

July 14, 1953

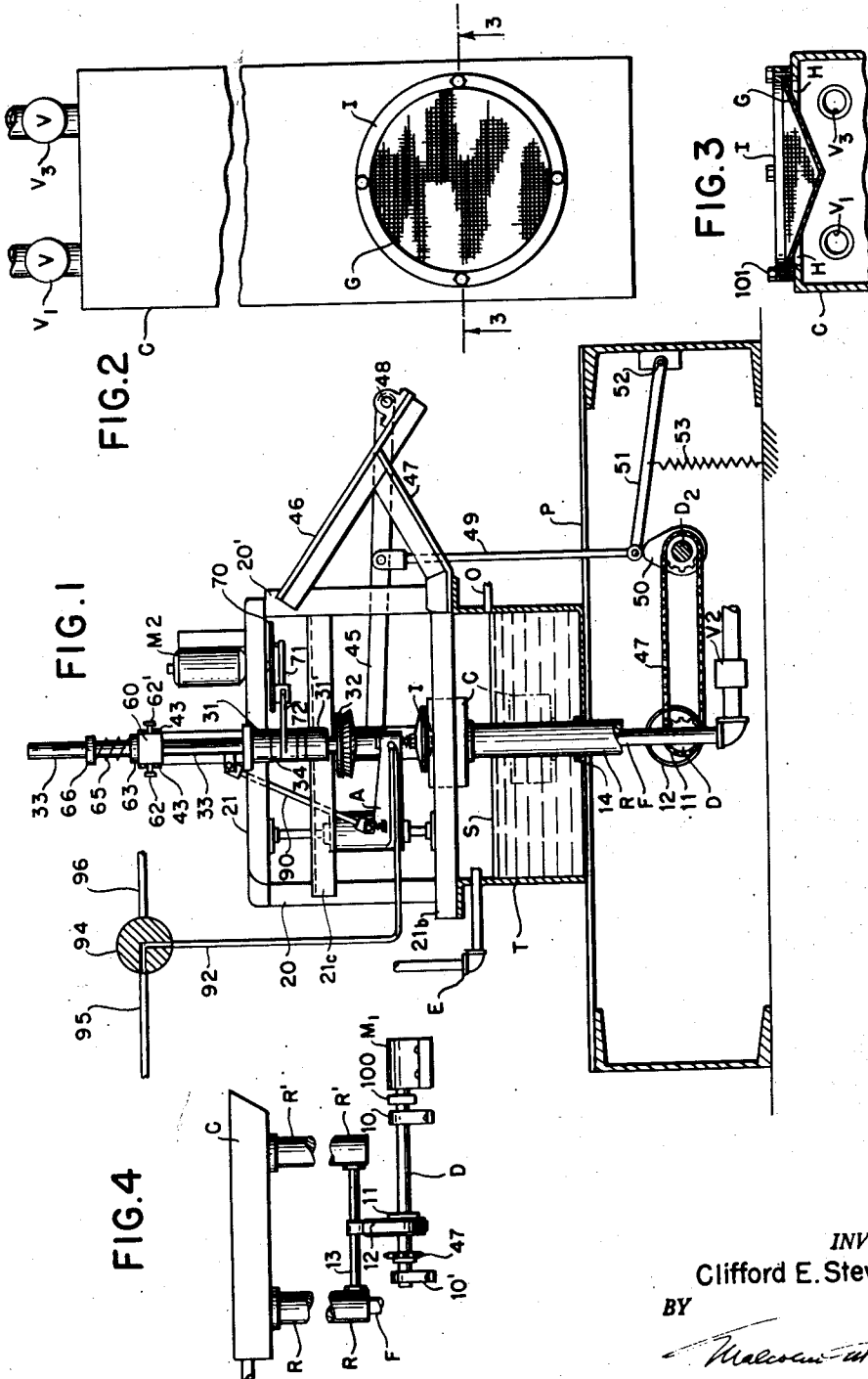
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2,645,165

