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2,050,058	8/1936	Keuffel.....	33/23 D
2,699,606	1/1955	Breau	33/23 K
3,218,717	11/1965	Hansen.....	33/23 D
3,238,624	3/1960	McCabe.....	33/23 C
3,398,452	8/1968	Little et al.	33/18 A

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[54] **DRAFTING APPARATUS**
10 Claims, 7 Drawing Figs.

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[51] Int. Cl.....	B43i 13/02
[50] Field of Search.....	33/18, 23, 25, 27, 32

[56] **References Cited**

UNITED STATES PATENTS

978,012	12/1910	Foster	33/25 B
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ABSTRACT: A drafting apparatus comprises a support mounted for predetermined movement above and with reference to a paper on which drafting is to take place. A plurality of drafting pens are provided each of which has a line-forming contact portion of different width, and which all have identical shaft portions each connected to and extending rearwardly from one of the contact portions. Shaft-holding means is provided on the support and serves to engage the shafts of respective ones of the drafting pens for maintaining the same in predetermined orientation with reference to the support and to the paper.

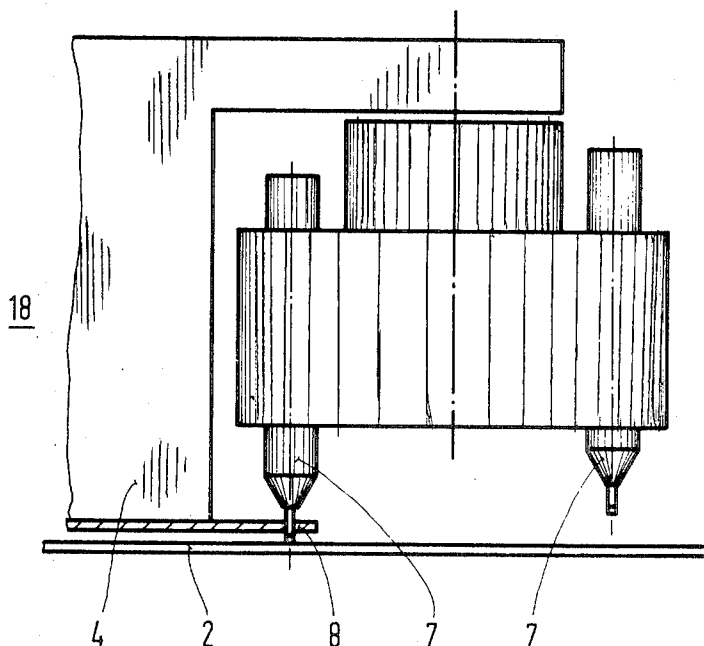


Fig. 1

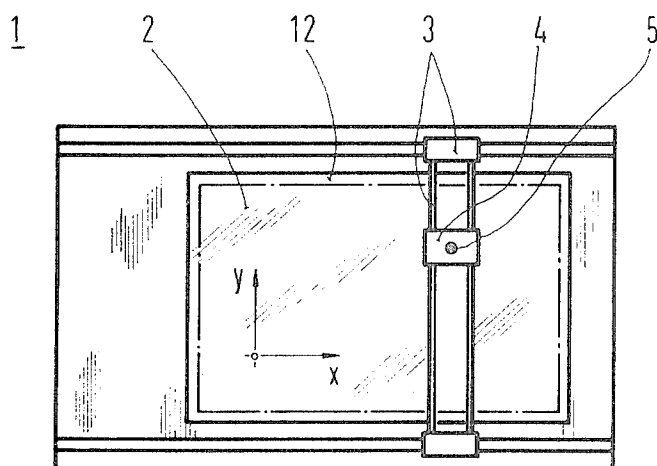
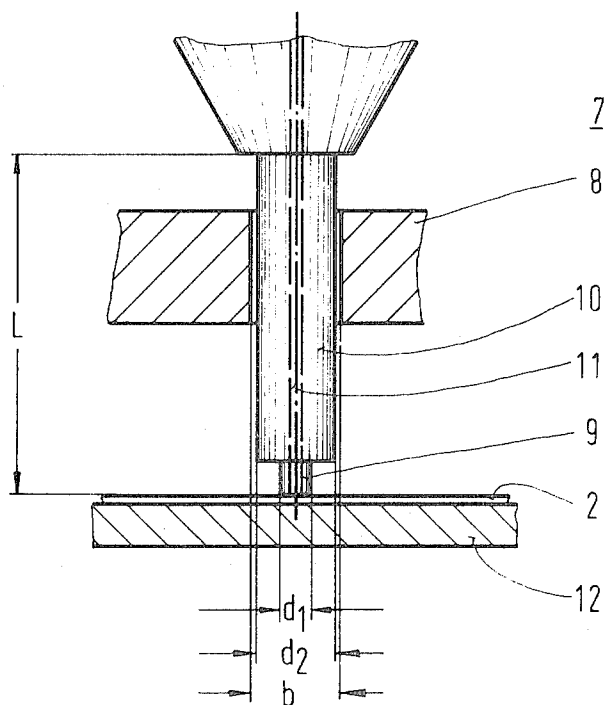


