

April 2, 1963

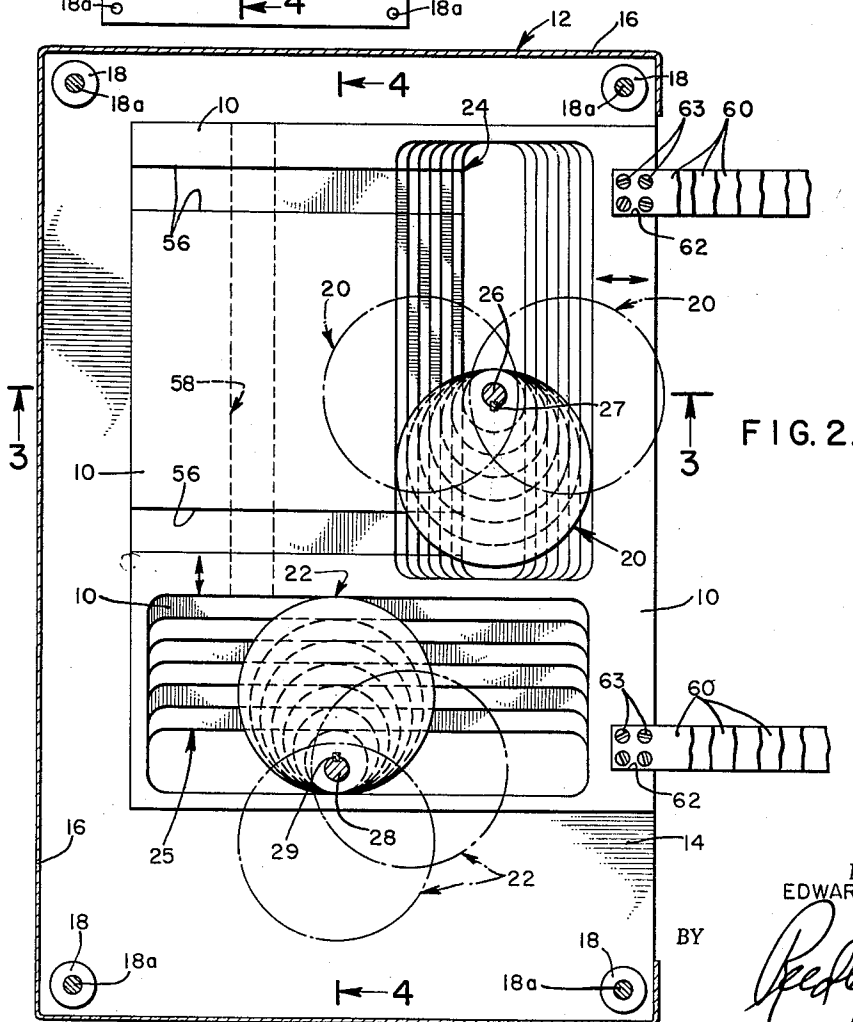
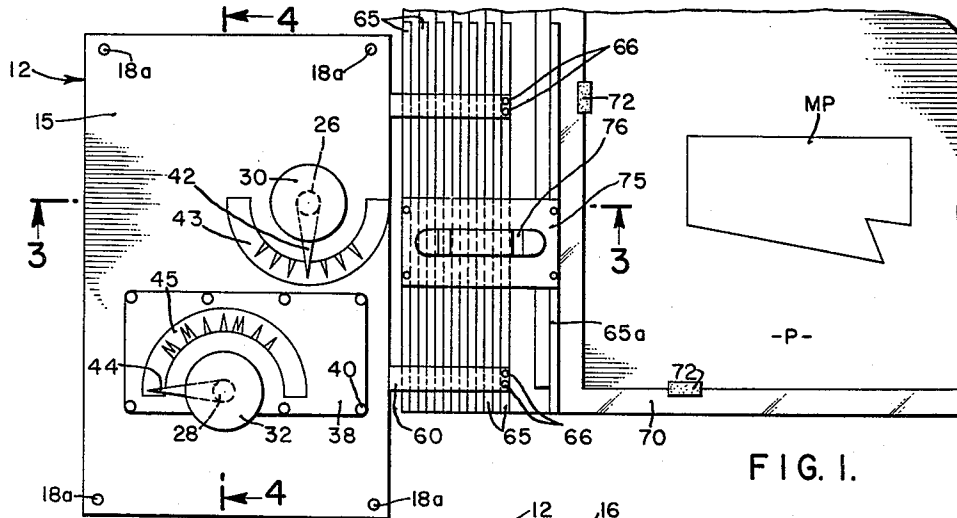
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3,083,465

