

Sept. 21, 1937.

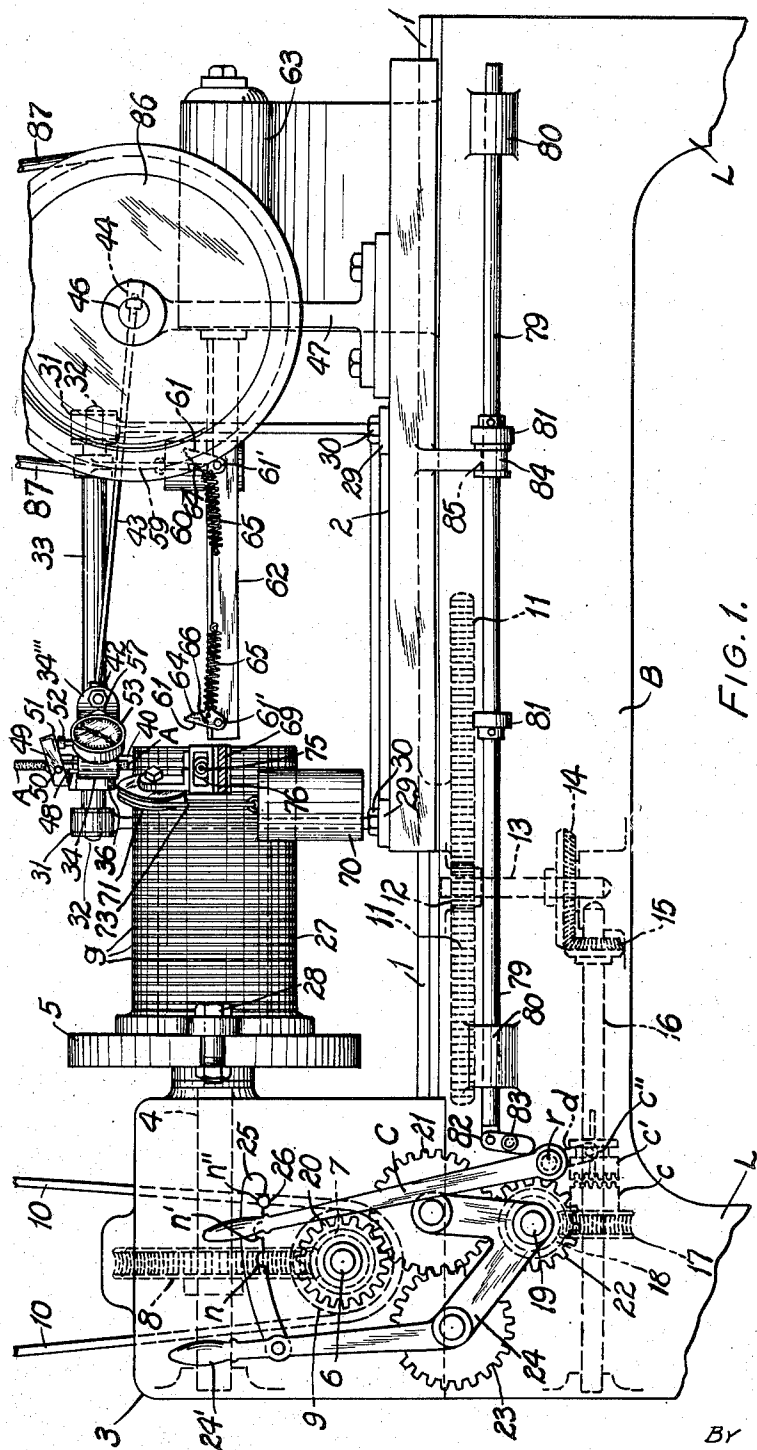
J. SUNNEN

2,093,650

MACHINE FOR TESTING ABRASIVE STONES

Filed June 4, 1934

3 Sheets-Sheet 1



INVENTOR:
JOSEPH. SUNNEN.

By *Harry A. Reimer*
ATTORNEY.

Sept. 21, 1937.

