br>② - GND (Fusible link)<br>③ - GND (Fuse box No.5)<br>④ - GND (Start key)<br>⑤ - GND (Start key)<br>⑥ - GND (Stop motor) | 20 ~ 27V |

## STARTING CIRCUIT



## 3. CHARGING CIRCUIT

When the starter is activated and the engine is started, the operator release the start switch to the ON position. Charging current generated by operating alternator flows into the battery.
The current also flows from alternator to each electrical component through the fusible link(CN-60) and the fuse box.

### 1) OPERATING FLOW

**(1) Warning flow**

Alternator[CN-74(I)] → I/conn[CN-1(4)] → Cluster charging warning lamp ON [CN-56(13)]

**(2) Charging flow**

Alternator[CN-74(B+)] → Starter[CN-45(B+)] → Battery(+) terminal → charging.

### 2) CHECK POINT

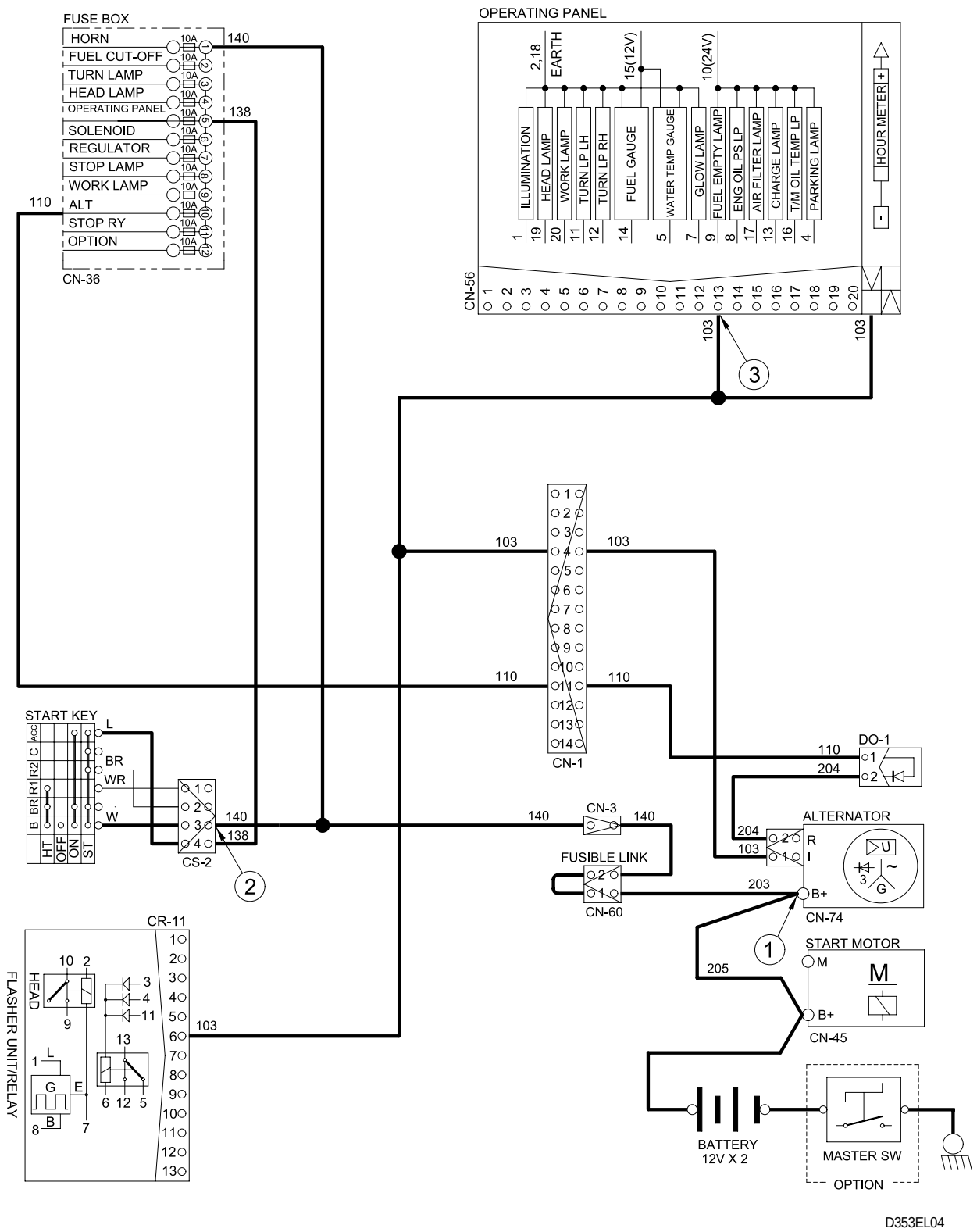
| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| ON | ON | ① - GND (Alternator B+)<br>② - GND (Start switch)<br>③ - GND (Cluster) | 20 ~ 27V |

※ GND : Ground

**※ Cautions**

1. When using an arc welder, always disconnect the ground lead from the battery to prevent alternator or battery damage.
2. Attach the welding ground clamp as close to the weld area as possible to prevent welding current from damaging the bearings of the alternator.
3. Do not disconnect the battery when the engine is running. The voltage surge can damage the diode and resistors in the electrical system.
4. Do not disconnect an electric wire before the engine is stopped and the switchs are OFF.

## CHARGING CIRCUIT




D353EL04

## 4. PREHEATING CIRCUIT

Combustion chamber glow plugs are used in order to give satisfactory starting of low ambient temperatures.

### 1) OPERATING FLOW

Battery(+) terminal → Fusible link[CN-60] → I/conn[CS-2(3)] → Start switch(B)
Battery(+) terminal → Start relay[CR-24]

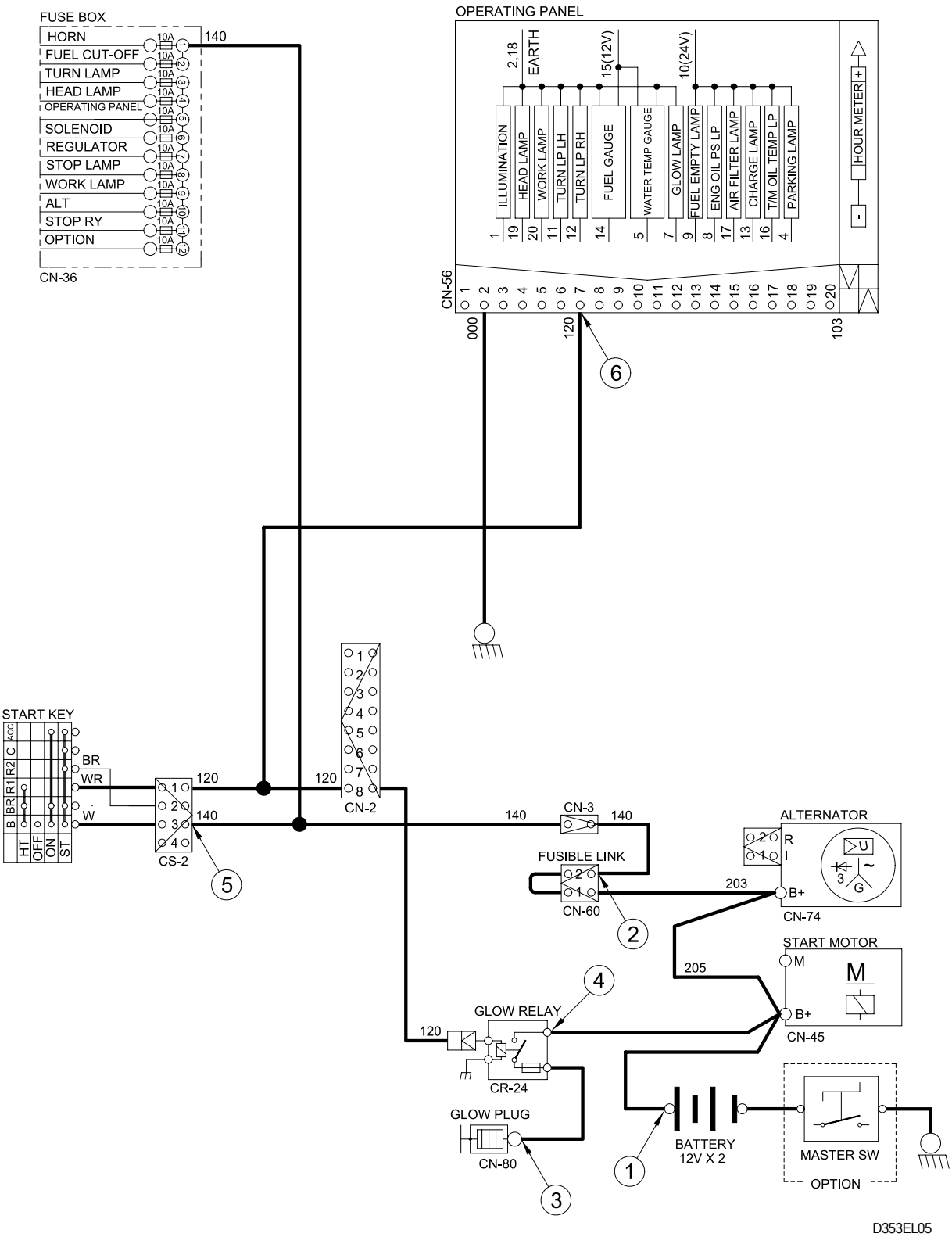
※ When you turn the start switch to the HEAT position, the glow relay makes the glow plugs operated and the glow lamp of the cluster turned ON.