Fig. 2



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Fig.3

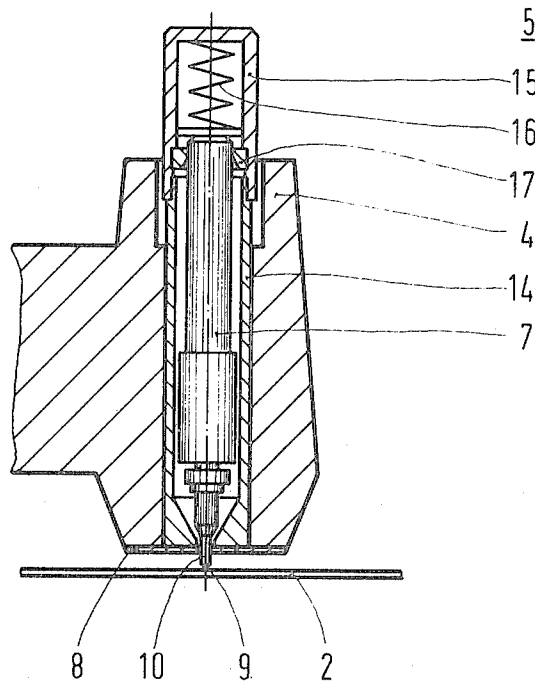
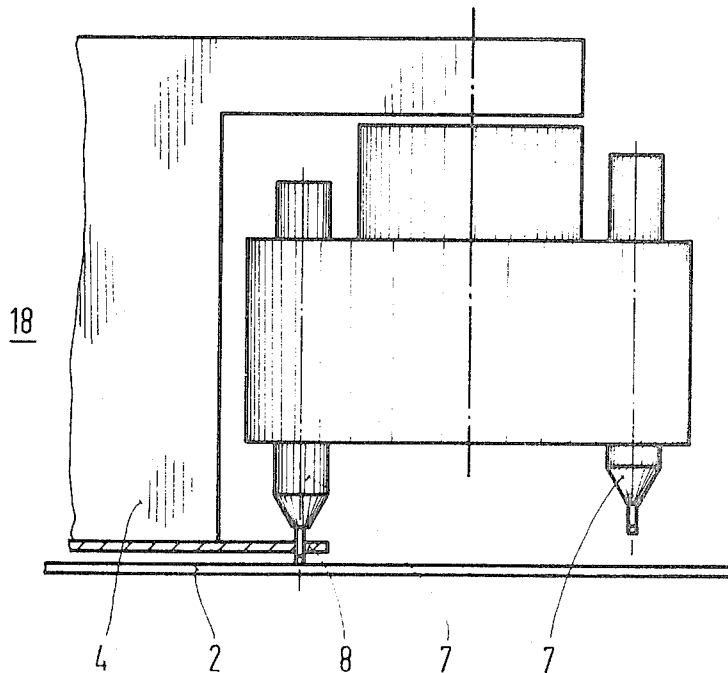


