No. 696,382. Patented Mar. 25, 1902.

F. STREICH & C. L. RUEHS.

AUTOMATIC CARVING MACHINE.

(Application filed Nov. 20, 1901.)

(No Model.) 10 Sheets—Sheet 1.

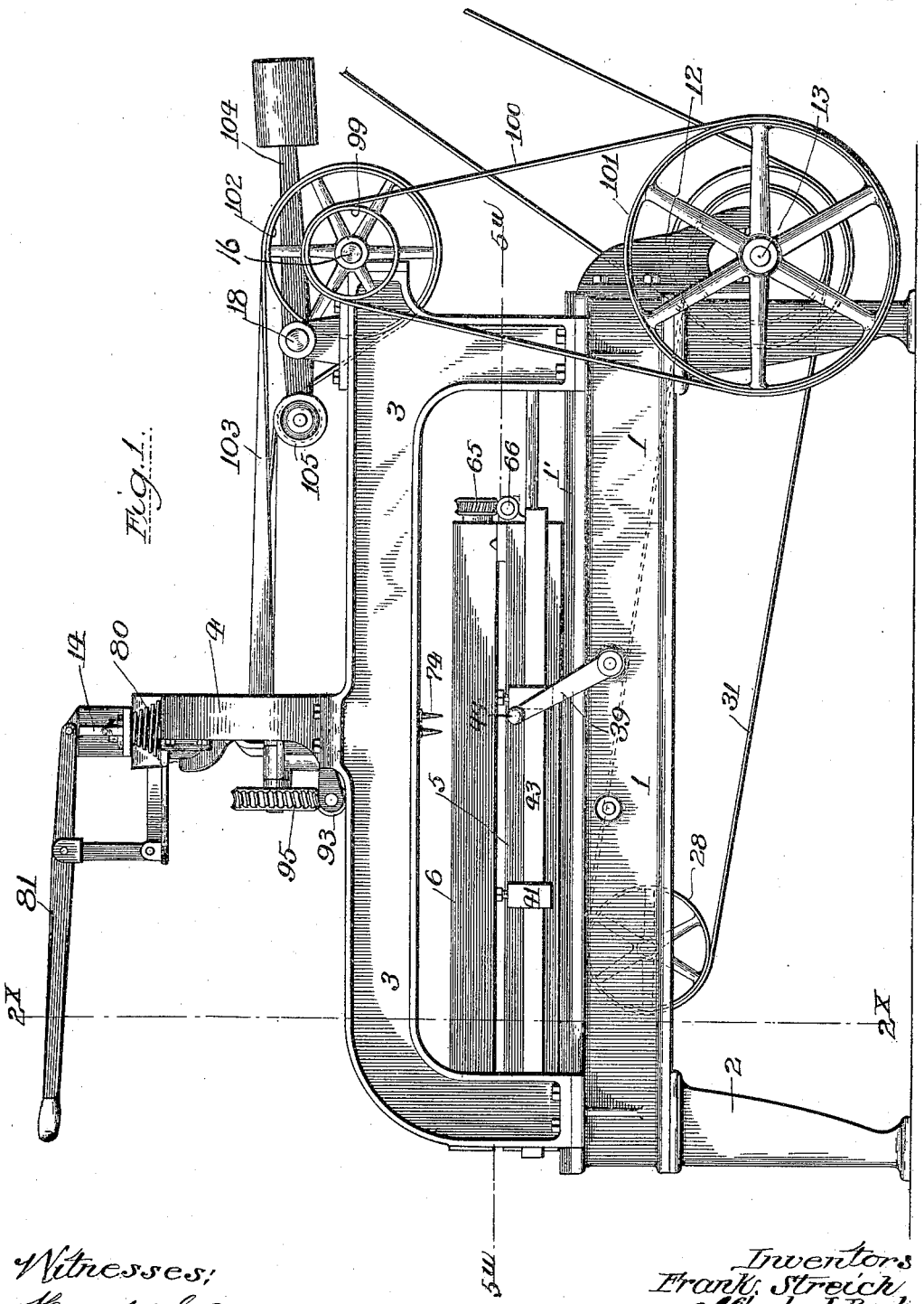

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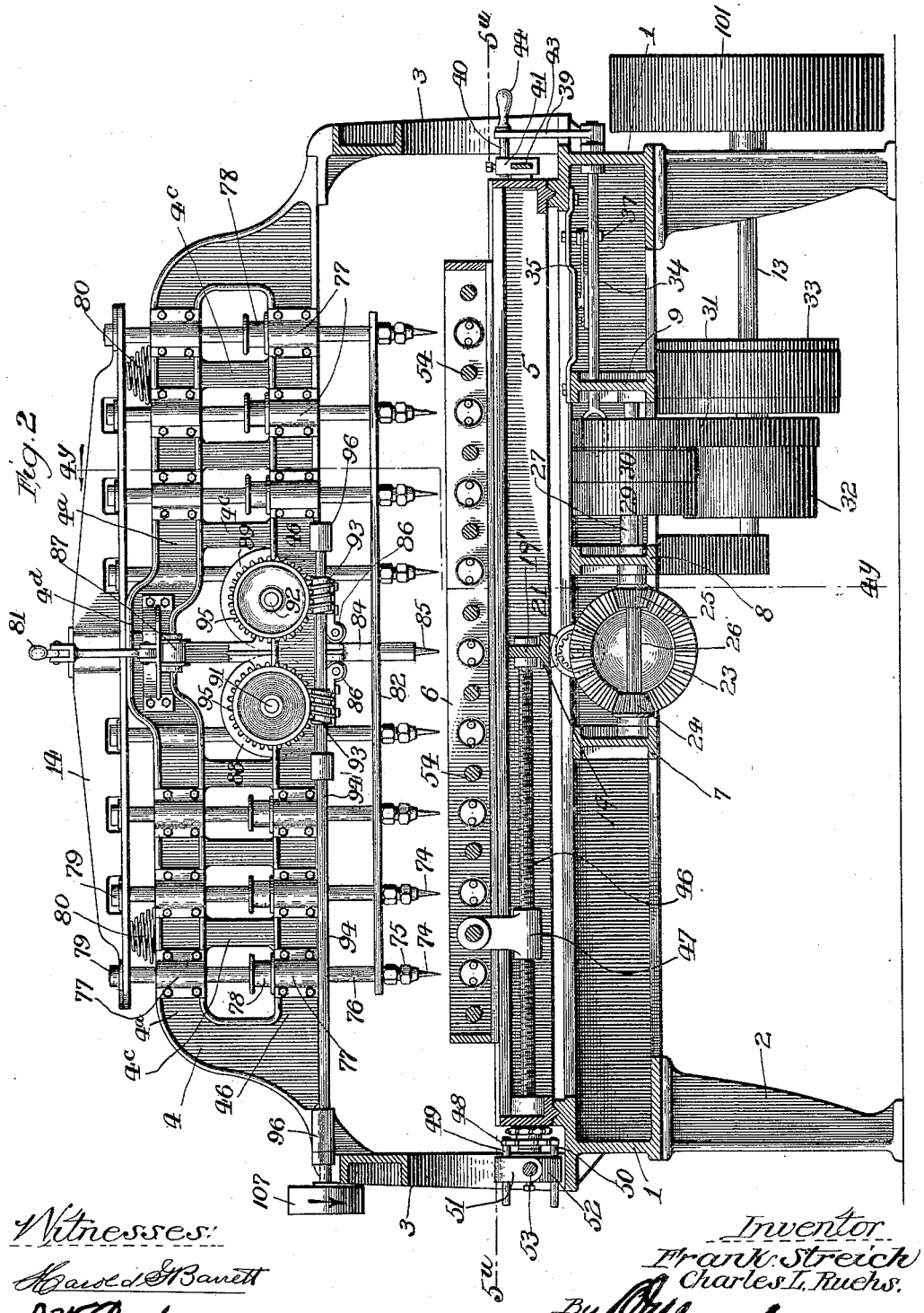
Fig. 2



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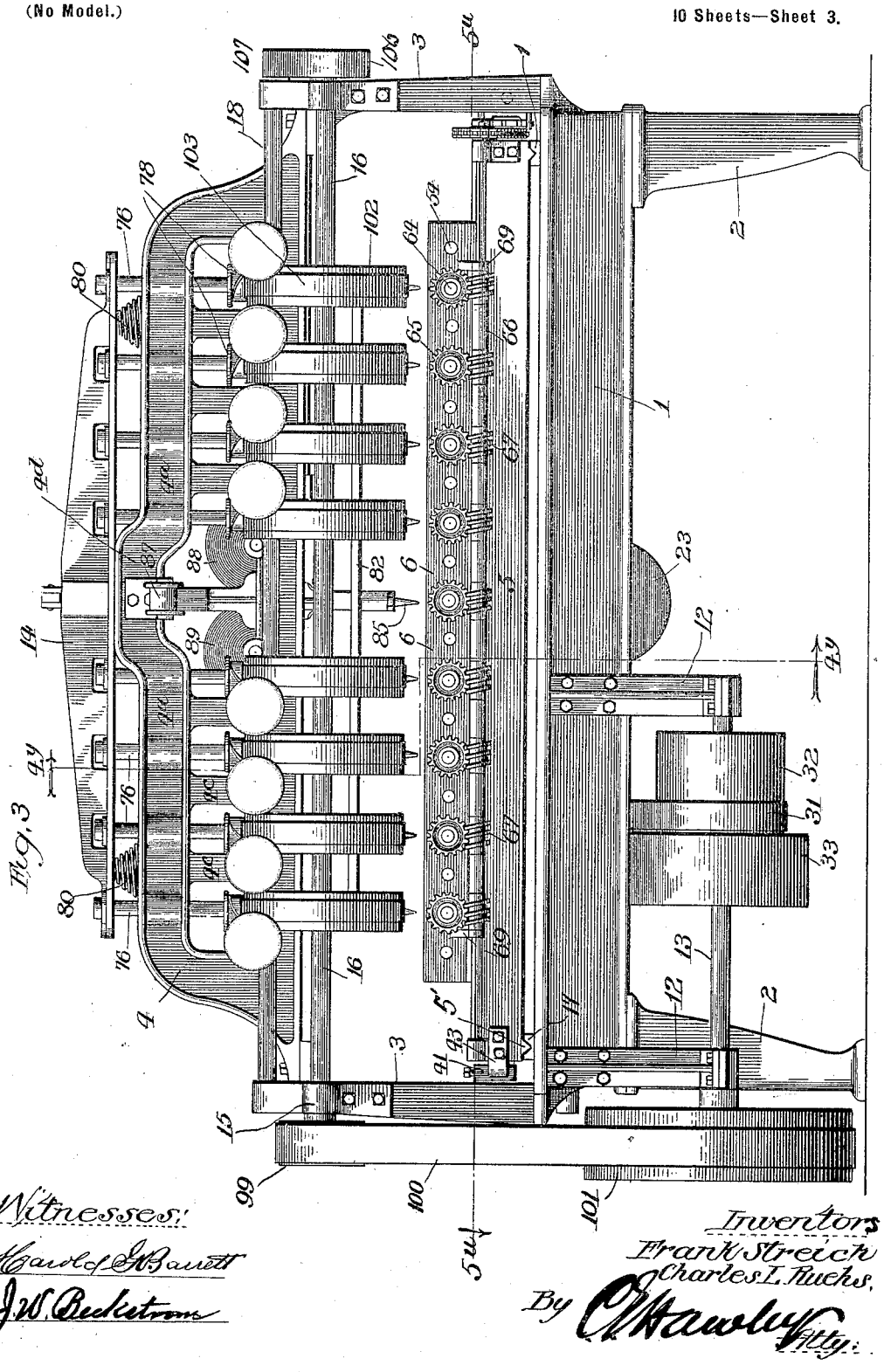

