Equipment Anatomy

Lumbar Extension Machine Parts

A. Upper Back Pad
1. attached to movement arm, serves as the mechanism to which lumbar extensor force is applied
2. pad is counterweighted for accurate measurement
3. maximal amount of back (shoulder) surface area should be applied to pad

B. Movement Arm
1. lever arm of machine; rotates on machine axes
2. connected to strain gauge for measurement of force output

C. Strain Gauge
1. one half anchored to machine; one half attached to movement arm of machine
2. measures changes in electrical resistance (ohms)
3. computer converts ohms to ft./lbs. (analog-to-digital conversion)

D. Potentiometer
1. device which indicates the position of the angle selector throughout the patient's ROM
2. one-half connected to machine; one-half connected to the angle selector

E. Handlebars
1. attached to movement arm; provide standardized positioning of upper extremities during testing and training
2. patient should maintain a loose, comfortable grip (thumb and forefinger) during set-up procedures, testing and training

E. Headrest
1. attached to movement arm; provides comfort, support and standardized positioning of the head
2. top of pad should be adjusted to the base of occipital bone
3. patient should not "arch" neck during testing and training

F. Angle Selector
1. locks movement arm into any 3°, from 72° to 0° of lumbar flexion
    a) handle in -- locks movement arm into even angles
    b) handle out -- locks movement arm into odd angles
    c) handle in neutral -- movement arm unlocked

H. Movement Arm Lock
1. changes mode of machine from isometric to dynamic, or dynamic to isometric
2. UP position = isometric; DOWN position = dynamic

(Lumbar Machine Parts)

I. Force/Angle Switch
1. when in testing mode, changes computer to indicate either angular position of movement arm, or force (torque) output
2. switch also performs other computer related functions
    a) logs in angle of top-dead-center
    b) logs in maximum angle of extension/flexion
    c) terminates dynamic exercise

J. Weightstack
1. stroke length = 6 in.
2. total of 400 “ft.” pounds; 800 “6 in.” pounds
    a) minimizes acceleration of weightload
    b) minimizes mechanical friction of machine

K. Variable Resistance Cam
1. designed to provide adequate muscle overload at all points throughout the lumbar extension ROM
2. varies the resistive torque (moment arm) from 72 to 0 deg. of lumbar extension on a ratio of 1. 4: 1

L. Pelvic Restraint
1. stabilization pads for lumbar/pelvic area
2. two round pads on their own axes of rotation
3. when pelvis is properly secured, pads should not rotate (pads and lumbar area act as a “gear”)
4. iliac crests should be at or above the axes of the pads

M. Thigh Restraint
1. adjustable crank, tightens and loosens thigh restraint

N. Femur Restraint
1. acts as fulcrum in redirecting restraining force from footboards down into the pelvic girdle
2. height of restraint is adjustable, with 6 hole settings
    a) most females = #3 or #4
    b) most males = #4 or #5
    c) for patients $\geq$ 6ft (long legs) or patients using auxiliary seat cushion, hole = #6
    d) knees should be placed in middle of pads, with front of restraints level with top of patellas

O. Footboard
1. serves as a platform for proper positioning of feet
    a) heels should be positioned at base of board
    b) toes should be pointed inward slightly

(Lumbar Machine Parts)

P. Footboard adjustment
1. adjustable crank system that pushes tibias into femurs, and femurs down into pelvic girdle
2. proper adjustment should allow 1/2 in. between heels and board when fully restrained

