April 3, 1951 F. A. BEST 2,546,962

BROACHING MACHINE

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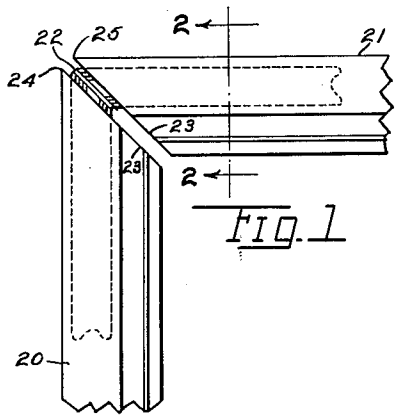


FIG. 1

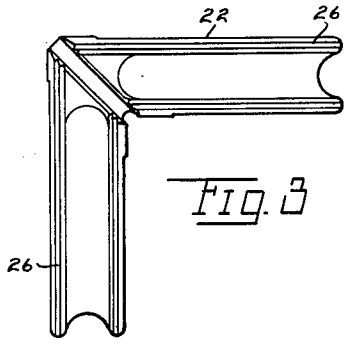


FIG. 3

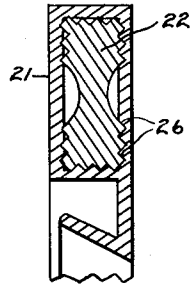


FIG. 2

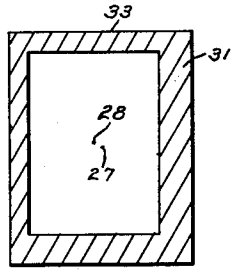


FIG. 4

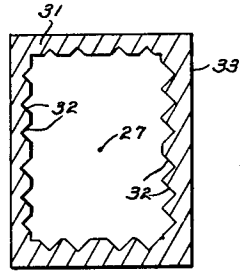


FIG. 5

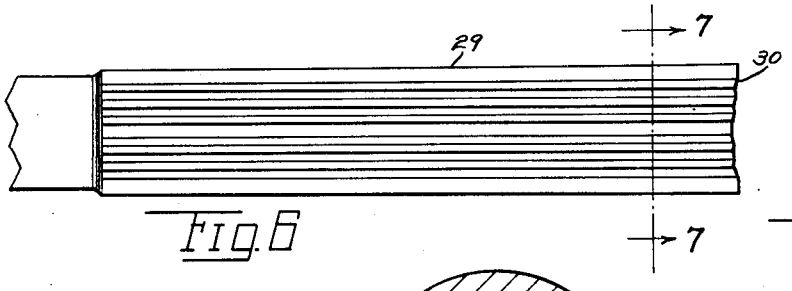


FIG. 6

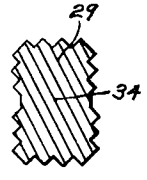


FIG. 7

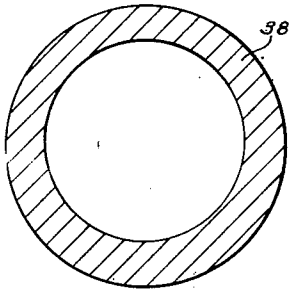


FIG. 8

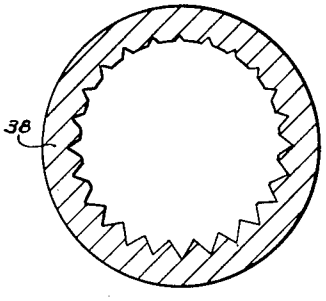


FIG. 9

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BROACHING MACHINE

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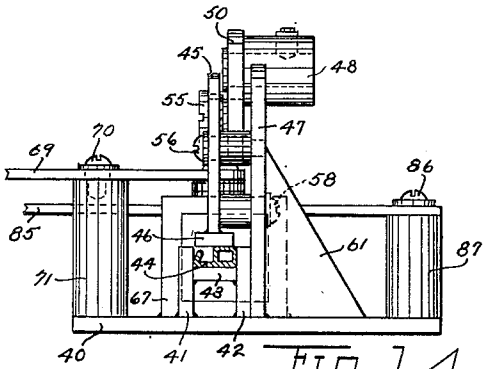


