GB203-1ME

INSTRUCTION MANUAL

FOR

ROCKWELL HARDNESS TESTING

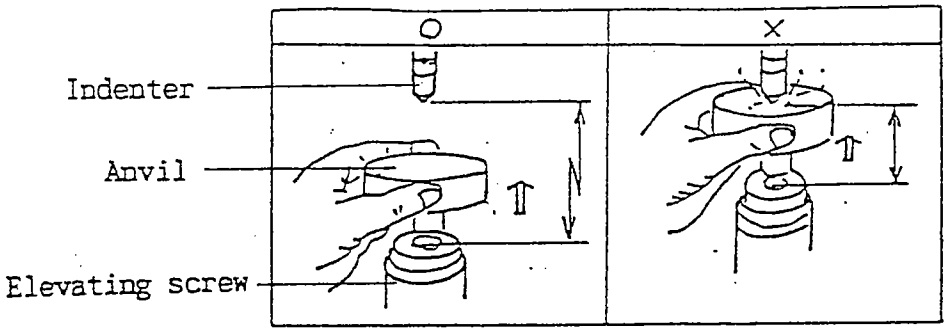
MODEL: ARK-600

Mitutoyo

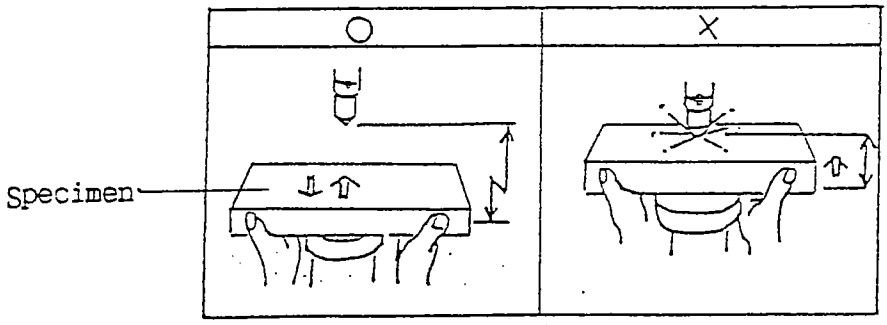
WARNNIG

Do not apply shock to the loading shaft or the tip of the indenter with the anvil or a sample. Otherwise, the gauge may be damaged, or inside of the loadingshaft, indenter tip, or anvil surface may be flawed, leading to incorrect hardness values.
Observe the following for proper operation:

1. To mount and dismount the anvil, lower the elevating spindle sufficiently.



2. To place or take off a large or heavy specimen onto/from the anvil, make sufficient clearance between the specimen and the indenter to prevent them from contacting.



3. When clamping the elevating spindle cover, leave a clearance (H) of 4mm or more so that the elevating spindle cover will not come in touch with the anvil.

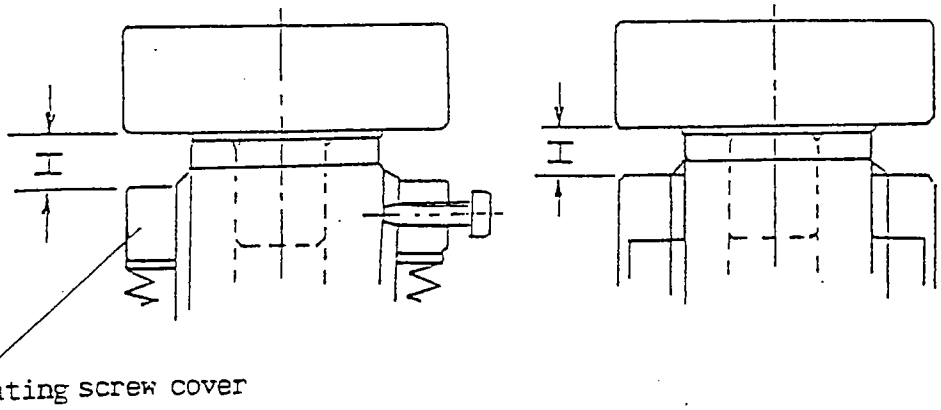
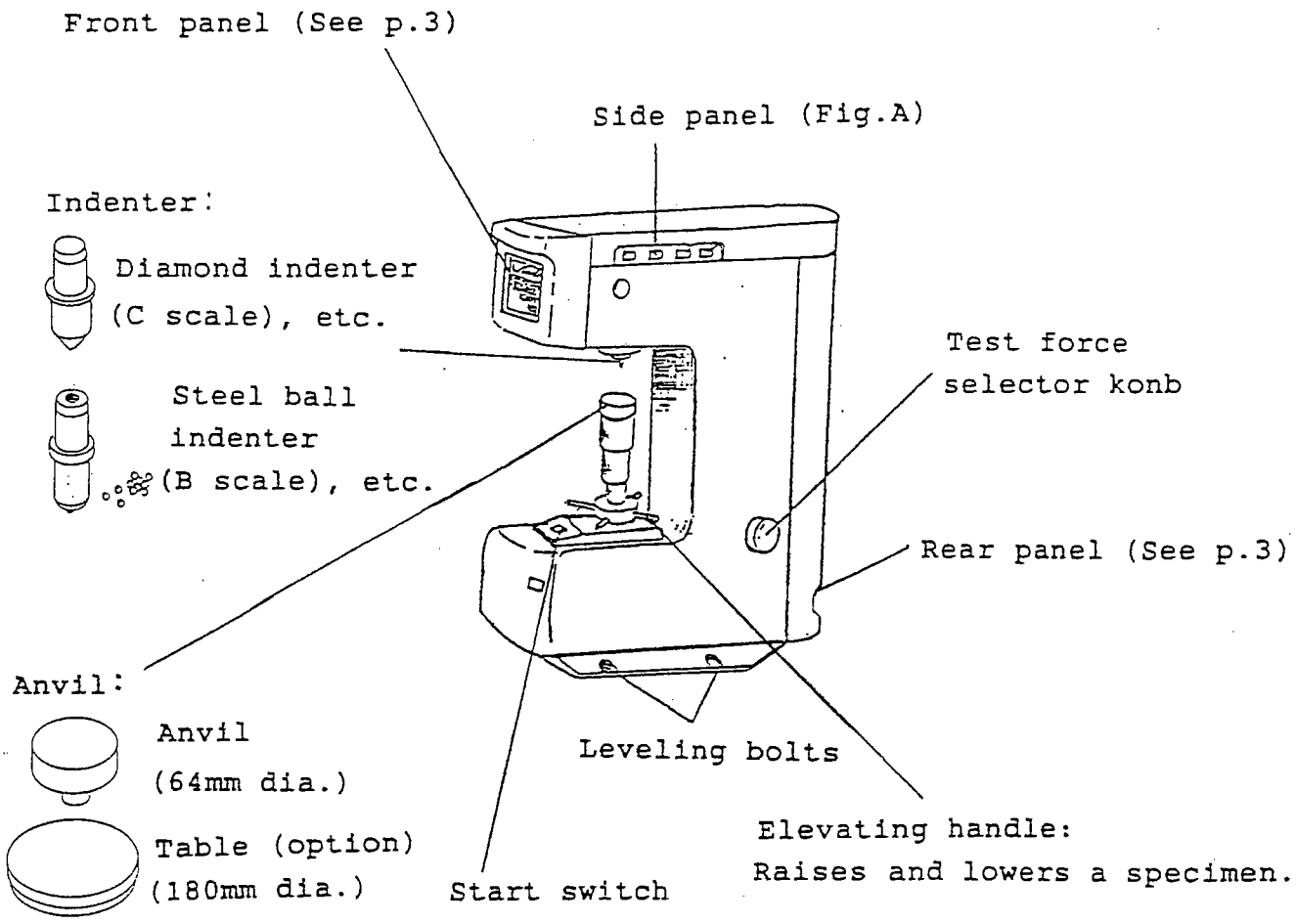