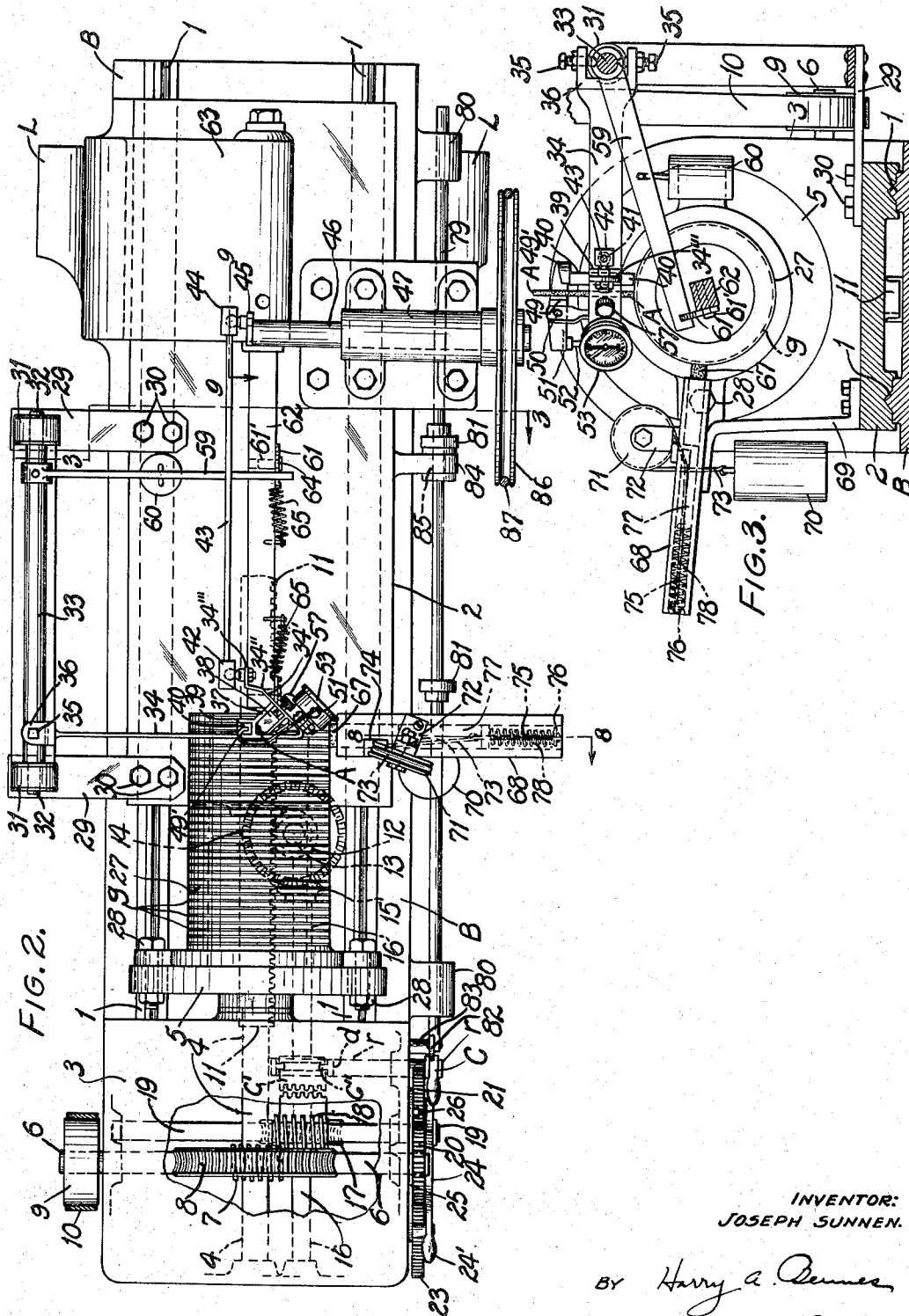
J. SUNNEN

2,093,650

MACHINE FOR TESTING ABRASIVE STONES

Filed June 4, 1934

3 Sheets-Sheet 2



INVENTOR:
JOSEPH SUNNEN.

BY *Harry A. Penner*
ATTORNEY.

Sept. 21, 1937.

