July 24, 1951 E. SKILLMAN 2,561,826

ROTARY LATH PUNCH DRIVE

Filed Feb. 28, 1950 4 Sheets-Sheet 1

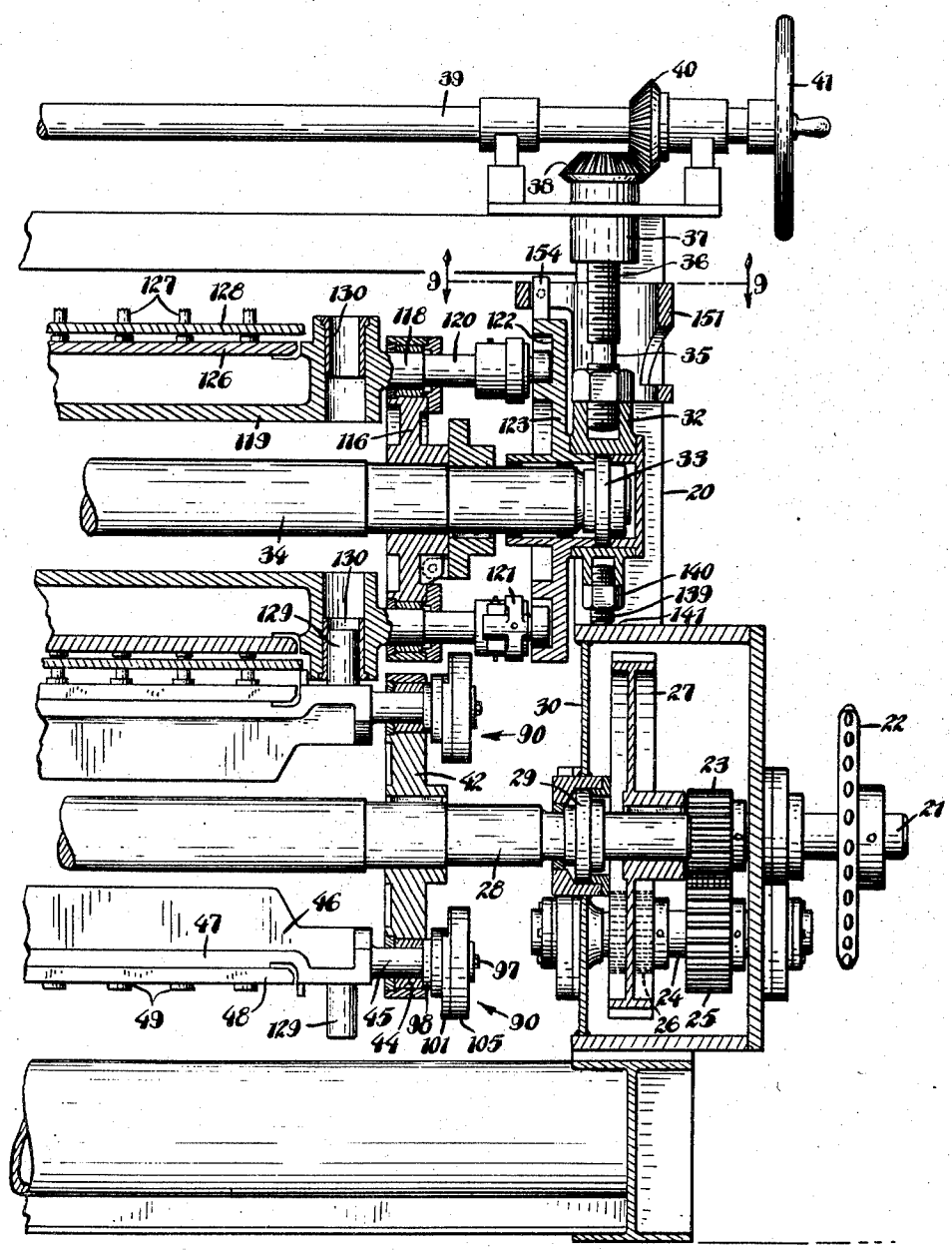

Fig. 1.