TABLE OF CONTENTS



Test force sequence switch:
AUTO: Performs one cycle of hardness measurement
DURATION: Used for appling and removing test force

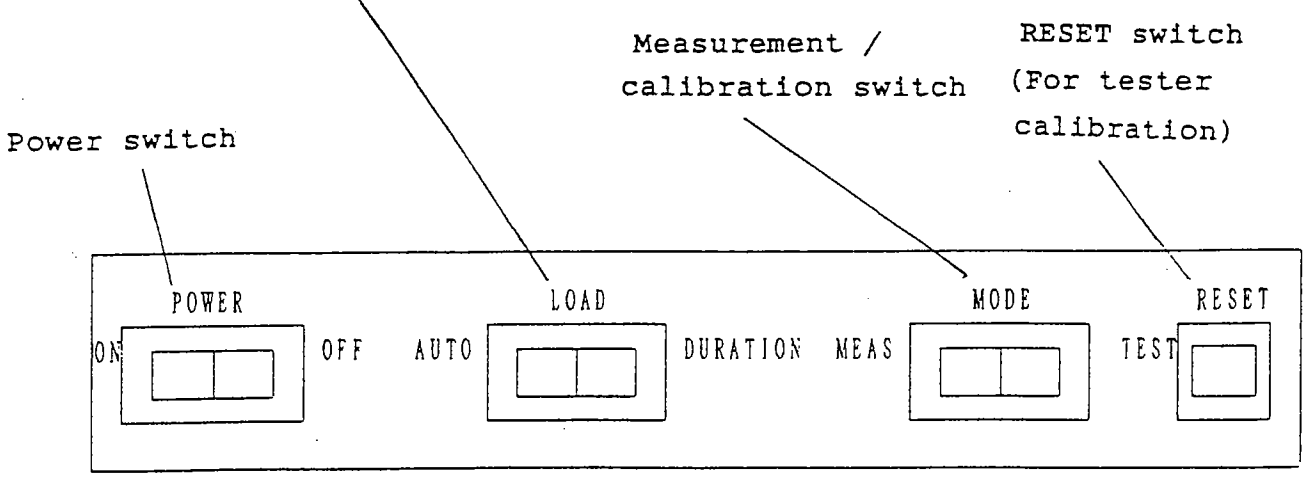
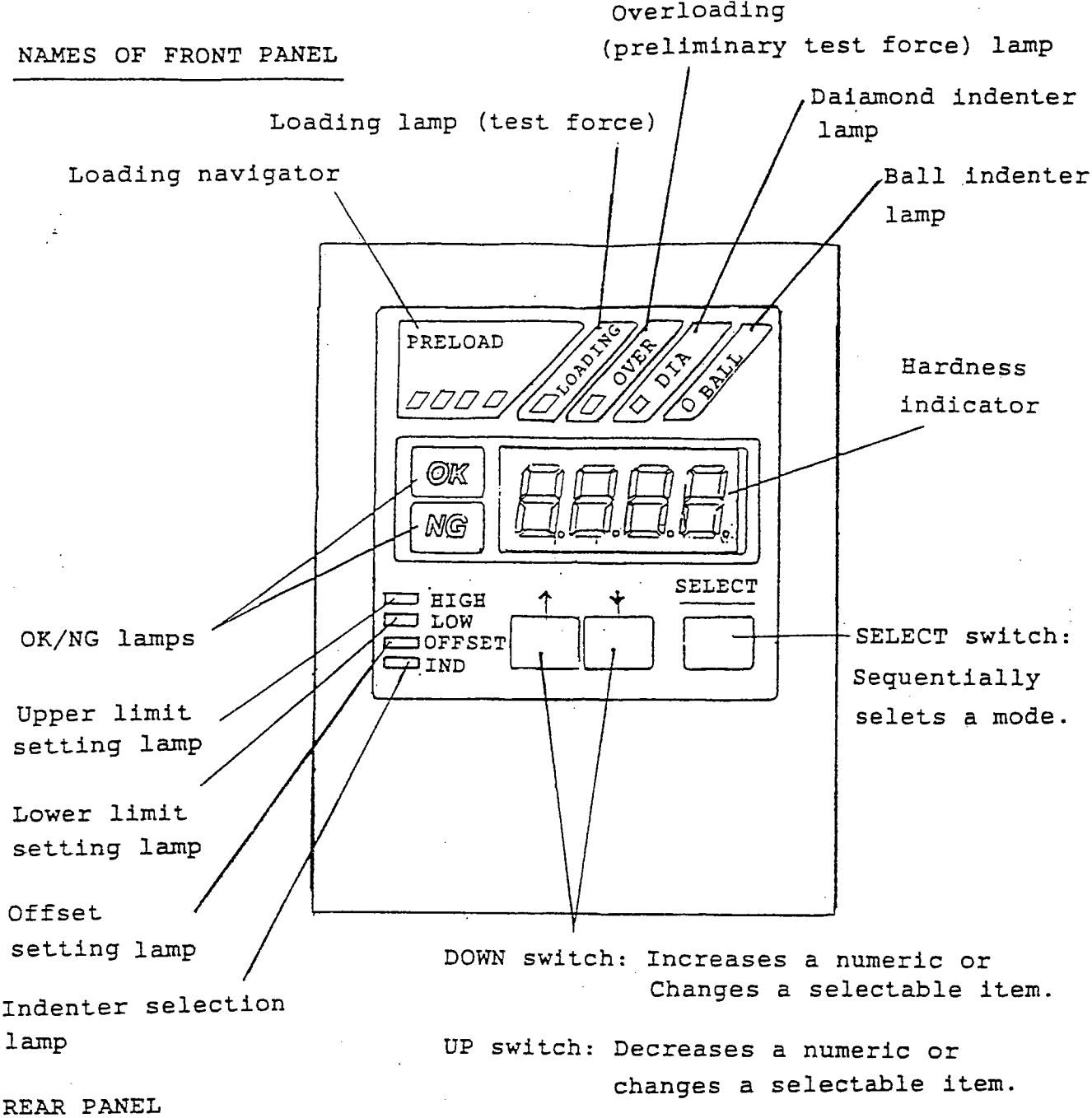
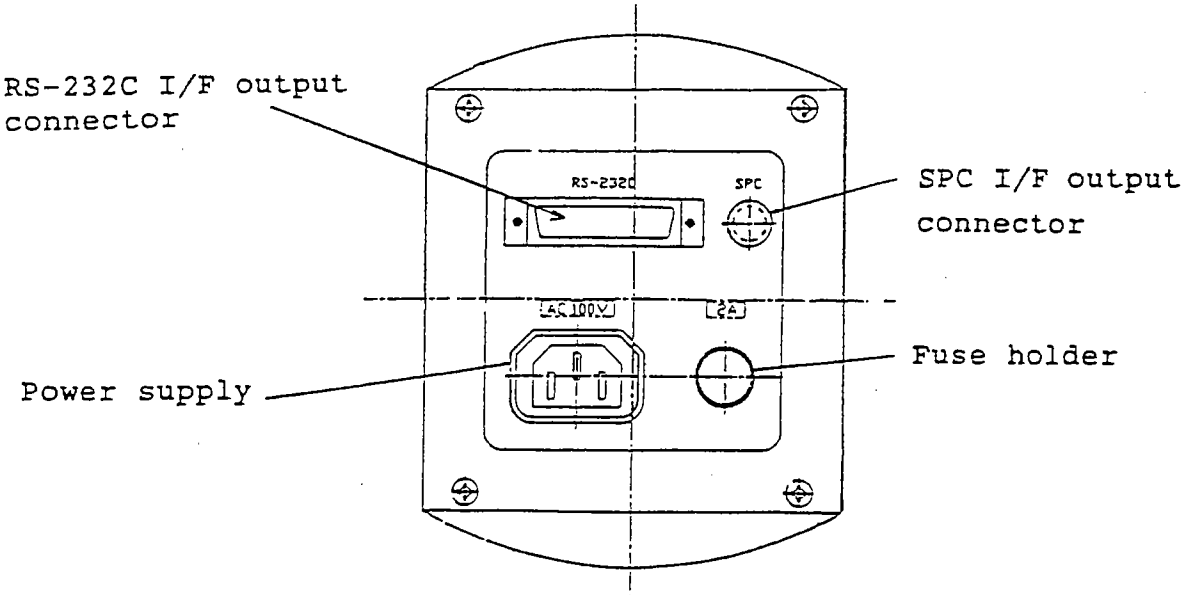