FIG. 14

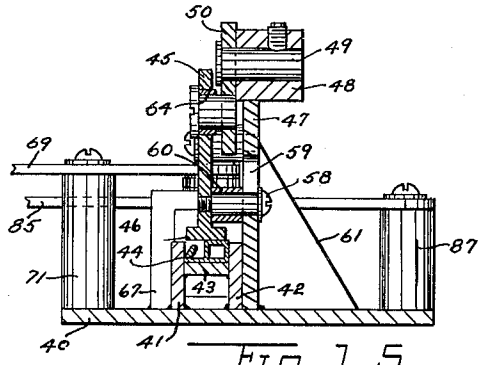


FIG. 15

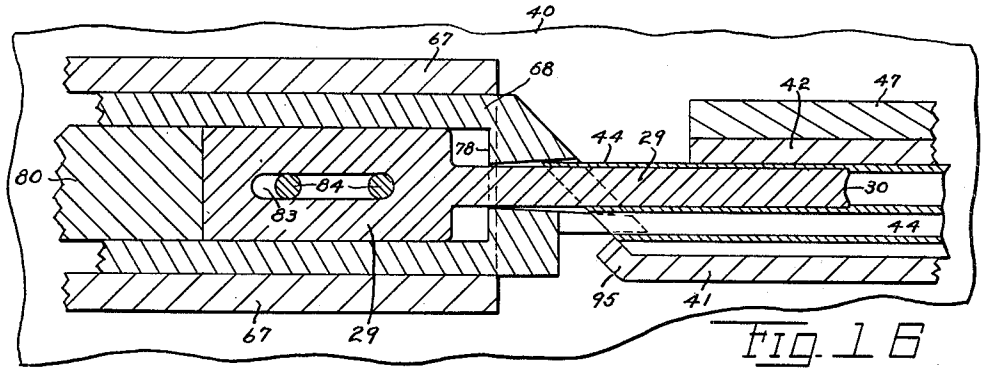


FIG. 16

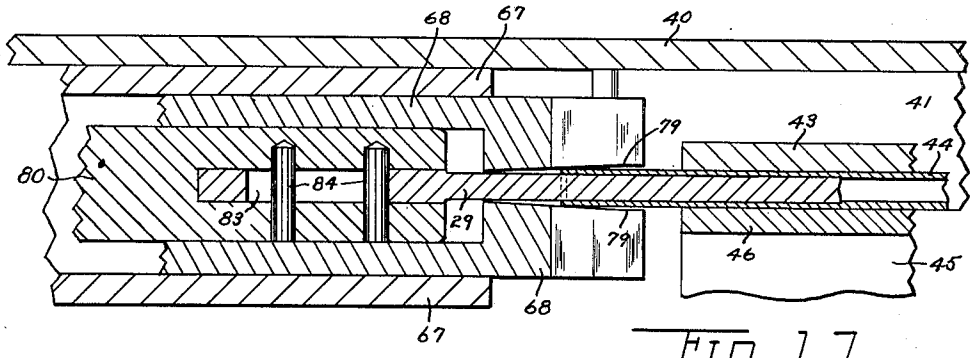


FIG. 17

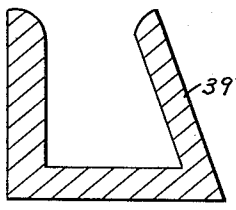


FIG. 10

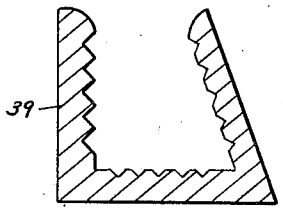


FIG. 11