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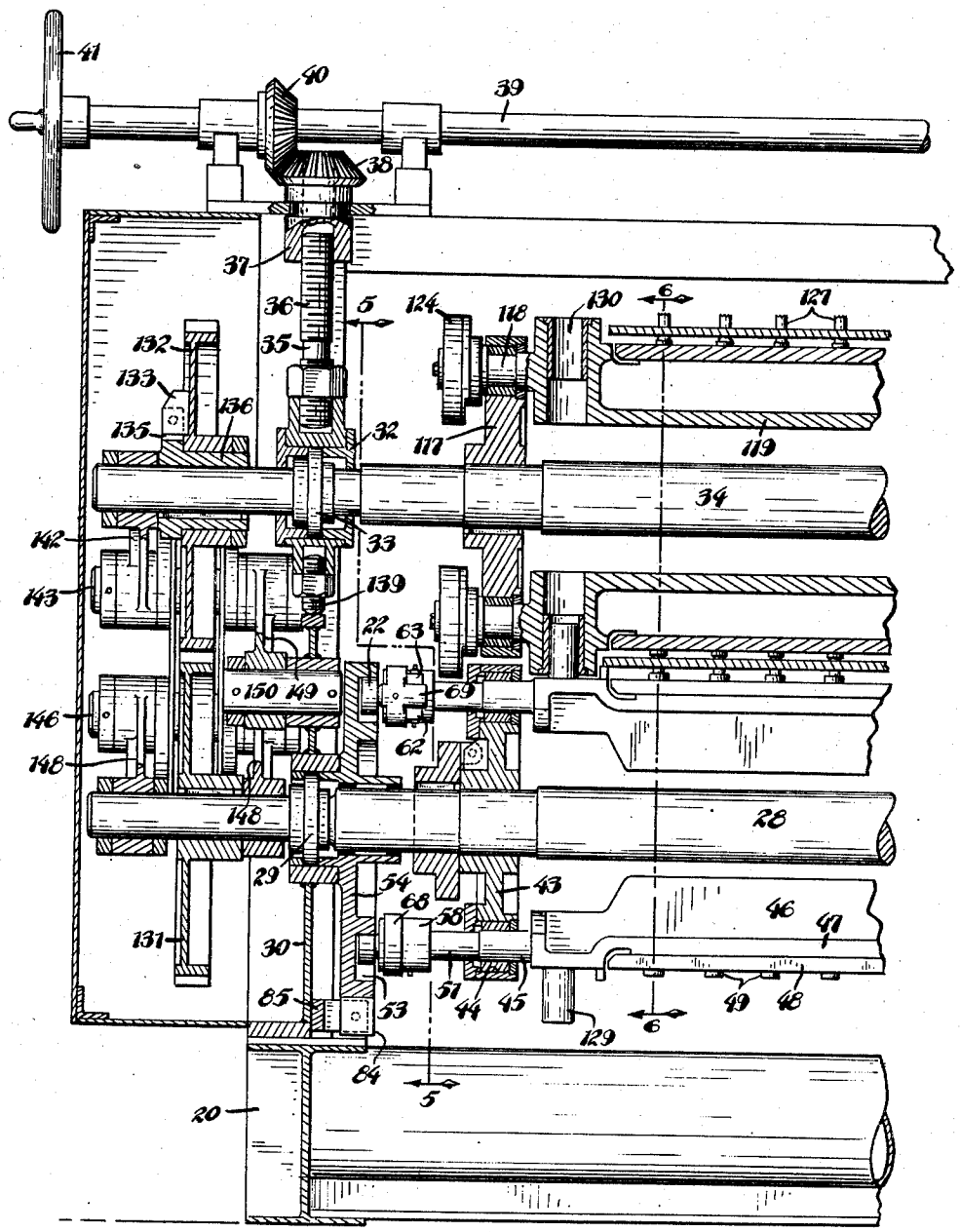

Fig. 2.

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ROTARY LATH PUNCH DRIVE

Filed Feb. 28, 1950 4 Sheets-Sheet 3

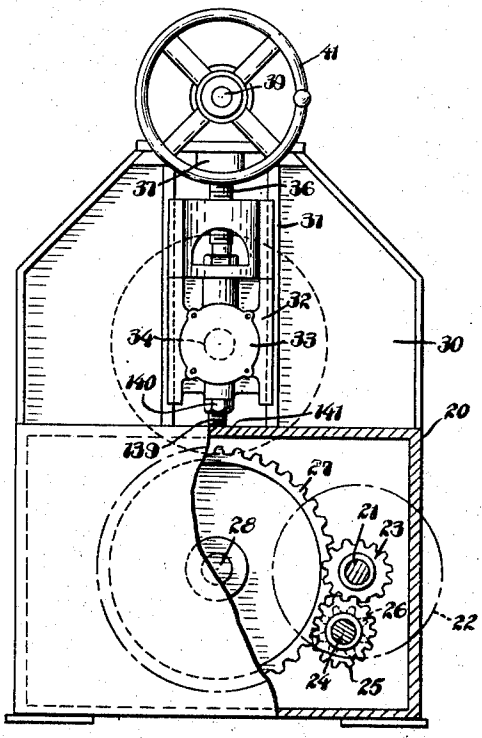


Fig. 3.

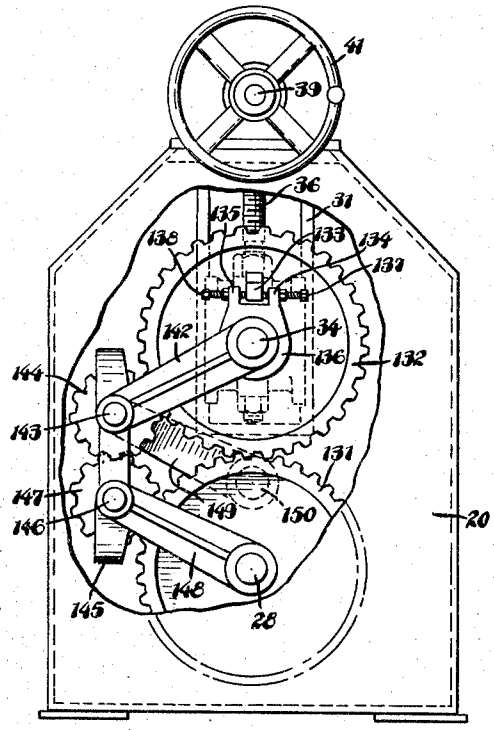


Fig. 4.

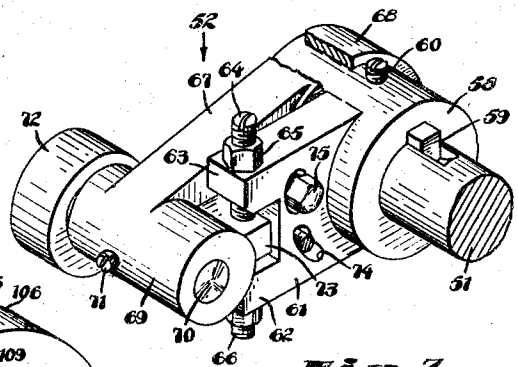
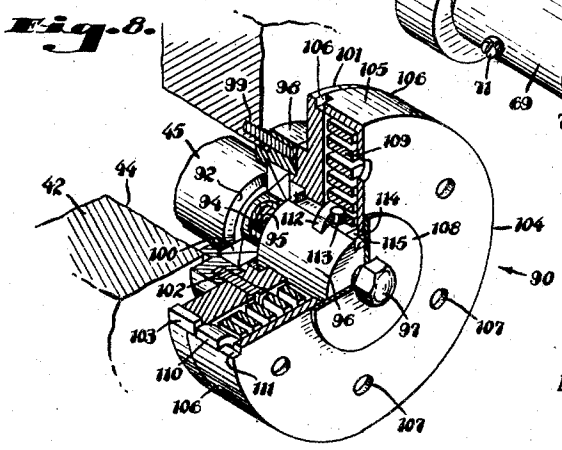


Fig. 7.