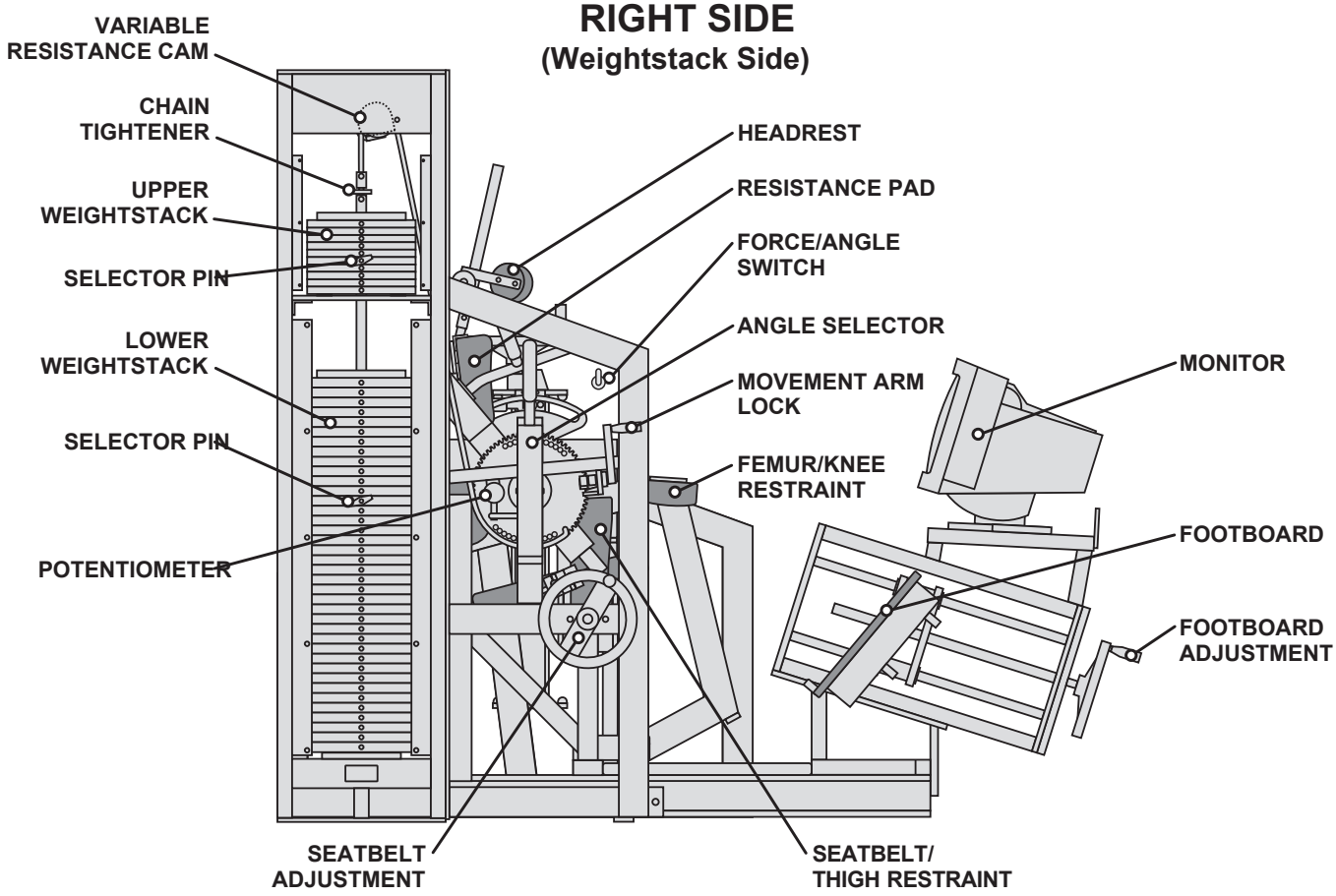
Q. Torso Mass Counterweight
1. 155 lb. weight counterbalances the mass of upper body to eliminate measurement errors due to gravity
   a) adds to measurement in flexed positions
   b) subtracts from measurement in extended position
2. must be leveled prior to being locked at top-dead-center

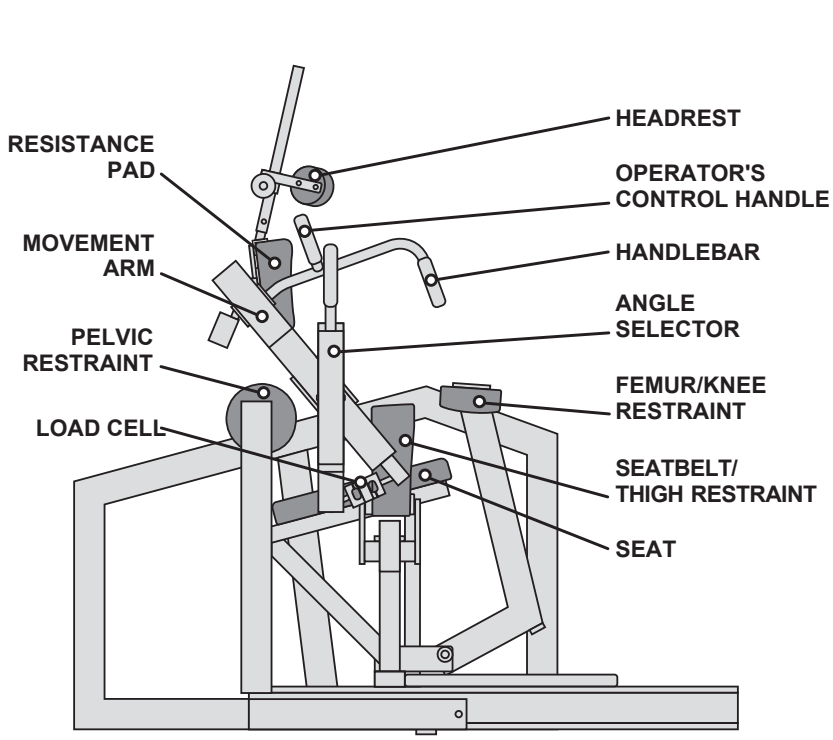
R. Torso Mass Counterweight Lock
1. locks CW to multi-position flange at top-dead-center position
2. should be unlocked during calibration and when locating top-dead-center position

S. Torso Mass Counterweight Adjustment
1. adjustable crank, raises and lowers CW, thereby increasing or decreasing amount of torque on movement arm
   a) cranking clockwise (raising CW) decreases torque
   b) cranking counterclockwise (lowering CW) increases torque
2. digital counter, allows standardization of CW position