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BROACHING MACHINE

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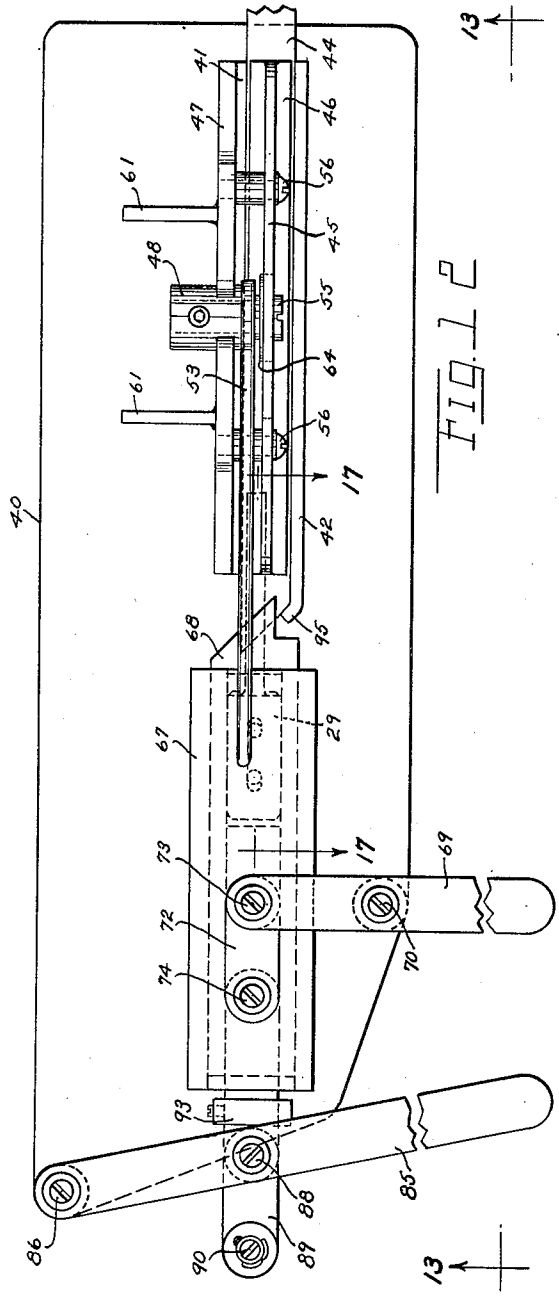


FIG. 12

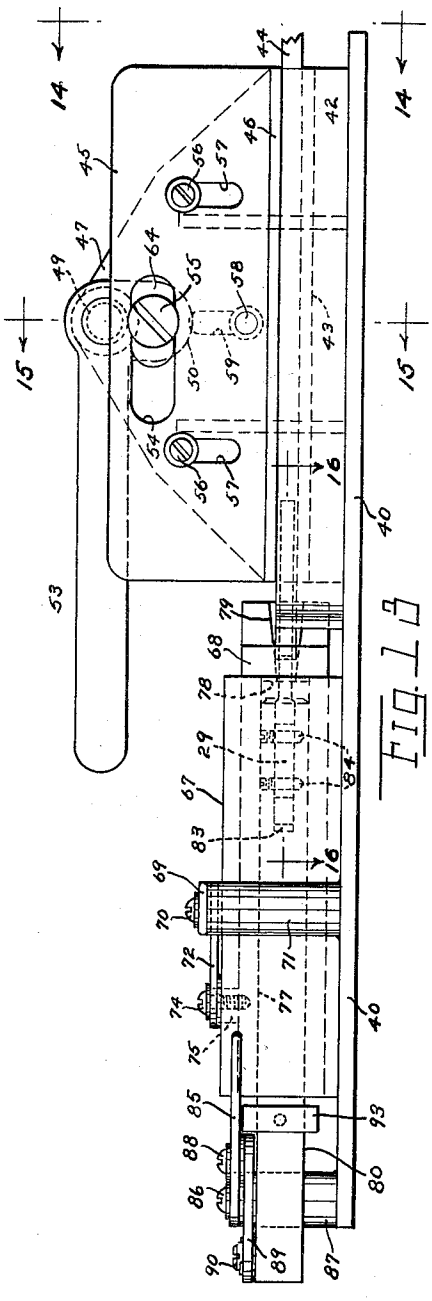


FIG. 13

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Patented Apr. 3, 1951 2,546,962

