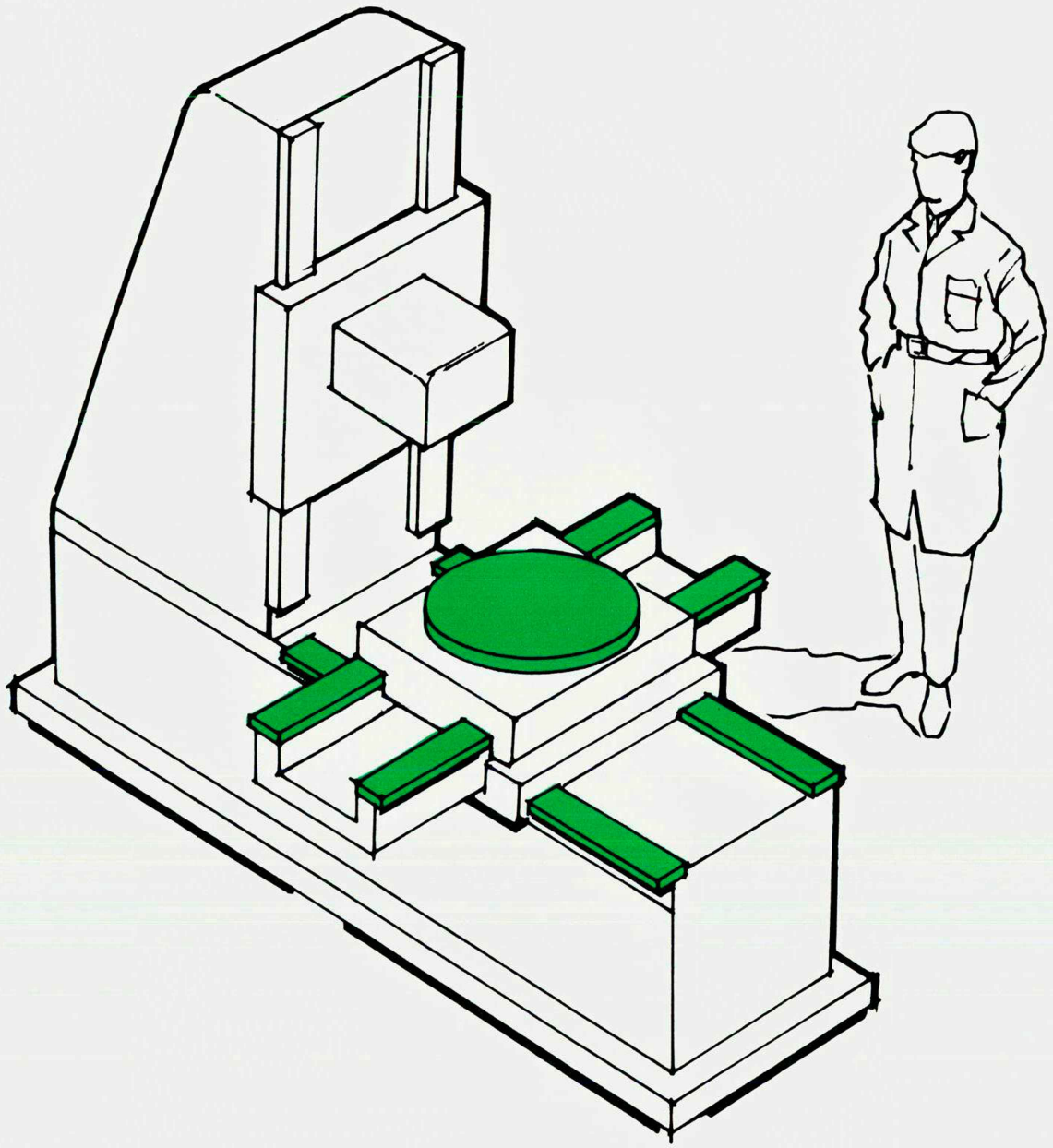
ELECTRONIC LEVELS

APPLICATIONS

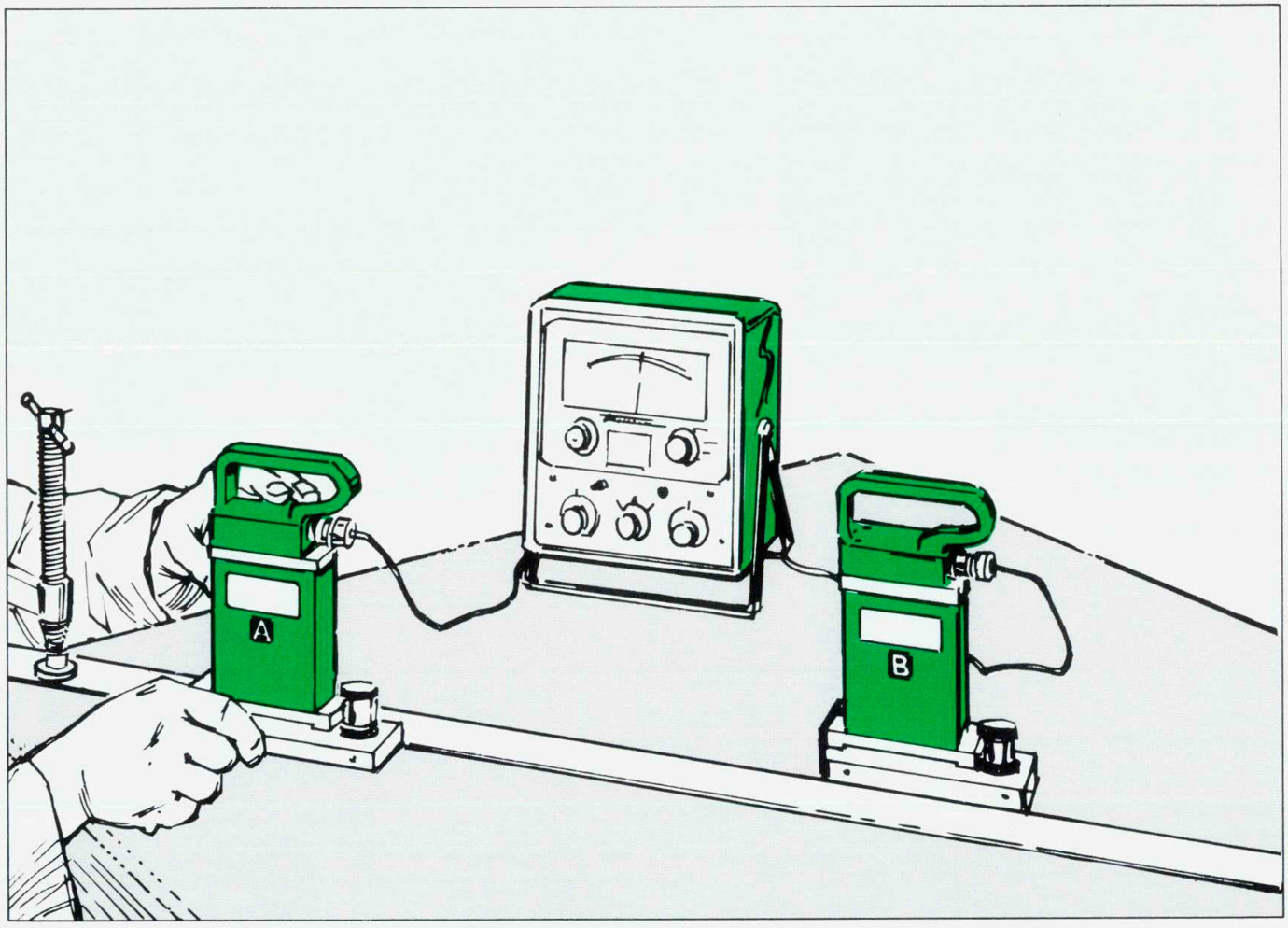


Machine Tools

The accuracy in a machine tool begins with the proper levelness, plus the proper relationship between the ways and the table. Accurate traverses are vital. Whether you are manufacturing a machine tool, setting it up, performing surveillance on it or rebuilding it, these relationships are critical.

The Federal Electronic Level permits you to quickly check to a very high degree of accuracy the straightness, parallelism, squareness, flatness and levelness of the ways and table. Pitch and yaw can also be determined.

Shown here are just a few of the many surfaces that can be checked on a machine tool, using the Federal Electronic Level.