APPARATUS FOR THE AUTOMATIC FORMING OF CAST FIBROUS
PULP CONE BLANKS FOR CONE SPEAKER DIAPHRAGMS

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3 Sheets-Sheet 1



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3 Sheets-Sheet 2

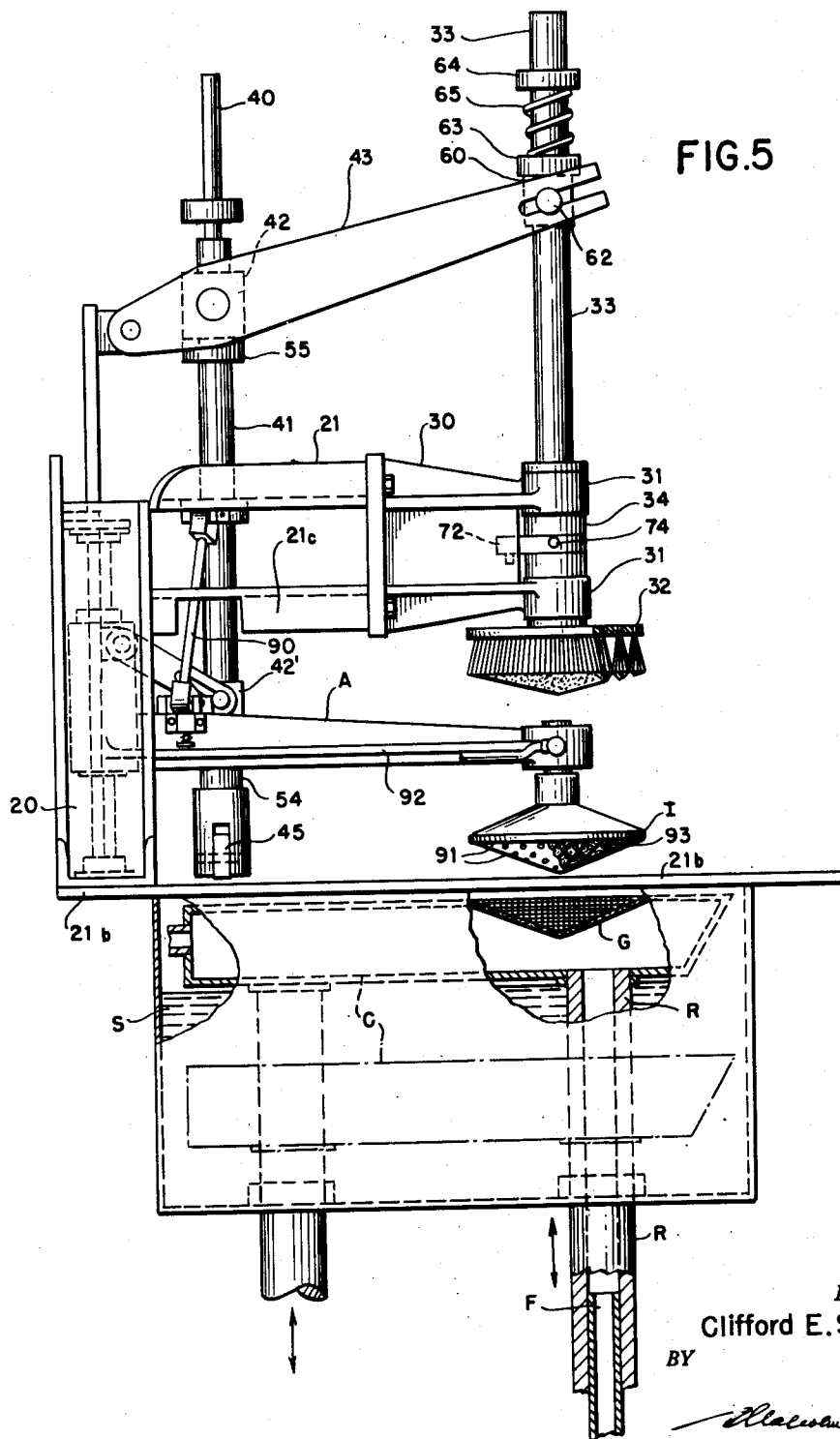


FIG. 5

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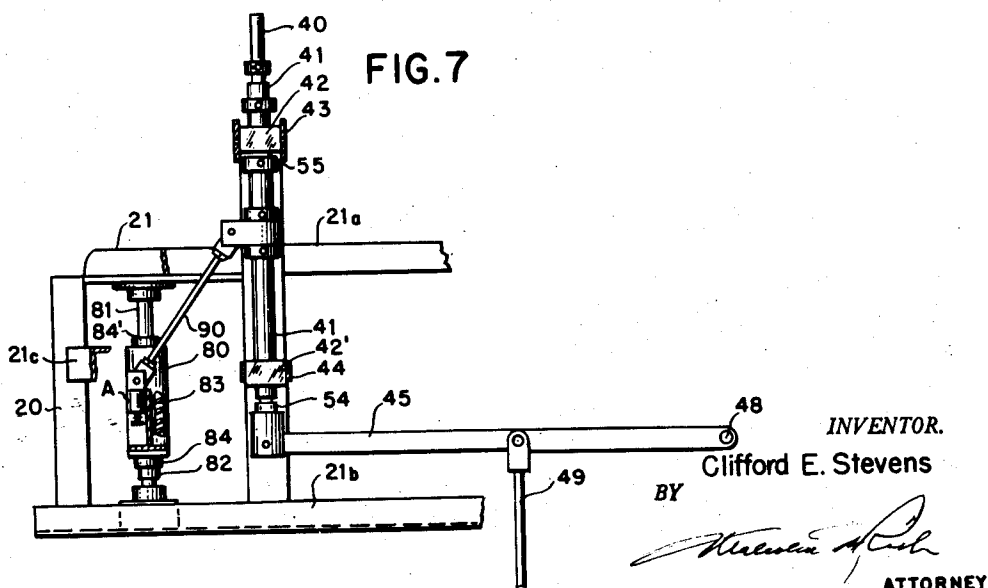
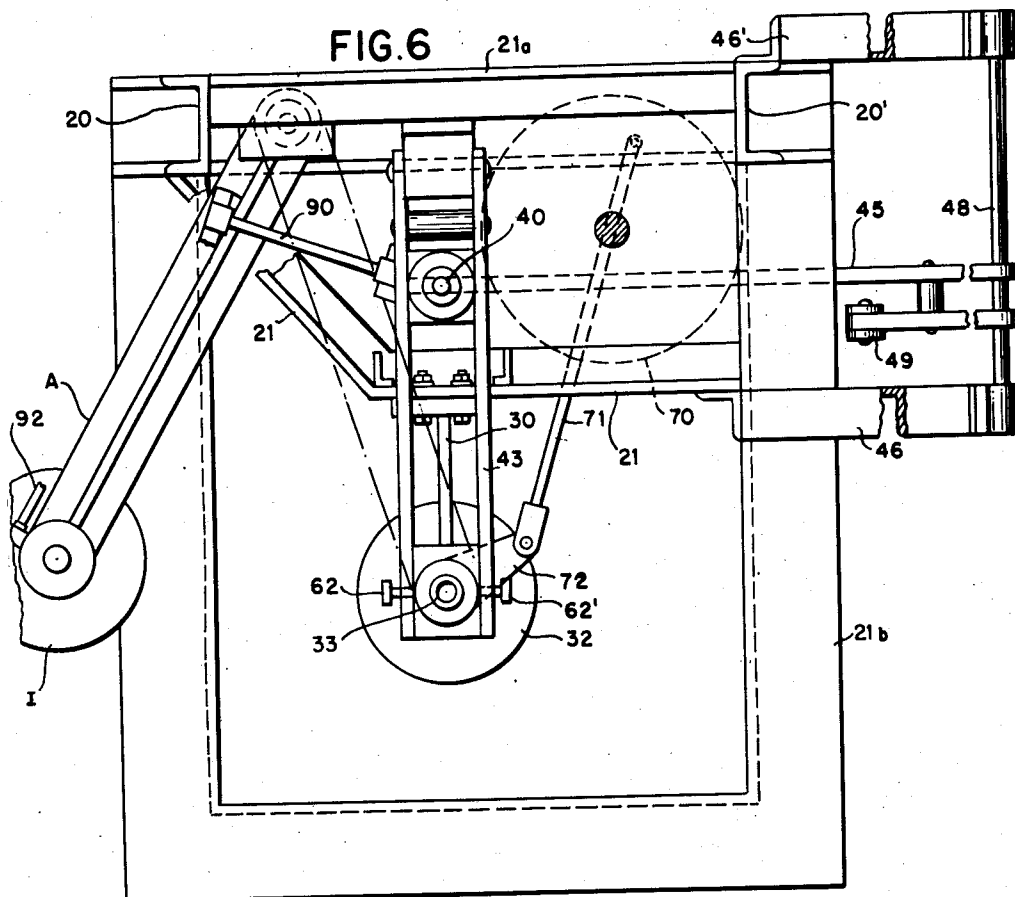
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UNITED STATES PATENT OFFICE

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APPARATUS FOR THE AUTOMATIC FORMING OF CAST FIBROUS PULP CONE BLANKS FOR CONE SPEAKER DIAPHRAGMS

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5 Claims. (Cl. 92—56)

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This invention relates to the art of manufacturing cone speaker diaphragms for radio loudspeakers and more particularly to the apparatus employed for producing automatically a plurality of identical one-piece cast cone-shaped blank pieces from which speaker diaphragms are to be molded.