Fig. 3

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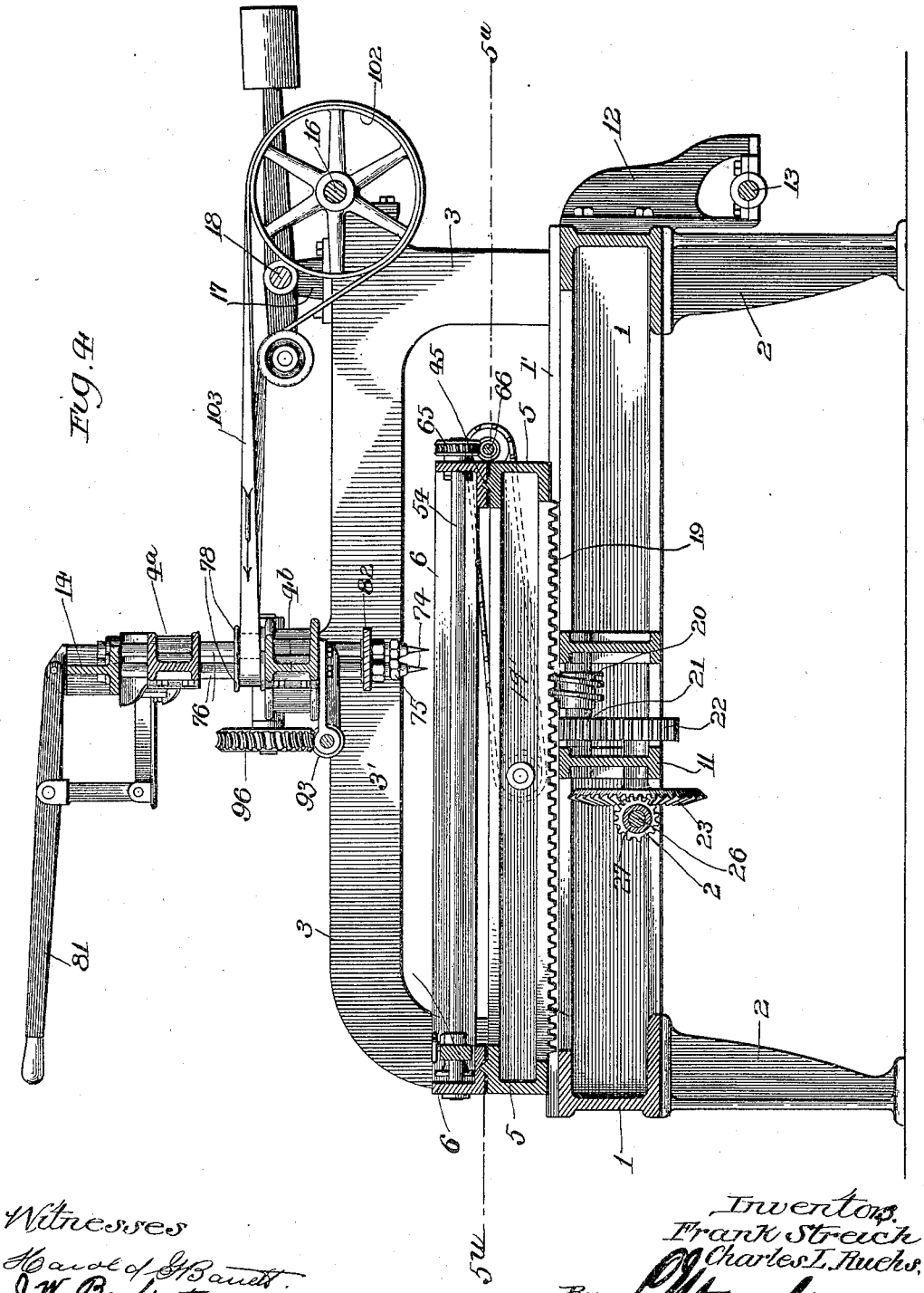
Fig. 4



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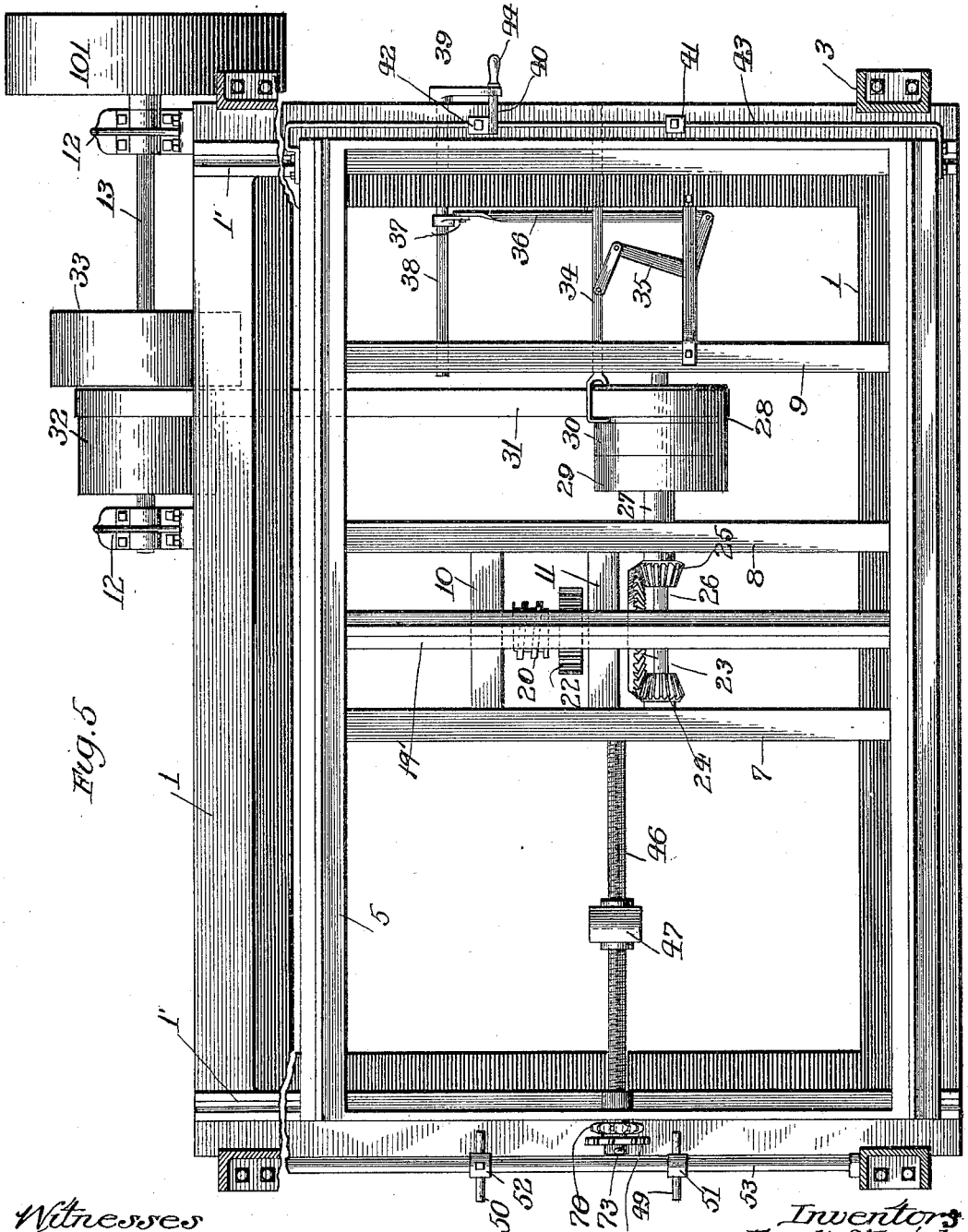

Fig. 5

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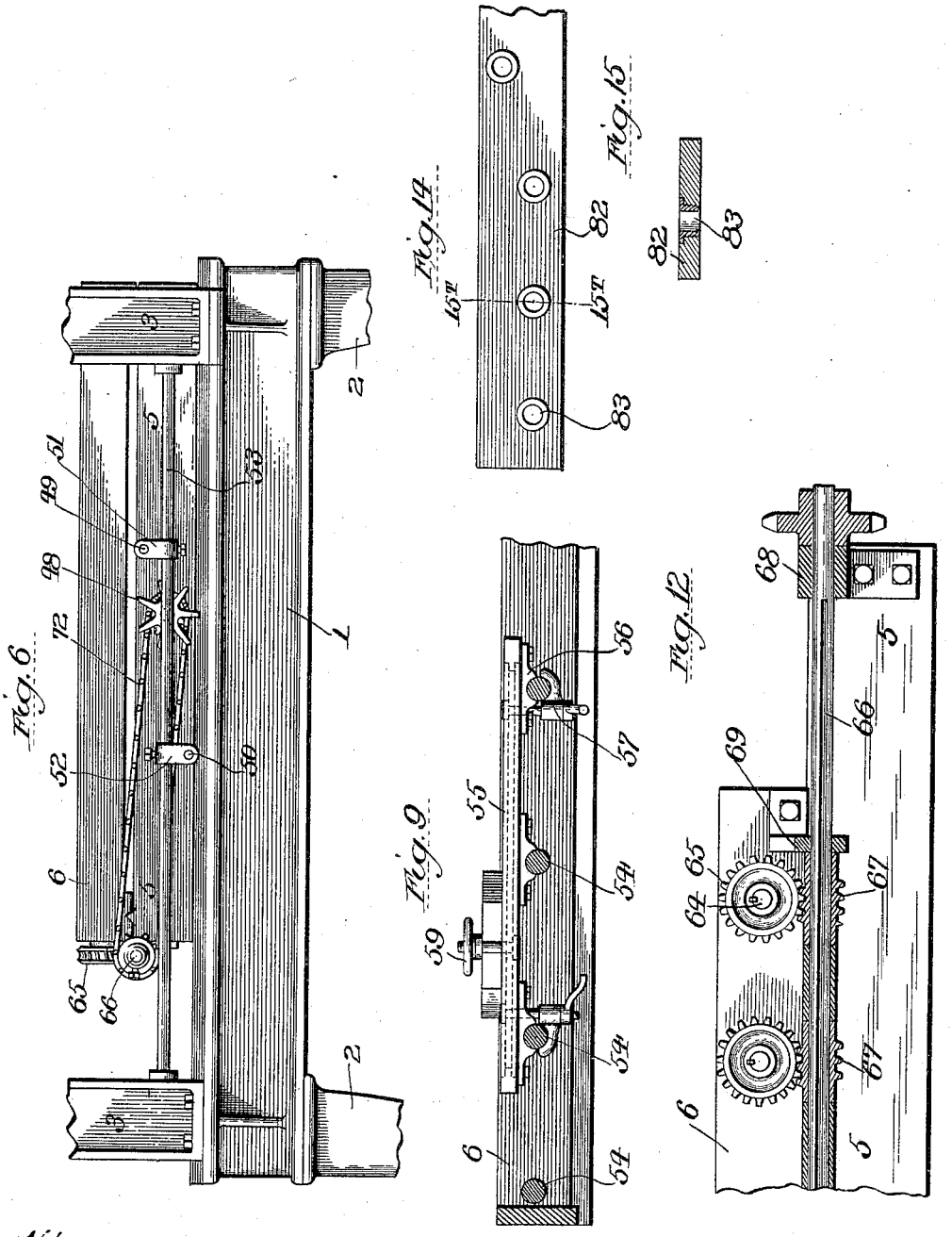

