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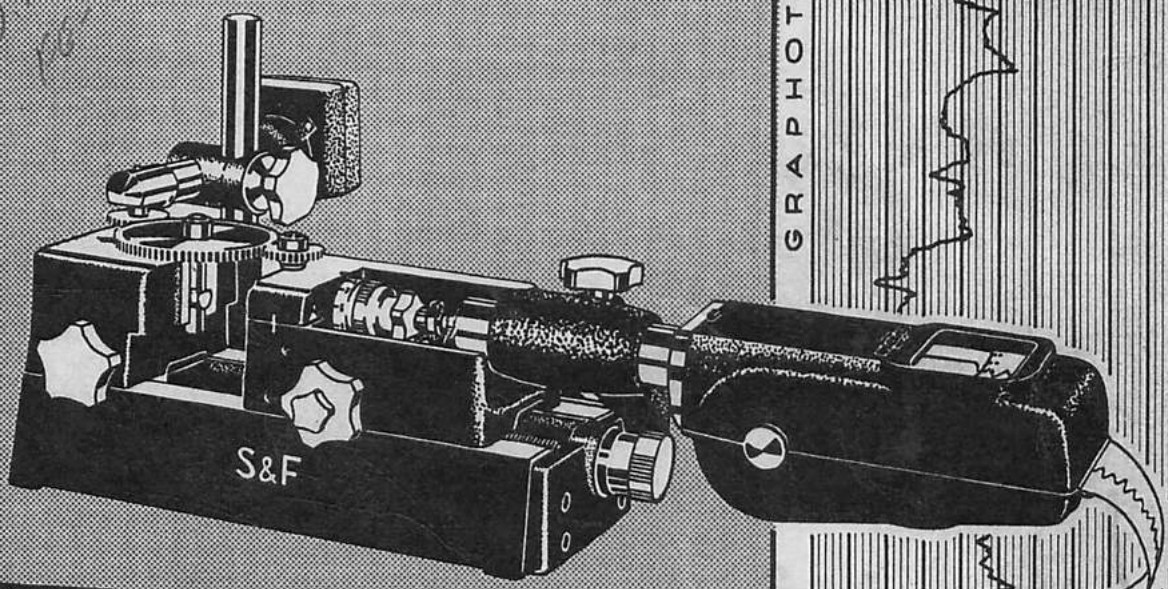
KO CO. INC
INDUSTRIAL IMPORTERS

SOLE IMPORTER AND DISTRIBUTOR: GEAR DIVISION

KURT ORBAN COMPANY, INC.

HARBORSIDE TERMINAL, JERSEY CITY 2, N. J. PHONES: JERSEY CITY: HENDERSON 5-3800
TELEX: JERSEYCITY 11. TELEGRAMS: WUX. NEW YORK CITY: DIGBY 9-1580



S&F TYPE 101

UNIVERSAL SUPER-SENSITIVE

TWO-FLANK ROLL TESTER

FOR ALL TYPES AND KINDS OF

FINE PITCH GEARS

GRAPHOTEST PHOTEST

KURT ORBAN CO INC JERSEY CITY, N.J. KURT ORBAN CO ERSEY CITY,

INDEX

TYPE 101 S&F

Since we are continously striving to improve and further develop our products, the text, descriptions, illustrations and weights mentioned in this catalog are not binding. We reserve the right to change without notice.

WHEREIN LIES THE SUPERIORITY OF THE S & F TESTER?

S&F TYPE 101

As borne out by experience, the accuracy of your gear generating equipment has never been fully utilized, since accurate and sensitive testing equipment was lacking. This is particularly true for fine-pitch gears of the precision and ultra precision classes required by the instrument and precision machinery industry. Suitable testing equipment for the various types of fine-pitch gears, requiring a minimum inversion interval, *) was non-existent. These deficiencies are overcome with the S & F Two-Flank Roll Tester Type 101, designed for testing all types and kinds of fine-pitch gears. The S & F Gear Tester Type 101 has been constructed particularly for checking involute gears of the very smallest sizes as found in high-precision instruments and easily surpasses the highest standards as defined by AGMA 236.02, ASA B6.11-1951.

Because of the

EXCEPTIONALLY HIGH SENSITIVITY **)

the S & F Tester is equally suited for production testing and inspection.

HERE THE PARTICULAR ADVANTAGES

TESTING OF ALL KINDS OF GEARS

such as straight and helical spur gears, pinions, shaft gears, bevel gears, worms, worm drives, flat and round racks.

SHORTEST CENTER DISTANCE 3/32"

for very small assembly gears, without the use of additional angle blocks or similar auxiliary equipment.

SIMPLE ARBORS with cylindrical clamping shaft. No tapered clamping shafts with the difficulty of accurate machining and not being adjustable in height for proper gear position.

QUICK, EASY, YET ACCURATE SETUP

by clamping the cylindrical arbors in vees.

NO DAMAGE TO TEETH

during setup or meshing of gears, with illumination provided from below.

SIMPLE AND SENSITIVELY ADJUSTABLE CHECKING PRESSURE

from 0 - 28 ounces, permitting testing of finest pitch gears.

HIGH TESTING SPEED

because of the low mass of the measuring slide (18 ounces), the basic reason for the great sensitivity and effectiveness.

The term: *) "Inversion Interval" defines the difference in indication when, in measuring the same value, the measurements are taken alternatively with the indicator pin being pushed in and retracted.

**) Sensitivity is the ratio: Change in indication to change in measuring size, with linear measuring instruments equivalent to transmission. Sensitivity is generally synonymous with response values, i. e. the smallest measuring size change to which the instrument yet responds.

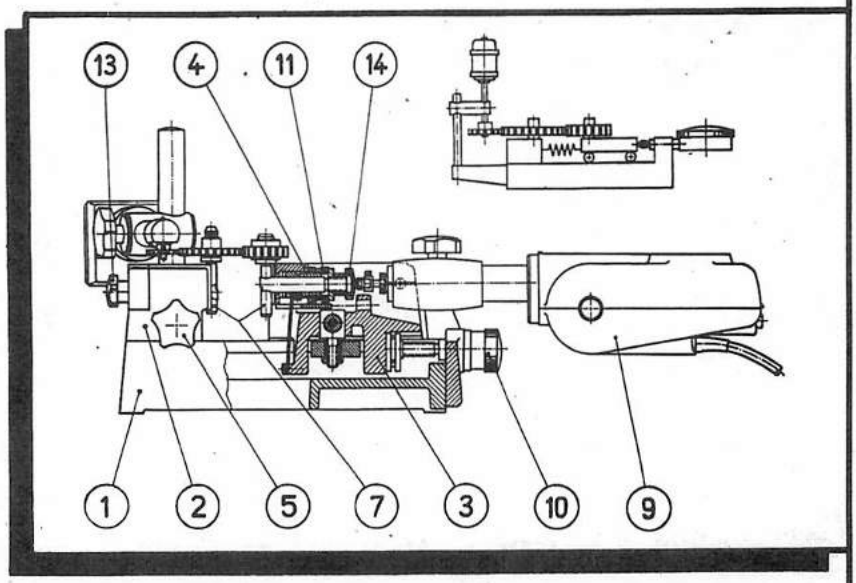
THE DESIGN OF THE S & F TESTER

TYPE 101

Measuring - Methods, Results and their
Interpretation as per separate pamphlet

The schematic diagram in picture 1, upper right, shows the basic arrangement of a Two-Flank Roll Tester. To the right is the measuring slide on ball bearings, on the left the stationary spur gear fixture. The two gears are held in mesh under spring tension, rotated manually or with a motor-drive, and the center distance variation is shown on a precision dial indicator.

The design of the S & F Tester is shown in the sectional view, picture 1, and the scale drawing, picture 2. Arranged on the flat ways of the cast iron base (1) are the spur gear slide (2) left and the measuring slide carrier (3) right on which the measuring slide (4) is mounted under leaf-spring tension. Star knobs (5) and (6) are used to clamp the spur gear slide (2) and measuring slide carrier to the base. Vees are provided on the inside face of both spur gear slide (2) and measuring slide (4) for centering and clamping the arbors (7) on which the gears are mounted. The spur gear slide (2) has an additional vee (8) to be used when testing large gears. The composite errors are either read off a precision dial indicator (9), picture 2, or recorded on a rolling diagram with the mechanically operated GRAPHOTEST (9), picture 1. The GRAPHOTEST is mounted in a bracket which clamps into the T-slot (15) of the base.



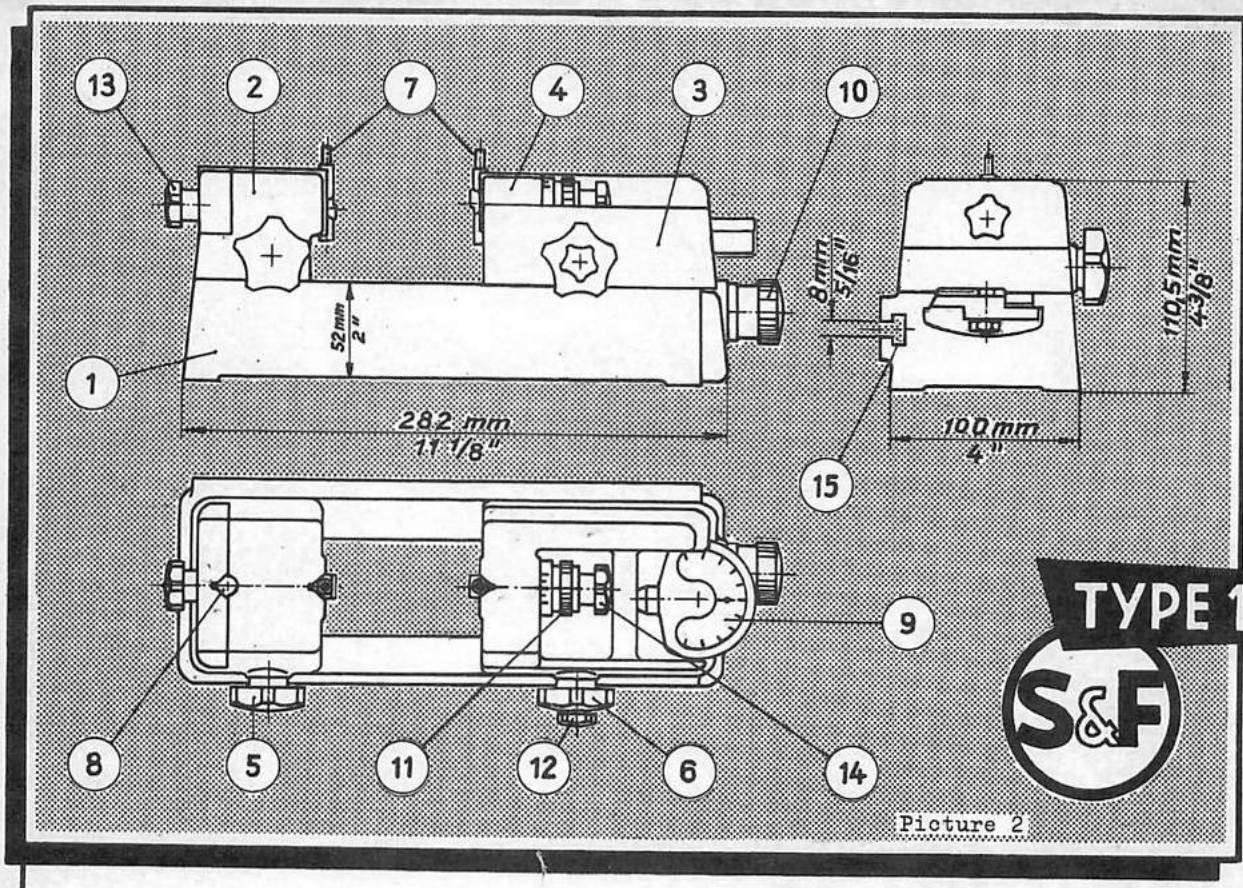
Picture 1
Schematic diagram
and cross section
of Tester

The measuring slide carrier (3) adjusts to the desired center distance by turning the lead-screw with the knurled knob (10). This knob has an overload clutch, preventing excessive clamping and possible damage to the gears, in case of careless operation. To set up a theoretical center distance, gauge blocks are used in small size production, gauge rings in mass production.

The measuring slide (4), moving forth and back according to the gear errors, is mounted on 3 ball bearings, running in hardened and ground ways. It is used to carry the master - or mating gear - and the adjustable checking pressure of a calibrated leaf-spring presses this gear against the test gear on the spur gear slide. The direction and amount of the checking pressure are adjustable with the knurled knob (11), for internal and external gears. The range of 0 - 28 ounces allows adjustment according to pitch and stability of gears.

The measuring slide travels plus or minus 1/8 inch to facilitate exchange of gears during the test. The small star knob (12) clamps the measuring slide when required. The star knobs (13) and (14) are used when clamping the cylindrical arbors in the vees. This type of clamping permits adjusting the gears to the proper height, even where hub height differs.

S&F UNIVERSAL FINE PITCH GEAR TESTER

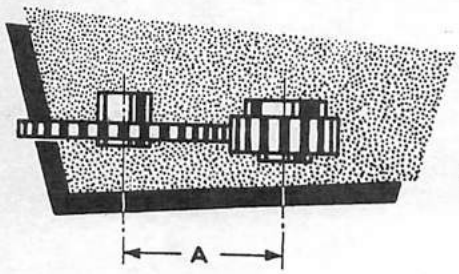


Picture 2

BASE INSTRUMENT AND SPUR GEAR SLIDE

This basic design of the S & F Tester, known as base instrument 4101.00, consists of base 4101.01, measuring slide 4101.02 and spur gear slide 4101.03.