Start switch HEAT [CS-2(1)] → Operating panel [CN-56(7)] → glow lamp ON
Start switch HEAT [CS-2(1)] → I/conn[CN-2(8)] → Glow relay ON [CR-24]
→ Glow plug operating[CN-80]

### 2) CHECK POINT

| Engine | Key switch | Check point | Voltage |
|---|---|---|---|
| Stop | HEAT | ① - GND (Battery B+)<br>② - GND (Fusible link)<br>③ - GND (Glow plug)<br>④ - GND (Glow relay)<br>⑤ - GND (Start switch)<br>⑥ - GND (Glow lamp) | 20 ~ 25V |

## PREHEATING CIRCUIT



## GROUP 3 COMPONENT SPECIFICATION

<table>
<tr><th>No</th><th>Part name</th><th>Qty</th><th>Specification</th><th>Remark</th></tr>
<tr><td>1</td><td>Battery</td><td>2</td><td>12V×68AH<br>Reserve capacity : 110min<br>-18。C Cold cranking ampere : 600A<br>Charge acceptance : 21A<br>Life cycle : 4400Cycle<br>5HR Capacity : 54AH</td><td></td></tr>
<tr><td>2</td><td>Working lamp</td><td>1</td><td>24V, 45W</td><td></td></tr>
<tr><td>3</td><td>License lamp</td><td>1</td><td>24V, 3W×2</td><td></td></tr>
<tr><td>4</td><td>Combination lamp</td><td>2</td><td>24V, 25/10W (Stop/Tail)<br>24V, 21W (T/S)<br>24V, 10W (Back)</td><td></td></tr>
<tr><td>5</td><td>Head lamp</td><td>2</td><td>24V, 55W</td><td></td></tr>
<tr><td>6</td><td>Flasher lamp</td><td>2</td><td>24V, 24/10W</td><td></td></tr>
<tr><td>7</td><td>Relay starter</td><td>1</td><td></td><td></td></tr>
<tr><td>8</td><td>Relay (5P)</td><td>1</td><td>24V, 5A</td><td></td></tr>
<tr><td>9</td><td>Flasher & Relay</td><td>1</td><td>24V, 20A (Relay)<br>24V, 62.5W (Flasher)<br>130W (Harzard)</td><td></td></tr>
<tr><td>10</td><td>Detector</td><td>1</td><td>12V, 2A</td><td></td></tr>
<tr><td>11</td><td>Regulator</td><td>1</td><td>24V, 1A</td><td></td></tr>
<tr><td>12</td><td>Back horn</td><td>1</td><td>24V, 90±5dB, 60±10C/M</td><td></td></tr>
<tr><td>13</td><td>Horn</td><td>1</td><td>24V, 1.5A, 105 ~ 115 dB</td><td></td></tr>
<tr><td>14</td><td>Fuel level sender</td><td>1</td><td>Reed switch - Magnet type
<table>
<tr><td>Float indicate</td><td>E</td><td>1/2</td><td>F</td></tr>
<tr><td>Resistance[Ω]</td><td>95</td><td>32.5</td><td>7</td></tr>
<tr><td>Allowance[Ω]</td><td>±2.5</td><td>±5</td><td>±2.5</td></tr>
</table></td><td></td></tr>
<tr><td>15</td><td>Master switch</td><td></td><td></td><td></td></tr>
<tr><td>16</td><td>Combination switch</td><td>1</td><td>24V, 5A</td><td></td></tr>
<tr><td>17</td><td>Combination switch</td><td>1</td><td>24V, 5A</td><td></td></tr>
<tr><td>18</td><td>Brake switch</td><td>1</td><td></td><td></td></tr>
<tr><td>19</td><td>Working lamp switch</td><td>1</td><td>24V, 8A</td><td></td></tr>
<tr><td>20</td><td>Hazard switch</td><td>1</td><td>24V, 8A</td><td></td></tr>
<tr><td>21</td><td>Start switch</td><td>1</td><td>24V, 28A</td><td></td></tr>
</table>

## GROUP 4 CONNECTOR DESTINATION

| Connector number | Type | No. of pin | Destination | Connector part No. | |
|---|---|---|---|---|---|
| | | | | Female | Male |
| CN-1 | KET | 14 | I/conn(Dashboard harness-frame harness) | S814-014001 | S814-114001 |
| CN-2 | KET | 12 | I/conn(Dashboard harness-frame harness) | S814-012001 | S814-112001 |
| CN-3 | KET | 1 | I/conn(Dashboard harness-frame harness) | MG640944-5 | MG650943-5 |
| CN-4 | KET | 4 | Support harness | - | S814-104001 |
| CN-5 | KET | 4 | Support harness | - | S814-104001 |
| CN-25 | MOLEX | 2 | Horn | 35215-0200 | |
| CN-36 | - | 2 | Fuse cox | F12890010 | |
| CN-48 | KET | 2 | Hour meter | S822-014000 | |
| CN-56 | MOLEX | 20 | Operating panel | 35109-2010 | |
| CN-58 | KET | 8 | Detector(indicator) | S810-008201 | |
| CN-60 | - | 2 | Fusible link | - | 21N4-01310 |
| CN-65 | KET | 2 | Back buzzer | S822-014000 | |
| CN-74 | KET | 2 | Alternator | MG640188-4 | |
| CN-79 | YAZAKI | 3 | Stop motor | 7323-9033 | |
| CN-122 | AMP | 2 | Forward solenoid 1 | S816-002001 | |
| CN-123 | AMP | 2 | Reverse solenoid 1 | S816-002001 | |
| CN-128 | AMP | 2 | Forward solenoid 2 | S816-002001 | |
| CN-129 | KET | 2 | Condensor | S810-002201 | |
| CN-138 | KET | 3 | Regulator | S810-003201 | |
| **Switch** | | | | | |
| CS-2 | RING TERM | 5 | Start switch | G9110009/19/23 | |
| CS-11 | AMP | 7 | Gear selector switch | S811-007002 | |
| CS-12 | AMP | 9 | Combination switch | S811-009002 | |
| CS-17 | KET | 2 | Parking switch | S810-002201 | |
| CS-21 | SWF | 10 | Work lamp switch | 593757 | |
| CS-41 | SWF | 10 | Hazard switch | 593757 | |
| **Lamp** | | | | | |
| CL-15 | - | 6 | Combination lamp-LH | 110-6PR | |
| CL-16 | - | 6 | Combination lamp-RH | 110-6PR | |
| CL-21 | SHUR | 2 | License lamp | S822-014000 | S822-114000 |
| CL-23 | SHUR | 2 | Work lamp | S822-014000 | S822-114000 |
| **Relay** | | | | | |
| CR-23 | AMP | 4 | Start relay | S810-004202 | |
| CR-24 | KET | 1 | Glow relay | S822-014000 | |
| **Sensor and pressure switch** | | | | | |
| CD-2 | KET | 3 | Fuel sendor | S810-003201 | |
| CD-4 | - | 2 | Brake switch | S822-014000 | |

| Connector number | Type | No. of pin | Destination | Connector part No. | |
|---|---|---|---|---|---|
| | | | | Female | Male |
| CD-8 | AMP | 2 | Water temperature sensor | S819-040222 | |
| CD-10 | KET | 2 | Air cleaner switch | 730057-2 | |
| CD-18 | AMP | 1 | Engine oil pressure switch | S819-010122 | |
| CD-29 | AMP | 1 | T/M temperature switch | S819-010122 | |