Fig. 8.



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ROTARY LATH PUNCH DRIVE

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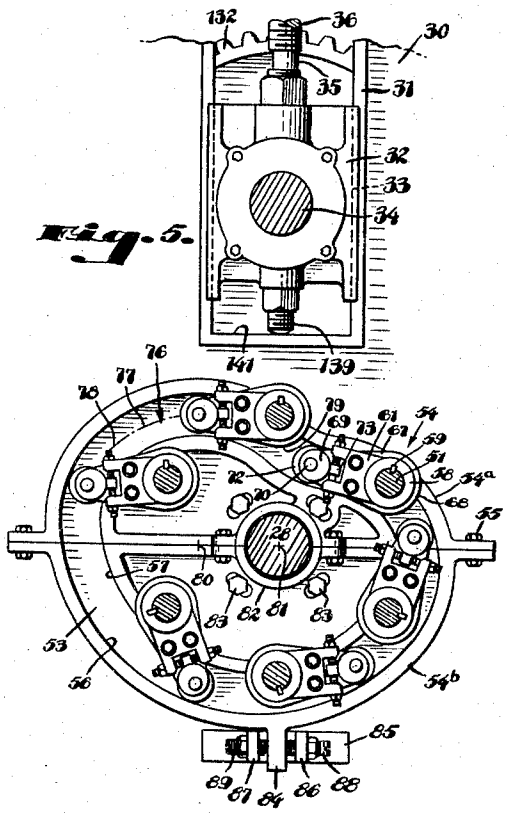

Fig. 5.

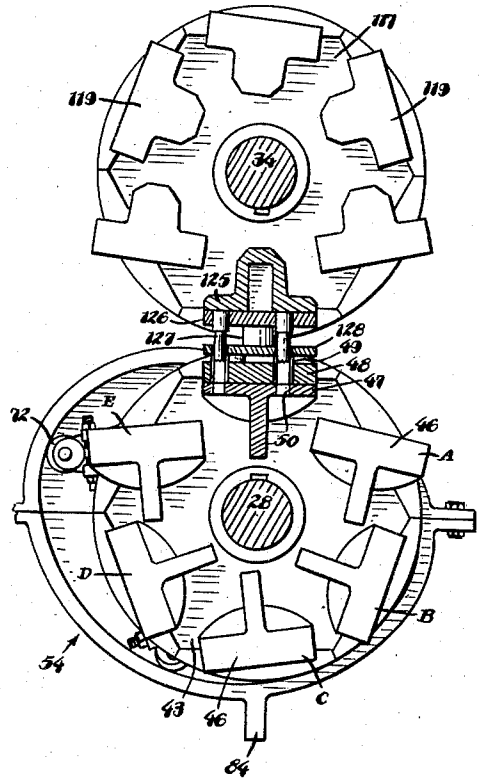

Fig. 6.

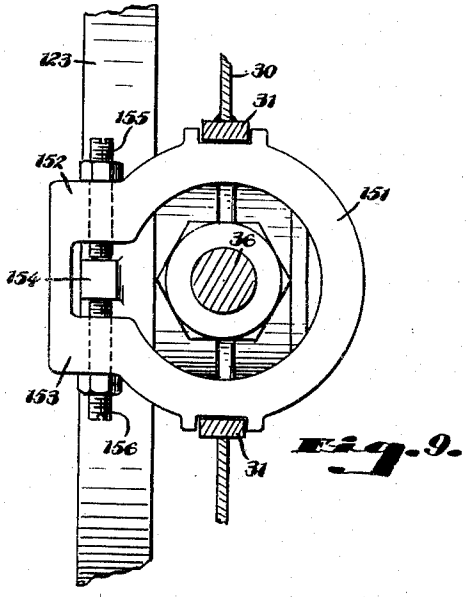

Fig. 9.

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Patented July 24, 1951

2,561,826

UNITED STATES PATENT OFFICE

2,561,826

ROTARY LATH PUNCH DRIVE

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Application February 28, 1950, Serial No. 146,769

17 Claims. (Cl. 74—25)

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The present invention relates to a rotary lath punch, and is particularly concerned with the improvement of certain details of structure, and a resultant improvement in operation, of previously known machines for accomplishing substantially the same basic function. That basic function, of course, is the production of multiple perforations in plaster lath flowing continuously, at uniform lineal velocity, from a board forming machine, by means of rotary punch and die assemblies. The conditions under which the work must be performed are substantially those described in the patent to Emmet D. Benham and John R. Rosenleaf No. 2,228,162, issued January 7, 1941, and the particular punch and die arrangement preferably used in the present machine will be substantially that disclosed in the patent to William J. Ehrsam No. 2,182,744, issued December 5, 1939.