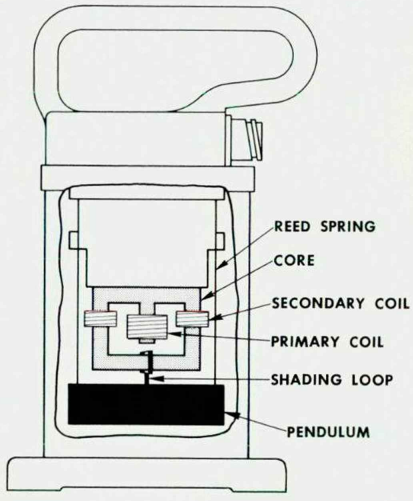


Surface Plates

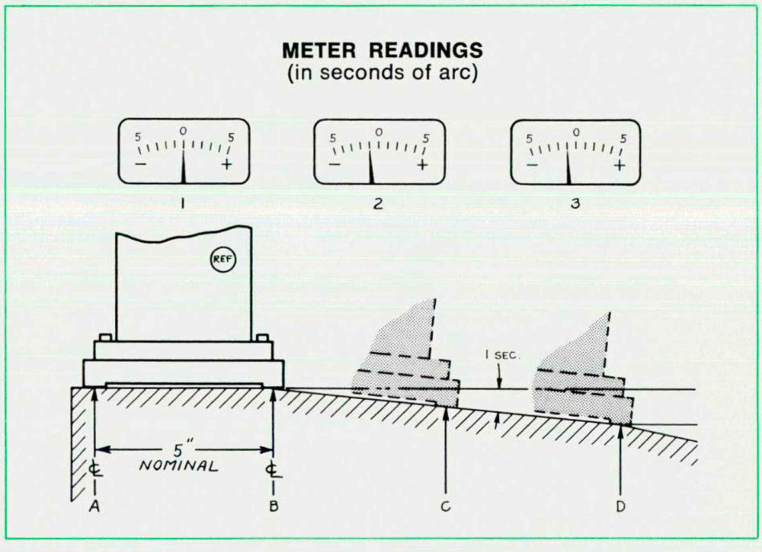
The Federal Electronic Level is ideal for profiling surface plates and large machined surfaces. It does the job faster and easier than an autocollimator, and is much more economical. The Sensing Head may also be permanently installed in machines, buildings, bridges or other structures and foundations to check settling and shifting. Or, it may be used to level radar, gyro and weapons platforms.

PRINCIPLE OF OPERATION

The pendulum is supported by two reed springs attached to an extension block at the top of the Sensing Head's housing. Tilting the Sensing Head causes a change in the position of the pendulum's shading loop in relation to the center leg of the core. This produces an electrical unbalance in the amount of flux passing through the two secondary coils, delivering a signal proportional to the displacement of the pendulum. This is displayed on a meter graduated in seconds of arc.



SENSING HEAD



MEASUREMENT

In a typical profiling application, measurements are made by adjusting the Level electrically so that the meter reads zero at the starting position. Then the Sensing Head is moved in convenient increments in a path along the surface to be checked. Comparison readings are taken at each successive position of the Head.

Here, the first move from a reference position (1) indicates a downward slope of one second of arc. This means a five micro-inch per inch drop over a span of five inches, placing point C at an elevation of 25 micro-inches below point B. The second move indicates the same degree of slope, placing point D at an elevation 50 micro-inches below point B. This figure is obtained by totaling the figures obtained in each of the two moves.

FEATURES

Two types of amplifiers are used with the Electronic Level. One is battery operated for portability and the other is A.C. powered. The latter is equipped for dual input to handle differential applications and has the output power to actuate accessory devices such as recorders. Both types of amplifiers have features that are unique.

"Click-Scale" Presentation gives you your choice of magnifications without the confusion of multiple scale values. Turn the Range Selector Switch and a patented "Click-Scale" action makes visible the one correct set of scale values for the magnification you have selected. No chance of mis-reading or assigning the wrong values.

Multi-Use Scales are used on every Level amplifier. In addition to the necessary angular values printed in red, each dial also contains linear values in black. This permits you to also use the amplifiers with a variety of Federal electronic gage heads for regular dimensional measurement from thousandths to millionths of an inch.

Dual Speed Electrical Zeroing provides long range approach and fine adjustment in one control for faster, more convenient set-up. Coarse control is driven by knob which gives independent fine adjustment when direction is reversed. Long range zero adjustment permits you to check surfaces which are not absolutely level.

