Jan. 8, 1952 E. N. BRODEN 2,581,928

WHEEL FINISHING MACHINE

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Fig. 1.

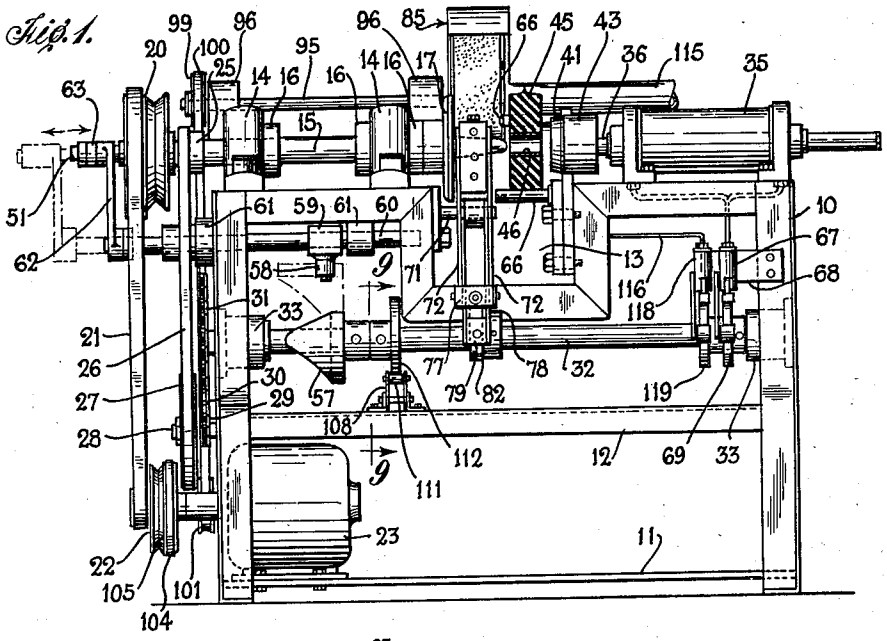
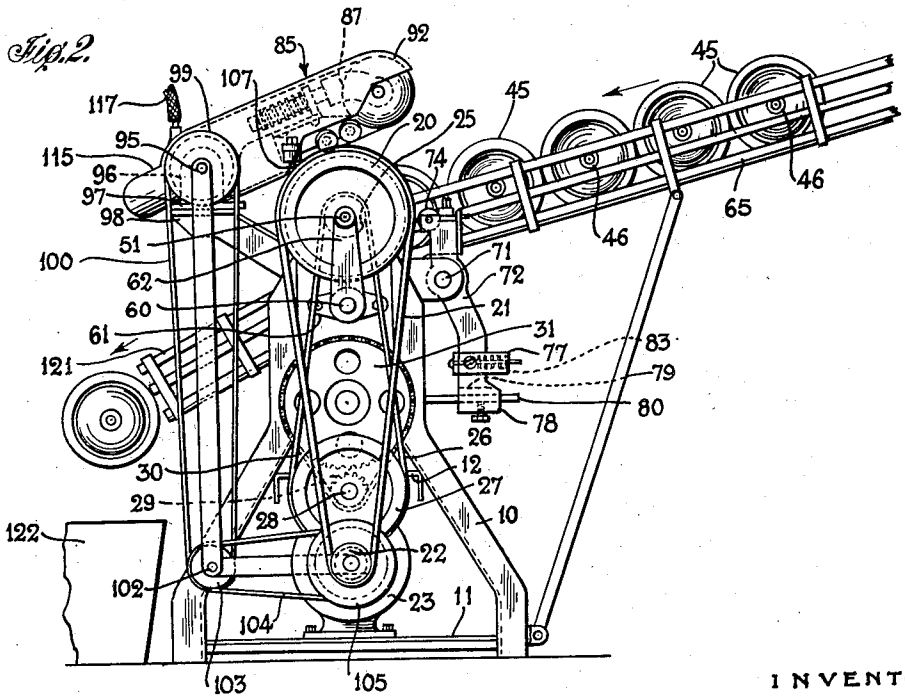


Fig. 2.



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WHEEL FINISHING MACHINE

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Fig. 3.