UNITED STATES PATENT OFFICE

2,546,962

BROACHING MACHINE

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Application April 22, 1947, Serial No. 743,056

5 Claims. (Cl. 90—33)

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The invention relates to novel and improved means and methods for joining complementary structural frame members.

The terminology "structural member" is here used to denote any one of the great variety of fabricated shapes obtainable in hollow or open contours such as squares, rectangles, rounds, channels, etc. In commercial practice many such structural members are readily producible, for example by extrusion, although simple open channel types may also be fabricated by rolling.

In assembling fixed lengths of such structural members into a completed article, for example a rectangular window screen frame, by telescoping adjacent elements on the respective legs of right angled brackets as will later be described, it has been the experience of the art that it is difficult to obtain a proper alignment and planar registration of the outer surfaces of said adjacent elements. The basic cause of the trouble is that the customary longitudinal bore or groove in the structural member is often off center to a greater or lesser extent. This is true particularly with conventional extrusion processes since the anchoring of the spud or mandrel around which the extruded metal flows is susceptible to a certain amount of lateral drift. As a result the wall of the finished structural member may not be of the desired thickness throughout its whole sectional periphery, and if the ends of adjacent members are telescoped on a common bracket or core, which may be straight or of any angularity or curvature desired, the outer surfaces of the meeting ends of the adjoining members may not register accurately. Time consuming tailoring methods have heretofore been required for producing individual compensating corrections in registration, so as to secure a neater finished appearance.

An object of the present invention, therefore, is to provide novel and improved methods and means insuring accurate mutual alignment and orientation of adjoining structural members in an assembly.

A further object of the invention is to provide novel and improved methods and means for accurately centering the axial apertures of cooperating structural members with respect to their outer surfaces so that said members may be telescoped on opposed ends of a common core with their outer surfaces in coplanar relationship, or otherwise in desired registration.

Another object of the invention is to provide novel and improved methods and means for simply and positively profiling the inner wall

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surface of the end of a structural member in accurately spaced relationship to its outer wall surface, so that when two such ends are telescoped on the opposed ends of a common core their outer wall surfaces are properly registered and aligned.

A further object of the invention is to provide methods and means, as defined in the last preceding paragraph, wherein the inner wall surface of the end portion of the member and the outer wall surface of the core to be inserted therein are formed to a predetermined serrated contour of such character that the longitudinal central axis of the core coincides with the longitudinal central axis of the member, regardless of initial variations in member wall thickness.

A further object of the invention is to provide novel and improved means and methods for positioning and holding the end portion of a hollow structural member, and for broaching the inner wall surface of said member in such manner that the broached inner contour is axially concentric with the outer end surface, and is likewise axially concentric with the outer surface of a supporting core.

A further object of the invention is to provide, for the purposes hereinbefore defined, a core having an external contour particularly adapted for a self-centering insertion in the abutting ends of adjacent hollow structural members.

Other objects and advantages will be apparent from a study of the following specification, in conjunction with the accompanying drawings, in which:

Fig. 1 is a view in elevation of one corner of a screen window sash, formed from the union of two extruded structural members telescoped on a common angle bracket or core;

Fig. 2 is a sectional view, somewhat enlarged, taken on the line 2—2 of Fig. 1;

Fig. 3 is a view in elevation of the bracket or core;

Fig. 4 is a transverse sectional view of a structural member of simple hollow rectangular contour, the bore being off center with respect to the outer walls;

Fig. 5 is a view similar to Fig. 4, but showing the sectional appearance after a broaching operation in accordance with the present invention;