Fig.A

NAMES OF FRONT PANEL



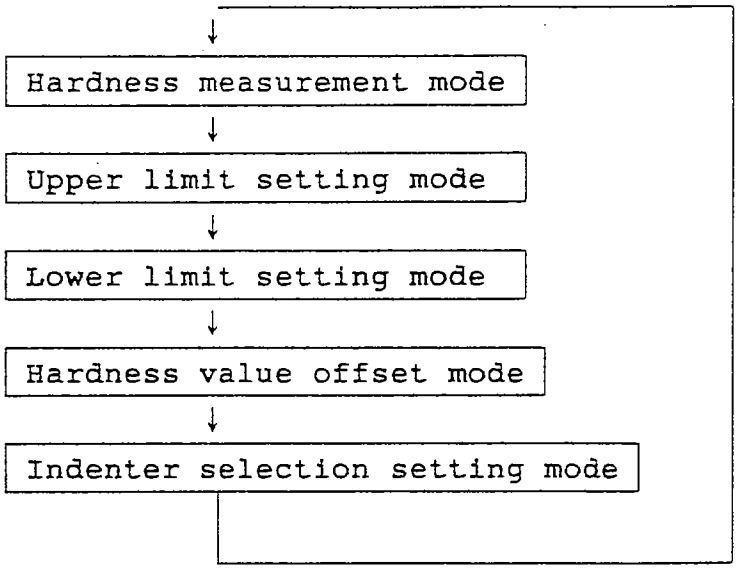
REAR PANEL



FUNCTIONS

1) Scroll selector

Upper / lower limits for judgement (HIGH, LOW), indenter selection (IND), offset of hardness value (OFFSET) in the setting of parameters can be easily set by means of three switches, SELECT, UP and DOWN.



The setting of parameters can be scrolled one by one in the order as shown in the left figure by pressing the SELECT switch.

Hardness measurement mode

Any of HIGH, LOW, OFFSET and IND lamps will be not lighted up.

Upper limit setting mode

1. " [ ] " HIGH will light up.
2. Operate UP / DOWN switches to change the upper limit value:

   [↑] (UP) switch: increases the value one by one;

   [↓] (DOWN) switch: decreases the value one by one.

Lower limit setting mode

1. " " [ ] LOW will light up.
2. Operate UP / DOWN switches to change the lower limit value.

Hardness value offset mode

1. " " [ ] OFFSET will light up.
2. Operate UP / DOWN switches to change the offset value.

Indenter selection mode

1. " " [ ] IND will light up.
2. Operate the UP / DOWN switches to select the indenter.

2) OK / NG for judgment

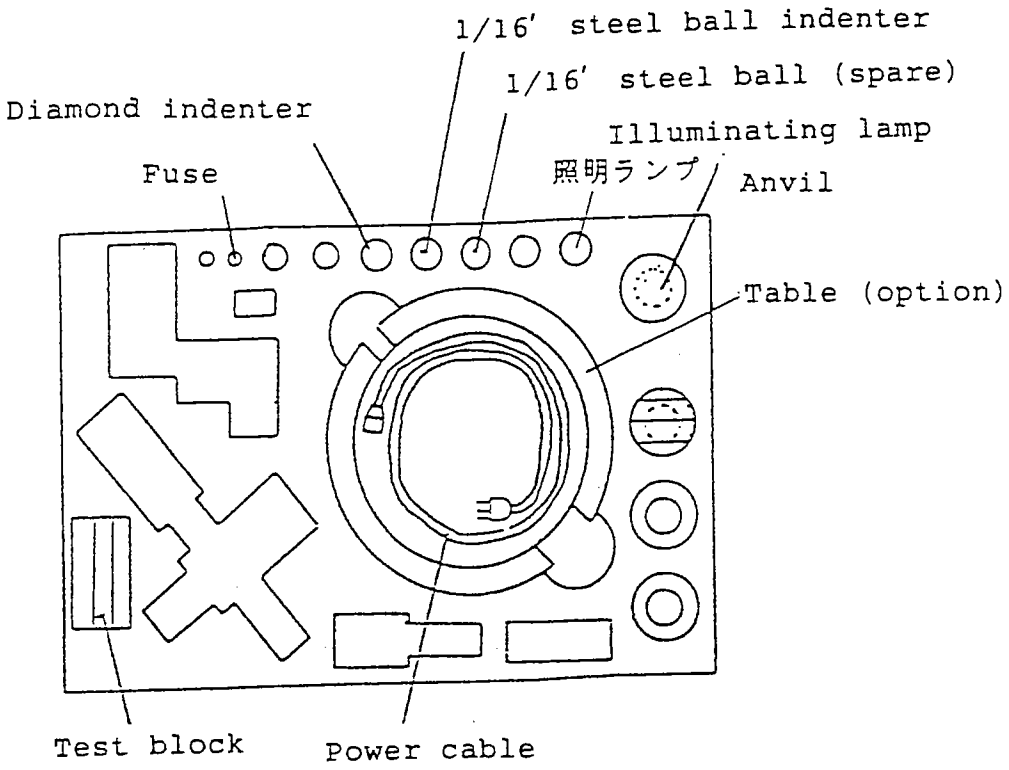
Set the upper and lower limit values. OK / NG lamp will light up to show judgment after the hardness is measured.

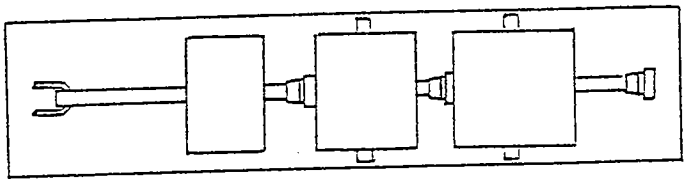
3) Loading navigator

When the preliminary test force is applied by the elevating handle, 4 LEDs of the loading navigator will show by flashing. When hardness indicator displays the appropriate value (360 approx.), 4 LEDs will light up.

Note: The appropriate value (360 to 370) is not the preliminary test force.