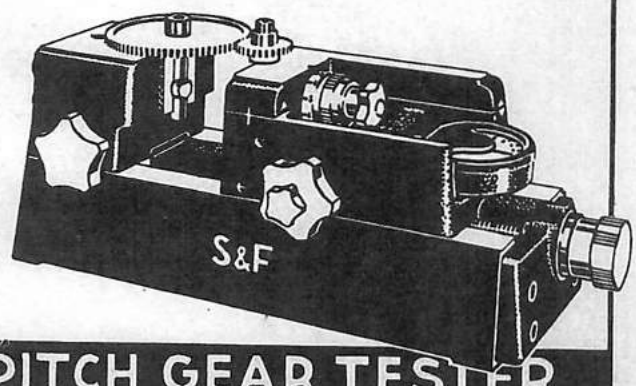
(1) Cast iron instrument base
(2) Spur gear slide (interchangeable)
(3) Measuring slide carrier
(4) Measuring slide
(5) Star knob for clamping (2)
(6) Star knob for clamping (3)
(7) Arbors (height adjustable)
(8) Vee
(9) Dial indicator
(10) Knurled knob with overload clutch for center distance adjustment
(11) Knurled knob for adjusting checking pressure
(12) Star knob for clamping of (4)
(13) and (14) Star knobs for clamping of arbors
(15) T-slot



RANGE: A min. 3/32" with holding devices for needle shafts
11/32" with standard arbors
A max. 5 " when using left vee in spur gear slide

On the rear of the base is the T-slot (15) used for mounting attachments such as motor-drive (see page 16), bracket for GRAPHOTEST (see page 17), microscope (see page 15) or dial indicator when used to check concentricity of gear hub.

The S & F Tester Type 101, designed on the module principle, can be used for testing pinions, shafts, bevel gears, worm gears, worm drives and racks by simply interchanging the left slide.

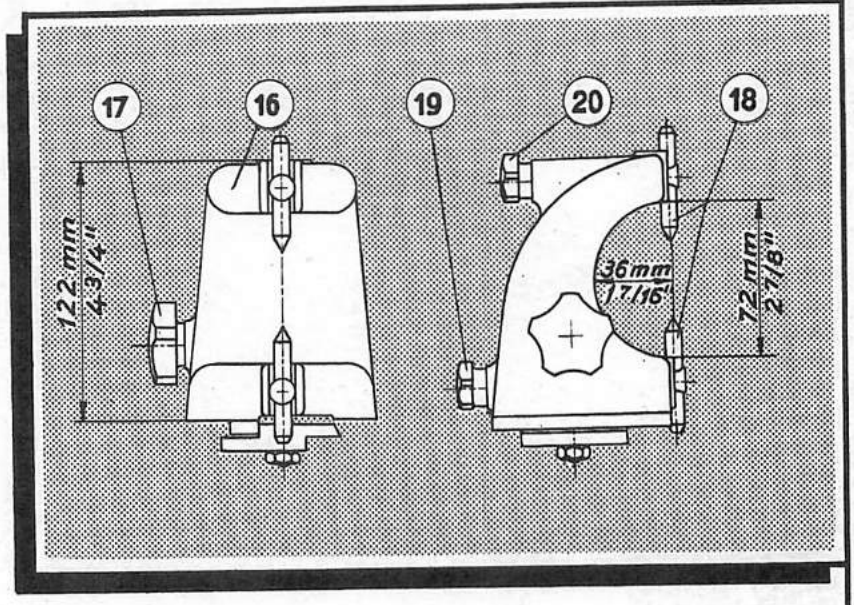


S&F UNIVERSAL FINE PITCH GEAR TESTER

CENTER SLIDE FOR PINION SHAFTS

TYPE 101

S&F

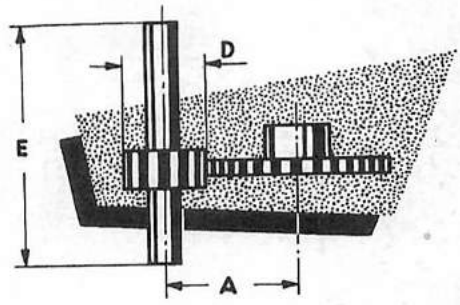


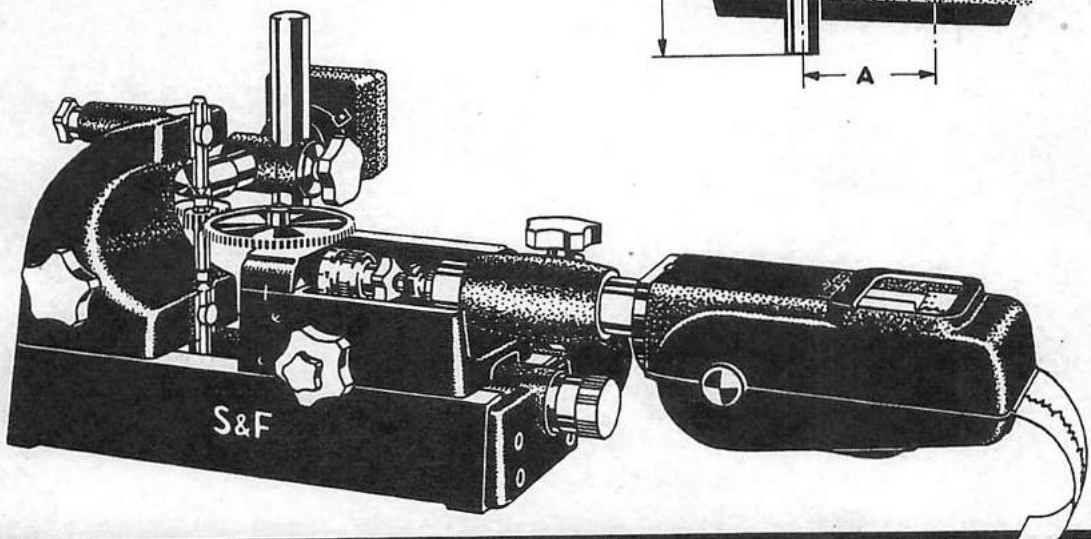
Order number: 4101.04

The center slide (16) has been designed for simple and quick testing of small pinions and shafts. It is interchangeable with the spur gear slide of the base instrument. The star knob (17) clamps the slide to the bed. Concave and convex 60° centers (18) in vees are provided for mounting the pinions or shafts. The centers are easily adjusted to proper height and fixed in position with star knobs (19) and (20).

(16) Center slide
(17) Star knob for clamping (16) to base
(18) Centers
(19) Star knob for clamping base center
(20) Star knob for clamping upper center

CAPACITY: Center distance A min. 11/32"
A max. 2-9/16"
E max. 2-3/4 "
Shaft diameter D max. 2-3/4 "

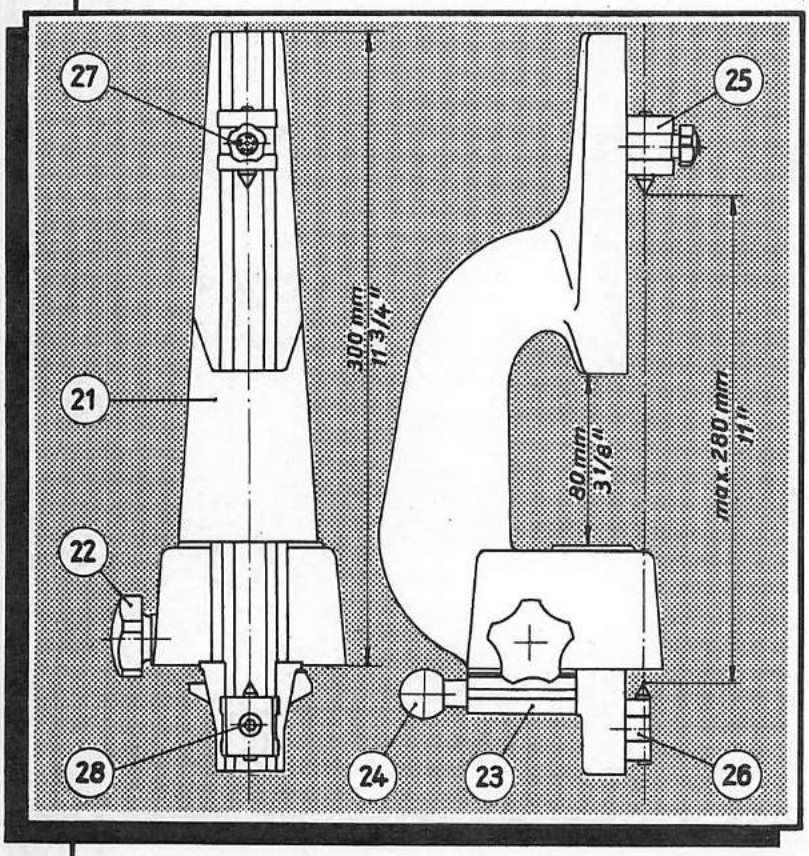




S&F UNIVERSAL FINE PITCH GEAR TESTER

LARGE CENTER SLIDE

TYPE 101



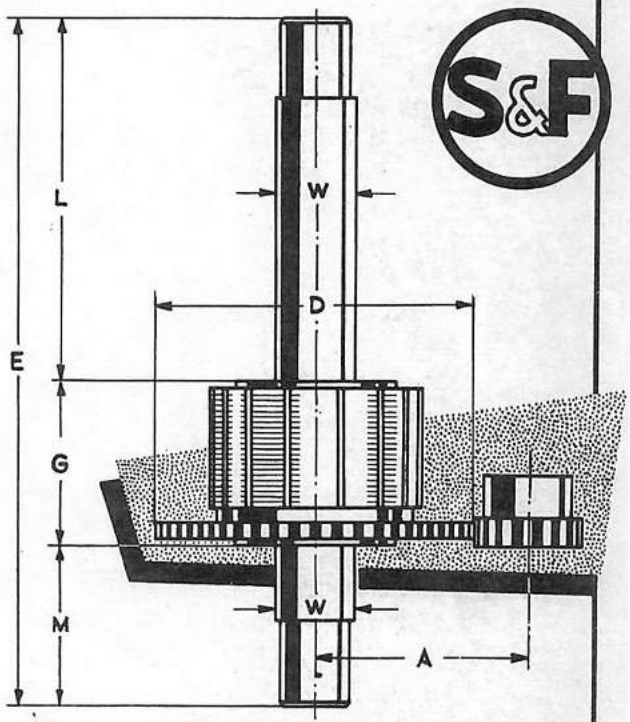
For testing long pinion shafts a large center slide (21) has been designed. Like the standard center slide, it is interchangeable with the spur gear slide of the base instrument and clamped to the bed with the star knob (22); for this the pressure plate (23) on knob (24) is pulled out. The pinion shafts are taken up between 60° centers (25) and (26) which are held in vees and clamped w. star nut (27) and Allen-type screw (28). These centers are easily adjustable in height, the upper one with spring tension to avoid accidental dropping.

(21) Large center slide

(22) Star knob for clamping of center slide

(23) Pressure plate

(24) Knob for removing (23)



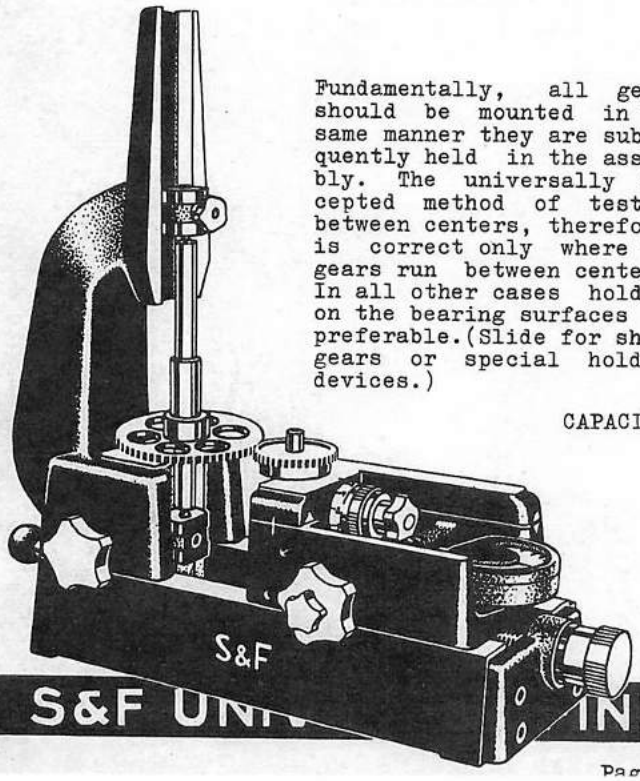
Order number:

4101.21

(25) and (26) Centers

(27) Star nut and

(28) Allen-type screw for clamping centers (25) and (26)



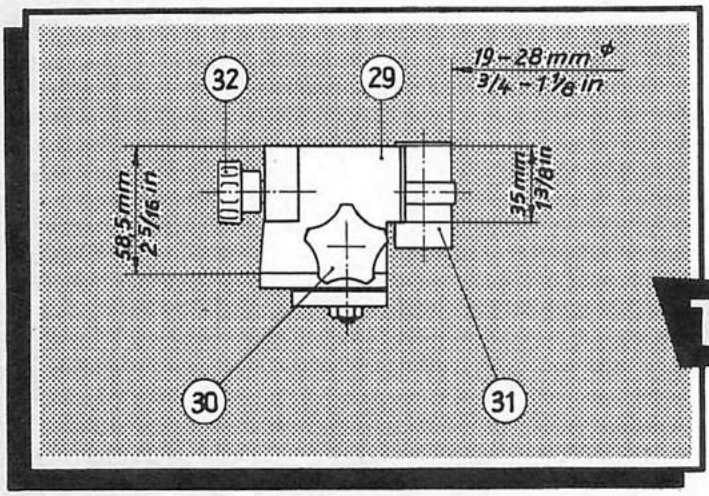
Fundamentally, all gears should be mounted in the same manner they are subsequently held in the assembly. The universally accepted method of testing between centers, therefore, is correct only where the gears run between centers. In all other cases holding on the bearing surfaces is preferable. (Slide for shaft gears or special holding devices.)

CAPACITY:

Center distance	A min.	11/32"
	A max.	2-9/16"
	E max.	11 "
Pinion diameter	D max.	4-3/4 "
Pinion face width	G max.	3 "
Shaft diameter	W max.	1-1/16"
Shaft length (when max. G)	M	3 "
	L	5 "

S&F UNI[illegible]INE PITCH GEAR TESTER

SLIDE FOR SHAFT GEARS



(29) Slide for shaft gears
(30) Star knob for clamping (29)
(31) Bushing for shaft gears
(32) Star knob for clamping (31)

Order number: 4101.17

TYPE 101

S&F

Until now pinion shafts and shaft gears are being tested between centers exclusively. The results are misleading and are contrary to the principle to hold the gears during the test in the same manner they are subsequently held in the assembly. This requirement is easily complied with by mounting these shafts in a bushing.