Fig.4



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Fig.5

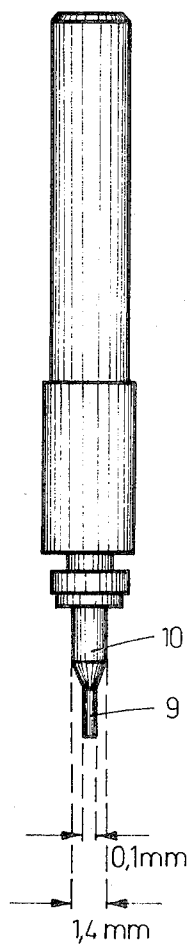


Fig.6

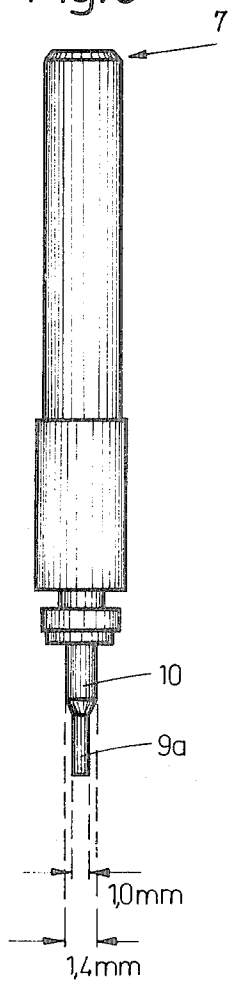
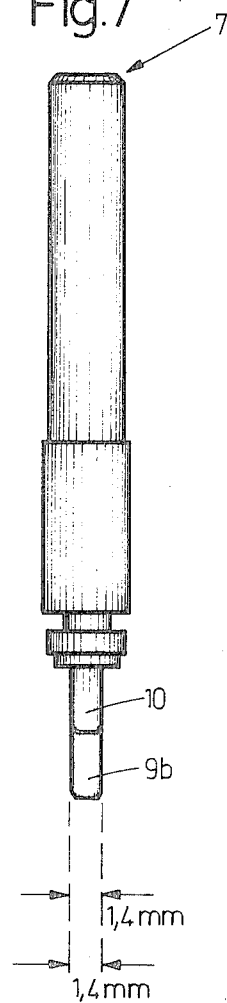


Fig.7



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DRAFTING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to drafting apparatus in general, and more particularly to drafting apparatus of the type wherein a support, movable in predetermined directions, carries one or more drafting pens.

German industrial norm DIN 6775 describes tubular drafting pens composed of two portions, a shaft portion and a line-forming contact portion carried by the shaft portion.

According to DIN 6775 the line-forming contact portions which form lines of narrow widths of 0.13 mm., 0.18 mm., and 0.25 mm., have shafts whose diameter is identical and amounts to 0.35 mm. However, the contact portions for lines whose width is in excess of 0.35 mm. the shaft diameter differs from case to case.

Drafting pens of this type are used in a known drafting apparatus which comprises a support or drafting head which can be shifted in two mutually normal directions above and with respect to the paper on which drafting is to be carried out. The drafting pens are carried by the support and, when they are in operative position in which the line-forming contact portions contact the paper, shifting of the support results in drawing of lines onto the paper. It is evidently necessary to be able to draft lines of different widths, and therefore the known apparatus comprises a plurality of the tubular drafting pens which are each adapted to draw a line of different width and which are each arranged in a sleeve in which they can be advanced from an idle position to a paper-engaging working position as required. These sleeves are of course so dimensioned as to be able to accommodate the differently dimensioned shafts of the different pens; they must be manufactured with precision and are rigidly fixed to the support.

This known construction is basically quite capable of fulfilling its intended function. However, where accuracy of a significant degree is required in the drafting operations, the known construction is quickly found to be in need of improvement. Evidently, the position of the individual drafting pens in their respectively associated sleeves can not and will not always be identical, just as the movable sleeves are capable of undergoing a certain amount of tilting with respect to the plane of the paper when they are advanced to operating position and just as the eccentric position of the respective contact portion with respect to its associated shaft is a further source of errors.

For this reason it has been found that the known drafting apparatus of the type in question is not suitable where drafting accuracy of ± 0.2 mm. or less is required.

SUMMARY OF THE INVENTION

It is a general object of the present invention to avoid the aforementioned disadvantage.

More particularly it is an object of the present invention to provide a drafting apparatus which overcomes this disadvantage.

A further object of the invention is to provide such a drafting apparatus which affords greater accuracy than the prior art with substantially the same technological expenditures as heretofore necessary or which, alternatively, requires the same drafting accuracy as the prior art but with lesser technological expenditures.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of my invention resides in the provision of a drafting apparatus which comprises separate means mounted for movement in predetermined direction, a plurality of drafting pens each having a line-forming contact portion of different widths, and all having identical shaft portions each connected to and extending rearwardly from one of said contact portions, and shaft-holding means provided on the support means and operative for engaging the shafts of respective ones of the drafting pens for maintaining the respective pen in predetermined orientation relative to the support means. Our novel apparatus makes it

possible to precisely predetermine and maintain the position of the shaft of the respective drafting pen, and to do so with lesser technological expenditures than was heretofore possible. The reason for this is that the position of each and every one of the different drafting pens is fixed and maintained by one and the same shaft-holding means, thereby eliminating time losses and drafting errors which heretofore have occurred as a result of changes in the holding means for differently configured or differently dimensioned drafting-pen shafts. Advantageously all drafting pens having contact portions which make lines of a width between 0.1 mm. and at least 1.0 mm. will have shafts of identical diameter. It is further advantageous in accordance with the present invention that the shaft diameter be 1.4 mm. for all drafting pens whose contact portions make lines of a width up to 1.4 mm.