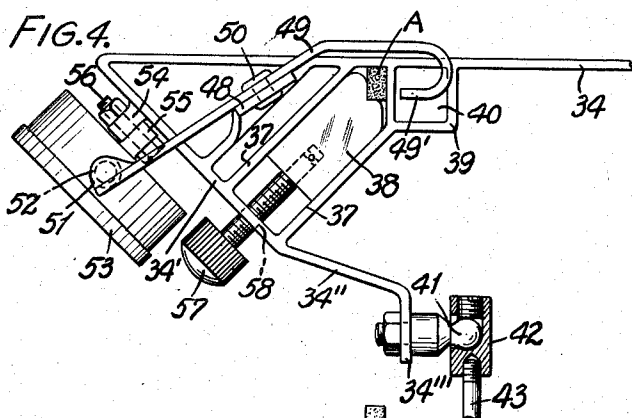
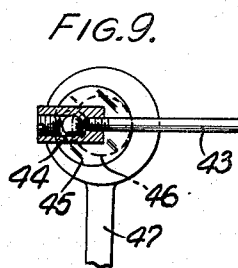
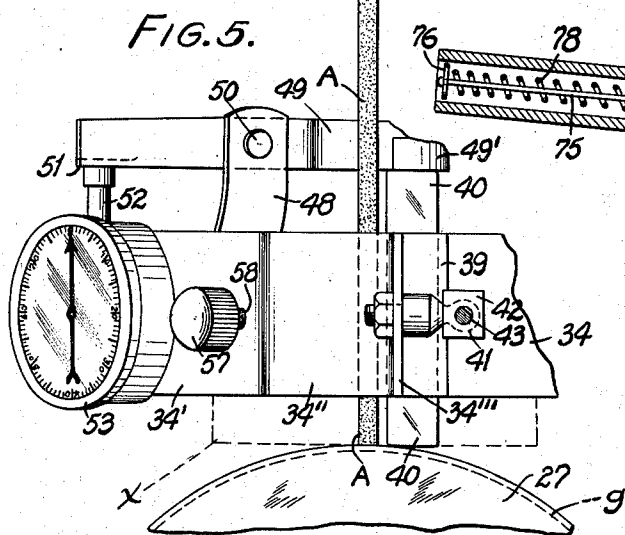
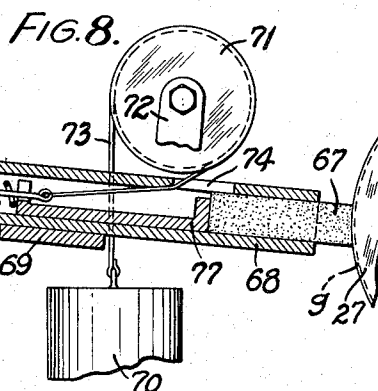
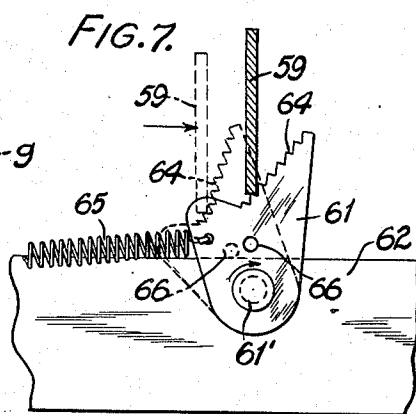
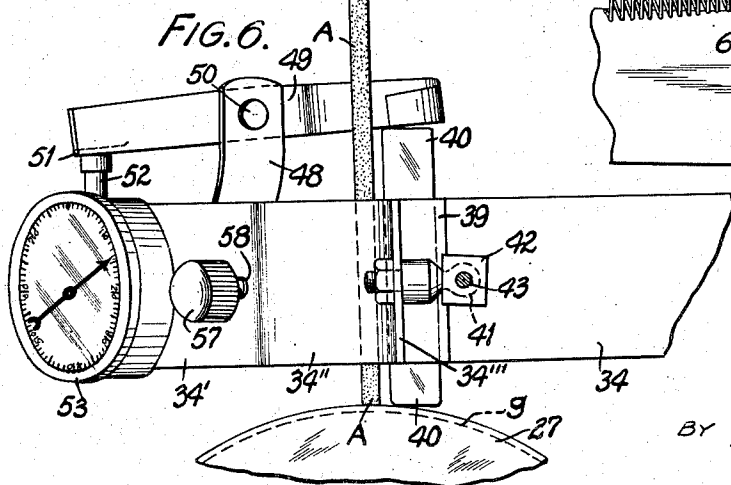
J. SUNNEN

2,093,650

MACHINE FOR TESTING ABRASIVE STONES

Filed June 4, 1934

3 Sheets-Sheet 3



INVENTOR:
JOSEPH SUNNEN.