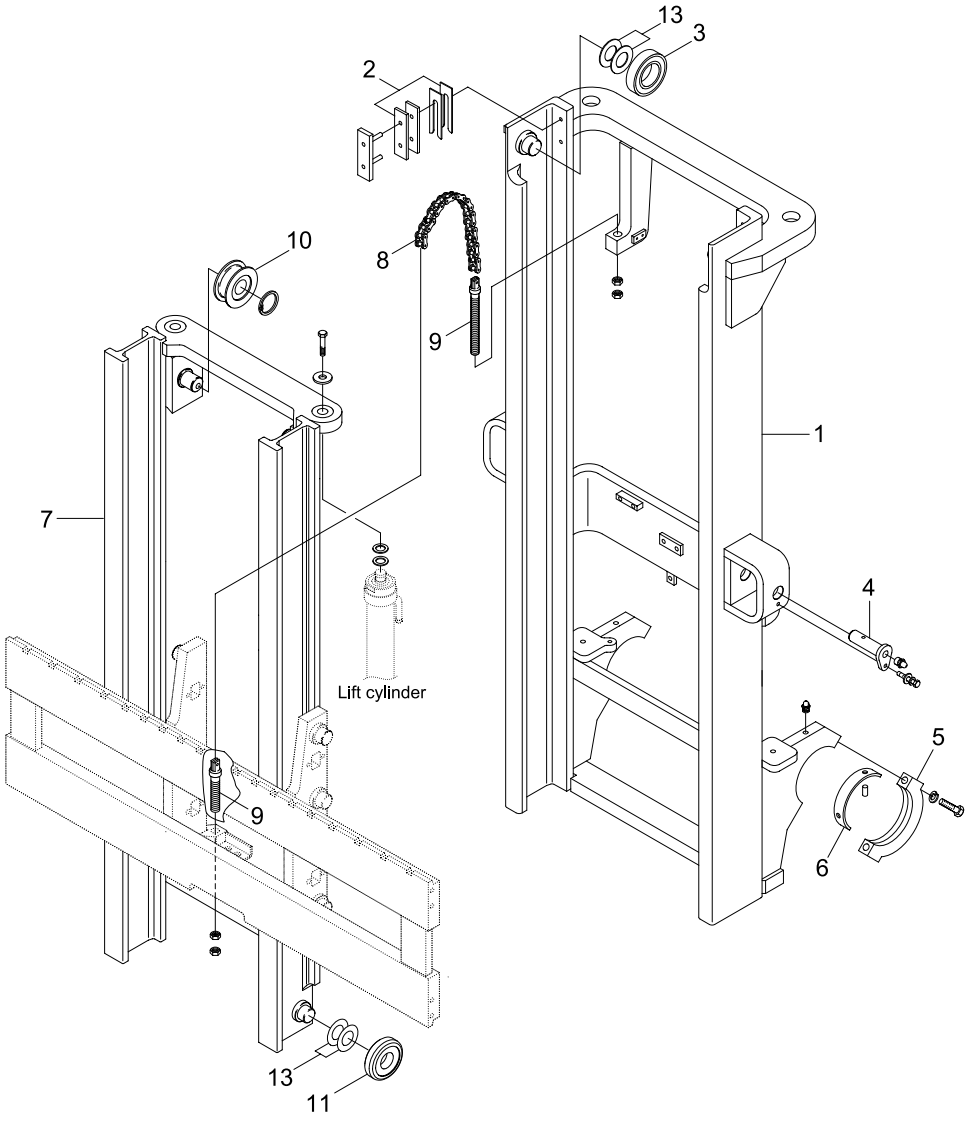
## GROUP 5 TROUBLESHOOTING

| Trouble symptom | Probable cause | Remedy |
|---|---|---|
| Lamps dimming even at maximum engine speed. | · Faulty wiring. | · Check for loose terminal and disconnected wire. |
| Lamps flicker during engine operation. | · Improper belt tension. | · Adjust belt tension. |
| Charge lamp does not light during normal engine operation. | · Charge lamp defective.<br>· Faulty wiring. | · Replace.<br>· Check and repair. |
| Alternator makes abnormal sounds. | · Alternator defective. | · Replace |
| Starting motor fails to run. | · Faulty wiring.<br>· Insufficient battery voltage. | · Check and repair.<br>· Recharge battery. |
| Starting motor pinion repeats going in and out. | · Insufficient battery voltage. | · Recharge battery. |
| Excessively low starting motor speed. | · Insufficient battery voltage.<br>· Starting motor defective. | · Recharge battery.<br>· Replace |
| Starting motor comes to a stop before engine starts up. | · Faulty wiring.<br>· Insufficient battery voltage. | · Check and repair.<br>· Recharge battery. |
| Heater signal does not become red. | · Faulty wiring.<br>· Glow plug damaged. | · Check and repair.<br>· Replace |
| Engine oil pressure caution lamp does not light when enigne is stopped (with starting switch left in"ON" position). | · Caution lamp defective.<br>· Caution lamp switch defective. | · Replace<br>· Replace |

# SECTION 8 MAST

## GROUP 1 STRUCTURE

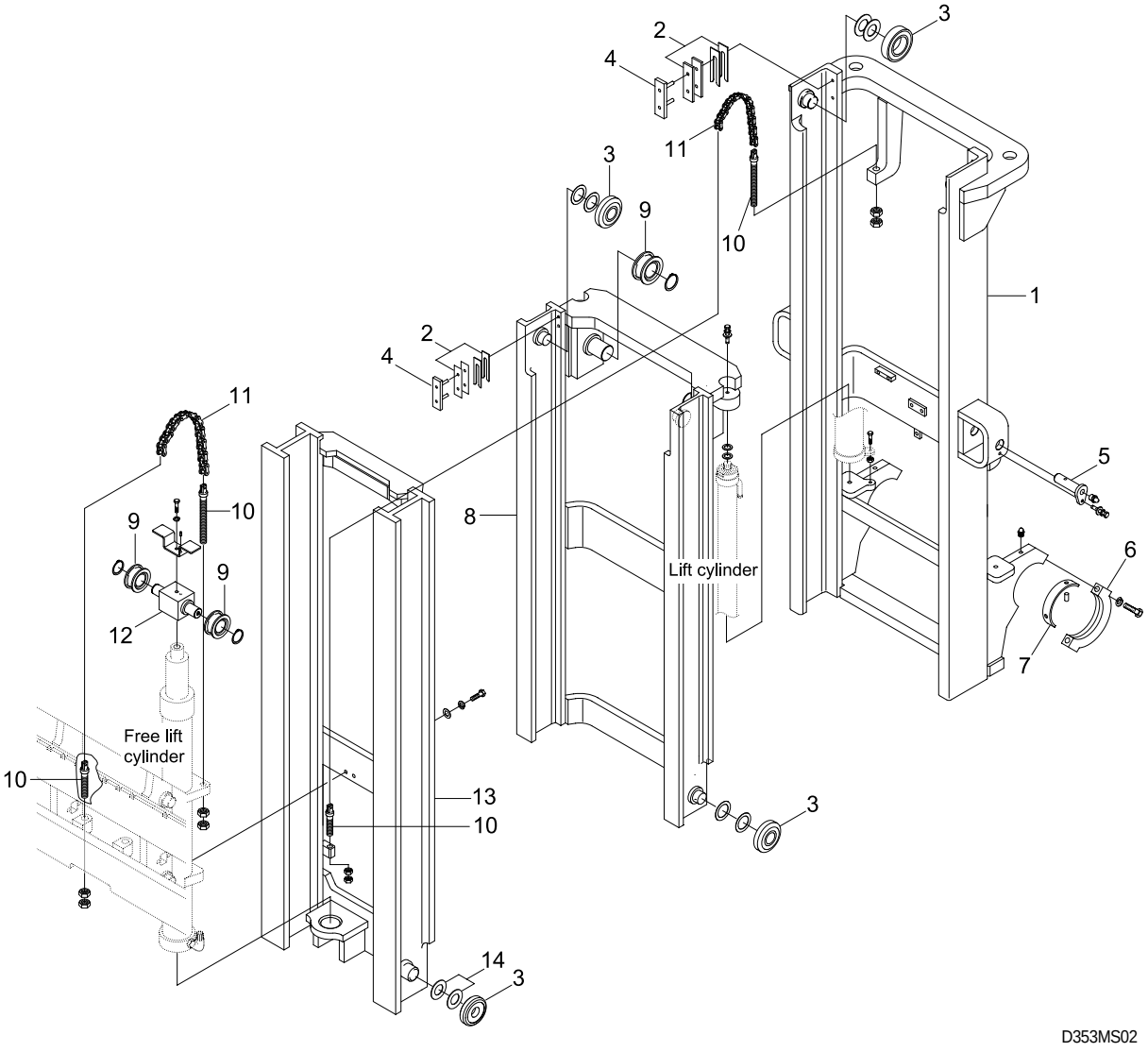
### 1. 2 STAGE MAST(V MAST)