The object of the invention is to provide an improvement in apparatus for producing said cast cone-shaped blank pieces.

Another object is to provide means for automatically removing the cast cone-shaped blank pieces from the screen element on which they are formed and for cleaning the screen prior to the forming of the next blank piece thereon.

Still another object is to provide a device for cast forming a succession of substantially identical cast cone-shaped blank pieces on the same screen element.

A further object is to improve and increase the rate of production of the cast cone-shaped blank pieces.

Other objects and advantages will be apparent as the invention is more fully hereinafter disclosed.

In accordance with these objects I have devised an improved apparatus for forming the cast cone-shaped blank pieces in which a plurality of the blank pieces can be produced successively on the same cone-shaped screen and removed automatically therefrom, in which device means is provided to remove automatically the cast cone blank from the screen and means is provided to clean the screen automatically before cast-forming the next blank piece thereon.

Heretofore in the art, an apparatus has been proposed and used widely in the cast forming of such blank pieces in which the forming screen is detachably mounted in closure position over an opening in the upper surface of a vacuum chamber which is submersible in a tank filled with a suspension of the fibrous mixture of materials of which the cone blank piece is to be formed and the time of immersion of the chamber in the suspension is controlled with respect to the vacuum employed such as to obtain on the screen the desired thickness of deposited fibrous material thereon. In such devices the screen, with its deposit of fibrous material, is removed manually from closure position in the chamber opening thereon after the chamber emerges from the suspension and a new screen is placed in closure position over the opening on which the next blank piece is formed on re-immersion of the vacuum chamber in the suspension.

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This device is hand operated and the time interval required to remove one screen with its formed blank piece thereon and to position the next screen in closure position across the chamber opening varies widely between operators and the rate of production for the blank pieces is widely variable and inordinately slow. By the improvement of the present invention the rate of production for such blank pieces is greatly increased, made fully automatic and the factor of operator dexterity in performing the manual operations is substantially eliminated with resultant standardization in blank piece quality and a material reduction in costs of production.

In accordance with the present invention continuous operation of the cone blank forming apparatus is obtained by fixedly securing the forming screen in closure position over the vacuum chamber opening and by providing means mechanically operative to oscillate the vacuum chamber from a first position to a second position repeatedly with a determined holding time interval at each position. The first position of the vacuum chamber is one locating the screen in a position above the level of the pulp suspension and the second position is a submerged position locating the screen well below the level of the pulp suspension. In second position, means automatically applying and maintaining a determined vacuum or negative pressure is applied to the chamber and in the first position the vacuum is automatically released and replaced by a positive pressure of air sufficient to discharge the water of the suspension that entered the chamber during the casting time period and to loosen the cast cone blank from the screen sufficiently for the blank piece to be picked up automatically by a blank piece removing element.

During the holding time interval at first position means operative automatically to pick up the loosened cone blank piece from the screen and to carry same to a discharge point is provided and means automatically operative to free the screen of adherent fibers before re-immersion of the screen in the pulp suspension also is provided.

With this improvement in the apparatus the only manual operation required of the operator is to locate at the discharge point of the blank piece a form element on which the blank piece may be discharged or deposited by the blank piece removing element (or means) for conveyance to a dryer. This manual movement also can be mechanized, if desired, without essential departure from the invention.

The improved apparatus of the present inven-

tion is illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevational view of the device, partly in section;

Fig. 2 is an enlarged top view of one element of the device;

Fig. 3 is a sectional view of the same taken along plane 3—3 of Fig. 2;

Fig. 4 is a schematic mechanical movement utilized in the present invention;

Fig. 5 is an enlarged side elevational view of the device;

Fig. 6 is a top view of the same; and

Fig. 7 is a stripped side elevation illustrating one mechanical movement of the device.