PATTERN GRADING MACHINE

Filed April 20, 1961

3 Sheets-Sheet 1



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PATTERN GRADING MACHINE

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3 Sheets-Sheet 2

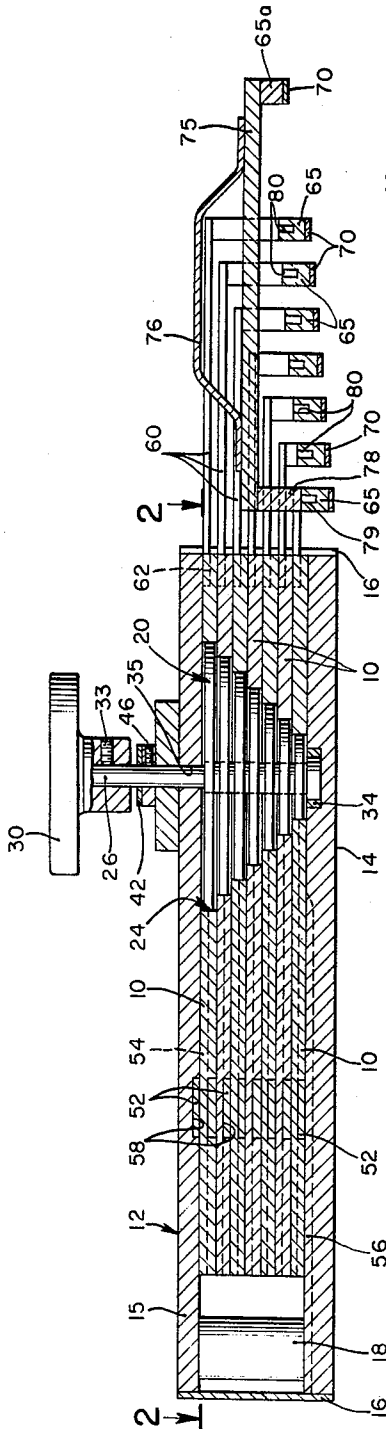


FIG. 3.

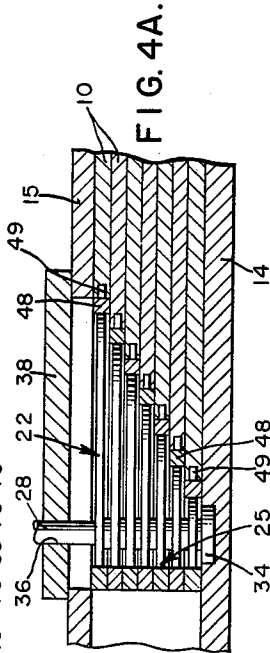


FIG. 4A.

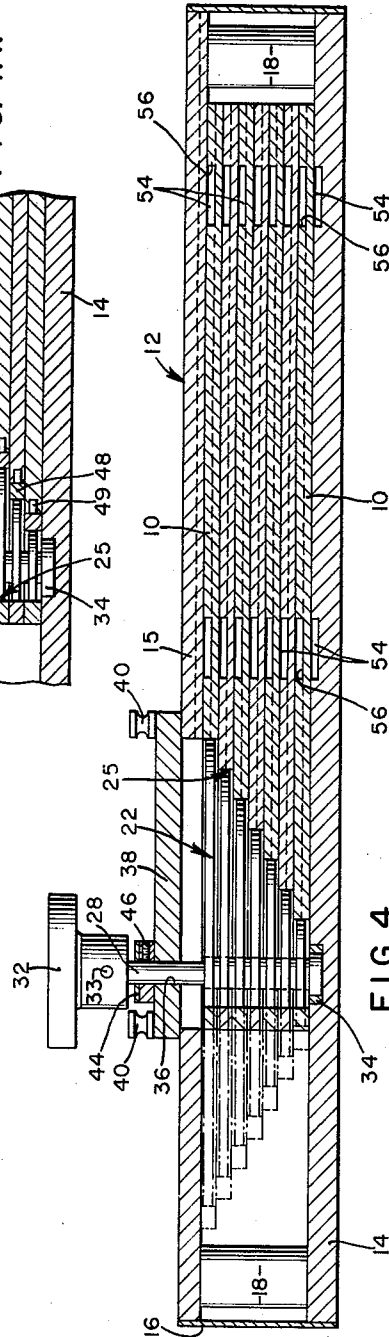


FIG. 4.

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3 Sheets-Sheet 3

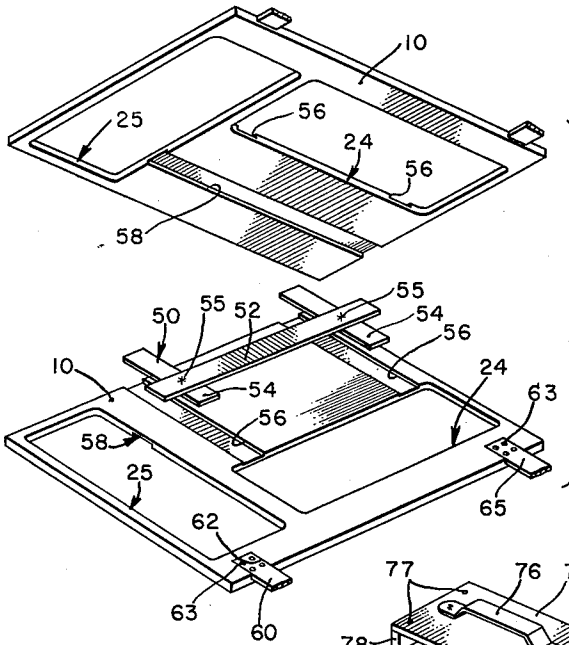


FIG. 5.

