

### 3. SPECIFICATIONS AND PERFORMANCE

#### ■ SPEED AND GRADEABILITY

| Model         | E9SR EVOLUTION        |                     |
|---------------|-----------------------|---------------------|
| Item          | (Rubber Crawler Shoe) |                     |
| Slewing Speed | 9.0 rpm               |                     |
| Travel Speed  | Low (1st.)            | High (2nd.)         |
|               | 2.0 km / h (1.2mph)   | 3.5 km / h (2.2mph) |
| Gradeability  | %(degree)             | 58% (30)            |

#### ■ SIDE DIGGING & DOZER

|                                       |                                  |     |
|---------------------------------------|----------------------------------|-----|
| Type                                  | Boom swing by hydraulic cylinder |     |
| Boom Swing Angle                      | Right                            | 50° |
|                                       | Left                             | 80° |
| Strokes of Dozer (above/below) mm(in) | 190 / 240 (7.5 / 9.4)            |     |

#### ■ ENGINE

|                                   |                                               |
|-----------------------------------|-----------------------------------------------|
| Model                             | YANMAR 2TNE68-YB                              |
| Type                              | Vertical, 4-cycle, water cooled diesel engine |
| Number of cylinders-Bore X Stroke | 2-68 mm X 72 mm (2.68 in x 2.83 in)           |
| Total Displacement                | 0.52 liters (31.7 cu.in)                      |
| Output Rating                     | 7.8PS (5.7kW) / 2000 rpm                      |
| Maximum Torque                    | 3.1 kgf·m/1500rpm (22 lbf·ft / 1500rpm)       |
| Starting Motor                    | 12V X 0.9 kW                                  |
| Generator (Dynamo)                | 12V X 20A                                     |

#### ■ HYDRAULIC COMPONENTS

|                                                             |                                               |
|-------------------------------------------------------------|-----------------------------------------------|
| Hydraulic Pump                                              | Variable displacement axial piston + gearpump |
| Hydraulic Motor                                             | Orbit motor                                   |
| Hydraulic Motor w/Reducer (Travel)                          | Axial piston, 2 speed motor                   |
| Control Valve                                               | 9-function multiple control valve             |
| Cylinder ( Boom, Arm, Swing<br>Bucket, Dozer, Frame width ) | Double acting cylinder                        |
| Return filter                                               | Safety valve containing / Filter Type (30μ)   |

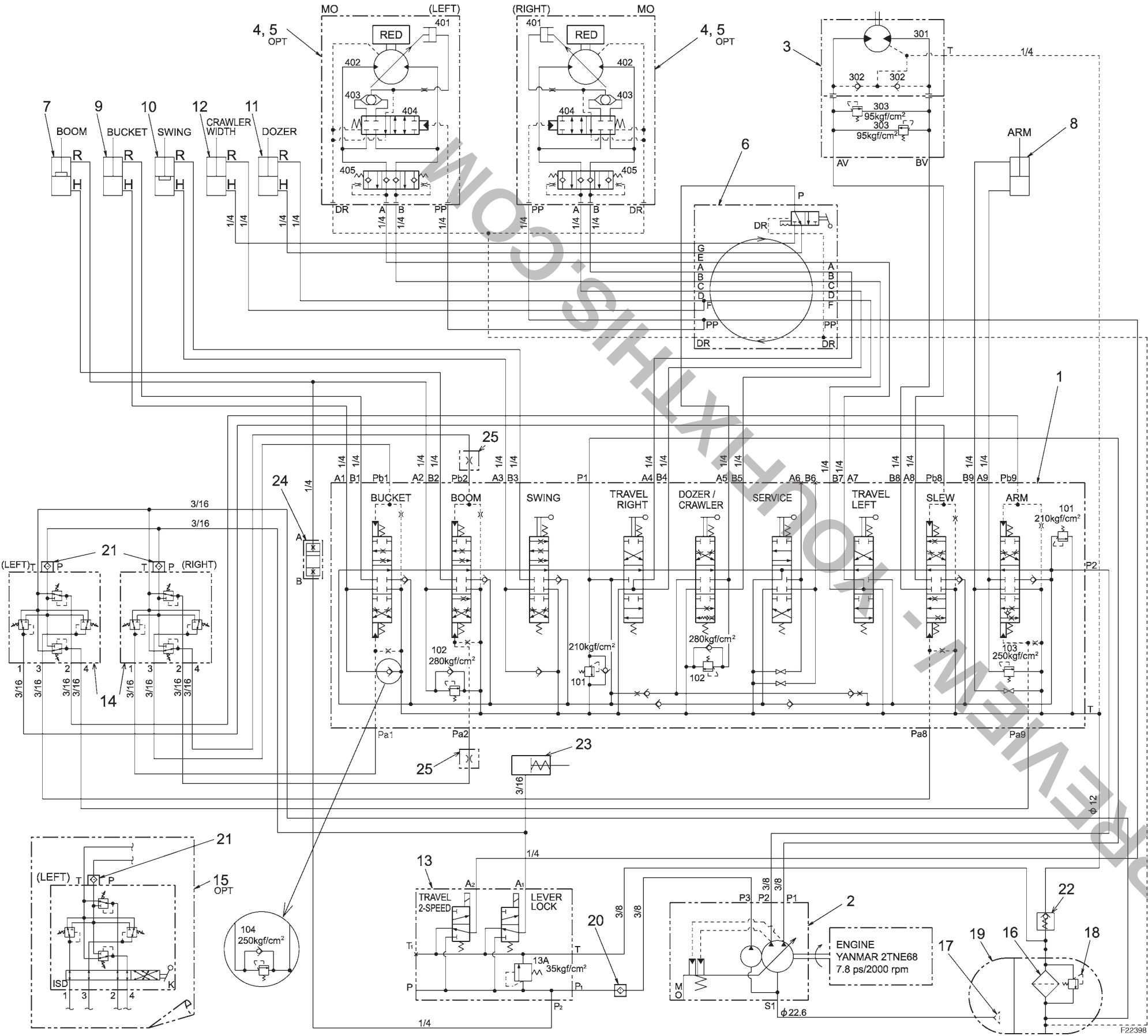
#### ■ NOISE LEVEL

|                   |           |
|-------------------|-----------|
| Sound power level | 87 dB (A) |
|-------------------|-----------|

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2. HYDRAULIC CIRCUITS AND COMPONENT MODELS

2.1 STANDARD SPECIFICATIONS

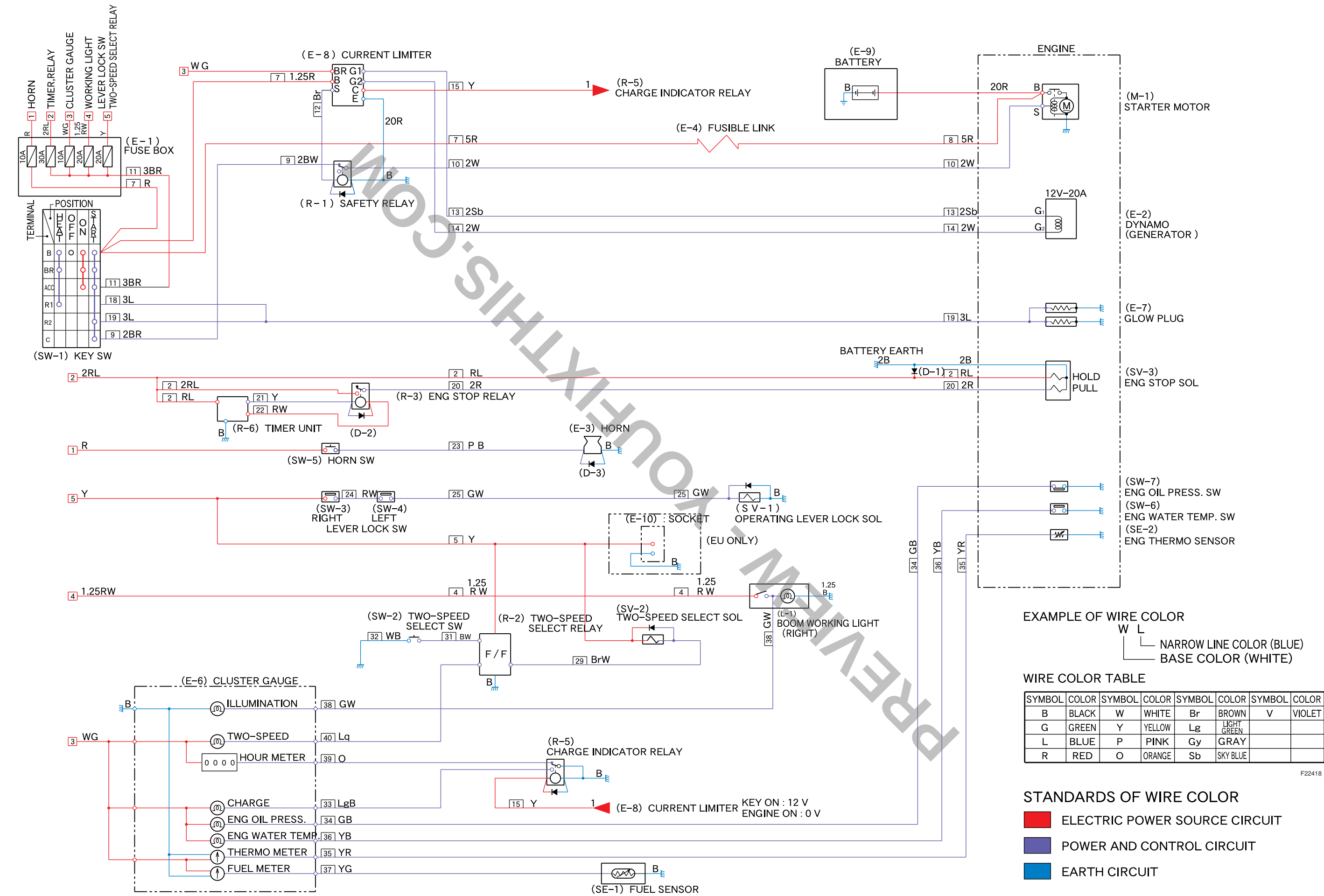


| No. | NAME                    | MODEL No.       |
|-----|-------------------------|-----------------|
| 1   | CONTROL VALVE           | KVS-31          |
| 2   | PUMP ASSY               | PVD-00B-11      |
| 3   | SLEWING MOTOR           | 2-160DOS        |
| 4   | TRAVEL MOTOR            | PHV-80-25       |
| 5   | TRAVEL MOTOR (With P/B) | PHV-80-25B      |
| 6   | SWIVEL JOINT            | YV-7185         |
| 7   | BOOM CYLINDER           | ø50 × ø25 × 323 |
| 8   | ARM CYLINDER            | ø50 × ø30 × 330 |
| 9   | BUCKET CYLINDER         | ø45 × ø25 × 270 |
| 10  | SWING CYLINDER          | ø65 × ø35 × 292 |
| 11  | DOZER CYLINDER          | ø50 × ø30 × 90  |
| 12  | CRAWLER WIDTH CYLINDER  | ø50 × ø25 × 230 |
| 13  | SOLENOID VALVE          | 2KWE5A          |
| 14  | PILOT VALVE             | PV48M1007B      |
| 15  | PILOT VALVE (A-B)       | PV48MR1008D     |
| 16  | RETURN FILTER           | Y-46900         |
| 17  | SUCTION STRAINER        | SFA-06          |
| 18  | RELIEF VALVE            | Y-148300        |
| 19  | HYDRAULIC OIL TANK      | —               |
| 20  | FILTER                  | —               |
| 21  | ELBOW WITH FILTER       | —               |
| 22  | CHECK VALVE             | —               |
| 23  | TRAVEL LOCK CYLINDER    | —               |
| 24  | DUMPER                  | —               |
| 25  | ELBOW WITH ORIFICE      | —               |

| No. | PART NAME (INNER PARTS)       | No. | PART NAME (INNER PARTS) |
|-----|-------------------------------|-----|-------------------------|
| 101 | MAIN RELIEF VALVE             | 303 | RELIEF VALVE            |
| 102 | PORT (OVER LOAD) RELIEF VALVE | 401 | 2-SPEED SHIFTING PISTON |
| 103 | PORT (OVER LOAD) RELIEF VALVE | 402 | HYDRAULIC MOTOR         |
| 104 | PORT (OVER LOAD) RELIEF VALVE | 403 | SHUTTLE VALVE           |
| 301 | HYDRAULIC MOTOR               | 404 | 2-SPEED SHIFTING VALVE  |
| 302 | MAKE UP (CHECK) VALVE         | 405 | COUNTERBALANCE VALVE    |