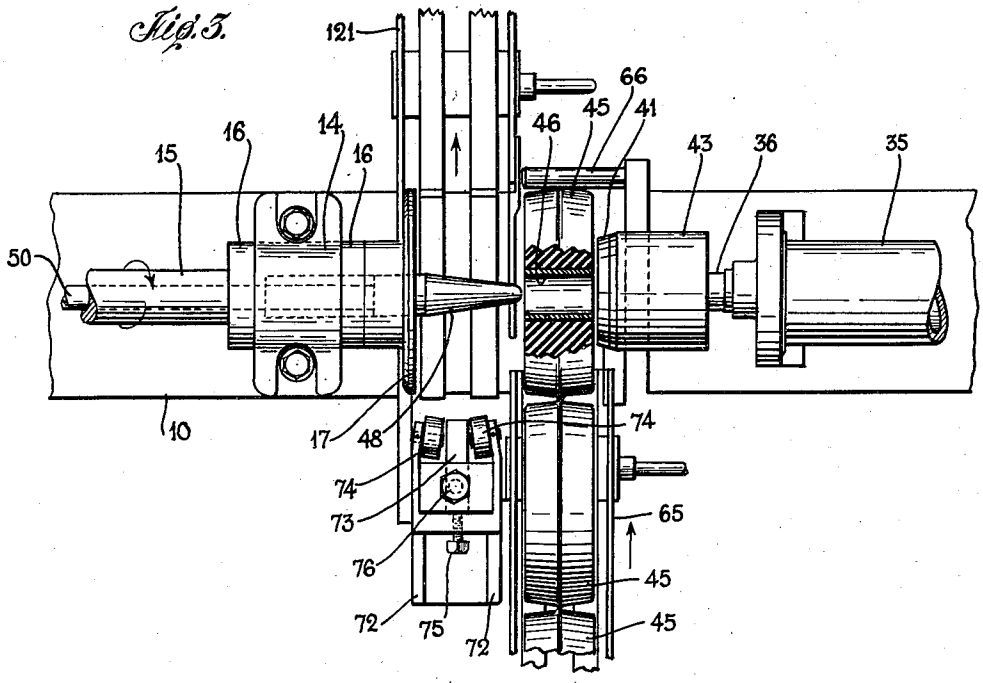
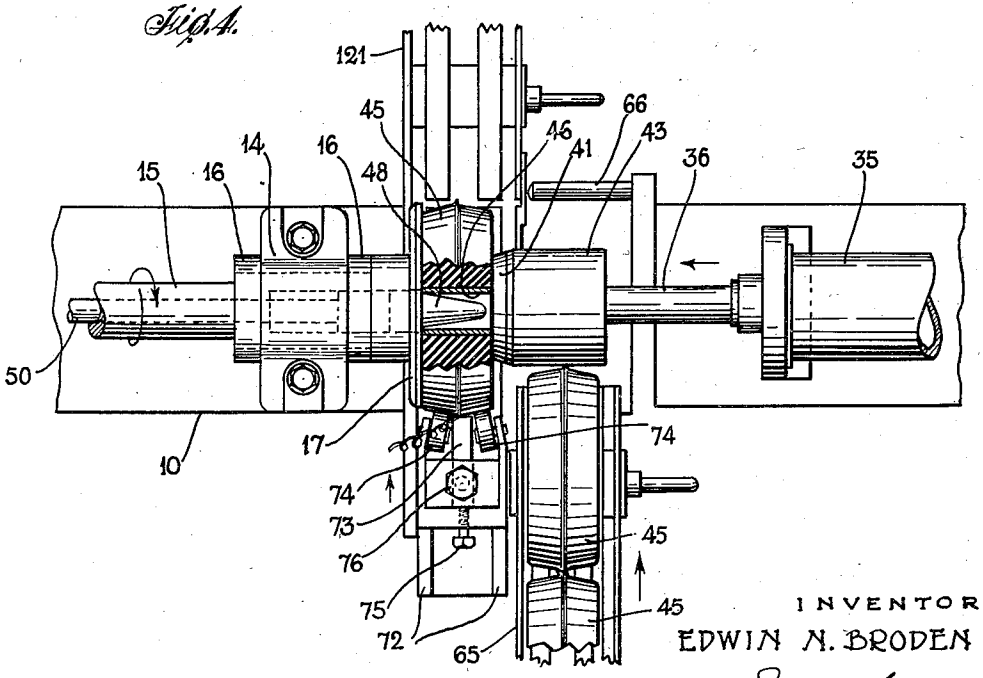


Fig. 4.



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WHEEL FINISHING MACHINE

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Fig. 6.

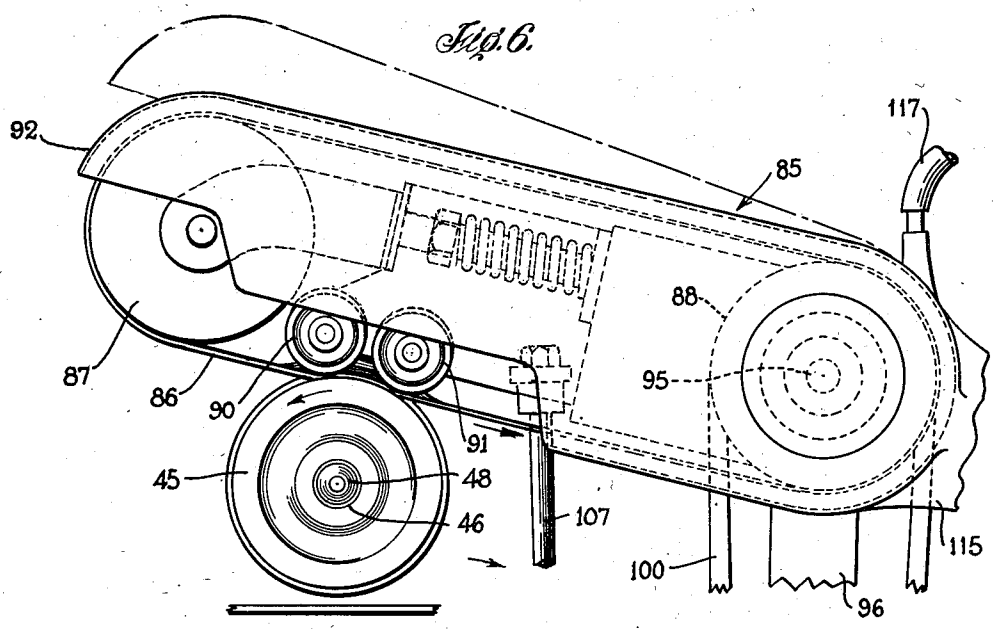
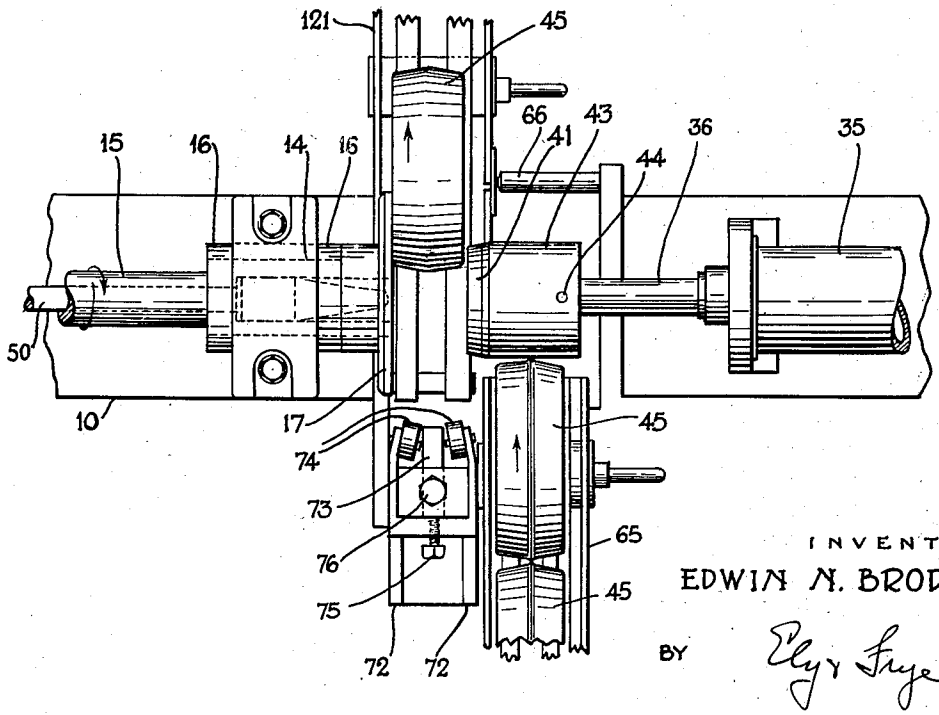