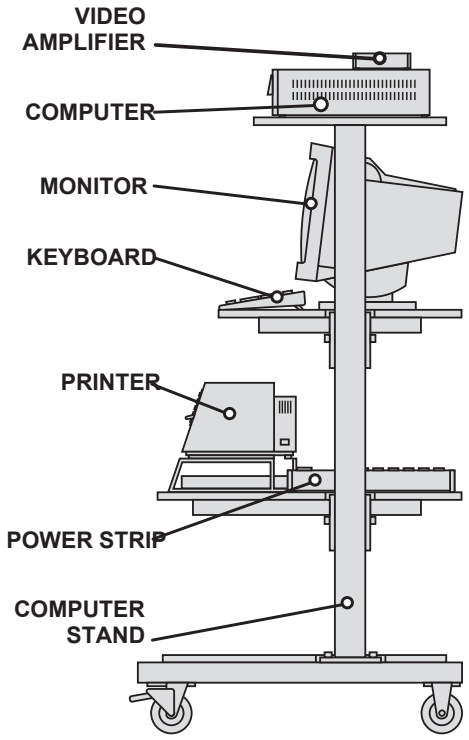
Lumbar Extension Machine

Figure 1





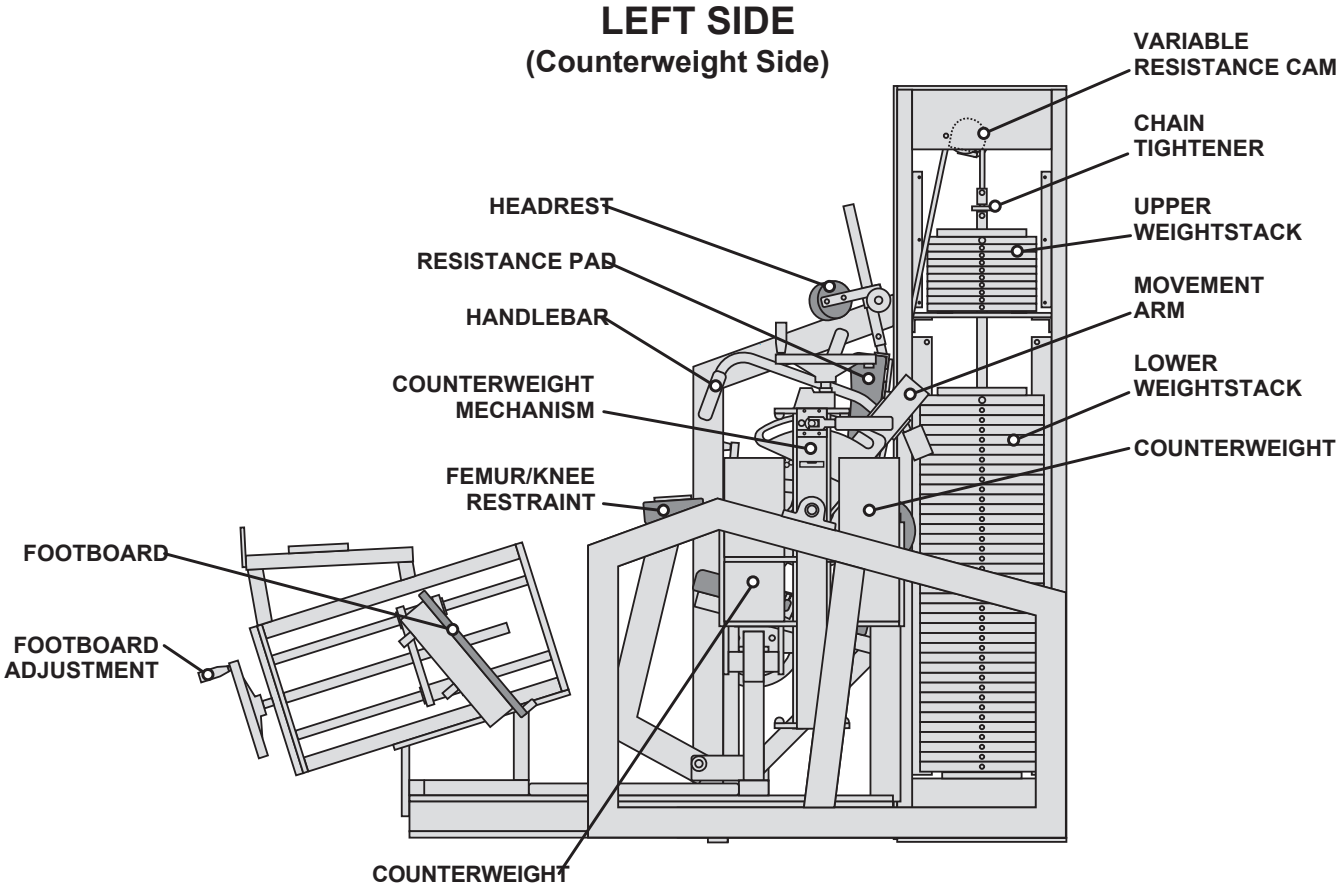
RIGHT SIDE (Some Assemblies & Parts Not Shown)