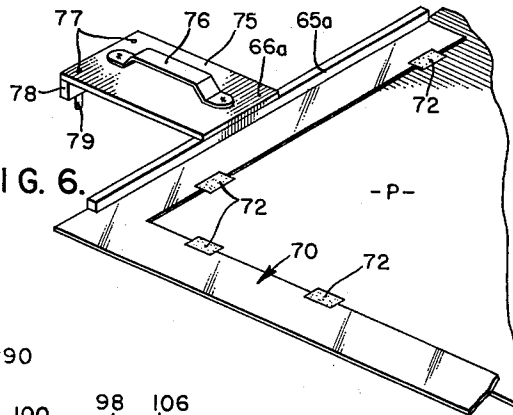


FIG. 6.

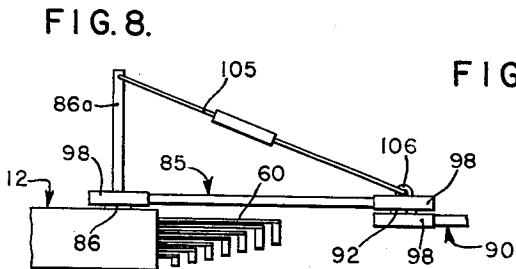


FIG. 8.

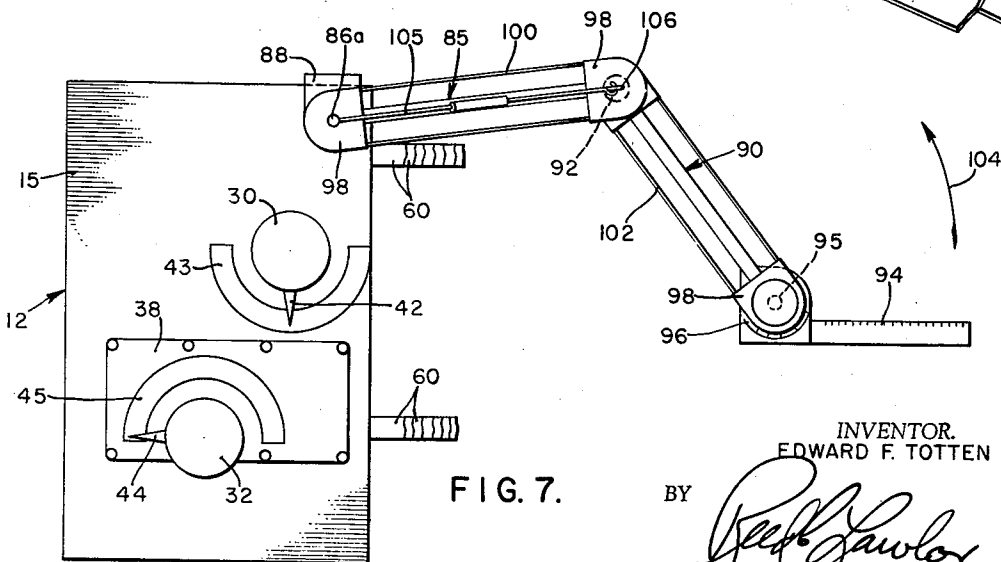


FIG. 7.

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3,083,465

PATTERN GRADING MACHINE

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15 Claims. (Cl. 33—12)

This invention relates to apparatus used in the clothing industry for reproducing patterns from master patterns and especially for reproducing a given master pattern in several different sizes simultaneously.

Devices of the indicated character are often known as pattern grading machines. Such machines have been attempted for the purpose of reducing the laborious manual operation of laying off from a master pattern another pattern of somewhat larger size, for example, by adding small increments at different parts of the pattern according to a system known to the industry. Machines which have been attempted for the indicated purpose seem never to have worked out to be very satisfactory.

It is therefore an object of the present invention to provide for the garment-making industry a pattern grading machine with which a master pattern may be mechanically associated with several paper sheets carried by a corresponding number of adjustable plates actuated in two different directions, more particularly in directions at right angles to each other, so that the paper sheets on which the new patterns are to be delineated will be moved automatically, as through the means of knobs, predetermined distances so as to produce simultaneously several new patterns of different sizes. Such new patterns are arrived at by marking at successively different spots around the edges of the master pattern, on a top sheet, for example, the sheets receiving the new pattern providing duplicating means which may be in the form of carbon copying coatings, or photosensitive coatings, or pressure-sensitive coatings, or the like.

A further object of the invention is to provide a machine of the indicated nature for marking off patterns of different sizes from a master pattern wherewith such different sizes may be either larger sizes than the master pattern, or smaller sizes than the master pattern, or sizes which are both larger and smaller than those of the master pattern.

Another object of the invention is to provide a pattern-grading machine in which the operator is guided through the medium of indicators, whereby to set the new pattern receiving sheets automatically, as by pointers adjustable along scales according to a predetermined schedule for each measurement change required to reproduce the pattern in different sizes.