Fig. 5.



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WHEEL FINISHING MACHINE

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Fig. 7.

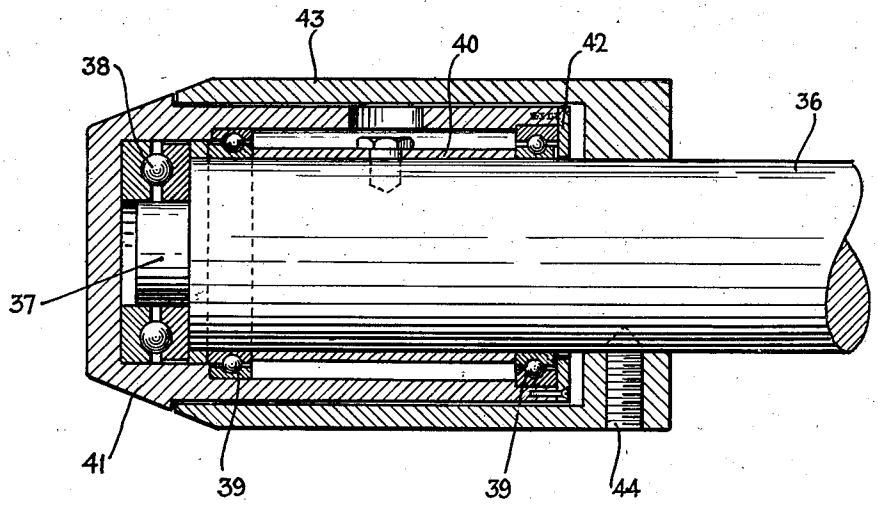
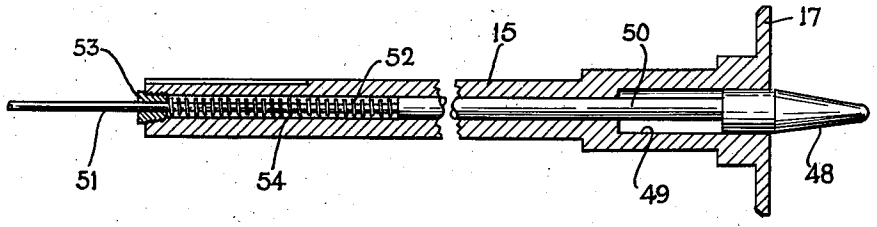


Fig. 8.



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WHEEL FINISHING MACHINE

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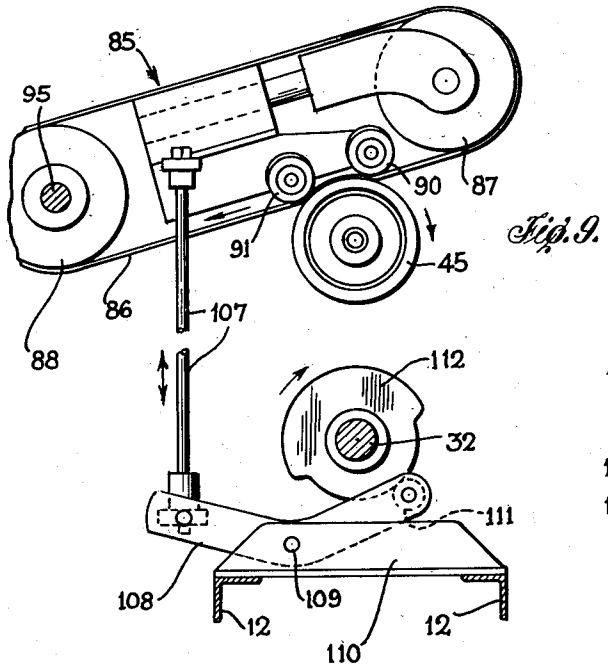


Fig. 9.