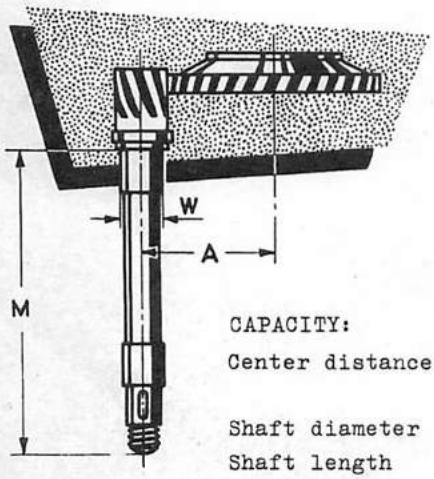
The S & F method of clamping cylindrical shafts in vees allows greatest flexibility and easy interchange of various holding devices for quick assembly-like setup.

Where the shaft of the gears to be tested is less than 1/4" diameter, the 5/16" arbors are furnished with the necessary bore holes and clamped into the spur gear slide 4101.03.

For shafts of 1/4" dia. and more, we will furnish a spur gear slide with extra large vee. This slide for shaft gears (29) to be clamped to the bed with the star knob (30) can take bushings (31) from 3/4" - 1-1/8" O.D. i.e.gears up to about 7/8" shaft dia. The bushing should be of minimum 1 - 3/8" length (like the vee) and otherwise be governed by the size of the bearing seat on the shaft to be tested. These bushings are clamped into the vee with the star knob (32). The height adjustment is as easily accomplished as with the standard arbors.

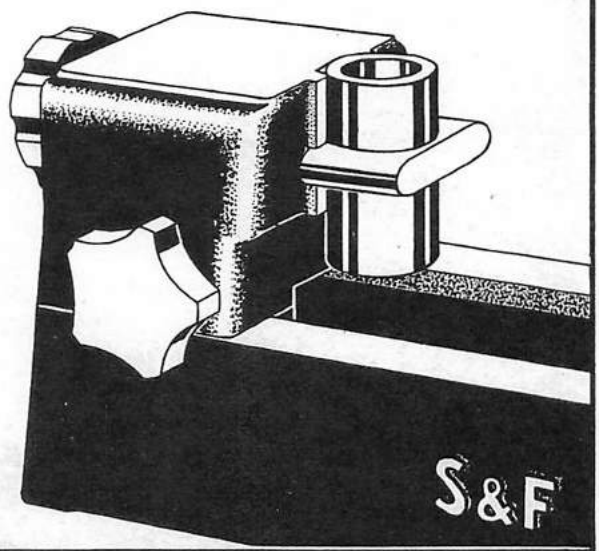
The shafts of the test gears can be up to 4-3/8" in length, as the base instrument has a gap. Where greater length is required, the base instrument can be put on raiser blocks.

The slide for shaft gears with its large vee is also suitable for larger and heavier holding devices.



CAPACITY:

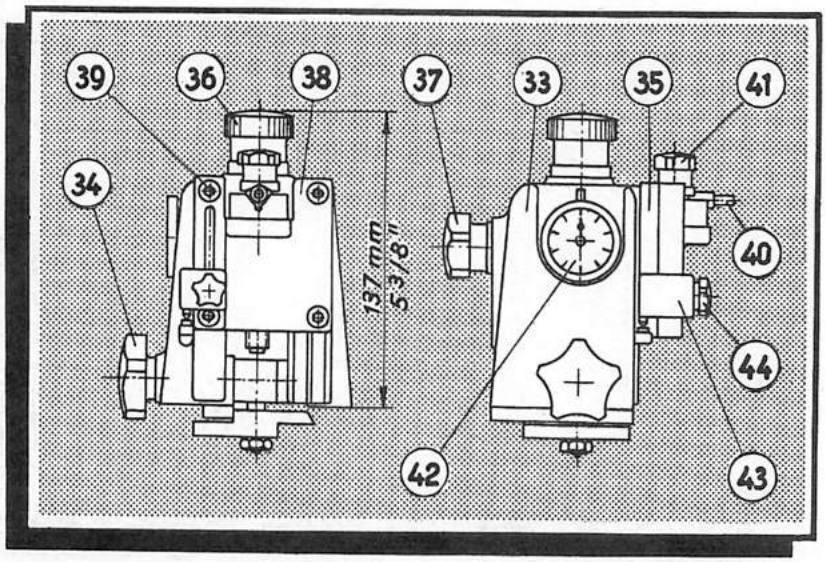
Center distance	A min.	5/8 "
	A max.	2-5/8 "
Shaft diameter	W max.	7/8 "
Shaft length	L max.	4-3/8 "



S&F UNIVERSAL FINE PITCH GEAR TESTER

SLIDE FOR BEVEL GEARS

TYPE 101



(33) Bevel gear slide
(34) Star knob for (33)
(35) Vertical slide
(36) Knurled knob with oberload clutch f. adjustment of (35)
(37) Star knob for (35)
(38) Interchangeable bracket
(39) Screws for (38)
(40) Arbors
(41) Star knob for (40)
(42) Precision dial indicator
(43) Slide bar for adjustment of (42)
(44) Star knob for (43)

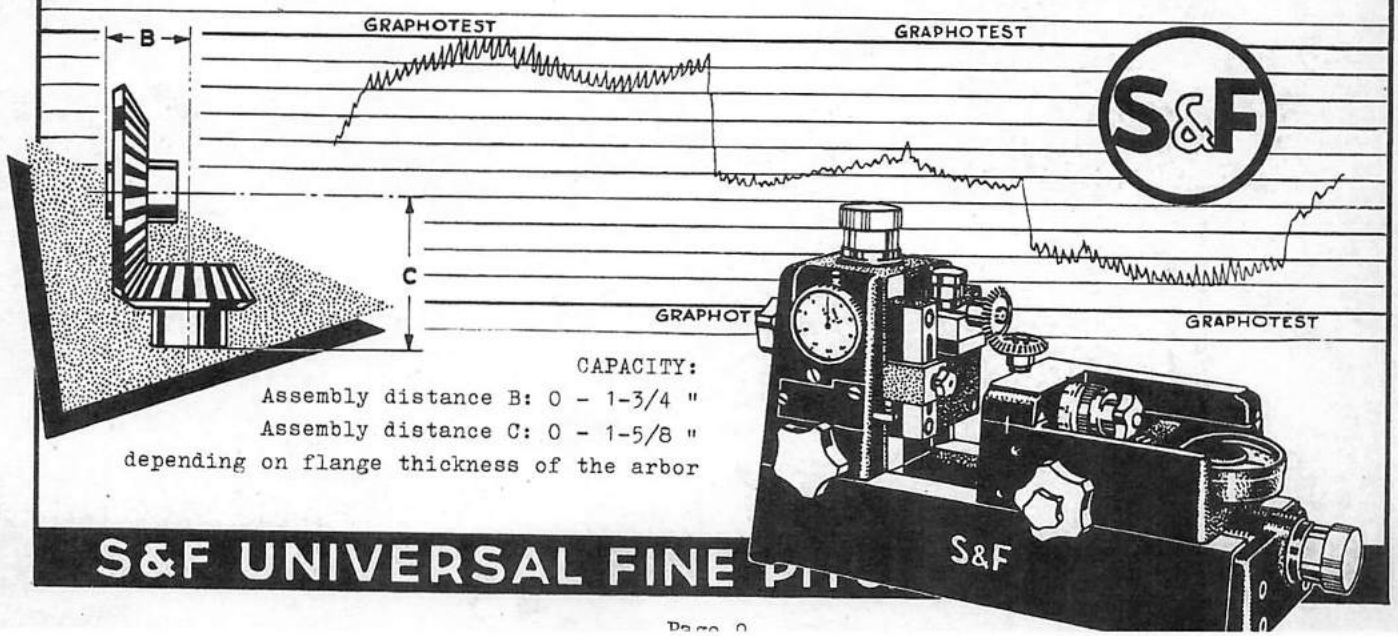
Order number: 4101.05

For testing bevel gears and their assembly dimensions, the bevel gear slide (33) is clamped to the bed with star knob (34). The vertical slide (35) is adjustable with knurled knob (36) and its lead-screw, then clamped with the star knob (37). To avoid excessive clamping, meshing or possible damage to the gears, knob (36) is equipped with an overload clutch. The bracket (38) attached to the vertical slide (35) with 4 Allen-type screws (39) can be removed to be exchanged for other brackets to mount racks, worms, etc. The bracket (38) has a vee for centering the arbor (40) of the test gear to be clamped with the star knob (41). The standard arbors are used (see page 21).

To obtain the assembly dimensions of the bevel gear pair, a precision dial indicator (42) is used. It is set up with the slide bar (43) and fixed in position with the star knob (44).

Using gauge blocks or measuring discs the 2 arbors are set up in accordance with the theoret. assembly dimensions of the bevel gear pair. Both indicators, in the measuring slide and the bevel gear slide, are then adjusted to zero. When mounting the bevel gears, the proper position for quiet running and optimum mesh is found by fine-adjustment with the knurled knob (36). The two indicators will then immediately show the deviations from the theoretical assembly dimensions to be considered when assembling the gears.

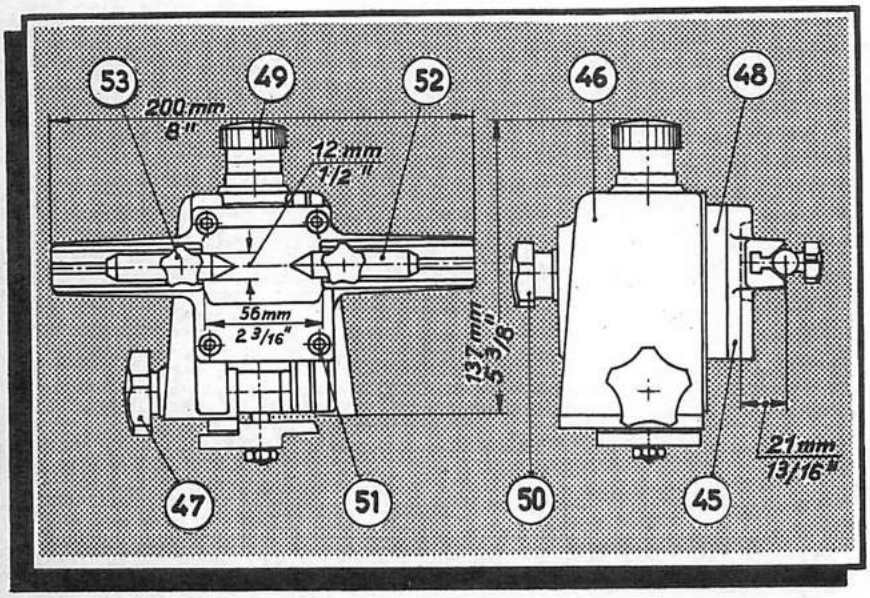
How quiet running of straight bevel gears depends on the correct assembly distances is exemplified by the 3 diagrams shown below. For the 2 on the left and right outside, the vertical slide was adjusted .003" up, resp. down. The center diagram shows the bevel gears running in their best position to each other. Our Tester permits easy locating of this position.



CAPACITY:
Assembly distance B: 0 - 1-3/4 "
Assembly distance C: 0 - 1-5/8 "
depending on flange thickness of the arbor

S&F UNIVERSAL FINE PI

BRACKET FOR WORMS AND WORM WHEELS



(45) Bracket with centers
(46) Simple slide
(47) Star knob for (46)
(48) Vertical slide
(49) Knurled knob with overload clutch f. adjustment of (48)
(50) Star knob for (48)
(51) Screws for (45)
(52) Arbors with 60° centers
(53) Star knob for (52)

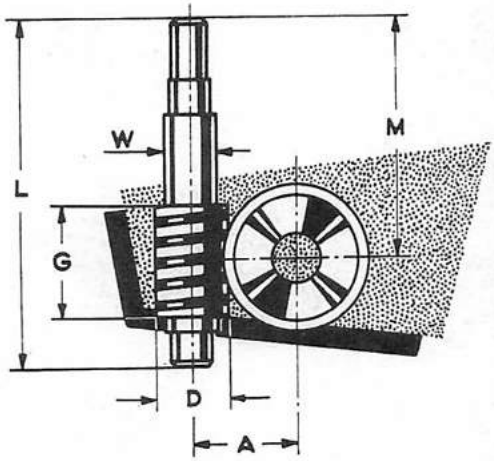
The bracket with centers for testing worms and worm wheels (45) is exchangeable with the bracket for bevel gears of the bevel gear slide. Where the bevel gear slide is neither available nor needed, the simple slide (46) must be used.

Worms and worm wheels with bores are mounted on standard arbors, worm shafts are taken up directly between the arbors (52) which have both 60° concave and convex centers. The arbors (52) are centered in vees and clamped with star knobs (53). The knurled knob (49) is used for vertical adjustment, the star knob (50) to clamp the vertical slide.

When rotating the gears, the direction should be noted to prevent lifting the mating gear off the measuring slide.