In brief, the improved pattern-grading machine includes a plurality of horizontal grading plates slidable with respect to each other in both longitudinal and transverse directions, each plate being movable to a greater or lesser distance than each other plate in one direction, and to a greater or lesser distance than the other in the other indicated direction. These variable movements are effected by means of two sets of cams of varying sizes working in two series of cam-slots in the respective plates, such cam-slots being of correspondingly varying sizes. Each set of cams is rotatable by a knob, one knob and its set of cams moving the plates in one direction by reason of the respective cam-slots and the walls thereof, and the other set of cams moving the plates in the other direction by engagement with the walls of the other set of cam slots. Arms connected with the respective plates and projecting outward therefrom are provided with means for holding the pattern-paper sheets on which the new patterns are to be reproduced. Another holder carries the master pat-

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tern superimposed above the new pattern sheets. The holder for the master pattern preferably in removably mountable on the holding means carried by any one of the adjustable plates, whereby varying pattern sizes of either larger or smaller dimensions than the master pattern may be produced as required. By such means a large array of pattern sizes may be accomplished with a single cam arrangement in each set of cams for operating a relatively small number of adjustable plates to which the new pattern sheets are respectively attached and by which they are respectively adjusted on the work table carrying the machine and the pattern sheets.

Other objects of the invention and various features of construction thereof will become apparent to those skilled in the garment industry upon reference to the following specification and the accompanying drawings.

In these drawings:

FIG. 1 shows a plan view of a housing in which are mounted the moving members of this improvement, sheet positioning arms being shown projecting from the right side of the housing, the uppermost positioning arm having a sheet connected thereto which supports the master pattern;

FIG. 2 is principally a plan view of the assembly of movable grading plates within the housing, the top cover of the housing and overlying parts being removed, and the view being indicated by the line 2—2 of FIG. 3;

FIG. 3 is a transverse vertical section taken on the lines 3—3 of FIGS. 1 and 2, FIGS. 1, 2 and 3 being taken on successively enlarged scales;

FIG. 4 is a longitudinal vertical section taken on the lines 4—4 of FIGS. 1 and 2 and being on substantially the same scale as that of FIG. 3;

FIG. 4A is a vertical sectional detail corresponding with a portion of FIG. 4 and showing a structural variation;

FIG. 5 is an exploded perspective view indicating the relationship of two opposed movable sheet-carrying plates and a guide member employed between them to guide their movements during operation;

FIG. 6 is a perspective view on a somewhat enlarged scale showing the positioning arm means for a master pattern and a sheet on which such pattern is mounted;

FIG. 7 is a plan view showing the housing, as in FIG. 1, and showing a protractor-type drafting machine mounted upon the mentioned housing and usable to delineate remote or angular portions of patterns being produced from the master pattern; and

FIG. 8 is in general an end elevational view of the structure of FIG. 7, a portion at the right being omitted.

In the drawings, there is illustrated an embodiment of the invention presently considered to represent the best mode of practicing the invention. Here, a stack of superimposed adjustable horizontal metal grading plates 10 is shown as mounted in a housing generally indicated at 12. The housing 12 includes a bottom wall or base 14, a top wall or cover plate 15 and a relatively thin sidewall member 16 which forms three sides of the housing as indicated in FIG. 2. As also best illustrated in FIG. 2, the movable plates 10 for positioning and adjusting pattern paper sheets P (as presently to be described) are in general rectangular in shape and are appreciably narrower than the housing 12 and shorter than the housing 12, whereby to accommodate the necessary adjusting movements of all the plates required to accomplish the pattern-grading functions hereof. The vertical capacity of the housing 12 between the base 14 and the cover plate 15 is such as to accommodate a desired number of the sheet actuating plates 10 in the assembly. As shown, seven plates 10 are employed, the lowermost plate 10 moving upon the base 14 and the uppermost plate 10 movably underlying and being retained by the cover plate 15. This relationship is accomplished through the medium of four

upstanding studs 18 provided at the corners of the housing 12 as represented in FIG. 2. These studs 18 are appropriately secured to the base 14 in any manner desired, and the cover plate 15 is retained on the tops of the studs 18 as through the medium of screws 18a received by the stud 18. Said screws 18a may be separate screws anchored in the studs 18 or may be in the form of through bolts which also bind the studs 18 to the base 14, or they may be in the form of machine screws or the like securing the parts together in any desired manner.

The plates 10 are variably movable or adjustable both transversely and longitudinally of the housing 12 through the medium of two sets of cams of varying sizes. One set of cams 20 of gradually decreasing sizes from top to bottom acts to move the cam plates transversely, and a second group of cams 22, also increasing in size from top to bottom, acts to move the plates 10 longitudinally of the housing 12.