D353MS01

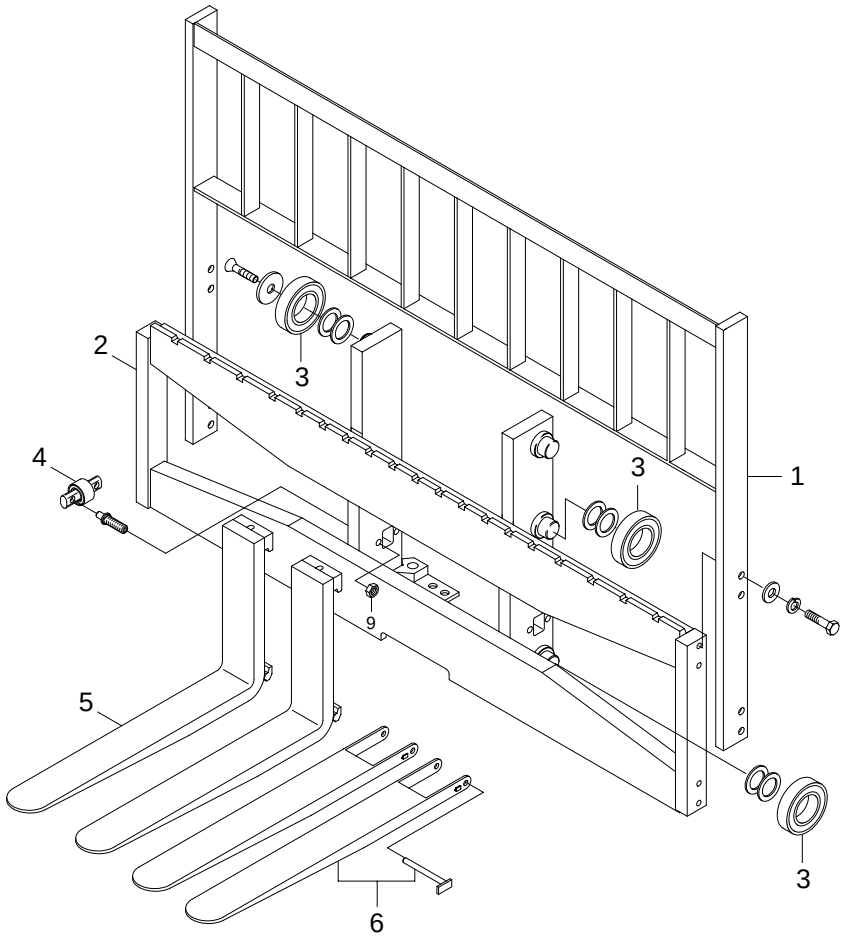
| | | | | | |
|---|---|---|---|---|---|
| 1 | Outer mast | 6 | Bushing | 10 | Chain sheave |
| 2 | Shim(0.5, 1.0t) | 7 | Inner mast | 11 | Roller |
| 3 | Roller | 8 | Lift chain | 12 | Back up liner |
| 4 | Tilt cylinder pin | 9 | Anchor bolt | 13 | Shim(0.5, 1.0t) |
| 5 | Cap | | | | |

## 2. 3 STAGE MAST(TF MAST)

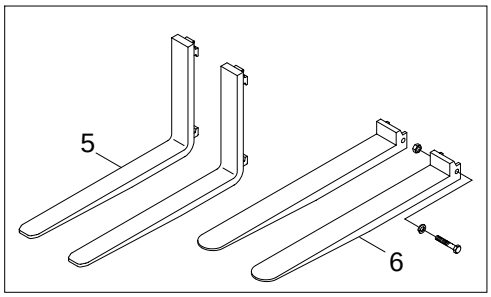



| | | | | | |
|---|---|---|---|---|---|
| 1 | Outer mast | 6 | Cap | 11 | Chain |
| 2 | Shim(0.5, 1.0t) | 7 | Bushing | 12 | Sheave bracket |
| 3 | Roller | 8 | Middle mast | 13 | Inner mast |
| 4 | Back up liner | 9 | Sheave | 14 | Shim(0.5, 1.0t) |
| 5 | Tilt cylinder pin | 10 | Anchor bolt | | |

## 3. CARRIAGE, BACKREST AND FORK




HDF35-3




D353MS03

| | | | |
|---|---|---|---|
| 1 | Carriage | 4 | Side roller |
| 2 | Backrest | 5 | Fork assy |
| 3 | Load roller | 6 | Extension fork |

# GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

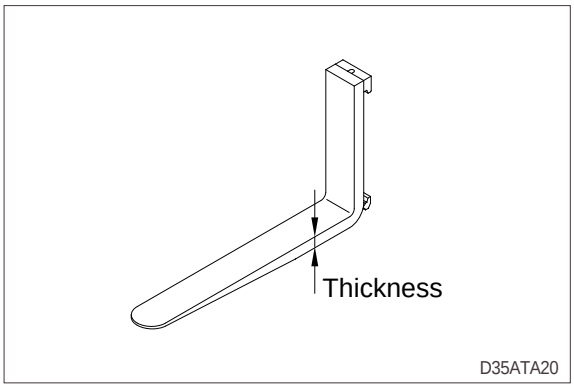
## 1. OPERATIONAL CHECKS

### 1) FORKS

(1) Measure thickness of root of forks and check that it is more than specified value.
EX : ℓ =1070mm(42.1in)

mm(in)

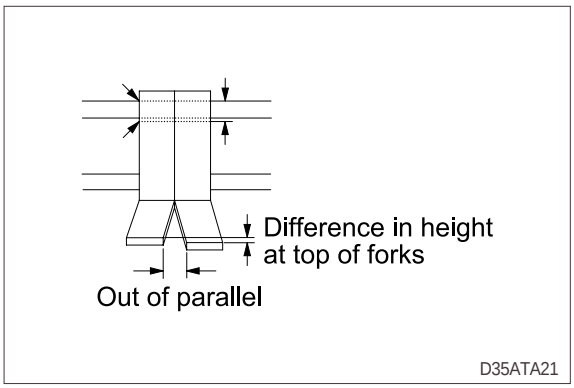
| STD Fork assy | Applicable model | Standard | Limit |
|---|---|---|---|
| S173896-02 | HDF35III | 50(2.0) | 48(1.9) |
| F173936-01 | HDF45III | 50(2.0) | 48(1.9) |




2) Set forks in middle and measure out of parallel and difference in height at top of forks.

mm(in)

| | |
|---|---|
| Difference in height | Max 15(0.6) |
| Out-of-parallel | Max 35(1.4) |




3) Most force is concentrated at root of fork and at hook, so use crack detection method to check cracks.

## 2. MAST

1) Check for cracks at mast stay, tilt cylinder bracket, guide bar, fork carriage and roller shaft weld. Check visually or use crack detection method. Repair any abnormality.
2) Set mast vertical, raise forks about 10cm from ground and check front-to-rear clearance and left-to-right clearance between inner mast and fork carriage, and between outer mast and inner mast. Use these figures to judge if there is any play at roller or rail.
   · Front-to-rear clearance : Within 2.0mm(0.08in)
   · Left-to-right clearance : Within 2.5mm (0.10in)
3) Check that there is an oil groove in bushing at mast support.
4) Set mast vertical, raise forks about 10cm from ground, and push center of lift chain with finger to check for difference in tension.
   If there is any difference in tension, adjust chain stopper bolt.
5) Check visually for abnormalities at thread of chain anchor bolt, and at contact surface between chain wheel and chain.
   Rotate chain wheel by hand and check for any play of bearing.