BY *Harry A. Reimes*
ATTORNEY.

UNITED STATES PATENT OFFICE

2,093,650

MACHINE FOR TESTING ABRASIVE STONES

Joseph Sunnen, Kirkwood, Mo.

Application June 4, 1934, Serial No. 728,932

4 Claims. (Cl. 73—51)

My invention has relation to improvements in machines for testing abrasive stones, and consists in novel features more fully set forth in the specification and pointed out in the claims.

5 The present invention is more particularly directed to abrasive stones in stick form, although it may be readily adapted to other forms of abrasive elements and has for its principal object the determination of the degree of hardness of any particular stone.

10 Abrasive sticks are now widely manufactured from artificial corundum or carborundum which is compressed with a suitable binder into the form and size desired. The degree of hardness of the stone depends upon the amount of impurities in the artificial corundum, and also the quantity of binder used and the amount of pressure applied in producing the stone. Consequently there are a number of more or less uncertain factors involved in the manufacture of abrasive stones so that it is impossible to manufacture stones that shall have an exact degree of predetermined hardness. The degree of hardness can only be approximated in the manufacture of the stone, after which the stones are tested and sorted and classified according to their hardness. The present practice in classifying abrasive stones is to designate the hardness by letters, e. g. from A to Z, those at the beginning of the alphabet being the hardest, so far as their abrasive action is concerned, and those at the end of the alphabet the softest. Thus, a stone midway between the hardest and the softest would be designated by the letter "M" and might be considered of average hardness.

35 Abrasive stones are also identified by their texture, that is, their degree of coarseness which is termed their "grit". For instance, a stone 136 grit is considered a very coarse stone, while a stone of 280 grit being extremely fine or superfine. In between these two extremes there is a range for practical grinding operations of from 60 grit to 150 grit, the former being used, e. g., in the rough honing of engine cylinders, and the latter for the finishing honing.

40 It is understood, however, that my invention has nothing to do with the "grit" of the stone as it is applicable for testing the hardness of any stone, irrespective of whether it carries a low grit number or a high grit number.

50 The principle involved with my invention is to operate the abrasive stone in contact with a "counter-abrasive", such as a cast iron cylinder, the abrasive stone bearing against the counter-abrasive with a measured pressure for a measured

length of time, after which the stone is measured to determine the amount of wear. During the abrading contact between the stone and the counter-abrasive the surface of the counter-abrasive is maintained of a uniform texture by a second abrasive member so that in testing subsequent abrasive stones the conditions will be the same as they were for the preceding tests. Therefore, an essential object of the invention is to provide means for maintaining the conditions of the tests constant for each test so that the results of the test may be referred to this constant and thus obtain the relative wearing quality of all the stones tested.

15 The advantages of the invention will be better apparent from a detailed description thereof in connection with the accompanying drawings, in which:

Figure 1 is a side elevation of my abrasive stone testing machine; Fig. 2 is a top plan thereof; Fig. 3 is a vertical cross-section taken on the line 3—3 of Fig. 2; Fig. 4 is an enlarged top plan of that part of the machine herein referred to as the work holder because it holds the stones that are being tested as well as the mechanism for indicating the result of the test; Fig. 5 is an enlarged side elevation of the work holder showing the stone at the beginning of the test operation; Fig. 6 is a view similar to Fig. 5 showing the stone after the completion of the test and a reading being obtained to indicate the result thereof; Fig. 7 is an enlarged view of one of the cam lifts for disengaging the work from the machine at the completion of a test; Fig. 8 is a cross-sectional detail taken on the line 8—8 of Fig. 2, and Fig. 9 is a sectional detail taken on the line 9—9 of Fig. 2.