A machine of the character here under consideration is primarily intended to perforate plaster lath, or other material moving through a machine in a continuous stream at a constant lineal velocity, by means of punches moving through the material upon lines normal to the plane of movement of the material, said punches concurrently moving with the material in the line of its flow and at its own velocity, while obviating the necessity of either starting and stopping the material flow or providing for reciprocation, in the line of material flow, of a carriage supporting the punching mechanism. Otherwise stated, such a machine must include punching mechanism, comprising cooperating elements moving continuously about separate closed orbits, but cooperating with a stream of material, moving uniformly in a single plane between those orbits, the punching mechanism being so operated as to penetrate the flowing material upon lines normal to the plane of movement of such material, while synchronizing the punching mechanism with the flowing material throughout the period of engagement of the punching mechanism with such material.

It is the primary object of the present invention to provide improved means for controlling the attitudes of gangs of punches and gangs of cooperating dies, arranged in separate series, during revolution of those gangs about separate axes, in such a fashion that, as each gang of punches approaches, passes through, and departs from a plane common to those axes, a mating gang of dies will similarly approach, pass through, and depart from that plane, in registry with the punching gang, and with the punches

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and the die axes precisely aligned and normal to the plane of flow of the material moving between the two gangs. It is a further object of the invention to provide such improved means which will so control the attitudes of the gangs of punches and dies that each gang will be inverted as it passes through the remaining portion of its orbit.

A further object of the invention is to provide, for each such gang of punches and for each such gang of dies, a follower arm of improved construction, all of such follower arms for the punch gangs cooperating with a single cam and all of such follower arms for the die gangs cooperating with another single cam, the follower arm construction being such as to provide for extremely delicate adjustment of the attitude assumed by its associated gang to correspond with any specific location of the follower arm relative to its cam. A further object of the invention is to provide improved means, in association with each such gang for resiliently holding its follower arm in cooperative association with its cam.

Still further objects of the invention will appear as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

Fig. 1 is a vertical sectional view through a fragment at one end of a machine constructed in accordance with the present invention;

Fig. 2 is a similar view of a fragment at the opposite end of such machine;

Fig. 3 is an end elevation, taken upon a reduced scale, and showing that portion of the machine illustrated in Fig. 1, parts being broken away for clarity of illustration;

Fig. 4 is a similar elevation of that part of the machine illustrated in Fig. 2, parts being broken away for clarity of illustration;

Fig. 5 is a sectional view taken substantially on the line 5—5 of Fig. 2;

Fig. 6 is a similar view taken substantially on the line 6—6 of Fig. 2;

Fig. 7 is a perspective view, taken upon an enlarged scale, and showing the details of construction of a follower arm;

Fig. 8 is a broken perspective view, likewise drawn to an enlarged scale, and showing the

structural details of the means for resiliently holding a follower arm in cooperative association with its cam; and

Fig. 9 is a fragmental horizontal section taken substantially on the line 9—9 of Fig. 1.

While the present invention is primarily designed for, and will be described in connection with, the perforation of green plaster board, it will be clear that the operational theories, and the specific structure illustrated, are applicable to the perforation of other punchable materials, of whatever nature, and to various pressing procedures, and the like.

Green plaster board is delivered, from a board forming machine, at a relatively high, constant, lineal velocity. In accordance with the present invention, it is led between the two rotors of the machine illustrated herein, and as it passes between those rotors, punch and die sets, arranged in series or gangs, cooperate with the moving stream of material to form, at spaced intervals, transverse lines of transversely spaced perforations, by severing from the green plaster board slugs of material whose size and shape will be determined by the punch and die sets used. The construction is such that the severed slugs of material will usually be driven downwardly completely through the dies, to drop from the lower ends of said dies; but the die sets are inverted, during each cycle of operation, so that such slugs may occasionally drop away from the dies in the opposite direction during such inversion thereof.

Referring more particularly to the drawings, it will be seen that I have illustrated a machine comprising a frame **20** upon which is journalled a power input shaft **21** which may carry a sprocket **22** through which the machine may be chain driven from any suitable outside source of power. Within a suitable housing upon the frame, the shaft **21** carries an elliptical gear **23** meshing with a mating elliptical gear **25** upon a second shaft **24** journalled in the machine frame upon an axis parallel with the axis of the shaft **21**. The reason for the use of elliptical gears, and the particular design of such gears, will appear as the description proceeds.

The shaft **24** further carries a pinion **26** meshing with a much larger spur gear **27** on a shaft **28** whose opposite ends are journalled respectively in the opposite end members of the frame **20**, bearings, such as **29**, preferably being provided for supporting said shaft ends in end panel members such as **30**.

Each end panel **30** is provided, in a region above the bearings **29**, with a vertically extending trackway **31** (Figs. 3–5) in which is slidably mounted a shoe **32**, each such shoe carrying a bearing **33**, in which bearings are journalled the opposite ends of a second shaft **34**, parallel with, and substantially coextensive with, the shaft **28**. To the upper end of each shoe **32** is suitably secured a rod **35**, threaded at its upper end, as at **36**, for cooperation with a nut **37** (Figs. 1 and 2) journalled for rotation, but held against reciprocation, in a suitable support on the frame panel **30**. Fixed to, or integral with, each nut **37**, is a beveled gear **38**, and a shaft **39** spans the region between said gears **38** and carries two beveled gears **40**, each meshing with one of said gears **38**. Two handwheels **41**, one at each end of the machine, are mounted upon the shaft **39** for rotating the same; and it will be obvious that rotation of the shaft **39** in one direction or the other will elevate or depress the shoes **32**, correspondingly shifting the shaft **34** which is journalled in said shoes, while maintaining parallelism of said shaft with the shaft **28**.

Two spiders, **42** and **43**, are mounted at opposite ends of the shaft **28**, each of said spiders being formed, at peripherally spaced points upon a common circle concentric with the shaft **28**, with a plurality of openings **44** for the reception of the shaft sections or trunnions **45** carried at opposite ends of carriages **46**. Each carriage **46** comprises a bolster **47** (Fig. 6) to the outer surface of which is suitably secured a plate **48** proportioned and designed to receive a plurality of hollow dies **49**, each die registering with a passage **50** extending through the bolster **47**. Any suitable means (not shown) may be provided for removably securing the dies **49** in the plate **48**.