## 2. TROUBLESHOOTING

### 1) MAST

| Problem | cause | Remedy |
|---|---|---|
| Forks fail to lower. | · Deformed mast or carriage. | · Disassemble, repair or replace. |
| Fork fails to elevate | · Faulty hydraulic equipment. | · See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system. |
| | · Deformed mast assembly. | · Disassemble mast and replace damag-ed parts or replace complete mast assembly. |
| Slow lifting speed and insufficient handling capacity. | · Faulty hydraulic equipment. | · See troubleshooting hydraulic pump and Cylinders in section 6, hydraulic system. |
| | · Deformed mast assembly. | · Disassemble mast and replace damag-ed parts or replace complete mast assembly. |
| Mast fails to lift smoothly. | · Deformed masts or carriage. | · Disassembly, repair or replace. |
| | · Faulty hydraulic equipment. | · See Troubleshooting Hydraulic Cylinders pump and control valve in section 6, hydraulic system. |
| | · Damaged load and side rollers. | · Replace. |
| | · Unequal chain tension between LH & RH sides. | · Adjust chains. |
| | · LH & RH mast inclination angles are unequal. (Mast assembly is twisted when tilted) | · Adjust tilt cylinder rods. |
| Abnormal noise is produced when mast is lifted and lower-ed. | · Broken load roller bearings. | · Replace. |
| | · Broken side roller bearings. | · Replace. |
| | · Deformed masts. | · Disassemble, repair or replace. |
| | · Bent lift cylinder rod. | · Replace. |
| | · Deformed carriage. | · Replace. |
| | · Broken sheave bearing. | · Replace. |
| Abnormal noise is produced during tilting operation. | · Insufficient lubrication of anchor pin, or worn bushing and pin. | · Lubricate or replace. |
| | · Bent tilt cylinder rod. | · Replace. |

**2) FORKS**

| Problem | cause | Remedy |
|---|---|---|
| Abrasion | Long-time operations causes the fork to wear and reduces the thickness of the fork.<br>Inspection for thickness is needed.<br>· Wear limit : Must be 90% of fork thickness | If the measured value is below the wear limit, replace fork. |
| Distortion | Forks are bent out of shape by a number of reasons such as overloading, glancing blows against walls and objects, and picking up load unevenly.<br>· Difference in fork tip height : 15㎜<br>· Difference in fork tip width : 35㎜ | If the measured value exceeds the allowance, replace fork. |
| Fatigue | Fatigue failure may result from the fatigue crack even though the stress to fork is below the static strength of the fork. Therefore, a daily inspection should be done.<br>· Crack on the fork heel.<br>· Crack on the fork weldments. | Repair fork by expert.<br>In case of excessive distortion, replace fork. |

## GROUP 3 ADJUSTMENT

### 1. MAST LOAD ROLLER(V MAST)

#### 1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

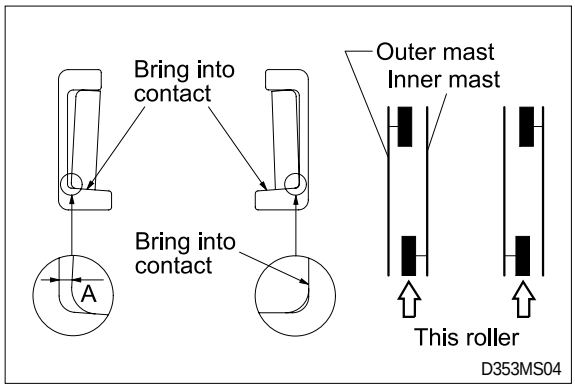
(1) Measure the clearance with the mast overlap at near 480mm.

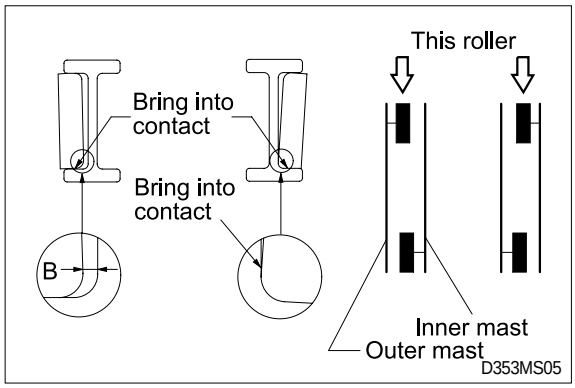
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner/outer mast roller shim.

- Standard clearance A, B = 0~0.6mm
- Shim thickness 0.5, 1.0mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Mast load roller and back up liner, removal and Installation.

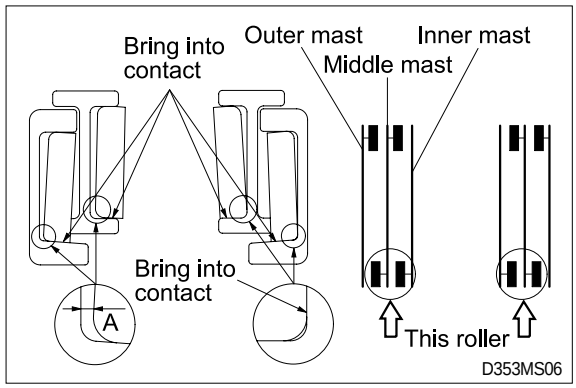
(4) After the adjustment, check that the inner mast moves smoothly in the outer mast.



## 2. MAST LOAD ROLLER(TF MAST)

### 1) INNER AND MIDDLE MAST ROLLER CLEARANCE ADJUSTMENT




(1) Measure the clearance with the mast overlap at near 480mm.

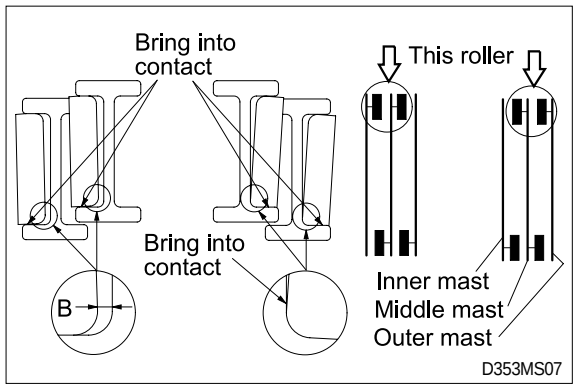
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner and middle mast roller shim, respectively.

- Standard clearance A = 0~0.6mm
- Shim thickness 0.5, 1.0mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Mast load roller and back up liner, removal and Installation.

(4) After the adjustment, check that the inner mast moves smoothly in the middle mast, and the middle mast moves smoothly in the outer mast.

### 2) OUTER AND MIDDLE MAST UPPER ROLLER CLEARANCE ADJUSTMENT.




(1) Measure the clearance with the mast overlap at near 480mm.

(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the outer and middle mast roller shim, respectively.

- Standard clearance B = 0~0.6mm
- Shim thickness 0.5, 1.0mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Mast load roller and back up liner, removal and Installation.

(4) After the adjustment, check that the inner mast moves smoothly in the middle mast, and the middle mast moves smoothly in the outer mast.

### 3) CARRIAGE LOAD ROLLER

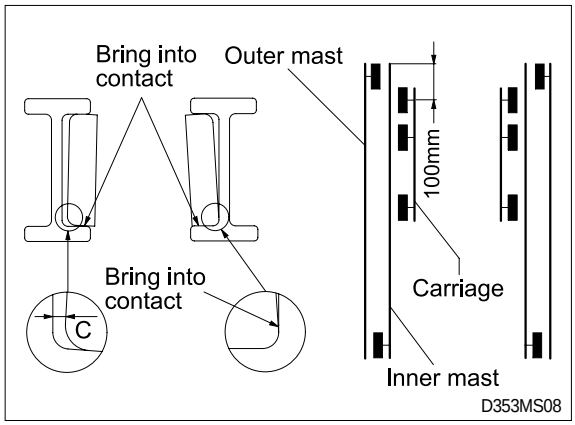
(1) Measure the clearance when the center of the carriage upper roller is 100㎜ from the top of the inner mast.

(2) Measure the clearance at upper, middle and lower rollers after loosen the adjust screws from the side rollers. Shift the carriage to one side to bring the roller into contact with the inner mast, and measure the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the carriage roller shim.

- Standard clearance C = 0~0.6㎜
- Shim thickness 0.5, 1.0㎜

(3) Distribute the shim thickness equally to the left and right roller. Refer to Carriage assembly.

(4) After the adjustment, the carriage should move smoothly along the overall mast length.



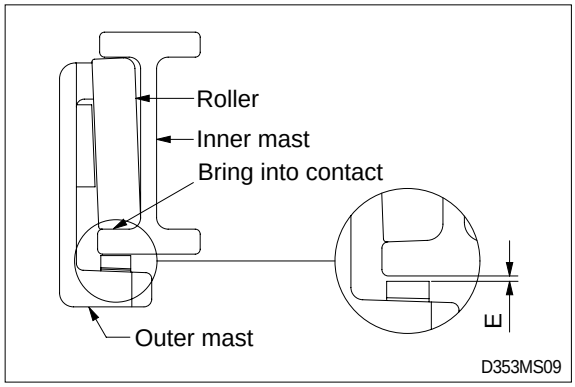

### 4) MAST BACK UP LINER

(1) Measure the clearance with the middle mast at the bottom position.

(2) With the middle mast in contact with the outer mast roller, adjust the clearance between the mast back up liner and middle to the following value by inserting the back up liner shim.

