June 23, 1953 M. J. QUILLINAN 2,643,057

SLIDE RULE

Filed March 5, 1951 3 Sheets-Sheet 1

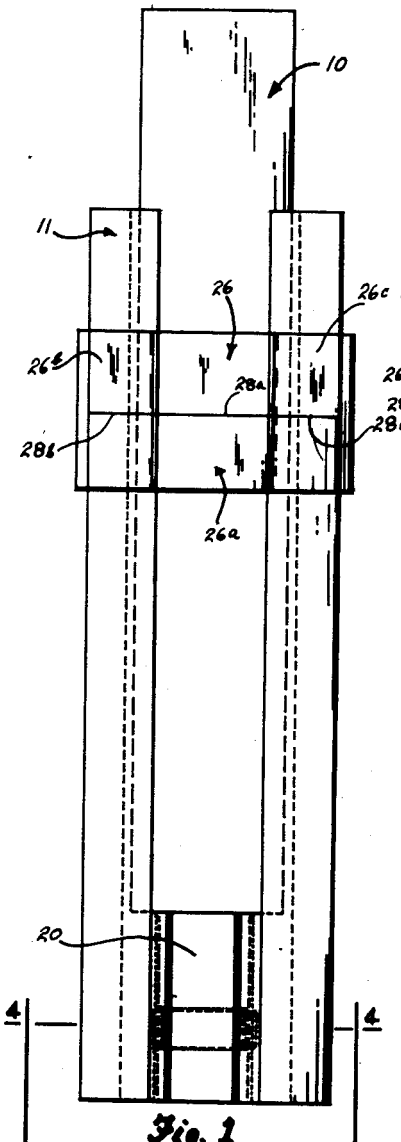



Fig. 1

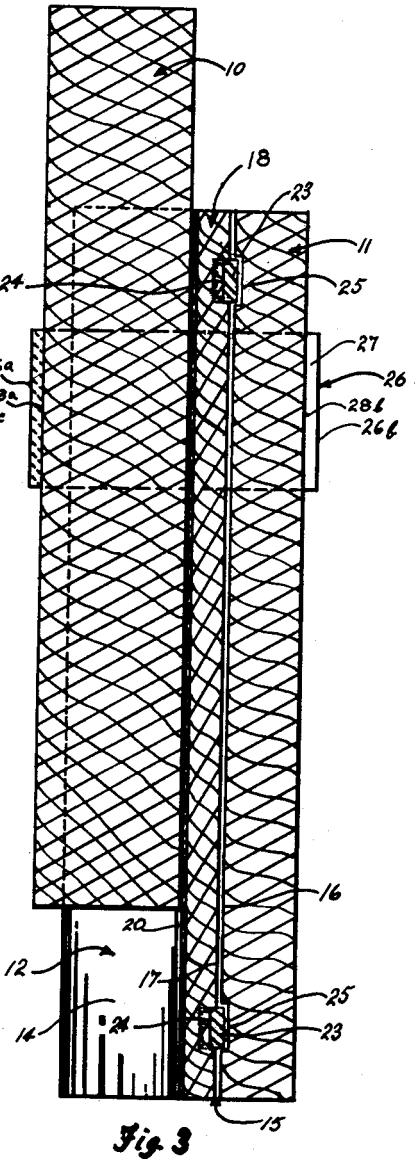



Fig. 3

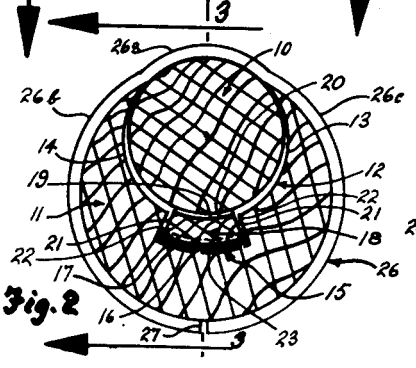



Fig. 2

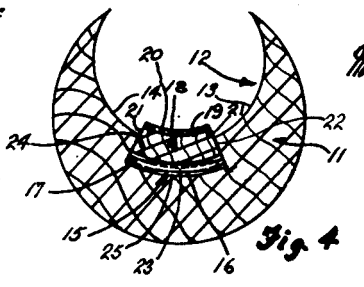



Fig. 4

Michael J. Quillinan

INVENTOR.