At one end of each carriage **46**, the trunnion **45** is provided with an extension **51** (Figs. 2 and 7) upon which is carried a follower arm indicated generally by the reference numeral **52** and adapted to cooperate with a cam track **53** defined on a cam plate **54**. Such a cam plate is illustrated in detail in Fig. 5, and may preferably comprise mating sections **54***a* and **54***b* suitably secured together by bolts **55** or other equivalent fastening means, and provided with cooperating, outstanding walls **56** and **57** which, when the sections are operatively connected, register to define the continuous cam trackway **53**.

Each follower arm **52** (Fig. 7) comprises a hub **58** fixed to its trunnion extension **51** by means of a key **59** and setscrew **60**, and having an arm **61** substantially radially projecting therefrom. At its free end, the arm **61** is bifurcated to define spaced furcations **62** and **63**. A screw **64** threadedly penetrates the furcation **63** and carries a locknut **65**; and a similar screw **66** is similarly associated with the furcation **52**. A lever **67** is provided at one end with a hub **68** freely journalled on the hub **58**; and is further provided at its opposite end with a further hub **69** in which a journal pin **70** is fixed by means of a setscrew **71**. At its end remote from the carriage **46**, the pin **70** mounts a cam-following roller **72** adapted to be received in the trackway **53** between the walls **56** and **57**.

The hub **69** projects axially to overlap the free end of the arm **61**, and is provided with a radially-inwardly-extending abutment finger **73** which, when the parts are assembled, lies between the arm furcations **62** and **63** with its opposite faces positioned for engagement, respectively, by the facing ends of the screws **64** and **66**. It will be obvious that, by adjustment of said screws, the position of the roller **72** relative to its carriage **46**, and so the position or attitude assumed by such carriage to correspond to any predetermined position of the roller **72** in the trackway **53**, may be very nicely and delicately adjusted. Headed bolts **75**, passing through arcuate slots **74** in the arm **61** and threadedly engaged in the lever **67**, hold said lever against axial movement away from the arm **61**, and may, if it is deemed desirable, be tightened to assist in holding said lever in any selected position of rotational adjustment relative to the arm.

As is most clearly to be seen in Fig. 2, the cam plate **54** is suitably supported upon an end panel **30** at that end of the machine remote from the gears **23** and **25**; and, in its region adjacent the shaft **34**, it is provided with a section, indicated by the reference numeral **76** in Fig. 5, in which the median line **77** of the trackway **53** lies in a circular arc, extending from a point **78** to a point **79**, cast about a point **80**. The point **80** lies in the

horizontal plane including the axis 81 of the shaft 28, and in a plane, parallel with the plane common to the axes of the shafts 28 and 34, and spaced therefrom by a distance equal to the distance between the axis of the trunnion extension 51 and the axis of the pin 70 of any follower arm. The radius of the arc 76 is equal to the radius of the orbit of the trunnions or shafts 45.

The cam plate sections 54a and 54b are joined in the plane common to the axis 81 and the point 80, being provided with sections forming a hub 82 coaxial with the shaft 28, the cam track 53 surrounding said shaft axis. The plate 54 is provided with a plurality of arcuately elongated slots penetrated by screws 83 threadedly engaging the panel 30.

At a suitable point in its perimeter, the plate 54 carries a tongue 84 radially arranged with respect to the hub 82; and the panel 30 carries a bracket 85 provided with parallel projecting fingers 86 and 87 in which, respectively, are mounted screws 88 and 89 projecting into engagement with the tongue 84. Adjustment of the screws 88 and 89 will, of course, result in very delicate and accurate adjustment of the cam plate 54 about the axis of the shaft 28.

The parts are so arranged that, as each carriage 46 approaches the plane common to the axes of the shaft 28 and 34, its follower arm roller 72 will enter the cam trackway section 76; and that section, designed in the manner above described, will hold the roller 72 in such a position, relative to the shaft axis of that carriage that, as the carriage approaches, passes through, and departs from the said plane common to the axes of the shafts 28 and 34, the surface of its bolster 47 will be held in a truly horizontal position.

As the roller 72, moving in a clockwise direction as viewed in Fig. 5, passes the point 79, it begins to move downwardly more slowly than does its associated shaft 45, so that the bolster will be tilted in a clockwise direction and will assume the position indicated at A in Fig. 6. From that position, the bolster will be moved to the positon indicated at B; and as the bolster again approaches the above-mentioned plane, in the region remote from the shaft 34, it assumes a fully inverted position as indicated at C. Any refuse which may have been deposited on the plate 48 will, of course, fall away from the bolster by gravity as the bolster passes through these positions; and since, at the position C, the carriage is inverted, slugs of material driven through the ports 50 of the carriage which is currently in active position, will fall upon the radially inward portion of the carriage which is in position C, rather than upon the active surface of its plate 48.

Thence, the carriage moves to position D and then to position E in which it is closely approaching the horizontal attitude which it will retain as its roller 72 traverses the section 76 of the cam trackway.

Adjustment of the cam plate through the medium of the screws 88 and 89 and the tongue 84 permits accurate location of the cam trackway section 76 relative to the path of the carriages carried on the shaft 34. Adjustment of the screws 64 and 66 (Fig. 7) makes possible absolutely accurate and uniform response, in the attitude of each carriage, to the cam trackway section 76 as the roller of that carriage traverses that section.