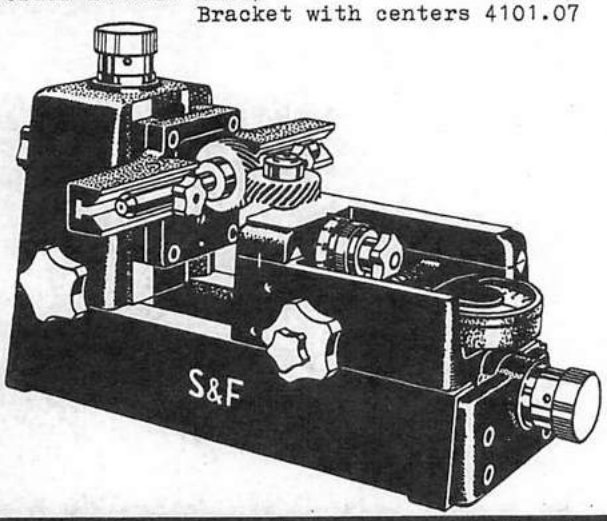
Order number: Slide 4101.06
Bracket with centers 4101.07

S&F TYPE 101



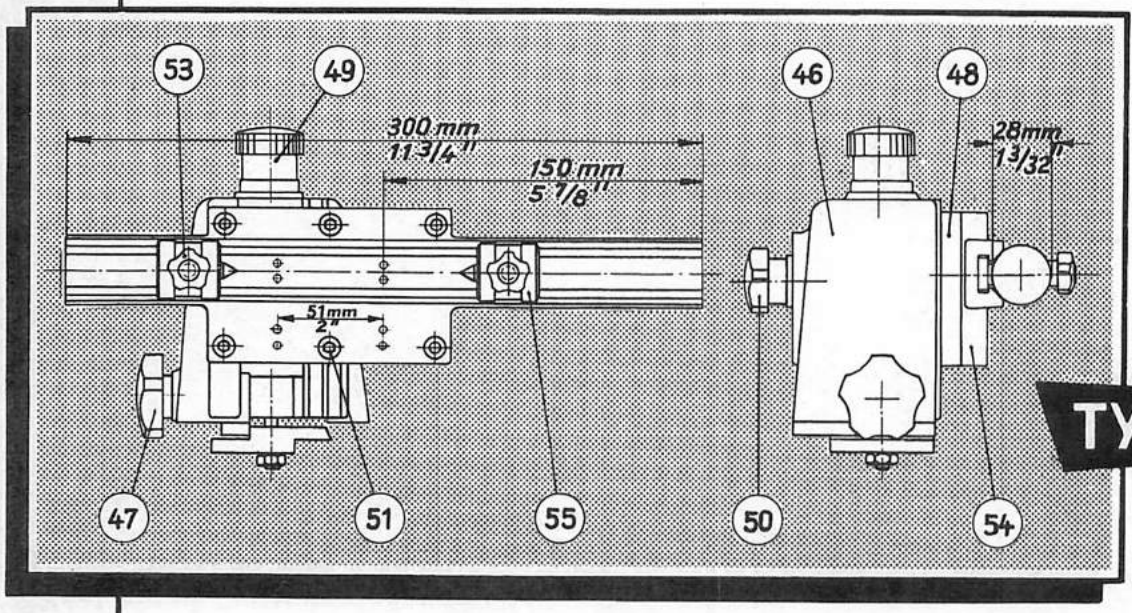
CAPACITY:

Center distance	A max.	1-5/8 "
Worm diameter	D max.	1-9/16"
Worm length	G max.	2 "
Shaft length	L max.	5-3/8 "
	M max.	2-3/4 "
Shaft diameter	W max.	7/16"

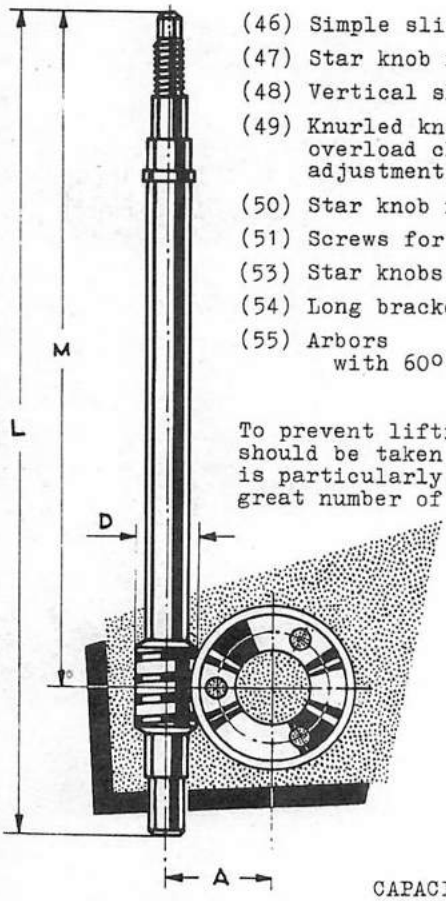


S&F UNIVERSAL FINE PITCH GEAR TESTER

BRACKET FOR LONG WORM SHAFTS



S&F TYPE 101



(46) Simple slide
(47) Star knob for (46)
(48) Vertical slide
(49) Knurled knob with overload clutch f. adjustment of (48)
(50) Star knob for (55)
(51) Screws for (54)
(53) Star knobs f. (55)
(54) Long bracket
(55) Arbors with 60° centers

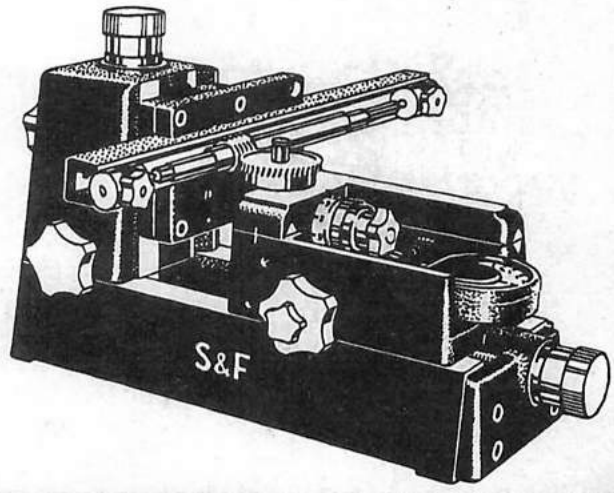
Order number: Slide 4101.06
Long bracket 4101.14

Where worm shafts of more than 5-5/16" total length need to be tested, the long bracket (54) should be used. For long one-sided worm shafts, this bracket can even be mounted 2" off center, either on the bevel gear slide or the simple slide (46) with four Allen-type screws (51). The worm shafts are held between the 60° centers (55), which are mounted in vees and clamped with star knobs (53). The height of the vertical slide (48) is adjusted with knurled knob (49) and clamped with star knob (50).

To prevent lifting the mating worm gears off the arbors, care should be taken to note the direction of rotation. A motor-drive is particularly helpful in testing worm drives because of the great number of revolutions required.

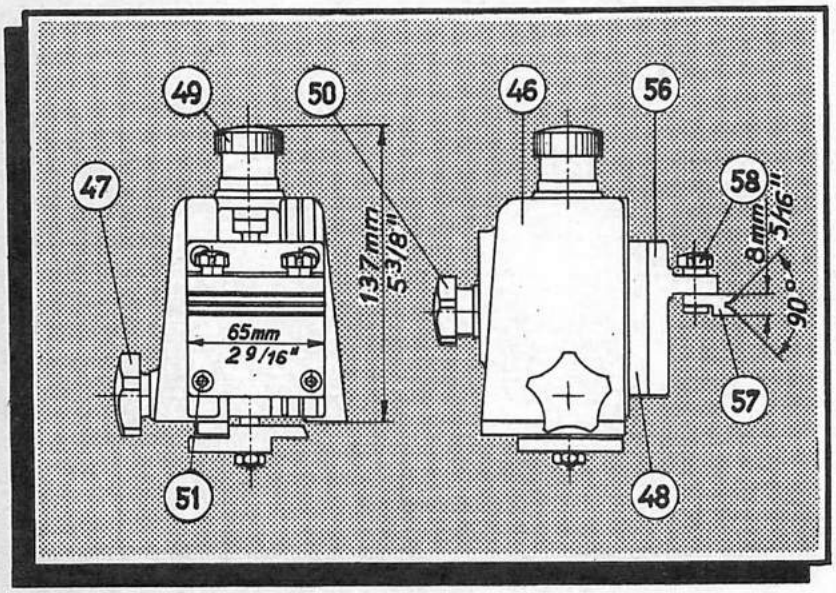
CAPACITY:

Center distance	A max.	1-5/8 "
Worm diameter	D max.	1-1/16"
Shaft length	L max.	9-1/16"
	M max.	6-1/2 "



S&F UNIVERSAL FINE PITCH GEAR TESTER

BRACKET FOR FLAT AND ROUND RACKS



(46) Slide
(47) Star knob for (46)
(48) Vertical slide
(49) Knurled knob with overload clutch f. adjustment of (48)
(50) Star knob for (48)
(51) Screws for (56)
(56) Angle bracket for racks
(57) Rim
(58) Star nuts for (57)

Order number:

Slide	4101.06
Bracket f.racks	4101.08

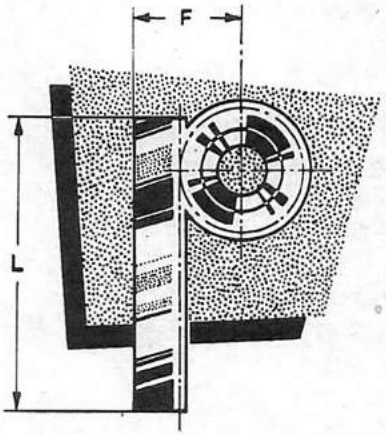
For testing flat and round racks the angle bracket (56) is mounted with four Allen-type screws (51) on the vertical slide (48) of the bevel gear slide or single slide (46). Height adjustment is by means of lead-screw with the knurled knob (49), then clamped with the star knob (50).

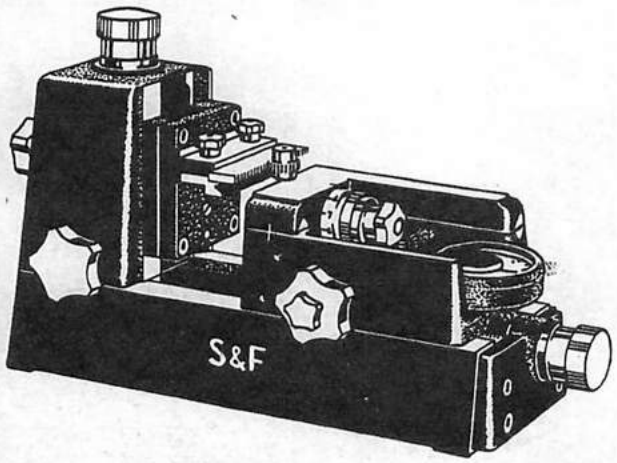
Flat racks are slid on the rim (57) until the rear edge is guided along the front edge of the angle bracket (56).

The rim is adjustable to the desired width and clamped into position with the star knobs (58). Round racks are taken up in the vee of the rim, where the testing pressure holds and securely guides the rack.

Special holding devices are available for testing racks used in Dial Indicators, Scales and Typewriters.

S&F TYPE 101



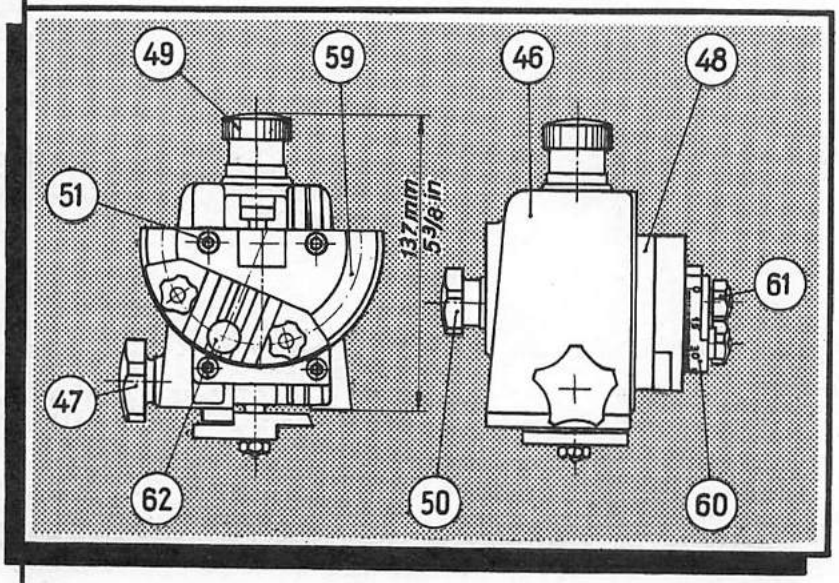


CAPACITY:

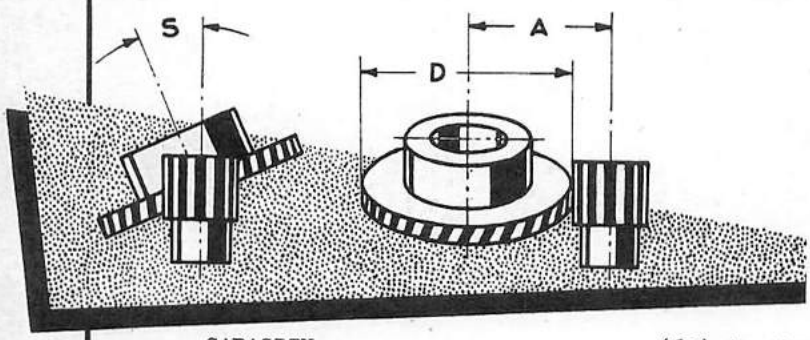
Distance	F max.	1-1/2"
Max. length	L abt.	6 "
Round racks	Ø max.	3/8"

S&F UNIVERSAL FINE PITCH GEAR TESTER

BRACKET FOR SPUR GEARS WITH CROSSED AXES



(46) Slide
(47) Star knob for (46)
(48) Vertical slide
(49) Knurled knob with overload clutch f. adjustment of (48)
(50) Star knob for (48)
(51) Screws for (59)
(59) Helical gear bracket
(60) Vee piece
(61) Star knob for (60)
(62) Clamping stud with star knob for the arbor



CAPACITY:

Center distance	A max.	1-3/4"
Gear diameter	D max.	1-3/4"
Helix angle	S max	± 45 °