Referring to the drawings, the device illustrated in Fig. 1, as one specific embodiment of the invention but not by way of limitation of the invention, consists essentially of a tank T supported on platform P and filled with a pulp suspension S continuously supplied with pulp suspension by conduit E from an overhead supply tank (not shown) to a constant level maintained by overflow pipe O, within which tank T is sustained vacuum chamber C by rams R—R' passing through the bottom of the tank T, which rams R—R' are spring urged upwardly to high position for the chamber C and are actuated by a rotating cam means (shown more particularly in Fig. 4) to low position against the action of the spring urged rams R—R' to low position in such manner as to oscillate the chamber C from the position shown in solid line high position in Fig. 1 to the submerged low position shown in dotted line with a determined holding time at each position.

As the chamber C is immersed in the pulp suspension S in its downward movement valve V₁ in chamber C (Fig. 2) is opened mechanically or automatically to apply a determined negative pressure (or vacuum) to the interior of chamber C from an evacuating means (not shown but old in the art, per se), and valve V₂ is closed mechanically or automatically to seal off water discharge conduit F. The particular manner in which valves V₁ and V₂ may be operated mechanically or automatically forms no part of the present invention except in combination and may be widely varied without departure from the invention and in the present embodiment the valves V₁ and V₂ are operated by a trip mechanism by chamber C which is old, per se, and is not shown for simplification of the drawings.

The negative pressure (or vacuum) in chamber C is maintained therein during the entire time period of submersion of chamber C and until the chamber C is returned to first position at which position valve V₁ is closed mechanically or automatically and valve V₃ is opened mechanically or automatically to admit a determined pressure of air into the chamber C. At the same time valve V₂ also is mechanically or automatically opened to permit the forced discharge of the water of the suspension filtered through screen G located in the top of chamber C from the chamber C to the usual drain outlet.

The air pressure admitted to chamber C through valve V₃ also releases the formed conical blank piece from the forming screen G and lifts same upwardly against the perforated conical end I of carrier arm A to which it adheres by air suction through the perforated conical end I for removal of the conical blank piece to discharge position, when the arm A is moved mechanically to discharge position as will be hereinafter disclosed.

Most of the elements hereinabove disclosed are

old in the art, per se, and form no part of the present invention except in combination with the remaining elements that will be hereinafter more fully described. However, certain of these old elements have been modified somewhat to adapt same for use with the remaining elements of the invention as will also be further disclosed. The principal modification made is that involving the mounting of the screen G in fixed position across the opening H in the upper face of chamber C by the ring and bolt means 101 indicated in Figs. 2 and 3, and in the provision of means automatically supplying air pressure directly into chamber C to release the formed conical blank piece from the screen G for pick-up by the pick-up and transfer means A. The remaining elements of chamber C and the mechanical movements actuating the same are substantially identical to that heretofore employed in the art except for the mechanical means for reciprocating or oscillating the chamber C from first to second position and return with holding times at each position which has been modified somewhat. This mechanical movement may be obtained in a plurality of ways from rotating drive shaft D. The mechanical movement shown in Fig. 4, however, has been found to be quite satisfactory.

The mechanical movement illustrated in Fig. 4 consists essentially of an electrical motor M₁ energized from a source of electrical energy (not shown) to drive the drive shaft D at a substantially constant and determined rate of speed in one direction through speed reduction means 100. The drive shaft D is supported in position by bearing support members 10—10'. Cam 11 is disposed on the drive shaft D to rotate therewith and strap 12 is secured to cross-bar 13 connected at each end to rams R—R', thereby operatively connecting the cam 11 to the rams R—R' to oscillate the chamber C from first to second position upon cam rotation. The contour of the cam is such as to provide opposite high and low areas thereon each of a determined size giving the desired holding time at each position. As indicated in Fig. 1 the spring-urged rams R—R' pass through the bottom of tank T in a standard type of stuffing box arrangement 14 preventing leakage of the suspension therethrough during ram movement.

The means provided by the specific embodiment of the instant invention to remove the formed conical blank piece from screen G and to clean the screen G from adherent fibers thereon during the holding time period for chamber C in first position and prior to the immersing of the chamber C in the suspension S for the forming of the next blank piece thereon will now be described. This means is mounted on a frame, consisting of vertical and horizontal support members 20—20' and 21, 21a, 21b and 21c, respectively, adapted to be detachably secured in the mounted position shown over tank T. The particular manner of detachably mounting the frame onto tank T may be widely varied without departure from the invention.

First will be described the means provided to clean the screen G between blank forming operations. This means includes the vertically sustained rod 33 with the conical brush 32 on the bottom end thereof. Means are provided to actuate the rod 33 from the high position shown in Fig. 1 to a low position engaging the screen G, and return, while continuously oscillating the brush 32 through a determined arc of rotation, in timed sequence with the oscillation of the

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chamber C to high and low positions and in such manner as to bring the brush 32 into oscillating contact with the screen G just before the screen is immersed in suspension S.