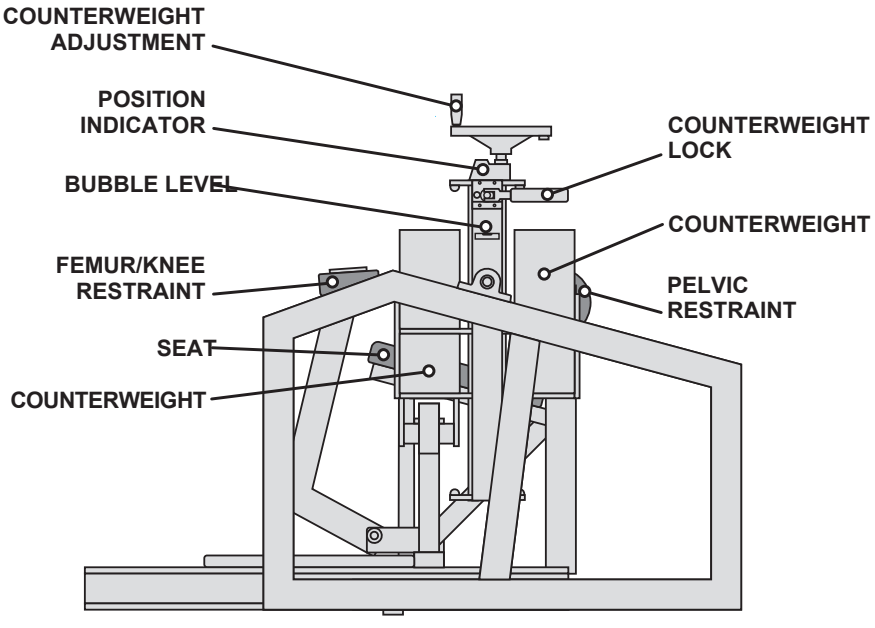


COMPUTER GROUP

Lumbar Extension Machine

Figure 2

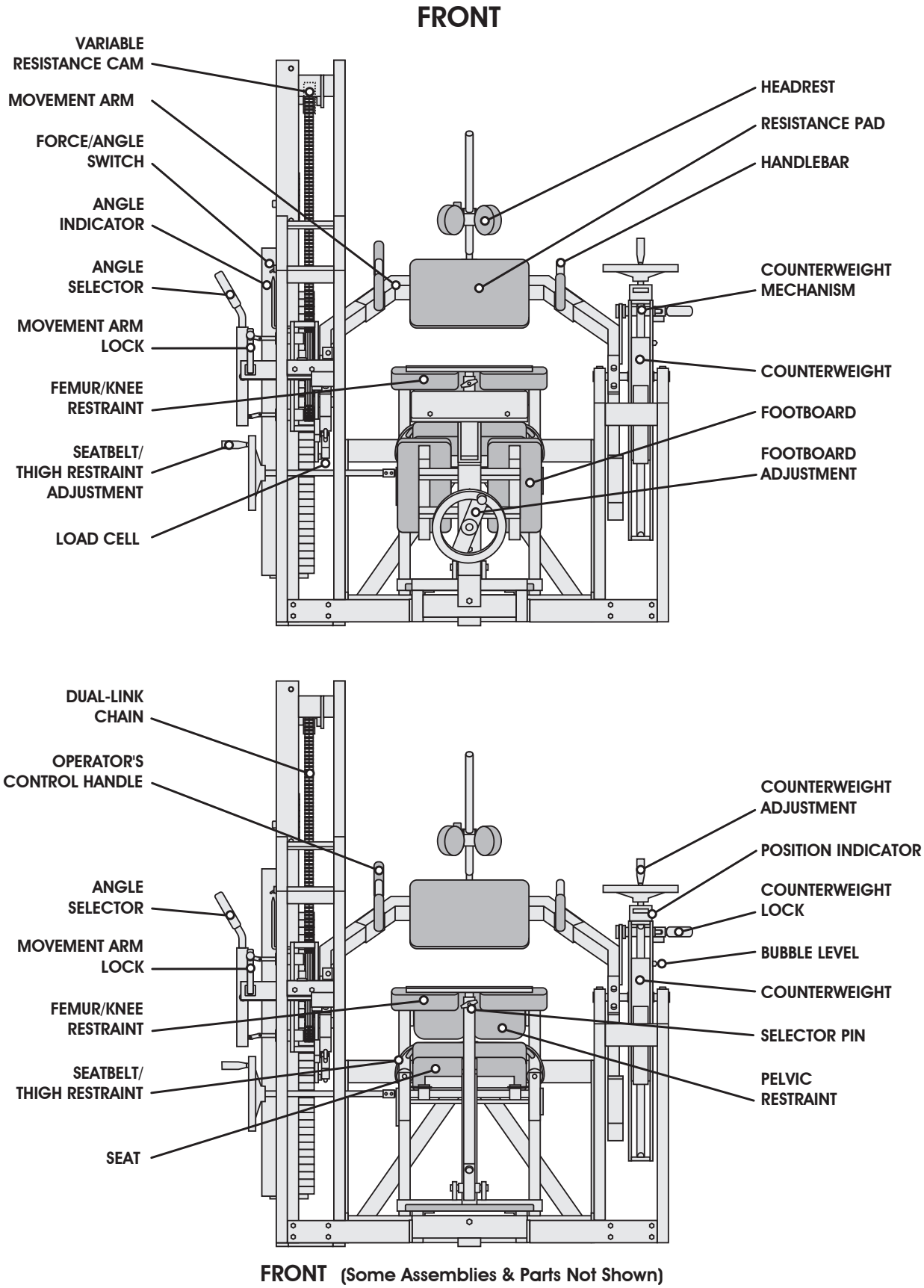




LEFT SIDE (Some Assemblies & Parts Not Shown)