Fig. 6 is a side elevational view of a broach suitable for performing the operation indicated in Fig. 5;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is a transverse sectional view of an off center bore in an extruded tube;

Fig. 9 is a view similar to Fig. 8 but showing the appearance of the tube after a broaching operation;

Fig. 10 is a sectional view of an open channel showing an undesired variation in wall thickness in the legs and base of the channel;

Fig. 11 is a view similar to Fig. 10, but showing the sectional appearance after a broaching operation;

Fig. 12 is a top plan view of my novel apparatus for concentrically axially broaching hollow or open structural shapes;

Fig. 13 is a side elevational view of the apparatus shown in Fig. 12;

Fig. 14 is an end view taken from the right of Figs. 12 and 13;

Figs. 15 and 16 are sectional views taken on the lines 15—15 and 16—16 of Fig. 13;

Fig. 17 is a sectional view taken on the line 17—17 of Fig. 12.

Before the present invention here illustrated is described in detail, it is to be understood that the invention here involved is not limited to the details of construction or the specific arrangement of parts herein illustrated or described, as the invention obviously may take various forms. It also is to be understood that the phraseology or terminology herein employed is for the purpose of description and not of limitation, the scope of the present invention being defined in the appended claims.

Referring now to the drawings, and particularly to Figs. 1 to 3 inclusive, there is shown a fragmentary portion of a window screen sash formed by uniting two structural member elements 20 and 21. Said elements are telescopingly assembled on the respective arms of an angle bracket or core 22. It will be apparent that if the axial bores in the respective ends of the members 20 and 21 are off center with respect to their outer wall surfaces, the abutting end edges 23 and the corner portions 24 and 25 will probably be out of proper mutual alignment, thereby presenting a crude and unfinished appearance. As hereinbefore indicated the present invention provides a method and means for aligning the axial centers of the arms of bracket 22 with the respective axial centers of the outer end surfaces of the members 20 and 21.

For a better understanding of the general principle whereby this end is accomplished, reference may be had to Figs. 2 to 11 inclusive.

Figs. 2 and 3 show the sectional profile and the surface configuration of the connecting bracket 22. It will be noted that the peripheral wall surfaces of the bracket are serrated by a series of longitudinal parallel triangular ridges 26. Fig. 4 shows the cross sectional appearance of an extruded structural member as received from the extrusion press, the eccentricity of the bore being exaggerated for purposes of illustration. Reference character 27 denotes the axial center of the outer walls as determined by the intersection of diagonals drawn from the outer corners. Reference character 28 denotes the axial center of the walls of the bore as determined by diagonals drawn from the inner corners. Figs. 6 and 7 show a broach 29 of rectangular section serrated to produce the inner wall contour shown in Fig. 5. The longitudinal walls of the broach taper backwardly from the leading end 30 to provide working clearance, the broach being designed to cut only with the peripheral edge of said leading end.

As will appear, I have devised means for broaching the bore of the end portion of a structural member while maintaining the axis 34 of the broach in coincidence with the axial center of the outer walls of the member. Said means will be described hereinafter.

In Figs. 4 and 5 illustrating the effect of concentric broaching on the eccentrically formed structural member 31 hereinabove noted, the effect of such concentric broaching is to place the broached profile 32 of the inner wall surface in axial alignment with the outer wall surfaces 33. In my apparatus to be hereinafter described the advance of the broach is coaxial with the outer walls, and the cutting teeth of the broach bite more deeply into the thicker walls than into the thinner walls. When an arm of bracket 22 is inserted in the broached opening, the axis of the arm will coincide with the axial center 27 of both the outer walls and the broached profile of the inner walls. When two adjacent structural members, treated as just described, are assembled on the common bracket 22 their adjacent end surface portions are self-aligning, and produce an exact match.

Figs. 8 and 9 show the effect of concentric broaching on the cross sectional profile of a tubular member 38, and Figs. 10 and 11 show the effect of concentric broaching on the walls of an open channel member 39.