Furthermore, and as will be discussed in more detail subsequently, it is advantageous that the combined length of each contact portion and its associated shaft portion be greater than 4 mm. but not substantially greater than 8 mm., a combined length of 6 mm. being preferred.

According to the present invention the drafting apparatus may also be provided with a revolving head carrying the drafting pens simultaneously so that each drafting pen can be moved by the head to an operating or working station, and can be moved to paper-contacting position at the working station. In such an arrangement the present invention is particularly advantageous because again all drafting pens are positioned and maintained by one and the same shaft-holding means.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic top-plan view of an apparatus according to the present invention;

FIG. 2 is a fragmentary diagrammatic elevation, partly sectioned, illustrating the principle of the present invention;

FIG. 3 is a fragmentary sectional elevation illustrating in detail one embodiment of the invention;

FIG. 4 is a diagrammatic fragmentary elevation showing a further embodiment of the invention; and

FIGS. 5-7 are somewhat diagrammatic illustrations of three representative drawing pens representing a range of different-width lines which can be drawn.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing firstly the embodiment illustrated in FIG. 1 it will be seen that reference numeral 1 generally identifies a drafting apparatus according to the present invention. Reference numeral 2 identifies a sheet of drafting paper positioned on a suitable support 12 which is well known. A so-called bridge 3 is movable in the direction of the arrow *x* along the lateral guides which are illustrated but not separately identified with reference numerals. Movable along the bridge itself, in the direction identified by the arrow *y* and therefore at an inclination to the direction identified by the arrow *x*, is a support or drafting head 4.

Drafting apparatus of the type thus far described is well known in the art and it will be understood that conventionally the movement of the bridge 3 and the drafting head 4 in the directions *x* and *y*, respectively, are effected in known manner via rope-transmissions, spindles, racks or similar devices and suitable motors; computers, punched tapes, magnetic tapes or other program-control means may be used for programming the movements in the directions *x* and *y*. However, all of this does not form a part of the present invention and, being well known to those skilled in the art, has been mentioned here only for the sake of completeness.

Generally speaking it will be appreciated that the combined movements of the bridge 3 and the drafting head 4 make it possible for a drafting pen held by the holding means 5 mounted on the drafting head 4, to reach any point on the drafting paper 2, and to draw lines on the paper during movement to such a point.

The holding means 5 carries a drafting pen capable of producing the particular line width which is desired at any given time. If a width of a different line is to be drawn, then the pen is removed and another pen, capable of providing the desired different line, is substituted.

The principle according to the present invention is illustrated diagrammatically in FIG. 2. Reference numeral 7 generally identifies a drafting pen, particularly a tubular drafting pen, composed of a line-forming contact portion 9 whose lower free end engages the drafting paper 2 which rests on the drafting table 12, and whose upper portion is constituted as a shaft portion carrying the contact portion 9 and provided with a drawing-fluid carrying channel 11 which extends into the portion 9.

As shown in FIG. 2 the shaft-holding means is identified with reference numeral 8 and it is rigidly connected, as more clearly evident from FIGS. 3 and 4, with the movable drafting head 4. The shaft-holding means 8 is provided with an aperture having a diameter b , whereas the diameter of the shaft portion 10 is identified with reference numeral d_2 and the diameter of the line-forming contact portion 9 is identified with reference numeral d_1 . Because of the manner in which the shaft portion 10 of the respective drafting pen 7 is inserted into the aperture in the shaft-holding means 8, and is fixed therein against tilting or skewing, the occurrence of drafting errors resulting from such skewing of the respective drafting pen 7 with reference to the surface of the drafting paper 2 is precluded or at least substantially eliminated. It is pointed out that the distance between the shaft-holding means 8 and the surface of the drafting paper 2 amounts to only a few millimeters, and that the aperture in the shaft-holding means 8 is just large enough to permit insertion of the shaft portion 10 therethrough in the manner illustrated in FIG. 2. Of course, the pen 7 itself is held in suitable manner in the drafting head 4 (not illustrated in FIG. 2) and the particular instrumentalities used for affixing the pens 7 in the drafting head 4 do not form a part of the present invention and are, in any case, well known to those skilled in the art. The shaft-holding means 8 serves to maintain the shaft portions 10 against tilting and fulfills this purpose admirably well. Because the diameters of the shaft portions 10 are identical, the shaft portion 10 of each and every one of the drafting pens 7 will all be held with identical accuracy when they are inserted through the aperture in the shaft-holding means 8.