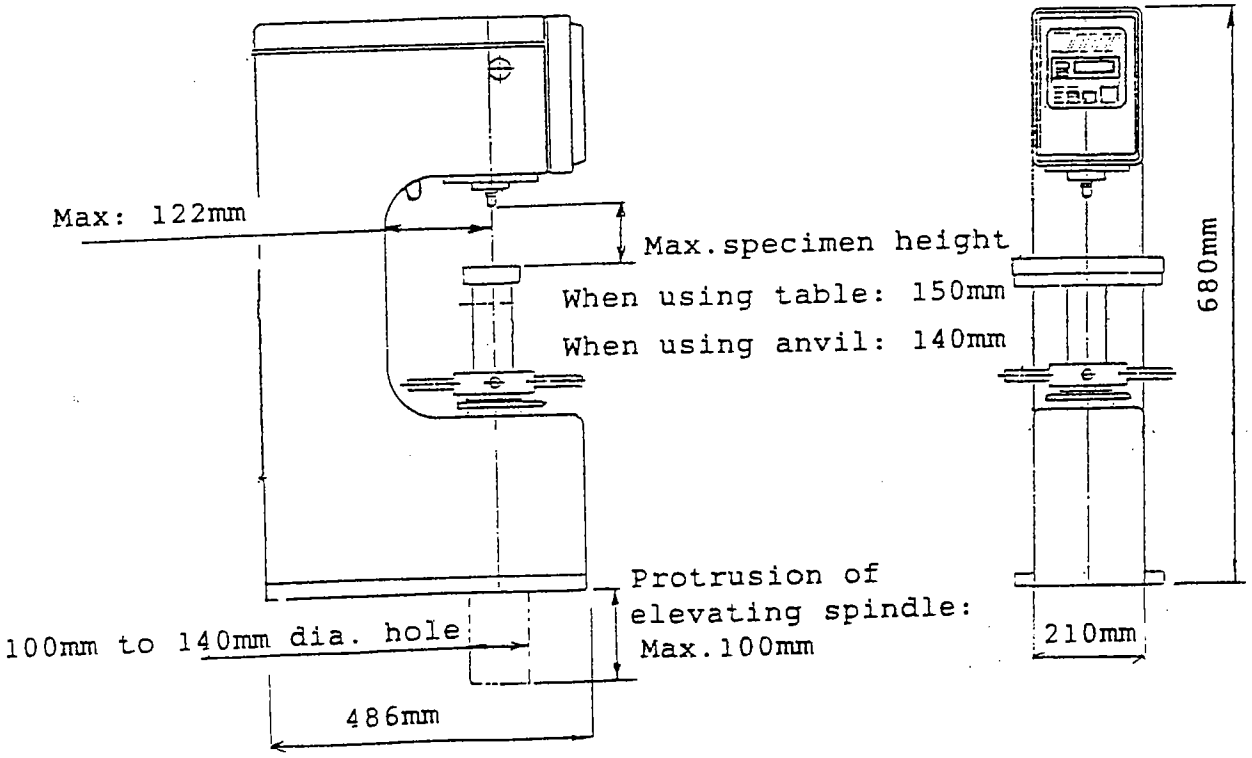
2.ACCESSORIES AND BASIC DIMENSIONS





Weights:
for 1471N (150kgf)
for 980.7N (100kgf)
for 588.4N (60kgf)

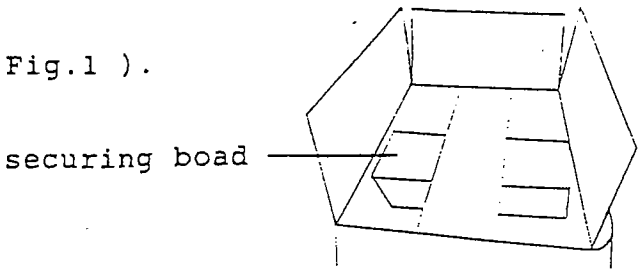
Basic Dimensions



Mass: 40kg Approx.

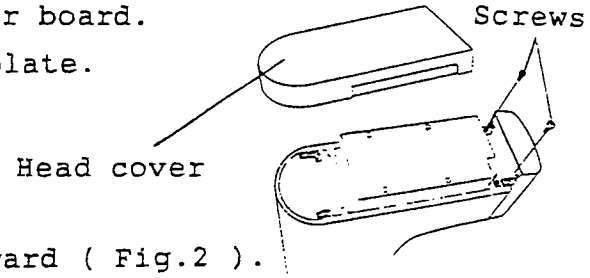
3. PREPARATION FOR OPERATION

1. Open the top of the case.
2. Remove the securing board (Fig.1).



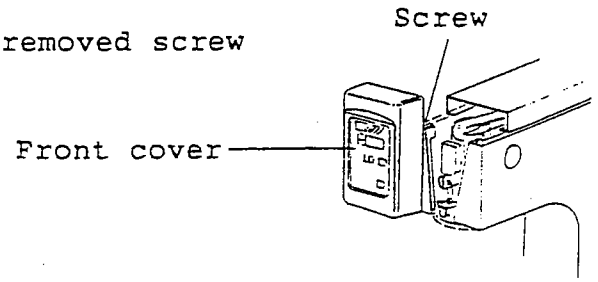
(Fig.1)

3. Remove the case.
4. Take down the accessory box from the lower board.
5. Take down the tester from the lower board.
6. Place the tester on a level base plate. Install it on a vibration-free or vibration-insulated place.
7. Open the accessory box.
8. Lift the head cover vertically upward (Fig.2).
9. Remove the two fixing screws from the head cover (Fig.2).



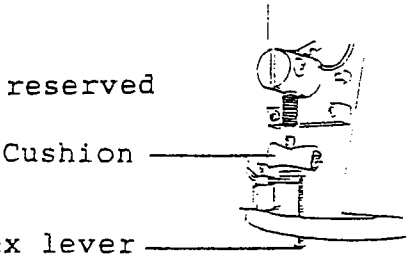
(Fig.2)

10. Fit the front cover with one removed screw temporarily. (Fig.3).



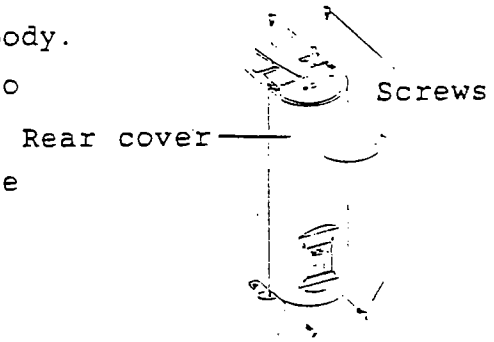
(Fig.3)

11. Unscrew the clamping screw of the index lever and remove the cushion (Fig.4). The removed clamping screw should be reserved in the accessories box.



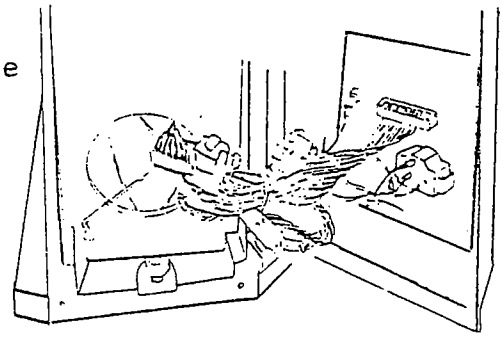
(Fig.4)

12. Remount the front cover to the main body. Confirm that the cable is connected to the tester.
13. Remove the four fixing screws from the rear cover (Fig.5).