Lumbar Extension Machine

Figure 3



FRONT (Some Assemblies & Parts Not Shown)

Cervical Extension Machine Parts

A. Headpad
1. attached to movement arm, serves as the mechanism to which cervical extensor force is applied
2. pad is counterweighted for accurate measurement
3. maximal amount of head surface area should be applied to pad

B. Movement Arm
1. lever arm of machine; rotates on machine axes
2. connected to strain gauge for measurement of force output

C. Strain Gauge
1. one half anchored to machine; one half attached to movement arm of machine
2. measures changes in electrical resistance (ohms)
3. computer converts ohms to ft/lbs. (analog-to-digital conversion)

D. Potentiometer
1. device which indicates the position of the angle selector throughout the patient's ROM
2. one-half connected to machine; one-half connected to the angle selector

E. Angle Selector
1. locks movement arm into any 3°, from 126° to 0°
   a) handle in -- locks movement arm into even angles
   b) handle out -- locks movement arm into odd angles
   c) handle in neutral -- movement arm unlocked

F. Movement Arm Lock
1. changes mode of machine from isometric to dynamic, or dynamic to isometric
2. UP position = isometric; DOWN position = dynamic

G. Force/Angle Switch
1. when in testing mode, changes computer to indicate either angular position of movement arm, or force (torque) output
2. switch also performs other computer related functions
   a) logs in angle of top-dead-center
   b) logs in maximum angle of extension/flexion
   c) terminates dynamic exercise

H. Weightstack
1. stroke length = 1.5 in.
2. total of 75 "ft" pounds; 900 "1.5 in." pounds
   a) minimizes acceleration of weightload
   b) minimizes mechanical friction of machine

(Cervical Machine Parts)

I. Chain Tightener
1. device which removes excess “slack” in the chain so that full ROM repetitions will be accurately counted
2. should be loosened during calibration and tightened during dynamic exercise

J. Variable Resistance Cam
1. designed to provide adequate muscle overload at all points throughout the cervical extension ROM
2. varies the resistive torque (moment arm) from 126° to 0° of cervical extension on a ratio of 1.4:1

K. Shoulder Harness
1. adjustable straps positioned over the shoulders which are used as part of the restraint system
2. assists in stabilizing the upper body during testing and training

L. Seat Belt
1. secured across the patient’s waist
2. stabilizes lower body during testing and training

M. Torso Restraint
1. stabilizes upper body during testing and training
2. two rotating pads adjust to fit contour of upper body

N. Torso Restraint Adjustment
1. adjustable crank tightens and loosens torso restraint

O. Seat Height Adjustment
1. adjustable crank, raises and lowers seat position
2. digital counter allows for standardized positioning of patient

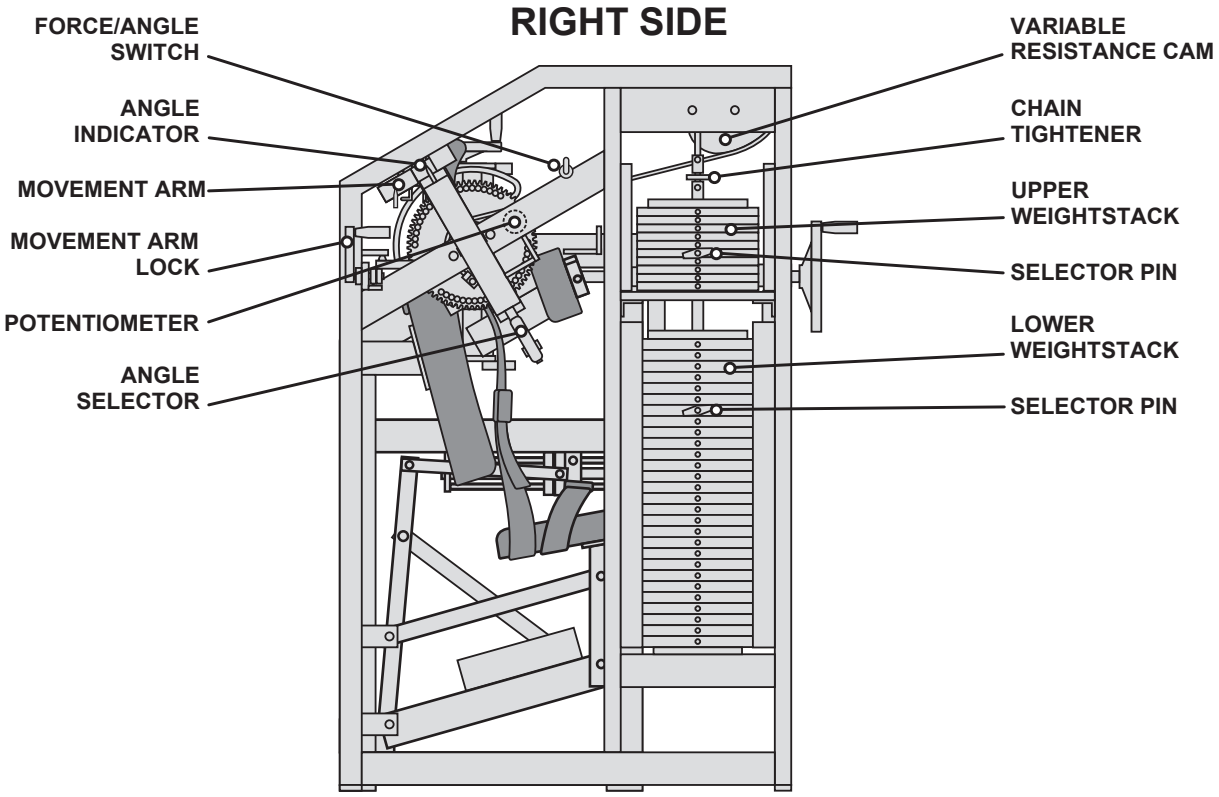
P. Head Mass Counterweight
1. counterbalances the mass of the head to eliminate measurement errors due to gravity
   a) adds to measurement in flexed positions
   b) subtracts from measurement in extended positions
2. must be leveled prior to being locked at top-dead-center