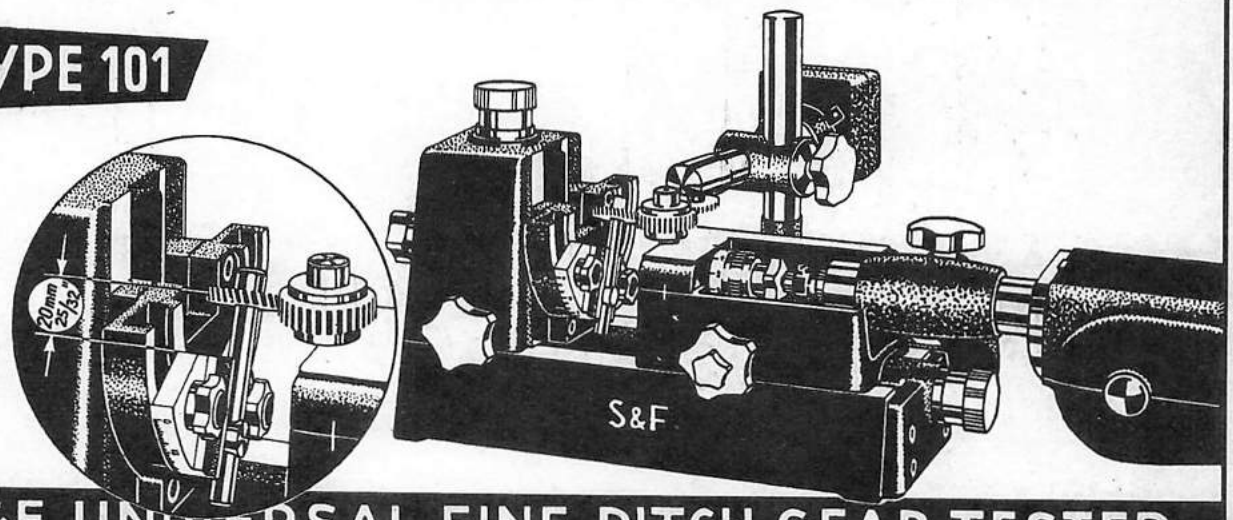
Order number: Slide 4101.06

Bracket for spur gears with crossed axes 4101.13

Helical gears and worm wheels up to 45° can be tested in mesh with a straight spur master gear by using this bracket (59). It is mounted with 4 Allen-type screws (51) on the vertical slide (48) of either the bevel gear or simple slide (46). Height adjustment is by means of the knurled knob (49), clamping with star knob (50). The graduated scale permits easy setting of the helix angle and the vee piece (60) is then clamped with star knobs (61). Standard arbors are mounted in this vee piece with clamping studs (62), so that a distance of about 25/32" is maintained from the bearing surface of the vee piece to the center of the helical gear. (See picture in circle)

As the lower picture shows, in this exceptional instance, the motor drive should be meshed with the gear on the measuring slide.

TYPE 101



S&F UNIVERSAL FINE PITCH GEAR TESTER

SET-UP
FOR SEMI-AUTOMATIC OPERATION

The test cycle of gears with the equipment described thus far is as follows:

1) Mounting test gear
2) Moving measuring slide into measuring position
3) Rotating test gear for min. one full rotation and simultaneously
4) Observing the precision dial indicator for error indication
5) Moving measuring slide away
6) Removing test gear

Because of the many movements involved, spot testing is generally resorted to, particularly with large runs. To safeguard troublefree assembly every single gear should, however, be tested. Modern methods and equipments have been improved to the point where the relation between generating time and test time becomes increasingly unfavorable. For this reason the S & F set-up for semi-automatic operation has been developed. The exchange of test gears is the only manual operation left. The complete testing cycle follows a predetermined course, allowing an optimum output and forcing a test in the desired manner, since the operator may focus his attention on the error recording only.

The errors again can either be read off a precision dial indicator or permanently recorded with the mechanical recording indicator GRAPHOTEST. When testing long runs, a slow paper speed will furnish a condensed diagram and permit spotting of errors at a glance. The diagram is likewise helpful for statistical reasons where records of production standards are desirable.

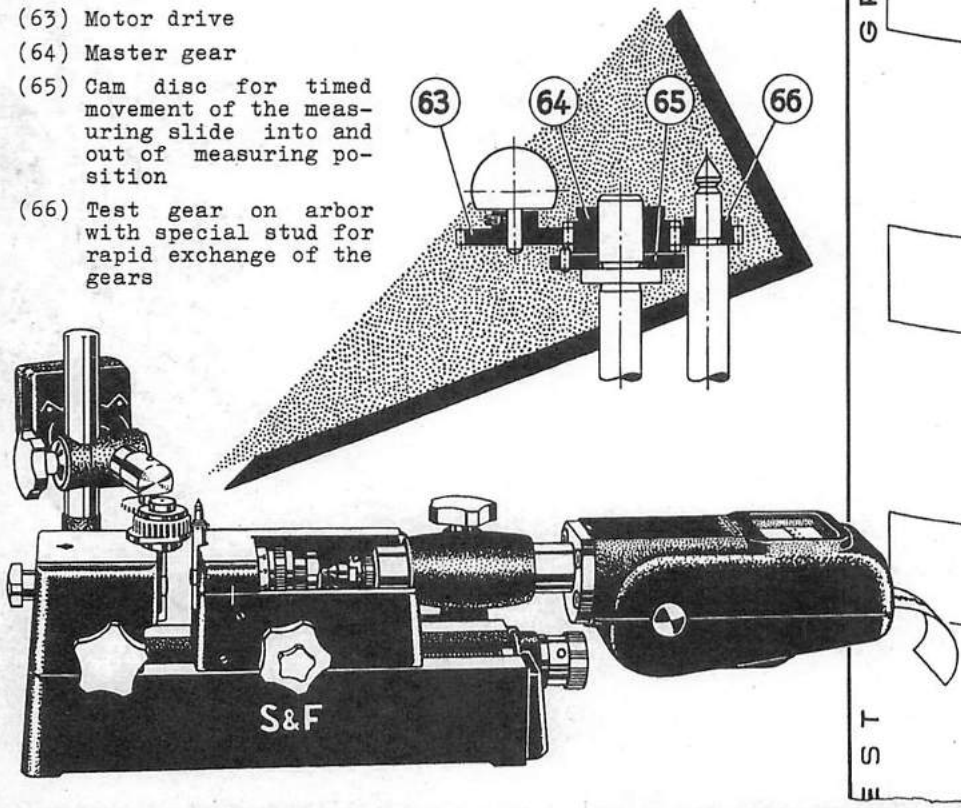
On hand of drawings and/or workpieces we shall gladly make our recommendation for the fastest and most economical set-up of testing your gears.

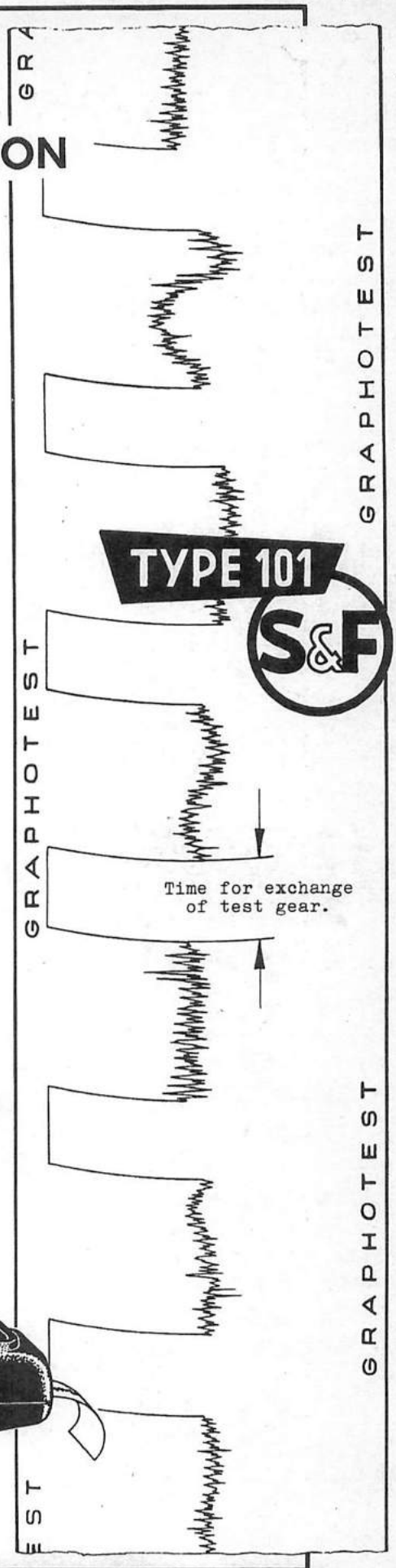
(63) Motor drive

(64) Master gear

(65) Cam disc for timed movement of the measuring slide into and out of measuring position

(66) Test gear on arbor with special stud for rapid exchange of the gears



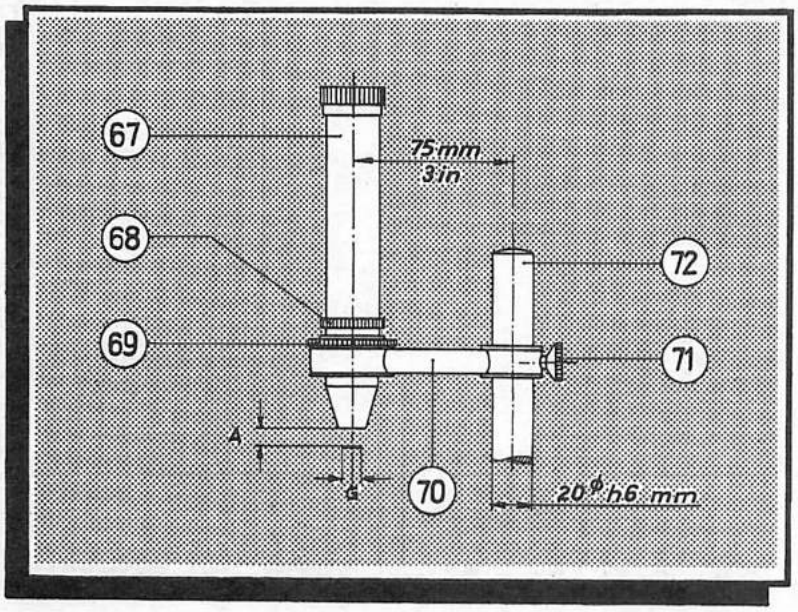


S&F UNIVERSAL FINE PITCH GEAR TESTER

MICRO-LENS WITH HOLDER

TYPE 101

S&F



(67) Interchangeable micro-lens
(68) Knurled wheel for interchanging (67)
(69) Time adjustment in holder
(70) Holder
(71) Coarse adjustment
(72) Column

Order number:

Column 4101.15

Micro-lens with holder 4101.19

(State specific magnification desired.)

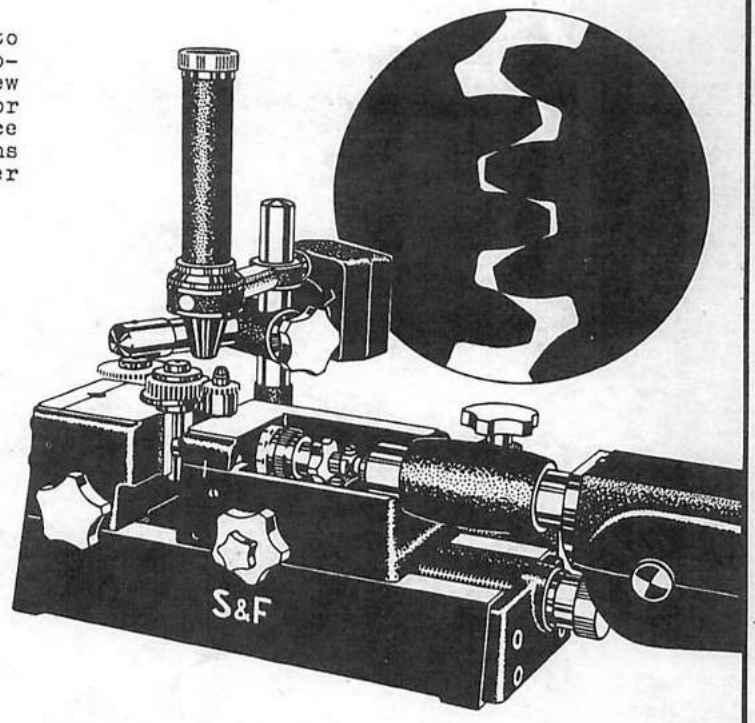
The advantage of using our micro-lens should not be underestimated. They facilitate observation of proper mesh of even the smallest gears, chips, burrs and dirt which are often the cause for large error indications. The control of tooth flanks of high precision gears makes the use of such micro-lenses imperative. These micro-lenses are available in 10 to 250 times magnification.

The micro-lens (67) is screwed into the holder (70) and fixed on the motor drive column (72) with set screw (71). Fine adjustment is provided for with knurled knob (69). Where space or set-up require it, the micro-lens can of course be mounted in any other manner.

Since the micro-lenses consist of ocular and optical lens providing an optical system, the picture shown will of course be side-inverted, i.e. the gear on the measuring slide will appear on the left. A light source from below is necessary when using the micro-lenses for which our work bench makes a provision.