The manner of operation of the broaching step, and the means whereby the same is accomplished, will now be disclosed.

Speaking generally, the apparatus comprises work guiding and clamping means, and broach holding, broach guiding, and broach advancing means. All such means will be described with particular reference to Figs. 12 to 17.

The apparatus is supported on a plate 40, which may be a table top, or work bench. The work receiving track or trough comprises a pair of vertical side plates 41 and 42 fixed in spaced parallel relationship on plate 40. A transverse floor plate 43 carried by said side plates supports the work piece 44, said work piece being inserted from right to left in Fig. 13. Various adjustments of the work-carrying channel for width and height may be provided as desired, but the elements just described are here shown as fixed, being adapted for commercial production on one particular size and style of work piece.

The work is initially advanced to the desired broach-receiving position, as will hereafter be described, and is then securely held in said position by a vertically movable clamping plate 45 having an elongated transverse web or foot 46 engageable with the work by downward movement of the foot. Said clamping plate is supported and actuated in the following manner. Fixed on plate 40 adjacent the work-receiving means is a clamp-supporting plate 47 having attached to its upper end a transverse bushing 48. The bushing has an axial aperture adapted to receive a stub shaft 49 eccentrically disposed on a cam head 50. The cam head is operated by a lever 53, and is here shown as integral with said lever. The upper portion of the clamping plate 45 has a horizontal slot 54 adapted to slidably receive a pin 55 fixed in the cam head 50. It will be apparent that clockwise movement of the lever 53 (Fig. 13) produces rising movement of the plate 45 and its clamping foot 46 so that the foot moves out of contact with the work 44.

Counterclockwise swing of the lever **53** returns the foot **46** to its work-clamping position. Vertical movement of the clamping plate **45** is guided by a pair of pins **56** extending through slots **57** in the clamping plate and fixed in the support **47**. An additional guiding pin **58** passes through a slot **59** in support **47** and is fixed in plate **45**. The pins **55**, **56** and **58** may conveniently be machine screws. Annular spacers **60** are carried on the shanks of screws **56** and **58** between the fixed plate **47** and the movable clamping plate **45**. The machine screws are drawn up just tightly enough to permit sliding movement of the clamping plate without side play. Buttresses **61** help to strengthen and support the fixed plate **47**.

An elongated collar **64** is pivotally mounted on the shank of pin **55** in such manner that it rides within slot **54**. It will be apparent that when lever **53** is moved counterclockwise, the right end (Fig. 13) of the collar eventually moves into contact with the right end of slot **54**, thereby constituting stop means for lever travel in counterclockwise direction. This stop means likewise limits cam clamp travel. At such stopping point the clamp foot **46** should be in tightly gripping contact with the work.

The broaching mechanism and the guiding and holding means therefore will now be described.

An elongated housing **67** of tunnel-like character is disposed on base plate **40** and is spaced somewhat from the work holding means above described, but is axially aligned therewith. Longitudinally slidable within said housing is a sleeve-like guide **68**. Movement of the guide is effected by a lever **69** pivoted at **70** to a pillar **71** fixed on plate **40**. The working end of the lever has a pivoted connection with a link **72** by means of a pivot pin **73**. The other end of link **72** in turn has a pivoted connection through a pin **74** which passes through a slot **75** and is fixed in the top wall of guide **68**. Movement of lever **69** of course advances or retracts guide **68**.

Sleeve **68** has a bored aperture **77** extending inwardly therein from the left end thereof (Fig. 13). This aperture is reduced in size at a stop shoulder **78**. Between shoulder **78** and the right end of sleeve **68**, the aperture is outwardly flared or bell-mouthed at **79** for a specific purpose as will appear. Slidable in aperture **77** is a plunger **80**. At the inner end of the plunger is a transverse slot **83** adapted to receive the shank of the broach **29** previously described. The broach shank is secured in slot **83** by means of pins **84**. Advance and retraction of the plunger is effected by a lever **85** pivotally mounted at **86** on a pil'ar **87** fixed to plate **40**. The working portion of the lever is pivotally connected at **88** to a link **89** the other end of which is pivoted at **90** to the end of plunger **80**. A stop collar **93** is fixed on plunger **80** so as to limit the working stroke of the plunger and consequently of the broach. The s'eeve **68** and the plunger **80** are movable independently of each other under the influence of their respective levers **69** and **85**.