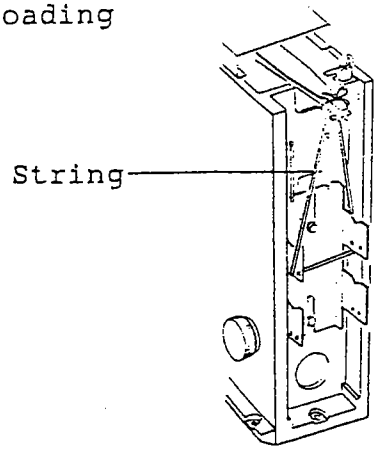
(Fig.5)

14. Remove the rear cover taking care not be damage cable (Fig.6).



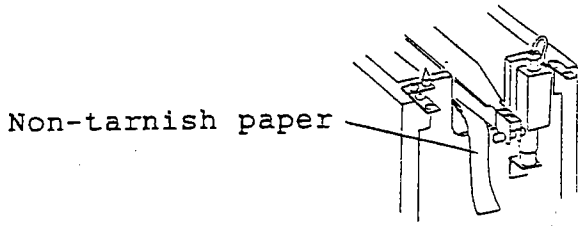
(Fig.6)

15. Remove the string which secures the loading lever (Fig.7).



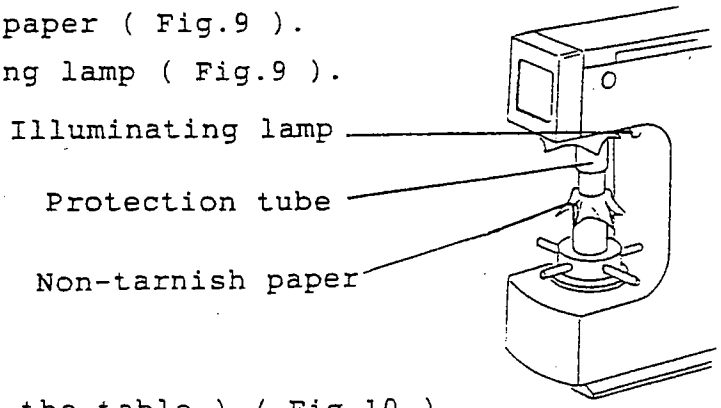
(Fig.7)

16. Remove non-tarnish paper (Fig.8).



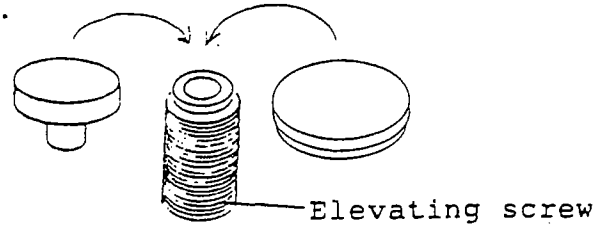
(Fig.8)

17. Lower the elevating handle to remove the protection tube and non-tarnish paper (Fig.9).
18. Attach the illuminating lamp (Fig.9).



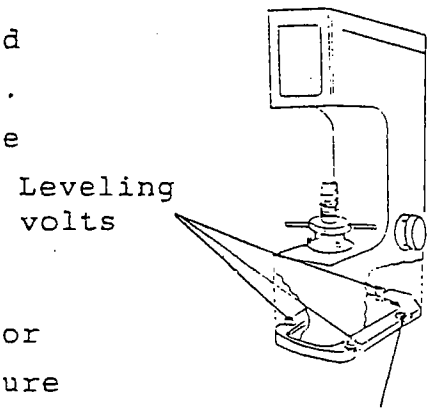
(Fig.9)

19. Attach the anvil (or the table) (Fig.10). Beware not to allow any dust to enter between the elevating screw and the anvil (or the table).



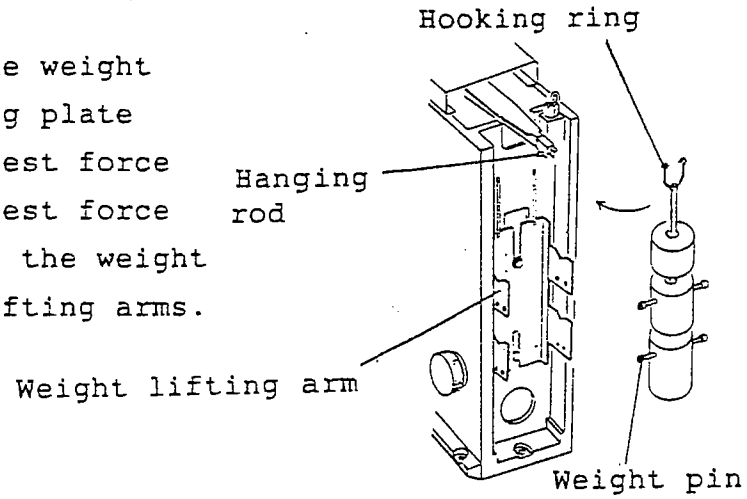
(Fig.10)

20. Place the level on the anvil and adjust the horizontality of the tester with the leveling bolts (two on the front and one on the rear), using the hexagon key. For fixing the tester to a warkbench, use the two bolts on the front and the two securing screws (through the two supplymentary tapped holes) (Fig.11). (These tapped holes are provided also for fixing the tester with the optional fixture for transportation.)



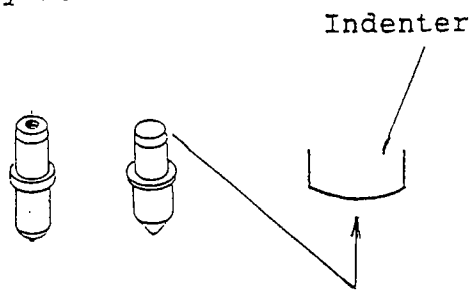
(Fig.11)

21. Hang the hooking rings of the weights set to the hanging rods of the loading lever (Fig.12).
22. Rest the weight pins on the weight lifting arms of the sliding plate (Fig.12). Then set the test force to 60kgf by means of the test force selector knob to test that the weight pins rest on the weight lifting arms.



(Fig.12)

23. Replace the rear cover.
24. Remount the head cover.
25. Connect the power cable to the power supply connector on the rear panel.
26. Insert the indenter into the hole of the indenter shaft taking care not to touch the tip of the indenter by hand (Fig.13).



(Fig.13)

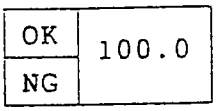
4. HARDNESS MEASUREMENT (Set the measurement / Calibration Switch to the "MEAS." position.)

4.1 AUTO —— Automatic Removal of Test Force

Set the test force sequence switch to the "AUTO" position.

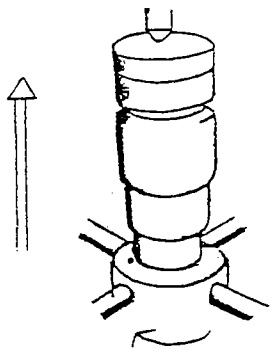
1) Turn "ON" the POWER switch.
   4 LEDs of the loading navigator will rapidly flash.

   Hardness indicator will display "100 (130) ".



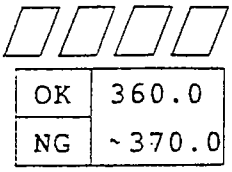
2) Place a specimen on the anvil (or table).

3) Turn the elevating handle clockwise carefully to raise the specimen to apply the preliminary test force.