At its opposite end, each carriage trunnion 45 is

provided with spring means indicated generally by the reference numeral 90 (Figs. 1 and 8) applying to the carriage a turning force resiliently holding its roller 72 in cooperative engagement with the wall 56 of the cam trackway 53.

At this end, each trunnion 45 is formed with a reduced section 91 defining an outwardly facing shoulder 92. This section of the trunnion is internally threaded as at 94 to receive a reduced threaded end 95 of a stud 96 whose opposite end is formed with a threaded socket for the reception of a clamping bolt 97. A ring 98 is removably secured to the outer face of the spider 42 by suitable means such as screws 99, and supports a ball or roller bearing 100, whose outer race is received in the ring 98 and whose inner race snugly embraces the reduced section 91 of the trunnion 45 to support the same. The stud 96 cooperates with the inner race of the bearing 100 to clamp the same against the shoulder 92.

An annular disc 101 is suitably secured to the ring 98 as by screws 102, or the like, and said disc is provided, at spaced points about its peripheral region, with a series of axially projecting teeth 103.

An annular housing member 104 is provided with an axially extending peripheral flange 105, and is adapted to be secured to the above-described parts, for rotational adjustment relative thereto, by means of the bolt 97, a washer 108 preferably being interposed therebetween. At spaced points about its free edge, the flange 105 is provided with a series of notches 106 for cooperative interengagement with the teeth 103 of the disc 101.

A coiled spring 109 is housed within the chamber defined by the elements 101 and 104, one end 110 of said spring being anchored upon the element 104, for instance, by projecting through a radial slot 111 in the flange 105. The other end 112 of the spring 109 is anchored upon the stud 96, and while such anchorage may take any desired form, I have shown a preferred means comprising a pin or rivet 113 received in a punched hole in the spring end and carried upon a key-like element 114 axially slidably movable, to a limited degree, within a keyway 115 formed in the periphery of the stud 96. This arrangement, while providing a solid anchorage preventing relative rotational movement between the trunnion 45 and the spring end 112, nevertheless permits limited relative axial movement therebetween to prevent any jamming which might otherwise occur during variations in the tension of the spring 109.

It will be obvious that, upon loosening the screw 97 to permit the element 104 to be backed away slightly from the stud 96, thereby disengaging the teeth 103 from the notches 106, the element 104 may be rotated in a clockwise direction, as by means of a wrench taking into two or more of the holes 107 formed in a peripheral series, to tighten the spring 109. So long as the teeth 103 and notches 106 are interengaged, there can be no relative rotation between the elements 104 and 101. While tensioned, of course, the spring 109 will exert a turning force upon the shaft or trunnion 45 tending to rotate the same in a clockwise direction, as viewed in Fig. 8 and in Fig. 5, to hold the roller 72 in engagement with the wall 56 of the cam trackway 53.

Similarly, the shaft 34 carries spiders 116 and 117 (Figs. 1 and 2) adjacent its opposite ends, said spiders being formed with peripheral series of openings for the journal mounting of trunnions

118 at opposite ends of carriages 119. At one end of each trunnion 118 there is provided an extension 120 upon which is carried a follower arm 121 in all respects identical with the follower arms 52, and received in a cam trackway 122 formed in a cam plate 123 in all respects identical to the cam plate 54. The cam plate 123 is, of course, reversed in position relative to the cam plate 54. That is, the section 76 of the cam plate 123 will be arranged at the bottom of the continuous trackway, so that all carriages 119 will be held in horizontal position as they pass through the lower section of their orbit. At the opposite end of the machine, each trunnion has associated therewith a spring device 124 in all respects identical with the spring devices 90 hereinabove described. Each carriage 119 comprises a bolster 125 upon which is suitably carried a plate 126 supporting a series of punches 127 for cooperation with the dies 49; and a stripper plate 128 may preferably be associated with said punches.

Preferably, each carriage 46 is provided adjacent each end with one or more heavy pins 129 perpendicular to the surface of its bolster 125; and each carriage 119 is provided at its opposite ends with corresponding sleeves 130 located on axes perpendicular to the surface of the bolster 125. As is indicated near the center of each of Figs. 1 and 2, the pins 129 of each carriage 46 will snugly nest in the sleeves 130 of its mating carriage 119 during the actual punching operation. Since all of the carriages are resiliently held in their cam-dictated attitudes, any slight misadjustment of any follower arm will be corrected, during the punching phase, by the engagement of the pins 129 in the sleeves 130.

At its end remote from the gear 27, the shaft 28 carries a large spur gear 131 (Figs. 2 and 4); and at its corresponding end, the shaft 34 similarly carries a similar gear 132 which, when the parts are in the positions of Figs. 3 and 4, meshes with the gear 131 to provide a driving connection between the shafts 28 and 34 whereby said shafts will be turned at equal velocities in opposite directions. The gear 131 is suitably fixed to the shaft 28, while the gear 132 is loosely mounted upon the shaft 34, the driving connection between the gear 132 and such shaft 34 being provided by the device now to be described. Projecting from one face of the gear 132 is a lug 133 adapted to be positioned between a pair of spaced ears 134 and 135 on a hub element 136 keyed on the shaft 34. The ear 134 mounts an adjusting screw 137 and the ear 135 mounts a similar adjusting screw 138. Said screws 137 and 138 are turned up against the opposite faces of the lug 133 to provide a fixed driving connection between the hub element 136 and the gear 132; and it will be clear that the angular relation between the shaft 34 and the gear 132 can be very delicately adjusted by opposite adjustment of the screws 137 and 138. By means of such adjustment, precise and accurate registry between the carriages 46 and the carriages 119 can be attained and maintained.