Fig. 1 Hydraulic circuit diagram

2. ELECTRIC CIRCUIT DIAGRAM



## 2. BUCKET

### 2.1 REMOVAL OF BUCKET

- (1) Operate the operating lever and place the bucket on the ground, so the bucket and arm connecting pins are not loaded.
  - (2) Move the O-rings (3) toward the bucket bosses using a spatula.
  - (3) In order to remove pin (K) which links arm and bucket, remove the ring (2) and the pin (3) by means of straight driver, and draw out pin (K).
    - If the pin does not come off easily, the pin is loaded. Take off the load by manipulating the operating lever.
    - Take care so the dust seal between the arm and the bucket bosses is not damaged.
  - (4) Adjust the bucket by manipulating the operating lever so the pin (J) between the bucket link and the bucket is not loaded.
  - (5) Remove the ring (2) and pin (1) then pull out the pin (J).
  - (6) Remove bucket assy.
- Weight: 17 kg (37 lb)

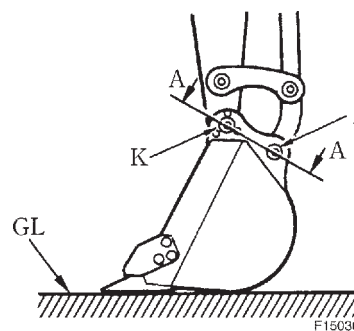


Fig. 2-2 To place bucket on ground

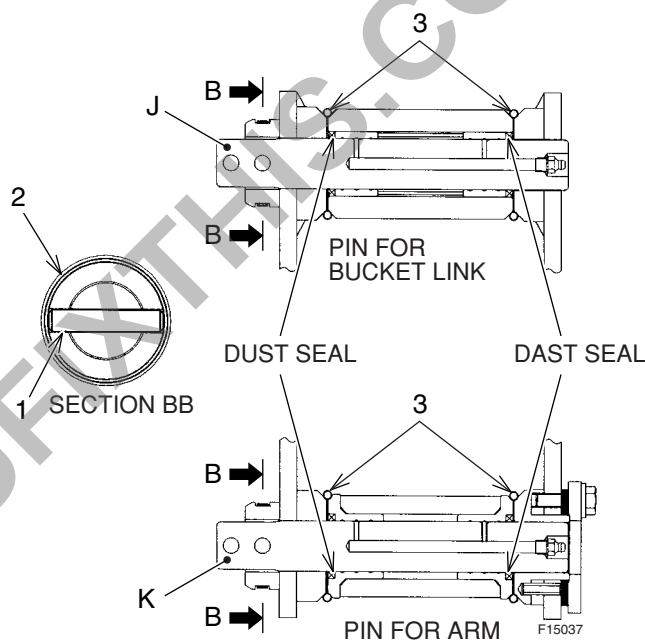


Fig. 2-3 Assembly of pin (SECTION A-A)

### 2.2 INSTALLATION OF BUCKET

Installation is performed in the reverse order of removal, including the following workings:



#### WARNING

*When aligning the pin bores, do not put your finger in the pin holes in any circumstances, but align them visually.*

- (1) Clean the welded part of the structures and check that there is no crack on the part.
- (2) Check that the dust seal is not damaged, and replace a faulty one if necessary.
- (3) Adjust the clearance between the bucket and the arm according to Item 2.3.
- (4) Replace the worn pins and bushings according to the section "ATTACHMENT DIMENSIONS" of "SPECIFICATIONS".
- (5) When inserting the pin, coat the shaft with grease.
  - The bucket can be mounted easily if the bucket link is installed in the beginning.

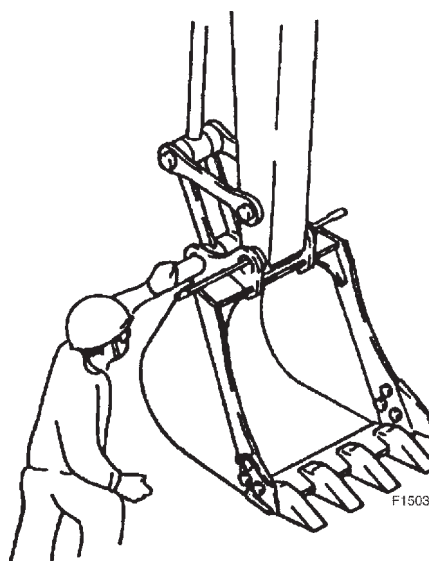


Fig. 2-4 Installation of bucket

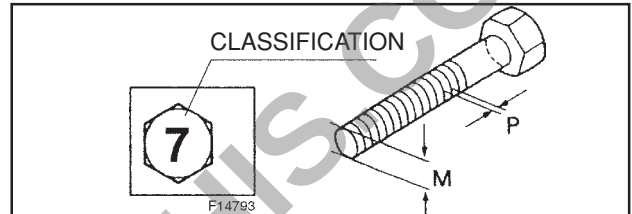
## 1. TORQUE SPECIFICATIONS FOR CAPSCREWS AND NUTS

The following Torque Specifications are provided for use when actual torque value of a fastener is not known. Check the capscrews and nuts for their looseness and dropping off before the start of daily work and at the periodical maintenance. Retighten the loosened ones, and install new ones for the dropped off. For the new machine, the check and retightening of them must be carried out at first 50 hours operation. For the replacement of them, make sure to use the same size of genuine parts.

Refer to the table below for the tightening and retightening of capscrews.

- The table below is not applicable for the capscrews to fix the cover, etc., made of plastic. For the tightening torque for such capscrews, consult with an authorized Distributor. Over-tightening may cause damages on the parts to be fixed.
- In case that the tightening torque is specified in the manual, use such torque values regardless to the table below.

- Numerical indication on the capscrew head shows the classification for strength (e.g., 7 = 7 T). No indication is provided for smaller size of capscrews, M 5 or less.



2. Metric coarse thread standard tightening torque values. Make certain to tighten all capscrews & nuts to proper torque values.

| Classification | 4.8 T              |                     | 7 T               |                    | 10.9 T              |                    |
|----------------|--------------------|---------------------|-------------------|--------------------|---------------------|--------------------|
| NOMINAL SIZE   | NO LUBRICATION     | OIL LUBRICATION     | NO LUBRICATION    | OIL LUBRICATION    | NO LUBRICATION      | OIL LUBRICATION    |
| M6 P=1         | 0.45±0.05(3.2±0.4) | 0.38±0.04(2.7±0.3)  | 0.98±0.1(7.1±0.7) | 0.83±0.08(6.0±0.6) | 1.77±0.18(12.8±1.3) | 1.5±0.15(10.8±1.1) |
| M8 P=1.25      | 1.09±0.11(7.9±0.8) | 0.92±0.09(6.6±0.7)  | 2.4±0.2(17.3±1.4) | 2.0±0.2(14.4±1.4)  | 4.3±0.4(31±2.9)     | 3.6±0.4(26±2.9)    |
| M10 P=1.5      | 2.2±0.2(15.9±1.4)  | 1.83±0.18(13.2±1.3) | 4.7±0.5(34±3.6)   | 4.0±0.4(29±2.9)    | 8.5±0.9(61±6.5)     | 7.2±0.7(52±5.1)    |
| M12 P=1.75     | 3.7±0.4(27±2.9)    | 3.2±0.3(23±2.2)     | 8.1±0.8(59±5.8)   | 6.8±0.7(49±5.1)    | 14.6±1.5(105±10.8)  | 12.3±1.2(89±8.7)   |
| M14 P=2        | 5.9±0.6(43±4.3)    | 5.0±0.5(36±3.6)     | 12.8±1.3(93±9.4)  | 10.8±1.1(78±7.9)   | 23±2(166±14.5)      | 19.5±1.9(140±13.7) |
| M16 P=2        | 9.0±0.9(65±6.5)    | 7.6±0.7(55±5.1)     | 19.5±2(140±14.4)  | 16.4±1.6(118±11.5) | 35±4(252±29)        | 29±3(209±22)       |
| M18 P=2.5      | 12.4±1.2(90±8.7)   | 10.5±1.0(76±7.2)    | 27±3(195±22)      | 23±2(166±14.5)     | 49±5(354±36)        | 41±4(296±29)       |
| M20 P=2.5      | 17.5±1.7(126±12.3) | 14.7±1.4(106±10.1)  | 38±4(274±29)      | 32±3(231±22)       | 68±7(491±51)        | 57±6(412±43)       |
| M22 P=2.5      | 23±2(166±14.5)     | 19.6±2(142±14.5)    | 51±5(368±36)      | 43±4(310±29)       | 92±9(665±65)        | 77±8(557±58)       |
| M24 P=3        | 30±3(217±22)       | 24±3(173±22)        | 65±7(470±51)      | 53±5(383±36)       | 118±12(852±87)      | 93±10(673±72)      |
| M27 P=3        | 44±4(318±29)       | 36±3(260±22)        | 96±10(694±72)     | 78±8(563±58)       | 173±17(1250±123)    | 140±14(1010±100)   |
| M30 P=3.5      | 60±6(433±43)       | 50±5(361±36)        | 131±13(948±94)    | 110±11(796±79)     | 235±24(1700±174)    | 198±20(1430±145)   |
| M33 P=3.5      | 81±8(585±58)       | 68±7(491±51)        | 176±18(1270±130)  | 148±15(1070±110)   | 317±32(2290±230)    | 266±27(1920±195)   |
| M36 P=4        | 105±10(758±72)     | 88±9(636±65)        | 227±23(1640±170)  | 190±19(1370±140)   | 409±41(2960±300)    | 343±34(2480±250)   |

TORQUE VALUE UNIT-kgf·m (lbf·ft)

2. Metric fine thread standard tightening torque values. Make certain to tighten all capscrews and nuts to proper torque values.