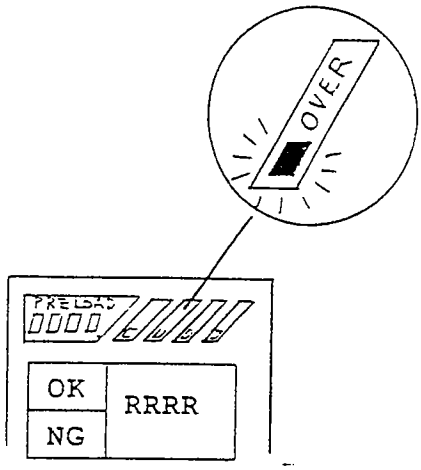


   The indicated value will count up.
   4 LEDs will slow by flashing.

4) Stop the handle operation as soon as 4 LEDs light up.

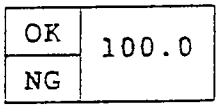


If the preliminary test force is overloaded, the overloading lamp will light up and the hardness indicator will display " RRRR ". In this case, lower the specimen, change its position, and retry.

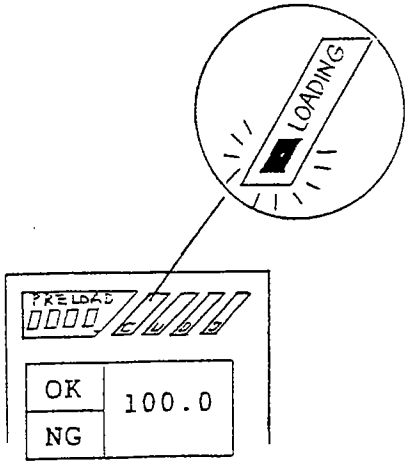


5) Press the START switch to start the test force sequence. The sequence of loading, duration, and unloading will be automatically performed.

Hardness indicator will preset.

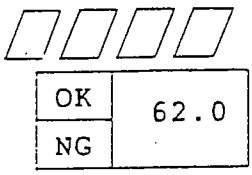


The loading lamp will light up.



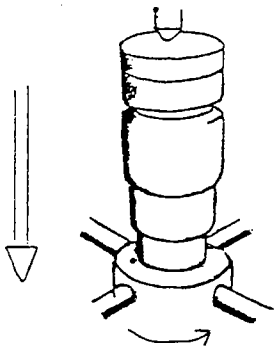
4 LEDs will flash.

6) After the loading lamp and 4 LEDs go out, read the indicated value.



- With "OK/NG judgment" setting:
  A judgment result is displayed by lighting OK or NG lamp.
- With "OUTPUT ON" setting:
  Data is transmitted out according to the data transmission format.

7) Turn the elevating handle counterclockwise to complete the mesurement.



4 LEDs will rapidly flash.

4.2 DURATION —— Optional Load Duration

Set the test force sequence switch to the "DURATION" position.

1) Turn "ON" the POWER switch.

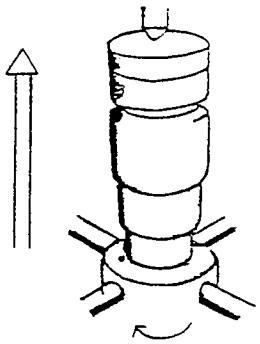
4 LEDs of the loading navigator will rapidly flash.

Hardness indicator will display "100 (130) ".

OK	100.0
NG	

2) Place a specimen on the anvil (or table).

3) Turn the elevating handle clockwise carefully to raise the specimen to apply the preliminary test force.

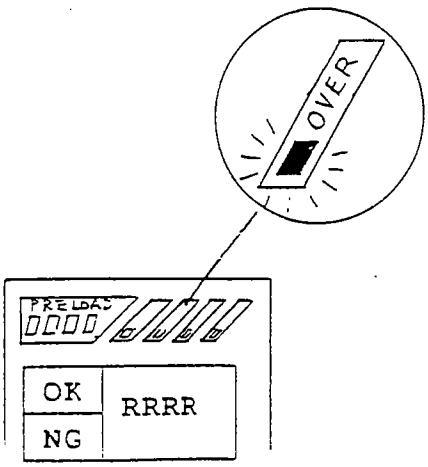


The indicated value will count up.
4 LEDs will slow by flashing.

4) Stop the handle operation as soon as 4 LEDs light up.

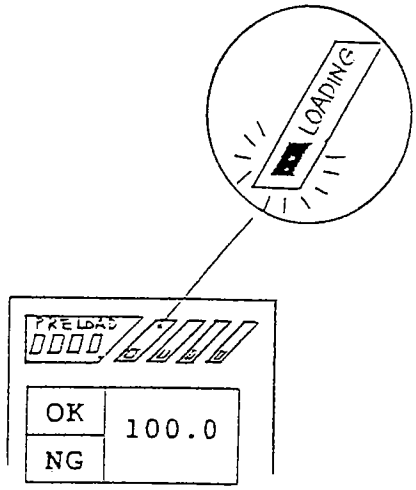
OK	360.0
NG	~370.0

If the preliminary test force is overloaded, the overloading lamp will light up and the hardness indicator will display " RRRR ". In this case, lower the specimen, change its position, and retry.

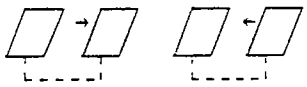


OK	RRRR
NG	

5) Press the START switch to apply the test force.
   The loading lamp will light up.

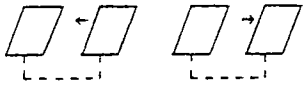


   4 LEDs will flash.

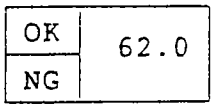


6) Start watching the time when the inner 2 LEDs light up. Load duration will be up to press the START switch again.

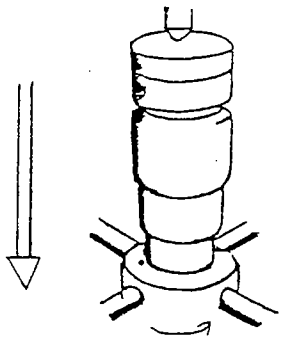
7) Repress the START switch to release the test force.
   4 LEDs will flash.



8) After the loading lamp and 4 LEDs go out, read the indicated value.
   - With "OK/NG judgment" setting:
     A judgmnt result is displayed by lighting OK or NG lamp.
   - With "OUTPUT ON" setting:
     Data is transmitted out according to the data transmission format.



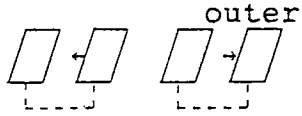
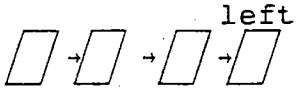
9) Turn the elevating handle counterclockwise to complete the mesurement.



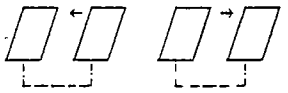
4 LEDs will rapidly flash.

5. RESET & ERRORS

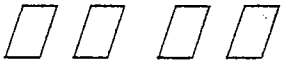
5.1 Test force not reset (after power on)

Operation	Value	Loading navigator	Comments
Power ON	100.0 ↓ ↓ ↓	Flashing (from inner to outer) 	Test force is released.
	100.0	Rapidly flashing (from right to left) 	Reset end

5.2 "Unload switch" error (after power on)

Operation	Value	Loading navigator	Comments
Power ON ≀ ≀ ≀	100.0 ↓ ↓ ↓	Flashing 	Test force is released.
After approx. 13sec.	----	4 LEDs light up. 	Repair is necessary notify your dealer.