It is essential, under certain conditions, that the shaft 34 be raised to an extent sufficient to prevent coaction between the punches 127 and the dies 49. It is likewise essential that the rotors be maintained always in accurate registry. Since elevation of the shaft 34 to a degree sufficient to prevent such coaction will inevitably disengage the meshing teeth of the gears 131 and 132, some means must be provided for maintaining that registry during such disengagement. Likewise, I have provided means for positively limiting downward movement of the shaft 34, in order that the gears 131 and 132 may not become jammed. Such limiting means preferably comprises a screw 139 (Figs. 2 and 3) adjustably received in a cooperating socket in the lower edge of the shoe 32, a lock nut 140 on said screw for holding the screw in any desired position of adjustment, and a fixed abutment 141, rigid with the machine frame, and engageable by the screw 139, upon downward movement of the shoe, to limit such downward movement.

A link 142 has one end journalled on a projection of the shaft 34, the other end of said link supporting an axle 143 upon which is fixed a spur gear 144. The link length is such as to hold the gear 144 always in mesh with the gear 132.

A frame 145, which may comprise merely a pair of straps, engages the axle 143 and another axle 146 upon which is mounted a gear 147 whose pitch diameter is identical with that of the gear 144, the frame 145 holding the two axles 143 and 146 in such a relation that the gears 144 and 147 are always in mesh. One end of a link 148 engages the axle 146, and the other end of said link is journalled upon the shaft 28, the length of the link 148 being such as to hold the gear 147 always in mesh with the gear 131. As shown, I provide two links 148, one engaging each end of the axle 146. A trunnion element 150 is supported in the frame panel 39 and provides a journal mounting for one end of a link 149, the other end of said link 149 being engaged with the axle 143. The axis of the trunnion element 150 lies in the plane defined by the axes of the shafts 28 and 34, and the trunnion element 150 is spaced above the fixed axis of the shaft 28 a distance equal to the distance between the axes of the axles 143 and 146, so that the links 148 and 149 are always parallel.

The cam plate 123 is mounted, like the cam plate 54, for rotational adjustment about the axis of the shaft 34. In Figs. 1 and 9, I have shown a member 151 formed to provide spaced parallel arms 152 and 153 between which projects a tongue 154 similar to the tongue 84, screws 155 and 156, threadedly carried by said arms 152 and 153, engaging opposite faces of said tongue 154 to provide for adjustment of said cam plate.

It will be clear that the punches 127 will be directly engaged with the work material throughout a period during which the carriages 46 and 119 move through an angular distance of some twenty-five or thirty degrees, corresponding to the cam track section 76. Since the carriages are moving in an arcuate path while the work material is moving rectilinearly, it will be obvious that the absolute velocity either of the work or of the carriage must be varied during that period of engagement, in order to maintain synchronism between the punches and the work. Since board-making machinery ordinarily delivers the green plaster board at a constant lineal velocity, I have provided for varying the angular velocity of the two rotors during the periods of engagement of the punches with the material in order to maintain desired synchronism. As has been stated, the entire machine herein described is driven, from the shaft 21, through the elliptical gears 23 and 25. Those gears are so proportioned and designed that, while the shaft 21 rotates at a constant angular velocity, the velocity of the shafts 28 and 34 will be continuously varied. As a punch 127 approaches contact with the flowing stream of work material, and from that point until the

point of deepest penetration is reached, the angular velocity of the shafts 28 and 34 will be gradually decreased; and, from the point of deepest engagement to the point at which the punches leave the work material, the angular velocity of such shaft will be gradually increased, the rate of variation in the angular velocity being such as to maintain constant lineal velocity of the carriages in the direction of flow of the work material throughout the period of engagement of the punches with the work material. The gear 26 (Fig. 3) has a pitch diameter, in the illustrated embodiment of the invention, equal to one-sixth of the pitch diameter of the gear 27; and each rotor is provided with six peripherally-spaced carriages. Thus the shafts 21 and 24 and the elliptical gears 23 and 25 make one complete revolution while moving each carriage 46 through its active cycle.

I claim as my invention:

1. In a device of the class described, a pair of rotors, means mounting said rotors for rotation upon parallel axes, a series of carriages for each rotor, the carriages of each series being mounted to turn upon axes parallel with its rotor axis and disposed in corresponding peripherally-spaced relation upon a common circle concentric with its rotor axis, each carriage of each series being provided with a work-cooperative surface, means for rotating said rotors at equal velocities in opposite directions, stationary cam means for each rotor mounted to surround the axis of its associated rotor, a follower arm fixed to each carriage and operatively engaging the associated cam means, said follower arms being of equal effective lengths, each cam means including a circular arcuate section acting upon each follower arm successively to hold the associated carriage with its work support normal to a plane joining said rotor axes as such carriage traverses such plane between said rotor axes during rotation of said rotors, and each cam means including other sections acting upon each follower arm successively to invert the associated carriage as such carriage travels through the section of its path remote from the other rotor, and means correlating said rotors to cause a carriage of one series to traverse said plane always simultaneously with, and in cooperative registry with, a carriage of the other series.

2. The device of claim 1 in which each cam means comprises an endless trackway defined by a pair of parallel, mutually facing walls, and a roller carried adjacent the end of each follower arm remote from its carriage and confined between said walls.

3. The device of claim 2 including resilient means operatively connected to each carriage and applying thereto a turning force about the axis of such carriage resiliently urging its associated roller toward one of said walls.

4. The device of claim 1 in which each follower arm comprises an element fixed to its carriage and projecting substantially radially away from the axis of said carriage, a second element mounted for oscillation about said axis and projecting substantially radially away from said axis, cooperating means on said first and second elements for shifting said second element angularly about said axis relative to said first element, and means engageable with said cam means carried by said second element at a point remote from said axis.

5. The device of claim 4 including spring means operatively connected with each carriage and with its rotor, said spring means applying a turning force to its carriage about the axis thereof resiliently urging said last-named means into coactive engagement with its cam means.