As illustrated, the cams 20 and the cams 22 are all circular cams, their diameters successively increasing from the lowermost cam upward, and conveniently the corresponding cams in the two series are of equal diameters. A longitudinal series of cam slot 24 has a length at least sufficient to accommodate the maximum throw of the plates 10 by the cams 20, and the length of a transverse series of the cam-slots 25 is at least equal to the maximum throw of the cams 22. In practice, as illustrated, slots 25 are all of the same length and slots 24 are all of the same length. The sides of each cam slot are parallel and the width of each individual cam slot is such as to accommodate the diameter of the respective cam. In FIG. 2, the plates 10 are shown as positioned at the end of the longitudinal throw in one direction by the cams 22. Both ends of the plates 10 are thus vertically flush as indicated also in FIG. 4. The cams 20 are shown as positioning the plates 10 in their intermediate positions of throw by the cams 20, in which positions the sides of the plates 10 are vertically flush, as seen in FIG. 3. As the various cams are rotated toward a position, such as indicated in the broken circle positions of the largest cams 20 and 22, the plates 10 will be in other positions of adjustment, such as the broken line positions of FIG. 4.

Rotational adjustment of the cams 20 and 22 is accomplished through the medium of vertical shafts and actuating means. Thus, cams 20 are anchored on a vertical shaft 26 as by means of a key and keyway indicated at 27. The cams 22 are similarly anchored on a vertical shaft 28 as by means of a key and keyway 29. The shaft 26 and its cams 20 are rotated by means of a knob 30 fixed on the top of shaft 26, and the shaft 28 and its cams 22 are rotated by means of a knob 32 fixed on the top of the shaft 28. Set screws 33 (FIGS. 3 and 4) or equivalent means may be employed for anchoring the knobs 30 and 32 to the tops of their shafts 26 and 28. The lower ends of the shafts 26 and 28 are mounted in suitable bearings 34 in the base 14; the upper portions of the shafts 26 and 27 are suitably borne in the cover plate 12 as indicated at 35 as to shaft 26 and at 36 as to shaft 28. In the latter instance the bearing 36 is in a cap plate 38 removably secured by screws 40 to the cover 15 for separate access to the cam-set 22 and removal of such cam-set 22 for replacement or independent adjustment should such be required.

In order that the knobs 30 and 32 may be rotated through predetermined arcs in accordance with predetermined and established schedules to accomplish delineation of varying pattern sizes with respect to any given master pattern MP being employed, suitable indicating means are used. Thus, the desired movement of the knob 30 and its shaft 26 is effected through the medium of a pointer 42 and a scale 43; and desired adjustment of the knob 32 and its shaft 28 are determined by a pointer 44 and a scale 45. Here again, pointers 42 and 44 may be fixed to their shafts 26 and 28 respectively by means of set screws 46 or the like.

In FIG. 4A, there is illustrated a means for reducing cam-slot widths in the event that it is found necessary to use smaller cams 22 where it is necessary to modify intermediate pattern sizes according to some desired plan. The same arrangement may also be employed in connection with the cams 20 and their slots 24. This feature involves the employment of mountable and demountable strips 48 having pins 49 which are insertable in corresponding holes in the edges of the cam slots 25 (or 24) whereby to reduce the effective width of the cam slots when to be used with cams of smaller diameters. Since the plates 10 and the cams 22 (and 20) are preferably formed from metal, the strips 48 and their pins 49 are easily producible from metal, and the holes to receive the pins 49 are easily drilled. Also, since the base 14, the cover plate 15 and the cap 38 are also formed from metal, metal shafts 26 and 28 and corresponding bearings 34, 35, and 36 are similarly readily usable.

As is apparent from the foregoing, the plates 10 are transversely adjustable by the cams 20 and their cam-slots 24, and the plates 10 are also longitudinally adjustable by the cams 22 and their cam-slots 25. For accurate work, it is essential that these transverse and longitudinal adjustments be consistent and accurately guided. Efficient guiding means is probably best indicated in the perspective view of FIG. 5 where the opposing faces of an upper plate 10 and a lower plate 10 are shown and one of the guide means between such plates is also illustrated in position to be received in guide grooves in the opposing faces of the opposing plates. Here, the guide is illustrated at 50 and is shown as being H-shaped in that it is formed with a crossbar 52 and two sidebars 54 which are rigidly connected adjacent the ends of the crossbar 52 as by spot-welding 55. The side-bars 54, when in operating guiding position, are disposed in guide grooves 56 running transversely in the upper face of the lower plate 10. Similarly, when the guide 50 is in operative position, the crossbar 52 will be disposed in a longitudinal groove 58 in the under side of the upper plate 10. Thus, two opposed plates 10 move longitudinally with respect to each other by reason of the sliding of the crossbar 52 in the longitudinal groove 58 and the sliding of the sidebars 54 in the transverse grooves 56. An identical guide 50 is used between the uppermost plate 10 and the cover plate 15, the crossbar 52, as seen in FIG. 3, travelling in another groove 58 in the under side of the cover plate 15 and the sidebars 54 travelling in transverse grooves 56 in the uppermost plate 10. Similarly, the lowest plate 10 is guided on the base 14 by reason of side-guide bars 54 (see also FIG. 4) riding in grooves 56 (FIG. 3) in the top wall of the base 14. By these means, accurate adjusting movement of the plates 10 sliding with respect to each other and to the base 14 and cover plate 15 is easily and efficiently effected, suitable lubrication being employed if desired.