- Standard clearance E = 0.2 ~ 0.6㎜
- Shim thickness 0.5, 1.0㎜

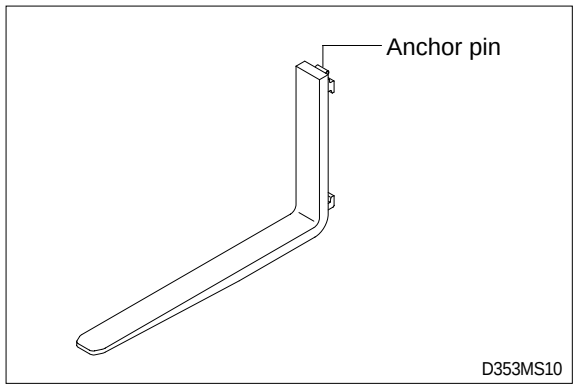
(3) After the adjustment, the must should move smoothly.



## GROUP 4 REMOVAL AND INSTALLATION

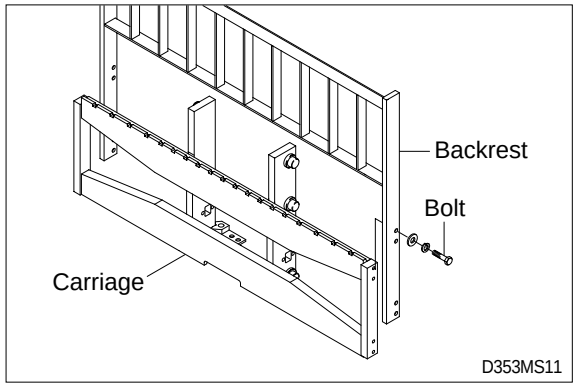
### 1. FORKS

1) Lower the fork carriage until the forks are approximately 25mm(1inch) from the floor.
2) Release fork anchor pins and slide forks, one at time toward the center of the carriage where a notch has been cut in the bottom plate for easy fork removal.
3) Remove the fork one at time. On larger forks it may be necessary to use a block of wood.
4) Reverse the above procedure to install load forks.




### 2. BACKREST

1) Remove bolts securing backrest to fork carriage. Lift backrest straight up and remove from carriage.
2) Position backrest on carriage and lower in place. Install and tighten bolts.




### 3. CARRIAGE ASSEMBLY

#### 1) CARRIAGE

(1) With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is raised.
(2) While supporting lift chains, remove the split pin and side out chain anchor pins from the chain anchors of stationary upright.
(3) Pull the chains out of the sheaves and drape them over the front of the carriage.
(4) Slowly raise elevating upright until mast clears top of fork carriage. Move carriage to work area and lower mast.

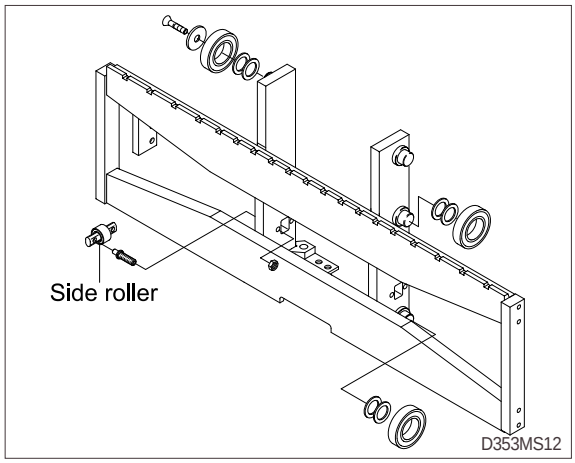
⚠ Make sure carriage remains on floor and does not bind while mast is being raised.

(5) Inspect all parts for wear or damage. Replace all worn or damaged pars.
(6) Reverse the above steps to reinstall.

⚠ Replace the split pin of chain anchor with new one.

**2) SIDE ROLLER**

(1) Remove carriage as outlined in the carriage assembly removal paragraph.
(2) Loosen and remove nuts, adjust screws and side rollers from carriage side pate.
(3) Thoroughly clean, inspect and replace all worn or damaged parts.
(4) Reverse the above procedure to assembly.

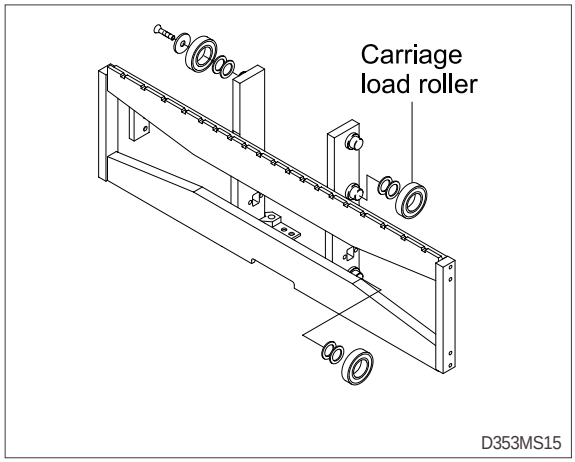



※ **Adjustment**

- Once carriage is properly installed, loosen nuts and adjust screws, (if not already done) allowing carriage to be centered in the inner mast.
- Adjust side roller by tightening screw until side roller just makes contact with mast. Back off approximately 1/10 turn on screw and tighten nut to lock screw in place.
- Run carriage up and down the inner mast to be sure the carriage has free movement and does not stick. Also, make sure chains are properly adjusted.
  Refer to chain adjustment paragraph.
  Make adjustment when necessary and recheck operation of carriage.

**3) CARRIAGE LOAD ROLLER**

(1) Remove carriage as outlined in the carriage assembly removal paragraph.
(2) Loosen and remove flat head bolts and plain washers from top load roller bracket.
(3) Using a player, remove load rollers from load roller bracket.
(4) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT paragraph.



**4) MAST LOAD ROLLER AND BACK UP LINER**

**(1) 2 stage mast(V mast)**

① Remove the carriage assembly and move them to one side.

② Loosen and remove hexagon bolts and washers securing lift cylinders to inner mast.

③ Loosen and remove hexagon bolts and nuts securing lift cylinders to inner mast.

④ Attach chains or sling to the inner mast section at top crossmember. Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.

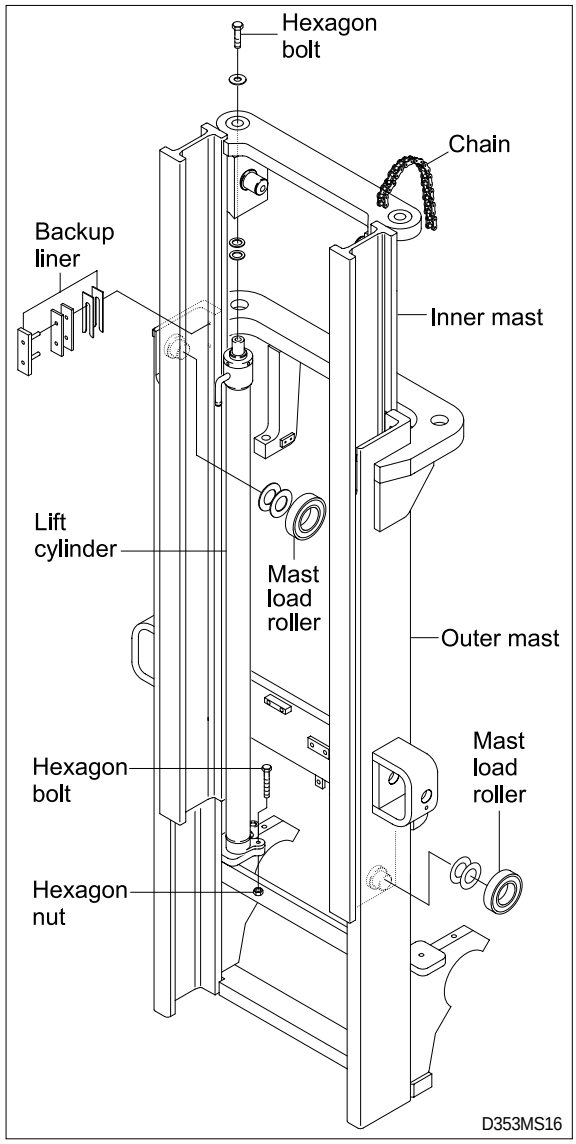
⑤ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and them with ropes to the outer mast.

⑥ Using the overhead hoist, lower inner mast until top and bottom rollers and back up liners are exposed.

⑦ Using a player, remove load rollers from load roller bracket. Remove back up liners and shims.

⑧ Thoroughly clean, inspect and replace all worn or damaged parts.

⑨ Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT paragraph.



**(2) 3 stage mast(TF mast)**

① Remove the carriage assembly and move to one side.