| Classification | 4.8 T              |                     | 7 T                |                     | 10.9 T              |                   |
|----------------|--------------------|---------------------|--------------------|---------------------|---------------------|-------------------|
| NOMINAL SIZE   | NO LUBRICATION     | OIL LUBRICATION     | NO LUBRICATION     | OIL LUBRICATION     | NO LUBRICATION      | OIL LUBRICATION   |
| M8 P=1.0       | 1.15±0.11(8.3±0.8) | 0.97±0.1 (7.0±0.7)  | 2.5±0.2 (18.0±1.4) | 2.1±0.2 (15.2±1.4)  | 4.5±0.4 (33±2.9)    | 3.8±0.4 (27±2.9)  |
| M10 P=1.25     | 2.3±0.2 (16.6±1.4) | 1.91±0.19(13.8±1.4) | 4.9±0.5 (35±3.6)   | 4.2±0.4 (30±2.9)    | 8.9±0.9 (64±6.5)    | 7.5±0.7 (54±5.1)  |
| M12 P=1.25     | 4.0±0.4 (29±2.9)   | 3.4±0.3 (25±2.2)    | 8.7±0.9 (63±6.5)   | 7.3±0.7 (53±5.1)    | 15.7±1.6 (114±11.6) | 13.2±1.3 (95±9.4) |
| M16 P=1.5      | 9.4±0.9 (68±6.5)   | 7.9±0.8 (57±5.8)    | 20±2 (144±14.5)    | 17.2±1.7 (124±12.3) | 37±4 (268±29)       | 31±3 (224±22)     |
| M20 P=1.5      | 19±1.9 (137±13.7)  | 15.8±1.6 (114±11.6) | 41±4 (296±29)      | 34±3 (246±22)       | 74±7 (535±51)       | 62±6 (448±43)     |
| M24 P=2        | 32±3 (231±22)      | 27±3 (195±22)       | 70±7 (506±51)      | 58±6 (420±43)       | 126±12 (911±87)     | 105±10 (759±72)   |
| M30 P=2        | 65±6 (470±43)      | 54±5 (391±36)       | 142±14(1030±100)   | 118±12 (852±87)     | 255±26 (1840±188)   | 212±21 (1530±150) |
| M36 P=3        | 109±11 (788±79)    | 91±9 (658±65)       | 238±23(1720±166)   | 198±20 (1430±145)   | 428±43 (3100±310)   | 357±36 (2580±260) |

TORQUE VALUE UNIT-kgf·m (lbf·ft)

2. TROUBLE DIAGNOSIS: HYDRAULIC

| Classification       | Group No. | Probable Cause/ Component |                                             |              |         | Pump    |         | Control valve      |              | Slewing motor |            | Travel motor |              | Cylinder         |       | Other valves |                       | Filter                                |                              | Relief valve  |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
|----------------------|-----------|---------------------------|---------------------------------------------|--------------|---------|---------|---------|--------------------|--------------|---------------|------------|--------------|--------------|------------------|-------|--------------|-----------------------|---------------------------------------|------------------------------|---------------|--------------|-----------------|----------------------|--------------|-------------|---------------------------------------|---------------------------|---------------|------------------|--------------------|---------------|-------------------|-----------|-------------|---------|
|                      |           | Trouble                   |                                             | Engine speed | Pump P1 | Pump P2 | Pump P3 | Pilot relief valve | Travel spool | Slewing spool | Boom spool | Arm spool    | Bucket spool | Load check valve | Motor | Motor        | Counter balance valve | Check valve for counter balance valve | 1st/2nd speed shifting valve | Boom cylinder | Arm cylinder | Bucket cylinder | Travel lock cylinder | Swivel joint | Pilot valve | 1st / 2nd travel speed solenoid valve | Lever lock solenoid valve | Inline filter | Suction strainer | Bypass check valve | Return filter | Main relief valve | Boom down | Arm digging | Slewing |
| Attachment operation | 1         | (1)                       | Incapable of attachment operation           |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
|                      |           | (2)                       | Attachment force small                      |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
|                      |           | (3)                       | Attachment speed low                        |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
| Travel operation     | 2         | (1)                       | Incapable of travel operation               |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
|                      |           | (2)                       | Traction force small                        |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
|                      |           | (3)                       | Travel speed low                            |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
|                      |           | (4)                       | Incapable of shifting 1st / 2nd speed       |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
|                      |           | (5)                       | Deviation in single (independent) operation |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
| Slewing operation    | 3         | (1)                       | Incapable of slewing operation              |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
|                      |           | (2)                       | Slewing speed low                           |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
|                      |           | (3)                       | Slewing force small                         |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |
| Pump                 | 4         | (1)                       | Malfunction of pump                         |              |         |         |         |                    |              |               |            |              |              |                  |       |              |                       |                                       |                              |               |              |                 |                      |              |             |                                       |                           |               |                  |                    |               |                   |           |             |         |

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## 1.2 CONSTRUCTION

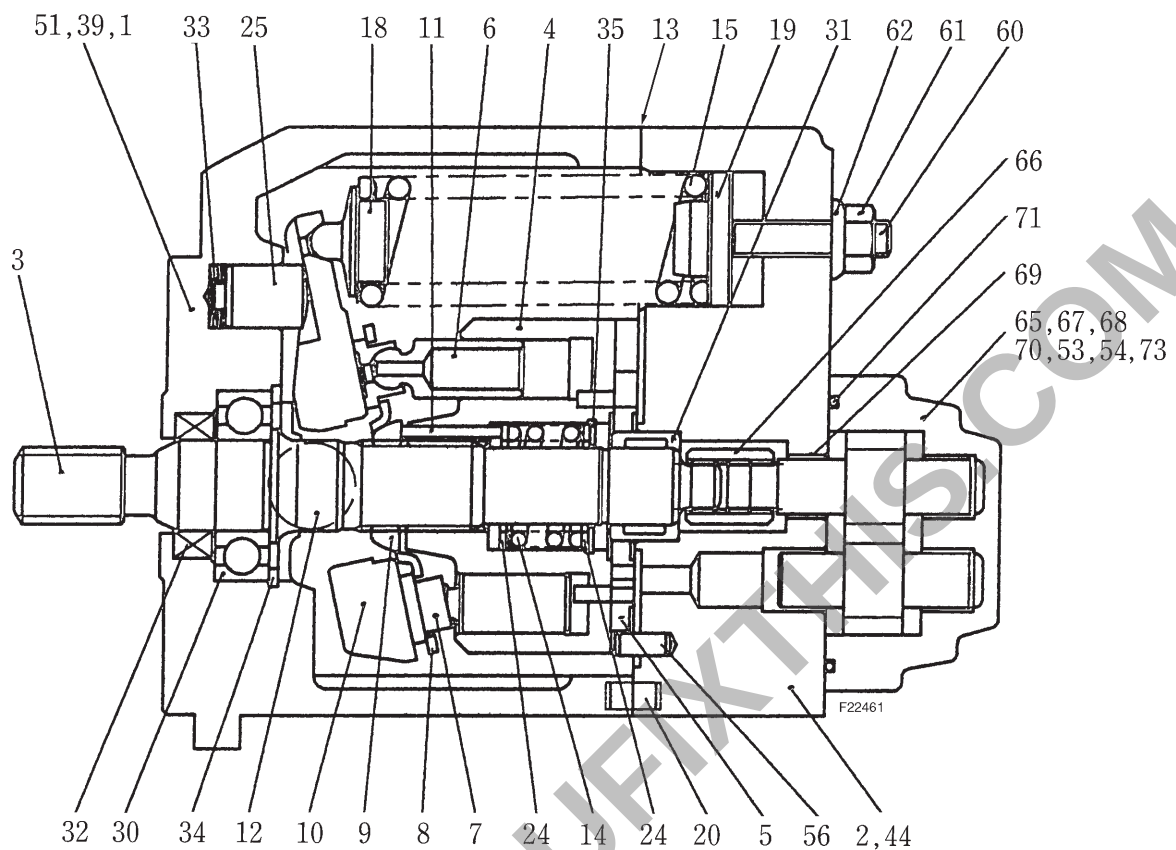


Fig. 1-2 Hydraulic pump-Selectional view

| No. | NAME            | Q'TY | No. | NAME              | Q'TY | No. | NAME          | Q'TY |
|-----|-----------------|------|-----|-------------------|------|-----|---------------|------|
| 1   | BODY S          | 1    | 18  | SPRING HOLDER     | 1    | 54  | O-RING        | 1    |
| 2   | BODY H          | 1    | 19  | SPRING GUIDE      | 1    | 56  | SPRING PIN    | 1    |
| 3   | SHAFT           | 1    | 20  | PIN               | 2    | 60  | SETSCREW      | 1    |
| 4   | CYLINDER BARREL | 1    | 24  | RETAINER          | 2    | 61  | NUT           | 1    |
| 5   | VALVE PLATE     | 1    | 25  | STOPPER PIN A     | 1    | 62  | SEAL WASHER   | 1    |
| 6   | PISTON          | 10   | 30  | BALL BEARING      | 1    | 65  | GEAR PUMP KIT | 1    |
| 7   | SHOE            | 10   | 31  | NEEDLE BEARING    | 1    | 66  | JOINT         | 1    |
| 8   | SHOE HOLDER     | 1    | 32  | OIL SEAL          | 1    | 67  | STEEL BALL    | 2    |
| 9   | BARREL HOLDER   | 1    | 33  | CONED DISK SPRING | 4    | 68  | SOCKET BOLT   | 4    |
| 10  | SWASH PLATE     | 1    | 34  | SNAP RING         | 1    | 69  | BUSHING       | 2    |
| 11  | NEEDLE          | 3    | 35  | SNAP RING         | 1    | 70  | WASHER        | 4    |
| 12  | OSCILLATING PIN | 2    | 39  | O-RING            | 1    | 71  | O-RING        | 1    |
| 13  | PACKING         | 1    | 44  | SOCKET BOLT       | 4    | 73  | GASKET        | 2    |
| 14  | SPRING C        | 1    | 51  | PLUG              | 1    |     |               |      |
| 15  | SPRING T1       | 1    | 53  | PLUG              | 1    |     |               |      |

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## 1.1 GENERAL SAFETY INFORMATION



### WARNING

*Do Not operate or perform any maintenance on this machine until all instructions found in the OPERATION & MAINTENANCE MANUAL have been thoroughly read and understood.*

*Improper operation or maintenance of this machine may cause accidents and could result in serious injury or death.*

*Always keep the manual in the operator's seat pocket. If it is missing or damaged, place an order with an authorized Distributor for a replacement.*

*If you have any questions, please consult an authorized Distributor.*

1. Most accidents, which occur during operation, are due to neglect of precautionary measures and safety rules. Sufficient care should be taken to avoid these accidents. Erroneous operation, lubrication or maintenance services are very dangerous and may cause injury or death of personnel. Therefore all precautionary measures, NOTES, DANGERS, WARNINGS and CAUTIONS contained in the manual and on the machine should be read and understood by all personnel before starting any work with or on the machine.
2. Operation, inspection, and maintenance should be carefully carried out, and safety must be given the first priority. Messages of safety are indicated with marks. The safety information contained in the manual is intended only to supplement safety codes, insurance requirements, local laws, rules and regulations.
3. Messages of safety appear in the manual and on the machine. All messages of safety are identified by either word of "DANGER", "WARNING" and "CAUTION".