June 23, 1953 M. J. QUILLINAN 2,643,057

SLIDE RULE

Filed March 5, 1951 3 Sheets-Sheet 2

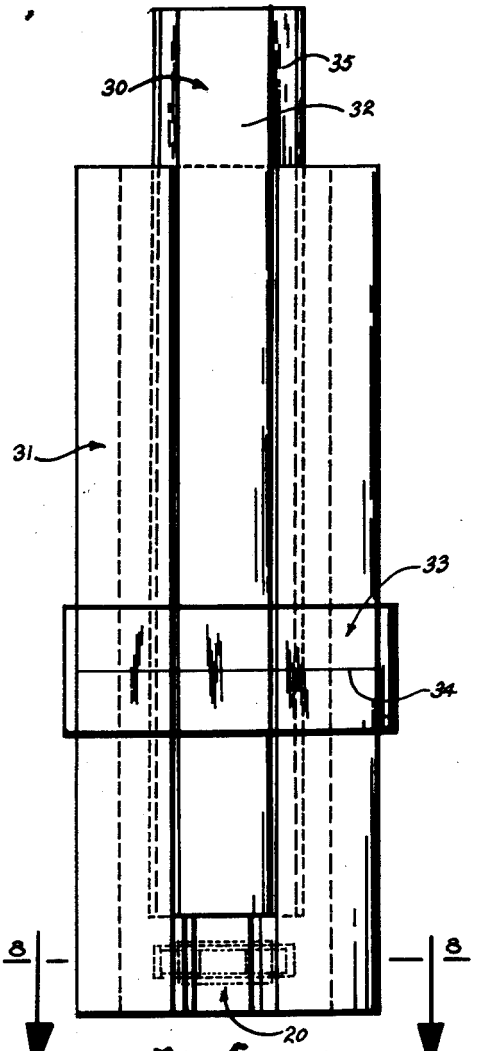



Fig. 5

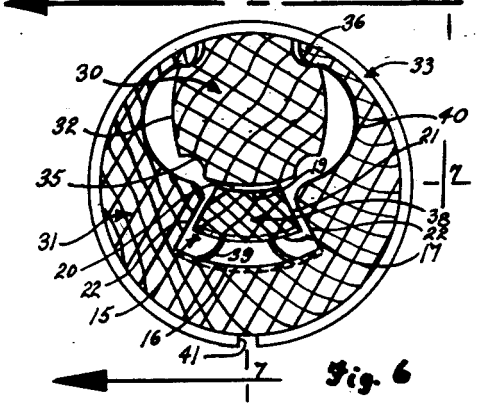



Fig. 6

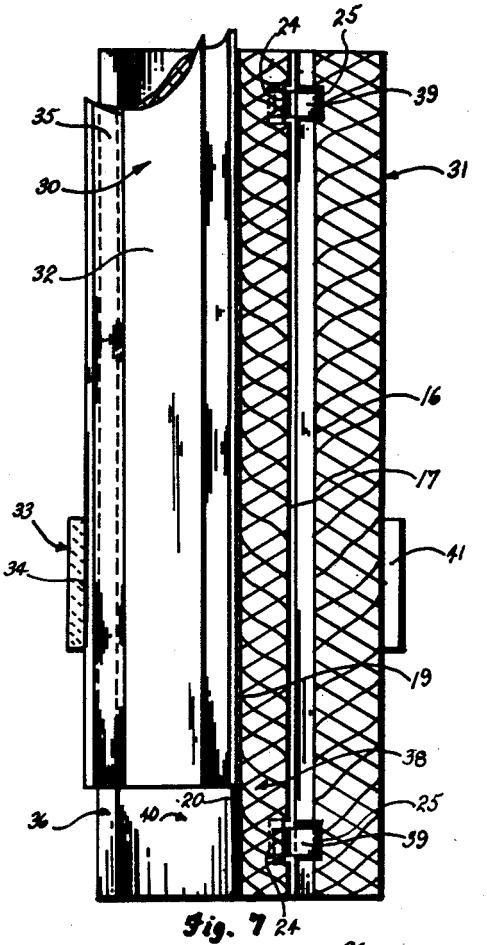