② Loosen and remove hexagon bolt securing bottom cylinder from outer mast.

③ Loosen and remove bolts and special washers securing lift cylinders to middle mast.

④ Attach chains or sling to the inner and middle mast section at top crossmember. Using an overhead hoist, slowly raise the uprights high enough to clear lift cylinder.

⑤ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and tie them with ropes to the outer mast.

⑥ Using the overhead hoist raise inner and middle masts. Place 4 inch block of wood under the free lift cylinder bracket of the inner mast then lower mast sections (this will create slack in the chains).

⑦ Remove retaining rings securing chain sheaves to sheave support brackets. While support chains, remove chain sheaves and let chains hang free. The upper outer and lower middle mast rollers and back up liners are now exposed.

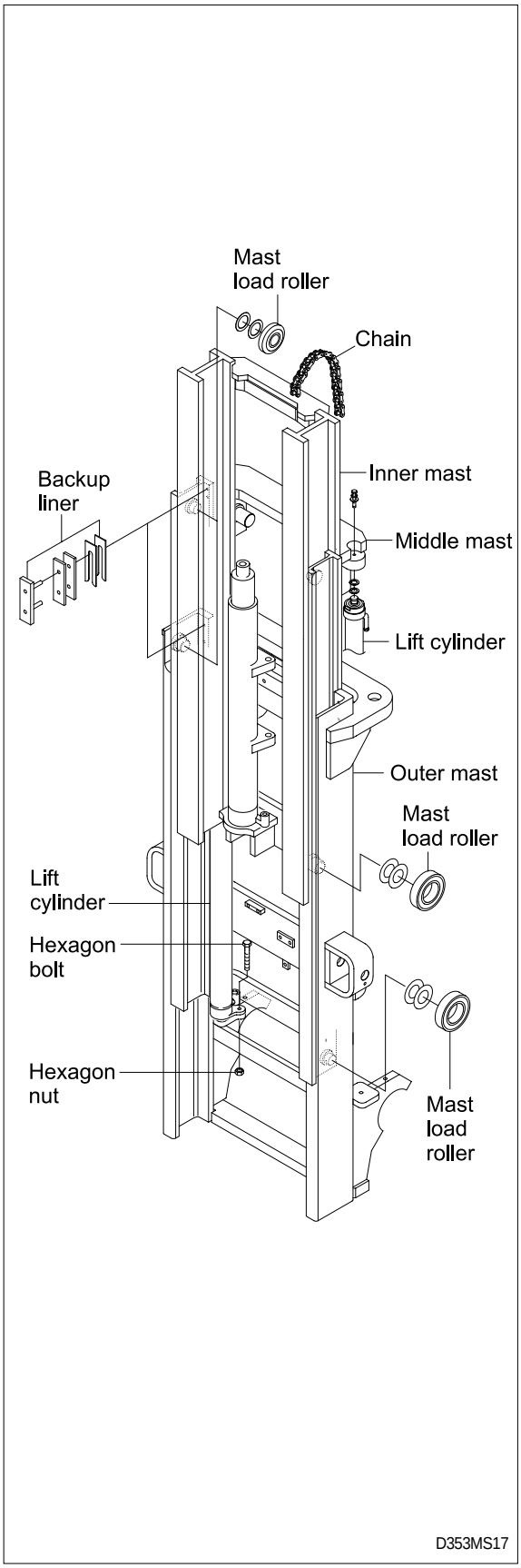
⑧ Using a player, remove load rollers from load bracket. Remove back up liners and shims.

⑨ Attach chains or sling to the middle mast section at top crossmember. Using an overhead hoist, slowly raise the middle mast until top and bottom rollers are exposed.

⑩ Using a player, remove load rollers from load roller bracket.

⑪ Thoroughly clean, inspect and replace all worn or damaged parts.

⑫ Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT paragraph.



### 5) ELEVATING MAST

#### (1) Inner mast (V mast)

① After completing all necessary steps for load rollers and back up liner removal use an overhead hoist and sling or chain around upper crossmember of the inner mast section.

② Lift inner mast upright straight up and out of outer mast section.

③ Replace and reverse above procedure to install. Make all necessary measurements and adjustments.

#### (2) Inner and middle mast(TF mast)

① After completing all necessary steps for load rollers and back up liner removal. Remove rear chains and sheave support if not already done.

② Disconnect free lift cylinder hose. Drain hose into a suitable pan or container and cap hose.

③ While supporting free lift cylinder assembly, remove bolts and washers securing cylinder to mast crossmember.

④ Place a sling around free lift cylinder and attach to an overhead hoist. Slowly raise and move cylinder to one side.

⑤ Attach chains or sling to the inner mast section at top crossmember. Using an overhead hoist slowly raise the upright straight up and out of middle mast section.

⑥ Attach chains or sling to the middle mast section at top crossmember. Using an overhead hoist slowly raise the upright straight up and out of outer mast section.

⑦ Replace upright and reverse above procedure to install. Make all necessary measurements and adjustments.

### 6) CHAIN

#### (1) Chain sheave(V mast)

① Place a sling around carriage and attach to an overhead hoist. Lift carriage high enough so that the tension on the chain over sheaves is relieved after the carriage is blocked. Position wooden blocks under the carriage and lower it.

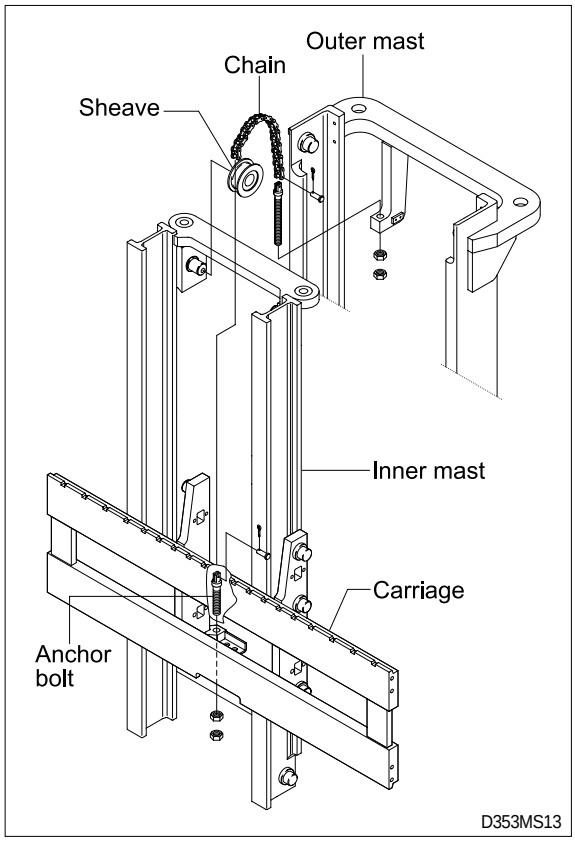
② Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins and drape the chains over the carriage.

③ Remove retaining ring securing sheaves to sheave support. Remove sheaves with bearings.

④ Remove bearining retaining ring from sheave and press bearings from sheaves.

⑤ Thoroughly clean, inspect and replace all worn or damaged parts.

⑥ Reverse the above to assemble and install. Use new split pins in chain anchor pins.




#### (2) Rear chain sheave(TF mast)

① Raise and securely block carriage and inner mast section.

② Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins from outer mast section.

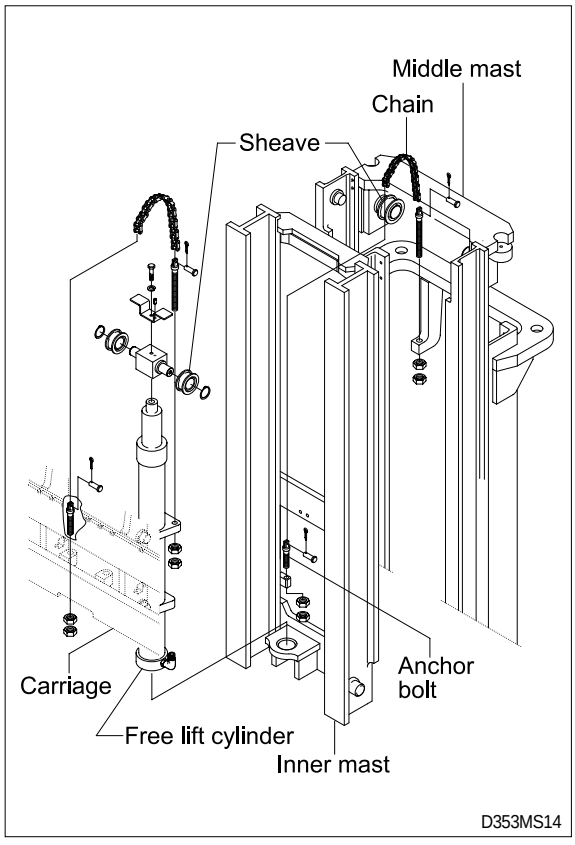
③ Remove chains.