### DANGER

*Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury and is represented as follows:*



### WARNING

*Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury and is represented as follows:*



### CAUTION

*Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against possible damage to the machine and its components and is represented as follows:*

4. It is very difficult to forecast every danger that may occur during operation. However, safety can be ensured by fully understanding proper operating procedures for this machine according to methods recommended by Distributor.
5. While operating the machine, be sure to perform work with great care, so as not to damage the machine, or allow accidents to occur.
6. Continue studying the manual until all Safety, Operation and Maintenance procedures are completely understood by all persons working with the machine.

## 1.2 SAFETY PRECAUTIONS



### WARNING

*The proper and safe lubrication and maintenance for this machine, recommended by Distributor, are outlined in the OPERATOR'S MANUAL for the machine.*

*Improper performance of lubrication or maintenance procedures are dangerous and could result in injury or death. Read and understand the MANUAL before performing any lubrication or maintenance.*

The serviceman or mechanic may be unfamiliar with many of the systems on this machine. This makes it important to use caution when performing service work. A knowledge of the system and or components is important before the removal or disassembly of any component.

Because of the size of some of the machine components, the serviceman or mechanic should check the weights noted in this manual. Use proper lifting procedures when removing any components. Weight of components table is shown in the section; SPECIFICATIONS.

## AVOID ACCIDENTS

Most accidents, whether they occur in industry, on the farm, at home or on the highway, are caused by the failure of some individuals to follow simple and fundamental safety rules or precautions. For this reason **MOST ACCIDENTS CAN BE PREVENTED** by recognising the real cause and doing something about it before the accident occurs.

Regardless of the care used in the design and construction of any type of equipment there are conditions that cannot be completely safeguarded against without interfering with reasonable accessibility and efficient operation.

Carefully read indications, cautions and safety warning quoted in the "SAFETY RULES" section.

A careful operator is the best insurance against an accident.

The complete observance of one simple rule would prevent many thousand serious injuries each year.

That rule is:

**Never attempt to clean, oil or adjust a machine while it is in motion.**



### ATTENTION

On machines having hydraulically, mechanically and/or cable controlled equipment (such as showels, loaders, dozers, scrapers etc.) be certain the equipment is lowered to the ground before servicing, adjusting and/or repairing.

If it is necessary to have the equipment partially or fully raised to gain access to certain items, be sure the equipment is suitably supported by means other than the hydraulic lift cylinders, cable and/or mechanical device used for controlling the equipment.

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## 2.2 ARM MAINTENANCE STANDARDS

### (1) Clearance of pin and bushing

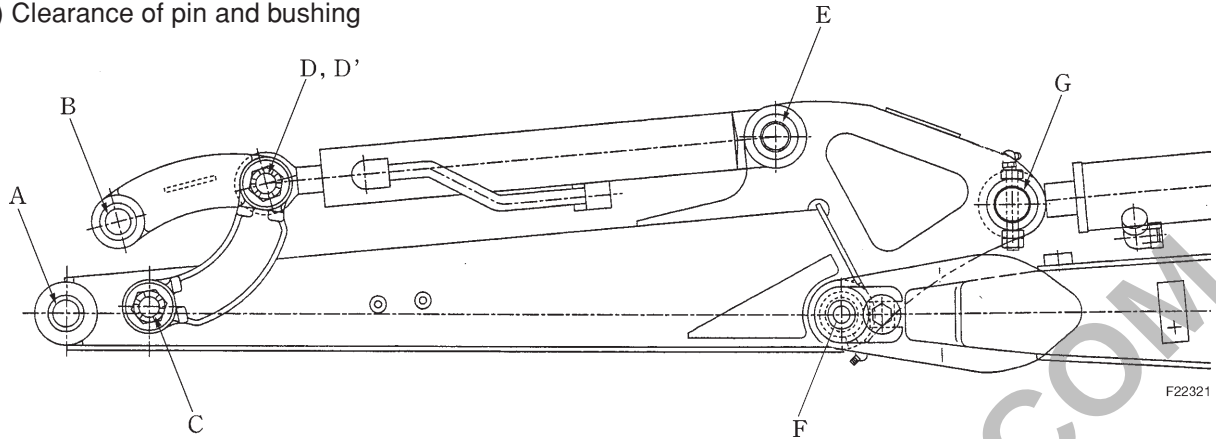


Fig. 2-2 Clearance of pin and bushing on arm section

Table 2-2

Unit: mm (in)

| Pos. | Item                                    | Standard dimensions |                                          |                                          | Clearance                                                        |                           |                      | Remedy                 |
|------|-----------------------------------------|---------------------|------------------------------------------|------------------------------------------|------------------------------------------------------------------|---------------------------|----------------------|------------------------|
|      |                                         | Pin dia.            | Tolerance on pin dia.                    | Tolerance on bushing bore dia.           | Standard value                                                   | Standard value for repair | Serviceability limit |                        |
| A    | Arm point<br>(Connected part of bucket) | ø25<br>(0.9843)     | -0.06<br>-0.09<br>(-0.0024)<br>(-0.0035) | +0.11<br>+0.07<br>(+0.0043)<br>(+0.0028) | 0.13~0.20<br>(0.0051 ~ 0.0079)<br>0.09~0.16<br>(0.0035 ~ 0.0063) | 0.5<br>(0.020)            | 0.8<br>(0.031)       | Replace bushing or pin |
| B    | Bucket link<br>(Bucket side)            |                     | -0.02<br>-0.05<br>(-0.0008)<br>(-0.0020) | +0.12<br>+0.08                           | 0.14~0.21<br>(0.0055 ~ 0.0083)<br>0.10~0.17<br>(0.0039 ~ 0.0067) |                           |                      |                        |
| C    | Idler link<br>(Connected part of arm)   |                     | -0.03<br>-0.05<br>(-0.0012)<br>(-0.0020) | +0.0047<br>+0.0031                       | 0.11~0.17<br>(0.0043 ~ 0.0067)                                   |                           |                      |                        |
| D    | Bucket link<br>(Idler link side)        |                     | -0.02<br>-0.05<br>(-0.0008)<br>(-0.0020) | +0.15<br>+0.05<br>(+0.0059)<br>(+0.0020) | 0.07~0.20<br>(0.0028 ~ 0.0079)                                   |                           |                      |                        |
| D'   | Bucket cylinder<br>(Rod side)           |                     | -0.03<br>-0.05<br>(-0.0012)<br>(-0.0020) | +0.18<br>+0.05<br>(+0.0071)<br>(+0.0020) | 0.08~0.23<br>(0.0031 ~ 0.0091)                                   |                           |                      |                        |
| E    | Bucket cylinder<br>(Head side)          |                     | -0.03<br>-0.05<br>(-0.0012)<br>(-0.0020) | +0.11<br>+0.06<br>(+0.0043)<br>(+0.0024) | 0.09~0.16<br>(0.0035 ~ 0.0063)                                   |                           |                      |                        |
| F    | Arm foot<br>(Connected part of boom)    |                     | -0.03<br>-0.05<br>(-0.0012)<br>(-0.0020) | +0.18<br>+0.05<br>(+0.0071)<br>(+0.0020) | 0.08~0.23<br>(0.0031 ~ 0.0091)                                   |                           |                      |                        |
| G    | Arm cylinder<br>(Rod side)              | ø30<br>(1.1811)     | -0.03<br>-0.05<br>(-0.0012)<br>(-0.0020) | +0.18<br>+0.05<br>(+0.0071)<br>(+0.0020) | 0.08~0.26<br>(0.0031 ~ 0.0102)                                   |                           |                      |                        |

#### NOTE:

- The tolerance for bushing inside diameter means the dimension after fitting of it into the place.
- The part number for pins may be changed owing to improvement, use them only for reference.

#### (4) Speed adjustment

- 1) Low / High idling speeds is low;  
the proper engine speed is obtained with specified length of accelerator wire as shown in the lower sketch. When the engine speed is lower than the standard speed due to improper length of the wire, adjust it with the capscrew (8).



#### WARNING

However, if the proper high idling speed is not obtainable, consult it with the engine manufacturer.

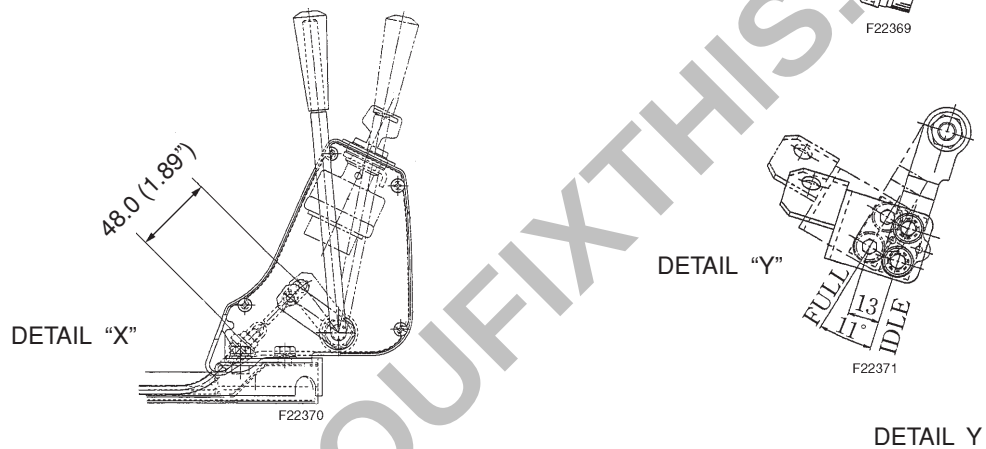


Fig. 3-2 Acelerator wire adjustment

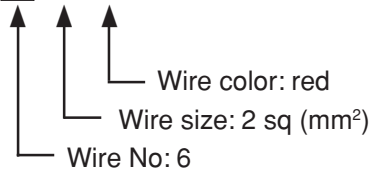
## 1. HOW TO READ CIRCUIT DIAGRAM AND HARNESS CONNECTION

### 1.1 ELECTRIC CIRCUIT DIAGRAM

- (1) In the diagram, the number, size and color of wires are shown on the wiring line.

The size of the wire is to be 0.75 sq (square mm = mm<sup>2</sup>) unless otherwise specified.

Example: 6 2 R

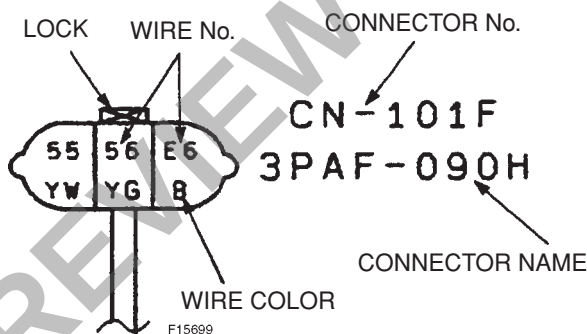


#### WIRING COLOR TABLE

| SYMBOL | COLOR  | SYMBOL | COLOR       |
|--------|--------|--------|-------------|
| B      | BLACK  | O      | ORANGE      |
| G      | GREEN  | Br     | BROWN       |
| L      | BLUE   | Lg     | LIGHT GREEN |
| R      | RED    | Gy     | GRAY        |
| W      | WHITE  | Sb     | SKY BLUE    |
| Y      | YELLOW | V      | VIOLET      |
| P      | PINK   |        |             |

### 1.2 HARNESS CONNECTION

- (1) Indication for connector



- The figure for the connector pin arrangement is shown by putting the lock (nail) to upper portion, and looking from the fitting face.
- The numbers in the connector show the wire No., and alphabetical letters show the wire color.
- On the side face of connector, the connector name and serial number of the connector No. are indicated.
- At the place indicated as "DOUBLE SPLICE", two wires are connected to one place.