Fig. 11.

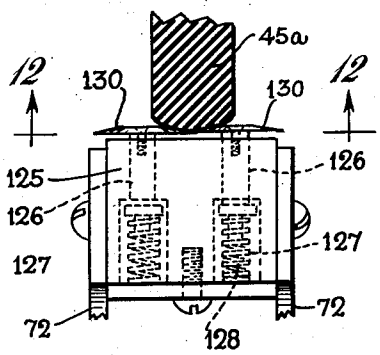


Fig. 12

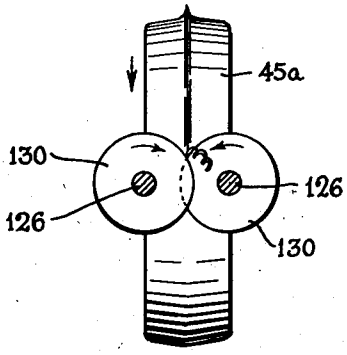
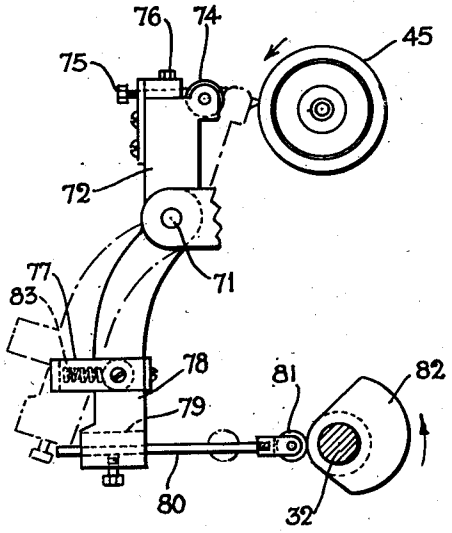


Fig. 10.



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2,581,928

UNITED STATES PATENT OFFICE

2,581,928

WHEEL FINISHING MACHINE

Edwin N. Broden, Assonet, Mass., assignor to The Firestone Tire & Rubber Company, Akron, Ohio, a corporation of Ohio

Application October 19, 1946, Serial No. 704,368

6 Claims. (Cl. 82—2.7)

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This invention relates to wheel-finishing machines, and more especially it relates to apparatus for finishing small wheels or casters made of molded plastic, which, for example, may be soft rubber or hard rubber, or rubber-like composition.

Wheels of the character mentioned usually are shaped and hardened in an internal cavity in a separable mold structure that leaves an overflow fin or rand located in the central plane of the wheels and extending circumferentially thereof. The wheels each have an axial aperture therein in which a tubular metal bearing or bushing is mounted with a force fit. After the wheels are provided with the bearings or bushings mentioned, they are subjected to the finishing operation which consists of removing the overflow fins or rands, and then smoothing the perimeters of the wheels. Heretofore the finishing operation has been manually performed, the wheels being mounted in a lathe, a file or rasp being employed to remove the mold flash or rand, and a piece of emery cloth used to smooth the peripheral surface of the wheels. Production by the prior method was about 125 units per hour per operator.

The chief objects of this invention are to provide a machine for finishing wheels of the character mentioned that is automatic in operation; that will effect increased production; that will effect uniformity of product; and that will reduce the unit cost of the finishing operation. Other objects will be manifest as the description proceeds.

Of the accompanying drawings:

Fig. 1 is a side elevation of apparatus embodying the invention, in non-operating condition, and the work therein, as viewed from the right of Fig. 2, a part thereof being broken away and the work being shown in section;

Fig. 2 is an end elevation of the complete apparatus as viewed from the left of Fig. 1;

Fig. 3 is a plan view, on a larger scale, of the work-trimming instrumentality of the apparatus, the means for mounting and driving the work, and the work itself as they appear immediately prior to beginning a cycle of operation;

Fig. 4 is a view of the elements shown in Fig. 3 during the work-trimming operation;

Fig. 5 is a view of the elements shown in Fig. 3 at the completion of a cycle of operation, showing the discharging of a finished work-unit;

Fig. 6 is a side elevation of the work-smoothing instrumentality of the apparatus;

Fig. 7 is a detail sectional view, on a larger scale, of one of the work-holding members;

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Fig. 8 is a detail sectional view on a smaller scale, of the other work-holding member;

Fig. 9 is a section on the line 9—9 of Fig. 1 showing means for periodically operating the work-smoothing instrumentality;

Fig. 10 is a side elevation, on a larger scale, of the work-trimming instrumentality and the mechanism that operates the same;

Fig. 11 is a plan view of another embodiment of the work-trimming instrumentality, and the work (in section) with which it is operatively engaged; and

Fig. 12 is a section on line 12, 12 of Fig. 11.