Fig. 7

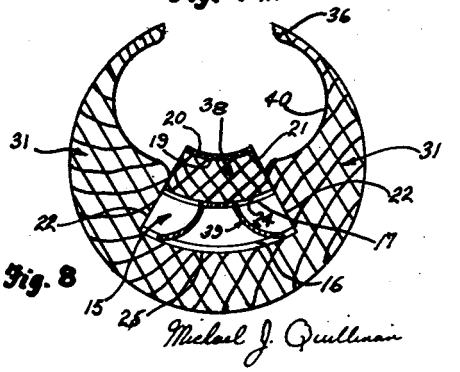



Fig. 8

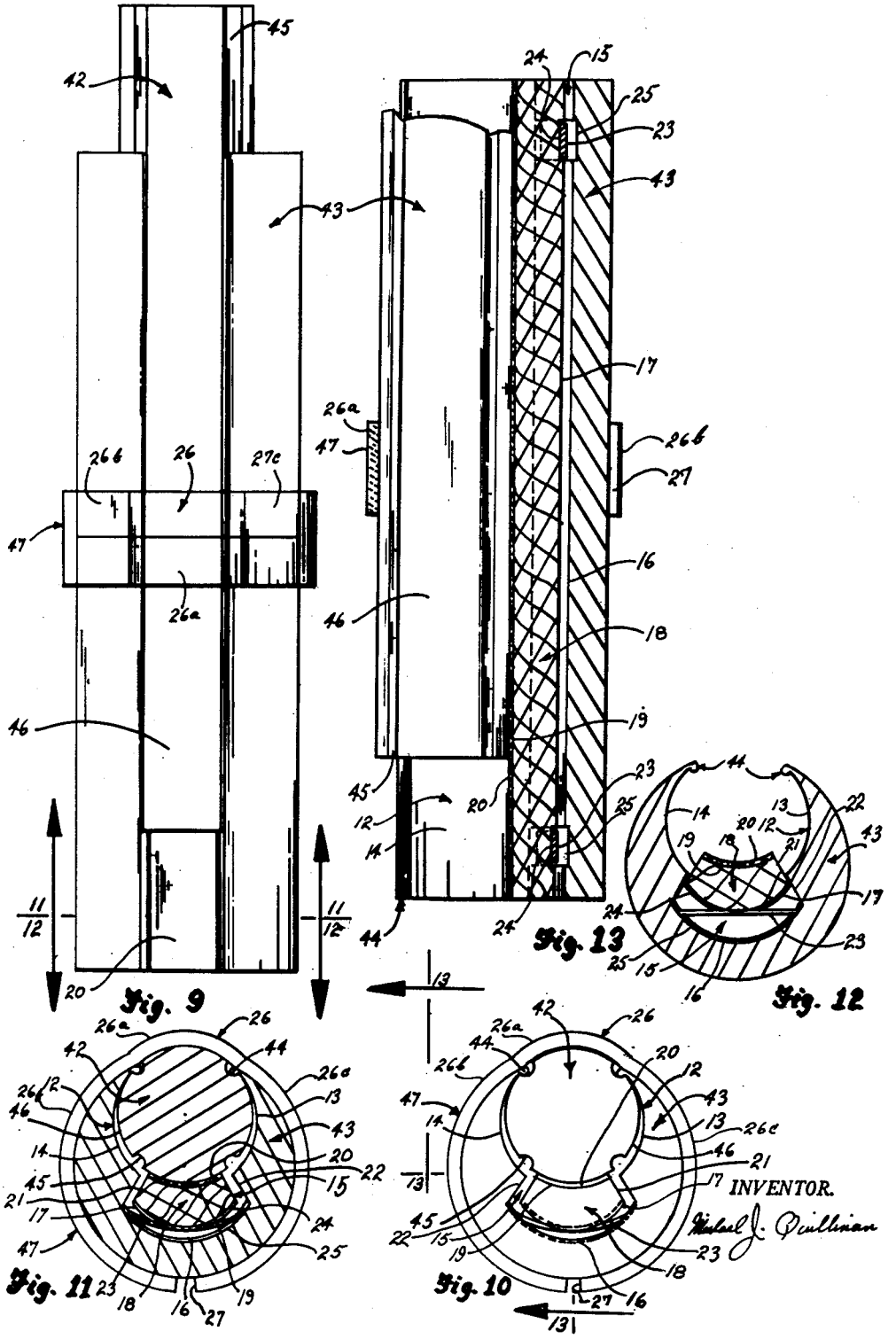
Michael J. Quillinan

INVENTOR.

June 23, 1953 M. J. QUILLINAN 2,643,057

SLIDE RULE

Filed March 5, 1951 3 Sheets-Sheet 3




INVENTOR.