Fast response time brings meter hand to rest in less than one second when taking readings.

Highest resolution is one-half second of arc for both the battery-powered and A.C. models.

Repeat accuracy is excellent . . . 1/10 of a scale division or 0.2 seconds of arc, whichever is greater.

Correlated scales mean that once zero is set on the highest magnification it is maintained within close limits as you switch to other magnifications.

Completely solid state Amplifiers give you greater dependability, instant use and cooler operation.

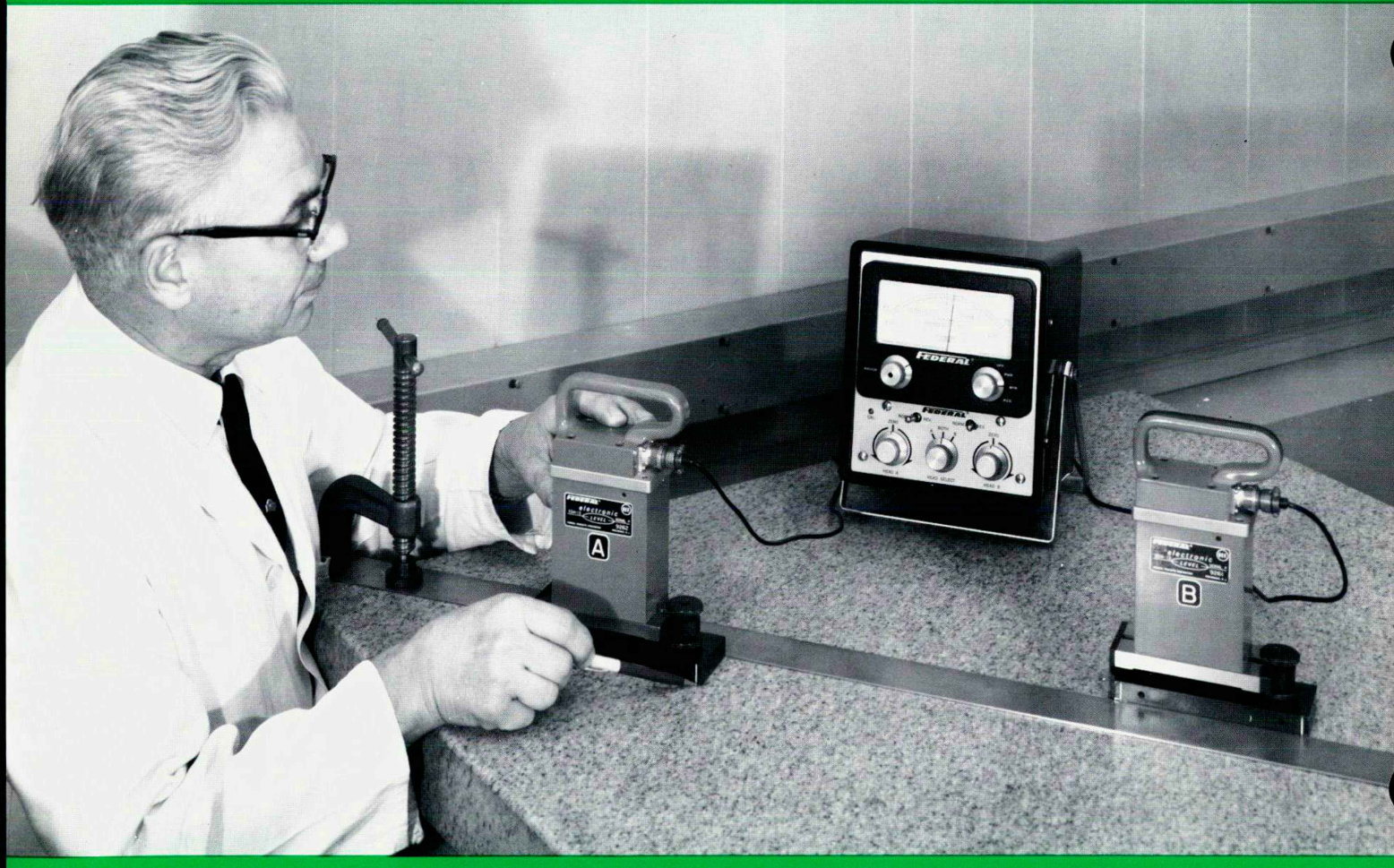
Conversion Table is located on the top of each Amplifier to facilitate fast, easy conversion of angular readings to corresponding slope values in inches.