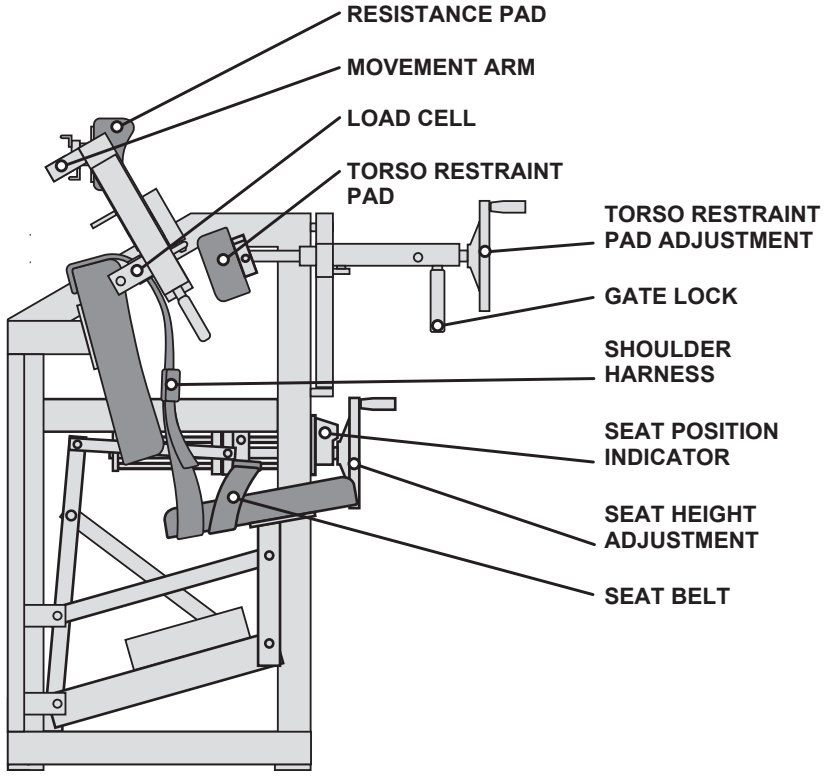
Q. Head Mass Counterweight Lock
1. locks CW to multi-position flange at top-dead-center position
2. should be unlocked during calibration and when locating top-dead-center position

R. Head Mass Counterweight Adjustment
1. adjustable crank, raises and lowers CW, thereby increasing or decreasing amount of torque on movement arm
   a) cranking clockwise (raising CW) decreases torque
   b) cranking counterclockwise (lowering CW) increases torque
2. number line ruler, allows standardization of CW position

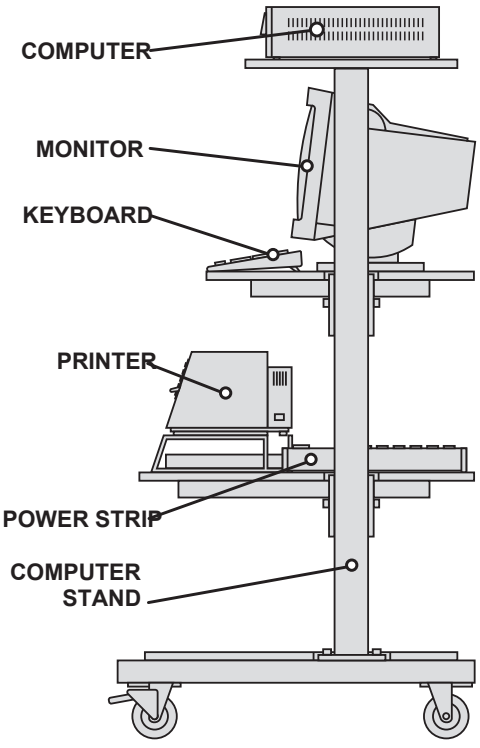
Cervical Extension Machine

Figure 1





RIGHT SIDE (Some Assemblies & Parts Not Shown)