- (2) The connector is to be connected with engaging the male (M) and female (F) connectors of the same number:

Example: CN-101M and CN-10F

Where: M means for Male and F for Female.

- (3) mark means the connector with diode. The direction for diode is shown by the arrow.
- (4) The AVSS wires are to be used for the size between 0.75 sq and 2 sq. AVS wires between 3 sq and 5 sq and others are AV wires, unless otherwise specified.
- (5) The wire size is 0.75 sq, unless otherwise specified.
- (6) The treatment for the harness end is to be as follows:
- After roughly applying harness taping, wires are installed in a corrugated tube.
  - Harness taping by two piles.
  - No harness treatment for connection.
- (7) The length for the above (6)-3) is to be 30 ± 10 mm; (1.2 ± 0.4 in), and the length includes in the total length of wire shown in the diagram.

## (2) Constituent Parts

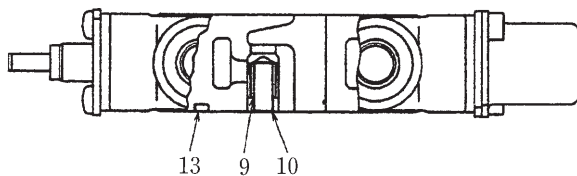
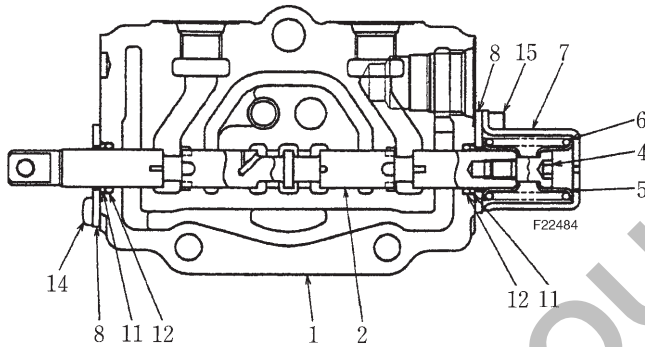
The control valve consists of the following three major groups.

- Manual Operating Block: Travel, swing, dozer and service
- Pilot Operating Block: Boom, arm, bucket and slew
- Accessory Valve: Main relief, port (overload) relief and anti-void

\* For the operating block, some typical examples are described in the below.

Refer to the Section for Control Valve in the Chart of Disassembling for the others.

## 1) Manual Operating Block : Swing (No.6)

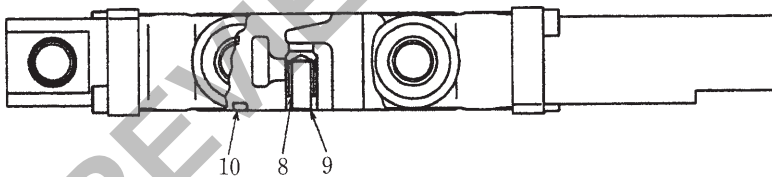
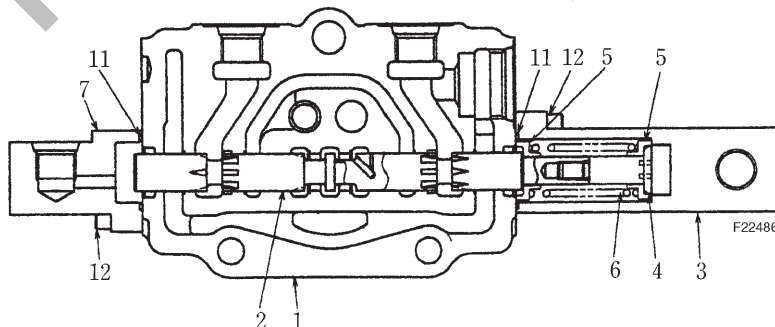


| No. | NAME                 | Q'TY |
|-----|----------------------|------|
| 1   | VALVE HOUSING        | 1    |
| 2   | SPOOL                | 1    |
| 3   | -                    | -    |
| 4   | CAPSCREW             | 1    |
| 5   | SPRING SEAT          | 2    |
| 6   | SPRING (SPOOL)       | 1    |
| 7   | CAP                  | 1    |
| 8   | SEAL PLATE           | 2    |
| 9   | LOAD CHECK VALVE     | 1    |
| 10  | SPRING (CHECK VALVE) | 1    |
| 11  | WIPER                | 2    |
| 12  | O-RING               | 2    |
| 13  | O-RING               | 1    |
| 14  | SCREW                | 2    |
| 15  | SOCKET BOLT          | 2    |

F22485

Fig. 3-3

## 2) Pilot operating block : Boom (No. 5)



| No. | NAME                 | Q'TY |
|-----|----------------------|------|
| 1   | VALVE HOUSING        | 1    |
| 2   | SPOOL                | 1    |
| 3   | CAP                  | 1    |
| 4   | CAPSCREW             | 1    |
| 5   | SPRING SEAT          | 2    |
| 6   | SPRING (SPOOL)       | 1    |
| 7   | CAP                  | 1    |
| 8   | LOAD CHECK VALVE     | 1    |
| 9   | SPRING (CHECK VALVE) | 1    |
| 10  | O-RING               | 1    |
| 11  | O-RING               | 2    |
| 12  | SOCKET BOLT          | 4    |

F22487

Fig. 3-4

## Part II: ELECTRICAL EQUIPMENT

## 1. ELECTRICAL EQUIPMENT LIST

| GROUP               | CODE | PART NAME                 |
|---------------------|------|---------------------------|
| DIODE               | D-1  | DIODE                     |
|                     | D-2  | DIODE                     |
|                     | D-3  | DIODE                     |
|                     |      |                           |
| ELECTRICAL FITTINGS | E-1  | FUSE BOX                  |
|                     | E-2  | DYNAMO                    |
|                     | E-3  | HORN                      |
|                     | E-4  | FUSIBLE LINK              |
|                     | -    |                           |
|                     | E-6  | GAUGE CLUSTER             |
|                     | E-7  | GLOW PLUG                 |
|                     | E-8  | CURRENT LIMITER           |
|                     | E-9  | BATTERY                   |
|                     | E-10 | SOCKET                    |
| LIGHT               | L-1  | BOOM WORKING LIGHT(RIGHT) |
|                     |      |                           |
| MOTOR               | M-1  | STARTER MOTOR             |
|                     |      |                           |
| RELAY               | R-1  | SAFETY RELAY              |
|                     | R-2  | 2-SPEED SELECTION RELAY   |
|                     | R-3  | E/G STOP RELAY            |
|                     | -    |                           |
|                     | R-5  | CHARGE INDICATOR RELAY    |
|                     | R-6  | TIMER UNIT                |
|                     |      |                           |

| GROUP    | CODE | PART NAME                  |
|----------|------|----------------------------|
| SENSOR   | SE-1 | FUEL SENSOR                |
|          | SE-2 | ENGINE THERMO SENSOR       |
| SOLENOID | SV-1 | LEVER LOCK SOL.            |
|          | SV-2 | 2SPEED SELECT SOL.         |
|          | SV-3 | E/G STOP SOLENOID          |
|          |      |                            |
| SWITCH   | SW-1 | KEY SWITCH                 |
|          | SW-2 | 2 SPEED SELECT SW.         |
|          | SW-3 | LEVER LOCK SW.(RH)         |
|          | SW-4 | LEVER LOCK SW.(LH)         |
|          | SW-5 | HORN SWITCH                |
|          | SW-6 | E/G WATER TEMP. SWITCH     |
|          | SW-7 | ENGINE OIL PRESSURE SWITCH |
|          |      |                            |

F22563

## 6. DOZER

### 6.1 REMOVAL

- (1) Put a support of appropriate height under the mounting side of dozer body, and make the dozer at a stable condition not to exert any load to the pin (B1).
- (2) Disconnect the hydraulic hoses and apply a plug to the connecting portions.  
 : 19 mm, 22 mm
- (3) Apply a nylon sling to the dozer cylinder (C1), and lift it up slightly not to exert any load to the Pin (Q) of rod side.
- (4) Remove the capscrew (C3) and nuts (C4) that are preventing the pin (Q) from coming out, of rod side. Remove the pin (Q), and support the cylinder (C1) with a timber, etc.  
 : 17 mm
- (5) Remove the capscrew (B2) and nuts (B3) that are preventing the dozer body fixing pin (P) from coming out, and remove the two pins (P).
- (6) Gradually move the machine to backward to remove the dozer.  
 Weight of dozer assy with: Approx. 50 kgf (110 lbs)
- (7) If necessary, remove the dozer cylinder by means of removing the pin (R) of head side.  
 Weight of dozer cylinder: 17 kg (37 lb)

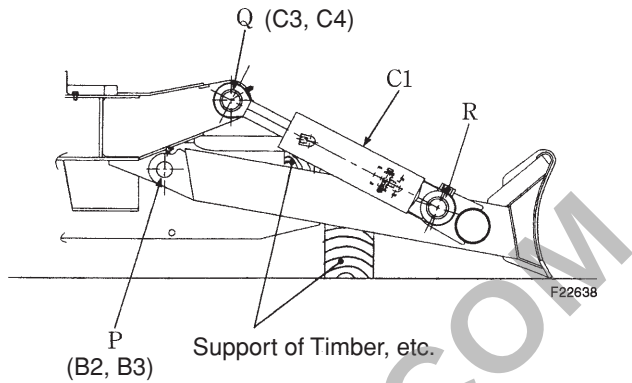


Fig. 2-20 Removing/installing dozer blade

### 6.2 INSTALLATION

The installation is carried out with the reverse order of the removal paying attention for the following.

- (1) Referring to the Section "ATTACHMENT DIMENSIONS" of Specifications, replace the worn-out bushings and dust seals to new ones.
- (2) Before installing pin (P), (Q) and (R), apply grease to their shaft area.
- (3) Referring to Fig. 2-21, install the nuts for capscrew to prevent the pin from coming out.

 : 17 mm

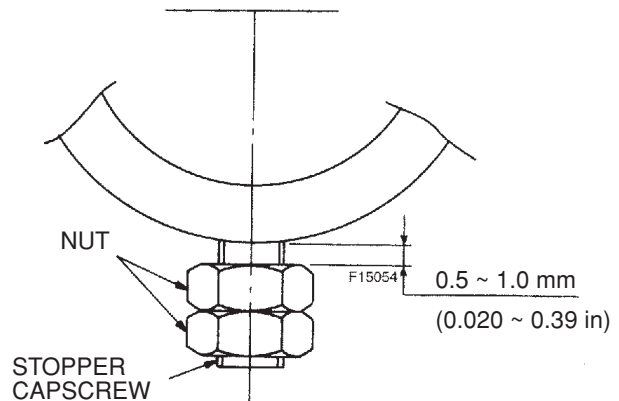


Fig. 2-21 Tightening procedures for nuts

## 12. HYDRAULIC OIL TANK

### 12.1 Disassembly preparation

- (1) Prepare removal of the hydraulic oil tank in the method similar to the fore-mentioned fuel tank.
- (2) Remove the front support and the lower support (See item 2.2).
- (3) Remove the battery (See item 3).