The means to move the rod 33 vertically within oscillating sleeve 34 to the two high and low positions is illustrated more particularly in Fig. 7. As shown in this Fig. 7, rod 40 is sustained vertically for axial movement within sleeve 41 which is sustained vertically and in vertical alignment by block members 42—42' in determined spaced relation to and rearwardly of rod 33 by the pivoted lever 43 and the pivoted support 44, respectively, with the bottom end of said rod 40 pivotally secured to the free end of lever 45. The lever 45 is pivotally sustained at the other end by pin 48 sustained at the proper horizontal level by arm extensions 46—47 from the vertical support 20' of the frame. Lever arm 45 is raised and lowered about its pivot point 48 by means of vertical lever 49 having its lower end riding on rotating cam 50 (Fig. 1) and held in contact with the rotating surface of the cam 50 by means of pivoted arm 51 pivotally secured at one end as shown at 52 and spring urged downwardly by tension spring 53. Various alternative and equivalent means for mechanically connecting the cam 50 to the lever 45 for oscillation of the lever 45 and vertically sustained rod 40 to the high and low positions of the cam will be apparent to those skilled in the art without essential departure from the invention.

In the instant specific embodiment of the present invention the vertical movement of rod 40 by the lever arm 45 is utilized to obtain the movement of oscillating rod 33 with its brush 32 on the end thereof to high and low positions and to simultaneously obtain the movement of arm A into take-off and discharge positions.

To obtain these movements, a collar 54 is disposed on the rod 40 in a position providing the desired time interval as the rod 40 is moved upwardly by the cam 50 before the collar 54 engages the bottom end of sleeve 41 to lift the sleeve upwardly along with the rod 40. Collar 55 on sleeve 41 is positioned to engage the under surface of block 42 to lift lever arm 43 simultaneously. This time interval is required to permit the chamber C to be moved upwardly from low position to a horizontal level just below the level of the suspension S in the tank T. During this time interval the chamber C is being moved upwardly by the rams R—R' from low position to high position and as the chamber C emerges from the suspension S the arrangement provided is designed to actuate the rod 33 with its brush 32 to high position and to simultaneously swing arm A from discharge position as shown in Fig. 6 to take-off position as shown in Figs. 1 and 5. The engagement of collar 54 with the bottom of sleeve 41 lifts the sleeve 41 vertically with corresponding movement of block members 42—42', pivoted lever 43 and pivoted support 44 to high position.

The slotted free end of pivoted lever 43 engages pins 62—62' in a loose fitting collar 60 on rod 33 to raise and lower the said collar 60 therewith. Spaced collars 63 and 64 are provided on rod 33 with a compression spring 65 therebetween, the upper collar 66 being keyed to the rod 33 and the lower collar 63 being a loose fitting collar attached to the compression spring 65. The upward movement of collars 60 and 63 by arm 43 is subject to the cushioning action of the spring 65 but the downward move-

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ment of the collar 60 is accelerated by the spring 65. By this arrangement as the collar 60 is moved upwardly by lever 43 to a position engaging collar 66 through the spring 65 to move rod 33 upwardly against the compression resistance of spring 65, the brush 32 is moved upwardly to high position and the strength of the spring 65 is selected to obtain a smooth, controlled movement of the rod 33 and brush 32 to high position.

As may be noted in the drawings, when the lever arm 43 is moved downwardly by the lever 45 from the high position shown in the drawings to the low position corresponding to the opposite side of the cam 50, the spindle 40 moves downwardly therewith, as does also rod 33 to a position bringing brush 32 into contact with the screen G and this movement is accelerated by compression spring 65.

The means provided in the instant specific embodiment to oscillate the brush 32 about its axis consists of motor M2 mounted on the frame A in a position to rotate horizontal disc 70 on which disc 70 is pivotally mounted at one end a connecting link 71 to rotate therewith. The other end of the link 71 is connected to lever arm 72 attached to sleeve 34 in such manner as to convert the rotary motion of the disc 70 into an oscillating or reciprocating movement of the sleeve 34 in its bearing supports 31—31' through a determined arc of axial rotation. The length of the link 71 controls the size of the oscillating arc movement of sleeve 34 as one skilled in the art will recognize, and the speed of rotation of disc 70 controls the frequency of the oscillation of sleeve 34. The rod 33 is connected to the sleeve 34 by a pin and slot connection 74 to be oscillated therewith and the brush 32 on the bottom end of rod 33 thereby is oscillated continuously in high and low positions through a determined arc of rotation.