Referring to Figs. 1 and 2 of the drawing, there is shown a machine comprising a table-like frame structure 10 having a shelf 11 at the bottom thereof and second shelf consisting of parallel angle irons 12, 12 located somewhat above the latter. The top of the frame is somewhat depressed or recessed midway between the ends of the frame, as indicated at 13, Fig. 1. Mounted upon the top of frame 10, to the left of the recess 13 as viewed in Fig. 1, are spaced apart bearing brackets 14, 14 in which is journaled a tubular driven shaft 15 that is disposed along the centerline of the machine. Thrust collars 16, 16 mounted on the shaft in laterally abutting relation to the brackets 14 restrain the shaft against axial movement. That end portion of the shaft 15 that is disposed beside and above the recessed region 13 is formed with a flange 17, which flange, and contiguous end face of the shaft, constitute a work-engaging and driving surface as subsequently will be explained.

The end portion of shaft 15 remote from said flanged end overhangs the frame 10, and has mounted thereon a two-step pulley 20 about which is trained a side-driving transmission belt 21, the latter also being trained about a two-step pulley 22 mounted on the shaft of an electric motor 23 that is mounted upon the shelf 11. The motor is driven constantly during the operation of the machine. The arrangement is such that the motor 23 drives the shaft 15 at all times the motor is in operation. The direction of rotation of shaft 15 is indicated by arrows in Figs. 3, 4, and 5. The provision of the two-step pulleys 20, 22 makes it possible to rotate the shaft 15 at different speed, if desired.

Also mounted on the overhanging portion of shaft 15, between pulley 20 and bearing bracket 14, is a pulley 25 about which is trained a transmission belt 26, the latter also being trained about a pulley 27 that is mounted upon a counter-shaft 28. Said counter-shaft is journaled in the frame

10, and has fixed thereon a relatively small sprocket 29 about which is trained a sprocket chain 30, the latter also being trained about a relatively larger sprocket 31 mounted upon the projecting end of a cam shaft 32. Said cam shaft is disposed parallel to shaft 15 and countershaft 28, and is journaled in bearings 33, 33 mounted upon frame 10. The arrangement is such that the motor 23 drives the cam shaft 32 at relatively slow speed as compared to the speed of the shaft 15, the ratio being about 1 to 19.

Mounted upon the top of frame 10 in axial alignment with shaft 15 and to the right of recess 13 as viewed in Fig. 1 is a double acting fluid pressure operated cylinder 35 having a piston rod or plunger 36 projecting from the end thereof that confronts flange 17 of said shaft 15. As is best shown in Fig. 7, the outer end of plunger 36 is formed with a short axial extension 37 of reduced diameter on which a thrust bearing 38 is mounted. Adjacent its end the plunger also carries bearings 39, 39 that are maintained in spaced-apart relation by an intervening spacer sleeve 40 fixedly mounted on the plunger. Journaled upon bearings 38, 39 is a nose piece 41 having a closed, frusto-conical forward end, the rear end of said nose piece having a collar 42 secured thereto in abutting relation to rear bearing 39 to retain said nose piece on the plunger. A sleeve 43, open at its front end, is mounted upon the plunger and encloses all of nose piece 41 except the tapered front end thereof, said sleeve being secured to plunger 36 by set screw 44. The arrangement is such that the nose piece 41 may rotate freely, relatively of plunger 36 and sleeve 43.

The purpose of the plunger 36 is to confine a work-piece between its nose piece 41 and the driven flange 17 on the confronting end of rotary shaft 15, whereby said work piece is frictionally driven, said flange 17 and nose piece 41 thus constituting, in effect, a chuck. The work pieces are designated 45, each consisting of a circular disc or wheel of hard rubber composition, and having a tubular, metal, axial bushing 46, Figs. 3 and 4, molded into its structure.

While a work piece is confined in and rotated by the driving chuck, it is centered with relation thereto by a tapered round-nosed pilot 48 that projects axially from the end of shaft 15 and is received within the bore of the bushing 46 of the work piece. As is best shown in Fig. 8, the pilot 48 is located in an axial counterbore or recess 49 in the end of shaft 15, which counterbore or recess is of sufficient depth to enable the pilot completely to be withdrawn thereinto. The pilot 48 is formed on the end of a spindle 50 of reduced diameter, which spindle is further reduced in diameter at its rear end portion so as to constitute a stem 51. The spindle 50 and stem 51 are slidably mounted for axial movement in a bore 52 in shaft 15, the rear end of said bore having an axially apertured plug 53 threaded thereinto, through which plug the stem 51 slidably extends. Surrounding stem 51, within bore 52, is a compression spring 54 that bears against plug 53 and against the shoulder formed at the juncture of spindle 50 and stem 51, said spring normally urging the pilot 48 outwardly from the counterbore 49.

The pilot 48 is retracted into the counterbore 49 periodically in determinate time-relation to the action of other elements of the apparatus, during each cycle of operation, and to this end an operating cam 57 is mounted upon cam shaft 32.

The cam 57 has a camming surface on one lateral face thereof that is adapted periodically to engage a cam roller 58 carried by a bracket 59 that is mounted upon a slide-rod 60, the latter being disposed above and parallel to cam shaft 32, and mounted for axial movement is suitable brackets 61 carried by the frame 10. Fixedly mounted upon the outer end of slide-rod 60, which is at the left thereof as viewed in Fig. 1, is an arm 62, the opposite end of which loosely embraces the stem 51 of the pilot 48 so that said stem may rotate relatively thereof. A thrust bearing 63 is mounted upon stem 51 in abutting relation to the outer face of arm 62. The arrangement is such that upon each revolution of the cam shaft 32 the cam 57 will retract the pilot 48 against the force of spring 54, the latter again projecting the pilot outwardly as the cam passes out of engagement with cam roller 58. It will be understood that pilot 48 rotates with the shaft 15 at all times, being frictionally driven thereby.