Table with view- and working distance dimensions for the various magnifications:

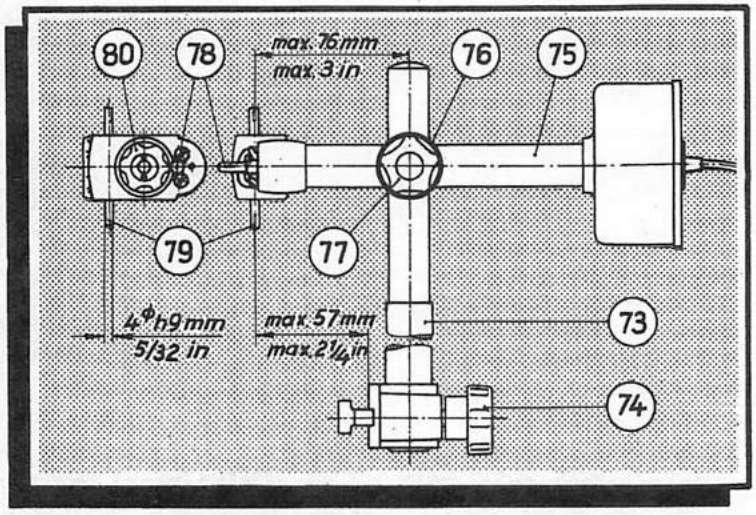
Magnification	View Diameter G = inches	Working Distance A = inches
10	9/16	1-9/16
25	1/4	1-3/8
50	1/8	5/8
100	1/16	1/2
150	3/64	5/32
250	1/32	1/16



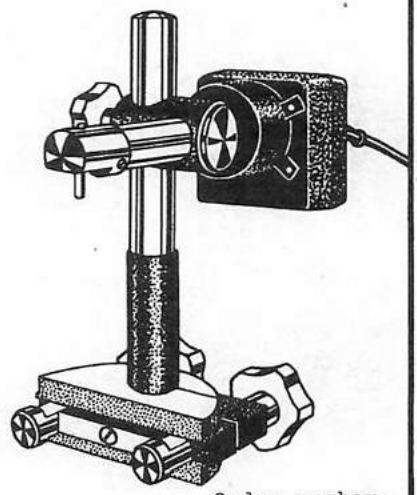
S&F UNIVERSAL FINE PITCH GEAR TESTER

TYPE 101

MOTOR DRIVE AND COLUMN



(73) Column
(74) Star knob for (73)
(75) Motor drive
(76) Cross hole piece
(77) Star knob for (76)
(78) Fast- and
(79) Slow moving drive shaft
(80) Drive gear



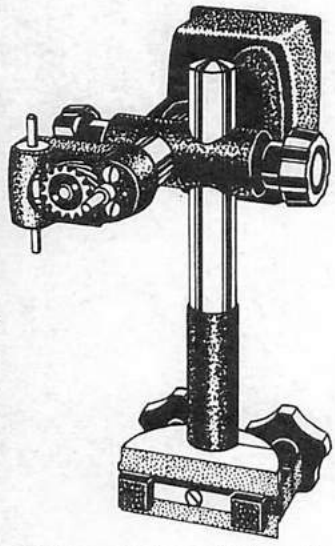
Order number:

Motor drive 4101.12
Column 4101.15

Where the gear errors are to be recorded with the GRAPHOTEST for roll-diagrams, the use of either motor drive 4101.12 or 4101.16 is required. Even where the errors are to be read off a precision dial indicator only a motor drive is advantageous, avoiding any manual interference of the test by the operator. Measuring accuracy, when using the motor drive is assured to a greater extent.

The motor drive is constructed as a self-starting synchro-motor, operative between 46 and 60 cycles, with proportional RPM. (Available for 110 or 220 V.) It is furnished with a strong, well insulated electrical cord, on-off switch and standard plug. Our workbench provides electrical outlets for the motor drive and GRAPHOTEST, permitting their control from the front of the workbench.

The motor drive (75) with column (73) fits into the T-slot of the instrument base. Available in two models, the simple motor 4101.12 is furnished with one slowly rotating drive shaft (79)(2 RPM) particularly for driving spur and bevel gears. The universal type 4101.16 has 2 drive shafts with different speeds. The fast shaft (78) at 60 cycles will travel 72 RPM and is used predominantly in testing drives. The slower shaft (79) is driven by an interchangeable drive gear (80), the same gears furnished for regulating the paper speed of the GRAPHOTEST. The rotations of the slow drive shaft are therefore controlled by the number of starts on the drive worm and operating at 60 cycles will furnish from 1 - 30 RPM. A spur gear with 5/32" bore, mounted on either shaft (78) or (79) and of identical pitch, is used to mesh with and drive the test gear. Meshing the drive gear with the gear mounted on the measuring slide should be avoided, to prevent erroneous findings. When driving bevel gears, the motor drive should be placed at an angle and the mesh width be held narrow to overcome the pitch difference. For driving worms an additional gear is needed as driven gear to be mounted on the worm shaft or arbor. To reduce the testing time required, despite the many worm revolutions necessary, the motor drive gear should be mounted on the fast rotating shaft (78) of the motor drive 4101.16.

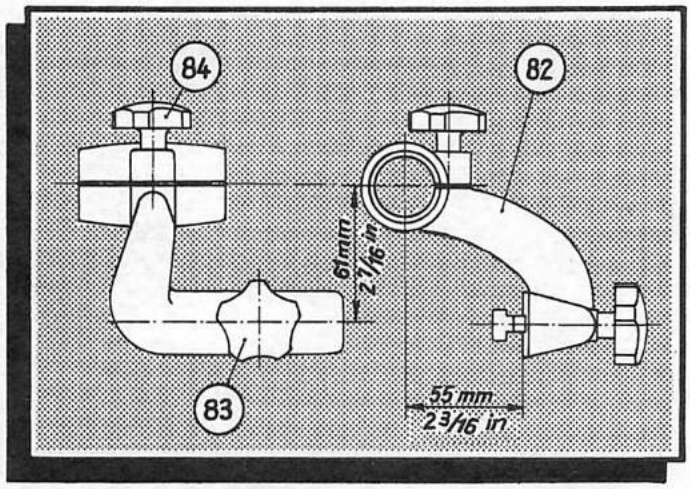


To facilitate the evaluation of the diagrams and comparison among these, the paper speed should be selected so that for equal pitch equal lengths diagrams are obtained, i.e. pitch of gear equals spacing on diagram. This illustrates the advantage of the longitudinal diagram in contrast to the circular diagram where the distance from tooth to tooth is controlled by the number of teeth, thereby complicating a comparison.

Order number: Motor drive 4101.16
Column 4101.15

HOLDING BRACKET FOR GRAPHOTEST

S&F TYPE 101



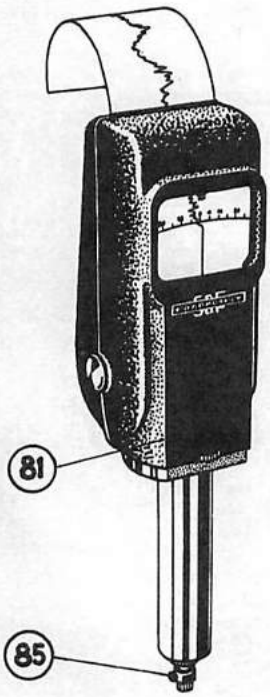
(81) Mechanical recording indicator GRAPHOTEST

(82) Holding bracket

(83) Star knob for clamping bracket (82)

(84) Star knob for clamping GRAPHOTEST (81)

(85) Feeler point



Our highly sensitive mechanical indicator GRAPHOTEST, has been designed for recording roll-diagrams in 100, 200, 250 or 400 x magnification (operating instructions, 107E/54). It consists of the shaft, containing the measuring device, and the housing. The lower part of the housing can be removed, it contains the paper supply and the paper drive. A self-starting synchro-motor drives an interchangeable worm and thereby a pin-pointed roll, which transports the paper continously. By exchanging the worm, the paper-speed can be regulated within large limits. The paper speed is preferably selected so that with identical modulus equal linear measurements are obtained (for example: Pitch of gear equals spacing on diagram). Composite errors, as defined in the AGMA standards are easily read off the diagrams.

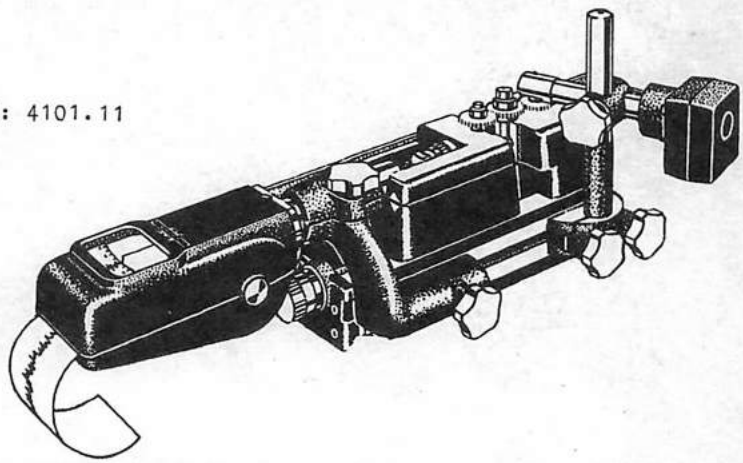
The holding bracket (82),which is clamped into the T-slot of the base instrument with star knob (83), is used for mounting the GRAPHOTEST (81). However the dial indicator must be removed. The GRAPHOTEST is clamped into the holding bracket (82) with star knob (84). The feeler point (85) with rotating ball (4101.02a) should touch the plane surface of the star knob used when tightening the arbor in its vee. To accomplish this, coarse adjustment is by means of the star knob (83) in the T-slot, and fine adjustment with the shaft of the GRAPHOTEST in the holding bracket.

Order number:

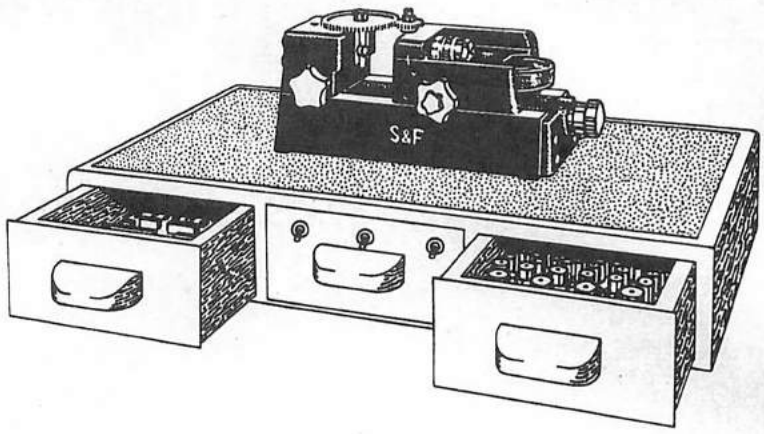
Holding bracket for GRAPHOTEST: 4101.11

GRAPHOTEST Type 107, as per separate catalog 107E/54.

For testing gears in their assembly (see page 20), where the measuring slide is moved to the left edge of the base, the star knob (14) picture 2, page 5 must be exchanged against the long clamping knob 4101.22.



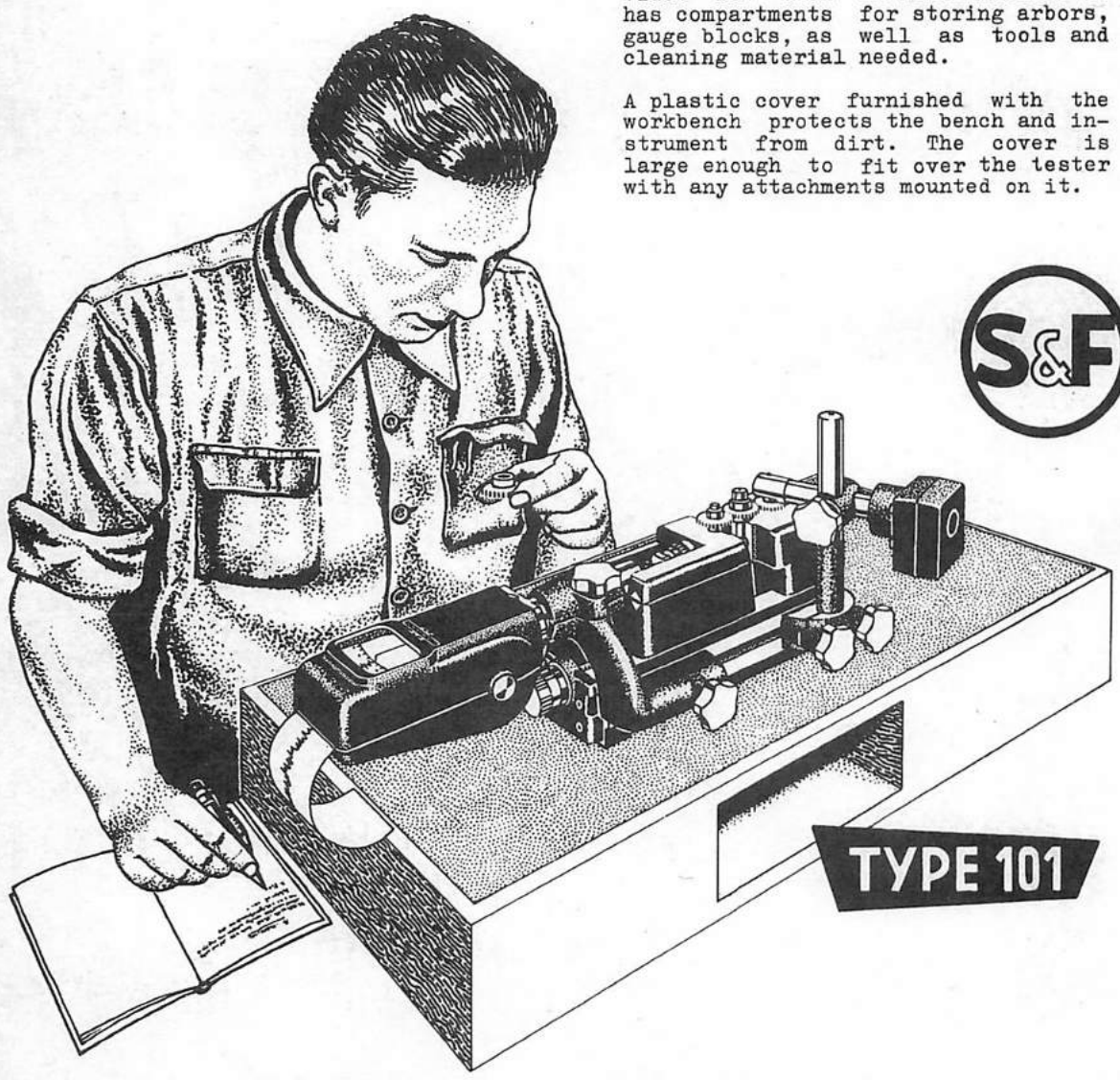
WORKBENCH



The high precision fine-pitch gears require the best possible care to prevent damage during set-up and inspection. This is more important yet where gears have narrow tooth width, are made of light metals, brass and similiar low resistance materials. Many a good gear has been damaged during inspection. An illumination from below, preferably a greenish tint, is helpful in meshing even the finest pitch gears quick and safely. The light source from below also easily identifies the apex of a gear tooth touching the root of a mating gear tooth, or the presence of burrs, chips or dirt particles causing excessive run-out errors.