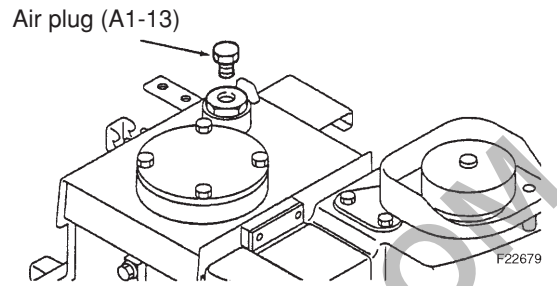


Fig. 12-1 Depressurizing tank

### 12.2 Disassembly

- (1) Depressurizing tank

The hydraulic tank is pressurized. Loosen the plug (A1-13) slowly to release air and depressurize.

⌀ : 22 mm

- (2) Remove the plug (A1-10) to drain hydraulic oil.

⌀ : 22 mm

Tank capacity: Approx. 10 l (2.6 gal)

- (3) Disconnecting suction hose

- 1) Remove the clip (18).

⌘ : Minus screw driver

- 2) Remove the hose (19).

⌘ : Minus screw driver

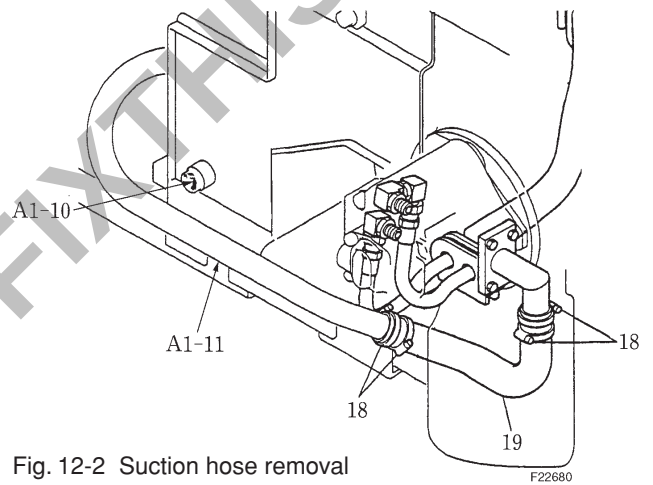


Fig. 12-2 Suction hose removal

- (4) Suction tube

Remove the capscrew (A1-5) and the suction tube (A1-11) with the strainer (A1-2), if necessary.

⌀ : 13 mm

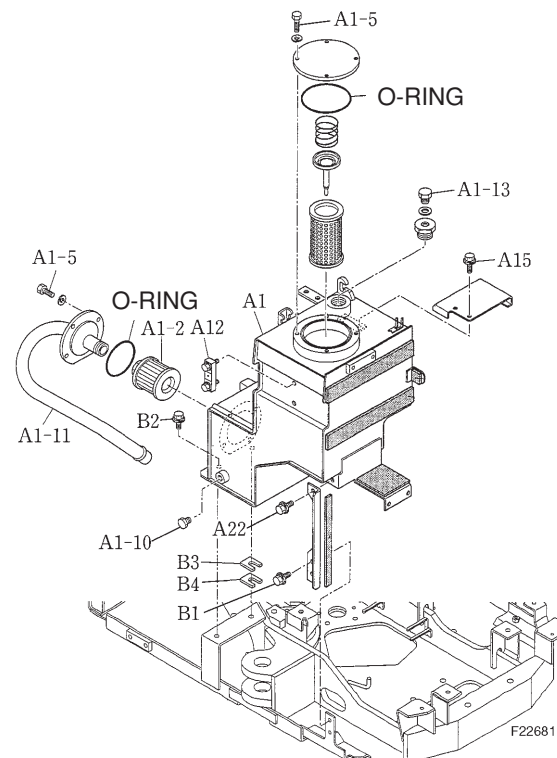
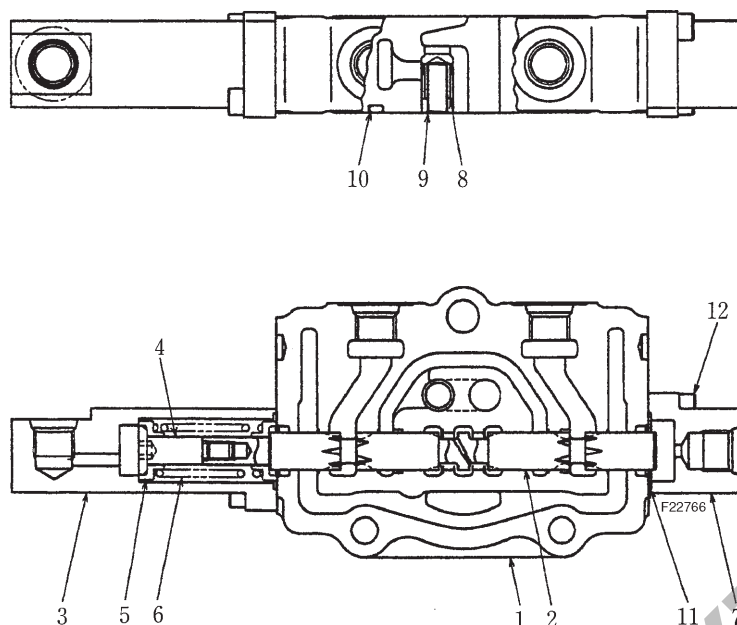


Fig. 12-3 Hydraulic oil tank disassembly

## (10) Slewing Block (No.11)

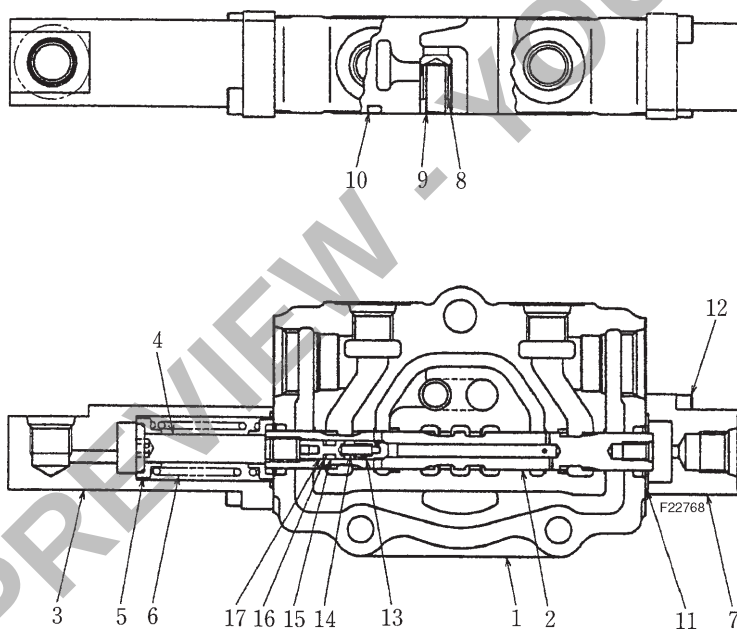


| No. | NAME                 | Q'TY |
|-----|----------------------|------|
| 1   | VALVE HOUSING        | 1    |
| 2   | SPOOL                | 1    |
| 3   | CAP                  | 1    |
| 4   | CAPSCREW             | 1    |
| 5   | SPRING SEAT          | 2    |
| 6   | SPRING (SPOOL)       | 1    |
| 7   | CAP                  | 1    |
| 8   | LOAD CHECK VALVE     | 1    |
| 9   | SPRING (CHECK VALVE) | 1    |
| 10  | O-RING               | 1    |
| 11  | O-RING               | 2    |
| 12  | SOCKET BOLT          | 4    |

F22767

Fig. 2-10

## (11) Arm Block (No.12)



| No. | NAME                 | Q'TY |
|-----|----------------------|------|
| 1   | VALVE HOUSING        | 1    |
| 2   | SPOOL                | 1    |
| 3   | CAP                  | 1    |
| 4   | CAPSCREW             | 1    |
| 5   | SPRING SEAT          | 2    |
| 6   | SPRING (SPOOL)       | 1    |
| 7   | CAP                  | 1    |
| 8   | LOAD CHECK VALVE     | 1    |
| 9   | SPRING (CHECK VALVE) | 1    |
| 10  | O-RING               | 1    |
| 11  | O-RING               | 2    |
| 12  | SOCKET BOLT          | 4    |
| 13  | POPPET               | 1    |
| 14  | SPRING               | 1    |
| 15  | O-RING               | 1    |
| 16  | BACK-UP RING         | 1    |
| 17  | SPACER               | 1    |

F22769

Fig. 2-11

## 4.4 TROUBLESHOOTING

| Troubles                   | Possible Causes                                                                                                                                                                                                                                                                                              | Remedy                                                                                                                                                                                                                                                                                                                                               |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Motor does not rotate      | <ul style="list-style-type: none"> <li>● Insufficient oil volume in hydraulic oil tank</li> <li>● Failure on hydraulic pump</li> <li>● Failure on relief valve or low setting pressure</li> <li>● Abnormal wear or scuffing on hydraulic motor</li> <li>● Short circuit at inside hydraulic motor</li> </ul> | <ul style="list-style-type: none"> <li>● Replenish tank with hydraulic oil</li> <li>● Replace hydraulic pump</li> <li>● Clean relief valve and set at proper pressure</li> <li>● Disassemble and check hydraulic motor and replace defective parts</li> <li>● Check breakage on face seal, etc., and replace defective parts, if required</li> </ul> |
| Unstable rotation          | <ul style="list-style-type: none"> <li>● Low relief setting</li> <li>● Mixing air at suction side of hydraulic pump</li> </ul>                                                                                                                                                                               | <ul style="list-style-type: none"> <li>● Set relief valve at proper pressure</li> <li>● Check suction side piping, and retighten as required</li> </ul>                                                                                                                                                                                              |
| Reverse rotating direction | <ul style="list-style-type: none"> <li>● Reverse piping</li> <li>● Reverse valve timing on hydraulic motor</li> </ul>                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>● Correct piping</li> <li>● Reassemble to proper valve timing</li> </ul>                                                                                                                                                                                                                                      |
| Oil leakage at connections | <ul style="list-style-type: none"> <li>● Loosened fixing capscrews</li> <li>● O-ring is caught by part or damage on O-ring</li> </ul>                                                                                                                                                                        | <ul style="list-style-type: none"> <li>● Tighten with proper torque</li> <li>● Replace O-ring</li> </ul>                                                                                                                                                                                                                                             |