Since the function of the movement of the plates 10 transversely and longitudinally of the housing 12 is to adjust pattern receiving sheets P so that markings delineated thereon will represent desired over-sizes or under-sizes, each of the plates 10 is provided with extending sheet-positioning means which project on the open side of the housing 12 as indicated especially in FIGS. 1, 2, and 3, as well as in FIGS. 7 and 8.

In the form shown these projecting positioning means are pairs of narrow arms 60 which are countersunk at 62 in the tops of the respective plates 10 as seen in FIG. 2, and as also indicated in FIG. 3, the inner ends of the arms 60 being secured in this counterset position as by means of set screws 63, or otherwise as may be deemed preferably. At the outer extremities of the various pairs of arms 60 illustrated, there is secured across each pair of arms a rigid crossbar 65, as by means of riveting or spot-welding represented at 66 in FIG. 1. Since the largest cam 20 actuates the uppermost plate 10 and imparts the greatest throw to the respective pattern paper, the holding bar 65 for the uppermost plate 10 is disposed

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farthest out from the housing 12. Similarly, since the lowermost cam 20 imparts the least throw to its pattern paper, its holding bar 65 is disposed nearest to the housing 12. The other holding bars 65 are positioned at progressively increasing distances from the innermost position toward the outermost position, because the intervening cams progressively increase the throw. Inasmuch as all the bars move inward together to their innermost positions effected by the throws of the respective cams 20, the spacings between the cross bars 65 at the intermediate position illustrated in FIGS. 1, 2 and 3 is not very great, and the representation given is accurate. At their innermost positions, such spacings are smaller. Similarly, since the throw of the crossbars 65 outward increases as the cam sizes increase, and since all bars move outward simultaneously and proportionately, such movements of the crossbars 65 produce increases in dimensions of the corresponding pattern sizes being obtained from a given master pattern MP.

In practice, the master pattern MP is mounted in any desired or appropriate manner upon a sheet of paper P which desirably will be a piece of pattern paper such as mounted on other crossbars 65 for the reproduction thereon of other patterns of somewhat different sizes. For example, a few spots of rubber cement may be used on the other side of the master pattern MP to secure it to the respective paper sheet P. Since the master pattern MP has appreciable thickness, its edges will serve as a guide against which to position a pencil or a stylus for the transferring of marks to the underlying pattern paper sheets P on which patterns of different sizes are being reproduced. The pattern paper sheets P are secured to the crossbars 65 in any appropriate manner, such as by cementing, and in practice the sheets are stabilized so that they may be readily moved from side to side or inward and outward and remain perfectly flat and without wrinkles. Such a stabilizer is desirably in the form of a stiff plastic L-shaped member 70 whose crossarm is secured to the underside of the respective crossbar 65. This arrangement is probably best indicated in FIG. 6. The pattern paper P is readily secured with the two arms of the L-shaped stabilizer 70 by an appropriate means, such as short pieces of adhesive tape 72.

Since the master pattern MP must be located on top of all of the underlying pattern sheets P so that they may receive transfer marks from overlying pattern paper sheets P, the master pattern MP must be on the topmost sheet P. This topmost sheet P might be mounted on the crossbar 65 of the uppermost plate 10. However, the result of such an arrangement would mean that all patterns produced on the underlying sheets would have to be smaller than the master pattern. It is often quite important that some of the reproduced patterns be larger than the master pattern, or that some be larger and some be smaller than the master pattern. To accomplish this end, the master pattern MP is carried on an auxiliary or master pattern holder 75 which is removably mountable at its inner end on any one of the crossbars 65. In this case the outer end of the auxiliary pattern holder 75 is fixed at 66a to its crossbar 65 and a handle 76 is provided for easy manipulation of the auxiliary holder 75. At its inner end the auxiliary holder 75 is fixed, as by spot-welding at 77, to an underlying mounting bar 78. This mounting bar 78 is removably mountable upon any one of the crossbars 65 carried by the outer ends of the above-mentioned arms 60. This may be effected through the medium of pins 79 on the underside of the mounting bar member 78, such pins 79 being receivable in recesses or seating holes 80 (FIG. 3) in the tops of the various crossbars 65.

Thus, the operator may move the auxiliary pattern holder 75 selectively to or from any one of the pattern-paper holding crossbars 65. As a consequence patterns larger or smaller than the master pattern MP may be formed upon the various underlying pattern-receiving papers P as desired.

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In producing other patterns of varying sizes from any given master pattern MP, the various pattern papers P having been secured to the various paper-holding crossbars 65, either through the medium of the L-shaped stabilizing members 70 or otherwise, the auxiliary pattern holder 75 is mounted upon such a crossbar 65 as required. Since the pattern which would be reproduced on the corresponding pattern paper P, would be a duplicate of the master pattern, the pattern paper P may or may not be affixed to the respective chosen crossbar 65, as may be desired.