Michael J. Quillinan

Patented June 23, 1953

2,643,057

# UNITED STATES PATENT OFFICE

2,643,057

## SLIDE RULE

Michael J. Quillinan, New York, N. Y.

Application March 5, 1951, Serial No. 213,927

28 Claims. (Cl. 235—70)

1

The present invention relates to a new and simplified slide rule having improved quality of reciprocation, readability, and accuracy.

The rule consists of a rotatable scaled rod which is matingly receivable in a scaled barrel. The barrel is bored on one of its sides to receive the rod along its length of travel and surrounds a majority of the perimeter of said rod leaving exposed scaled portions. These latter exposed scaled portions and the scaled portions of the barrel register with an index surrounding both and in yielding engagement therewith.

By use of novel automatic adjusting and compensating means provided in the barrel, the rod flexibly travels in the bored side of the barrel resulting in a combination of sliding scale, stationary scale, and index which uniquely overcomes the adverse effects of increment of temperature and humidity in the atmosphere to which slide rules are sensitive. Moreover, these adverse effects, such as warpage, surface stickiness and uncalculable expansion, heretofore adversely affecting more fluid reciprocation of the rule's elements, are compensated for automatically in a thoroughly practicable and economical manner. By combining a rotatable rod with a barrel arrangement and indexing means, as is to be hereinafter disclosed, greater scale area per unit length of slide rule is furnished permitting a greater multitude of graduations with corresponding allowable increase in the spacing of said graduations, thereby enhancing readability as well as accuracy.

Accordingly, it is among the primary objects of the invention to provide a slide rule that provides a maximum of scaled surfaces while having a fluid reciprocation along its length of travel.

Another object of the invention is to provide a more readable rule with automatic adjusting and compensating means.

Another primary object of the invention is to provide a slide rule index which is expandable and necessarily remains coaxial with the rule's reciprocating elements.

Another primary object of the invention is to provide a slide rule index that is expandable, nongyrable and economical.

Still another object of the invention is to provide a slide rule that has automatic adjusting and compensating means and scaled elements which remain co-axial throughout the extremes of reciprocation, said means being simple and economically provided.

A further object of the invention is to provide a slide rule having the advantages of cylindrical slide rule construction, namely, increased scale area, and yet practically and economically has the

2

graduated surfaces placed proximate to the index mark.

Another object of the invention is to provide in a rotatable sliding scale more fluid reciprocation and rotation and corresponding superior automatic adjusting and compensating means.

Another object of the invention is to provide a slide rule that is rotatably stationed throughout the extremes of reciprocation while being alternately rotatable as it is desired to realign sliding and stationary scales, said rule having automatic adjusting and compensating means.

A still further object of the invention is to provide a slide rule having automatic adjusting and compensating means which rule is economical in manufacture having readily assembled, simply fabricated components.

Other objects will be in part apparent and in part pointed out, similar parts having similar reference characters in the accompanying disclosure, wherein:

Figure 1 is a lengthwise view of the slide rule.

Figure 2 is an end view of the slide rule in Figure 1.

Figure 3 is a longitudinal sectional view of the rule taken along line 3—3 in Figure 2.

Figure 4 is a transverse section view of a portion of the rule similar to that of Figures 1–3, taken along line 4—4 in Figure 1. Figure 4, however, is a view of the barrel of the rule when the rod is not in place in the barrel bore, while Figures 1–3 illustrate the rule when the rod is inserted in the barrel bore.

Figure 5 is a lengthwise view of a modification of the slide rule.

Figure 6 is an end view of the rule in Figure 5.

Figure 7 is a sectional, longitudinal view of the rule taken along line 7—7 in Figure 6.

Figure 8 is a transverse sectional view of the rule taken along line 8—8 in Figure 5 and comparable to Figure 4 of the first modification.

Figure 9 is a lengthwise view of a second modification of the slide rule.

Figure 10 is an end view of the rule in Figure 9.

Figure 11 is a transverse sectional view of the rule taken along line 11—11 in Figure 9.

Figure 12 is a transverse sectional view of the rule taken along line 12—12 in Figure 9 similar to those views in previous Figures 4 and 8.

Figure 13 is a sectional longitudinal view of the rule taken along line 13—13 in Figure 10.

Inasmuch as the invention refers to slide construction and not to the scales provided thereon, the same are omitted from the drawings for sake of clarity.