F22854

## 8. TRAVEL MOTOR

### 8.1 REMOVAL AND INSTALLATION PROCEDURES

#### 8.1.1 Removing

- (1) Remove the crawler assy.
- (2) Place square lumber under the lower frame so the sprocket is off the ground.
- (3) Remove the capscrews (A5) located inside the lower frame and remove the cover (A8).  
 : 13mm
- (4) Loosen the air plug of hydraulic oil tank and release air in the tank.  
 : 22mm
- (5) Disconnect the joint of hydraulic piping connected with the travel motor, and plug the joints in order to prevent outflow of oil and entering of dust.  
 : 19mm, 22mm
- (6) Remove socket bolts (B4) that fasten the travel motor to the lower frame. On that occasion, put a matching mark between the lower frame and the travel motor.  
 : 8mm
- (7) Place a wire sling in a part near the sprocket of the travel motor for balancing, and remove the unit out of the lower frame.  
 Weight of travel motor (with sprocket) :  
 23 kgf (51 lbs)

#### 8.1.2 Installing

- (1) If there are burrs and dirt on fitting part with which the travel motor are fastened, eliminate it beforehand. Place a wire sling in the travel unit with the same way as in the removing, and install it to the lower frame.
- (2) Coat the threaded part of the mounting socket bolts (B4) with Loctite #262 and tighten them.  
 : 8mm  
 T : 5.6 kgf·m (41 lbf·ft)

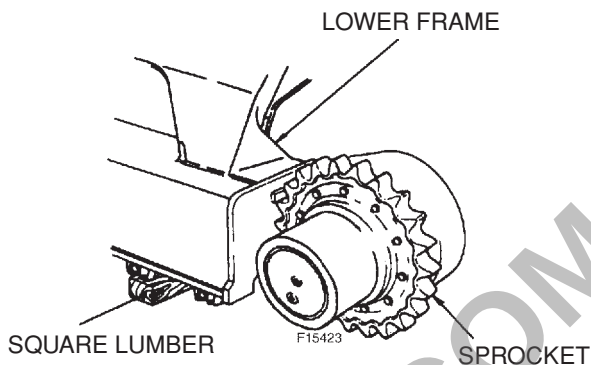


Fig. 8-1 Free sprocket free from load

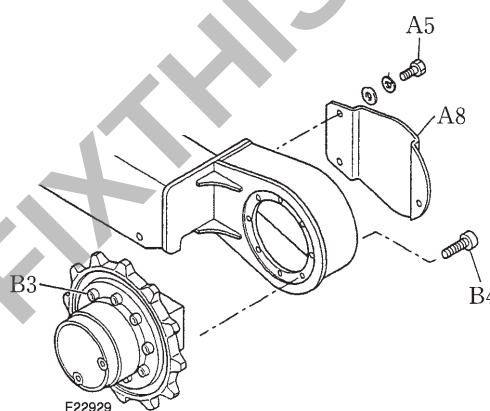


Fig. 8-2 Removing cover / travel motor

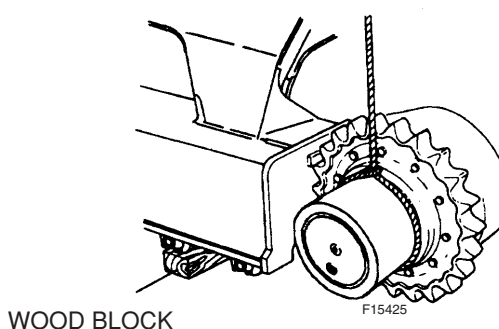


Fig. 8-3 Removing / Installing travel motor

# 1.4 3TNE78A

\*Output conditions: Intake back pressure ≤ 250 mmAq, Exhaust back pressure ≤ 550 mmAq, other conditions complying with JIS D 1005-1986. After minimum 30 hour's run-in.

|                         |                                             | Model                      | 3TNE78A                                          |                                                                      |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|-------------------------|---------------------------------------------|----------------------------|--------------------------------------------------|----------------------------------------------------------------------|-------------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|---------------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Item                    |                                             | Unit                       |                                                  |                                                                      |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
| SPECIFICATIONS          | Application                                 |                            | —                                                | CL                                                                   |                                     | VM                               |                                  |                                  |                                  |                                  |                                  | CH                               |                                       | VH                               |                                  |                                  |
|                         | Type                                        |                            | —                                                | Vertical, 4-cycle water-cooled diesel engine                         |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Combustion system                           |                            | —                                                | Direct injection system                                              |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | No. of cylinders – Bore X Stroke            |                            | mm                                               | 3 – 78 X 84                                                          |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Displacement                                |                            | C°                                               | 1.204                                                                |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Firing order                                |                            | —                                                | 1 – 3 – 2 – 1                                                        |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Revolution speed                            |                            | rpm                                              | 1500                                                                 | 1800                                | 2000                             | 2200                             | 2400                             | 2600                             | 2800                             | 3000                             | 3000                             | 3600                                  | 3200                             | 3400                             | 3600                             |
|                         | Output*                                     | Continuous rating          | kW(HP)                                           | 9.1<br>(12.2)                                                        | 10.8<br>(14.5)                      | —                                | —                                | —                                | —                                | —                                | —                                | 18.0<br>(24.1)                   | 21.0<br>(28.2)                        | —                                | —                                | —                                |
|                         |                                             | Max. rating                | kW(HP)                                           | 9.9<br>(13.3)                                                        | 11.9<br>(16.0)                      | 13.2<br>(17.7)                   | 14.6<br>(19.6)                   | 15.9<br>(21.3)                   | 17.2<br>(23.1)                   | 18.5<br>(24.8)                   | 19.9<br>(26.7)                   | 19.9<br>(26.7)                   | 23.2<br>(31.1)                        | 20.5<br>(27.5)                   | 21.6<br>(29.0)                   | 23.2<br>(31.1)                   |
|                         | Max. revolution speed at no load            |                            | rpm                                              | 1575 <sup>+50</sup> <sub>0</sub>                                     | 1870 <sup>+50</sup> <sub>0</sub>    | 2180 <sup>+50</sup> <sub>0</sub> | 2375 <sup>+50</sup> <sub>0</sub> | 2570 <sup>+50</sup> <sub>0</sub> | 2780 <sup>+50</sup> <sub>0</sub> | 2970 <sup>+50</sup> <sub>0</sub> | 3180 <sup>+50</sup> <sub>0</sub> | 3150 <sup>+50</sup> <sub>0</sub> | 3745 <sup>+50</sup> <sub>0</sub>      | 3455 <sup>+50</sup> <sub>0</sub> | 3670 <sup>+50</sup> <sub>0</sub> | 3890 <sup>+50</sup> <sub>0</sub> |
|                         | Min. revolution speed at no load            |                            |                                                  | ≤1200                                                                |                                     | ≤800                             |                                  |                                  |                                  |                                  |                                  | ≤1500                            |                                       | ≤800                             |                                  |                                  |
|                         | Direction of rotation                       |                            | —                                                | Counterclockwise (viewed from flywheel)                              |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Power take off                              |                            | —                                                | Flywheel                                                             |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Compression ratio                           |                            | —                                                | 18.0                                                                 |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Fuel injection timing (FID, b.T.D.C.)       |                            | deg                                              | 10±1                                                                 |                                     | 12±1                             |                                  | 14±1                             |                                  | 16±1                             |                                  | 24±1                             |                                       | 18±1                             | 20±1                             | 24±1                             |
|                         | Compression pressure                        |                            | MPa<br>(kgf/cm²)                                 | 3.14±0.1 (32±1), at 250 rpm                                          |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Fuel injection pressure                     |                            | MPa<br>(kgf/cm²)                                 | 19.6 <sup>+1.0</sup> <sub>0</sub> (200 <sup>+10</sup> <sub>0</sub> ) |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Recommended diesel gas oil                  |                            | —                                                | ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.: 45 min.)                 |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Lubrication system                          |                            | —                                                | Forced lubrication with trochoid pump                                |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Lubricating oil capacity<br>Max/Effective   |                            | C°                                               | 3.6/1.3                                                              |                                     |                                  |                                  |                                  |                                  | 5.0/1.7                          |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Recommended lubricating oil                 |                            | —                                                | API grade CC class or higher                                         |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Cooling system                              |                            | —                                                | Liquid cooling/Radiator                                              |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Cooling water capacity                      |                            | C°                                               | 1.8 (for engine only)                                                |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Cooling fan<br>No. of blade X dia.          |                            | mm                                               | Pusher type, 6 X Ø335                                                |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
|                         | Crank V-pulley dia./<br>Fan V-pulley dia.   |                            | mm                                               | Ø120/Ø90                                                             |                                     | Ø110/Ø110                        |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
| Governor                |                                             | —                          | Mechanical centrifugal governor (All speed type) |                                                                      |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
| Starting system         |                                             | —                          | Electrical                                       |                                                                      |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |
| *1 Dimensions L X W X H |                                             | mm                         | 553X489X565                                      |                                                                      | 520.5 X 489 X 565 / 528 X 489 X 565 |                                  |                                  |                                  |                                  |                                  | 528 X 489 X 565                  |                                  | 520.5 X 489 X 565/<br>528 X 489 X 565 |                                  |                                  |                                  |
| *1 Dry weight           |                                             | kg                         | 138                                              |                                                                      | 112/128                             |                                  |                                  |                                  |                                  |                                  | 124                              |                                  | 112 / 124                             |                                  |                                  |                                  |
| PERFORMANCE             | Governing performance<br>(full speed range) | Transient speed difference | %                                                | ≤10                                                                  | ≤8                                  | ≤12                              |                                  |                                  |                                  |                                  |                                  | ≤10                              | ≤8                                    | ≤12                              |                                  |                                  |
|                         |                                             | Steady state speed band    | %                                                | ≤5                                                                   | ≤4                                  | ≤9                               | ≤8                               | ≤7                               | ≤6                               | ≤5                               | ≤4                               | ≤8                               |                                       |                                  |                                  |                                  |
|                         |                                             | Recovery time              | sec                                              | ≤5                                                                   |                                     | ≤6                               |                                  |                                  |                                  |                                  |                                  | ≤5                               |                                       | ≤6                               |                                  |                                  |
|                         |                                             | Fluctuation of revolution  | rpm                                              | ≤15                                                                  |                                     | ≤25                              |                                  |                                  |                                  |                                  |                                  | ≤30                              |                                       |                                  |                                  |                                  |
|                         | L.O. press.                                 | Rated operation            | MPa<br>(kgf/cm²)                                 | 0.29±0.05<br>(3.0±0.5)                                               |                                     |                                  |                                  |                                  |                                  | 0.34±0.05<br>(3.5±0.5)           |                                  |                                  |                                       |                                  |                                  |                                  |
| Idling                  |                                             |                            | ≥0.06 (≥0.6)                                     |                                                                      |                                     |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                       |                                  |                                  |                                  |

\*1. Designation of engine dimension and dry weight in numerals.