The work-pieces 45 are delivered to the machine by gravity, an inclined chute 65 being provided for the purpose. The work-pieces are manually placed in the chute at the upper end thereof, and rest in upright position upon their circular perimeters so as to roll freely downwardly when the lower end of the chute is unobstructed. A work-piece discharged at the lower end of the chute 65 is received upon a pair of stop-studs or pins 66, 66 that support the work-piece substantially in axial alignment with the nose-piece 41 and flange 17. A work-piece located on the stop-pins 66 as described obstructs the downward movement of the succeeding work-pieces, as is clearly shown in Fig. 3. The work-piece that rests upon stop-pins 66 is moved axially therefrom by the nose-piece 41 when the rear end of cylinder 35 is charged to project its piston rod 36. Such charging of said cylinder is effected in determinate time-relation to the operation of other elements of the machine, and to this end a control valve 67 for the cylinder is mounted on a bracket 68 secured to frame 10 below the cylinder, said valve being operated automatically by a cam 69, Fig. 1, mounted on the cam shaft 32. When the nose-piece 41 is projected by operation of cylinder 35 and the work in front of said nose-piece is moved axially into engagement with the constantly rotating flange 17 of shaft 15, the pilot 48 is received in the bore of bushing 46 of the work-piece, with the result that the work-piece is centered or axially aligned with said flange and shaft. The spring 54 enables the pilot 48 to retract somewhat when engaged by said bushing 46. This position of the work-piece 45 is shown in Fig. 4, said work-piece being rapidly rotated by the rotating shaft 15, and the plunger sleeve 43 obstructing the path of the lowermost work-piece in chute 65. It is while the work-piece is being rotated that the overflow fin or rand is removed therefrom.

To this end a pivot pin 71 is mounted upon the frame 10 and extends horizontally in front of the recessed region 13 therein. Pivotally mounted on pin 71 is a pair of spaced-apart arms 72, 72 which at their upper ends carry a trimming device, the same being located in the plane of the work-piece when the latter is in the position shown in Fig. 4. As best shown in Fig. 3, the trimming device comprises a chisel-like cutter 73 that presents a flat cutting edge to the work-piece, and a pair of gauge rollers 74, 74 mounted

upon opposite sides of said cutter 73. The rollers 74 have their axes disposed at an angle to each other, as shown, so that they may bear flush against the slightly sloped or tapered peripheral faces of the work-piece at each side of the medial circumferential plane of the work-piece, in which plane the overflow rand is located. An adjusting screw 75 engages the rear end of the cutter 73 for moving the latter relatively of the rollers 74 and thus to vary the amount of material removed by the cutter from the work-piece. A set screw 76 engages the cutter for holding the same in adjusted position. At their lower ends the arms 72 are connected by a U-shaped bridge-piece or bracket 77. Also pivotally mounted on pin 71, between arms 72, are parallel arms 78, 78 that extend downwardly to a point below bridge piece 77 of arms 72, the lower ends of arms 78 being joined by an apertured block 79. A rod 80 is adjustably mounted in the aperture in block 79, said rod having a cam roller 81 journaled in one end thereof, which cam roller engages a cam 82 mounted upon cam shaft 32. A compression spring 83 suitably interposed between the arms 78 and bracket 77 provides a yielding connection therebetween whereby the cutter 73 is yieldingly urged against a work-piece 45 by the cam 82, as shown in broken lines in Fig. 10.

The wheel-smoothing instrumentality of the machine is a sander designated as a whole by the numeral 85. As is best shown in Fig. 6, said sander comprises an endless belt of abrasive material, such as sand paper 86, which belt is trained about two pulleys 87, 88 respectively, of which the latter is power-driven, as presently will be explained. The mounting of pulley 87 includes a compression spring 89 that normally urges said pulley away from pulley 88 to maintain the sanding belt 86 in taut condition. At the region of the sander where the belt 86 engages the perimeter of the work, said belt is backed by two pairs of relatively small rollers 90, 91 of which the rollers of each pair are disposed at an angle to each other, which angle corresponds to the reverse taper of the work-pieces at each side of the central plane thereof. The rollers 90, 91 are spaced apart from each other and so positioned that the reach of the belt 86 disposed between them engages the work when the sander is moved into engagement therewith, the arrangement being such that the belt engages a substantial circumferential area of a work-piece as it operates thereupon. The belt 86 is driven in the opposite direction to the peripheral movement of the work-piece, as indicated by the arrows in Fig. 6, whereby increased abrading efficiency is achieved. The sanding device 85 is enclosed in a metal housing or guard 92 except in the region at the bottom thereof where the belt 86 requires to be exposed so that it may engage the work.

The pulley 88 of the sander is mounted upon a driven shaft 95 that is journaled in a pair of bearing brackets 96, 96, said bearing brackets being positioned upon a mounting plate 97, Fig. 2. Plate 97 is supported upon brackets, such as the bracket 98, that project rearwardly and upwardly from the frame 10, said plate being adjustable forwardly and rearwardly on said brackets so that the sanding device may be positioned accurately for operating upon work of various diameters. For driving the shaft 95 a pulley 99 is mounted on the end thereof remote from pulley 88, and a transmission belt 100 is trained about pulley 99 and about a pulley 101, Fig. 1 that is mounted upon a countershaft 102, Fig. 2, journaled in frame 10, near the bottom thereof. Countershaft 102 also carries a pulley 103, and a transmission belt 104 is trained about pulley 103 and a pulley 105, the latter being mounted upon the shaft of motor 23. The arrangement is such that the sander belt 86 is driven at all times the motor 23 is in operation.