The slide rule consists of a rod, generally shown

as 10, and a barrel, generally shown as 11. The barrel 11 is bored as at 12 providing arcuate seats 13 and 14 wherein and whereabout rod 10 is designed to reciprocate and rotate. The rod 10 being substantially similarly arcuate on its surface is freely receivable in the bore portion 12 and the latter surrounds the former by something substantially greater than 180 degrees, thereby permitting barrel 11 to retain rod 10 so as to leave only a portion of the scaled perimeter of the rod exposed.

While the barrel is shown as circular on its outer periphery it may well be shaped comparable to the Mannheim variety without departing from the spirit of the invention. The instant cylindrical modification is deemed preferable since it permits a greater plurality of scale area.

Located below seats 13 and 14 is channel 15, arcuate on its lower face 16 and substantially matingly engageable with the peripheral portion 17 of strip 18 which extends along the length of barrel 11. The upper face 19 of strip 18 is correspondingly concave so as to bear against a substantial portion of the enclosed rod's surface. A felt-lined layer 20 of even-textured lining material is optionally interposed between the scaled surfaces of rod 10 and strip face 19 thereby protecting the rod's graduations from undue scorations and soiling as the rod is manipulated.

The strip 18 is substantially less in lateral dimension than the channel 15 although being of sufficient width to insure that the strip's slanting sides 21 will not be displaced past the throat of the channel located at the latter's upper extremities where its slanting sides 22 join seats 13 and 14, respectively, of the barrel 11. Thus it will be seen that strip 18 is retained in channel 15 being limited in its displacement in a direction substantially perpendicular to the longitudinal axis of the channel.

Moreover, the layer 20 and concave face 19 clear the throat of channel 15 a substantial amount when the strip 18 approaches its lower limits of displacement in the channel. This feature of construction will be hereinafter explained.

Springs 23 are located along the length of the strip 18 and barrel 11 is deposited between the face of peripheral portion 17 and the lower face 16 of channel 15, respectively. Springs 23 in the preferred modification consist of strips of elastic spring-like material such as spring steel, which, when distorted from a substantially flat condition to a concave condition, directs spring tension in a direction the reverse of the distorting force. The springs 23 are seated in spring seats 24 and 25 located both on the strip's peripheral portion 17 and the channel's lower face 16 respectively, said seats being inset from the lowermost contacting surface of strip 18 and channel 15 such that when springs 23 are properly deposited and put under tension strip 18 and channel 15 are evenly coaxially engageable throughout. Furthermore, spring seats 24 and 25 serve to keep the strip 18 and barrel 11 in longitudinal alignment throughout. The above arrangement of strip 18, barrel 11 and spring 23 serve as, and are what has been alluded to as, automatic adjusting and compensating means.

Referring to Figure 4, it will be seen that spring 23 lies in a substantially flat position when the rod 10 is not inserted in seats 13 and 14 of the barrel 11, the slanting sides 21 of the strip 18 being urged against slanting sides 22 of the barrel 11.

In operation, when the rod 10 is inserted into



place in the barrel 11, the rod 10 is of such dimension that the rod displaces strip 18 downward against springs 23 such that the rod is suspended between the upper free edges of barrel seats 13 and 14 and layer 20.

Throughout the extremes of reciprocation, the even free edges of the barrel seat in conjunction with the positioning effect of the face 19 of strip 18, since it corresponds in arc to that of rod 10, maintains the latter at all times coaxial and parallel with the barrel 11.

Manual adjustments necessary to overcome friction between the reciprocating scales are avoided since the springs 23 resiliently yield to accommodate such conditions along the length of travel of the rule's components.

Augmenting this automatic compensation for the necessary adjustment to the changing atmosphere is the compensating effect of index 26. The index consists of an arcuate portion 26*a* which engages and registers with rod 10, and supplemental arcuate portions 26*b* and 26*c* which embrace the barrel 11 providing an expandable transparent index.

By the inherent resiliency of the material of the index 26, and since the index is slit longitudinally as at 27, the function of automatic adjusting and compensating dimensions to changing atmospheric conditions is enhanced. It will be noted that the axes of arcuate portions 26*a*, 26*b* and 26*c* are parallel. To explain, since these axes are parallel and since the index 26 resiliently embraces the scaled surfaces of rod 10 and barrel 11, these scaled rule components are constrained to reciprocate along parallel axes. Moreover, the effect of the springs 23 in coaxially positioning the rod and barrel, mutually contributes to the constraining of the index 26 to slide coaxially and not to gyrate. Furthermore, since the axes of portions 26*a*, 26*b* and 26*c* are parallel, any eccentric application of force which would ordinarily tend to gyrate the index 26 would be neutralized not only by the resiliency of the index material but also by the incongruous relationship that would exist between the dissimilar surfaces of arc portions 26*a*, 26*b* and 26*c*. The overall net effect of such compensating action is that hairlines 28*a*, 28*b* and 28*c* remain respectively coaxial with each other as well as with rod 10 and barrel 11, while the rod and barrel remain coaxial with the index as a whole and each materially contributes to the desired relationship of coaxiality throughout the extremes of reciprocation.