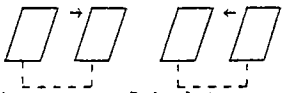
5.3 "Preliminary test force" error (during normal operation)

Operation	Value	Loading navigator	Comments
After preliminary test force is applied (ascending operation by handle).	>370.0 ↓ RRRR	4 LEDs light up. 	If this is the case, lower the elevating screw, change the specimen position, and retry.

5.4 "Test force" error (during normal operation)

Operation	Value	Loading navigator	Comments
During test force application	 ↓ ↓ ----	4 LEDs light up. 	Test force is badly applied. Specimen is too soft, or scale is badly selected.

5.5 "Load switch" error (during normal operation)

Operation	Value	Loading navigator	Comments
During test force application After approx. 7 sec.	Rapid countdown ↓ ↓ – – – –	Flashing from outer to inner  4 LEDs light up.	Repair is necessary. Notify your dealer.

6. INSPECTION

1) No dust should remain on the contact surfaces.
   Clean the contact surfaces between the specimen base (anvil or table) and elevating screw, between specimen base and specimen, and between indenter and indenter shaft.
2) Measuring deformation of tester frame.
   Carry out the same operation as hardness measurement under the condition illustrated on the right.
3) Lubrication
   A "ball oil filler" is provided on the upper surface of the elevating screw handle. Lubricate with machine oil as necessity requires.
   Other parts do not reguire lubrication.

7. ROCKWELL HARDNESS SCALES

Scales listed in the table below are provided. Select a scale as accustomed.

Preliminary test force (kgf)			98.07N (10)			Use
Test force (kgf)			588.4N (60)	980.7N (100)	1471N (150)	
Indenter	Diamond indenter		A	D	C	Steel
	Steel ball indenter (dia. mm)	1.854	F	B	G	Soft steel, Light alloys
		3.175	H	E	K	Soft metals Plastics
		6.35	L	M	P	
		12.7	R	S	V	
Hardness Equation ①			100 -0.5h ② 130 -0.5h ③			

① "h" denotes diference of indenter displacement in twice application of the preliminary test force. (units in microns)
② When using diamond indenter.
③ When using ball indenter.

8. TESTER CALIBRATION

(Unnecessary in ordinary maintenance of tester. Special divices are required in this calibration.)

To check the load and indicator, set the Measurement/Calibration switch of the tester side panel to the "TEST" position.

8.1 Preliminary Test Force Measurement

Put a load measuring device on the specimen base. Apply the preliminary test force and read a load value when all pilot lamps light up.
(Displayed value: "365.0")

8.2 Test Force Calibration

1) Place a load measuring device on the anvil (or table). Apply the preliminary load, and set the Measurement / Calibation switch on the side panel to the "RESET" position in the same condition as above (displayed value: "365.0") in order to reset the displayed value to the standard value (100.0).
2) Elevate the anvil to apply preload suitable for the load measuring device used.
3) Press the START switch to apply the test force. Read displayed hardness values as related to the load.
   For evaluating the load corresponding to another hardness value on the display, modify the preload condition mentioned in the previous item, or change the position of the indenter by raising or lowering the specimen base with the load applied, and mesure the load.
4) To release the load, press the START switch again.

8.3 Indicator Calibration

1) Put a meter testing device on the specimen base. The device shall be regarded as the datum position.
2) Elevate the anvil to apply the preliminary test force.
3) Lower the spindle of the meter testing device, and elevate it again to set it to the datum position.
4) Press the RESET switch for approx. 1 second to reset the displayed value to the standard value.
5) Lower the spindle of the meter testing device below "-30". Then, raise it a little to measure the reading error in the upward direction of the indenter.

9. SPECIFICATIONS

Model:	ARk-600 code No. 810-218
Chassis srtucture:	Simpulified dustproof structure; Flange base structure

Preliminary test force:

N	98.07
kgf	10

Test force:

N	588.4	980.7	1471
kgf	60	100	150

Test force switching:	Preliminary test force: Fixed Test force: By knob operation
Load control:	Preliminary test force: Manual Test force: Automatic (loading, duration and unloading) Load controled by loading navigator.
Duration time:	Automatic: 3 to 5s Manual: As desired Switch between antomatic and manual at the flip of a switch.
Hardness display:	4 digits digital display (LED display) Minimum displayable display: 0.1HR
Functions:	Judgment, Loading navigator, Hardness value offset
Functions settings:	Scroll selector system
Data output:	RS-232C interface output SPC interface output
Maximum height of specimen:	0 to 140mm (When using flat anvil) 10 to 150mm (When using table) (For adjusting to the height of specimen, removal of screw cover may be required.)
Maximum depth of specimen:	112mm (from center of indenter shaft)

Dimentions of chassis:	210(W) × 486(D) × 680(H) approx.
Mass of machine:	40kg approx.
Applicable power supply:	100V AC ±10%, 50/60Hz (120V AC, 220V AC or 240V AC applicable if so specified in the oder.)
Power consumption:	30VA or less

10. PARTS LIST AND OPTIONAL ACCESSORIES

Parts List (standard)

No.	Item	Specification	Number of pieces
1	Main machine unit	220(W) × 486(D) × 680(H)mm	1
2	Accessories		
2- 1	Weights	588.4N (60kgf), 980.7N(100kgf), 1471N (150kgf)	1set
2- 2	Diamond indenter		1
2- 3	Steel ball indenter	1/16′	1
2- 4	Flat anvil	64mm dia.	1
2- 5	Screw cover		1
2- 6	Power cable	for 100V AC 120V AC 220V AC 240V AC	1
2- 7	Test block	30 to 35 HRC	1
2- 8	Test block	60 to 65 HRC	1
2- 9	Test block	90 to 95 HRB	1
2-10	Illuminating lamp	100V AC, 5W (JIS E-12)	1
2-11	Accessory box		1
2-12	PVC dust cover		1
2-13	Instruction Manual		2copies
2-14	Warranty		1
2-15	Spare steel balls	1/16′	12
2-16	Fuses	for 100 to 120V (Midget, 5.2mm dia.×20mm, 125V AC, 2A); for 220 to 240V (Midget, 5.2mm dia.×20mm, 250V AC, 1A)	2 (one of which is built in the machine.)
2-17	Level		1
2-18	Hex-key		1
2-19	Screwdriver		1
2-20	Leveling bolts		3
2-21	Securing screws		2

Optional Accessories

These accessories are available to meet various user requirments.

① 1/2' steel ball indenter
② 1/4' steel ball indenter
③ 1/8' steel ball indenter
④ V-anvil (40mm dia, groove width: 30mm)
⑤ V-anvil (40mm dia, groove width: 6mm)
⑥ Small V-anvil (10mm dia, groove width: 8mm, height: 13mm)
⑦ Spot anvil (12mm dia, hight: 1.5mm)
⑧ Spot anvil (5.5mm dia, hight: 13mm)
⑨ Round table (180mm dia.)
⑩ Extension support
⑪ Jack support

etc.

11. INTERFACES

11.1 RS-232C interface

(1) Connector pin assignment

Contact No.	Name	Contact No.	Name
1	F.G	14	
2	TxD(OUT)	15	
3	RxD(IN)	16	
4	+V	17	
5		18	
6	+V	19	
7	S.G	20	+V
8		21	
9		22	
10		23	
11		24	
12		25	
13			

D-sub connector (25 contacts)

(2) Communication method

Start bit	1
Stop bit	2
Data bit	8(ASCII)
Parity bit	None
Boud rate	9600

(3) Output format (fixed point)

☆□□□.□CRLF
☆□□□.□CRLF
☆□□□.□HR CRLF

The output signal at a single measurement has a format of one of these lines illustrated above.