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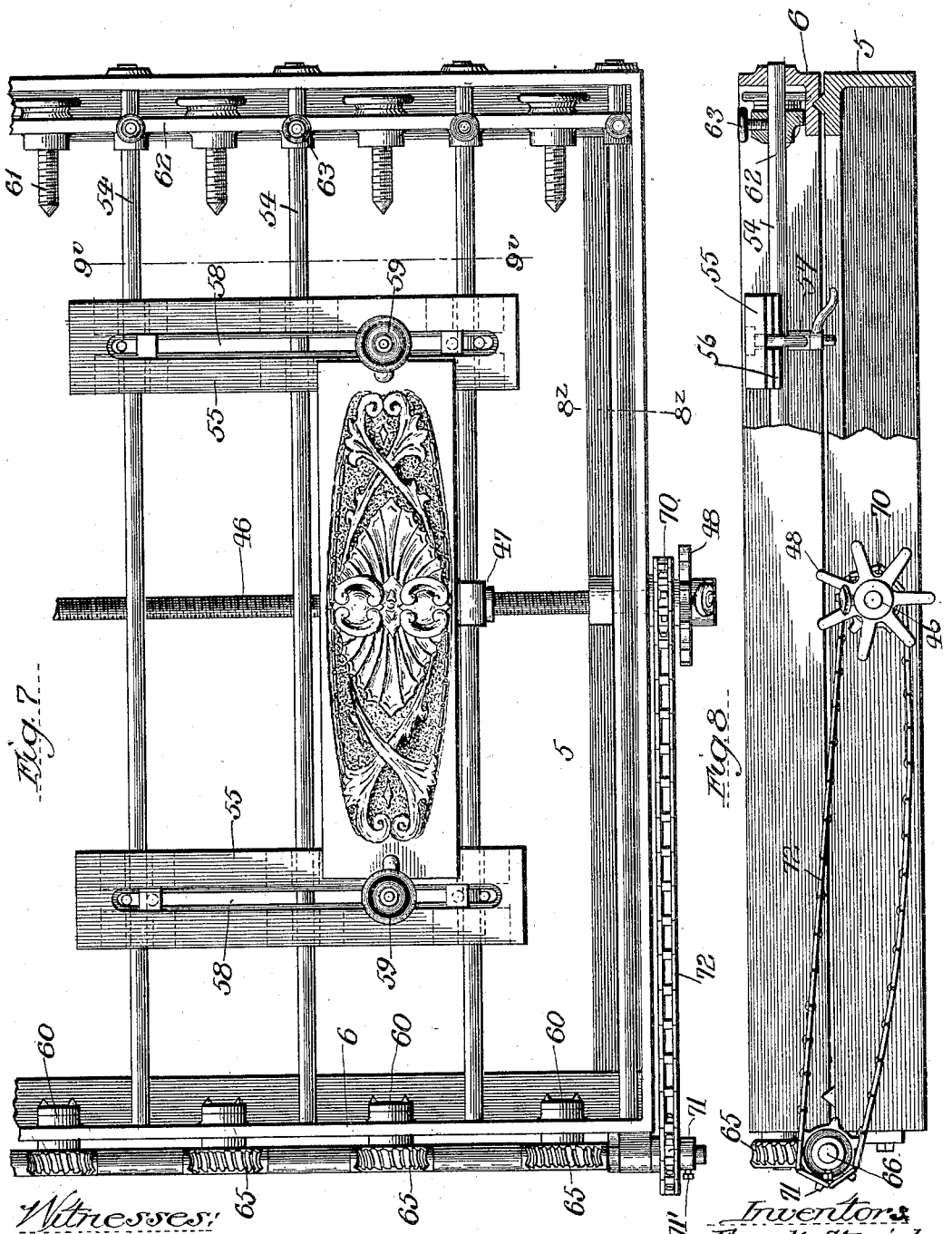

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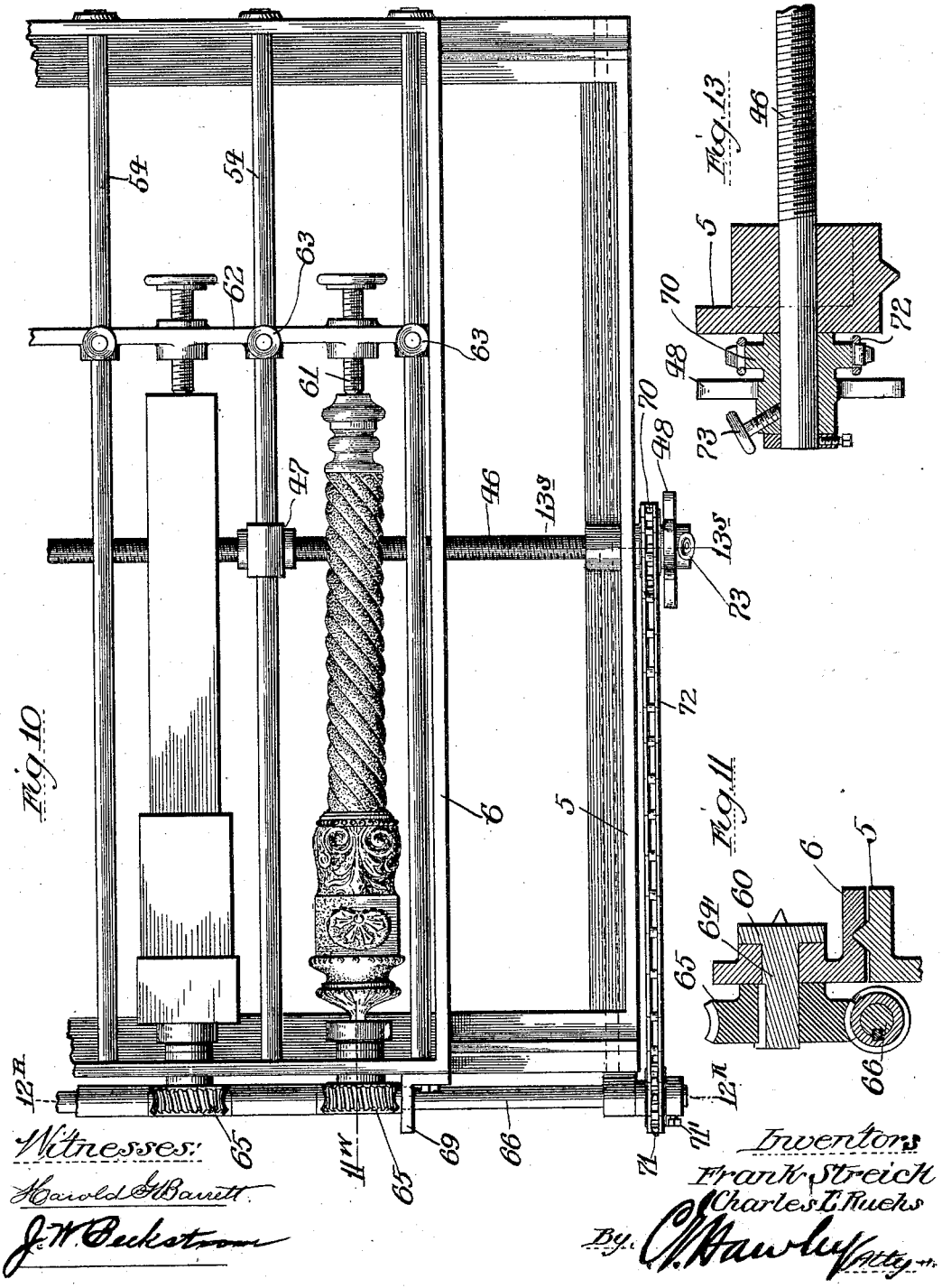

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AUTOMATIC CARVING MACHINE.

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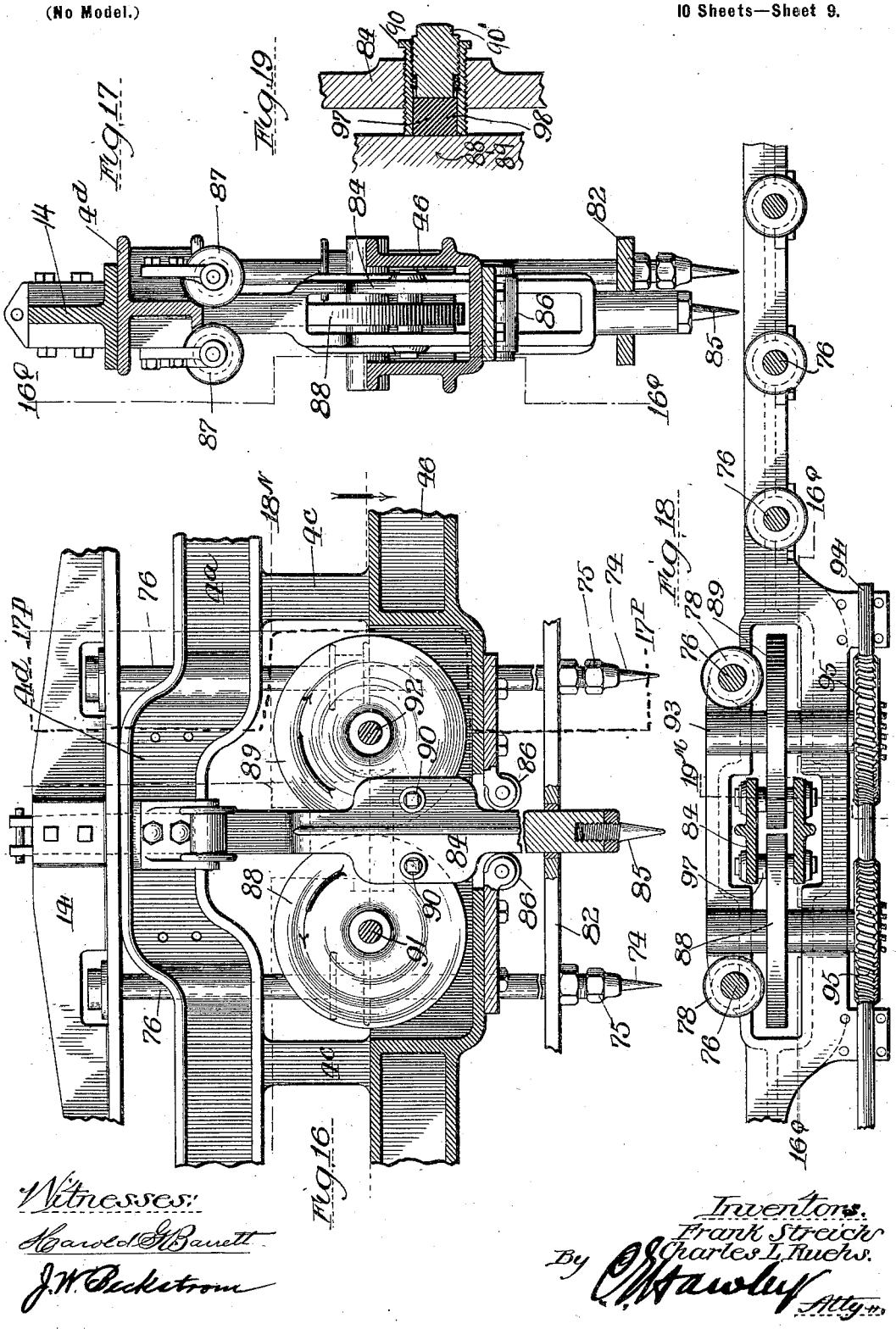

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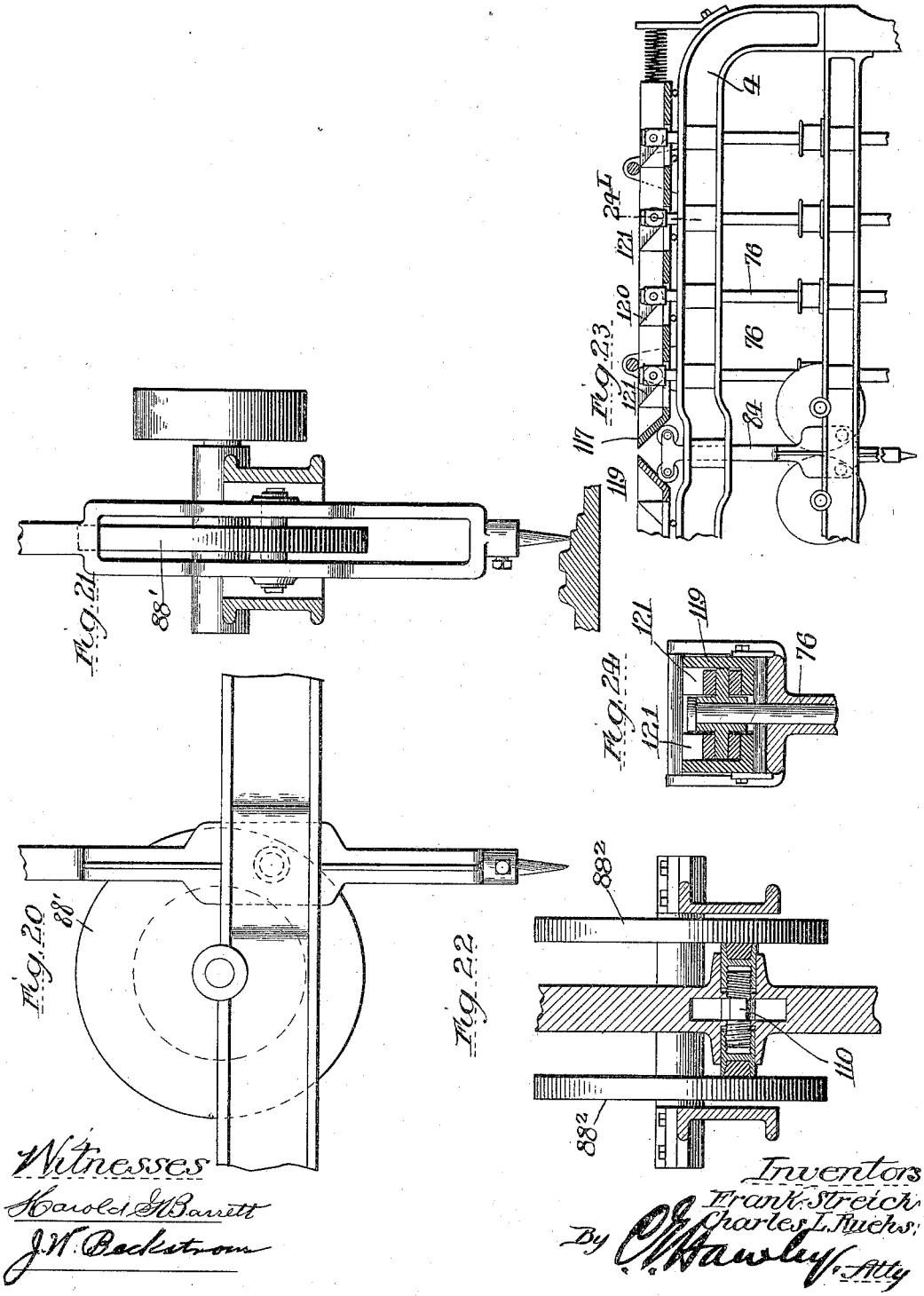

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UNITED STATES PATENT OFFICE.