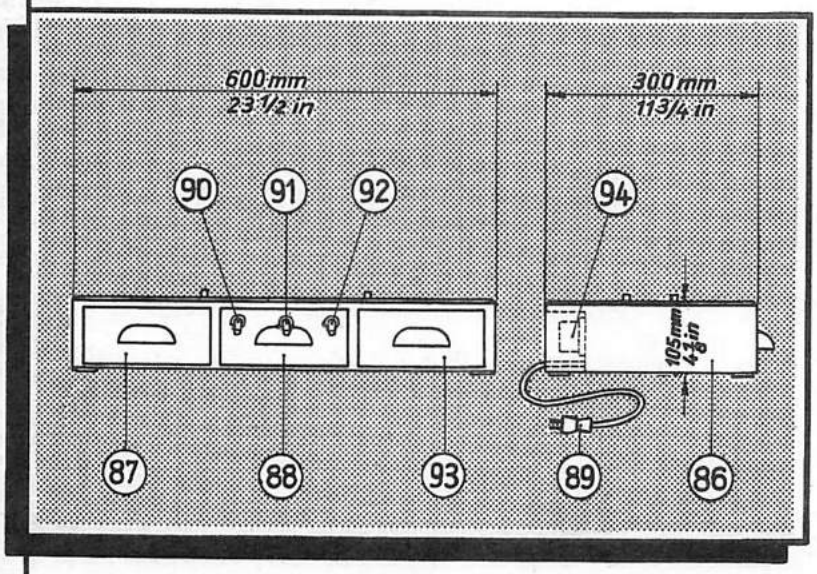
The workbench has been designed for use with the S & F Tester and provides for such an illumination. It has compartments for storing arbors, gauge blocks, as well as tools and cleaning material needed.

A plastic cover furnished with the workbench protects the bench and instrument from dirt. The cover is large enough to fit over the tester with any attachments mounted on it.



S&F UNIVERSAL FINE PITCH GEAR TESTER

WORKBENCH



(86) Workbench
(87) Drawer for gauge blocks, tools, etc.
(88) Drawer with light source
(89) Connecting cord
(90) Switch f.motor drive
(91) Switch for light
(92) Switch f. GRAPHOTEST
(93) Drawer for arbors
(94) Outlets f. motor and GRAPHOTEST

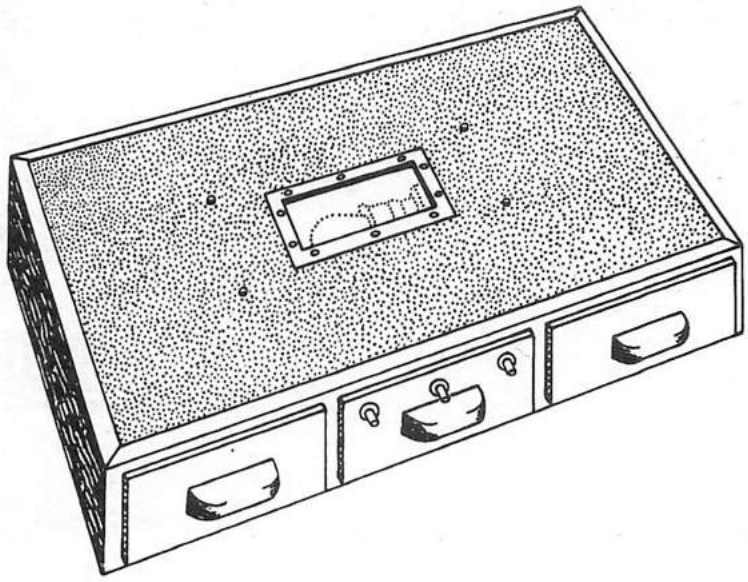
Our workbench is made of hardwood (metal in preparation), the top covered with linoleum. Four studs permit positioning of the base instrument. When not in use, the plastic covering should be used to protect the equipment from dust.

On the front are three drawers, the left one (87) for gauge blocks, tools etc.

The middle drawer (88) provides space for cleaning and degreasing agents. The rear compartment contains socket for a 15 W light bulb. Its light passes through the rectangular opening, covered with green Plexiglass, and provides the illumination for observing the proper mesh of the gears.

The electric cord (89) connects the bulb socket. The on-off switch (91) is conveniently located on the front of the workbench. There are two more switches on the front (90) and (92) which control the two outlets (94) on the rear of the middle drawer. These outlets permit connecting the motor drive and the GRAPHOTEST.

The right hand drawer has an inset with about 100 bore holes for storing arbors.



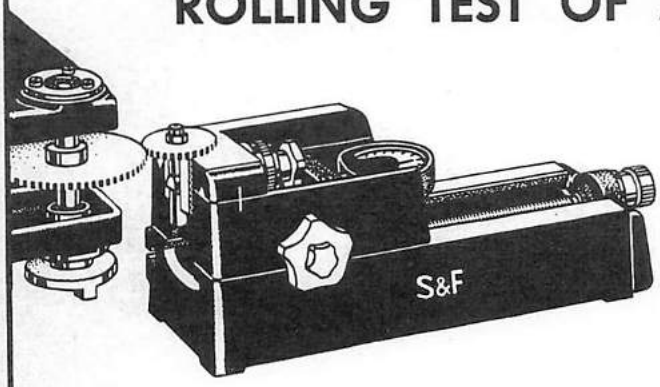
TYPE 101 S&F

Order number:

Workbench	4101.09
Plastic cover	4101.08

ROLLING TEST OF ASSEMBLED GEARS

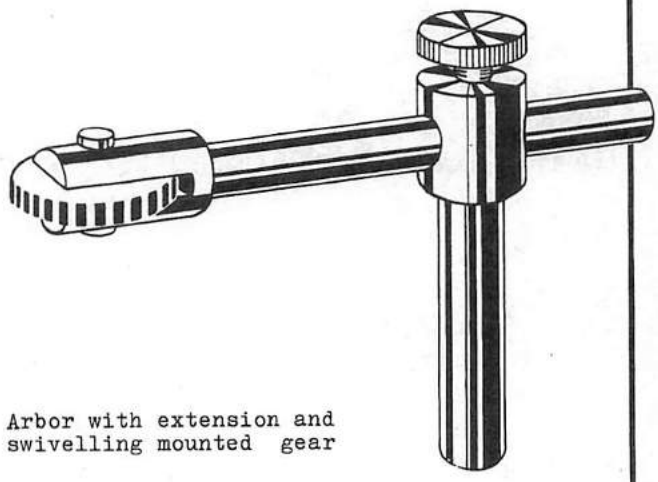
TYPE 101



Inasmuch as run-out of gears is influenced also by any run-out of shafts and bearings, it is important to have the gears undergo checking while assembled. The S & F Universal Gear Tester can be used for this purpose as well, because measuring slide carrier and measuring slide with recording instrument can be used as unit in itself.

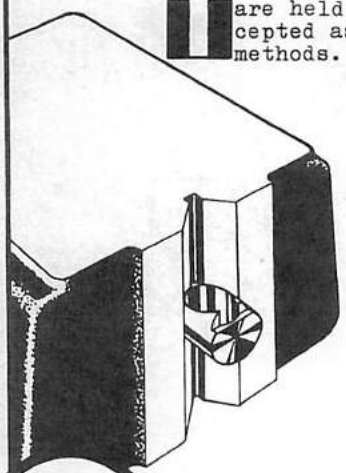
Setting up for such testing is simple. The assembly to be tested and the instrument base are placed on a firm support. If needed, the instrument can be set on raiserblocks to overcome any height differences. The measuring slide carrier and measuring slide with its gear is then moved towards the left until it meshes with the assembly gear to be tested. The rolltest will then, in the conventional manner, allow recording of the run-out.

Even where assembled gears are not freely accessible, the adjustable extension illustrated here will permit access in practically all cases. The extension fits into the vee of the measuring slide like the arbors. The fork at the end of the extension can be rotated, for testing gears on horizontal or oblique axes. When using the GRAPHOTEST, the clamp (4101.22) should be used instead of the star knob (14) picture 2. page 5.



Arbor with extension and swivelling mounted gear

MOUNTING SHAFTS IN VEES



The S & F Universal Gear Tester uses arbors with cylindrical shafts, which are held in vees. Holding cylindrical bodies in vees is universally accepted as the most accurate, secure and yet simplest of all clamping methods. In addition, this method has the following advantages for the S & F Tester:

Cylindrical arbors are easily machined with the required accuracy in contrast to tapered arbors.

Cylindrical arbors are easily adjusted to any desired height, where varying hub width of gears demand it. This is not possible with tapered shafts.

Where special holding devices are required, their design and manufacture is relative simple, regardless of shape. No matter what the shape need be, mounting it on a cylindrical shaft will insure positive and accurate clamping. Tapered shafts would here, too, make simple solutions difficult to carry out.

The arbors in their vees can be moved towards each other to the point where they nearly touch. Without aid of any attachments, which would of course impair the accuracy, minute center distances can be obtained.

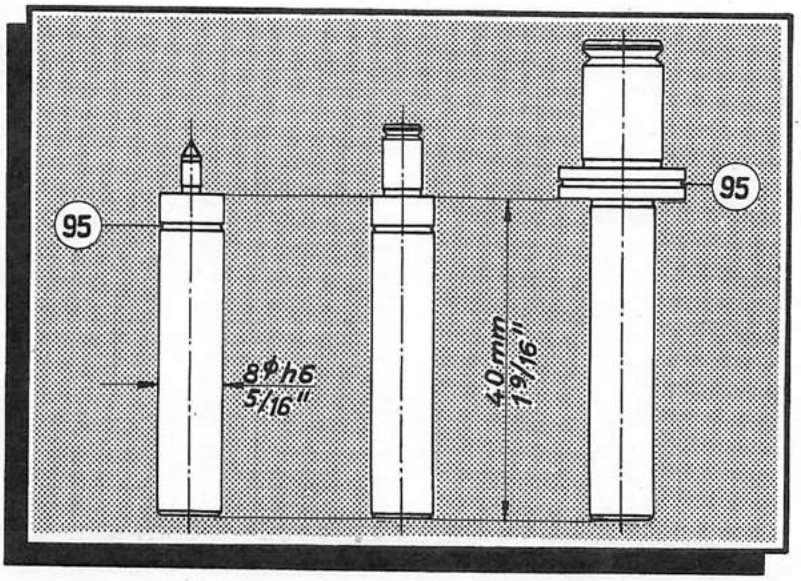
S&F

S&F UNIVERSAL FINE PITCH GEAR TESTER

ARBORS

TYPE 101

S&F



(95) Color ring (for identification of any given set of arbors)

All of the S & F Two-Flank Roll Testers utilize cylindrical arbors clamped in vees. This method guarantees quick and yet accurate mounting of the gears, permits simple height adjustment and simplifies the design and machining of special holding devices.

The arbors have three distinctive forms, governed by machining methods; up to 1/8" Ø a male center, over 1/8" a female center and over 7/32" Ø a shoulder.

The arbor must have a sliding fit with the gear bore. When ordering arbors, both arbor diameter and bore dimensions should be furnished. Where high accuracy and close tolerances are called for, several arbors with varying diameters are required to cover the complete plus and minus tolerance of the bore. For arbors of less than 1/4" Ø, the shafts can be furnished with arbors on both ends, cutting the number of arbors required in half and furnishing every shaft with the plus and minus tolerance of the gear bore.

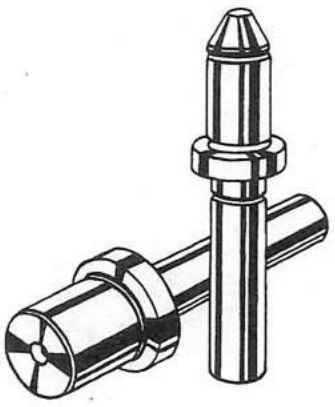
Where desired, a color stripe (95) can be provided to identify the arbors belonging to a particular instrument.

Special arbors have been designed for rapid exchange of gears to prevent freezing the gears on the shaft. Such a "Quick-change Arbor" is shown upright in the picture on the right.

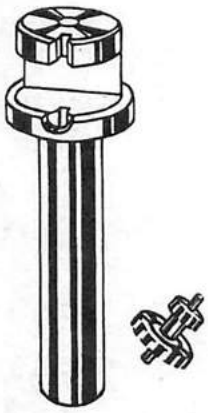
For bores of less than 1/8" Ø the arbors are designed as shown here. The cylindrical shaft has a vee in shaft direction for mounting interchangeable, hardened, ground and lapped needles. Similar arbors are used for testing small shaft gears with one-sided axes. These shafts are held under spring pressure in the vee.

For bores of 1/8" diameter and larger, expansible arbors are available.

Where the bore exceeds 1-1/4 " Ø, arbors with flanges are recommended. The flange is mounted on the measuring slide or spur gear slide with three screws.