Control codes: CR ··· Carriage Return (0DH)
LF ··· Line Feed (0AH)
␣ ··· Space (20H)
☆ ··· Sign (Space or "-")

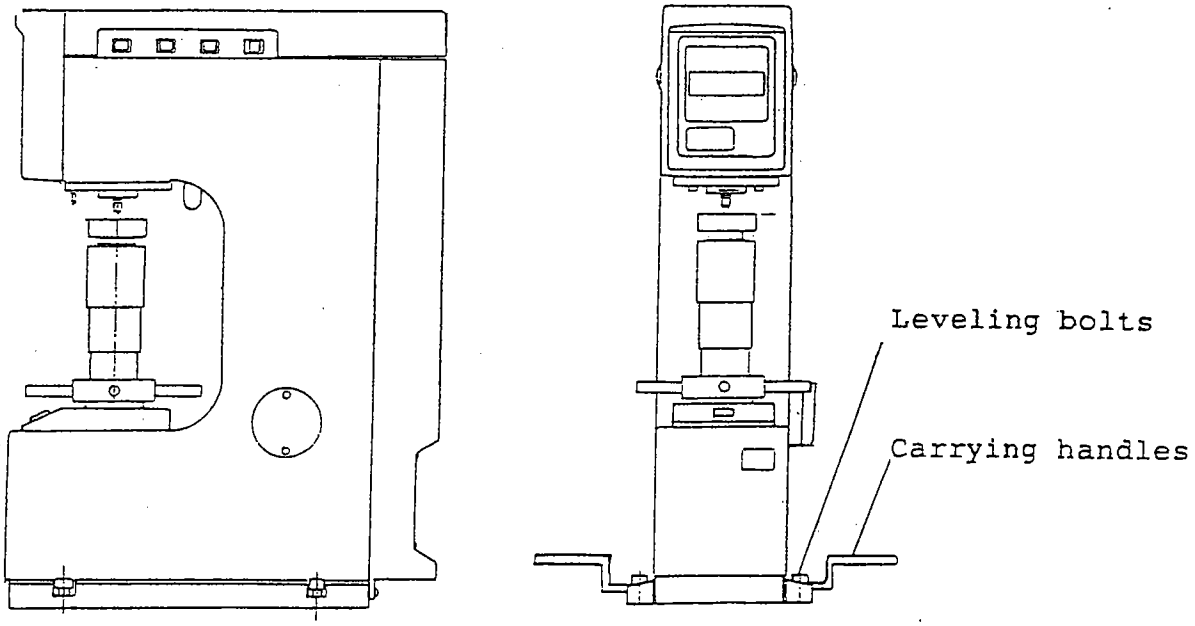
For Carrying the Instrument

1. Take out the four carrying handles and the hex-key (8 mm) from the accessory box.

2. Unscrew the two leveling bolts on the front and the two securing screws on the rear using the hex-key.

3. Screw each of these bolts and screws through the hole of a carrying handle into a tapped hole of the instrument and tighten it (see illustration).

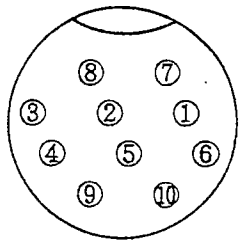
4. After carrying, take off the carrying handles and keep them in the accessory box. Then, screw the bolts and screws into the instrument as before.



11.2 DIGIMATIC interface

(1) Connector pin assignment

Contact No.	Name	Description
1	GND	Ground
2	DATA	Open collector
3	CK	
4	$\overline{\text{REDY}}$	
5	$\overline{\text{REQUEST}}$	Pull up to V_{DD}(+5V)
6 ~ 10	N.C	



(2) Data format

Each data comprises 13 digits (4bits/digit) and output is effected in bit serial starting from 2^0 of d_1 through 2^3 of d_{13}.

d_1 d_2 d_3 d_4 d_5 d_6 d_7 d_8 d_9 d_{10} d_{11} d_{12} d_{13}

$d_1 \sim d_4$
All "F" (1111)

d_5: Sign +: 0(0000)
-: 8(0001)

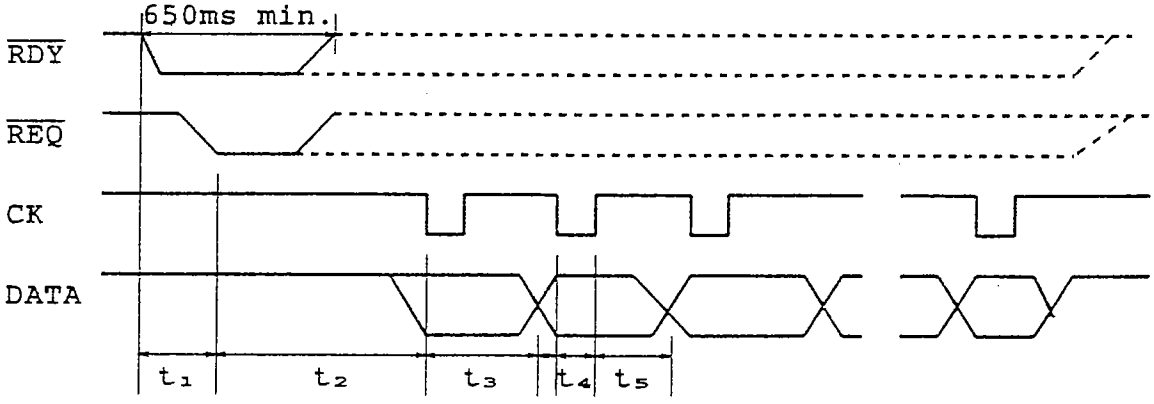
$d_6 \sim d_{10}$: Measurement data: 6-digits (Hardness value)

d_{11}: Decimal point "1" (1000)

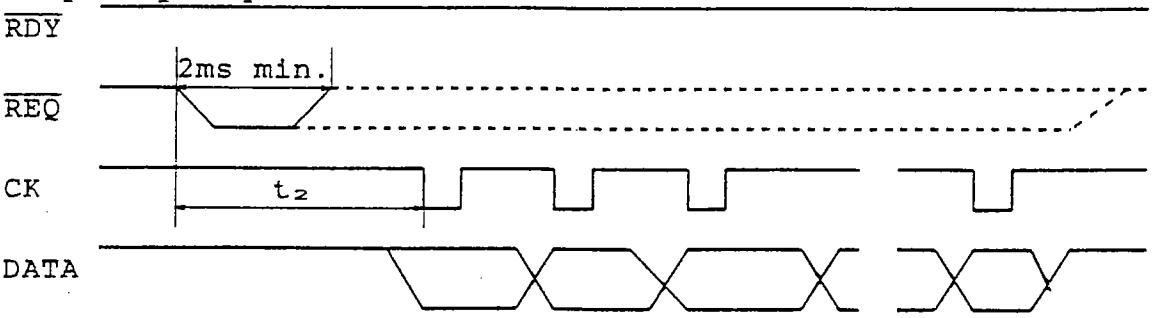
d_{12} d_{13}: "F" (1111)

(3) Timing chart

① Output at measurement end



② Output by request from external device



t_1 < 650ms, t_2=350ms, t_3=320μs , t_4=240μs , t_5=320μs