The means provided in the instant specific embodiment to actuate the take-off means A by lever 45 consists of a link 90 having one end secured to the arm A and the other end secured to the sleeve 41 at a horizontal level above the horizontal level of the arm A in such manner that as the sleeve 41 is lifted vertically by the collar 54 on rod 40 the secured end of link 90 is lifted therewith to move the arm A from the position shown in Fig. 6 to a position shown in Figs. 1 and 5 locating the take-off means I on the end thereof in take-off position over the screen G against the tension of a torque spring means normally urging the arm A to return to first or discharge position.

As shown in Fig. 7, arm A consists of a lever arm A pivoted at one end in a torque spring mounting normally urging the arm A to discharge position with the opposite end provided with the suction take-off means I located thereon in a position to center directly over and nesting in the screen G when the said screen G is in high position.

The means mounting the lever arm A in spring urged discharge position also is illustrated in Fig. 7. As indicated in Fig. 7, the arm A is secured at one end to annular sleeve 80 which is rotatively secured at a desired horizontal level on vertically sustained shaft 81 by collar 82 keyed to shaft 81 with the rotation of the sleeve 80 about its center axis from its mounted position opposed by a torque compression spring 83.

The mechanical movement of arm A from first or spring urged position shown in Fig. 6 to second or pick-up position as shown in Fig. 5, is accom-

plished mechanically and automatically by means of the link 90 connecting the arm A to the sleeve 41 in such manner that when the sleeve 41 is moved upwardly to high position the end of the link 90 attached to sleeve 41 moves therewith. The movement of the attached end of the link 90 operates to move the arm A against the action of torque spring 83 to pick-up position at which position conical end I is located directly over the screen G in alignment therewith in a position to nest in the screen G as it moves into high position in relatively closed spaced relation to the formed conical blank piece thereon to receive the formed blank piece as it is released from the screen G by the air pressure injected into chamber C and to hold it on the hollow conical end of said means I by gentle suction through openings 91 therein applied through conduit 92 to the hollow interior of the means I. To prevent injury to the relatively soft fibrous formed blank piece, the exterior surface of the cone end of means I is covered with a perforated relatively soft resilient material 93 such as foam or sponge rubber, perforated in a plurality of places to permit the suction to function therethrough. In Fig. 5 the position of chamber C relative to the cone end I of the arm A is shown just before it reaches high position for purposes of clarity, it being understood that the chamber C rises to a position nesting the cone end I in close spaced relation to the screen G when chamber C is at high position. Arm A remains stationary until the chamber C moves downwardly in its return to its low or dotted (submerged) position to a position permitting the arm A to clear the chamber C before being returned to first or discharge position as cam 50 rotates to a position initiating downward movement in spindle 40. As arm A moves out of covering position over screen G the oscillating brush 32 is moved into contacting position with the screen G and cleans the screen G in the time interval remaining before the chamber C is immersed in the suspension S.

As the arm A reaches discharge position, means for automatically releasing the suction retaining the formed blank piece on the conical end thereof is actuated, said means including a means to apply a slight air pressure through the conduit 92 to the hollow cone interior of the means I. This means, in the instant specific embodiment is shown as being manually operative but it may be made automatic without departure from the invention where means automatically aligning a receiver for the discharged cone blank piece is provided. The manually operative means for releasing the formed cone blank piece from the conical end I of arm A shown in the drawings consists of an ordinary type of rotating two-way valve 94 as indicated in Fig. 1, which is located in the conduit 92, one connection 95 of which passes the evacuating means and the other connection 96 of which passes to a source of compressed air.

From the above description of the present invention and the specific embodiment of the same as illustrated in the drawings, it is believed apparent that the device of the present invention in its automatic operation is adapted to produce in timed succession a plurality of formed conical blank pieces on the same conical screen G which are substantially identical as to size, composition and thickness. By providing different sized cone screens G with corresponding sized conical ends I on the end of arm A and similar sized brushes 32 on the end of rod 33, formed cone blank pieces

of substantially any desired cone size, within the provided size of the opening H of the chamber C may be similarly produced having consistently uniform composition and thickness.