Referring to the drawings, my testing machine comprises a bed B supported by legs L, L and having a pair of rails 1, 1 on which a carriage 2 is slidable, similar to the general construction of a lathe.

45 What may be termed the head-stock 3 is carried by one end of the bed B and has a spindle 4 mounted in it, on the outer end of which is fixed a face plate 5. The spindle 4 is driven from a drive shaft 6 by means of a worm 7 and worm wheel 8, the driven shaft 6 carrying on its outer end a pulley 9, over which is passed a belt 10 leading from a countershaft or motor not shown. Obviously, when the pulley 9 is connected to the source of the power the spindle 4 and face plate 5 will be rotated until said pulley is again disconnected from the source of power. A rack bar 11 is fixed to the carriage 2 and extends down

into the bed B and longitudinally thereof, said rack being engaged by a pinion 12 carried on a vertical shaft 13 suitably bearing in the bed B. The lower end of shaft 13 is provided with a bevel gear 14 which meshes with the bevel pinion 15 at one end of a longitudinally extending shaft 16 which is also supported by suitable bearings in the bed B. Near the end of shaft 16 opposite to the pinion 15 there is a worm wheel 17 fixed to the shaft for meshing with a worm 18 fixed to a transversely disposed shaft 19. The shaft 19 is driven from the shaft 6 by means of a chain of gears 20, 21, 22 and 23. Gear 20 is mounted on driving shaft 6 and gear 22 is mounted on the driven shaft 19 while gears 21 and 23 are mounted on a shift lever 24 having a handle 24', said lever 24 being rotatably mounted on the shaft 19. The lever 24 may be shifted from side to side to cause either gear 21 to mesh with gear 20 or gear 23 to mesh with said gear in order that the shaft 19 may be driven in either direction to propel the carriage toward or away from the head-stock 3.

In order that the lever 24 may be held in either of its driving positions, or in its neutral position, when both gears 21 and 23 are out of engagement with gear 20, I provide a lock bar 25 having a series of notches n, n', n'' , any one of which may engage with a pin 26 to hold the lever 24 in the desired position. A suitable clutch comprising members c, c' is provided on the shaft 18 so that this shaft may be connected or disconnected with the worm 18 by means of a clutch lever C fixed on the rock shaft r mounted in the bed B. A short lever d is also fixed on the rock shaft and engages with the member c'' of the clutch to actuate the same when the clutch lever C is shifted from one side to the other. This particular mechanism for driving the machine is not of the essence of the invention but may be modified at will.

A cast iron cylinder 27 is fixed by bolts 28, 28 to the plate 5, and is provided with parallel annular grooves g , etc. A pair of brackets 29, 29 are fixed in spaced relation on the carriage 2 by means of bolts 30, 30, the upper ends of which brackets are provided with bearings 31, 31 in which are rotatably mounted the reduced ends 32, 32 of an arbor 33. A bracket arm 34 is mounted for lateral oscillation on the arbor 33 by means of oppositely disposed pivot pins 35, 35 secured in the sides of the bifurcated extremity 36 of said arm 34. The bracket arm 34 extends laterally over the bed B and has a component 34' extending rearwardly from its free end to form an acute angle, in which angle is also formed a confining guide comprising the members 37, 37 in which is disposed a block 38, which together with the bracket arm 34 serves as a holder for the abrasive stone A being tested.

Immediately adjacent to the confining guide formed by the members 37, 37 there is provided a holder 39 for what may be termed a measuring post 40, to be more fully referred to hereinafter. Component 34' has a rearward extension 34'' from which a flange 34''' extends and in which is fixed the ball element 41 of a ball and socket connection 42 between flange 34''' and an actuating rod 43. Said rod has its opposite end connected by means of a similar ball and socket connection 44 with an eccentric disk 45 on the end of the shaft 46 mounted in a bearing 47 secured to the carriage 2. A finger 48 extends upwardly from bracket arm 34 adjacent to the inner guide member 37 and a lever 49