It is essential, however, that the shaft-holding means 8 be rigidly connected with the drafting head 4, that is that there be no relative movement possible between the two. This is illustrated in FIGS. 3 and 4 and it is immaterial what specific means for effecting such rigid connection are employed. This is particularly advantageous when lines of various different widths are to be drawn. However, for certain specific reasons it may be desirable to make the rigid connection separable, and how this can be done is again not illustrated because it is evident to those skilled in the art, screws or analogous means being only one possibility. It is essential, however, that when the connection is effected, that is when the shaft-holding means 8 is connected to the drafting head 4, that the connection will then be rigid.

With a construction according to the present invention as discussed with respect to FIG. 2, particularly where the shaft portions 10 of the various different drafting pens 7 are not only identical in general, but are of identical diameter so as to all fit into the single aperture on the shaft-holding means 8, the positioning error of the respective shaft portions 10 with reference to the drafting head 4 can be reduced to approximately 0.02 mm.

Reference character L in FIG. 2 identifies the combined length of the contact portion and shaft portion of the respective drafting pens 7. This length L should be as short as possible in order to reduce possible skewing of the respective drafting pens 7 with respect to the drafting paper 2. On the other hand, however, the drafting pens 7 must have a certain amount of play in direction normal to the surface of the drafting paper 2, not only to permit them to be moved to and withdrawn from their working position in which they engage the surface of the drafting paper 2, but also to compensate for irregularities in the surface of the drafting paper 2. In addition to this it is evident that reasons of strength and rigidity require that the shaft-holding means 8 have a certain thickness, and finally it is desirable that the drafting paper 2 be introducible without any difficulties between the shaft-holding means 8 and the support surface or table 12. Taking these various and slightly contradictory requirements into account I have found that it is advantageous for the length L to be greater than 4 mm. but not substantially greater than 8 mm. It is advantageous that the length be at least 5 mm. and preferably it will be 6 mm. This is significantly greater than known tubular drafting pens of this type.

Coming now to FIG. 3 it will be seen that this is a more detailed illustration of one embodiment of the invention, with identical reference numerals identifying the same components as in the previous Figures. The drafting head is identified with reference numeral 4 and carries a sleeve 14 located in a suitable bore in the drafting head 4. A drafting pen 7 is located in the sleeve 14 and a cap 15 closes the upper open end of the sleeve 14. A spring 16 located in the cap 15 bears against the transverse end wall of the latter and also against the upper end of the shaft portion of the drafting pen 7, urging the latter towards the drafting paper 2. Suitable means (not illustrated but well known) may be provided for lifting the drafting pen 7 upwardly in direction away from the drafting paper 2 normal thereto.

A ring or nut 17 is provided in the interior of the cap 15 and the upper end of the shaft portion of the drafting pen 7 extends through the aperture in the member 17 and is guided thereby and prevented from tilting. Similarly, the shaft-holding means 8, which is provided at the lower end of the drafting head 4 as illustrated and rigid therewith, guides and maintains the shaft portion 10, as shown in FIG. 3. Because the shaft-holding means 8 is located very close to the drafting paper 2, and because it is directly and rigidly connected with the drafting head 4, a highly exact positioning of the shaft 10 and thereby of the pen 7 with reference to the drafting head 4 and thereby with reference to the surface of the drafting paper 2 is possible.

A plurality of different drafting pens for use in the apparatus according to the present invention is diagrammatically shown in FIGS. 5-7. From these Figures it is evident that the diameter of the shaft portions 10 in all three of the illustrated drafting pens 7 is identical, and in the illustrated embodiment is 1.4 mm. In the three illustrated drafting pens in FIGS. 5-7 the line-forming contact portions are identified with reference numerals 9, 9a and 9b, respectively. It will be seen that the portion 9 has a diameter of 0.1 mm., the portion 9a a diameter of 1.0 mm. and the portion 9b a diameter of 1.4 mm. which, thus, corresponds to that of the associated shaft portion 10.