In operation, the rate of production of such cone blank pieces by the device of the present invention may be controlled or regulated by adjusting the speed of the device by means of a suitable speed reducing gear means 100 connecting motor M₁ to drive shaft D and by a proper design of the cam 11 to provide any desired frequency of movement of chamber C from first or high position to second or low position and return. Then by suitable design of cam 50 on driven shaft D₂ and selection of an appropriate selection of gear ratios in the chain and gear drive means 47, the rate of rotation for the driven shaft D₂ through the chain and gear drive means 47, by the drive shaft D the actuation of the spindle 40 may be synchronized with the movement of the chamber C to actuate the arm A and the brush 32 as hereinabove contemplated and disclosed to function in the described manner as a blank piece take-off means and screen cleaning means, respectively. Once the principle of operation is known to one skilled in the art, as hereinabove disclosed, the particular design and organization of the various elements of the present invention may be widely varied and modified without essential departure from the invention or from the specific embodiment of same shown and illustrated in the drawings and all such modifications and departures are contemplated as may fall within the scope of the following claims.

What I claim is:

1. Apparatus for producing cast fibrous cone blanks which comprises in combination, a tank, means for feeding a fibrous pulp suspension into the tank and means to maintain a constant fluid level therein, a hollow chamber and means sustaining the chamber in the tank for vertical movement from a high position bringing the upper surface of the chamber above the fluid level of the suspension in the tank to a low position bringing the said upper surface of the chamber below the fluid level of the suspension in the tank, means to oscillate the said chamber between said two positions at timed intervals and with determined holding time periods at each said position, means applying a negative air pressure to the chamber interior during the time interval the chamber is submerged, means applying a positive air pressure to the chamber interior during the time interval the chamber is unsubmerged, means to charge the water present in the chamber when the said positive air pressure is applied to the chamber, an opening in the upper surface of the chamber, a cone-shaped screen and means detachably securing the screen in closure position in the said opening, a hollow perforated cone-shaped member adapted to nestingly engage the said screen and means sustaining the said member at a horizontal level above the level of the said screen to be movable into nesting position with the screen as the screen is moved with the said chamber into high position and out of nesting position to a second position as the said screen is moved with the said chamber out of high position and means to apply selectively a negative and a positive pressure of air to the hollow interior of said member, a conically shaped brush adapted to seat within the said screen and means sustaining the brush in a position above the screen to be movable into and

out of nesting contact with the screen as the said screen approaches high position and departs from high position, respectively, said means being operatively connected with the means actuating said hollow perforated member into and out of nesting engagement with said screen to be actuated subsequently to the removal of the cone blank piece from the screen and just prior to screen immersion in the pulp suspension in the said chamber, and means to oscillate said conical brush continuously through a determined arc of axial rotation.

2. In combination, a rod sustained vertically to be movable axially, a lever arm having one end pivotally secured and the opposite end secured to the bottom end of said rod, means for periodically raising and lowering said lever arm and said rod to high and low positions, a second rod sustained vertically in determined spaced relation to the first rod to be movable axially, means continuously oscillating the said second rod through a determined angle of axial rotation, means connecting the two said rods for vertical axial movement of the second rod with vertical axial movement of the first rod, a pivoted lever arm having its pivoted end close spaced to the said first rod at a horizontal level adjacent the bottom end of the first rod and a lever arm length locating the free end of said arm directly under the second rod in one position of lever arm movement, spring means holding said lever arm out of said one position of lever arm movement, and means connecting the said lever arm to the said first rod to be moved upon upward movement of the said arm against the action of said spring means to said one position.

3. The combination of claim 2, a conical brush means secured to the bottom end of said oscillat-

ing second rod to oscillate therewith and a hollow perforated conical member dependently secured to the free end of said spring-pressed lever arm, and means selectively applying a negative and a positive pressure of air to the interior of said perforated conical member.

4. The combination of claim 3, in combination with a hollow chamber having an opening in the upper wall thereof and a conical screen secured in closure position across the said opening and means sustaining the chamber to be movable from a first position at which the said perforated conical member is in nesting position with the said conical screen when the said perforated conical member is in alignment with the said second rod to a second position at a lower horizontal level.

5. The combination of claim 4, a tank enclosing the said chamber, means feeding a fibrous pulp suspension into the said tank to a level submerging the chamber while in second position, means applying a negative pressure of air to the chamber while in submerged second position, means applying a positive pressure of air to the chamber when the chamber is in first position and means to discharge water from the chamber while in first position.

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