The sander 85 is supported by the shaft 95 and constructed and arranged to oscillate thereabout. The limits of oscillatory movement of the sander are indicated in Fig. 6 wherein the full line position shows the sander moved by gravity to the point where it rests upon a work-piece, and the broken line position indicates the maximum elevation of the sander to which point it has been lifted by power-operated mechanism. To this end a lift-rod 107 is connected to the sander structure intermediate the ends thereof, said lift-rod extending downwardly therefrom and having its lower end pivotally connected to one end of a first class lever 108. The latter is pivotally mounted at 109 on a bracket structure 110 on the shelf 12. The other end of the lever 108 carries a cam roller 111 that bears against a cam 112 that is mounted upon the cam-shaft 32, as is clearly shown in Fig. 9. The arrangement is such that the sander is lowered into operative engagement with the work and lifted therefrom in determinate time-relation to other operations of the machine.

Operation of the sander 85 produces dust composed of sand particles and particles of material abraded from the work. Such dust is removed by way of a duct 115 extending from the rear end of the housing or guard 92 of the sander, said duct having a flexible section (not shown) to enable the sander to oscillate as described during operation thereof. The duct extends to any suitable receptacle (not shown) wherein the dust is collected. For dislodging dust from the sander belt 86 and inducing it to enter the duct 115, a jet of air under pressure is directed against the belt substantially tangentially thereof as it passes over driving pulley 88, said air being conducted to the sander by a conduit or pipe 116 that includes a flexible section 117 to enable oscillation of the sander. Air is discharged against the belt 86 periodically, and only during those intervals that said belt is operatively engaged with the work. To this end the pipe 116 extends to a control valve 118 that is mounted upon bracket 68, beside valve 67, said valve 118 being operated automatically by a cam 119 mounted upon cam shaft 32.

When the finished work is released from the driving chuck, it rolls by gravity down a chute 121 at the rear of the machine and drops into a suitable receptacle 122 positioned at the lower end of said chute.

In the operation of the machine, assuming the various elements thereof to be in the positions shown in Figs. 1 and 2 and the motor 23 idle, the chute 65 first is loaded with the small wheels 45 that are to be trimmed and finished, the leading wheel of the series resting upon the stop-pins 66. The motor 23 then is set in motion to drive the shaft 15 and the cam-shaft 32, the latter making about 1 revolution to each 19 of the shaft 15. The motor also drives shaft 95 of the sander 85. As the cam-shaft 32 rotates it initiates a cycle of operation by operating valve 67 in a manner that charges the rear end of cylinder 35 and projects the plunger 36 thereof whereby the nose piece 41 of the chuck structure on the end

thereof engages the lowermost work-piece 45 and moves it axially toward the rotating flange 17 on shaft 15. During such movement the pilot 48 enters the bore of bushing 46 of the work-piece so that the latter is positioned co-axially of said flange 17. During this operation the pilot may be forced rearwardly somewhat against the force of spring 54. As the work-piece is driven by the shaft 15, cam 82 operates cam roller 81 to move the cutter 73 and rollers 74 into operative engagement with the work-piece, as shown in Fig. 4, whereby said cutter removes the overflow rand from said work-piece. The cam 82 holds the cutter in engagement with the work-piece while the latter makes about six revolutions, and then retracts the cutter, at which time cam 112 operates the sander 85 to lower the same and cam 119 operates valve 118 to deliver air to the sander. After the sander has operated upon the work-piece for a determinate interval sufficient to smooth and finish the work-piece, cams 112 and 119 operate to raise the sander and cut off the air thereto, and at the same time cam 57 engages cam roller 58 to effect retraction of pilot 48 so that it is entirely outside the plane of the work-piece. Concurrently with the retraction of the pilot, cam 69 reverses the position of valve 67 to reverse the cylinder 35 and withdraw nose-piece 41 from engagement with the work-piece. The latter thus released rolls down the chute 121, as shown in Fig. 5, and falls into the receptacle 122. As the chuck structure on the end of plunger 36 becomes fully retracted, it no longer obstructs the file of work-pieces in the chute 65, and the leading work-piece in the chute is enabled to move to the advanced position wherein it rests upon the stop-pins 66. This completes a cycle of operation which is repeated continuously and automatically so long as the motor 23 is in operation and there are work-pieces in the chute 65. The machine completes about 15 cycles of operation each minute.

From the foregoing it will be apparent that the invention saves time and labor as compared to prior practice, and also increases production, whereby unit cost is reduced. The machine produces work having uniformity of finish, and improves working conditions by removing from the air the dust resulting from the manufacturing process.

Sometimes the work-pieces 45 are composed of soft rubber composition instead of hard rubber, in which case a somewhat different trimmer is employed. As shown in Figs. 11 and 12, the trimmer that operates on soft rubber work-pieces 45a comprises a mounting block 125 that is carried in the upper ends of the arms 72, said block formed with two parallel bores in which respective spindles 126 are mounted. Said spindles project from the block 125 toward the work-piece 45a, and are yieldingly backed by respective compression springs 127 that are confined in the block by a closure plate 128. Rotatably mounted upon the projecting outer ends of spindles 126 are respective disc cutters 130, 130 that have peripheral cutting edges that overlap, as shown in Fig. 12. In operation the cutters 130 are urged against the work and rotated thereby, the overflow rand of the work being fed between the rotating cutters and severed thereby with a shearing action.