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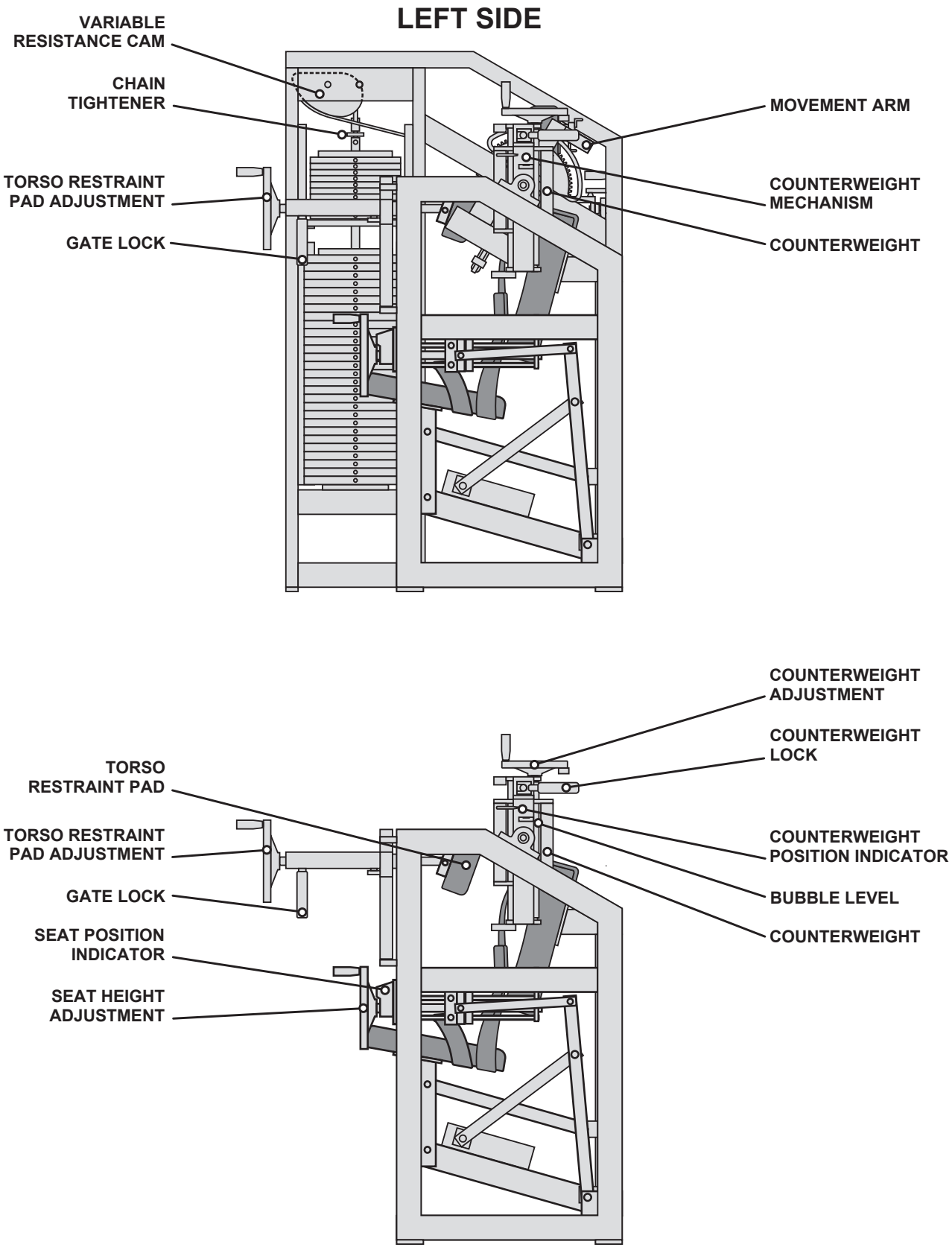
Cervical Extension Machine