is pivotally connected at 50 to said finger, the inner end 49' of said lever having its extremity bent laterally to engage with the top of post 40. The outer end of said lever 49 has a terminal lug 51 for engagement with the top of operating stem 52 of a dial micrometer 53 secured by means of lugs 54, 55 and bolt 56 to the component 34' of bracket arm 34. The block 38 which serves to hold the abrasive stone A securely in place is moved back and forth between the guide members 37, 37 by means of a set screw 57 which has its inner end rotatably secured in the end of the block 38 and operates through a threaded opening 58 in the component 34' of bracket 34. The parts just described, which are carried by the bracket 34, comprise what may be termed the operating head of the device, inasmuch as they comprise the means for holding the stone A that is to be tested and also the means for indicating the result of such test.

The shaft 33 has a lever arm 59 fixed to it in spaced relation with the pivoted lever arm 34, and a weight 60 is suspended from the arm 59 for the purpose of imposing a uniform pressure on the arm 34 which, as we have just seen, carries on its free end what I have termed the operating head of the device. Thus, when the device is in operation the stone A, which is being tested, will rest upon the cylinder 27 with a fixed pressure. The lever 59 during the operation of the device (to be described in detail hereinafter) moves back and forth between two lifting cams 61, 61 pivotally mounted in spaced relation on a bar 62 projecting from a bracket 63 extending upwardly from the base B of the machine. The cams 61, 61 are each provided with a serrated edge 64, the serrations of which are in step formation. Normally, each of the cams 61 is maintained in the position shown dotted (Fig. 7) by a spring 65 and pin 66 which limits the movements of the cam 61 through engagement with the upper edge of bar 62. However, as the arm 59 impinges on one of the serrations of the cam 61 as it nears the end of its travel, it will rock the cam 61 outwardly (full position Fig. 7) and be lifted by said cam, said bar in turn lifting the entire operating head.

As the spindle 4 and, of course, cylinder 27 rotates the cylinder has abrasive contact with an abrasive stone 67 mounted in a stone holder 68 supported by a bracket 69 fixed to and projecting upwardly from the carriage 2. A uniform pressure is maintained against the abrasive stone 67 by means of a weight 70 suspended from a pulley 71 rotatably mounted in a bracket 72 carried by the holder 68. One end of a cord 73 is fixed to the weight, said cord then passing around the pulley 71 through an opening 74 in the holder 68.

The cord is also secured to a rod 75 within the holder 68, at the outer end of which rod is a washer 76 between which and a spacing strut 77 is a coiled spring 78. Thus the force of the weight is imposed on the spring 78 which communicates this force to the strut 77, which in turn bears against the abrasive member 67. The interposition of the spring between the weight and the abrasive member 67 prevents the communication of any shocks from the operation of the machine to the abrasive member and insures that said abrasive member will bear with uniform pressure at all times against the cast iron cylinder 27.

In the operation of the device, as will presently appear, the carriage 2 travels back and forth between fixed limits and in order to stop the travel

of the carriage at these limits an automatic clutch shift is provided, which comprises a bar 79 slidably mounted in bearings 80, 80 on the side of the bed B, said bar having collars 81, 81 fixed to it in spaced relation, the spacing being determined by the amount of travel of the carriage 2. The end of the bar 79 adjacent to the clutch lever C is pivotally connected to a short lever 82, which lever is mounted on a pin 83 intermediate its ends so that it is free to be oscillated by the reciprocation of the bar 79. A lug 84 projects from the side of the carriage 2 and has an opening 85 in its outer end for receiving the rod 79. As the carriage 2 travels back and forth the lug rides over the rod 79, and just before the end of the travel of the carriage 2 in either direction the lug 84 strikes one of the collars 81 to move the rod 79 longitudinally and thereby rock the lever 82 either one way or the other. In the rocking of the lever 82 this lever encounters the clutch lever C and throws the same to the left to disengage the clutch member *c'* from the clutch member *c*, thus stopping the travel of the carriage.

The dial micrometer 53 is not described in detail as this is well known in the art, being of a type that gives a reading when the stem 52 is depressed and has a rotatable dial so that no matter where the needle may be pointing the dial may be turned to give the reading of zero.