Other modification may be resorted to without departing from the spirit of the invention or the scope thereof as defined by the appended claims.

What is claimed is:

1. A wheel finishing machine comprising a work-holding chuck composed of two confronting axially aligned rotatable elements, power-driving means for one of said elements to rotate the same, a fluid pressure operated means for moving the other chuck element axially toward and away from the first mentioned chuck element, to confine a work-piece therebetween, a freely rotatable nose-piece journaled on the work-engaging end of last mentioned chuck element, a tapered pilot located at the axis of the power-driven chuck element and projecting therefrom adapted to enter an axial aperture in a work-piece to center the same, yielding means normally holding said pilot in projected position, and power operated means for retracting the pilot out of engagement with the work in determinate time-relation to operation of the fluid pressure cylinder.

2. A combination as defined in claim 1 including a work-trimming device, and means for moving the same into and out of operative engagement with the work in determinate time-relation to the operation of the fluid pressure operated cylinder.

3. In a wheel-finishing machine comprising a work-holding chuck composed of two confronting rotatable elements, power means connected with one of said elements to rotate the same, a fluid pressure-operated cylinder connected to the other of said elements to move it axially from an inoperative position relatively remote from the first-mentioned element to an operative position relatively near the same, to confine a work-piece therebetween, an inclined chute discharging said work-pieces by gravity into the space between said chuck elements when the axially movable element is in operative position, said axially movable element having a pair of stop-studs obstructing the movement of work-pieces in said chute when in operative position, a tapered pilot member located at the axis of the power-rotated chuck element, yielding means normally holding said pilot in projected position in centering engagement in an axial aperture in a work-piece in the chuck, and power-operated means for retracting the pilot out of work-engaging position in determinate time-relation to the operation of said fluid pressure cylinder that moves the other chuck element.

4. In a wheel-finishing machine of the character described, a work-holding chuck composed of two confronting rotatable elements, power means connected to the first of said elements to rotate the same, a fluid pressure-operated cylinder connected to the second of said elements to move it axially from an inoperative position relatively remote from the first-mentioned element to an operative position relatively near the same, to confine a work-piece therebetween, an inclined chute discharging said work-pieces by gravity into the space between said chuck elements when the axially movable element is in retracted position, said axially movable second element having a pair of stop-studs obstructing the movement of work-pieces in said chute when in operative position, a tapered pilot member located axially of the power-rotated chuck element, yielding means normally holding said pilot in projected position in centering engagement in an axial aperture in a work-piece in the chuck, trimming means comprising a cutter and a pair of gauge rollers mounted on opposite sides of said cutter, said rollers being adapted to bear against the

peripheral surface of the work-piece and to adjustably control the amount of material removed by said cutter, a continuously driven cam shaft having cams mounted thereon for actuating said chuck and trimming mechanism whereby the work-pieces are successively delivered to said machine, trimmed, and discharged from said machine.

5. In a wheel-finishing machine of the character described, a work-holding chuck composed of two confronting rotatable elements, power means connected to the first of said elements to rotate the same, a fluid pressure-operated cylinder connected to the second of said elements to move it axially from a retracted inoperative position relatively remote from the first-mentioned element to an operative position relatively near the same, to confine a work-piece therebetween, an inclined chute discharging work-pieces by gravity into the space between said chuck elements when the axially movable element is in retracted position, said axially movable second element having a pair of stop-studs obstructing the movement of work-pieces in said chute when in operative position, a tapered pilot member located axially of the power-rotated first chuck element, means normally holding said pilot in projected position in centering engagement in an axial aperture in a work-piece in the chuck, and power-operated means for retracting the pilot out of work-engaging position in determinate time-relation to the operation of said fluid pressure cylinder that moves the other chuck element, trimming means comprising a cutter and a pair of gauge rollers mounted on opposite sides of said cutter, said rollers being adapted to bear against the peripheral surface of the work-piece and to adjustably control the amount of material removed by said cutter, a continuously driven cam shaft having cams fixedly mounted thereon, cam followers associated with said cams and the actuating means of said pilot, chuck, and trimming mechanism whereby said work-pieces are successively delivered to said pilot member, the second chuck member brought into operative position for rotation of the work-piece by the chuck, the trimming means brought into operation on the work-piece, and said pilot member retracted to permit discharge of said work-piece.

6. In a wheel-finishing machine of the character described, a work-holding chuck composed of two confronting rotatable elements, power means connected to the first of said elements to rotate the same, a fluid pressure-operated cylinder connected to the second of said elements to move it axially from a retracted inoperative position relatively remote from the first-mentioned element to an operative position relatively near the same, to confine a work-piece therebetween, a chute discharging said work-pieces by gravity into the space between said chuck elements when the axially movable element is in retracted position, said axially movable second element having a pair of stop-studs obstructing the movement of work-pieces in said chute when in operative position, a tapered pilot member located axially of the power-rotated first chuck element, means normally holding said pilot in projected position in centering engagement in an axial aperture in a work-piece in the chuck, trimming means comprising a cutter adapted to be brought into engagement with each work-piece, and power-operated means for retracting the pilot out of work-engaging position in determinate time-relation to the operation of said fluid pressure cylinder that moves said second chuck element and to the operation of said trimming means.

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