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AUTOMATIC CARVING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 696,382, dated March 25, 1902.

Application filed November 20, 1901. Serial No. 82,971. (No model.)

To all whom it may concern:

Be it known that we, FRANK STREICH and CHARLES L. RUEHS, citizens of the United States, residing at Chicago, Cook county, Illinois, have invented a certain new, useful, and Improved Automatic Carving-Machine, of which the following is a specification.

Our invention relates to machines for carving or grinding wood, metal, stone, glass, or other material, having particular reference to automatic machines for the purpose; and its object is to produce a number of copies of any given relief or intaglio design at one operation with accuracy and rapidity and at less cost than has been possible heretofore.

The special object of our invention is to provide a machine for automatically producing in wood or other material a plurality of copies of a single master design or pattern, being particularly directed toward the improvement of automatic carving-machines of that class in which a tracer which rests upon a moving pattern controls a plurality of cutting-tools as to depth of cut and in a measure causes the rise and fall thereof and in which a power-actuated lifting or retracting mechanism is employed to help or lift the tracer or feeler over steep inclines or prominences encountered in the pattern. A gently-undulating design may be reproduced without the assistance of a retracting mechanism; but the latter is a necessity in the cutting or carving of the high reliefs and sharp incisions found in many pattern-carvings. In such a machine the pattern and work move at the same rate of speed, and it is obvious that if there is any delay in lifting the tracer and the cutting-tools upon an incline or prominence the onward movement of the pattern and work will result in breaking some part of the machine or in chipping or breaking the points or prominences of the work or panels being carved. These are the chief difficulties that have been encountered in the machines hitherto devised; but in addition to these drawbacks the machines have been disproportionately heavy and bulky and made up of a great number of parts difficult of access, maintenance, adjustment, or repair, as well as expensive to set up and operate, all of which, in view of the torn, chipped, scored, and rough product, difficult and expensive to finish, has prevented the general adoption of these machines. We believe that these difficulties and objections are due principally to the fact that the operation of the retracting mechanism and the cutting-tools depending thereon has not been simultaneous with the moment of side contact of the pattern with the tracer. In other words, in order to place the retracting mechanism in operation through the medium of the tracer it has been considered indispensable to permit or provide for the preliminary movement of the tracer by the moving pattern. This condition, structurally analyzed, develops a differential or lost motion between the tracer and the tools, the latter being delayed in their movement away from the moving work or carving, endangering the integrity of the design and the prominences and delicate portions of the carving. We have further observed that the work or carving is jeopardized and breakages thereof are frequent because of additional lost motion resulting from the complicated connections that have been employed between the tracer and the cutting tool or tools, which lost motion is constantly increased by wear. Likewise, we believe that the surface inequalities of the carving have been principally due to the simultaneous employment of several tracers upon a pattern and several tools upon a single piece of work, it being practically impossible to secure equally-accurate work by all the tools, the result of the relative inaccuracy being longitudinal scores or lines in the work. Again, the transverse scores or lines observed in the carvings heretofore produced have been the result of the step-by-step feeding of the work, secured by several longitudinal adjustments of pattern and work, during which the working level is frequently changed. Other objections are due to the awkward construction and arrangement of the pattern and work carrying parts or tables, the same having invariably been separate parts, between which the tracing and cutting members have been inaccessibly located, and the latter, because of their position, have necessarily been compactly arranged, thereby increasing the difficulty of reaching them for purposes of lubrication, adjustment, and repair.

In view of the foregoing the particular objects of our invention are to provide a carving-machine that may be properly termed "automatic," in which the work and pattern shall lie in a horizontal plane and move together, their relations being absolutely fixed, in which gravity shall be relied upon for the return of the tracer and the cutting-tools to the pattern and work, in which the operation of the retracting or lifting mechanism shall be simultaneous with and in proportion to the pressure of the pattern against the tracer-point, in which the cutters shall be positively connected with the tracer to move simultaneously therewith, in which every part shall be conveniently accessible at all times, in which the stroke or reciprocation of the pattern and work shall be equal to the length of the pattern, in which but a single cutting-tool shall be employed upon each piece of work, which will produce exact copies as to form and size, which will be of light weight, which will occupy a comparatively small space, and which shall be adapted for carving designs upon flat, curved, and cylindrical surfaces.

Our invention consists generally in an automatic carving-machine of the construction and combination of parts hereinafter described, and particularly pointed out in the claims.

The invention will be more readily understood by reference to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a side elevation of an automatic carving-machine embodying our invention. Fig. 2 is a front view thereof, the forward portion of the machine being shown in section on the line 2^X 2^X of Fig. 1. Fig. 3 is a rear elevation of the carving-machine. Fig. 4 is a longitudinal vertical section on the line 4^Y 4^Y of Figs. 2 and 3. Fig. 5 is a plan view of the machine in horizontal section on the line 5^U 5^U of Figs. 1, 2, 3, and 4. Fig. 6 is a detail of the side of the machine in elevation, showing the longitudinally-moving bed and the transverse feed-table thereon. Fig. 7 is an enlarged plan view of the feed-table partly broken away. Fig. 8 is a side view thereof, the side of the feed-table and the bed being broken away on the line 8^Z 8^Z of Fig. 7. Fig. 9 is a transverse sectional detail on the line 9^V 9^V of Fig. 7. Fig. 10 is another plan view of the feed-table partly broken away, showing how the work is arranged between centers therein. Fig. 11 is an enlarged section on the line 11^W 11^W of Fig. 10. Fig. 12 is a vertical transverse section substantially on the line 12^R 12^R of Fig. 10. Fig. 13 is an enlarged vertical section on the line 13^S 13^S of Fig. 10. Fig. 14 is a detail plan view of the bar carried by the cutting-tools and which prevents the chattering thereof. Fig. 15 is a cross-section on the line 15^T 15^T of Fig. 14. Fig. 16 is an enlarged front view of the tracer and the tracer elevating or retracting mechanism, the frame being shown in section on the lines 16^Q 16^Q of Figs. 17 and 18. Fig. 17 is a vertical transverse view of the tracer-elevating mechanism in section on the lines 17^P 17^P of Figs 16 and 18. Fig. 18 is a plan view of the tracer-elevating mechanism substantially on the line 18^N 18^N of Fig. 16. Fig. 19 is a sectional detail of one of the friction buttons or pieces on the line 19^M 19^M of Fig. 18. Figs. 20 and 21 are respectively front and side views of a modified form of the tracer elevating or retracting mechanism wherein a single disk is employed. Fig. 22 illustrates a further modification of the tracer-elevating mechanism wherein the tracer is placed between two friction-disks. Fig. 23 illustrates a modified positive connection between tracer and the cutters. Fig. 24 is an enlarged detail section on the line 24^L 24^L of Fig. 23.

Referring now to the drawings, our machine in its preferred form is made up of a horizontal reciprocating bed movable longitudinally upon a suitable frame and carrying a transversely-movable feed-table for the pattern and the several blocks or pieces of work, in combination with a tool-head bridging said bed and table and containing the cutting-tools, the tracer, and the retracting mechanism, said tracer and tools being preferably rigidly connected, and suitable means being provided for driving said bed, table, tools, and retracting mechanism. When the machine is set into operation, the pattern and the work are reciprocated slowly and also intermittently fed transversely beneath the stationary cutters and tracer. The tracer rests upon the pattern and being rigidly coupled to the cutters or tools controls the depth of cut in exact accordance with the pattern. The tracer and the tools drop or return by gravity, and the tendency of the moving pattern to lift or wedge up the tracer is assisted by the retracting mechanism, which operates instantly whenever the moving pattern exerts any considerable side pressure upon the tracer, the actuating member of the retracting mechanism being in constant rotation. Our invention will be better understood by separately considering the main parts of the machine.

The frame.—The carving-machines heretofore constructed have been of objectionable size and weight, principally due to the necessary employment therein of vertical feed-tables or carriers for the pattern and work. The machines have also been objectionable because of the arrangement of the working parts between the vertical feed-tables, where they cannot be reached conveniently; and one object of our invention is to improve the carving-machine as to weight and size and convenient access to its working parts. To this end we employ a low horizontal frame, on which the work and pattern are arranged in a horizontal plane, with all of the tools above them within easy reach, the tools being held in a very light frame or superstructure.

In the drawings, 1 is the main frame or bed of the machine. This is supported on legs 2, and its top is horizontal.

3 3 are light side frames erected on the frame 1, and 4 is the overhanging frame, bridge, or head for the tools. This extends transversely of the frame 1, some distance above the same, about midway of its length. The frame 1 carries the traveling bed 5 and the feed-table 6, one upon the other, while the bridge or head 4 supports the cutting-tools and the tracer mechanism.

7, 8, and 9 are longitudinal beams in the frame 1, and 10 and 11 are cross-beams between the beams 7 and 8. These beams are preferably cast integrally with the frame 1.

12 12 are hangers depending from the frame 1, having bearings for the power-shaft 13 of the machine.

The legs of the side frames are placed at the corners of the main frame 1, with unobstructed spaces between them. In these spaces we arrange the devices for controlling the longitudinal travel or stroke of the bed 5 and the transverse feed movement of the table 6. The head or bridge 4 of the frame has upper and lower parts 4^a and 4^b, connected by divisions 4^c and provided with the rise 4^d at the middle, the top thereof serving as the rest or stop for the tracer and tool coupling or connecting bar 14. On the rear upper corners of the side frames 3 we provide boxes or bearings 15 for the tool-spindle-driving shaft 16 and also provide bearings or fastenings 17 for the shaft 18 of the take-up or tension devices for the belts which drive the tool or cutter spindles.

The reciprocating bed.—With a view to simplifying the bearings of the work-carrying bed and to place the work and pattern within sight and reach we employ a horizontal bed 5 of less length than the frame 1 and having V's 5′, which slide freely in the longitudinal V grooves or ways 1′ provided on the top of the frame 1, at the sides thereof, the bed 5 being nearly as wide as said frame 1. The bed 5 is a rectangular frame or casting and is provided with a longitudinal part or beam 19′, upon the bottom of which is the rack 19.

20 is a worm or screw that engages with the rack 19 and whereby the bed is slowly moved or recipocated. The shaft of the worm 20 has bearings in the cross parts 10 and 11 of the frame 1 and is driven by its pinion 21 and a gear-wheel 22. The shaft of the large gear has a bearing in the lower part of the frame 11 and on its forward end carries the beveled gear-wheel 23. This being rotated in one direction causes the movement of the traveling bed toward the rear of the frame 1 and when reversed operates the bed through its return stroke. For operating the gear 23 and the bed we employ two beveled pinions 24 and 25, mounted, respectively, on the transverse shaft 26 and the sleeve-shaft 27. This shaft has bearings in the frame-beams 7, 8, and 9. To the shaft 26 we fasten the pulley 28 and to the sleeve-shaft 27 the pulley 29. Between the two pulleys 28 and 29 there is a loose pulley 30.