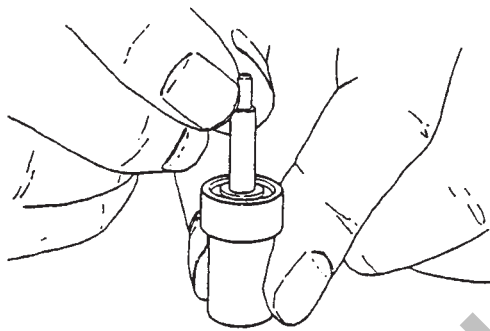
CL/CH application: engine with flywheel housing

VM/VH application: engine with back plate/with flywheel housing

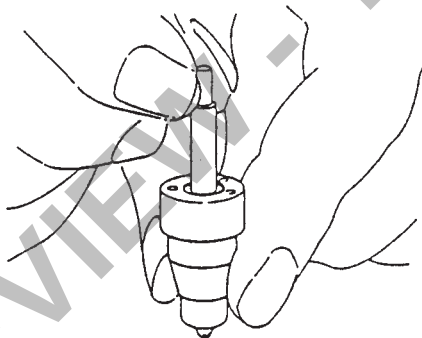
**3. Nozzle valve sliding test**

Thoroughly wash the nozzle valve using clean diesel oil. Hold the nozzle body vertically, and lift the nozzle valve approx. 1/3 of its length with one hand.

Check to see if the nozzle falls smoothly by itself gravity when released. If so, the nozzle valve is good. In case of a new nozzle, remove the seal peel, and immerse it in clean diesel oil or the like to clean the inner and outer surfaces and to thoroughly remove rust-preventive oil before using the nozzle. Note that a new nozzle is coated with rust-preventive oil and is pasted with the seal peel to shut off outer air.



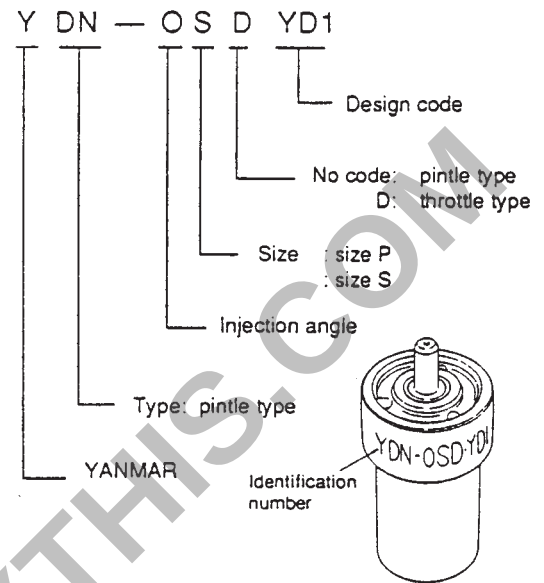
( Nozzle valve sliding check by gravity )  
for indirect injection system



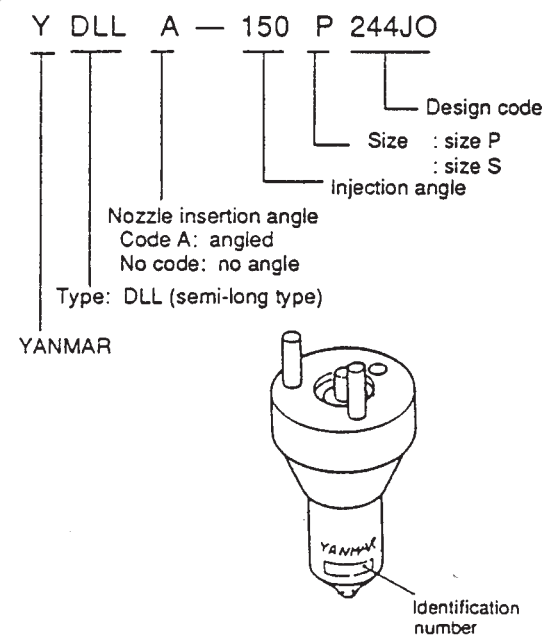
( Nozzle valve sliding check by gravity )  
for direct injection system

**4. Nozzle body identification number**

(Indirect injection system)



(Direct injection system)



F20284

## 7.8 GEARS

### 1. Checking gears

Inspect the gears and replace if the teeth are damaged, worn, or chipped.

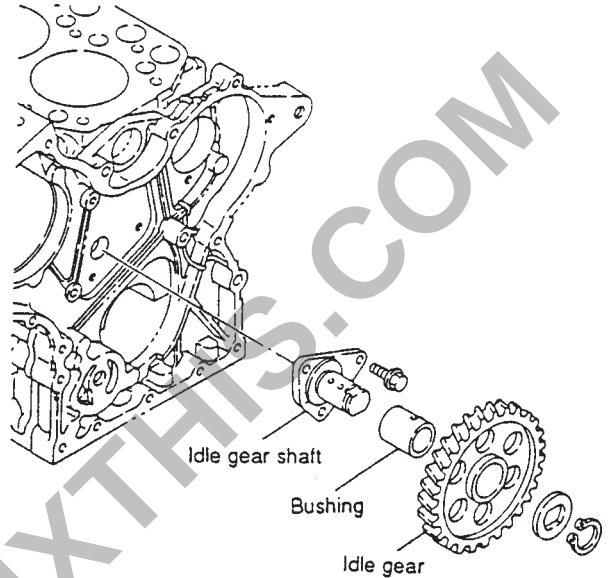
### 2. Measuring the backlash

Apply a dial gauge onto the pitch circle of the gear, and measure the backlash.

(mm)

|               |                                                                                          | 2/3TNE68,<br>3TNE74 | 3TNE78A/82A,<br>3/4TNE82,<br>3/4TNE84(T),<br>3/4TNE88 |
|---------------|------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------|
| Back-<br>lash | Crankshaft gear,<br>Camshaft gear,<br>Idle gear and<br>Fuel injection<br>pump drive gear | 0.04~0.12           | 0.07~0.15                                             |
|               | L.O. pump gear                                                                           | 0.11~0.19           |                                                       |

(Indirect injection system)



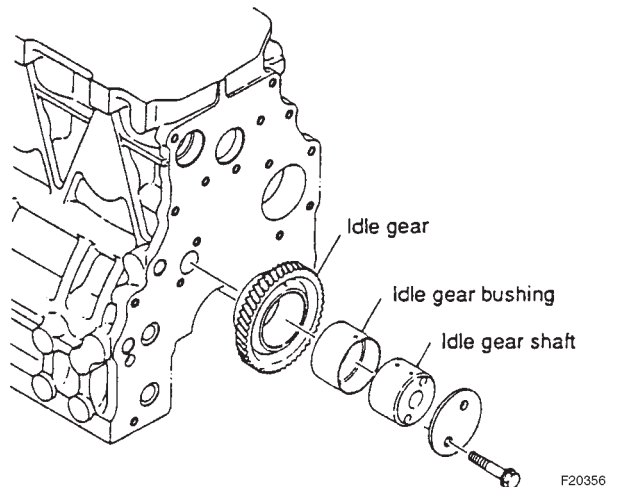
### 3. Checking and measuring the idling gear shaft and idling gear

- (1) Measure the bushing inside diameter and the idle gear shaft outside diameter, and replace the bushing or idling gear shaft if the oil clearance exceeds the wear limit.

(mm)

|              |                        | 2/3TNE68<br>3TNE74 |               | 3TNE78A/82A,<br>3/4TNE82,<br>3/4TNE84(T),<br>3/4TNE88 |               |
|--------------|------------------------|--------------------|---------------|-------------------------------------------------------|---------------|
|              |                        | Standard           | Wear<br>limit | Standard                                              | Wear<br>limit |
| Idle<br>gear | Shaft outside<br>dia.  | 19.959<br>~19.980  | 19.93         | 45.950<br>~45.975                                     | 45.93         |
|              | Bushing<br>inside dia. | 20.000<br>~20.021  | —             | 46.000<br>~46.025                                     | 46.08         |
|              | Oil clearance          | 0.020<br>~0.062    | 0.15          | 0.025<br>~0.075                                       | 0.15          |

(Direct injection system)

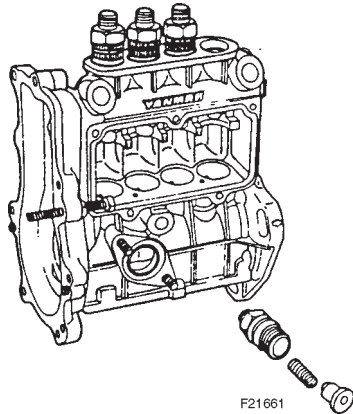


F20356

- (2) Make sure that the oil hole of the idle gear shaft and bushing is a through hole.

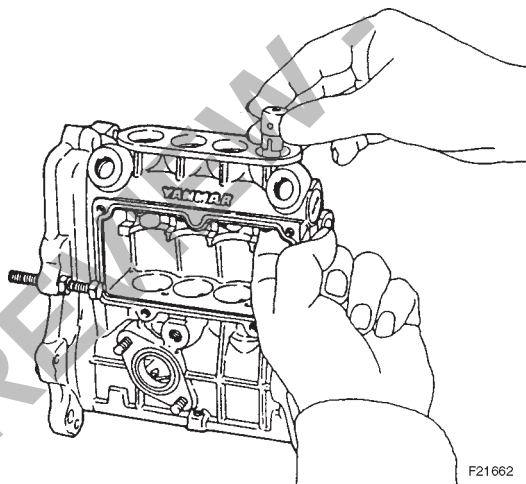
(19) Take out the delivery valve assembly.

- \* 1. Carefully prevent small parts such as the delivery valve packing, delivery valve spring and delivery valve stopper from being missing.
- \* 2. Clearly separate the delivery valve assembly for each cylinder.



(20) Take out the plunger barrel toward the upper part of the fuel injection pump.

- \* Keep the plunger barrel just picked up together with the plunger which has been taken out.

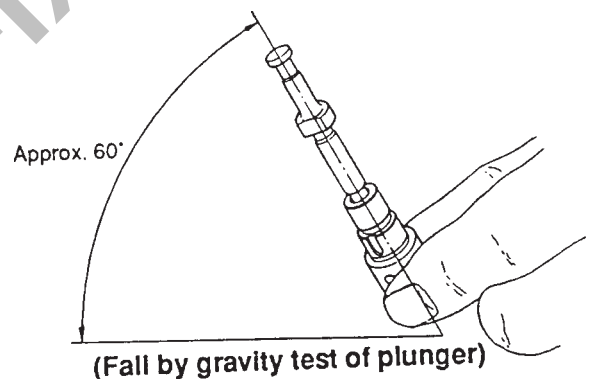


## 12.4 INSPECTION

Before inspection, thoroughly clean the parts, using new diesel oil. Be careful to avoid damage to the sliding surface of the plunger and delivery valve, etc.

### (1) Plunger

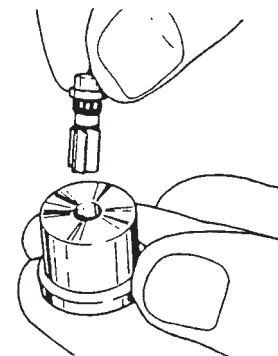
1. Thoroughly clean the plunger. If any plunger lead is scratched or discolored, replace the plunger assembly with a new one.
2. To test the plunger, hold the plunger barrel tilted approx. 60° and check to see if it slides down smoothly. If so, the plunger is acceptable. While turning the plunger, repeat the test several times. If any plunger slides down too quickly (slowly) or jams in the midway, correct it or replace the whole plunger assembly.



F21636

### (2) Delivery valve

1. If the suck-back collar or seat of the delivery valve is found scratched, dented, worn, or otherwise damaged, replace the whole delivery valve assembly.



(Check for delivery valve)

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