It is emphasized, however, that the three illustrated drafting pens 7 in FIGS. 5-7 are representative only of the upper and lower range possibilities as concerns the width of the lines to be drawn. Clearly, drafting pens having contact portions capable of drawing lines wider than 1.4 mm. are possible, and equally clearly there will be drafting pens for drawing lines wider than 0.1 mm. and narrower than 1.4 mm. or whatever the upper range may be.

Coming, finally, to the embodiment illustrated in FIG. 4 it will be seen that the diagrammatic illustration is of a portion of a drafting head 4 corresponding to the one shown in FIG. 1. The drafting head 4 in FIG. 4 carries a turnable member or revolving member 18 which is secured to the projecting arm of

the drafting head 4 for rotation about a vertical axis A. The latter is shown in chain lines in diagrammatic form and the manner in which the member 18 can be connected to the drafting head 4 is immaterial and is in any case well known to those skilled in the art. What is important for purposes of the present invention is that the member 18 carries a plurality of the drafting pens 7 (two shown) which serve to produce with their contact portions lines of different widths or, alternately, may produce lines of different colors. In any case, the drafting pens 7 may be moved to a retracted position (compare the one at the right-hand side of FIG. 4) and to an advanced or working position (compare the one at the left-hand side of FIG. 4) wherein the respective contact portion engages the surface of the drafting paper 2. As the member 18 is turned about the axis A, the respective drafting pens 7 are moved to their working station in which their shaft portion 10 registers with the aperture provided in the shaft-holding means 8 which corresponds to that shown in FIG. 2 and is again directly and rigidly secured to the drafting head 4. Thus, whenever one of the drafting pens 7 is moved to the working station or working position, it can then be shifted from retracted to advanced position in which its shaft portion will be located in and maintained against movement by the aperture of the shaft-holding means 8. Tilting of each individual drafting pen 7 thus secured is thereby eliminated. If another one of the drafting pens 7 is to be used, the one engaged by the shaft-holding means 8 is retracted until it assumes the position shown with respect to the right-hand one of the drafting pens 7 in FIG. 4, and thereupon the member 18 is turned until the desired pen 7 registers with the aperture in the shaft-holding means 8, to be then advanced onto the shaft portion is located in the aperture of the shaft-holding means 8 and the associated contact portion engages the surface of the drafting paper 2.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a drafting apparatus, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

We claim:

1. A drafting apparatus comprising, in combination, support means including a support member mounted for movement in predetermined direction, and a turnable member mounted on said support member upwardly spaced from a surface on

which lines are to be drawn and turnable relative to said surface and support member about an axis normal to said predetermined direction; a single holding means on said support member movable therewith and located above said surface but substantially closer to the same than said turnable member; and a plurality of drafting pens carried and engaged by said turnable member and each having a line-forming contact portion of different width, said pens all having identical elongated shaft portions each having one part engaged by said turnable member and a longitudinally spaced part connected with a respective contact portion, said shaft portions being individually engageable by said holding means intermediate said parts in response to requisite turning of said turnable member so as to be maintained in predetermined orientation relative to said surface.

2. A drafting apparatus as defined in claim 1, wherein said shaft portions are tubular and of identical diameter.

3. A drafting apparatus as defined in claim 1, wherein said line-forming contact portions have respective widths ranging between substantially 0.1 mm. and at least 1.0 mm.

4. A drafting apparatus as defined in claim 1, wherein the combined length of the shaft portion and contact portion of the respective drafting pen is greater than 4.0 mm.

5. A drafting apparatus as defined in claim 4, wherein said combined length is at most equal to substantially 8.0 mm.

6. A drafting apparatus as defined in claim 4, wherein said combined length is substantially 6.0 mm.

7. A drafting apparatus as defined in claim 1, wherein said line-forming contact portions have respective widths ranging between substantially 0.1 mm. and at least 1.4 mm., and wherein said shaft portions for drafting pens whose contact portions have a width up to substantially 1.4 mm. each have a diameter of substantially 1.4 mm.

8. A drafting apparatus as defined in claim 1, said mounted turnable member including a plurality of engaging sections each adapted to engage one of said drafting pens and arranged to be placed individually into registry with said holding means for engagement of the shaft portion of the respective pen by said holding means.

9. A drafting apparatus as defined in claim 8, said drafting pens extending in at least substantial parallelism with said axis, and being shiftable in direction of said axis between an advanced working position and a retracted idle position.

10. A drafting apparatus as defined in claim 9, said axis and said drafting pens extending normal to said surface on which lines are to be drawn by said drafting pens.

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