31 is a shifting belt extending from the broad pulley 32 on the power-shaft 13, of which 33 is the driving-pulley. The pinions 24 and 25 on opposite sides of the gear 23 rotate in the same direction and are employed to operate the frame in opposite directions, the reversal being obtained by shifting the belt 31 from one fixed pulley 28 29 to the other across the loose pulley 30. For this purpose we provide a shifter 34, engaging the belt 31 and held in slide-bearings in the side of the frame 1 and the part 9 thereof and operated from the bed 5. The operating connection comprises the bell-crank 35, pivoted in the frame 1, connected to the shifter or rod 34 and by a link 36 to the arm 37 of the rocking shaft 38, journaled in the frame 1. On the outer end of the rocking shaft 38 is an arm 39, provided with a pin 40, which lies in the path of the dogs or blocks 41 42 on the side of the reciprocating bed 5. These blocks are adjustable on the rod 43, provided on the side of the bed 5, and by means of them the stroke or reciprocating movement of the bed is determined. The block 42 engages the arm 39 near the end of the forward stroke of the bed and shifts the belt onto the pulley 29, thus setting the pinion 24 in action to run the bed back. Near the end of the backward stroke the block 41 strikes the arm 39 and shifts the belt 31 over the pulley 29 to reverse the bed. In addition to the pin 40 the shifting-arm 39 is preferably provided with a handle 44, by which the shifter may be operated to throw the belt 31 onto the loose pulley 30, and thus stop the movement of the bed. If desired, the bed 5 may have a rocking movement as it travels beneath the tools, in which case curved guides would be provided for the bed. Such a curved bed is convenient for use in the carving of curved articles or panels. The flat bed may be taken off and a curved bed used without alteration in the driving, regulating, and reversing means. When the machine is to be used only for carving of cylindrical pieces, the centers for holding the work may be placed in this bed 5; but this is an uncommon condition, and we prefer to provide a separate pattern and feed-table that is adapted for holding all kinds of work and feeding the same either transversely or revolubly.

The feed-table.—The feed-table 6 is horizontal, is of less width than the bed 5 and of substantially the same length, and the bed 5 is provided with transverse V-guides 45 at its ends, whereon the table slides freely. The movement of the table transversely is employed to feed the pattern and work to the tools, and this movement is secured by means of screw 46, the ends of which are held in the side and beam 18 of the bed 5. The connection between the table and the screw 46 is a threaded collar or sleeve 47, movable on the

screw and attached to the table 6. The screw 46 is rotated by means of a star-wheel 48 upon its outer end, adapted as the bed is reciprocated to engage with and be partially rotated by the stationary pins 49 and 50, held in the frame of the machine. These pins engage the top and bottom of the star-wheel 48 at opposite strokes of the bed, and the transverse movement is imparted to the table only at the ends of the stroke of the bed. The pins 49 and 50 are held in blocks 51 and 52, that are adjustably fixed upon the rods 53, which extend between the legs of the side frame 3 at the left-hand side of the machine. These pin-blocks are adjusted according to the position of the dogs 41 and 42 and are also adjusted to determine the extent of throw or rotation which they shall impart to the star-wheel 48, or, in other words, determine the feed movement of the table 6. When hard materials are being worked, the feed movement is very slight, while in soft material the side cut of the tools may range from one-sixteenth to one-fourth of an inch. This side movement of the table 6 is only employed when carving panels, as distinguished from round or cylindrical objects. For the latter work the star-wheel 48 is loosened on the screw-shaft, (after the table has been moved to a central position,) so that the reciprocation of the table will not cause its transverse movement, and thereafter the star-wheel 48 is employed to drive or rotate the center chucks, which are provided in the table. The detailed construction of the table is best shown in Fig. 2 and Figs. 6 to 13. The table comprises a rectangular iron frame or grating having a number of work-holding rods 54 extending longitudinally — that is, from front to back of the machine. These rods are fixed solidly in the rectangular frame and are sufficiently rigid to prevent their being bent or flexed by the weight of the "work" and tools thereon. For holding a flat pattern and a number of panels we provide two or more plates 55, which, if desired, may extend clear across the table, or there may be a number of these plates. The design shown in Fig. 7 in the position shown represents a carved panel. If placed at the middle of the table, it would represent the pattern, which is usually made of metal, though we propose in some cases to employ heavily-electroplated plaster molds or casts. As shown, the plates 55 have grooved blocks 56, resting on the rods 54 of the table and secured thereto by screw-clamps 57, the upper ends of which are T-shaped to be adjustable in the T-slots 58 of the plate 55. The pattern or panel, as the case may be, is fastened by screw-clamps 59, adjustable in the slots 58. The stroke of the bed is little in excess of the length of the pattern to be carved, and the screw-clamps 59 are therefore never struck by the tools.

For carving cylindrical objects, at which time the table is at rest on the bed, the plates 55 are removed and the work and pattern secured between the chucks 60 and the tailpieces or centers 61. The tailpieces 61 are pointed screws held in the bar 62, that is arranged within the frame of the table and is slidable upon the rods 54 thereof, set-screws 63 being provided to fasten the bar 62, as shown in Fig. 10. The chucks 60 are simple point-plates, (see Figs. 7 and 11,) the shafts 64 of which have bearings in the rear end of the table and carry worm-gears 65. Beneath the row of worm-gears we provide the shaft 66, carrying a row of worms or screws 67, meshing with the worm-gear 65. This shaft is held in bearings 68, provided on the rear end of the bed 5, and the worms 67 are connected to the shaft 66 by a key-slot in the shaft and keys in the worms 67, whereby the worms are adapted both for rotation by the shaft and to slide freely thereon without turning the chuck whenever the table is fed transversely across the bed by the means hitherto described. For keeping the worms in mesh with the gears 65 when the shaft 66 is rotated we provide a thrust bearing or bearings 69 on the end of the feed-table.

As before remarked, the star-wheel 48 is employed to drive the chucks or centers when the table is stationary on the bed, and this is accomplished by connecting the star-wheel and the shaft 66. We prefer the sprocket connection, comprising the sprockets 70 and 71 and the spocket-belt 72, as shown in Figs. 6 to 8. 73 is a hand set-screw in the hub of the star-wheel 48 for fastening the star-wheel to the screw-shaft 46 and which is released when center work is being done. It will be seen that it is only necessary to tighten or loosen this set-screw to change the machine from one kind of work to the other. If it is desired to carve spirals, the star-wheel may be continuously rotated except at the moments of reversal of the bed. It is seldom though sometimes desirable that the transverse and rotary feeds be used simultaneously. While it is not particularly objectionable to rotate the chucks 60 during the carving of panels, we prefer to loosen the set-screw 71′ of the sprocket 71 at such times, so that the shaft 66 will not be rotated. After the table has traveled the full distance across the bed it is reversed by simply giving the shaft 53 a half-turn, so as to present the pins 49 and 50 in reversed positions with respect to the star-wheel 48. It is for this purpose that the pins 49 and 50 are extended through the blocks, as shown in Figs. 2 and 5.

The cutting-tools.—For carving wood we employ side-bitted tools or cutters occupying positions perpendicular to the table 6 and rotated at a high speed. The spacing of the tools corresponds to the spacing of the chucks or centers in the table, with the exception that there is no cutting-tool opposite the middle chuck of the table, this space being reserved for the tracer. The cutting-tools 74 are held in tool-chucks 75, provided on the

lower ends of the tool spindles or shafts 76, which are held in vertical bearings 77 in the head or bridge 4 of the frame and extend some distance below the bottom of said head. The pulleys 78 are fastened to the spindle 76 between the bearings 77, and said bearings serve as bottom and top limiting-stops for the spindles and their tools. The pulleys 78 are permitted to rise and fall several inches, and the play of the pulleys between the spindle-bearings determines the length of tool 74 that can be employed and the depth of the cut of the tool, or, in other words, the highest-relief carving that may be produced on the machine. It is not necessary to employ the pulleys as stops, however, as suitable stops may be provided in connection with the tracer-bar. The upper ends of the spindles have collars 79 and are journaled in the lifting or coupling bar 14. The weight of this bar and of the spindles is partially compensated and cushioned by the springs 80, arranged beneath the bar, or other suitable means. 81 is a lever, by means of which the bar and the tools depending therefrom may be raised from the work at any time. The spindles upon opposite sides of the middle of the machine are preferably driven in opposite directions in order to equalize their force on the table during the work of carving, this being necessary to prevent the tendency of the table to twist under the tools. 82 is a bar, preferably of wood, having bushings 83 for the several spindles. This bar rests upon the top of the tool-chucks and by tying the spindles together as to their centers prevents much of the chattering and springing of the spindles experienced before the application of this antichatter-bar.

The tracer.—The tracer proper is a bar 84, having a hard tracer-point 85, that is adjustable in its lower end. Its upper end is fastened to and supports the cross or coupling bar 14. It is guided between antifriction-rolls 86 near its lower end and by oppositely-placed flanged antifriction-rolls 87 near its upper end. When the tracer-point is resting upon a prominence of the pattern, the bar 14 will be raised from the frame 4 and the tool-spindles will be elevated correspondingly. The connection between the tracer and the tools is thus made absolutely positive and rigid, and whenever the tracer moves the tools move with it. The bar 84 is preferably rectangular in cross-section and cannot rotate. When the pattern to be reproduced is of a gently-undulating character free from abrupt angles or shoulders, the pattern itself may be relied upon to wedge and move the tracer and tools upwardly upon its inclines. The tracer will naturally follow the downward inclines of the pattern. The requirements for patterns of this character are few, however, as designs in low relief can be produced more cheaply by the well-known process of pressing or crushing the wood fibers, and the principal work required of an automatic carving-machine is the production of high-relief carvings. It is therefore necessary to provide powerful means to assist the tracer over abrupt inclines or shoulders in patterns of high relief or deep intaglio, and the principal object of our invention is to provide a tracer and cutter retracting mechanism that will be free from all of the objectionable features pointed out in the foregoing and which shall be free from lost motion. In short, the object of our invention is to provide a carving-machine with a retracting mechanism that is incapable of any other movement than strictly perpendicular or vertical movement with relation to the feed-table and which at the same time shall be highly sensitive and powerful in order to instantly free the tracer-point from a projecting shoulder of the pattern. The practice heretofore has been to employ a number of friction-pulleys adapted for peripheral engagement with the tracer-bar and to move the bar laterally into contact with the peripheries of these friction-pulleys, this being done by the moving pattern; but such a device is objectionable, not only by reason of the fact that a distinct movement of the tracer is required to set the mechanism in operation, but also because the rapidly-rotating friction-pulleys quickly wear scallops in the sides of the tracer-bar, which thus becomes more and more difficult to retract, increasing the chances of breakage.

The essence of our invention, so far as it concerns the retracting mechanism, lies in placing the rotary friction-pulleys in actual contact with the tracer-bar to start with, the pulley or pulleys themselves preventing any lateral movement of the tracer, and in depending upon pressure caused by the pattern to strengthen the engagement between the rotary pulleys and the bar to such an extent that the weight or resistance of the bar and attached parts will be overcome and the same will be forcibly retracted from the pattern and work. If constructed in accordance with our invention, the efficiency of a retracting mechanism of the old form may be greatly increased by placing the friction-pulleys in direct contact with the tracer-bar and depending upon pressure alone instead of movement and pressure to produce sufficient friction between the parts to cause the retraction of the tracer when struck by the pattern; yet on account of the scalloping of the bar we much prefer to entirely depart from the old constructions and to employ a retracting mechanism wherein the parts will wear smooth and increase in efficiency with use. The retracting mechanism which we prefer, therefore, has as its essential elements a friction-disk longitudinally fixed and a tracer-bar having contact pieces or buttons always in engagement with the sides (not the periphery) of said friction-disk and constituting a more or less positive connection therewith, according to the force that is exerted to press the bar upon the disk. While in this manner the tracer-bar and the frictional retracting-disk

are always kept in contact and are restrained from lateral movement, the frictional engagement of the tracer-bar with the friction-disk is too weak to affect the tracer until lateral pressure is exerted on the tracer-point; but the strength of the engagement between the tracer and the upwardly-turning friction-disk obviously increases in exact proportion to the lateral pressure that is placed upon the tracer-point, and when this becomes strong enough to overcome the weight of the tracer, the bar 14, and the cutter-spindles such associated parts will be slowly or instantly raised at a speed in exact ratio to the pressure exerted upon the tracer-point at any given moment. It will be evident, further, that when great pressure is exerted upon the tracer-point, as by a sharp shoulder in the pattern, such pressure will temporarily make the frictional connection between the bar and the disk quite as positive as a crank-pin connection would be, and as the peripheral speed of the disk is quite high under such circumstances the retraction of the tracer will be instantaneous and all danger to the tracer from the pattern will be avoided. After the tracer has mounted the rise in the pattern, either by a sudden movement of the tracer with the disk or because of the operation of the disk plus the wedging action of the pattern, it is obvious that the tracer will be relieved from side pressure, whereupon the relation of mere contact as opposed to pressure between the tracer-bar and the disk will be reëstablished and the force of gravity will return and hold the tracer upon a descending part of the pattern, and the tools, which are connected to the tracer by the rigid bar 14, will of course likewise descend and cut into the panels upon the feed-table.