A cycle of operation of the apparatus will now be described, in conjunction with the broaching of the bore of a structural member such as is shown in Figs. 1 and 2.

The guide sleeve **68** is first fully retracted by means of lever **69** until its bell-mouthed end is withdrawn within housing **67**. The broach and plunger assembly is also retracted as far as its linkage will permit by means of lever **85**. The structural member **21** is inserted from the right (Fig. 13) into its guide track and advanced until its leading end abuts a stop **95** fixed with respect to the guide track. The work is then clamped in position by counterclockwise movement of lever **53**.

By clockwise movement of lever **69** the guide sleeve **68** is advanced to the right, until the leading end thereof receives the end of the structural member in its bell-mouthed aperture. A self-centering effect is produced between the flaring walls of the aperture, and the leading end of the work. The peripheral walls of the bell-mouthed aperture may be suitably cut away or tailored to accommodate variations in the contour of the leading end of the work. As soon as the work is suitably wedged into position in the aperture, lever **85** is swung to produce advance of plunger **80** thereby forcing the broach **29** into the bore in the work. In every work piece thus broached the inner profile is axially centered with relation to the outer surface walls, and all such work pieces will be mutually registrable on suitable brackets or cores, such for example as is shown in Fig. 3.

It will be obvious that the apparatus shown in Figs. 12 to 17 may be suitably modified to accommodate various structural shapes other than the one herein shown.

As a result of the application of the method above described to the structural members shown, when a set of members intended for assembly in a matched group are arranged so that adjacent ends of a pair of members are assembled on a common core, the outer surfaces of the members will lie in mutual planar alignment. While the broached profile of the bores will normally be concentric with the outer wall surfaces surrounding the bore as in the embodiment illustrated, this is not necessary to assure accurate planar alignment of the outer walls. The essence of the invention resides in the reduction of non-uniformity to uniformity, and if the longitudinal axis of motion of the broach is constantly maintained at any fixed relationship to the outer wall surfaces, whether coaxial or not, the said outer surfaces on one member so treated will be registrable with the outer surfaces of another member also so treated, when they are assembled on a common core.

I claim:

1. Apparatus of the character described for producing a series of work pieces each having an aperture therein which is accurately dimensionally aligned with respect to its outer surface so that a pair of work pieces thus treated may be fixed in mutually end-abutting registrable relationship on a common supporting core, said apparatus comprising an elongated work piece holder having a bottom wall and a pair of spaced opposed side walls extending therefrom to define a work receiving channel open at its ends, stop means for establishing a fixed termination point for forward movement of said work piece in said channel, clamp means for retaining said work piece at said termination point, broach-guiding means spaced from said work piece holder and in longitudinal alignment with said channel, said guiding means comprising a tunneled housing, a guide sleeve telescopingly advanceable and retractable in said housing, said guide sleeve having an axial aperture therethrough, and a broach advanceable and retractable in said guide sleeve, means for advancing said broach into cutting contact with the peripheral wall of the aperture in said work piece, the alignment of said broach and said work piece being such that the internal profile produced by broach operation

is accurately aligned with respect to the outer walls of said work piece.