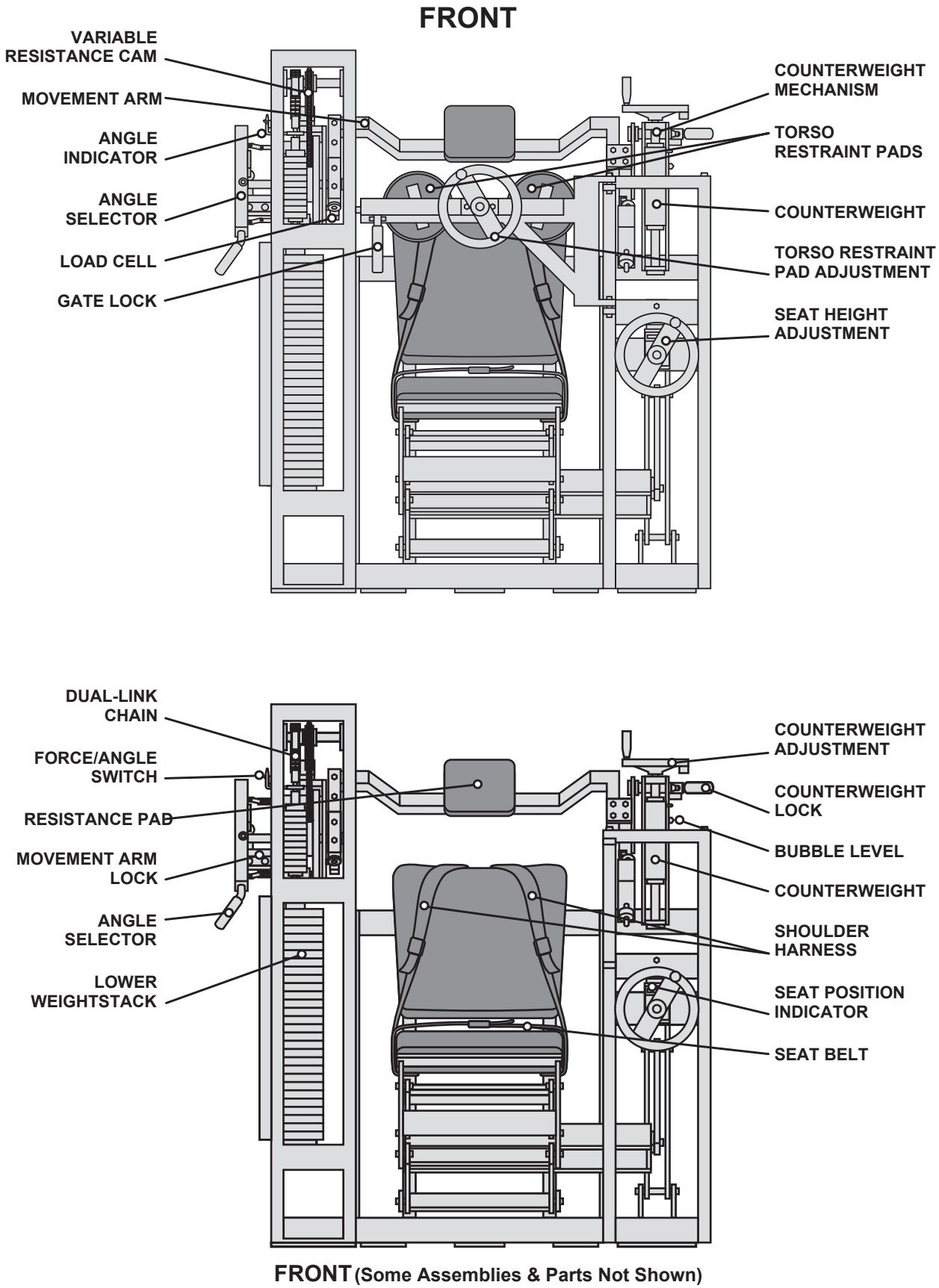
Figure 2



LEFT SIDE (Some Assemblies & Parts Not Shown)

Cervical Extension Machine

Figure 3



FRONT (Some Assemblies & Parts Not Shown)

Machine Comparisons

Machine	Standard Testing Angles	Cam Ratio	% Max TFT (Dynamic Training	
			Clinical	Healthy Normal
Lumbar	72° 60° 48° 36° 24° 12° 0°	1.4:1	50%	50%
Cervical	126° 108° 90° 72° 54° 36° 18° 0°	1.4:1	80%	80%

Stroke Length/Weight Stack Conversions

Machine	Absolute Wt. Stack Value	Stroke Length	Ft-lbs.	In-lbs. (Ft-lbs X 12)
Lumbar Extension	800	0.5 ft (6 in.)	400	--
Cervical Extension	600	0.125 ft. (1.5 in)	75	900

Machine	Absolute Wt. Of each plate	Ft-lbs of Each WT plate	In-lbs. each plate
Lumbar Extension	20	20 X 0.5 = 10	--
Cervical Extension	20	20 X 0.125 = 2.5	30

Machine Comparisons (cont.)

Set-Up and Testing

Major Components	Lumbar	Cervical
Positioning	• Footboard • Femur & thigh restraint • Pelvic restraint (rotation)	• Seat height adjustment • Head pad sliding • Torso restraint (shoulder shrug)
T.D.C.	• No tendency to fall forward or backward	• Looking straight ahead, pad touching scalp
R.O.M.	• Watch for pelvic rotation	• Chin to chest
Counterbalance	• 0° or > angle of full extension	• 18° or > angle of force-free extension
Testing	• Explain test • Push with shoulders • 7 angles • 3 sec build, 1 sec hold, 3 sec relax • 10 sec between angles	• Explain test • Push with head • 8 angles • 3 sec build, 1 sec hold, 3 sec relax • 10 sec between angles
Calibration	18°, C.W. unlocked	90°, C.W. unlocked