Referring now to the drawings, it is to be noted that our preferred form of retracting mechanism comprises two large friction-disks 88 and 89 and the tracer-bar 84, the intermediate portion of which is bifurcated to admit the peripheral portions of the two disks, and said bar being provided with four contact pieces or buttons 90, that press upon opposite sides of the disks, one being provided on each side of each disk. The friction-disks are narrow-faced and of quite large diameter. They are fixed upon their shafts 91 and 92, and these shafts are fixed in bearings 93 in the frame 4 and by these bearings are positively held against longitudinal movement, which, if permitted, would amount to lateral movement at the tracer-point. The disks are slowly rotated in opposite directions and turn upwardly with relation to the tracer-bar, as indicated by the arrows, Fig. 16. They are driven by oppositely-pitched worms 93 upon the cross-shaft 94 and which mesh with the worm-gears 95, provided upon the forward ends of the disk shafts 91 and 92. The shaft 94 has three bearings 96 on the bridge 4. The buttons 90 in opposite sides of the tracer-bar are set against the sides of the disks, the adjustment being so close that there is no lost motion between the disks and buttons. The tracer-bar is capable of very free vertical movement in its roller-bearings, friction at all points except with the disk being substantially eliminated. The result is that when pressure is exerted upon the tracer-point in either longitudinal direction of the pattern the buttons upon the side (front or back) from which the pressure is exerted will be forced strongly against the sides of the disks, tending to frictionally clamp the tracer-bar upon the disks, without, however, moving the tracer laterally. From this moment the friction-disks, although they may continue to rotate without perceptibly lifting the bar, will tend to raise the bar, or, in other words, assist the wedging action of the pattern inclination, and if the pattern-angle is great the pressure upon the tracer-point will be such as to clamp the tracer upon the disks firmly enough to cause the buttons to more firmly adhere thereto and rise with the upward-moving sides of the disks, thus positively lifting the tracer-bar independently of the pattern, though without actually removing the tracer-point from contact with the pattern, and when a very abrupt shoulder is encountered in the pattern the maximum pressure of the pattern will be instantly exerted upon the tracer-point and, being communicated to the disks, will result in the instantaneous retraction or lifting of the tracer and the associated tools, the tracer in this instance usually rising clear of the corner or top of the shoulder, but instantly settling back upon the pattern, for it is obvious that as soon as the pattern-pressure is relieved the friction between the tracer-bar and the disks is also relieved and the tracer will instantly drop, being checked only by the cushions or springs 80, provided beneath the cross or coupling bar or beam 14. We always prefer to place the tracer midway of the group of cutter-spindles, so that the machine may be balanced, and as the tracer-bar has no play in its bearings the cross-beam 14 may be rigidly attached to the upper end of the tracer-bar.

The wear in the retracting mechanism is upon the end surfaces of the buttons 90 and upon the sides of the disks 88 and 89, and it is obvious that these parts will wear smooth, their efficiency being increased by their smoothness of surface. The friction-buttons 90 of the tracer-bar may be of the same material as are the friction-disks 88 and 89; but we prefer to secure a higher coefficient of friction by using another material, preferably hard or semihard rubber, which gives a high coefficient of friction upon a steel or iron surface. Any lost motion between the tracer-bar and the disks is instantly observed from the work that is being done by the machine. Therefore the friction-buttons 90 require occasional, though not frequent, attention. Furthermore, any material such as rubber, fiber, or wood used for friction-buttons possesses

considerable elasticity and if used alone between the tracer-bar and the disks without a rigid material would permit the tracer-bar to yield to a greater extent than we deem expedient. For these reasons we make the buttons proper, 90, of metal to contain the rubber or like material. As shown in Fig. 19, 90 is a tube the inner end of which is in constant contact with the side of the disks 88 89. This tube is threaded in the tracer-bar 84, and therefore is adjustable toward and from the disks. The inside or recess 97 of the tube contains the rubber 98, which is compactly forced into the tube and is independently adjustable against the disk by means of the screw-plug 90′, provided in the outer end of the tube 90. In practice the button is adjusted by applying a wrench to the end of the plug 90′, both the metal and rubber parts being simultaneously and delicately adjustable thereby. In this way we are able to secure a strong frictional engagement between the parts when necessary and at the same time preserve the fine metallic bearing between the buttons and disks. The wear upon the thin edge around the recess 97 is not very rapid, and the buttons are cheap and easily renewable.

The driving of the cutters and the retraction-disks.—In the carving-machines hitherto devised the faulty arrangement of the tracing and cutting tools between feed-tables has necessitated a very compact arrangement of the parts, and particularly the driving-belts, making it very difficult to repair damaged belts or to tighten pulleys which may become loose on their spindles. A distinct object, therefore, of this invention is to simplify the belting of the machine, and it is with a view to this that the bridge of the machine is designed. The shaft 16 on the rear end of the machine has a small pulley 99, driven by a belt 100 from a large pulley 101 on the power-shaft 13. On the shaft 16 are a number of pulleys 102 of narrow face and large diameter, one for each cutter-spindle, and from these narrow belts 103 extend around the small pulleys or sheaves 78 of the spindles 74. The tops of the pulleys 102 are preferably opposite the middle position of the pulleys 78, between the upper and lower portions of the bridge 4. The direction of twist of the belts determines the direction of rotation of the spindles, and, as shown in Fig. 3, the belts are twisted oppositely upon the two sides of the tracer, so that the spindles in the two groups of spindles run in opposite directions. To permit the rise and fall of the spindles and to take up the slack of the belts, we provide each belt with a tension device comprising a weighted lever 104, pivoted on the cross-shaft 18 and in its forward end provided with an idle pulley 105, over which the lower leg of the belt runs. In case the belt breaks, the operator standing in front of the machine is protected by the vertical divisions 4° in the bridge, which prevent the belt from throwing forward. The retraction-disks are driven by a belt extending from a pulley 106 on the shaft 16 to the pulley 107 on the shaft 94, the speed being much lower than that communicated to the spindles.

The operation of our machine is, in brief, as follows: When the driving-shaft 13 is rotated, the cutters and the tracer-lifting disks are set into rotation, but the traveling bed of the machine is not reciprocated until the shifter is thrown to move the belt 31 upon one or the other of the fixed pulleys 28 and 29. While the bed is stationary the pattern and the pieces of work are secured upon the feed-table in the machine, the plates 55 described, or the chuck centers being employed, according to the character of the pattern and work. After the pattern and the blocks of material are secured the shifter 39 is thrown to move belt 31 upon one of the fixed pulleys, and thereafter the bed will reciprocate slowly upon the frame and beneath the tracer and cutting-tools. The bed will be automatically reversed at the end of each stroke by the action of the dogs 41 and 42 and the shifting mechanism. In the meantime the table, which has been set to one side, will begin to feed transversely across the bed, so that at the end of each stroke of the bed the table will be given a slight feed movement beneath the tracer and the cutting-tools. In this way the work is fed toward the sides of the cutting-tools, which work at a depth varying with the elevation of the tracer by the pattern. As the bed reciprocates it is obvious that the pattern will move beneath the tracer and will cause its rise and fall either directly or through the operation of the forcible tracer-retracting mechanism. Whenever a prominent projection in the pattern encounters the tracer-point the instant pressure of the pattern thereon will cause a lift or jump of the tracer to lift the bar 14 and all of the cutting-tools. Thus by reciprocation and transverse movement of the pattern and work and by vertical movement and control of the cutting-tools the exact pattern or design is produced upon the panels or blocks upon the table during one complete transverse movement of the table. In case it is desired to inspect the work at any time the bed may be stopped by throwing the shifter 39, or the bed may continue to move and the tools may be lifted by means of the lever 81. When the work has been completed, it will be removed from the table and new work placed thereon, after which the rod 53 will be given a half-turn to reverse the pins 49 and 50, so that the feed-table will move back or return during the completion of the second lot of work. The operation of the parts in detail will be understood from the foregoing detailed description.

There are various possible modifications of our invention, some of which are shown in the drawings. Thus in Figs. 20 and 21 we have illustrated a retracting mechanism in which but one rotating disk 88′ is employed

for elevating the tracer-bar; but we prefer the construction shown in the main figures of the drawings, as the two oppositely-rotating friction-disks serve to balance the forces upon the tracer-bar.

Instead of placing a single friction-disk between the parts of the tracer-bar the tracer-bar may be made as shown in Fig. 22, disks 88^2 88^2 being arranged upon opposite sides of the tracer-bar to be engaged by the buttons arranged between the disks and simultaneously adjustable in the tracer-bar by means of the right and left adjusting-screw 110.

Further, our invention may be modified to the extent of employing upwardly-traveling belts to take the place of the friction-surfaces presented by the sides of the rotary disks. In this case we should prefer to make the belts of leather and have them travel over plain metal surfaces, the contact-buttons of the tracer-bar being preferably of a different material in order to secure as high a coefficient of friction as possible and at the same time secure durability for the parts. In place of leather belts metal belts may be used. Further, our invention may be modified to the extent of dispensing entirely with the friction-retracting mechanism and adapting the point of the tracer to rapid auxiliary vibration in either lateral or vertical directions, with a view to diminishing the friction between the tracer-point and the pattern, so that the tracer-point will climb up the elevations of the pattern. Again, the tracer and cutting-tools may be subjected to a constant elevating force, and this may be opposed by magnetic attraction between the tracer-point and the pattern, which attraction will vary according to the area of contact between the pattern and the tracer-point. It is obvious also that the tracer-bar may be actuated by fluid-pressure and by the direct application of retracting-magnets. In any of these cases the other portions of the machine would remain as shown in the drawings.

Any suitable means may be employed for communicating a vertical movement of the tracer to the tool-spindles so long as the means are of a positive character, and the coupling shown in the main figure of the drawings may be modified, as illustrated in Fig. 23. Here the coupling or cross bar instead of having vertical movement is movable longitudinally. The upper end of the tracer-bar 84′ operates against the wedge-surface 119 of the bar 120 to force the bar outwardly along the top of the bridge 4 of the machine-frame. The bar in turn is provided with wedges or inclines 121, which operate to raise the tool-spindles 76′. By varying the inclinations of the cams or wedges 121 a variety of panels may be produced from a single pattern, the same varying in depth of relief, while being strictly proportional and exact in plan and contour. Antifriction means are interposed between the tracer and each part of bar 119, between the bars and the frame 4, and between the upper ends of the spindles 76 and the wedges 121 of the bars 119. The weight of the spindles upon the inclines or wedges 121 will cause the automatic return of the bars when free from the tracer; but we prefer to exert the force of a spring upon the end of each bar 119, as indicated in Fig. 23.

The cutters for ordinary work are side cutting-tools or bits; but fixed planer-points may be substituted therefor, the spindles being adapted for vertical movement only; but in place of such a tool we may substitute milling-cutters in the lower ends of vertical moving spindles or tool-bars 74, driving the cutters by any suitable means and preferably reversing them at the end of each stroke of the bed. These cutters are adapted for working iron and other metals and may be replaced by grinding-wheels for the cutting of harder materials, such as glass. For cutting stone reciprocatory hammers or chisels may be substituted in the lower ends of the spindles or tool-bars 74. Our machine, made in various sizes and proportions, is adapted for all classes of carving and engraving work, ranging from minute articles, such as watchcases and the like, to large figures and designs in wood, metal, and stone.

The term "relief-pattern" herein and hereinafter employed is intended to include reverse or obverse and intaglio patterns and any pattern having surface prominences.

It is obvious that numerous other modifications of our invention will readily suggest themselves to one skilled in the art, and we therefore do not confine our invention to the particular construction herein claimed and described.

Having described our invention, we claim as new and desire to secure by Letters Patent—

1. In a carving-machine, a cutter in combination with a tracer wherewith said cutter is movable, a pattern and work holding and feeding mechanism, the relief-pattern held thereby and engaging said tracer and limiting the movement thereof in one direction, and a driven device exerting retractile force upon said tracer at all times, said force increasing in proportion to the lateral pressure of the pattern on the tracer, substantially as described.