ARBORS WITH BEARING PRISMS



TYPE 101

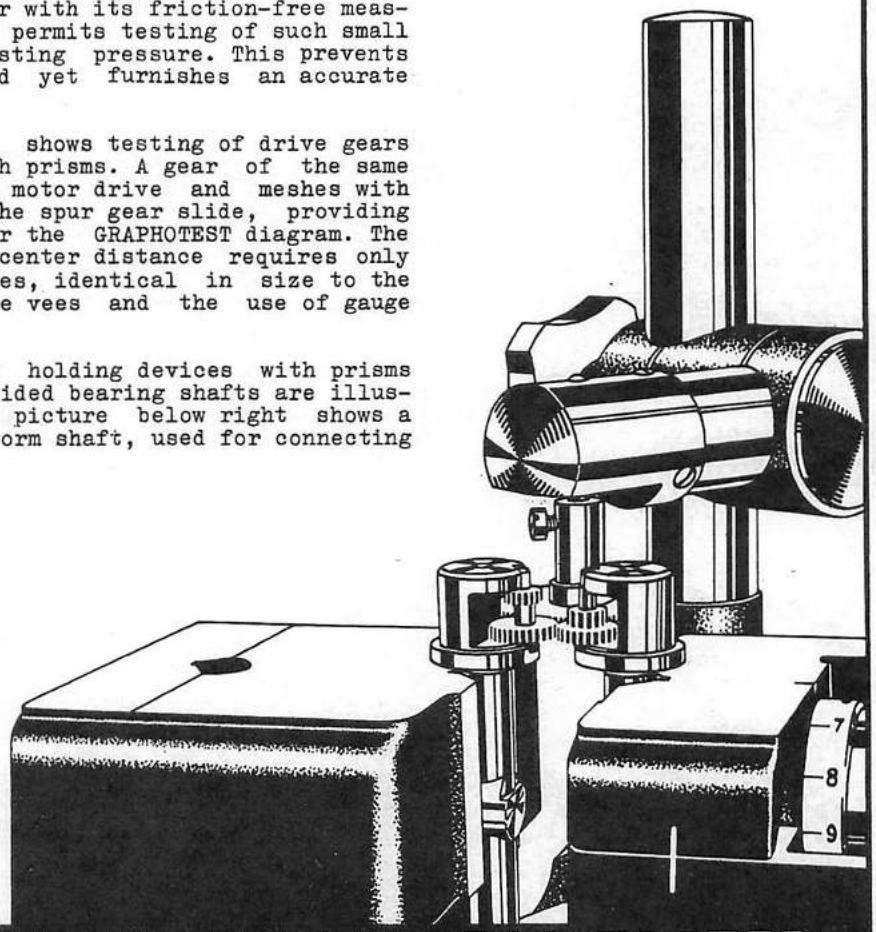
Fundamentally, in testing gears, these should be mounted on the same bearing surface on which they are to be mounted in the assembly. Only in that manner can run-out of shaft and bearing surface be caught in production testing. This required, however, special holding fixtures, designed for this purpose which, thanks to the cylindrical shafts used, are easily designed and machined. The set-up and mounting of the gears is quick, safe and accurate.

Gears or sets of gears mounted on their axes generally have bearing shafts on both sides, which should be used in holding the gears during the test. The picture above shows simple arbors with vees. These vees are machined in the head of the arbor in shaft direction; the pinions are placed in the vees. A ring slipped over the lower vee holds the gears until the test pressure pushes them into the vee and holds them securely during the rotation.

This type of arbor can also be used for mounting minute and highly sensitive gears, as used in dial indicators. The S & F Tester with its friction-free measuring slide of low mass permits testing of such small gears with little testing pressure. This prevents damage to the gears and yet furnishes an accurate roll diagram.

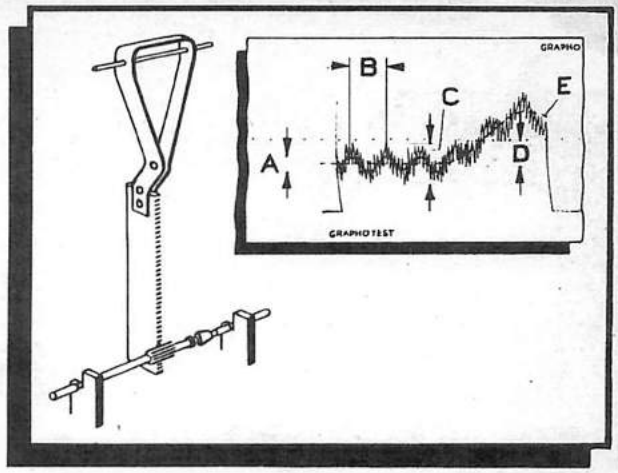
The picture below right shows testing of drive gears mounted in arbors with prisms. A gear of the same pitch is used with the motor drive and meshes with the gear mounted on the spur gear slide, providing the uniform rotation for the GRAPHOTEST diagram. The set-up for theoretical center distance requires only the placing of needles, identical in size to the bearing shafts, into the vees and the use of gauge blocks.

Additional examples of holding devices with prisms for gears with double sided bearing shafts are illustrated on page 23. The picture below right shows a pinion mounted on the worm shaft, used for connecting the motor drive.

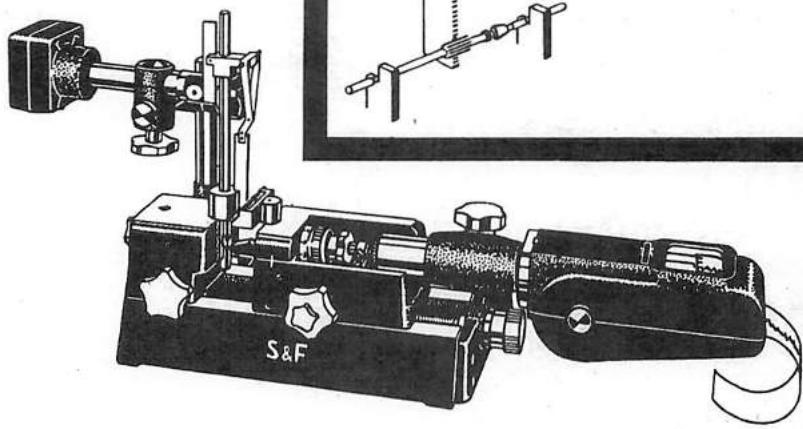


S&F UNIVERSAL FINE PITCH GEAR TESTER

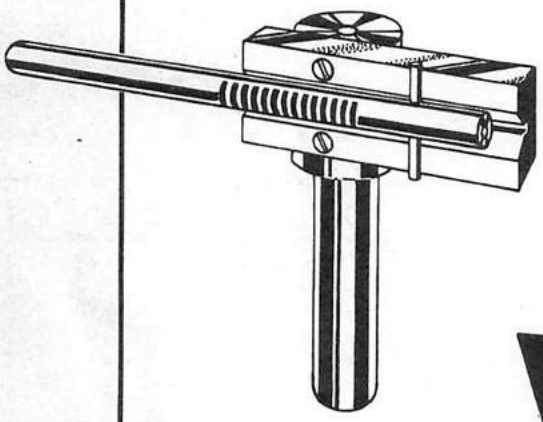
HOLDING DEVICES



These are pictures of various holding devices. They demonstrate that the fundamental thesis, to mount gears during the test in the same manner they are mounted in the assembly, is easily complied with. The picture to the right shows the S& F Tester set up for checking a rack and the mating pinion (10 teeth with 80 D.P.) of a precision weighing scale. The pinion is held on its bearing surface in vees; the rack in its axes. The rack is operated from the motor drive with a gear and an auxiliary rack. The two-flank roll diagram reproduced here on a smaller scale indicates:



A	Run-out of pinion	.00005 "
B	One revolution of pinion	
C	Total composite error	.00011 "
D	Tooth to tooth composite error	.00008 "
E	Course of gearing on rack	



Geared shafts of dial indicators are just as easily tested with the holding device pictured on the left, without using the bracket for racks.

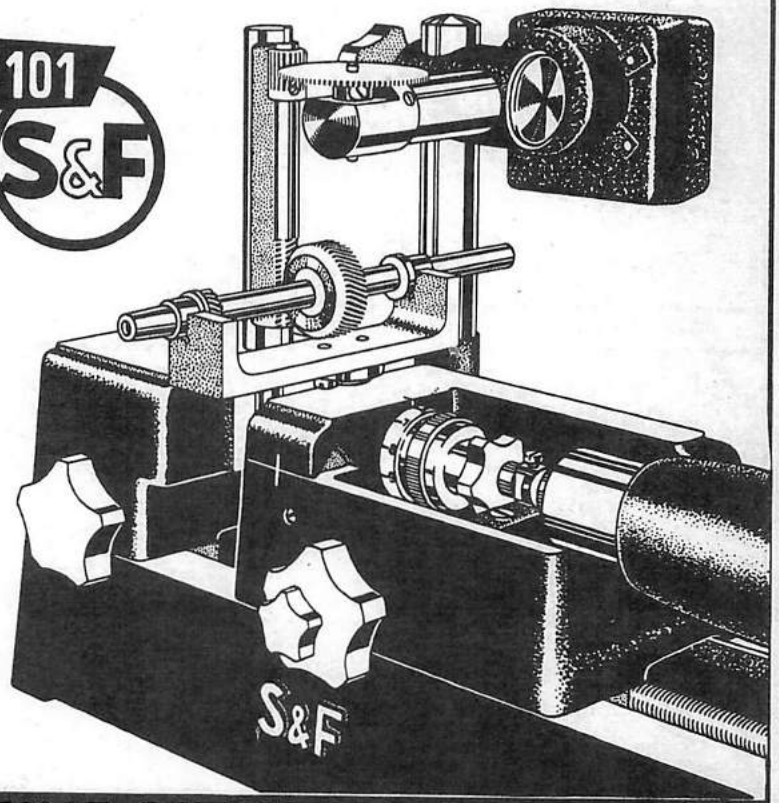
The lower picture illustrates testing of a worm drive for a tape recorder. The holding devices have been designed to permit mounting the two test gears on their bearing surface in vees freely rotating.

Not only the spur gear slide 4101.03 is suitable for holding devices of this type, but likewise the slide for shaft gears 4101.17. This larger vee accommodates larger and heavier holding fixtures.

Your drawings of parts to be tested will receive our prompt recommendations for holding devices. Please indicate on your drawings the bearing surfaces.

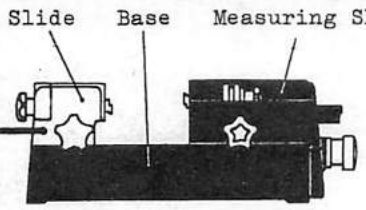
Many special fictures have already been designed for specific purposes, for example long racks as used in typewriters.

TYPE 101 S&F



S&F UNIVERSAL FINE PITCH GEAR TESTER

ASSEMBLING THE



DESCRIPTION	ORDER-NUMBER	WEIGHT
Base Instrument consisting of: Base Measuring Slide	4101.00 4101.01 4101.02	16.5 lbs
THE INTERCHANGEABLE SLIDES		
Slide for Spur Gears	4101.03	4.2 lbs
Slide f. Shaft Gears	4101.17	11.0 lbs
Large Center Slide f.Long Pinion Shafts	4101.21	4.2 lbs
Small Center Slide for Pinion Shafts	4101.04	5.3 lbs
Slide f. Bevel Gears	4101.05	7.7 lbs
Simple Slide for Various Brackets	4101.06	7.7 lbs
THE INTERCHANGEABLE BRACKETS for Bevel Gear Slide 4101.05 or Simple Slide 4101.06		
Bracket f. Worms and Worm Wheels	4101.07	1.8 lbs
Bracket for Long Worm Shafts	4101.14	3.5 lbs
Bracket for Flat and Round Racks	4101.08	0.7 lbs
Bracket for Helical Gears (Gears with Crossed Axes)	4101.13	3.3 lbs
ACCESSORIES For any fine-pitch gears outside the above work-range or special testing		
Workbench	4101.09	17.6 lbs
Motor Drive Motor Drive Column	4101.12 4101.16 4101.15	5.0 lbs 5.0 lbs 4.4 lbs
GRAPHOTEST	Type 107	4.4 lbs
Holding Bracket for GRAPHOTEST	4101.11	3.3 lbs
Micro-Lens w. Holder	4101.19	0.3 lbs

TYPE 101

S&F

S&F UNIVERSAL FINE PITCH GEAR TESTER

TWO-FLANK ROLL TESTER TYPE 101

CAPACITY	PAGE	NOTE
Testing pressure from 0 - 8 ozs or 0 - 28 ozs.	4-5	For dial indicator 1/10,000 inch and arbors 5/16"Ø shaft (1/2" Ø on request)
Center Distance A min 3/32" with holders for needle shafts 11/32" with standard arbors A max 5 " using rear vee of spur gear slide	5	For 5/16 " Ø arbors (1/2" Ø on request)
Center Distance A min 5/8 " A max 2-5/8 " Shaft Diameter W max 7/8 " Shaft Length L max 4-3/8 " and more	8	For bushings with 3/4" to 1-1/16"O.D.
Center Distance A min 11/32" Center Distance E max 11 " A max 2-9/16" Shaft Diameter W max 1-1/16" Pinion Diameter D max 4-3/4 " Pinion Width G max 3 "	7	———
Center Distance A min 11/32" Center Distance E max 2-3/4 " A max 2-9/16" Pinion Diameter D max 2-3/4 "	6	———
Assembly Distance B up to about 1-3/4 " C up to about 1-5/8 "	9	For dial indicator 1/1000 inch and arbors 5/16"Ø shaft (1/2" Ø on request)
———	10-13	———
Center Distance A max 1-5/8 " Shaft Length L max 5-3/8 " Worm Diameter D max 1-9/16" Shaft Diameter W max 7/16" Worm Length G max 2 " Shaft Length M max 2-3/4 "	10	———
Center Distance A max 1-5/8 " Shaft Length L max 9-1/16" Worm Diameter D max 1-1/16" Shaft Length M max 6-1/2 "	11	———
Distance F max 1-1/2 " Rack Length L max 6 " Round Rack Diameter max 3/8 "	12	———
Center Distance A max 1-3/4 " Gear Diameter D max 1-3/4 " Helical Lead S max plus or minus 45°	13	For 5/16 " Ø arbors (1/2" Ø on request)
problems, kindly submit drawings, indicating bearing surfaces and approximate quantity manufactured.		
———	18-19	For 15 watt bulb, Edison 27 base specify voltage if other than 110 V
1 Drive shaft 5/32" diameter with 2 RPM 2 Drive shafts 5/32" diameter w. from 1-30 (selective) and 72 RPM	16	60 cycle A.C., specify current
Measuring Range .02 " with 100 x magnification of the GRAPHOTEST Measuring Range .01 " with 200 x magnification of the GRAPHOTEST Measuring Range .008" with 250 x magnification of the GRAPHOTEST Measuring Range .005" with 400 x magnification of the GRAPHOTEST	17	Selection of the GRAPHOTEST as per separate pamphlet
———	17	———
10 x magnif.: Viewing area 1/2" 100 x magn.: Viewing area 1/16" 25 x magnif.: Viewing area 1/4" 150 x magn.: Viewing area .04 " 50 x magnif.: Viewing area 1/8" 250 x magn.: Viewing area .02 "	15	Please specify desired magnification