The shaft 46 which actuates the rod 43 through the eccentric disk 45 is rotated by a pulley 86 on the end thereof, said pulley being driven by a belt 87 from an independent motor (not shown) elevated a considerable distance above the carriage 2 on which the bracket 47 is mounted. The travel of the carriage 2 and of course the pulley 86 is so slight compared with the length of the belt 87 that it will in no manner impair the actuation of the pulley 86 through said belt. One of the reasons for mounting the driving motor for the belt 87 outside of the machine itself is to avoid the communications of vibrations to the machine and impair the results of the tests.

In the operation of my testing machine an abrasive stone A, the hardness of which is unknown, is clamped in the holder by means of the clamping block 38 with its lower end projecting below the bracket 34 in a measured amount. The amount of this projection may easily be determined by inserting a spacing block *x* between the bracket arm 34 and the cylinder 27 and dropping the stone A downwardly in the holder until it engages with the cylinder 27. The stone is now securely clamped in this position and the spacing block *x* removed, after which the dial micrometer 53 is adjusted to give a zero reading. The motor (not shown) that drives the belt 10 and the motor that drives the belt 87 are now started and the lever 24 shifted to cause the gears 20, 21, 22, and 23 to drive the carriage 2 in the proper direction.

When the lever C is in a vertical position, the clutch members *c, c'* will be engaged so that the motion of the gear train 20, 21, 22, and 17 will be communicated to shaft 16, gears 15 and 14, shaft 13 and pinion 12, and the rack bar 11 which is fixed to carriage 2. Thus the carriage will be propelled toward the head-stock 3 until lug 84 impinges upon collar 81 to move the rod 79 a sufficient distance forwardly to cause the upper end of the lever 82 to impinge upon lever C and throw the same in the position shown in Fig. 1.

This movement of the lever C disengages the

clutch members *c, c'*, whereupon the carriage 2 is stopped.

At the same time the carriage 2 travels to the left the bracket 34 is reciprocated over the cylinder 27 by virtue of its connection with the eccentric disk 45 on shaft 46. Thus the stone A will be rubbed back and forth over the cylinder 27 and at the same time will travel from one end of said cylinder to the other, being abraded by contact with the cylinder owing to the pressure with which it bears thereagainst due to the weight 60. By the time the abrasive stone has reached the end of its travel over the cylinder 27 the lever arm 59 will engage the cam 61, toward which it has been traveling, impinging thereon and rocking the cam so as to lift said lever and also the lever arm 34 in which is clamped the abrasive stone A. The stone is thus automatically lifted from the cylinder 27 and the travel of the carriage 2 automatically stopped by means of the stop mechanism comprising lug 84, collar 81, rod 79 and rocking lever 82. If now it is desired to repeat the operation with the carriage 2 traveling in the reverse direction, the operator shifts the lever 24' to the right so as to disengage gear 21 from gear 20 and cause gear 23 to be engaged with gear 20. This, of course, reverses the direction of rotation of worm wheel 17, and when lever C is moved to the right to cause clutch members *c, c'* to be engaged, the shaft 16 and gears 15 and 14 will drive the pinion 12 in a direction to propel the carriage 2 away from the head-stock 3. When the carriage 2 has reached the end of its travel, the lug 84 will impinge upon collar 81, moving the rod 79 to the right and rocking the lever 82 so that the lower end thereof will impinge upon lever C, throwing said lever to the left and causing the clutch members *c, c'* to be disengaged to allow the carriage 2 to come to rest. During the time that the abrasive stone A has been moving over the surface of the rotating cylinder 27 the abrasive stone 67 has also been moving over the surface of the cylinder 27 so that any change in the abrasive effect of the cast iron cylinder 27 caused by the action of the abrasive stone A will be overcome by the abrasive stone 67. Thus, when the next abrasive stone A is to be tested the condition of the cylinder 27 is the same as it was for the one that has just been tested because the abrasive stone 67 remains in contact with the cylinder 27 for all of the tests that are made.