2. In a carving-machine, a cutter in combination with a tracer wherewith said cutter is movable longitudinally, a pattern and work holding and feeding mechanism, the relief-pattern held by said mechanism, engaging said tracer, limiting the movement thereof in one direction, and exerting pressure upon said tracer laterally to its direction of movement, and a driven device at all times exerting retractile force upon said tracer, the force of said driven device upon said tracer increasing in proportion to the lateral pressure of the pattern upon the tracer whereby said tracer is retracted upon lateral engagement with said pattern, substantially as described.

3. In a carving-machine, the connected cutter and tracer; and, the pattern and work holding mechanism, movable relatively to one another in intersecting planes, in combination with the relief-pattern engaged by said tracer, limiting the movement thereof in one direction, and exerting varying pressure upon the tracer during the relative movement of the pattern and tracer; and a retracting device operating upon said tracer at all times with a force that increases in proportion to the pressure of the pattern upon the tracer and said device coacting with the pattern to retract the tracer and cutter, substantially as described.

4. In a carving-machine, a tracer longitudinally movable, and positively held against other movement, a cutter moved and controlled by said tracer, a pattern and work holding mechanism movable laterally with relation to said tracer, the relief-pattern held by said mechanism, slidably engaged by said tracer continuously and exerting lateral pressure upon said tracer during the movement of said mechanism, and a driven device continuously coöperating with said pattern to retract said tracer and cutter, substantially as described.

5. In a carving-machine, a tracer movable longitudinally and held against lateral movement, in combination with a cutter movable with said tracer, a laterally-movable pattern and work holding and feeding mechanism, the relief-pattern held thereby, engaging and exerting lateral pressure on said tracer, and a device exerting retractile force upon said tracer at all times, the force exerted by said device upon the tracer being increased by the lateral pressure of the pattern on said tracer, substantially as described.

6. In a carving-machine, the relatively movable cutter and the work-holding mechanism, in combination with the relatively movable tracer and relief-pattern, said tracer being connected with and controlling said cutter, said pattern being engaged by said tracer, limiting the movement thereof in one direction, and exerting pressure thereon during the relative movement of the tracer and pattern, and a retracting device operating upon said tracer at all times and with force increasing in proportion to the pressure of the pattern thereon, substantially as described.

7. In a carving-machine, the cutter and the work-holding mechanism relatively moved while in engagement, in combination with a tracer and a relief-pattern relatively moved while in engagement, said tracer and said cutter being connected together for movement corresponding to the sinuosity of the pattern, said pattern exerting varying lateral pressure upon the tracer during said relative movement, and a driven retracting device associated with said tracer exerting retractile force thereon at all times and retracting said tracer simultaneously with the exertion of lateral pressure upon the tracer by said pattern, substantially as described.

8. In a carving-machine, the pattern and work holding and feeding mechanism, in combination with a longitudinally-movable tracer and connected cutter, with relation to which said mechanism is laterally movable, a pattern carried by said mechanism in slidable engagement with said tracer and exerting a varying lateral pressure thereon, and a retracting device engaged with said tracer, said device and associated parts constantly holding said tracer against lateral movement by said pattern and said retracting device operating automatically to retract said tracer with a force and speed increasing in proportion to the increase of lateral pressure of said pattern upon said tracer, substantially as described.

9. In an automatic carving-machine, the pattern and work holding and feeding mechanism, in combination with a longitudinally-movable tracer and a cutter connected therewith, with relation to which tracer and cutter said mechanism is laterally movable, a continuously-rotated retracting device constantly engaged with said tracer, and parts associated with said device holding said tracer against lateral movement, substantially as described.

10. In a carving-machine a longitudinally-movable tracer, in combination with a mechanism carrying a relief-pattern and the work and moved laterally with relation to the direction of movement of said tracer, said pattern as it is moved exerting varying lateral pressure upon said tracer, a cutter connected with said tracer and movable therewith, and a driven tracer-retracting device in constant frictional engagement with said tracer and functionally responsive to the pressure of the pattern upon the tracer, substantially as described.

11. In an automatic carving-machine the pattern and work holding and feeding mechanism and the relief-pattern thereon, in combination with a rigid tracer rigidly held for movement only toward and from said pattern, a cutter moved with said tracer, and a driven retracting device in constant frictional engagement with said tracer and functionally responsive to lateral pressure, and said tracer communicating the lateral pressure of the pattern upon the tracer to said device, substantially as described.

12. In an automatic carving-machine the pattern and work holding and feeding mechanism and the relief-pattern held thereby, in combination with the cutter, a continuously-operating retracting device, and a tracer connected with said cutter and constantly pressing upon said retracting device, said pattern as it is moved augmenting the pressure of said tracer upon said device and thereby causing the retraction of the tracer and cutter by said device, substantially as described.

13. In an automatic carving-machine a plu-

rality of cutters, in combination with a single tracer connected with all thereof, the pattern and work holding and feeding mechanism, the relief-pattern held thereby and engaged with said tracer and exerting varying pressures thereon, and a driven retracting device at all times exerting retractile force upon said tracer and opposed thereby and functionally responsive to the pressure of the pattern upon said tracer, substantially as and for the purpose specified.

14. In an automatic carving-machine the pattern and work holding and feeding mechanism, and the relief-pattern held thereby, in combination with a reciprocable tracer, one or more cutters connected therewith, and a rotating friction device constantly engaged with said tracer and communicating thereto movements that vary in length and correspond to the varying relief of the pattern, substantially as described.

15. In a carving-machine the connected cutter and tracer and the relatively movable work and pattern holding mechanism, in combination with a driven retracting device exerting retractile force upon said tracer at all times and causing the same to retire when subjected to pressure, substantially as described.

16. In a carving-machine the connected cutter and tracer and the relatively movable work and pattern holding mechanism, in combination with a driven retracting device at all times in frictional engagement with said tracer and exerting retractile force thereon causing its retraction when subjected to pressure, substantially as described.

17. In an automatic carving-machine the pattern and work holding and feeding means in combination with the cutter and a retracting mechanism comprising a relief-pattern tracer-bar and means at all times exerting a retracting force upon the tracer-bar and increasingly effective to retract the tracer in proportion to the lateral force wherewith the tracer-bar is applied to said means, and means partially counterbalancing said tracer and cutter, substantially as described.

18. In an automatic carving-machine the pattern and work holding and feeding mechanism, in combination with a cutter movable toward and from said mechanism, a relief-pattern tracer connected to said cutter, and a continuously-moving means in engagement with the tracer constantly tending to retract the same, and made functionally operative, to move the tracer, by side pressure upon the tracer, substantially as described.

19. In an automatic carving-machine, the pattern and work holding and feeding mechanism, in combination with a cutter and a relief-pattern tracer suitably connected and normally in engagement with the work and pattern respectively, and a driven retracting device functionally dependent upon pressure, constantly tending to retract said tracer and cutter but insufficient to retract the same until pressure is applied to increase the retractile tendency of said device, substantially as described.

20. In an automatic carving-machine, the pattern and work holding and feeding mechanism, in combination with the cutter movable toward and from said mechanism, the tracer movable with said cutter, driven means constantly tending to retract said tracer and cutter and operating to retract the same simultaneously with the lateral engagement of the pattern with the tracer, substantially as described.

21. The pattern-tracing and cutter-retracting mechanism for carving-machines comprising a longitudinally-movable cutter-operating tracer-bar, in combination with driven means constantly exerting a retractile force upon said tracer-bar and retracting the tracer-bar when subjected to lateral pressure or thrust, substantially as described.

22. In a carving-machine the mechanism for holding and feeding the pattern and work, in combination with a relief-pattern tracer and a cutter movable toward and from said mechanism, said mechanism being laterally movable with relation to said tracer and cutter, a continuously-driven retracting device constantly engaged with said tracer, and said device with associated parts holding said tracer against movement laterally with said mechanism and exerting a retractile force upon said tracer at all times, said force increasing when the tracer is pressed upon said device by laterally-directed force, substantially as described.

23. In an automatic carving-machine the pattern and work holding table and means for moving the same in a horizontal plane, in combination with a vertical tracer-bar and a vertically-movable cutter, said bar and cutter being connected and normally depressed by gravity, means partly counterbalancing the weight of the connected tracer-bar and cutter, and a retracting device driven in constant engagement with said tracer-bar and tending to retract the same, and made functionally operative to lift the tracer-bar and cutter by the pressing of the tracer-bar thereon, substantially as described.

24. The retracting mechanism for carving-machines comprising a longitudinally-movable tracer-bar, fixed guides for said bar, and a continuously-driven retracting device associated with said guides for preventing lateral movement of said bar, said device operating to move said bar longitudinally and said bar being sensitive to movement by said device from the moment of the application of lateral pressure thereto, substantially as described.

25. In an automatic carving-machine, the pattern and work carrying table in combination with a single tracer and a plurality of cutters, connected for simultaneous perpendicular movement with respect to the pattern and work, and a driven retracting mechanism in continuous retractile engagement with

said tracer and made increasingly effective to retract the tracer by the lateral pressure of the pattern upon the tracer, substantially as described.

26. In an automatic carving-machine, the pattern and work carrying mechanism in combination with a tracer-bar and a cutter suitably connected and movable toward and from said mechanism, and a rotary retracting device exerting retractile force upon said tracer-bar at all times and functionally responsive to varying lateral pressure upon said bar, substantially as described.

27. In an automatic carving-machine, the pattern and work carrying mechanism in combination with a tracer-bar and a cutter-spindle suitably connected together and movable toward and from said mechanism as required to trace a relief-pattern, a rotary retracting device, said bar having parts in constant engagement with opposite sides of said device and said device causing the retraction of the bar and spindle when either of said parts is forcibly pressed upon said rotary device, substantially as described.

28. In an automatic carving-machine, the pattern and work feeding mechanism in combination with a tracer-bar and a cutter-spindle connected for simultaneous movement, a rotating friction-disk, said bar having friction-buttons coöperating with opposite sides of said disk, and suitable guides for said bar and spindle, substantially as and for the purpose specified.

29. In an automatic carving-machine, the pattern and work feeding mechanism in combination with a tracer-bar and one or more cutter-spindles connected therewith a rotary friction-disk, said bar having projections in constant frictional engagement with opposite sides of said disk and guides which with said disk prevent lateral movement of said bar, substantially as and for the purpose specified.

30. In an automatic carving-machine, the combination of a traversing feed mechanism for the pattern and work with a tracer and cutters suitably connected and normally engaged with the pattern and work, and a friction-disk suitably rotated, said tracer having friction parts on opposite sides of said disk to coöperate therewith in retracting the tracer, as and for the purpose specified.

31. In an automatic carving-machine, the combination of a traversing feed mechanism for the pattern and work, with a tracer and cutters suitably connected and normally engaged with the pattern and work, and a driven friction-disk, said tracer having friction parts normally in contact with opposite sides of said disk, whereby when the tracer is subjected to lateral pressure the same will be retracted by said disk, substantially as described.

32. The combination, of a frame, with the friction-disk mounted to rotate therein and held against movement in the direction of its axis, the tracer-bar to receive lateral pattern-pressure and having a bearing at its outer end in said frame, the other end of said bar being engaged with said disk and thereby held against movement in the direction of said axis and said disk being adapted to move said bar in its bearing in said frame, substantially as described.

33. In an automatic carving-machine, the work and pattern feeding mechanism in combination with a cutter, a suitably-guided tracer connected therewith, contact-buttons provided on said tracer, and the driven disk moving between said buttons for engagement therewith, substantially as described.

34. In an automatic carving-machine, the work and pattern feeding mechanism in combination with a cutter, a tracer connected therewith, contact-buttons provided on said tracer, the driven disk moving between said buttons, and the antifriction-bearings for said tracer above and below said disk, substantially as described.

35. In an automatic carving-machine, the work and pattern feeding mechanism in combination with a cutter, a tracer-bar connected therewith, the contact-buttons provided on said tracer-bar, the oppositely-rotated disks moving between said buttons, the antifriction-rolls 86, below said disk and therewith guiding said tracer-bar, substantially as described.

36. The tracer-retracting mechanism for carving-machines comprising the frame, the tracer-bar slidable in bearings therein, the oppositely-rotated disks 88 and 89 and the friction-buttons provided on said bar upon opposite sides of said disks to coöperate therewith, substantially as and for the purpose specified.