6. The device of claim 1 including spring means operatively connected with each carriage and with its rotor, said spring means applying a turning force to its carriage about the axis thereof resiliently urging its follower arm into coactive engagement with its cam means.

7. In combination, a shaft, means supporting said shaft for revolution about an external axis and for turning about its own axis, cam means mounted to surround said external axis, an arm fixed to said shaft and projecting substantially radially therefrom, a lever mounted for oscillation about the axis of said shaft and projecting therefrom substantially in the direction of projection of said arm, means carried by said lever at a point remote from said shaft axis and operatively engaging said cam means, and cooperative means on said arm and on said lever for shifting said lever angularly about said shaft axis relative to said arm and for holding said lever in any selected position of adjustment relative to said arm.

8. The combination of claim 7 in which said last-named means comprises an abutment on said lever and two oppositely-facing elements carried by said arm in facing relation to opposite surfaces on said abutment, said elements being independently adjustable, relative to said arm, along lines substantially tangent to a circle drawn about said shaft axis.

9. The combination of claim 7 in which said lever is longer than said arm, the free end of said arm being bifurcated, and in which said last-named means comprises a substantially radially-inwardly projecting abutment on said lever located between the furcations of said arm, a screw adjustably mounted in one of said arm furcations and bearing against one face of said abutment, and a second screw adjustably mounted in the other of said arm furcations and bearing against the opposite face of said abutment.

10. In combination, a shaft, means supporting said shaft for revolution about an external axis and for turning about its own axis, cam means mounted to surround said external axis, a follower arm fixed to said shaft and projecting substantially radially therefrom and provided with means engageable with said cam means to control turning movement of said shaft about its own axis during revolution thereof, and means mounted to move with said shaft about said external axis and continuously resiliently urging said shaft toward turning movement in one direction about its own axis to hold said last-named means in cooperative engagement with said cam means.

11. In combination, a shaft, means supporting said shaft for revolution about an external axis and for turning about its own axis, cam means mounted to surround said external axis, a follower arm fixed to said shaft and projecting substantially radially therefrom and provided with means engageable with said cam means to control turning movement of said shaft about its own axis during revolution thereof, an element fixed to said supporting means and projecting radially from the axis of said shaft, a member journalled for rotation about the axis of said shaft, a coiled spring having one end anchored relative to said shaft and one end anchored relative to said mem-

ber, and means for holding said member selectively in any one of a plurality of positions of rotational adjustment relative to said element.

12. In combination, a shaft, means supporting said shaft for revolution about an external axis and for turning about its own axis, cam means mounted to surround said external axis, a follower arm fixed to said shaft and projecting substantially radially therefrom and provided with means engageable with said cam means to control turning movement of said shaft about its own axis during revolution thereof, bearing means including an inner race supporting said shaft and an outer race, an annular element fixed to said supporting means and carrying said bearing outer race, a member journalled for rotation about the axis of said shaft, a coiled spring having one end anchored relative to said shaft and one end anchored relative to said member, and means for holding said member selectively in any one of a plurality of positions of rotational adjustment relative to said element.

13. In combination, a shaft, means supporting said shaft for revolution about an external axis and for turning about its own axis, cam means mounted to surround said external axis, a follower arm fixed to said shaft and projecting substantially radially therefrom and provided with means engageable with said cam means to control turning movement of said shaft about its own axis during revolution thereof, an annular device fixed to said supporting means and concentric with the axis of said shaft, a second annular device journalled for rotation about the axis of said shaft, one of said devices being provided with an axially-extending peripheral flange projecting into engagement with the other of said devices to define a chamber, a coiled spring mounted within said chamber and having one end anchored relative to said shaft and one end anchored relative to said second annular device, interengaging means on said annular devices cooperable to hold said second device selectively in any one of a plurality of positions of rotational adjustment relative to said first annular device, and means for preventing accidental disengagement of said interengaging means.

14. In combination, a shaft, means supporting said shaft for revolution about an external axis and for turning about its own axis, cam means mounted to surround said external axis, a follower arm fixed to said shaft and projecting substantially radially therefrom and provided with means engageable with said cam means to control turning movement of said shaft about its own

axis during revolution thereof, an element fixed to said supporting means and projecting radially from the axis of said shaft, a member journalled for rotation about the axis of said shaft, a coiled spring having one end anchored relative to said member, means rotationally fixed relative to said shaft but mounted for limited axial movement relative thereto, the other end of said spring being anchored relative to said last-named means, and means for holding said member selectively in any one of a plurality of positions of rotational adjustment relative to said element.

15. In combination, a rotor including a pair of axially-spaced, coaxial spiders, a shaft having one end journalled in one of said spiders and having a reduced section at its other end, an annular element fixed to the other of said spiders, a bearing including an outer race supported from said element and an inner race sleeved on said reduced section and supporting the other end of said shaft, a stud axially removably secured to said other end of said shaft and having an external diameter exceeding that of said reduced section, said stud coacting with said bearing inner race to confine the same against axial movement relative to said shaft, an annular member journalled for rotation about the axis of said shaft, a coiled spring confined between said annular member and said annular element and having one end anchored relative to said annular member and one end anchored relative to said shaft, and means for holding said annular member selectively in any one of a plurality of positions of rotational adjustment relative to said annular element.

16. The combination of claim 15 in which said stud is provided with an axially extending key slot, a key mounted in said slot for limited axial movement therein, and means anchoring said last-named end of said spring to said key.

17. The combination of claim 16 in which said annular member and said annular element cooperate to define a closed chamber in which said spring is located, and in which said holding means comprises interengaging means on said element and member.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
27,057	Lazelle	Feb. 7, 1860