The abrasive stone 67 also moves over the cylinder 27 in a path across the reciprocating path on the cylinder of the stone A that is being tested. The purpose of this cross-travel of the conditioning stone 67 is to destroy the tracks made by stone A and create a track (abrasion lines) cross-wise of the path of movement of stone A to maintain the abrasive effect of the cylinder as nearly constant as possible. If it were not for the conditioning stone 67 the testing of successive relatively hard stones A would after a while wear a comparatively smooth path on the cylinder 27, gradually decreasing its counter-abrasive property until it would no longer give useful results, and the testing of successive relatively soft stones A would increase the roughness of the counter-abrasive so that its abrasive property would become excessive. The conditioning stone 67 maintains the counter-abrasive in condition so that its abrasive action would be comparatively constant as it eradicates the abrasion lines produced by the stone being tested and imposes its own abrasion lines on the counter-abrasive.

As the abrasive stone A wears down during its

travel across the cylinder 27 the bracket arm 34 will gradually lower, sliding the stellite post 40 upwardly through the space in the bracket arm in which it is held and causing the lever 49 to be rocked so as to depress the stem 52 of the gauge 53. Since the post 40 is formed of material that will undergo comparatively no wear during the travel of the stone A over the cylinder 27 the relative amount of wear between the stone A and the post 40 will be apparent by the amount of tilting movement imparted to the lever 49. This wear is indicated on the dial of the gauge 53.

The operation just described is repeated for every test, and the amount of material worn from the abrasive stone during each test is measured in the same manner. Since the surface of the cylinder 27, which acts as a counter-abrasive on the abrasive stone A, is maintained in a uniform condition by the abrasive stone 67 and all other conditions of the tests are uniform, the amount of material worn from the abrasive stone A indicates its relative hardness. For example, if twenty-five abrasive stones are to be tested and the amount of material worn from the stones varies between .050 and .250, the stone which has worn only .050 is a comparatively hard stone and may be graded as of A, B, or C hardness, while the stone having the greatest amount of wear is a comparatively soft stone and may be graded as of X, Y, or Z hardness, while the twenty-three stones showing wear in between the two extremes are correspondingly graded according to the amount of wear resulting from the test. Since the conditions are maintained constant for any test that may be made the results of any test are absolutely reliable and bear a true relationship to the results of any other test.

Having described my invention, I claim:

1. A device for testing abrasive stones comprising a counter-abrasive, means for holding the stone in contact with the counter-abrasive, means for imposing a definite pressure on the stone and the counter-abrasive, means for rotating the counter-abrasive, means for moving the stone across the rotating surface of the counter-abrasive, an abrasive element other than the stone in contact with the counter-abrasive, and means for lifting the stone out of contact with the counter-abrasive after a pre-

determined amount of relative movement between the stone and counter-abrasive.

2. A device for testing the hardness of abrasive stones comprising a member having a counter-abrasive surface, means for holding the stone in contact with said surface, means for imposing a definite pressure of the stone against said surface, means for rotating said member to cause abrasive action between the stone and the counter-abrasive, means for moving the abrasive stone holder across said rotating member, a conditioning element mounted adjacent to the counter-abrasive surface, means for holding said conditioning element in contact with said surface under definite pressure, means for moving said conditioning element across the counter-abrasive surface, and said conditioning element and abrasive stone holder being spaced on the surface of the counter-abrasive so that the conditioning element will follow but not track the abrasive stone.

3. A device for testing abrasive stones comprising a counter-abrasive, means for rotating said counter-abrasive, a carriage in proximity to said counter-abrasive, said carriage having an abrasive stone holder and a holder for a conditioning abrasive element, means for holding the abrasive stone in contact with the counter-abrasive under definite pressure, means for causing the conditioning abrasive element to bear against the counter-abrasive with definite pressure, and means for moving the carriage relative to the counter-abrasive.

4. A device for testing abrasive stones comprising a counter-abrasive, means for holding the stone in contact with the counter-abrasive, means for imposing a definite pressure between the stone and counter-abrasive, a conditioning element arranged to bear with definite pressure against the counter-abrasive and in spaced relation with the holding means for the stone, and means for imparting rotative movement to the counter-abrasive relative to the stone and conditioning element, and means for moving the abrasive stone and conditioning element over the surface of the counter-abrasive in non-tracking paths.

JOSEPH SUNNEN.