The invention herein disclosed is necessarily susceptible of many ramifying modifications and the number of rods need not necessarily be limited in number to one but rather may be multiplied about the rule perimeter.

One such modification is shown in Figures 5–8. This second modification has provided therein the automatic adjusting and compensating hereinabove alluded to and in addition has provided means whereby the rod 30, in reciprocating along the length of travel in barrel 31, is rendered non-rotatable while the scaled portions 32 of the rod are registering with cylindrical index 33 and the hairline 34 provided on the inner face thereof.

This latter means consists of grooves 35 uniformly positioned between scaled portions 32 about the perimeter of rod 30, which grooves receive a bulb or such similar projection 36 provided on the upper free ends 37 of barrel 31. The arc of scaled portions 32 coincides with the arc of the scaled perimeter of barrel 31 such that

the index 33 registers evenly with both the sliding and stationary scales of the rule. The strip 38 is similar to the strip of the previous modification and is urged upward by the leaf spring 39 against rod 30 in a manner also similar to that of the previous modification.

Should it be desirable to reposition one of the scaled portions 32 such that the rod scales are replaced from indexing relation with the barrel 31, by simply applying downward pressure on the rod 30, the bulbs 36 are brought out of engagement with grooves 35, the leaf springs 39 allowing strip 38 to yield downwardly, and the rod is spun such that the desired scaled portion 32 is brought into proximate relation with the index 33 and the barrel scales. The barrel seats 40 are indented substantially to allow such free rotation or rod 30 to take place.

Thus it will be seen that the rod 30 is readily rotatable when the same is desired, and yet stationed to permit the bulbs 36 to ride in grooves 35 as the rule is manipulated, thereby assuring that the desired scale remains exposed along its length of travel without the necessity of removing the rod 30 completely should a repositioning of the scaled portions 32 by needed.

The index 33 being expandable by being split as at 41, assists in the function of the automatic adjusting and compensating means as alluded to heretofore.

Another such similar modification is shown in Figures 9–13. This modification serves substantially the same function as the last modification in that resilient depression of rod 42 permits the rod to be alternately spun as the need arises without requiring the rod to be removed from its socket in barrel 43, and still allows the barrel 43 to reciprocate with rod 42 by the bulbs 44 riding in grooves 45 along the length thereof. In addition, the rod's scaled portions 46 extend beyond the circumferential outline of barrel 43 permitting the use of a multi-arced split index 47 similar to that of the first disclosed modification. Thus the rule accuracy gained by the multi-arced index 47 in maintaining an expandable and non-gyrable expandable index, as herein disclosed, are advantageously combined with automatic adjusting and compensating means while permitting such flexible scale stationing means as indicated in the disclosure of the second slide rule modification.

Having fully described the invention, and desiring a broad as distinguished from a literal and strict interpretation of the modifications herein, what I claim is:

1. A slide rule comprising a reciprocable rod and a barrel, said barrel bored along at least one face thereof, said rod retained in the bored portion of said barrel, the axis of said rod eccentric to the axis of said barrel, scales provided upon the external faces of said rod and said barrel, the faces of said rod and said barrel arcuate and having different respective arc radii, said faces adapted to receive a multi-arced index resiliently embracing said faces.

2. A slide rule comprising a scaled rod and barrel, said barrel bored along at least one face thereof, said rod retained and reciprocable in the bored portion of the barrel, the faces of said rod and said barrel arcuate and having different respective cambers, a multiarced index complementary to said faces and resiliently embracing said faces.

3. A slide rule comprising a scaled rod and barrel, said barrel bored along at least one face thereof, said rod retained in and reciprocable along the bored portion of said barrel, the axis of said rod eccentric to the axis of said barrel, the faces of said rod and said barrel convex and having different respective cambers, a multi-arced index complementary to said faces and resiliently embracing said faces.