37. In an automatic carving-machine, the combination with work and pattern feeding means, of a plurality of cutter-spindles, a tracer-bar, said spindles and bar being connected and movable together, the oppositely-rotated disks 88 and 89 embraced and constantly engaged by said tracer-bar, and suitable guides wherein said bar and spindles are movable by said disks, substantially as described.

38. The combination of the frame 4 with the friction-disks 88 and 89 having bearings therein and held against movement in the direction of their axes, the tracer-bar guided at its outer end by a suitable bearing and having its inner portion in continuous contact with and guided by said friction-disks, substantially as described.

39. In an automatic carving-machine, the pattern and work carrying means in combination with a plurality of cutter-spindles, a tracer-bar parallel therewith and connected with the spindles to communicate its movement thereto, a rotary friction device, and contact-buttons provided in said bar and having friction portions or fillers, substantially as described.

40. The tracer-retracting mechanism com-

prising the rotary friction member and the tracer-bar having the opposed friction-buttons for coöperation with said member, each of said buttons comprising a metallic tube adjustable in said bar and a filler, substantially as described.

41. In an automatic carving-machine, the combination with the horizontal frame, of the horizontally-movable bed, the table thereon, the transverse tool head or bridge, the cutter-spindles therein, perpendicular to said bed, the tracer-bar parallel to said spindles and coupled to said spindles, means for rotating said cutters, the opposite disks 88 and 89 held against axial movement in said bridge, the contact-buttons in said tracer-bar engaging the upwardly-turning sides of said disks, the worm-gears for said disks and the worm-driving shaft upon said bridge, substantially as described.

42. In an automatic carving-machine, the pattern and work feeding table and means for moving the same in combination with the frame bridging said table, a plurality of rotating cutter-spindles arranged in said frame and movable in a plane substantially perpendicular to said table, a tracer-bar parallel with said cutter-spindles, means rigidly connecting said tracer-bar and said spindles, the oppositely-rotating friction-disks substantially in the plane of said tracer-bar and spindles, said tracer-bar partly embracing said disks and having friction-buttons coöperating with said disks, and suitable driving means for said disks and spindles, substantially as described.

43. In an automatic carving-machine, the tracer-bar, guides for the bar in which the bar is slidable, the cutter or cutters movable with said bar, the rotating friction-disk in constant frictional engagement with said bar, means for taking up the wear between said bar and disk, and suitable pattern and work holding and feeding means, substantially as described.

44. The retracting mechanism for carving-machines comprising the cutter-operating tracer-bar 84, the bearings for said bar, the oppositely-rotating friction-disks 88 and 89, the friction buttons or parts 90 upon said bar engaging the opposite surfaces of said disks, and means for taking up the wear between said buttons and said disks, substantially as described.

45. In a carving-machine, the work and pattern feeding table and suitable driving means therefor in combination with a tracer, a plurality of cutters all connected with said tracer and movable therewith toward and from said table, and a driven retracting device in constant frictional engagement with said tracer to coact with the pattern and retract the tracer and cutters, substantially as described.

46. In a carving-machine, the work and pattern feeding table and suitable driving means therefor in combination with a tracer, a plurality of cutters all connected with said tracer and movable therewith toward and from said table, and a single driven retracting mechanism associated with said tracer and at all times exerting retractile force upon said tracer, the force expended upon the tracer by said device varying with the sinuosity of the pattern followed by the tracer, substantially as described.

47. In a carving-machine, a tracer, a plurality of cutters rigidly connected for movement therewith, a work and pattern holding and feeding mechanism, a relief-pattern held thereby, and a constantly-actuated retracting device arranged in connection with said tracer, exerting retractile force thereon at all times and instantly coactive with the pattern to retract the tracer and cutters, substantially as described.

48. In an automatic carving-machine, a suitable fixed frame in combination with a bar 14 movable toward and from said frame, the tracer movable in said frame for moving said bar, the plurality of cutter-spindles journaled in said frame, and suspended from and movable with said bar, suitable pattern and work feeding means and a driven retracting device operable automatically to retract said tracer-bar and spindles, substantially as described.

49. In an automatic carving-machine, the combination with pattern and work holding and feeding means of the fixed frame, a plurality of cutter-spindles movable toward and from the feeding means in said frame, a tracer likewise movable, a driven automatic retracting mechanism associated with said tracer for moving the same, the cross bar or beam arranged in the plane of said spindles and supported by said tracer and movable therewith, said spindles being journaled in said beam, substantially as described.

50. In an automatic carving-machine, the combination with a pattern and work holding table and feeding mechanism in combination with a plurality of cutter-spindles perpendicular to said table, a tracer, the driven retracting device associated with and constantly operating upon said tracer, and the bar or beam connecting said tracer with said cutters and movable parallel with itself, substantially as described.

51. In a carving-machine, the feed-table in combination with a plurality of parallel rotary cutter-spindles, the fixed frame bridging said table and having parallel journal-bearings for said spindles wherein the spindles are slidable, the tracer-bar guided in said frame, and the T bar or beam 14 carried by said tracer-bar, the ends of said spindles being journaled in said bar substantially as described.

52. In an automatic carving-machine, the feed-table in combination with the fixed frame bridging said table and having a plurality of parallel journal-bearings, the cutter-spindles revoluble and slidable in said bearings, the pulleys fixed to said spindles, the belts for

driving said pulleys and movable therewith, the bar or beam movable in the plane of said spindles and wherein said spindles are journaled and held, for simultaneous movement in said frame, and suitable tracing and retracting means operative upon said bar, substantially as described.

53. In an automatic carving-machine, the pattern and work holding and feeding table and means for reciprocating the same, in combination with a frame overhanging said table, a plurality of cutter-spindles having bearings in said frame, the tracer-bar also having bearings in said frame, the bar or beam 14 connecting said tracer-bar and said cutter-spindles and movable toward and from said table, the rotary friction-disk held in said frame, said tracer-bar having friction parts to coöperate with said disk and retract said tracer-bar, beam, and spindles, substantially as described.

54. In an automatic carving-machine, the horizontal pattern and work feeding means in combination with a tool-head, a tracer and a cutter-spindle vertically movable in said head, means for driving the cutter-spindle, a rigid bar suitably cushioned and connecting said tracer and cutter-spindle, and therewith operable by gravity toward the pattern and work and constantly-rotating means tending to retract said tracer and cutter and made effective by the pattern, as and for the purpose specified.

55. In an automatic carving-machine, the combination of a pattern and work feeding mechanism with a tracer and a series of cutter-spindles, the fixed frame having a pair of journal-bearings for said tracer and a pair for each spindle and rigid means movable in the plane of said spindles and wherein said spindles are journaled and connected with the tracer for movement simultaneously therewith, substantially as described.

56. In an automatic carving-machine, a relief-pattern and work feeding mechanism in combination with automatic means for reciprocating the same, a suitable fixed frame, a tracer and cutters individually mounted and all vertically movable in said frame, the single bar or beam rigidly connecting said tracer and cutters and movable in the plane thereof, automatic tracer-retracting means controlled by the pattern, and means for driving said cutters and said retracting means.

57. In an automatic carving-machine the pattern and work feeding mechanism and a pattern thereon, in combination with the tool-frame, a plurality of cutter-spindles having slide-bearings in said frame, the tracer-bar also slidable in said frame, the bar 14 connecting said tracer-bar and said spindles and movable toward and from said frame, means partly counterbalancing the weight of said bar, spindles and tracer, and the automatic tracer-retracting mechanism, substantially as described.

58. In an automatic carving-machine the pattern and work holding and feeding mechanism, in combination with the fixed tool-head, two groups of cutter-spindles, slide-bearings for each in said head, a tracer-bar located between the groups of spindles and longitudinally slidable in said head, a connection common to said spindles and the tracer-bar, positively joining the same for rigid movement together and a moving retracting device in said head operable to retract said tracer-bar and spindles, substantially as described.

59. In an automatic carving-machine, the rectangular frame occupying a horizontal plane, in combination with the reciprocating bed thereon, the pattern and work holding table transversely movable on said bed, the tool-head bridging said bed and fixed upon said frame, a plurality of vertical bearings in said head, cutter-spindles revoluble and slidable in said bearings, the tracer-bar vertically movable in bearings in said head midway of the group of spindles, means above said head connecting said tracer-bar with all said spindles, rotary tracer-bar-retracting means having fixed bearings in said head, and mechanisms for driving said retracting means and said spindles at different speeds.

60. In an automatic carving-machine, a suitable frame in combination with pattern and work supporting and feeding table moved therein, the tool bridge or head fixed upon said frame, the tracer vertically movable in said head, the continuously-revolving device provided in said head for retracting said tracer, the plurality of tool-spindles mounted in said head, means connecting said spindles with said tracer for rigid movement therewith, and whereon the spindles are suspended, and mechanisms for driving said retracting means, spindles and work-feeding means, substantially as described.

61. In an automatic carving-machine, the horizontal bed in combination with the reciprocating bed 5 and tool-head arranged above said bed transversely thereof and containing a plurality of tools, the rack upon the lower side of said bed, the worm meshing therewith, the driving-gear for said worm and pinions engaging opposite sides of said gear, the pulleys connected with said pinions and an automatic belt-shifting device operable by said bed, substantially as described.

62. The feed-table for automatic carving-machines, comprising the rectangular frame having transverse guides and a plurality of longitudinal rods 54, the center chucks provided in one end of said frame and the bar 62 adjustable upon said rods 54 and carrying the tailpieces or centers 61, substantially as described.

63. The table for automatic carving-machines, comprising the ends and a plurality of longitudinal rods 54, in combination with the bar 62 adjustable upon said rods 54, the centers 61 adjustable in said bar 62 and parallel with said rods 54, the center chucks pro-

vided in one of the ends of the table and the chuck-driving means carried by said end of the table, substantially as described.

64. The pattern and work feeding mechanism for automatic carving-machines, comprising the longitudinally-movable bed in combination with the table transversely movable upon said bed, bed-driving means, transverse table-feeding device provided upon said bed and including the intermittently-movable wheel 48 operated by the reciprocation of the bed, the chuck-centers provided upon said table and a common driving-shaft therefor provided upon said bed, and means for connecting said wheel 48 with said shaft or said transverse feeding device, or both, substantially as described.

65. The pattern and work feeding mechanism for automatic carving-machines, comprising the longitudinally-movable bed and operating means therefor, in combination with the feed-table transversely movable upon said bed, the table-feeding screw provided upon the bed and connected with the table, a plurality of center chucks provided in the end of said table, the worm gear-wheels therefor, the shaft 66 provided upon the end of said bed, the worms provided upon said shaft and slidable thereon with said table and means for driving said screw or said shaft, or both, by the reciprocation of said bed, substantially as described.

66. The pattern and work feeding mechanism for automatic carving-machines, comprising the longitudinally-movable bed and operating means therefor, in combination with the feed-table transversely movable upon said bed, the table-feeding screw-shaft provided upon the bed and connected with the table, a plurality of center chucks provided in the end of said table, the worm gear-wheels therefor, the shaft 66 provided upon the end of said bed, the worms provided upon said shaft and slidable thereon with said table, the star-wheel provided upon the screw-shaft, the belt or equivalent means connecting said wheel and the shaft 66 and means detachably securing said star-wheel to the screw-shaft, substantially as described.

67. The pattern and work feeding mechanism for automatic carving-machines, comprising the longitudinally-reciprocating bed, in combination with the table transversely movable upon said bed, the table-feeding device carried by said bed and including a star-wheel, the stationary rod 53, the oppositely-extending blocks 51 and 52 on said rod and provided with pins 49 and 50 reversible as to said wheel by the partial rotation of said rod 53 whereby the movement of the table may be reversed, substantially as described.

68. In an automatic carving-machine, the combination with pattern and work carrying means, of a tool-head and a series of parallel rotary cutter-spindles longitudinally movable in said head, means for driving said spindles, tracer mechanism controlling all of said spindles and the antichattering-bar carried by and movable with said spindles and connecting the same, substantially as and for the purpose specified.

69. In an automatic carving-machine, the pattern and work feeding means in combination with a tracer, a continuously-driven tracer-retracting device the plurality of cutter-spindles, the frame wherein said tracer and said spindles are movable vertically, the beam connecting said tracer and spindles and the springs partially supporting the weight of said bar and spindles, substantially as described.

In witness whereof we have hereunto set our hands, in the presence of two witnesses, this 14th day of November, 1901.

FRANK STREICH.
CHARLES L. RUEHS.

In presence of—
C. G. HAWLEY,
J. W. BECKSTROM.