Compact gage head permits making checks in cramped quarters.

Very easy to use . . . even a semi-skilled operator can produce accurate results.

Eliminates the variables inherent in working with a spirit level, providing a much higher order of accuracy and much faster response.

More economical than an auto-collimator in most applications . . . and using the Level is a simple, one man job. It requires no sight path alignment, has no optical surfaces to keep clean and does not require a turbulence-free atmosphere for error-free results.



The Differential Electronic Level is being used here to profile a surface plate. Input from the two heads is received in opposite modes, so that the Amplifier will respond only to changes which affect them differently. Consequently, any tilting of the surface plate as it is being profiled is ignored.

DIFFERENTIAL ELECTRONIC LEVEL

Model 232P-68

Model 232P-68 consists of two Sensing Heads operating simultaneously with just a single amplifier, permitting an immediate comparison between two surfaces. In addition, when the input from the heads is arranged for opposite responses to a common motion, the motion will be ignored. The amplifier responds only to changes which affect the two heads differently. Vibrations or a shift in attitude of the object whose surfaces are being compared will not influence the measurement.

So, a deviation in flatness, squareness, parallelism or alignment can be accurately determined even though the object, such as a surface plate or machine tool, does not maintain a constant orientation.

Conversely, the Differential Electronic Level can also be used as an attitude indicator, comparing the orientation of separate or adjacent horizontal surfaces or to show any change in their relationship over a period of time.

Panel mounted switches on the Amplifier are used to reverse gage head response. This dual input Amplifier eliminates the expense of a separate amplifier for each gage head. Sensing Heads can also be used individually, if desired.

The electronic amplifier, which is A.C. powered, has provisions for auxiliary readout from a single-track, linear recorder. It can provide a permanent record of measurement by either Sensing Head or by both in combination.

The Sensing Heads are the same as the one described on Pages 4 and 5 except they are marked "A" and "B" for identification purposes and have adjustable bases, permitting setup on surfaces that are out of level or square by as much as ±1½°.

The electronic amplifier has five ranges with the highest magnification having a minimum graduation of ½ second of arc. "Click-Scale" numerals change to suit the range selected, preventing confused readings. Direction of slope is indicated by corresponding reference marks on the Sensing Heads and meter dial.

Angular values appear in red on the dual purpose dial. Linear values are also present — printed in black — to permit using the Amplifier with Federal's linear gage heads like those described on Pages 6 and 7 for greatly increased gaging versatility. The Differential Electronic Level is furnished in a protective case.

SPECIFICATIONS

DIMENSIONS	
Amplifier	8″ H x 7″ W x 6″ D
Sensing Head	8¼″ H x 4½″ L x 2″ W
Sensing Head Cable	8 feet long
Adjustable Base	5¾″ L x 2″ W
Range of Adjustment	±1½°
Two Rest Feet	⅜″ L x 2″ W (hardened steel)
WEIGHTS	
Amplifier	11½ pounds
Sensing Head	7¾ pounds
REPETITION ACCURACY	1/10 of a scale division or 0.2 seconds of arc, whichever is greater
CALIBRATION ACCURACY	within 2% of full scale
POWER REQUIREMENTS	7 watts (117v., ±10%, 50-60 Hertz)
POWER OUTPUT	25-0-25 at up to 500 μa
ELECTRICAL ZEROING	±200 seconds

RANGES

Angular	(Slope Equivalent)*	Linear
±1000	(±.005 inches per inch)	±.010″
±200	(±.001 inches per inch)	±.002″
±100	(±.0005 inches per inch)	±.001″
±20	(±.0001 inches per inch)	±.0002″
±10	(±.000050 inches per inch)	±.0001″

MINIMUM GRADUATIONS

Angular	(Slope Equivalent)*	Linear
50 seconds	(.00025 inches per inch)	.0005″
10 seconds	(.000050 inches per inch)	.0001″
5 seconds	(.000025 inches per inch)	.000050″
1 second	(.000005 inches per inch)	.000010″
.5 seconds	(.0000025 inches per inch)	.000005″

**Nominal. One second equals .0000048481 inches.*

NOTE: Special bases available. Prices on application.