4. A slide rule comprising a scaled rod and barrel, said barrel bored along at least one face thereof, said rod retained in and reciprocable with the bored portion of said barrel, the axis of said rod eccentric and parallel to the axis of said barrel, said rod rotatable within said barrel, said rod having a substantially cylindrical face, the external face of said barrel arcuate and having an arc radius different from that of said rod, a multi-arced index complementary to the faces of said rod and said barrel and resiliently engageable therewith and circumjacent thereto.

5. A slide rule comprising a scaled rod and barrel, said barrel bored along at least one face thereof, said rod retained in and reciprocable within the bored portion of said barrel, the axis of said rod eccentric and parallel to the axis of said barrel, said rod rotatable within said barrel, said rod having substantially cylindrical connecting faces, the external face of said barrel arcuate and having a camber different from that of the rod, said rod and barrel adapted to receive a multiarced index complementary to the faces of said rod and said barrel and yieldingly embraceable thereon.

6. A slide rule of the character described in claim 5, which slide rule has a felt strip deposited in said bored portion between said rod and said barrel.

7. A slide rule of the character described in claim 5, said slide rule having a felt strip deposited in said bored portion between said rod and said barrel, a multiarced split index complementary to and expandable upon said rod and barrel combination.

8. A slide rule comprising in combination, a rod, a barrel bored throughout its length to eccentrically receive said rod, said rod of external contour complementary to said bore, slideable therewith, and rotatable therein, and automatic adjusting and compensating means located within the body of said barrel acting upon said rod to urge it into engagement with said barrel, a slot lengthwise of the barrel and communicating with said bore and indicia on said rod in position to be observed through said slot, and indicia along at least one side of the slot, said indicia on said rod and said barrel being respectively registrable by sliding said rod within said barrel.

9. A slide rule comprising in combination, a rod, a barrel bored throughout its length to eccentrically receive said rod, said rod of external contour complementary to said bore, slideable therewith and rotatable therein, and automatic adjusting and compensating means located within the body of said barrel acting upon said rod resiliently to urge it into engagement with said barrel, said barrel arcuate on its exposed portions, the rod associated with said barrel presenting an arcuate surface differing from the exposed portions of said barrel, whereby said rod and said barrel may receive a resilient expandable index of multiarced contour on said slide rule.

10. A slide rule comprising in combination, a rod, a barrel bored throughout its length to eccentrically receive said rod, said rod of external

contour complementary to said bore, slideable therewith, and rotatable therein, and automatic adjusting and compensating means resiliently located within the body of said barrel acting upon said rod to urge it into engagement with said barrel, a slot lengthwise of the barrel and communicating with said bore, the sides of said slot receivable in grooves provided about the perimeter of said rod, whereby said rod is depressible in said barrel and rotatable therein against the action of said adjusting and compensating means.

11. A slide rule comprising in combination, a rod, a barrel bored throughout its length to eccentrically receive said rod, said rod of external contour complementary to said bore, slideable therewith, and rotatable therein, and resilient means located within the body of said barrel acting upon said rod to urge it into engagement with said barrel, a slot lengthwise of the barrel and communicating with said bore, the sides of said slot receivable in grooves provided about the perimeter of said rod, the exposed portions of said rod extending resiliently without said slot and arcuate, said rod being depressible in said barrel.

12. A slide rule comprising in combination, a rod, a barrel bored throughout its length to eccentrically receive said rod, said rod of external contour complementary to said bore, slideable therewith, and resilient means located within the body of said barrel acting upon said rod to urge it into combination relation with said barrel, a slot lengthwise of the barrel and communicating with said bore, the sides of said slot receivable in grooves provided about the perimeter of said rod, said rod depressible in said barrel, and means for constraining said resilient means to act coaxially upon said rod.

13. A slide rule comprising a rod and a barrel having scales thereon, said barrel retaining said rod therewithin on a bored face thereof, a substantial portion of the perimeter of said rod without the confines of said barrel, automatic adjusting and compensating means provided on said barrel between said rod and said barrel, said means comprising a channel in said barrel, a strip interfitting therein, at least one spring deposited between the lower extremities of said strip, and said channel, said spring urging said strip against said rod and the latter against the upper reaches of said barrel.

14. A slide rule comprising a rod and a barrel scaled on their respective faces and acting in combination, said barrel bored to receive said rod coaxially, a majority of the perimeter of said rod being enclosed by the free edges of said barrel, said free edges coaxial with said rod, automatic adjusting and compensating means provided between said rod and said barrel and comprising a yieldingly supported strip, means for resiliently supporting said strip in said barrel, said strip being urged against said rod, said rod being urged against the upper reaches of said barrel.