④ Remove retaining ring securing chain sheaves to sheave support. Pry off sheaves with bearings.

⑤ Remove bearing retaining ring from sheave and press bearings from sheaves.

⑥ Thoroughly clean, inspect and replace all worn or damaged parts.

⑦ Reverse the above procedure to assemble and install. Use new split pins in chain anchor pins.



**(3) Sheave support(TF mast)**

① Remove the carriage assembly and move to one side.
② After removing bolt to securing sheave support assembly to free lift cylinder.
Attach a sling to the sheave support assembly. Using an overhead hoist, lift support assembly straight up and off of free lift cylinder. Move assembly to work area.
③ Remove retaining ring securing sheave to sheave support.
④ Remove bearing retaining ring from sheave and press bearings from sheaves.
⑤ Thoroughly clean, inspect and replace all worn or damaged parts.
⑥ Reverse the above procedure to install.

**(4) Rear chain(TF mast)**

① Remove the carriage assembly and move to one side. Refer to carriage removal and installation.
② Raise and securely block truck approximately 6 inches from the floor.
③ Using a sling or chain around inner mast section attached to an overhead hoist, slowly raise inner mast until there is enough slack in the chains to remove them. Block inner mast section.
④ Remove split pins and chain anchor pins securing chains to chain anchor(part of inner mast).
⑤ While supporting the chains, remove split and chain anchor pins securing chains to chain anchors attached to outer mast section.
⑥ Remove chains.
⑦ Reverse the above to assemble and install. Use new split pins in chain anchor pins. Refer to this section for Load chain lubrication and adjustment.

**(5) Carriage chain**

① Place a sling around carriage front plate and attach to an overhead hoist. Lift and secure carriage high enough so that split and chain anchor pins on carriage can be easily be removed. Remove chain anchor pins from carriage and drape chains out over carriage.
② Place a wooden block under the carriage and lower the carriage on the block.
③ While supporting the chains, remove split pins and chain anchor pins from chain anchors.
④ Remove chains and wash them with solvent. Refer to this section for Load chain inspection and maintenance.
⑤ Reverse the above procedure to assemble and install. Use new split pins in chain anchor pins.
Refer to this section for Load chain lubrication and adjustment.

**(6) Load chain inspection and maintenance**

After every 200 hours of truck operation, lift chains should be inspected and lubricated inspect for the following chain conditions :

**① Wear**

As the chain flexes on and off the sheaves, the joints very gradually wear. The stretch a chain developes in service is due to material being worn off pin outer diameter and pitch hole inner diameter on the inside plate.

Chain wear can be measured using a wear scale or steel tape. When chains have elongated 2%, they should be discarded. When checking chain wear, be sure to measure a segment of chain that operates over a sheave. Do not repair chains by cutting our the worn section and splicing in a new piece. If part of the chain is worn, replace all the chains on the truck.

② **Rust and corrosion**

Chains used on lift trucks are highly stressed precision components. It is very important that the "as-manufactured" ultimate strength and fatigue strength be maintained throughout the chain service life. Corrosion will cause a major reduction in the load-carrying capacity of lift chain or roller chain because corrosion causes side plate cracking.

③ **Cracked plate**

The most common cause of plate cracking is fatigue failure. Fatigue is a penomenon that affects most metals and many plastics. After many repeated heavy loads, the plates may crack and the chains will eventually break. Fatigue cracks are almost always found through the pitch holes perpendicular to the pitch line. Contrast this failure mode to the random failures caused by stress-corrosion cracking. If cracks are present, replace all the chain on the truck. Noise in the chain indicates that the plate is on the verge of cracking and will be failed before long.

④ **Tight joints**

All joints in lift chain should flex freely. Tight joints resist flexure, increase internal friction, thus increasing chain tension required to lift a given load. Increased tension accelerates wear and fatigue problems.

Tight joints in lift chains can be caused by :

- Bent pins or plates.
- Rusty joints.
- Peened plate edges.

Oil rusty chains and replace chains with bent or peened components.

⑤ **Protruding or turned pins**

Heavily loaded chains operating with lube generate tremendous friction between pins and plates. In extreme cases, the frictional torque in the joint can actually turn pins in the press-fit outside plates. If chain is allowed to operate in this condition, the pins slowly work out of the chain causing chain failure. Turned pins can be quickly spotted because the flats on the V heads are no longer in line. Chains with turned or protruding pins should be replaced immediately. Do not attempt to repair the chain by driving pins back into the chain.

⑥ **Chain side wear**

A wear pattern on pin heads and outside plates indicates misalignment. This condition damages chain and sheaves as well as increasing internal friction in the chain system.

⑦ **Chain anchors and sheaves**

An inspection of the chain system includes a close examination of chain anchors and sheaves. Check chain anchors for wear, breakage and misalignment. Anchors with worn or broken fingers should be replaced. Anchors should be adjusted to eliminate twisting or other misalignment in the chain. When chain is misaligned, load is not distributed uniformly between the plates. Prolonged operation will result in premature fatigue failure. Sheaves with badly worn flanges and outside diameter should be replaced. Heavy flange wear indicates chain misalignment.

**⑧ Chain wear scale**

The chain can be checked for wear or stretching with the use of a chain wear scale. Stretching of a chain is due to the elongation of the pitch holes and wearing of the pin O.D. The greatest amount of stretching occurs at the areas of the chain that flex over the sheaves most frequently. Check the chain at this point with a scale. The wear scale has instructions printed on the sides for use in determining chain stretch and are as follows :

- Determine pitch length of chain using 6 inch scale on one side of wear scale.
- If pitch is 1/2(12.7mm), 3/4(19.05mm), 1(25.4mm), 1-1/2(38.1mm), 2(50.8mm), use side A of scale.
- If pitch is 5/8(15.875mm), 1-1/4(31.75mm) or 2(50.8mm), use side B.
- Align point A or B to center of a pin and note position of the opposite A or B point.
- If other point also lines up with a pin, the chain is worn and should be replaced.

If any of the above conditions exists(cracked plates, turned pins, stretching etc), the chains should be replaced in pairs as a complete assembly. Order chains by part number to insure the correct chain length, pitch and material specifications.

**(7) Load chain lubrication and adjustment**

**① Lubrication**

The most important consideration in field maintenance of lift chains is lubrication. Hard working, heavily loaded chains cannot be expected to give satisfactory wear life without scheduled periodic re-lubrication. Like all bearing surfaces, the precision manufactured, hardened steel, joint-wearing surfaces require a film of oil between mating parts to prevent rapid wear. Oil must penetrate the chain joint to prevent wear. Applying oil to external surfaces will prevent rust, but oil must flow into the live bearing surfaces for maximum wear life. Frequency of re-lube will vary with operating conditions and environment, the best estimate of lube period is 200 hours. Trucks parked outdoors or trucks in extremely severe service, may require more frequent re-lube to maintain an oil film on all chain surface.

- Wipe off the old oil with a clean cloth and blow out the remaining dirt with compressed air.

**⚠ Wear eye protection.**

- With a clean brush, apply EP-140 extreme pressure lubricant or heavy motor oil(40W).

**② Replacement**

Replace chains as a pair. It will be virtually impossible to maintain uniform loading between the strands if a new chain is put into service opposite an old chain. The jonts in the old chain will be greater than that on the new chain, greatly complicating the problem of maintaining equal chain tension. The new chain will wear more slowly causing it to bear the major portion of the load resulting in premature wear and fatigue failure. Don't steam clean or decrease new chains.

The manufacturer's grease is effective in reducing wear and corrosion. If the original factory lube is dried out or wiped off, soak the new chain in heavy engine oil for at 1/2 hour prior to installing on truck. After the old chains have been stripped from the mast, very carefully inspect chain anchors and sheaves. Broken, cracked or worn anchor must be replaced using the new anchor pin and split pin. Do not paint newly replaced chain after it has been installed.

③ **Adjustment**

Chain adjustments are important for the following reasons :

- Equal loading of chain.
- Proper sequencing of mast.
- Prevent over-stretching of chains.
- Prevent chains from jumping off sheaves if they are too loose.

④ **Adjustment procedure**

- With mast in its fully collapsed and vertical position, lower the fork to the floor.
- Adjust the chain length by loosening or tightening nut on the chain anchor.
  After making adjustment on the mast, be sure to tighten the nut.