In making the new pattern series, the operator produces a mark at a predetermined portion of the edge of the master pattern MP in accordance with a prepared chart. In conformity with such chart, the knobs 30 and 32 are rotated to move their pointers 42 and 44 over the respective scales 43 and 45 through the arcs required by the chart. Marks are then made at predetermined and selected edge portions of the master pattern MP in conformity with pattern varying practices. Since the pattern papers P are formed of transfer sheets, various markings are thus transferred through the sheets from sheet to sheet, each marking varying as the respective sheet has been moved inward or outward or shifted from side to side by the cams 20 and 22 in accordance with the required chart indications. When the various edge portions of the master pattern MP throughout its periphery have been properly marked, the pattern paper sheets P are then removed from their holders. A complete pattern outline now appears on each of the various sheets. Thus, the operator may have started with pattern size 14, the auxiliary master pattern holder 75 having been mounted on the middle crossbar 65. As a result of his work, he may have smaller pattern sizes $13\frac{1}{2}$, 13, $12\frac{1}{2}$ and larger pattern sizes $14\frac{1}{2}$, 15 and $15\frac{1}{2}$, as well as a duplication of the 14 size pattern if a pattern transfer sheet P was used on the respective crossbar 65.

In FIGS. 7 and 8, there is indicated, mounted at one corner of the forward side of the housing 12, an adjustable overhanging arm structure whose use is very important in making delineations at positions outlying beyond the principal pattern area and at some angle with respect to a given line position of the master pattern. This may be typified by an angular tuck or a gore to be located several inches out from the main pattern position at a chosen angle, for example 45° , to a transverse baseline. This arm structure is illustrated as an adjustable jointed-arm drafting machine embodying protractor features, for example, a pair of jointed arms having at the outer swinging a flat scale for a measuring rule disposed on a protractor head provided with a protractor scale with reference to which the flat measuring rule is adjusted at a required angle.

More particularly, the overhanging arm structure illustrated includes an arm section 85 pivotally carried at 86 on a clamp 88, or other appropriate mounting means, mounted on the housing 12. At its outer end, the arm section 85 pivotally carries an arm section 90, the pivot connection between the two arm sections being generally indicated at 92. At the outer end of the arm section 90, a measuring rule section 94 is pivotally mounted at 95 for rotary adjustment with respect to a protractor scale 96 or the like. At each end of each arm 85 and 90, pulleys (not shown) are located in corresponding housings 98. The pulleys in the housings 98 of the arm 85 are driven by a belt 100 which interconnects them, and the pulleys within the housings 98 of the arm 90 are driven by an interconnecting belt 102. The pulley about the pivot 86 is fixed to the clamp 88, and as a consequence when the swinging portions of the structure are moved generally through an arc such as indicated by the double ended arrow 104, the cables 100 and 102 move the measuring rule 94 correspondingly in a parallelogram relationship. This is true because the pulleys about pivot 92 are connected through such pivot and move together. Similarly, the pulley about the pivot 95

is connected to drive the rule 94 in a rotary fashion, conventional means being however employed to permit manual adjustment of the angular position of the measuring rule 94 with respect to the pivot 95 by reference to the protractor scale 96. Since it will be desired that the master pattern MP and all the pattern-receiving papers P be freely movable under the arms 85 and 90 and the measuring rule 94, provision is made to carry the outer end portions of the arm structure in a floating relationship above such pattern and pattern papers. This may be accomplished through the medium of an upstanding extension 86a of the pivot post 86 and a guide wire 105 attached to an eye 106 aligned with the pivot 92 at the outer end of the arm section 85 and secured to the top of the respective casing 98. Otherwise, any counterbalancing means such as a weight or spring counterbalance may be employed for the same purpose.

From the above, it will be apparent that when an outlying delineation is required to be formed on a pattern paper or pattern papers P with respect to any given point or outline on a master pattern MP, and such outlying delineation must be located at some predetermined angle, the rule 94 may be angularly adjusted to the required angle as determined by reference to the protractor 96. The rule 94 will then be swung outward along the arc indicated by the arrow 104 to the required location, and the marking required will be drawn in such location at the required angle along the measuring rule 94 for as great a distance as desired and as determined by the scale on the rule 94.

From the foregoing description it will be apparent that by making the cams 20 and 22 of such diameters as required to correspond with the varying pattern sizes to be produced from a given master pattern, and by employing conventional grading charts for determining the amount of transverse and longitudinal movements of the grading plates 10 through the knobs 30 and 32 and their pointers 42 and 44, pattern sizes may be delineated on underlying pattern sheets P by the application of various markings at various locations around the edges of the master pattern MP as the latter and the pattern papers P are successively shifted from position to position in accordance with the grading chart used. Since the pattern paper P are transfer papers, the markings will be transferred from the topmost paper P to the lowermost. The relative positions of each transferred marking on the respective pattern papers P vary in accordance with the varying movements effected by the cams 20 and 22 and the edges of their cam slots 24 and 25. When an angular delineation on outlying parts of the various pattern papers is required, such as for the purpose of indicating the position, direction and length of a tuck, the adjustable swinging arm structure, comprising the arm sections 85 and 90 and the measuring rule 94, will be adjusted and moved from the position of FIGS. 7 and 8 to an outlying location or locations in the general direction of the arrow 104, as required.