2. Apparatus of the character described for producing a series of work pieces having respective apertures therein which are accurately dimensionally aligned with the respective outer walls of the work pieces so that a pair of adjacent work pieces may be fixed in mutually end-abutting registrable relationship on a common supporting core, said apparatus comprising an elongated work piece holder having a bottom wall and a pair of spaced opposed side walls extending therefrom to define a work receiving channel open at its end, stop means fixed with respect to said work holding means for establishing a fixed termination point for forward endwise movement of said work piece in said channel, clamp means for retaining said work piece in said channel at said termination point, broach-guiding means in longitudinal alignment with said channel and with an aperture in said work piece, a broach carried in said broach-guiding means, means for effecting relative approach movement between said broach and the work clamped as aforesaid to effect cutting contact between the broach and the wall of the aperture in said work piece, the end of said broach guiding means adjacent said work having a bell-mouthed flare to receive and abut the forward end of said work piece and retain it in position during the broaching operation.

3. Apparatus of the character described for producing a series of work pieces having respective apertures therein which are accurately dimensionally aligned with the respective outer walls of the work pieces so that a pair of adjacent work pieces may be fixed in mutually end-abutting registrable relationship on a common supporting core, said apparatus comprising an elongated work piece holder having a bottom wall and a pair of spaced opposed side walls extending therefrom to define a work receiving channel open at its ends, stop means fixed with respect to said work holding means for establishing a fixed termination point for forward endwise movement of said work piece in said channel, clamp means for retaining said work piece in said channel at said termination point, broach-guiding means in longitudinal alignment with said channel and with an aperture in said work piece, said broach guiding means comprising a tunneled housing, a guide sleeve telescopingly advanceable and retractable in said housing said guide sleeve having an axial aperture therethrough, and a broach advanceable and retractable in said guide sleeve, means for effecting endwise movement of said guide sleeve in said housing, further means for effecting endwise movement of said broach in said guide sleeve, the end of said guide sleeve nearest said work holding means having a bell-mouthed flare to receive and abut the forward end of said work piece and retain it in position during the broaching operation.

4. Apparatus of the character described for producing a series of work pieces each having an aperture therein which is accurately aligned with respect to its outer surface so that a pair of work pieces thus treated may be fixed in mutually end-abutting registrable relationship on a common supporting core, said apparatus comprising a base, an elongated work piece holder fixed on said base, said holder having a pair of spaced upwardly extending side walls to define a work receiving channel open at its ends, stop means carried by one of said walls for establishing a fixed termination point for endwise forward movement of said work piece in said channel, a clamp support fixed with respect to said base, a clamping cam movably carried on said clamp support and movable into contact with the upper surface of a work piece in said channel, a broach, broach-guiding means comprising a tunneled housing fixed with respect to said base, and spaced from said work piece holder, a guide sleeve telescopingly advanceable and retractable in said housing, said guide sleeve having an aperture therethrough in axial alignment with said work receiving channel, a broach advanceable and retractable in said sleeve aperture, a lever pivotally fixed on said base, and operatively engaging said guide sleeve for producing limited endwise reciprocation of said sleeve, a second lever pivotally fixed on said base and operatively engaging said broach for producing limited endwise reciprocation of said broach in said sleeve, cooperative action of both said levers effecting cutting contact between the leading end of said broach and the wall of said aperture in said work piece whereby the internal profile produced by broach operation is accurately aligned with respect to the outer walls of said work piece.

5. Apparatus of the character described for producing a series of work pieces each having an aperture therein which is accurately aligned with respective to its outer surface so that a pair of work pieces thus treated may be fixed in mutually end-abutting registrable relationship on a common supporting core, said apparatus comprising an elongated work piece holder having a bottom wall and a pair of spaced, opposed side walls extending from said bottom wall to define a work receiving channel open at its ends, clamping means movable with respect to said side walls to secure a work piece in said channel, broach-guiding means in longitudinal alignment with said channel and with an aperture in said work piece, a broach in said guiding means, means for producing relative approach movement between said broach and said work piece whereby to effect broaching contact between said broach and the walls of said aperture in said work piece and said broach having a peripherally serrated cutting face whereby to produce a serrated inner wall contour in said aperture in fixed relationship to said outer surface, and adapted to receive a serrated core.

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