15. A slide rule comprising a rod and a barrel acting in combination, said barrel bored to receive said rod at at least one face thereof, a majority of the perimeter of said rod being enclosed by the free edges of said barrel, said free edges coaxial with said rod, automatic adjusting and compensating means including a strip provided between said rod and said barrel and comprising means for yieldably supporting said strip in said barrel, said strip being longitudinally stationary in said barrel.

16. A slide rule comprising a rod and a barrel bored on at least one face thereof, a majority of the perimeter of said rod being enclosed by the free edges of said barrel, said free edges coaxially aligned with said rod, automatic adjusting and compensating means provided between said rod and said barrel and comprising means for yieldingly supporting a strip in said barrel, said strip being axially stationary in said barrel, bulb portions on said free edges engaging grooved portions on said rod, said rod depressible in and rotatable in said barrel.

17. A slide rule comprising a rod and a barrel acting in combination, said barrel and rod scaled on their respective outer surfaces, said barrel retaining said rod therewithin, along at least one face thereof, a majority of the perimeter of said rod encompassed by the free edges of an arcuate barrel bore, automatic adjusting and compensating means provided within said barrel bore between said rod and said bore, said means having a channel with a strip interfitted therein, said strip arcuate on its lower face, said strip matingly receivable on the lower face of said channel, at least one spring deposited between said strip and said channel.

18. A slide rule of the character described in claim 17, said rod rotatable in said barrel.

19. A slide rule of the character described in claim 17, said rod rotatable within said barrel, the upper face of said strip matingly receivable with said rod.

20. A slide rule of the character described in claim 17, said spring being characterized as a leaf spring.

21. For a slide rule having a reciprocating rod and barrel and index, the barrel portion of said slide rule, said barrel scaled on its outer surface, said barrel being adapted to retain said rod therewithin along at least one face thereof, said barrel encompassing a majority of the perimeter of said rod by the free edges of a barrel bore, the lower extremity of said bore having a channel therein to receive automatic adjusting and compensating means.

22. For a slide rule having a reciprocating rod and barrel, the barrel portion of said slide rule, said barrel scaled on its outer surface, said barrel being adapted to receive said rod therewithin along at least one bored face thereof, said barrel encompassing a majority of the perimeter of said rod, said bore arcuate on its sides and substantially complementary to said rod to permit the depression of said rod in said barrel and the rotation of said rod relative to said barrel's scaled surface, automatic adjusting and compensating means being retained by said barrel on the lower extremity of said bore.

23. For a slide rule having a reciprocating rod, barrel and index, the barrel of said slide rule, said barrel bored along at least one face thereof, a channel area on the lower extremity of the bored portion of said face, a channel strip complementary to said channel, means for urging said strip out of said channel, said means comprising spring means uniformly deposited along and between the respective faces of said strip and said channel, and means for limiting the extent which said strip may be urged out of said channel.

24. In a barrel of the character described in claim 23, means for stationing said strip within said channel so as to permit said strip to be displaced in a direction substantially in a direction solely normal to the axis of said barrel.

25. In a barrel of the character described in

claim 23, said limiting means comprising inwardly slanting sides on said channel coaxially engageable with said strip's sides.

26. In a barrel of the character described in claim 23, the under portion of said strip cambered and complementary to the lower face of said channel.

27. A slide rule comprising a rod and a barrel scaled on their respective faces acting in combination, said barrel bored to receive said rod, a majority of the perimeter of said rod being enclosed by the free-end edges of said barrel, automatic adjusting and compensating means provided between said rod and said barrel and comprising a yieldable strip, at least one spring member spacing said strip from said barrel, said strip being urged by said spring member against said rod, said rod being urged against said barrel.

28. For a slide rule, an index having a plurality



of arced connecting portions, said portions having axes respectively parallel and coaxial with the slide rule, said portions embracing said slide rule and resilient thereon, the slide rule having a rod and barrel with coaxial axes of reciprocation and complementary contacting faces for said portions.

MICHAEL J. QUILLINAN.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 980,412 | Gibson | Jan. 3, 1911 |
| 1,041,204 | Van Rensselaer et al. | Oct. 15, 1912 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 152,123 | Austria-Hungary | Dec. 27, 1937 |
| 183,723 | Great Britain | Aug. 3, 1922 |