When all of the required markings around the master pattern MP, and with respect to various points and locations on the body thereof in outlying positions through the medium of the overhanging arm structure of FIGS. 7 and 8, have been completed, the various pattern papers P are detached from their respective positioning bars 65. The delineation of each pattern on its respective pattern paper P is now complete. Thus, using a given master pattern, a series of new patterns is produced of either larger or smaller sizes than that of the master pattern MP, or of both larger and smaller sizes, as previously indicated. Such larger and smaller sizes are effected by shifting the auxiliary master pattern positioning arm 75 (FIGS. 3 and 6) selectively to anyone of the pattern-holding crossbars 65 where the pins 79 on the mounting bar 78 are positioned in the illustrated seat-forming holes or recesses 80.

Should patterns be required differing in size relation-

ships from those of a machine as originally furnished, a new set of cams and sheet actuating plates may readily be employed; or changes or removal of the demountable strips 48 and different cams may be relied upon. This provision for change of pattern sizes is an important aspect of this invention.

It will be appreciated that other specific structures than those here shown and described will occur to those skilled in the art, and it is therefore intended to protect all such structures as fall within the scope of the patent claims.

What is claimed is:

1. In pattern grading apparatus:

a base;

a stack of sheet actuating plates carried on said base, each plate having a transverse cam slot and a longitudinal cam slot, the sizes of the transverse cam slots varying from plate to plate and the sizes of the longitudinal cam slots varying from plate to plate, and said plates being movable transversely and longitudinally with respect to each other;

a first stack of cams fixed with respect to each other and varying in size to fit into the respective transverse cam slots to move said plates longitudinally simultaneously;

a second stack of cams fixed with respect to each other and varying in size to fit into the respective longitudinal cam slots to move said plates transversely simultaneously;

sheet positioning means carried by each of said plates for sheets to receive markings for new patterns to be delineated;

and means to position a master pattern with respect to said movable plates and their sheet positioning means.

2. Apparatus as in claim 1 including;

means between adjacent plates guiding the respective plates in their transverse and longitudinal movements.

3. Apparatus as in claim 1 wherein the two slots in each plate are elongated slots having parallel sides engaged by the respective cams, and the slot axes are generally at right angles to each other.

4. Apparatus as in claim 1 wherein each stack of cams is mounted on a vertical shaft having means to turn the shaft and its cams predetermined amounts for shifting said plates correspondingly.

5. Apparatus as in claim 4 including a housing, an indicator on each shaft, and a scale for each indicator on said housing.

6. Apparatus as in claim 1 wherein said sheet positioning means for each plate is rigid means extending beyond said plates and includes horizontal means lying in progressively spaced relation to such horizontal means of the other plates.

7. Apparatus as in claim 6 wherein said master pattern positioning means is selectively mountable upon any one of said horizontal means to move therewith.

8. Apparatus as in claim 1 wherein said sheet positioning means for said plates extend rigidly beyond said plates and include mounting means positioned successively beyond one another, and said master pattern positioning means is provided with mounting means cooperating selectively with any of said successively positioned mounting means to move therewith.

9. Apparatus as in claim 1 wherein shafts carry said two stacks of cams, and said cams are circular and are eccentrically mounted on their shafts.

10. In pattern grading apparatus:

a support;

a stack of sheet-actuating plates carried by said support, each plate having an elongated transverse slot and an elongated longitudinal slot, the slots in each plate being relatively angularly disposed and varying in size from plate to plate, the transverse slots being superimposed and forming a first vertical set of slots,

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and the longitudinal slots being superimposed and forming a second vertical set of slots;
 a first stack of connected cams of varying sizes selectively disposed in said first set of slots to shift said plates simultaneously in one direction;
 means to rotate said first stack of cams as a unit;
 a second stack of connected cams of varying sizes selectively disposed in said second set of slots to shift said plates simultaneously in a second direction;
 means to rotate said second stack of cams as a unit;
 sheet-positioning means carried by said plates for locating sheets to receive pattern markings;
 pattern-locating means to position a master pattern with respect to said sheet-positioning means;
 and means for selectively connecting said pattern-locating means to said plates.

11. Apparatus as in claim 10 wherein said sheet positioning means extend progressively beyond said plates, and said pattern-locating means is attachable selectively to such progressively extending means.

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12. Apparatus as in claim 11 wherein said plates are provided with means for guiding each plate in one direction with respect to an adjacent plate and with means for guiding each plate in another direction with respect to an opposite adjacent plate.

13. Apparatus as in claim 10 wherein said plates are provided with means at their opposite sides for guiding the movement of each plate in different directions with respect to the plates on its opposite sides.

14. Apparatus as in claim 10 including an adjustable protractor arm means mounted on said support and projecting therefrom to establish outlying positions with reference to points on the master pattern.

15. Apparatus as in claim 10 wherein said stacks of cams and slotted plates are replaceable with cams and plates of different dimensions.

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